Final Report

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by the Alliance to Save Energy

The Efficient Windows Collaborative

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Contact person at the Alliance to Save Energy:
Nils Petermann
Research Associate
(202) 530-2254
Fax: (202) 331-9588
npetermann@ase.org

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TABLE OF CONTENTS

Final Report - Alliance to Save Energy
Efficient Windows Collaborative
DE-FC36-97GO10240

A EXECUTIVE SUMMARY

The Efficient Windows Collaborative (EWC) is a coalition of manufacturers, component suppliers, government agencies, research institutions, and others who partner to expand the market for energy efficient window products. Funded through a cooperative agreement with the U.S. Department of Energy, the EWC provides education, communication and outreach in order to transform the residential window market to 70% energy efficient products by 2005. Implementation of the EWC is managed by the Alliance to Save Energy, with support from the University of Minnesota and Lawrence Berkeley National Laboratory.

1. Introduction

Windows are possibly the most complex element of building envelopes, and also one of the most important determinants of a building's energy demand for heating and cooling. Since the energy crises of the 1970s, dramatic improvements have been made in the energy efficiency of windows and other fenestration technologies including the development of cost-effective fenestration products with improved energy efficiency features such as low-emissivity coatings and thermally-improved frames have been introduced to the residential market by vendors and manufacturers. Nonetheless, information deficits, lack of market transparency, and initial cost barriers have thwarted optimal market penetration by energy-efficient fenestration products, which in turn have lead to shortcomings in the supply of these products. The Efficient Windows Collaborative set to address these issues by promoting collaborative efforts among window manufacturers, window rating organizations and other market actors to increase consumer and industry education through window rating and labeling and to spread information about how to maximize the benefits of energy efficiency while minimizing the cost.

Building on its efforts started in 1997, the EWC entered a new project phase in October 2000. With funding from the Department of Energy, the EWC expanded its effectiveness through increased levels of effort in previously started activities, plus new initiatives in key markets and technical areas. The Alliance to Save Energy and its partners at Lawrence Berkeley National Laboratory, the University of Minnesota, and others improved ongoing efforts and launched new initiatives in the fields of communication, regional initiatives, education and training, distribution of informational tools and materials, media activity, and international initiatives. These efforts were planned and carried out by the EWC program team and supported by the various EWC members.

The original work scope for this cooperative agreement included seven tasks. The EWC worked on these tasks from the start of the project period in 2000 until the end of the project period in 2006. In 2003, a new work scope included additional activities, which the EWC pursued from 2004 to 2006. These additional activities are listed as Task 8 in the following project description.

2. The Program Team

The EWC program implementation team consists of the Alliance to Save Energy (the Alliance), Lawrence Berkeley National Laboratories (LBNL), and the University of Minnesota (UMN). While all partners in the program team contributed to the EWC efforts, the Department of Energy funding under this cooperative agreement was only directed at the Alliance to Save Energy, whereas LBNL and UMN were funded separately. Therefore, the activities described in this report cover primarily the Alliance activities as part of the overall EWC effort.

3. EWC Membership

The EWC divides its members into three categories: manufacturers, suppliers and affiliates. The manufacturer category encompasses producers of whole fenestration products such as windows, doors and skylights. The supplier category includes producers and suppliers of components such as glazing, lineals, spacers, and other components of fenestration products. Affiliates are non-manufacturing interested parties such as trade associations, utilities, consultants, and government agencies.

Throughout the contract period, membership to the EWC has been free of membership dues. However, the EWC required its manufacturer members to agree to test and certify at least 50 percent of their products according to NFRC standards by the end of the first year of their membership and 90 percent by the end of their second membership year. The EWC also called on its member companies to apply ENERGY STAR labeling to their eligible products. This way the EWC could significantly increase the use of fenestration product labeling among its manufacturing members and thus increase the availability of consumer information about the energy performance of different fenestration products in the U.S. market.

Upon beginning their membership, EWC members were also asked to declare their commitment to supporting EWC initiatives that increase awareness and market penetration of energy-efficient windows. Throughout the funding period, the EWC received in-kind and financial support from its members for organizing and conducting initiatives such as training workshops, presentations to industry professionals and other outreach activities. On the other hand, the EWC supplied its members with informational material such as brochures and web content on the importance of energy-efficient windows, on energy performance characteristics of windows in different regional climates, and on NFRC and ENERGY STAR labeling for fenestration products. This informational material helped EWC members sell the message of energy efficiency and contributed to promoting knowledge of energy labels for fenestration products among consumers.

Efficient Windows Collaborative Members by Membership Category

Manufacturers
Accent Windows
Air Chek – Window Depot
Alside, Inc.
Amerimax Building Products
Amsco Windows
Andersen Corporation
Atrium Windows and Doors
B.F. Rich Co., Inc.
CertainTeed Corporation
Champion Window Manufacturing
Clawson Windows
Comfort Line Ltd.
Crystal Window and Door Systems, Ltd.
CrystaLite, Inc.
Custom Window Systems, Inc.
Eagle Window & Door
Empire Pacific Windows
Energy Saving Products of Florida, Inc.
Gorell Windows & Doors
Graham Architectural Products
Great Lakes Window
Gilkey Window Company
Hurd Millwork
Hurd Millwork Company
Ideal Window Manufacturing, Inc.
Insulate L.L.C.
Interstate Building Materials
Jeld-Wen Windows and Doors
Jones Paint and Glass
Kasson & Keller, Inc.
KINCO, Ltd.
Kinro
Kolbe & Koble Millwork Co., Inc.
Lincoln Wood Products, Inc.
Lockheed Window Corp.
Loewen Windows
Marvin Windows and Doors
Mathews Brothers Company
MI Home Products
Milgard Manufacturing, Inc.
MW Manufacturers, Inc.
Northeast Building Products Corporation
Patriot Manufacturing, Inc.
Pella Corporation
PGT Industries
Polar Seal Window Corporation
RJT Industries, Inc.
Scherer Brothers Lumber Company
Sears Home Improvement
Semco Windows & Doors
Silver Line Windows
Simonton Windows
Soft-Lite Windows
Superseal Window & Door Company, Inc.
Superior Engineered Products
Supreme Building Products
Thermal Industries, Inc.
ThermaStar
Thermotech Windows Ltd.
Traco
United Window & Door Manufacturers Inc.
VELUX America Inc.
Viking Industries, Inc.
VIPLEX Industries, Inc.
VPI Quality Windows
The Window Factory
Windows From Us, Inc.
Window Technologies, LLC
Winstrom Manufacturing Inc.

Suppliers
AFG Industry, Inc.
Ameritech Construction Corporation
Amesbury Group
Arkema, Inc.
Cardinal Glass Industries Inc.
Chelsea Building Products
Dayton Technologies
Edgetech I.G., Inc.
Glass Equipment Development
Guardian Industries Corp.
Inline Fiberglass LTD.
Les Chateaux, Inc.
Mikron Industries, Inc.
P.H. Tech Corporation
Pilkington/Libbey-Owens-Ford
PPG Industries, Inc.
Sage Electrochromics, Inc.
Southwall Technologies
Spectus Systems, Inc.
Titon, Inc.
TruSeal
Truth Hardware
VEKA, Inc.
Vinyl Building Products, Inc.

Affiliates
American Architectural Manufacturers Association
Architectural Glazing Consultants
Aurora-Horizons Consulting, Inc.
Austin Green Building Program
Barry Smith Construction
Carefree Exteriors, Inc.
Consortium for Advanced Residential Buildings (CARB) c/o Steven Winter & Assoc.
DSET Laboratories
Ed Thomas Consultors
Electronics Packaging Solutions, Inc.
Elite Exteriors, Inc.
Energy Opportunities
Enermodal Engineering
Fenestration Manufacturers Association
Florida Extension Service
Florida Solar Energy Center
Great Plains Restorations, Inc.
GAF Materials Corporation
Hansons' Windows & Siding
Honeywell
K&H Windows & Doors
KeySpan Corporation
Keystone Certifications, Inc.
Madison Gas and Electric Company
Mid-American Energy Company
Midwest Energy Efficiency (MEEA)
National Certified Testing Labs
National Fenestration Rating Council
Newark Door and Window Co.
Northeast Energy Efficiency Partnership
Northeast Window and Door Association
1 Source Vinyl Replacement Windows Inc.
Pacific Gas & Electric
Primary Glass Manufacturer's Council (P
PRYSM Marketing, Inc.
R.A. Haney Builders & Remodelers
Texas Home Industries, Inc.
Thermal Installations
Thermal Line Windows
Utah Energy Conservation Coalition
Volt VIEWtech
WESTLab
Window and Door Manufacturers Association
Windows Plus, LLC
Window.Com
Woods and Associates

4. Program Objectives and Approach

The stated goals of the Efficient Windows Collaborative were to:

- Make National Fenestration Rating Council (NFRC) labeling nearly universal in the U.S.;
- Double the domestic market penetration of energy-efficient windows from 35 percent at the start of the project period to 70 percent at its end;
- Support the ENERGY STAR® Windows program.

The EWC assumed that the intended increase in the market penetration of energy-efficient windows would yield 8.4 Trillion Btu's in annual savings by reducing heating and cooling demand in residences. Although it has to be concluded that by the end of the project period the market penetration of energy efficient windows was still below 70 percent, the market has improved significantly. This assessment is based on studies stating that the national market penetration of windows with the ENERGY STAR label increased from 34 percent in 2001 to 38 percent in 2003 and to 53 percent in 2005.[1]

The EWC worked to achieve these goals through three core activities: education, communication and outreach. We targeted a broad range of audiences in order to reach all market sectors that influence the decision process in selection of residential windows. In all activities we consistently promoted NFRC and ENERGY STAR to these audiences.

Audiences on the supply side of the windows market included window manufacturers, part suppliers, and distributors. The EWC educated these audiences about technology and energy performance in residential windows; we provided informational resources to help manufacturers sell more efficient products; and we worked one-on-one with manufacturers to support NFRC testing and certification along with ENERGY STAR labeling.

Audiences on the demand side included home owners, home builders and public housing authorities. The EWC educated these groups about making informed purchase decisions that provide maximum benefits from investment in energy-efficient windows and how to finance such investment through rebates and tax credits. The basic message for these audiences was to look for the ENERGY STAR and to look for the energy-efficiency properties on the NFRC labels. These and other messages were propagated on the EWC web site and through articles, trade shows, and our email and phone hotline for web site visitors.

[1] Ducker Research Company. *Study of the U.S. Market for Windows, Doors and Skylights*. 2004 and 2006 editions.

B PROJECT SUMMARY

1. Executive Summary

The activities under this cooperative agreement were started in October 2000 and completed in March 2006. Throughout this period the Efficient Windows Collaborative pursued its efforts to communicate its message of energy efficiency to manufacturers, retailers and customers in the windows market, train window and building professionals in capturing and marketing advances in window energy efficiency and form alliances with like-minded groups to promote energy-efficient windows in collaboration.

Prior efforts built the basis for several EWC activities during this project period. Information on the EWC web site was expanded, e.g. with new data about locally-specific window performance, code information, and a window product selection tool. Pre-existing regional promotion efforts in collaboration with energy-efficiency groups in the Northwest and the Northeast were continued. The *Residential Windows* book, published in 2000, was distributed among interested professionals throughout the project period. The message consistently delivered to consumers throughout the project period was to look for NFRC-rated and ENERGY STAR-labeled windows. An EWC hotline for phone calls and emails helped hundreds of consumers to better understand window energy efficiency and make informed purchase decisions.

Numerous new activities were started under this cooperative agreement. A major step for helping consumers make purchase decisions was the development of a window selection tool that was integrated into the EWC web site in 2004. This tool, the development and maintenance of which was funded through manufacturer contributions, allowed consumers to find window products according to energy performance criteria. While greater participation by window manufacturers will have to be encouraged, this tool established a basis on which the EWC can build a more elaborate database in the future.

In terms of regional promotion activities, the EWC focused most strongly in the South. The EWC helped initiated a transformation of the Southern windows market toward products that reduce solar heat gain and cooling loads. This effort was most pronounced in the states of Florida and Texas with their high levels of housing starts. Activities consisted of numerous workshops and involvements in builder and window industry events. EWC involvement in the South started early in the project period and was supported in 2004 by the white paper *Energy Efficient Windows in the Southern Residential Windows Market*, written by several EWC members and co-authored by Alliance to Save Energy's Bill Prindle and Lawrence Berkeley National Laboratories' Dariush Arasteh.

A major task that the EWC was not able to implement in the way it had been envisaged was the launch of a program for efficient commercial windows. In 2002 the EWC realized that the commercial market was far more fragmented than the residential one and that greater and more concentrated efforts were needed to establish a network in the commercial market. Nevertheless, extensive research was conducted to assess the best options for energy efficient commercial fenestration and the 2004 release of *Window Systems for High Performance Buildings* by EWC team members at the University of Minnesota and Lawrence Berkeley National Laboratories provided the EWC with a good basis for starting a commercial windows program in the future.

During the last two years of the project period the EWC concentrated on integrating energy efficiency more firmly into segments of the windows market where opportunities for increasing efficiency remained. Accordingly, the Alliance studied and researched shortcomings in the low-income housing and the new construction sector as well as reasons for the relatively low acceptance of NFRC rating among smaller window manufacturers. Staff changes at the Alliance between 2004 and 2006 limited the scope of research that could be done on these topics. Nonetheless, the EWC concluded with important suggestion on how to achieve progress in these sectors, outlined in Alliance 2005 and 2006 white papers.

The following pages provide an overview of the specific Alliance tasks pursued under this cooperative agreement. These tasks are divided into two groups: the basic program tasks outlined in the original project work scope of 2000 and additional tasks added to the project in 2004.

2. Program Tasks

1. COMMUNICATION
    - 1.1 Enhanced Web Site Features
    - 1.2 Developed Additional Databases Linked to the EWC Web Site
    - 1.3 Provided Advice to Consumers, Window Professionals and other Audiences

2. EXPANDED REGIONAL INITIATIVES
    - 2.1 Sustained Existing Regional Efforts
    - 2.2 Developed New Regional Efforts

3. EXPANDED EDUCATION AND TRAINING
    - 3.1 Increased Trainings and Other Presentations
    - 3.2 Presented and Exhibited at Conferences & Meetings
    - 3.3 Expanded Partnerships

4. PLANNED LAUNCH OF COMMERCIAL PROGRAM

5. INCREASED VARIETY AND DISTRIBUTION OF INFORMATIONAL TOOLS AND MATERIALS
    - 5.1 Created EWC Pamphlet
    - 5.2 Increased Number and Distribution of EWC Fact Sheets
    - 5.3 Supported Software Development and Distribution
    - 5.4 Distributed the New Books about Energy-Efficient Residential and Commercial Windows

6. EXPANDED MEDIA ACTIVITY

7. EXPLORED INTERNATIONAL INITIATIVES

8. ADDITIONAL PROGRAM TASKS (2004-2006)
    - 8.1 Developed an Advisory Council
    - 8.2 Increased Market Penetration of Efficient Products in New Construction
    - 8.3 Increased NFRC Labeling among Small and Midsize Manufacturers
    - 8.4 Studied and Promoted Opportunities to Increase Market Penetration of Efficient Products in Low-Income Housing
    - 8.5 Analyzed Federal Energy Efficient Windows Tax Credit

3. Summary of Tasks

Activities and summary results of Tasks 1 through 8 are listed below. Specific accomplishments in each area are described in section C of this report.

Task	Activities	Summary of Results
1. Communication	Enhanced web site features	• Addressed consumers and different professional audiences • Increased web site traffic
	Developed additional databases linked to EWC web site	• Integrated code guides • Integrated window product database • developed incentives/ programs document • Developed builder toolkit • Created web portal on improving energy performance in low-income housing
	Provided advice to consumers, window professionals and other audiences	Answered thousands of consumer and builder questions by phone, email and letters
2. Expanded regional activities	Sustained existing regional efforts	Supported efforts of Northwest Energy Efficiency Alliance (NEEA) and Northeast Energy Efficiency Partnerships (NEEP)
	Developed new regional efforts	• Promoted solar-control glazing in Florida, Arizona and Texas markets • Supported efforts of Midwest Energy Efficiency Alliance (MEEA)
3. Expanded education and training	Increased trainings and other presentations	Conducted targeted trainings for • Window manufacturers • Builders • Distributors and retrofit contractors • Code officials • Energy raters • Windows rating community
	Presented and exhibited at conferences and meetings	• Educated various audiences about the benefits of efficient windows • Increased awareness of NFRC, ENERGY STAR Windows and the EWC
	Expanded partnerships	Coordinated education and outreach efforts with utilities, market transformation organizations, window manufacturers and industry groups

Task	Activities	Summary of Results
4. Planned launch of commercial program	• Supported Northwest Energy Efficiency Alliance's (NEEA) Commercial Windows Initiative (CWI)	
5. Increased variety and distribution of informational tools and materials	Created EWC brochure	Envelope-sized brochure distributed through EWC and partner activities
	Increased number and distribution of EWC fact sheets	Revised fact sheets graphically Increased number to 101 different local areas
	Supported software development and distribution	Supported development and distribution of RESFEN 5.0
	Distributed the new books about energy-efficient residential and commercial windows	• Distributed 2000 version of *Residential Windows* • Distributed 2004 publication *Window Systems for High Performance Buildings*
6. Extended media activity	• Published *Word on Windows* newsletter • Improved radio exposure for EWC through on air interviews and satellite media tours that referenced the programs • Increased print impressions through media outreach and story placement • Published numerous articles	
7. Explored international initiatives	Presented EWC information to delegations from China, Kazakhstan, Norway and Russia	
8. Additional Program Tasks	Developed an advisory council	Advisory council consisting of 7 windows and energy efficiency experts
	Increased market penetration of efficient products in new construction	Included paper about barriers to energy efficiency in new construction Builder Toolkit
	Increased NFRC labeling among small and midsize manufacturers	Paper about barriers to NFRC testing among small manufacturers
	Studied and promoted opportunities to increase market penetration of efficient products in low-income housing	Paper on opportunities for transformation in the low-income market Web portal as a guide for energy-efficiency improvements in low-income housing White paper on energy-efficient mortgages
	Analyzed Federal window tax credit	Paper on the role of ENERGY STAR windows for the tax credit

C PROGRAM TASK ACCOMPLISHMENTS

The following chapter describes the Efficient Window Collaborative's accomplishments under the seven program tasks outlined in the original work scope of 2000. Additionally, the activities added to the EWC work scope in 2003 and performed from 2004 to 2006 are described as Task 8.

1. COMMUNICATION

1.1 Enhanced Web Site Features

The Efficient Windows Collaborative web site (www.efficientwindows.org), designed by John Carmody and Kerry Haglund of the University of Minnesota, provides its visitors with unbiased information about the benefits of energy-efficient windows, descriptions of how they work, and recommendations for their selection and use. The website is designed for an audience that consists equally of consumers, home builders, window and design professionals, and anyone interested in building energy efficiency.

Over the project period of this cooperative agreement, the EWC substantially enhanced the features of this web site and added new tools to appeal to a more diverse audience. These new tools, listed in sub-chapter 1.2, provide information for all participants in the windows market as well as utilities and public bodies, such as public housing authorities and code officials. The Alliance significantly broadened the breadth of the web site audience while simultaneously enhancing the depth of previously existing features such as the regional fact sheets.

In 2001, the EWC web site received 822 daily visits on average. In 2002, the number of daily visits rose to an unprecedented average of 1,101 visits daily. This surge can be attributed to a particular focus on media outreach during the 2002 and 2003 period. By 2004, however, daily visits were down to 739 on average. After the integration of the Window Selection Tool into the web site, average daily visits rose again to 955 in 2005 and to 1,284 daily visits in early 2006. On average, the length of the visits was between 5 and 11 minutes.

1.2 Alliance Developed Additional Databases Linked to the EWC Web Site

- **Integrated Code Guides.** In an increasing number of states, NFRC labeling and window efficiency standards are driven by the International Energy Conservation Code® (IECC). Therefore, the EWC integrated state guides to the residential requirement of the 2000/2003 IECC on its web site (http://www.efficientwindows.org/code.cfm). These guides include county-by-county lists of the specific window efficiency requirements in each state (see Attachment 1 as an example). These code guides were developed as a cost-share contribution by Brickfield, Burchette, Ritts, and Stone, PC.
- **Integrated Window Product Database.** In 2004, using EWC member funds, the Alliance and its project partners at the University of Minnesota developed a products database accessible through a *Window Selection Tool*. This web tool is linked to the web site, so that site visitors can identify specific energy-efficient products that meet their needs, and can then be directed off the site to specific company sites for further action. *No DOE funds were used for this particular activity.*
- **Developed Incentives/Programs Document.** Because site visitors and other consumers frequently asked about rebates and other incentives to help them purchase windows, the EWC developed a document which identified utility, state and local programs that provide incentives, rebates or other services facilitating the purchase of energy-efficient windows. This document was integrated with the web site in 2004 and updated in 2005 (see Attachment 2).
- **Developed Builder Toolkit.** Based on the results of research performed in 2005 on the barriers and needs in new construction, the Alliance EWC program developed a toolkit designed to

educate builders about window energy performance and to help them sell energy-efficient window products to their consumers. This is posted on the EWC Web site, and provided in printed form where appropriate (Attachment 3).

- **Created web portal on improving energy performance in low-income housing.** In order to educate those working to support low-income housing, the Alliance developed a web-based portal, accessible through the EWC web site, which provides a one-stop shop for all audiences seeking information and guidance on improving energy performance of low-income housing (Attachment 4).

1.3 Provided Advice to Consumers, Window Professionals and other Audiences

The Alliance received and answered hundreds of questions by phone, email and letters from homeowners, homebuilders, and window professionals who requested information and advice concerning energy-efficient windows.

2. EXPANDED REGIONAL INITIATIVES

The EWC acted as an umbrella organization to regional efforts across the country. The EWC supported activities, provided support materials and information resources and sponsored training sessions for regional and local organizations to give them the tools to help change their local markets. In doing so we continued previous EWC efforts across the country, focusing specifically on the southern half of the United States, where the opportunity for market transformation was greatest.

2.1 Sustained Existing Regional Efforts

- **Northwest.** The Alliance continued to support the Northwest Energy Efficiency Alliance (NEEA) in their efforts to promote ENERGY STAR® windows. The Alliance supported NEEA's Commercial Windows Initiative (CWI) as a member of the initiative's steering committee. The CWI captures some of the energy savings available through new commercial fenestration technologies and is seeing impressive results from its activities aimed at transforming the northwest commercial window market to more energy-efficient products. The EWC increased the overall awareness of this initiative by including an article about the CWI in its *Word on Windows* newsletter.

- **Northeast.** In 2002, the EWC participated in a planning meeting with Northeast Energy Efficiency Partnerships (NEEP) to review a NEEP baseline study of market penetration of ENERGY STAR® windows in the Northeast and to provide input to NEEP's plans for its regional market transformation program.

  In 2004 and 2005, the EWC collaborated with NEEP and state energy officials in order to provide trainings to salespeople for selling energy-efficient windows. The Alliance held sessions in Maryland, New Jersey, and Delaware and educated more than 270 window sales representatives about low-E technologies, ENERGY STAR® and sales techniques for high-efficiency products.

2.2 Developed New Regional Efforts

In 2002, the EWC hosted a meeting of regional energy efficiency organizations including Northeast Energy Efficiency Partnerships, the Northwest Energy Efficiency Alliance, the American Council for an Energy Efficient Economy, the Midwest Energy Efficiency Alliance and D&R International (representing ENERGY STAR Windows) to share resources and lessons learned and to discuss opportunities for collaboration for window market transformation.

- **South.** One of the EWC's top priorities was to develop a market for high-performance windows in Southern cooling climates. The potential for energy savings and associated pollution reduction is great in the South, where air conditioning use is high and the market penetration of energy efficient windows is low. The Alliance also expanded its reach to often-neglected locations, for instance by conducting an energy-efficiency-education training for builders in the US Virgin islands in 2001. ASE's three principal target states, however, were Florida, Texas, and Arizona.
  - **Arizona.** With its large building market and heavy cooling loads, Arizona was an opportune target for EWC efforts. The Alliance conducted simulations for a home with vinyl windows in Tucson, AZ that indicated that solar control glass could greatly reduce heating and cooling costs over double-pane clear glass.
  - **Florida.** As the home construction market with the largest growth nationwide, and an equivalently high growth in space conditioning energy consumption, Florida was a focus point for the EWC efforts to integrate energy-efficiency considerations into the residential construction and retrofit markets. The Alliance closely coordinated its EWC efforts with work being done by the Florida Solar Energy Center.

- In 2000, the EWC presented on energy-efficient windows and Florida-specific window and code issues at the Daytona Beach Home Show.
- In 2001, the EWC conducted 9 trainings in Florida on energy-efficient windows, testing and labeling, and Florida code developments. The audiences included manufacturers and distributors, builders, energy raters and the Florida Power utility. The EWC also presented to the League of Environmental Educators of Florida in Leesburg, FL. In 2001, the EWC also recruited the first Florida window manufacturer to participate in NFRC and ENERGY STAR labeling.
- In 2002, the EWC coordinated a meeting with the Florida Solar Energy Center (FSEC) and Lawrence Berkeley National Laboratories (LBNL) to discuss possible changes to Florida Energy Code software.
- In 2003, the EWC partnered with the Florida Energy Extension Service (FEES) to update the windows module for the Build Green & Profit Continuing Education sessions, which were held in August 2003.
- In 2004, the EWC exhibited at the Southeast Building Conference in Orlando, FL, where it shared booth space with NFRC. EWC used the opportunity to meet with marketing officials of Florida Public Utilities to discuss collaboration and to educate builders about the benefits of efficient windows in the Southeast.
- In 2005, the EWC reached out to Florida window manufacturers and builders at the Institute for Building Sciences meeting in Orlando, FL and at the Fenestration Manufacturers Association meeting in Altamonte Spring, FL. NFRC certification of windows was a core issue. The NFRC label and window energy performance were also a topic of the EWC's presentation to the South Florida Building Officials Association conference on windows. The EWC also explained Florida Energy Code and window compliance issues in the context of new federal air-conditioning requirements.

- **Texas.** Prior to the funding period, Texas had no practical experience with energy codes. In order to increase the presence of efficient fenestration products in the Texas market, the EWC strongly supported the Texas Window Initiative (TWI). The EWC served on the TWI advisory council and provided training materials to its market transformation initiative. The EWC also promoted TWI at EWC presentations and exhibits in the region.
  - In 2000, the EWC conducted several planning and coordination meetings with the new Texas Window Initiative to help develop the Texas windows market and provide input on a building codes strategy for the North Texas Council of Governments.
  - In 2004, the EWC promoted energy-efficient window technologies and NFRG rating to Texas window manufacturers, builders and consumers at the Sunbelt Builder's Show in Dallas, TX and at the Energy and Environmental Building Association show in Austin, TX.
- **Midwest.** In 1999, a new organization called the Midwest Energy Efficiency Alliance (MEEA) was created. Modeled to some extent on other regional market transformation efforts in the Northwest and Northeast, MEEA spearheads partnerships across a six-state area to develop markets for energy efficient products. Windows are a key market target for MEEA, and the EWC supported MEEA's efforts in the windows market.
  - In 2000, the EWC provided comments to the new Midwest Energy Efficiency Alliance regarding future possibilities for Midwest windows market development.
  - In 2002, the EWC developed informational materials for the MEEA's Annual Conference, held in May 2002 in Chicago, IL.

3. EXPANDED EDUCATION AND TRAINING

The Alliance undertook EWC education and training efforts to increase knowledge about the basic aspects of energy-efficient windows among various market actors. The EWC program served to promote energy rating and NFRC labeling of window products in order to increase the transparency of the market and help consumers make informed purchase decisions. Many of these efforts were directed at increasing awareness of ENERGY STAR as a reliable and easily recognizable sign of energy efficient windows.

3.1 Increased Trainings and Other Presentations

The EWC provided training to key market audiences, including window companies, retailers, builders, architects, code officials, and utilities.

In 2000, the EWC conducted trainings at the Southeastern Building Conference and other locations for various audiences in Florida, including realtors, builders and others. Overall, the trainings attracted 337 attendees.

In 2001, the EWC conducted nine training sessions in Florida, one in Washington, DC, one on the US Virgin Islands and one in Louisiana. The audiences included, among others, energy raters, builders, distributors and installers. Among the partners for some of these trainings were Florida Power, ENERGY STAR, Guardian Industries, Inc., the Virgin Islands Energy Office and the Florida Solar Energy Center. The EWC also co-sponsored an Installation Masters training seminar in Florida.

In 2002, the EWC conducted one training seminar in Pennsylvania and four in Florida. The audiences included builders, architects, window retailers, and HVAC installers.

In 2003 the EWC gave a presentation about window energy efficiency to the sales force of EWC member TRACO in Pittsburg, PA.

In 2004, the EWC collaborated with the Northeast Energy Efficiency Partnerships (NEEP) and state energy officials in order to hold training sessions for salespeople in Maryland and New Jersey. The sessions provided over 120 window sales representatives with training on energy efficient windows. The trainings consisted of components educating on low-e technologies, ENERGY STAR® and sales training.

In 2005, the EWC, NEEP and state energy officials built on their 2004 experiences with educating window sales representatives about the assets of energy efficient windows and organized training seminars in New Jersey and Delaware, reaching an audience of more than 250.

Specific target groups:

- **Manufacturers –** In 2001, the EWC assisted EWC member Custom Windows in becoming a participant in Florida Power's low interest loan program.

  The EWC conducted on-site trainings for manufacturers as opportunities arose. Cost sharing with these manufacturers was emphasized. In 2004 and 2005, the EWC concentrated on specifically targeting small window manufacturers in order to help increase the number of small manufacturers that participate in NFRC testing and certification and in the ENERGY STAR partnership.

  Throughout the project period EWC educated numerous window manufacturers and home builders about the function and benefits of NFRC and ENERGY STAR labeling.

In 2003, the EWC responded to manufacturers who expressed demand for clarification of issues concerning the transition in Georgia to the IECC requirements for windows. At DOE's National Codes Workshop in Atlanta, GA the EWC offered a workshop that addressed these concerns. 200 attendees learned about the NFRC rating process, structural certification, insulated glass durability and selling ENERGY STAR Windows. Among the attendees were 80 window manufacturers and dealers and 13 government representatives. As a result of the workshop, the Georgia government clarified the language of the new legislation. The workshop was supported with grants from Rebuild America, GEFA, Cardinal Glass, Andersen Windows, Veka and AFGD. The manufacturer TruSeal sponsored a second workshop for 30 attendees that could not be accommodated during the first workshop for lack of space.

In 2004, the EWC sponsored a talk on energy efficient windows at the Alliance to Save Energy offices in Washington, DC. The 22 attendees included a speaker from Cardinal Glass, who spoke on the direction of the window and low-e glass markets.

Also in 2004, the Alliance presented in Tampa, FL to a group from window manufacturer NuAir about the future of low-e insulated glazing.

In 2005, the EWC held a meeting with its partners at the Institute for Building Sciences meeting in Orlando, FL to discuss challenges in the industry and collaborate on strategies to overcome these challenges. The Alliance also presented on EWC activities to increase participation in the program.

The EWC worked with several manufacturers to increase its outreach efforts in 2005 and held trainings with Silverlight and Crystal Windows, conducted consumer inquiries with Andersen Windows, and collaborated with Pella on MA code assistance.

- **Builders –** The Alliance worked to transform the new construction sector, which lags behind the retrofit market in the penetration of ENERGY STAR windows, to more energy-efficient products. These efforts included research, training sessions, and preparation of education materials.

  The EWC exhibited and presented at regional builders' shows in Florida and the Southeast, the West Coast, East Coast, Southwest, and Midwest.

  In 2000, the EWC conducted a training session at the Southeastern Building Conference and hosted an information booth at the National Association of Home Builders Remodelers Show. This served to educate builders about energy efficient windows and increased awareness of ENERGY STAR and NFRC.

  In 2001, the EWC educated builders about the benefits of energy efficient windows and the functions of the NFRC at the Annual Energy and Environmental Building Association Meeting and Exposition in Orlando, FL, at the Southeast Builders Conference in Orlando, Florida, and at the National Association of Home Builders Remodelers Show in Atlantic City, NJ. In conjunction with the University of Florida's Build Green and Profit program the EWC presented to builders in St. Petersburg, FL. Additionally, the EWC conducted ten "Maximizing Your Window Opportunities" trainings for builders and distributors in Florida, with guest presenters from ENERGY STAR Windows. With coordination from the Virgin Islands Energy Office and the Florida Solar Energy Center, the EWC also conducted training for builders in the US Virgin Islands.

  Two of the training seminars held by the EWC in 2002 were targeted specifically at builders and architects. Thirty-eight participants attended these seminars.

Based on the results of research performed in 2005 on the barriers and needs in new construction, the EWC developed a toolkit designed to educate builders about window energy performance and to help them sell energy-efficient window products to their consumers. This is posted on the EWC Web site, and was provided as printed material where needed (see Attachment 3).

- **Distributors and Retrofit Contractors –** In 2001, the EWC conducted ten "Maximizing Your Window Opportunities" trainings for builders and distributors in Florida, and a training session for distributors in the Washington, DC area on behest of Guardian Industries. In 2001, the EWC also co-sponsored AAMA's Installation Masters training seminar in Florida and presented to HVAC contractors in central Florida on the effect of energy efficient windows on load and moisture control.

  In 2003, the EWC presented to the Certified Contractors Network at their conference in Duck Key, FL on the importance of energy-efficient windows.

- **Code Officials –** In 2003, the EWC presented at DOE's National Codes Workshop in Atlanta, GA and hosted an information booth at a Building Officials Association of Florida meeting in Orlando, FL

- **Energy Raters –** In 2001, the EWC and Florida Power collaborated in training energy raters in Ocala, FL. The EWC also conducted training for the Louisiana Energy Raters Association in New Orleans, LA.

- **Windows Rating Community –** Through its board-level involvement with the National Fenestration Rating Council, the EWC was an active participant in the windows rating community. The EWC contributed to the discussion of windows rating standards and procedures and benefited from the experienced gained through this involvement.

3.2 Presented and Exhibited at Conferences and Meetings

The EWC gave presentations about energy-efficient windows at the following meetings:

2000

- Daytona Beach Home Show in Daytona Beach, FL
- American Council for an Energy Efficient Economy 2000 Summer Study in Pacific Grove, CA

2001

- Northeast Window and Door Association (NWDA) Winter Meeting in Providence, RI
- Window and Door Manufacturers Association (WDMA) in La Jolla, CA
- Builder Marts of America (for EWC manufacturer member Guardian) in Las Vegas, NV
- Glass Association of North America (GANA) educational seminar in Las Vegas, NV
- DOE Rebuild America project in Ford City, PA
- American Architectural Manufacturers Association's (AAMA) National Summer Meeting, Denver, CO
- NWDA's regional meeting in Fredriksburg, VA
- Florida Smart Homebuyers seminar in Gainesville, FL
- Southeast American Architectural Manufacturers Association meeting at Marco Island, FL
- League of Environmental Educators of Florida in Leesburg, FL
- National Fenestration Rating Council's (NFRC) Annual Fall Meeting in New Orleans, LA

2002

- Glass Association of North America's (GANA) Glass Expo Rocky Mountain 2002 in Denver, CO
- American Society of Heating, Refrigerating and Air-Conditioning Engineers' (ASHRAE) Winter Meeting in Atlantic City, NJ
- GANA's Building Envelope Contractors educational seminar in Houston, TX
- Florida Manufacturers Association meeting in Orlando, FL
- GANA's Laminating and Fabricating educational seminar in Pittsburg, PA
- American Council for an Energy Efficient Economy (ACEEE) Summer Study on Residential Buildings in Asilomar, CA (presented peer reviewed paper, "Energy Efficient Windows in the Southern Residential Market")
- Southeast American Architectural Manufacturing Association Meeting in San Destin, FL
- Window & Door Manufacturer Association Summer Meeting in Montreal, Quebec
- National Fenestration Rating Council (NFRC) Fall Meeting in Anchorage, AK

2003

- GANA Glass Week in Dana Point, CA
- Certified Contractors Network conference in Duck Key, FL
- Glass Build America Show in Atlanta, GA
- GANA Glass Fabrication 2003: Insulating, Laminating and Tempering Educational Seminar in Chicago, IL
- DOE's National Codes Workshop in Atlanta, GA. The EWC offered a workshop that addressed manufacturers concerns about the transition in GA to the IECC requirements for windows. 200 attendees learned about the NFRC rating process, structural certification, insulated glass durability and selling ENERGY STAR Windows.
- NFRC's annual meeting in Scottsdale, AZ

2004

- NFRC's meeting in Portland, OR. The EWC discussed upcoming opportunities for manufacturer participation in promotion activities for energy-efficient windows such as sales force trainings.
- ACEEE Summer Study in Pacific Grove, CA. The EWC presented on the Southern market for energy-efficient fenestration.

2005

- International Builders Show in Orlando, FL. Attended and presented at a meeting of key window industry professionals to update industry on EWC activities including the Window Product Database.
- Northeast Window and Door Association (NWDA) meeting in Philadelphia, PA. Spoke about EWC activities to increase manufacturer involvement in the services that the EWC provides, such as the Window Product Database. The EWC worked on helping ease concerns of small manufacturers regarding NFRC rating.
- Window and Door Manufacturers Association (WDMA) annual meeting in Litchfield, AZ. Spoke about EWC activities, ways manufacturers can be more involved in EWC and the services EWC provides, such as the Window Product Database.
- Institute for Building Sciences meeting in Orlando, FL. Presented on EWC activities and increased participation in the program.
- Fenestration Manufacturers Association meeting in Altamonte Spring, FL. Presented and answered questions on energy-efficiency. Made arrangements to meet with Win-Door and Florida Extruders to discuss NFRC certification and testing and the production of efficient windows.
- Presented to the South Florida Building Officials Association conference on windows, the Florida Energy Code and window compliance issues. Explained and introduced the NFRC label. Spoke on the impact the new federal air-conditioning requirements will have on windows

In order to educate builders and homeowners about the benefits of energy-efficient windows and to increase awareness of NFRC, ENERGY STAR and the EWC among window manufacturers and parts suppliers, the EWC also hosted information booths at the following events:

2000

- National Association of Home Builders Remodelers Show
- Energy and Environmental Building Association
- Symposium of the Building Environment and Thermal Envelope Council.

2001

- Vermont Efficiency's Building Solutions Symposium in Burlington, VT
- National Association of Home Builders (NAHB) Remodel America in Dallas, TX
- Pennsylvania Builders Show in Harrisburg, PA
- National Glass Association (NGA) Trade Show and Conference in Miami, FL
- Journal of Light Construction Training Show in Providence, RI
- PCBC Builder Show in San Francisco, CA (assisted with NFRC booth)
- Southeast Builders Conference in Orlando, FL
- Office of the People's Council's Energy Awareness Day in Washington, D.C.
- "Conservation or Crisis: A Northwest Choice" conference in Portland, OR
- Annual Energy and Environmental Building Association Meeting and Exposition in Orlando, FL
- National Association of Home Builders Remodelers Show in Atlantic City, NJ
- InterGlassMetal Fenestration World Exhibit and Conference in New Orleans, LA
- Oak Ridge National Laboratories' Performance of Exterior Envelopes of Whole Buildings VIII Conference in Clearwater, FL

2002

- Contractors and Builders Supply Show in the Washington DC area
- Southface Energy Institute's Greenprints Conference
- Residential Energy Service Network's (RESNET) annual conference in Cocoa, FL
- Affordable Comfort's annual conference in Cincinnati, OH
- Affordable Comfort's regional conference in Syracuse, NY
- Energy and Environmental Builders Association Conference in Pheonix, AZ
- NE Florida Refrigeration and Air Conditioning Contractors Show in Jacksonville, FL
- US Green Building Council's Conference in Austin, TX

2003

- Affordable Comfort in Kansas City, MO
- Building Officials Association of Florida in Orlando, FL

2004

- Southeast Building Conference in Orlando, FL. Shared booth space with NFRC. Met with marketing officials of Florida Public Utilities to discuss collaboration between the FPU and the EWC.
- NAHB Remodeling Show in Chicago, IL. The EWC received free booth space leveraged DOE's funds by convincing NAHB of the value of the EWC.
- Sunbelt Builder's show in Dallas, TX
- Energy and Environmental Building Association (EEBA) show in Austin, TX
- South East AAMA Fall Meeting in Naples, FL

2005

- International Builders Show in Orlando, FL

- Building Industry Association builder show in Honolulu, HI. Education efforts focused on talking about NFRC rating with Coastal Windows as Coastal is the only window manufacturer in the region and only manufactures single-pane, uncoated glass windows.
- Northeast Window and Door Association (NWDA) meeting in Philadelphia, PA
- NFRC membership meeting in Kona, HI

3.3 Expanded Partnerships

The EWC developed partnerships of various kinds with utilities, market transformation organizations, federal programs, state energy officers, window manufacturers, industry groups, and others to support education and promotion efforts for efficient fenestration products. The EWC worked with Building America, ENERGY STAR Homes, Partnership for Advanced Technologies in Housing (PATH), and other relevant government-sponsored projects to promote the success of energy-efficient fenestration. The Alliance constantly sought to expand the EWC partnerships to meet the stated goal of the DOE Window Industry Technology Roadmap, to 'develop communication channels among building industry groups to address integration issues in areas of education, research, and collaboration'.

In its education activities, the EWC consistently sought to coordinate its efforts with the National Fenestration Rating Council to ensure that the work of the two groups was complementary and that the core message of energy efficiency remained on target. In fact, the Director of the Alliance's Buildings and Utilities program was on the board of NFRC which further facilitated this relationship.

The EWC continuously worked with the Fenestration Manufacturers Association (FMA), American Architectural Manufacturers Association (AAMA), Window and Door Manufacturers Association (WDMA), and other industry groups on key issues such as recognition of the NFRC and ENERGY STAR labels, and coordination of education materials and outreach to consumers and builders to raise awareness of energy-efficient fenestration.

In 2001, the EWC assisted EWC member Custom Windows to become a participant in Florida Power's low interest loan program. That same year, the Alliance hosted a presentation by Jim Larsen of Cardinal Glass to familiarize the Washington, DC energy efficiency community with energy efficient glazing.

In 2003 the EWC collaborated with the EWC members ATOFINA and Andersen to educate consumers about energy efficiency through manufacturer-funded materials.

In 2004, the EWC worked with EWC member Andersen Corp. on consumer inquiries and worked with the Southwest Energy Efficiency Project on the deployment of energy efficient window technologies.

In 2004 and 2005, the EWC collaborated with the Northeast Energy Efficiency Partnerships (NEEP) and state energy officials in order to provide trainings to salespeople for selling energy-efficient windows. EWC members Silverline Windows and BF Rich were actively involved in facilitating the trainings.

4. PLANNED LAUNCH OF COMMERCIAL PROGRAM

The Alliance's initial focus for EWC has been on residential fenestration markets, as dictated by member interests and by the interests of key partners such as NFRC. However, the EWC has also considered providing similar education and training services for the commercial market.

The Alliance supported the Northwest Energy Efficiency Alliance's (NEEA) Commercial Windows Initiative (CWI) by joining its steering committee in 2004. The CWI captures some of the energy savings available through new commercial fenestration technologies. The CWI is seeing impressive results from its activities aimed at transforming the northwest commercial window market to more energy efficient products. The EWC increased the overall awareness of this initiative by including an article about the CWI in its *Word on Windows* newsletter. In addition, the Alliance promoted the 2004 publication *Window Systems for High Performance Buildings* by Carmody, Selkowitz, Lee. Arasteh, and Willmert on the EWC website. This book is a resourceful guide for energy performance in commercial buildings through the effective use of energy-efficient windows.

The EWC planed to start an ambitious commercial windows program, including training sessions, collaboration with NFRC, and a new commercial section of the EWC web site. These plans were discussed among the EWC partners but had to be postponed for a later time when, with sufficient preparation, more time and resources can be focused on these projects.

5. INCREASED VARIETY AND DISTRIBUTION OF INFORMATIONAL TOOLS AND MATERIALS

As the EWC expanded, so did the demand for a broader range of informational tools and materials needed to serve market audiences, ranging from printed fact sheets to software. The Alliance increased the variety and distribution of EWC informational tools and materials.

5.1 Created EWC Brochure

While most of the EWC information efforts were channeled through the web site, there was increasing need for a simple, envelope-sized brochure that introduced the Collaborative. Therefore the Alliance designed and printed such a brochure, summarizing the benefits of efficient windows, introducing the Collaborative, and inviting visits to the web site. This provided a low-cost, flexible piece that could be widely distributed through a range of EWC and partner activities. The brochure was made available to manufacturers and utilities for inclusion in mailings to their customers. The latest version of the brochure was printed in early 2005 and distributed among the EWC members and among audiences at conferences, training sessions and trade shows.

5.2 Increased Number and Distribution of EWC Fact Sheets

- **Revised fact sheets graphically.** The popular EWC fact sheets provide locally specific information about desirable window properties for many local areas across the nation. In response to feedback from users and industry stakeholders, the Alliance developed changes to the look and content of these fact sheets. This way the Alliance, working with its University of Minnesota colleagues, helped ensure continuity and quality in these fundamental EWC products.
- **Increased the number of fact sheets**. From 13 regions initially, the EWC increased the number of fact sheets tailored to local areas so that the fact sheets now provide specific information for a total of 101 different local areas, including 3 areas in Canada. These sheets are updated on a regular basis in reflectance of changing energy prices. The fact sheets were made available in print form at EWC events, and as .PDF files on the web site. See Attachment 11 as an example of a fact sheet.

5.3 Supported Software Development and Distribution

At the start of this cooperative agreement period, LBNL's RESFEN 3.1 was a popular tool for calculating the energy and cost savings from windows in a specific house and climate. However, it needed some enhancements for better user-friendliness. Therefore, Alliance staff consulted closely with LBNL, which developed a 5.0 version of the software for the EWC which showed results more effectively through graphics reporting and included comparison reports to show the impact of various windows on the same home. After version 5.0 was developed, the EWC publicized its availability on the EWC web site and in the *Word on Windows* newsletter.

5.4 Distributed the New Books about Energy-Efficient Residential and Commercial Windows

In 2000, the Alliance purchased copies of the 2000 revised version of *Residential Windows* by Carmody et al. for wide-scale distribution. While much of this book's content is summarized on the EWC web site, there continued to be strong demand for a desk volume that could be referred to for specific details.

In addition, the EWC purchased and distributed additional copies of the 2004 publication *Window Systems for High Performance Buildings* by Carmody et al. This book is a resourceful guide for energy performance in commercial buildings through the effective use of energy-efficient windows.

Both publications were described and advertised on the EWC web site.

6. EXPANDED MEDIA ACTIVITY

The Collaborative's media activities increased in accordance with the need to reach more market audiences in more geographic areas.

In 2001, EWC press coverage totaled 3.3 million media impressions.

From 2002 through March 2004, the EWC estimates to have reached the following audiences through a host of communication vehicles:

Media circulation	15 million
Trainings & Presentations (attendees)	1920
Web site traffic (approximated visits)	901,000
Newsletters & fact sheets distributed	18,643
Outreach--Builders, manufacturers, sales reps	875
Trade Show Exhibits (attendees)	12,000

The latest media impressions count reached a total of more than 4 million for the last quarter of 2005 alone.

- **Produced *Word on Windows* Newsletter.** The Alliance continued the production of the *Word on Windows* newsletter. Printing and distribution expanded as the EWC membership and mailing lists continued to grow. In addition to distribution by mail, the Alliance started email-distribution, which helped reduce paper consumption and save funds. Examples of *Word on Windows* newsletters are included in Attachments 12-15.
- **Radio Exposure.** During much of 2003, the Alliance had monthly appearances on the *The Money Pit: Home Improvement Radio Show*, to which it contributed with a wide range of seasonal energy saving tips, including information on energy-efficient windows. In April 2003, a *Money Pit* radio interview with the EWC concentrated on windows and reached one million listeners.
- **Increased Print Impressions.** In 2001, print media impressions mentioning the EWC totaled more than 2.8 million. In 2002 media impressions of EWC-related articles reached more than 5.8 million. In 2003 this number increased to more than 7.6 million. For example, the Detroit Free Press (1.2 million readers) interviewed the EWC for a major story on selecting replacement windows. The story was released in March 2003 as a full-page article on the cover of the consumer section. In 2005, a story about replacement windows by Associated Press that included EWC information was featured by newspapers nationwide and reached more than 4 million media impressions.
- **Articles.** In November 2000, the Florida Home Builder magazine published an article entitled "Top 5 Myths that Limit your Window Choices" by Alliance EWC consultant Arlene Stewart. In 2001, Alliance to Save Energy's Bill Prindle and Lawrence Berkeley National Laboratories' Dariush Arasteh conducted a study on *Energy Savings and Pollution Prevention Benefits of Solar Heat Gain Standards in the International Energy Conservation Code*. Based on this research several EWC members collaborated in writing the white paper *Energy Efficient Windows in the Southern Residential Windows Market* (see Attachment 8), which was presented at the 2002 ACEEE Summer Study.

7. EXPLORED INTERNATIONAL INITIATIVES

The EWC has noted increasing interest among its member companies in opportunities overseas. Moreover, EWC has received several requests from non-U.S. organizations to use parts of the EWC web site content.

The EWC's expertise in the area of energy-efficient fenestration was a great asset for the Alliance to Save Energy's international activities. Since most Alliance international programs are funded from non-DOE sources, the extension of EWC efforts through these international programs can create significant leverage for DOE resources.

In 2001, the EWC conducted trainings on energy-efficient windows for government and industry delegations visiting from Russia and China. The presentation slides were translated into Russian and later also into Chinese.

In 2002, the Alliance to Save Energy started its China Energy Efficient Windows Initiative with funding from the Energy Foundation. This initiative promoted testing and labeling for energy performance in window products among glass and window manufacturers in China. In cooperation with the Ministry of Construction of the People's Republic of China, the Alliance convened several workshops in China aimed at educating manufacturers and government officials on the benefits of labeling and the models of labeling systems, based on the experiences the EWC had gained with rating, labeling and energy building codes in the United States. The project's long-term goal was to promote inclusion of energy-efficient window products in building codes and construction practices in China. To this end, the Alliance conducted a series of workshops in China to assist with the development of labeling and promotion of energy-efficient windows in China. All activities under the China Energy Efficient Windows Initiative were funded with a grant from the Energy Foundation.

Under Alliance to Save Energy funding, the EWC gave presentations on the EWC to delegations from both Kazakhstan and Norway in March 2003. Kazakhstan was in the process of considering building energy codes for its country. The EWC discussed the importance of market transformation activities in advance of codes and suggested programs such as ENERGY STAR as strategies for continuing transformation after code adoption. Norway had recently developed a new organization—Enova—tasked with developing programs to promote energy efficiency and renewable energy. The discussion with Norway focused on the voluntary and collaborative nature of the EWC, as well as the necessity for energy performance testing such as NFRC.

8. ADDITIONAL PROGRAM TASKS (2004-2006)

8.1 Developed an Advisory Council

The Alliance developed an Advisory Council designed to mobilize the industry to increase market penetration of efficient window products in the residential sector. The Advisory Council had the following tasks:

- Plan joint strategies for industry action to encourage and assist in transformation of the residential window market;
- Provide guidance and input to the Alliance's activities related the EWC.

The Advisory Council consists of members of the EWC and Alliance Associates who have demonstrated strong commitment to advancing energy efficiency in the residential sector. In 2005, these members were the following:

- John Carmody – University of Minnesota
- Ray McGowan – National Fenestration Rating Council
- Steve Johnson – Andersen Corporation
- Harry Misuriello – Alliance to Save Energy
- Steve Selkowitz – Lawrence Berkeley National Laboratories
- Arlene Z. Stewart – AZS Consulting
- Garrett Stone – Brickfield, Burchette, Ritts & Stone, PC

8.2 Increased Market Penetration of Efficient Products in New Construction

The EWC partnered with ENERGY STAR®, NFRC and many others to move the new construction market to more efficient products.

- **Researched barriers and needs in new construction.** This research included three components. The first component combined a literature review to determine successes and lessons learned. The second component was to research and investigate barriers and opportunities through discussions with experts in different areas including builders and organizations actively working to advance energy efficiency in the new construction sector. The third component included an evaluation of existing tools and resources available to builders and to their consumers to determine the impact and effectiveness of these resources. The results were compiled in the technical paper *Opening the Window of Opportunity for Energy-Efficient Windows in the New Homes Market* (Attachment 5). This paper identified barriers and needs, and made recommendations for next steps to transforming the window market in new construction.

- **Developed Builder Toolkit.** Based on the results of research on the barriers and needs in new construction, the EWC developed a toolkit designed to educate builders about window energy performance and to help them sell energy-efficient window products to their consumers. This is posted on the EWC Web site, and provided as printed material where needed (Attachment 3).

8.3 Increased NFRC Labeling among Small and Midsize Manufacturers

As a founding member of NFRC and continuously serving board member of the NFRC, the Alliance to Save Energy dedicated considerable resources to the advancement of energy performance testing and labeling of building products. The Alliance's EWC program is committed to increasing the availability and the volume of NFRC tested and certified window products in the market. To achieve this objective, the EWC sought to gain a greater understanding of the barriers that exist for small to midsize manufacturers.

- **Researched barriers and identified needs in increasing NFRC testing and certification among small manufacturers.** The Alliance's research consisted of two components. The first component was to research and investigate barriers through meetings with those organizations most involved in NFRC testing and certification including NFRC staff and membership, NFRC certified testing and simulation laboratories and LBNL staff. The second component consisted of meetings with small manufacturers who have completed NFRC testing and certification within the past two to three years to discuss obstacles and identify needs. The Alliance compiled the results of this research along with recommendations for next steps in the technical paper *Identifying Barriers to NFRC Participation by Small Manufacturers* (Attachment 6).

8.4 Studied and Promoted Opportunities to Increase Market Penetration of Efficient Products in Low-Income Housing

The Alliance identified untapped opportunities for increasing market penetration of efficient window products in the low-income sector. This sector includes low-income home owners, public housing and weatherization programs. The Alliance achieved this objective by benchmarking prevalent practice, identifying cost-effective opportunities for market transformation, developing targeted material and researching alternative mechanisms for financing energy-efficient windows in the low-income housing sector. The research audience included staff from state energy offices and state weatherization programs, employees and contractors of the U.S. Housing and Urban Development Agency, financing organizations such as Fannie Mae and others working to increase affordable and efficient housing.

- **Researched prevalent practice and identified opportunities for transformation in the low-income market.** The Alliance researched the market penetration of energy-efficient windows in the low-income market and identified untapped opportunities to increase the use of efficient window products in this sector. The research was based on two components: research on weatherization programs and discussions with various organizations dedicated to improving low-income housing. The research efforts included trips to New York for conversations with implementers of low-income weatherization programs as well as attendance of two seminars by the Department of Housing and Urban Development. This research determined a number of factors including: prevalent practice in low-income housing programs, investment in improving energy performance of low-income homes; share of investment dedicated to efficient fenestration products; barriers to the increased use of energy-efficient windows; and mechanisms to surmount these barriers. The results of this research and recommendations for the next steps to transforming this sector were compiled in the technical paper *The Challenges to Increased Use of Energy-Efficient Windows in Low-Income Housing* (Attachment 7).

- **Evaluated and compiled resources currently available for improving energy performance of low-income housing.** In order to educate those working to support low-income housing, the Alliance developed a Web-based portal, accessible through the EWC Web site, which provides a one-stop shop for all audiences seeking information and guidance on improving energy performance of low-income housing (Attachment 4).

- **Researched alternative financing mechanisms for increasing the use of energy-efficient windows.** The Alliance researched models for alternative financing mechanisms for energy-efficient windows. In a white paper, the Alliance reported on one of the financing mechanisms in the marketplace, energy-efficient mortgages (Attachment 10).

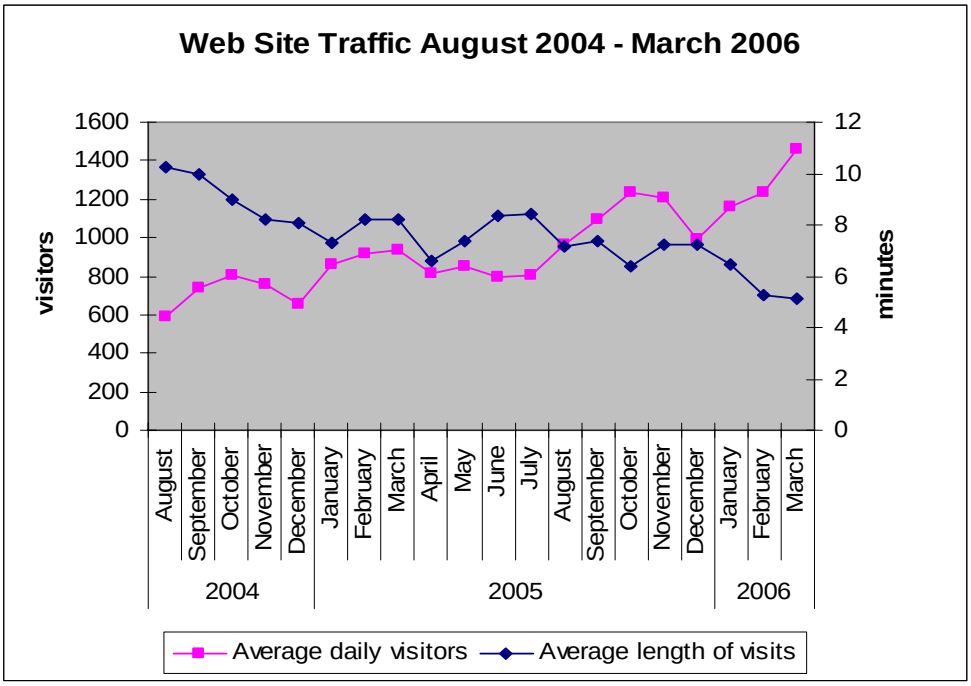
8.5 Analyzed Federal Tax Credit for Energy-Efficient Windows

The Energy Policy Act of 2005 established a Federal tax credit for energy efficiency improvements in existing homes. Such improvements include the installation of energy-efficient windows, based on International Energy Conservation Code (IECC) criteria. In November 2005, the EWC analyzed the windows-related provisions of the Federal tax credit in the white paper *The Tax Credit for the Installation of Energy-Efficient Windows: Does the ENERGY STAR Help Consumers Find Products that Qualify?* (Attachment 9). In a detailed analysis of 3,111 US counties and jurisdictions, the paper demonstrated that the ENERGY STAR label met or exceeded the IECC code criteria in all but a small number of counties. The EWC recommended that regional ENERGY STAR window labels be the qualifying criteria for the windows tax credits because of: 1) the large existing public awareness of the ENERGY STAR labeling program, 2) the significant investment the taxpayers have made in promoting the ENERGY STAR brand and 3) the simple and effective messaging that would result for promoting energy efficient windows to achieve the energy savings intended by Congress. Based on these recommendations, the Internal Revenue Service issued a special rule in February 2006 determining that all ENERGY STAR Windows qualify for the Federal tax credit in the regions designated on their ENERGY STAR labels. This decision facilitated further consumer outreach efforts and increased recognition of the ENERGY STAR mark for windows.

D CONCLUSION

The Alliance to Save Energy has managed the Efficient Windows Collaborative since its inception in 1997 under partnership with the University of Minnesota, Lawrence Berkeley National Laboratory, and contractor AZS consulting. The mission of the Alliance's Efficient Windows Collaborative has been to promote the production and use of energy-efficient windows in the residential market. The Collaborative has developed and/or promoted various tools, including an interactive website, printable city-specific fenestration fact sheets, residential and commercial window books, training tools such as slide presentations and handouts that we customize to our audiences' needs, the RESFEN software, rebate guides and others.

A significant achievement of the EWC is the heavily trafficked www.efficientwindows.org website, which has seen its daily average of visitors increasing to more than 1,000. As an illustration, the following graph shows the development of web traffic to our site over a period from August 2004 to March 2006:



It is evident that, while the number of visitors more than doubled over this period of time, the average length of visits decreased by about half. A reason for this might be that more links to other sites have been included on the EWC web site thus drawing the visitors eyes to other resources. In particular, visitors are directed to manufacturer web sites through the Window Selection Tool, but also to web sites where software such as RESFEN or WINDOW can be downloaded. In addition, the EWC site features links to the sites of organizations such as the Alliance to Save Energy, AAMA, and DOE's and EPA's ENERGY STAR program.

The Alliance's EWC website is highly regarded as the premier source of objective information on efficient windows. To promote this web-based tool and to spread its message of energy efficiency and related benefits, the Collaborative has engaged in the following outreach activities:

- Presentations at industry events
- Booths at builder trade shows
- Press releases

- Interviews for broadcast and print media
- Articles and monthly columns in industry publications, magazines and newspapers
- Partnerships with industry to co-market energy efficiency message with their marketing materials
- Direct consumer outreach in the form of in-person phone conversations and email responses to website inquiries
- Collaboration with industry and energy-efficiency groups, such as the Northeast Energy Efficiency Partnership, to promote a consistent message to consumers of window and door products

Such activities have made a dual impact on consumer awareness, promoting energy efficient window and door products while simultaneously promoting the specific tools offered by the Collaborative.

A major task that the EWC has not been able to implement in the way it was envisaged has been the launch of a program for efficient commercial windows (Task 4). There are significant differences between the role of windows in the residential and the commercial sectors so that approaches tried in the residential sector could not simply be transferred to the commercial sector. The EWC team conducted extensive research to assess the best options for energy efficient commercial fenestration, and the release of *Window Systems for High Performance Buildings* by Carmody et al. in 2004 provides the EWC with a good basis for starting a commercial windows program in the future. However, other developments may have to precede the establishment of such a program as a large-scale success. The EWC will have to broaden its membership base from the present concentration on the residential market to a membership with greater representation of commercial market participants. At GlassBuild in Miami in 2002 we realized that the commercial market was far more fragmented than the residential one. We will therefore have to invest more concentrated efforts in establishing a network throughout the commercial market.

The National Fenestration Rating Council is currently in the process of determining a new component-based fenestration rating procedure for commercial windows. Once this procedure is established, the promotion of energy-efficient commercial windows will have gained a new basis. The EWC will actively pursue these developments in the coming years and establish a program for efficient commercial windows. The EWC has promoted the NFRC site built program whenever possible and many architects use the EWC website as a reference. However, because of the fragmentation of the commercial industry, we agree with NFRC's efforts to fully develop the component program.

In its other tasks, the Efficient Windows Collaborative has consistently expanded its activities and thus created a significant and lasting impact on the national fenestration market. We accelerated market transformation toward more energy-efficient products, increased consumer awareness about efficient window technologies and financing options, promoted the transparency of the market and supported government and utility incentives for energy efficiency. Over the course of the project period, the EWC seized arising opportunities to support energy efficiency even further, so that several new activities were added to the Collaborative's work scope (Task 8).

One of the crucial roles that the EWC played and plans to continue in the future is bridging gaps between different groups involved in the windows market, be it industry, retailers, consumers or government. On a state, regional and federal level, the EWC seized opportunities to provide understanding to both industry and governmental entities to remove barriers to market penetration.

After completion of this cooperative agreement, the EWC plans to break new ground for the introduction of the next generation of efficient windows in the residential sector and create momentum for the establishment of rating procedures for commercial windows and a stronger incorporation of efficient fenestration in commercial building design.

One of the EWC's key intentions for the project under this cooperative agreement was achieving a significant increase of the market penetration of energy-efficient windows, with the stated project

objective of doubling the market share from 35 percent at the start of the project period to 70 percent at its end. However, if the definition of energy-efficient windows is based on the ENERGY STAR label, the Alliance has to assume that the goal of a 70 percent market penetration has not been achieved at the end of the period under this cooperative agreement. The national market penetration of windows with the ENERGY STAR label increased from 34 percent in 2001 to 38 percent in 2003 and had risen to 53 percent in 2005.[2] One factor that limited the increase of the market share of ENERGY STAR Windows is the revision of the ENERGY STAR qualification criteria in May 2003. Revised climate zones lead to stricter SHGC criteria in large parts of the former Central Zone (now divided into North/Central Zone and a South/Central Zone) and to stricter U-factor criteria in those parts of the former Southern Zone that have now become part of the South/Central Zone. Accordingly, a slightly smaller percentage of windows qualified under the new criteria than under the previous criteria.

Apart from the increased stringency of the ENERGY STAR criteria in some regions, other factors that limited the increase in market share for ENERGY STAR Windows were temporary uncertainty about the new ENERGY STAR qualification criteria and lagging penetration of high-performance products into the new construction market. Uncertainty about the new criteria before these had been finalized meant that several window manufacturers were reluctant to factor ENERGY STAR into their marketing plans for a period of time. The window market for new construction still holds a large unused potential for more energy efficiency despite the great steps that were made to increase market transparency and consumer awareness on the retrofit side of the market, The EWC has addressed this potential by studying decision making processes concerning windows in the residential construction business and providing a toolkit to help homebuilders with making optimum decisions for fenestration in new homes. Further efforts will have to back up the penetration of efficient windows into the new construction market. To this end the EWC seeks collaboration with utilities across the nation to include energy-efficient windows in utility market transformation programs. The Efficient Windows Collaborative considers its achievements in facilitating a significant increase in consumer awareness about energy-efficient windows and a growing market transparency through NFRC energy performance labeling a vital basis for the effectiveness of further market transformation efforts.[3]

[2] Data from the 2004 and 2006 editions of the *Study of the U.S. Market for Windows, Doors and Skylights.* Ducker Research Company.
[3] According to the *Study of the U.S. Market for Windows, Doors and Skylights,* 81 percent of window units sold in 2003 were NFRC labeled.

E ATTACHMENTS

1. *IECC Window Compliance Guide to Window Selection in Maryland*
2. *Residential and Commercial Programs that Offer Incentives and Rebates for Energy Efficient Windows*
3. *EWC Builder Toolkit*
4. *Improving Energy Performance in Low-Income Housing*
5. *Opening the Window of Opportunity for Energy-Efficient Windows in the New Homes Market*
6. *Identifying Barriers to NFRC Participation by Small Manufacturers*
7. *The Challenges to Increased Use of Energy-Efficient Windows in Low-Income Housing*
8. *Energy Efficient Windows in the Southern Residential Windows Market*
9. *The Tax Credit for the Installation of Energy-Efficient Windows: Does the ENERGY STAR Help Consumers Find Products that Qualify?*
10. *Energy Efficient Mortgages Help Reduce the Energy Consumption of Homes*
11. *Fact Sheet: Selecting Energy Efficient Windows in Oregon*
12. *Word on Windows* – Fall 2001
13. *Word on Windows* – Fall 2002
14. *Word on Windows* – Summer 2004
15. *Word on Windows* – Winter 2004/05

IECC Compliance Guide to Window Selection in Maryland

Designed to Comply with the IECC Requirements for New Single-Family Residential Buildings in Maryland

Code: 2000 International Energy Conservation Code (IECC) First Editio

How to Use This Guide

This guide is designed to help select windows that will meet the requirements of the IECC in Maryland. Each county is assigned to one of five packages (A through E), which vary according to the different climate zones in Maryland.

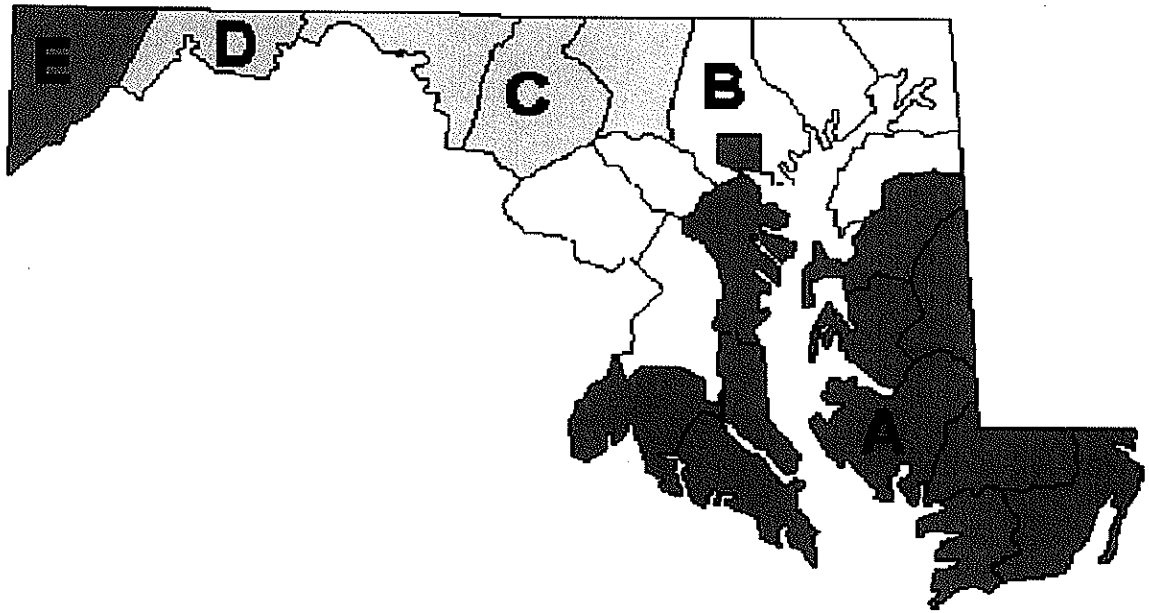
Step-by-Step Instructions

1. Use the color-coded map to locate the county in which construction is taking place and find the package (A through E) associated with that county.

2. Use the "Table of IECC Requirements for Window Selection in Maryland" (on the back of this sheet) to find the prescriptive path based upon the package selected in Step 1, above.

3. Construct the home with windows that have area weighted average U-factors less than or equal to the values for the corresponding path and meet the code maximum air leakage requirements.

Example: *If you are constructing a home with a window area of 15% in Baltimore County, found in Package B, you will comply with the IECC window requirements in Maryland if your windows have an area weighted average maximum U-factor of 0.45 and air leakage less than 0.3 cfm/sq.ft.*



Obtaining the IECC

The IECC is published by the International Code Council (ICC). For additional details on the IECC or to purchase a copy, contact the ICC or visit its website at www.iccsafe.org.

Limitations

This guide is an energy code (IECC based) window selection compliance aid for Maryland and does not provide a guarantee for meeting the state energy code. The guide has not been customized to reflect any state-specific amendments to the IECC that Maryland may adopt or has adopted. The window requirements in this guide also depend upon the energy performance values of other envelope components in the home, i.e., insulation R-values in ceilings, walls, etc., not identified in this guide. For those values, refer to Tables in Chapter 5 of the IECC. For additional details on Maryland's energy code, contact your local building code official.

Maryland Counties by Package

A — 4,000 - 4,499 HDD
Anne Arundel, Baltimore City, Calvert, Caroline, Charles, Dorchester, Queen Annes, Somerset, St. Marys, Talbot, Wicomico, Worcester

B — 4,500 - 4,999 HDD
Baltimore, Cecil, Harford, Howard, Kent, Montgomery, Prince Georges

C — 5,000 - 5,499 HDD
Carroll, Frederick, Washington

D — 5,500 - 5,999 HDD
Allegany

E — 6,000 - 6,499 HDD
Garrett

HDD = Heating Degree Days

Table of IECC Requirements for Window Selection in Maryland

Simplified Prescriptive Window Requirements for Compliance with the IECC for New Single-Family Residential Buildings in Maryland

Package[a]	Maximum Window U-Factor[b]
A	0.45
B	0.45
C	0.45
D	0.40
E	0.35

a. This table of prescriptive requirements is applicable to homes in which the ratio of the rough opening of windows to the gross wall area, expressed as a percentage, is 15%. For homes with glazing areas that are greater than 15%, please refer to Tables 502.2.4(4)-(6) in the IECC.

b. U-factors may be determined by calculating an area weighted average U-factor for all windows. For example, Area Weighted Average U-factor equals ((Area1 x U1) + (Area2 x U2)) / (Total Area). The area weighted average must not exceed the maximum values in the selected path.

NOTES:

1. This table of window requirements is based upon the International Energy Conservation Code (IECC) and does not reflect any state-specific amendments to the IECC. The IECC specifies additional requirements for other parts of the building envelope not listed here, such as insulation for walls and ceilings.
2. This table applies to single-family, residential construction.
3. "Window" refers to any translucent or transparent material (i.e., glazing) in exterior openings of buildings, including skylights, glass doors, the glass areas of opaque doors, and glass block, along with the accompanying sashes, frames, etc.
4. Window area % is the ratio of the area of the rough opening of windows to the gross wall area, expressed as a percentage. Up to one percent of total window area may be exempt from the U-factor requirement.
5. U-factor is a number, generally between 0.2 and 1.20, that indicates the rate of heat loss (or gain) through a window. A lower U-factor demonstrates a greater resistance to heat loss and gain, i.e., better insulating value, of the window. This number is important for winter comfort.
6. Window U-factor must be determined from a National Fenestration Rating Council (NFRC) label on the product (see sample label below), or from a limited table of product "default" values in the IECC.
7. The code requires that windows be labeled in a manner to determine that they meet the IECC's air infiltration requirements; specifically, equal to or better than 0.30 cfm per square foot of window area (swinging doors below 0.50 cfm) as determined in accordance with AAMA/WDMA 101/I.S.2 (ASTM E 283).
8. The labeled product U-factor value should also be used in calculation procedures to properly size the home's HVAC equipment. The IECC requires the use of a computational procedure like ACCA Manual J to size equipment. Properly sized equipment will operate more efficiently and effectively and will save money up front because consumers can avoid paying extra for oversized equipment.

Look for the NFRC Label!

The most important value to look for is the U-factor

For more information on energy efficient windows, go to the Efficient Windows Collaborative website at:

www.efficientwindows.org

Efficient Windows Collaborative

Residential and Commercial Programs that Offer Incentives and Rebates for Energy Efficient Windows

September 2005

- Do you intend to replace old windows with high-performance, energy efficient windows?
- Do you plan to construct a new home equipped with windows that keep energy costs low and provide for a comfortable interior?
- Are you looking for programs within your state that can help you finance such investment in efficient windows?

The following pages give an overview of programs that can help you as a resident, building owner or constructor to finance and implement improvements in window energy efficiency.

Programs are listed by state and by the specific energy supply companies that administer the programs. For detailed information about each program, please refer to the web-links in the list.

Some programs are explicitly intended to assist customers with improving window energy performance. Direct mention of windows in the list is marked in red. Other programs are more general in scope and give incentives for overall residential energy-efficiency. Improvements in window performance can greatly enhance a building's energy efficiency and you should consider these programs as a possible means of financing or paying for your investment in energy-efficient windows. For details about the eligibility criteria of specific programs, please contact the respective sponsors.

State and Company	Program Name(s)	Explanation	Web Site Links as of September 2005
California Burbank Water and Power and ENERGY STAR	-Home Rewards Rebate Program	ENERGY STAR qualified windows are eligible. Requirements are: U-Factor of 0.40 or lower and a SHGC of 0.40 or lower. Rebate amount is dependent on the amount spent and if the purchase it made from a Burbank retailer.	http://www.burbankwaterandpower.com/rebate.html#appliance
California City of Glendale Water & Power and ENERGY STAR	-Smart Home	ENERGY STAR qualified windows are eligible for a $3 rebate per square foot ($3.50 if purchased in Glendale).	http://www.ci.glendale.ca.us/government/gwp/money%20saving%20programs/Residential%20Programs/rebate.html
California City of Lodi Electric Utility and ENERGY STAR	-Residential Services	ENERGY STAR qualified windows are eligible for a $0.50 rebate per square foot.	http://www.lodielectric.com/residential/rebateoffer.php?id=5

California City of Redding Electric Utility and ENERGY STAR	-Earth Advantage Rebate Program	ENERGY STAR qualified windows are eligible for a rebate of 25% of pre-tax material costs (up to $1,000 for homes / $5,000 for commercial buildings).	http://reddingelectricutility.com/energysvc/energy-rebates.asp
California Sacramento Municipal Utility District (SMUD) and ENERGY STAR	-High Performance Window Program	100% financing (interest rates vary, for current rates call 1-888-442-7683) payable over ten years for installations of ENERGY STAR qualified windows. Materials must be installed by a contractor on SMUD's Participating Contractor List.	http://www.smud.org/residential/saving/faqs_pdfs/windows_factsheet.pdf
California Sempra Energy (San Diego Gas & Electric)	-SDG&E Home Improvement Rebates	Rebates for the installation of high-performance windows	http://www.sdge.com/residential/res_ee_weatherization.shtml
California Southern California Edison	-Residential Incentive: Multifamily Energy Efficiency Rebate Program	Incentives for property owners and managers: energy efficiency improvements in lighting, HVAC, insulation and window categories.	http://www.sce.com/RebatesandSavings/Residential/Multi-FamilyEfficiency/

California Turlock Irrigation District and ENERGY STAR	-Window Treatments Rebate	ENERGY STAR qualified windows are eligible for a $1 per square foot rebate.	http://www.tid.org/electric/rebates.htm
Connecticut United Illuminating	-Energy Star Homes Enhancement	Design assistance, technical assistance, rebates and cash incentives for Energy Star homes (including high-performance windows).	http://www.uinet.com/your_home/estar_homes.asp
Connecticut Connecticut Light & Power	-Energy Efficiency at Home -WRAP Weatherization	Program to reduce, among others, heat loss / heat gain. Free program for customers with income up to 200% of federal poverty level.	www.cl-p.com/clmres/indexclmres.asp
	- New Construction Program	Program pays average incremental costs of installing better-than-standard equipment during construction.	www.cl-p.com/clmbus/indexclmbus.asp

Delaware Delmarva Power	-DE Weatherization Assistance (WAP)	WAP is provided at no cost to customers with income up to 200% of federal poverty level. Includes window replacement.	http://www.dhss.delaware.gov/dhss/dssc/weatheriz.html
Florida Florida Power & Light (FPL Energy)	-Business Incentive Programs	Incentive programs for commercial and industrial customers to improve building envelope (including energy efficient window treatments).	www.fpl.com/savings/contents/business_incentive_programs.shtml
Idaho Idaho Power	-Weatherization Assistance Program	Financial assistance to Idaho Community Action Partnership agencies to help cover cost for weatherization.	http://www.idahopower.com/pdfs/customerservice/Weatherization_05.pdf
	-Energy Star Homes Northwest	Incentives for home builders to build Energy Star homes.	http://www.idahopower.com/energycenter/energyefficiency/YourHome/ESHomesNW.htm

Idaho Fall River Rural Electric Cooperative and ENERGY STAR	-Loans and Rebates	ENERGY STAR qualified windows are eligible for $8 per square foot (conditions apply) or for 0% financing for 36 months.	
Iowa Aliant Energy	-Residential Rebates and Incentives	Low-interest financing for equipment including Energy Star (U-factor 0.40 and SHGC 0.55) windows. Replacement windows/sashes rebates - $25 per window/sash	http://www.alliantenergy.com/stellent/groups/public/documents/pub/res_ia_ri_blaze_001841.hcsp http://www.alliantenergy.com/stellent/groups/public/documents/pub/res_ia_ri_blaze_001857.hcsp
	-Commercial New Construction	Construction incentives relative to energy savings achieved (at least 15% savings)	http://www.alliantenergy.com/stellent/groups/public/documents/pub/bus_ps_pcf_ia_con_013407.hcsp#TopOfPage
Louisiana CLECO (Central Louisiana Electric Company)	-Power Miser Homes	Program to assist customers in building energy efficient homes - Standards for windows are included as criteria for 10% energy bill rebate	http://www.cleco.com/site.php?pageID=161

Massachusetts Massachusetts Electric	-Home Energy Services	Incentives for efficiency upgrades in homes. 50% of cost (up to $1,500) are paid.	http://www.nationalgridus.com/masselectric/home/energyeff/4_energy_svcs.asp
Massachusetts Nantucket Electric	-Energy Star Homes -Mass- Home Energy Services	Incentives and technical support for building a new Energy Star home. Incentives for efficiency upgrades in homes. 50% of cost (up to $1,500) are granted.	http://www.nationalgridus.com/nantucket/home/energyeff/4_energy_svcs.asp http://www.nationalgridus.com/nantucket/home/energyeff/4_energy_svcs.asp
Minnesota Alliant Energy	-Residential Rebates and Incentives -Commercial New Construction	Low-interest financing for equipment including Energy Star (U-factor 0.40 and SHGC 0.55) windows. Replacement windows/sashes rebates - $25 per window/sash Construction incentives relative to energy savings achieved (at least 15% savings)	http://www.alliantenergy.com/stellent/groups/public/documents/pub/res_ia_ri_blaze_001841.hcsp http://www.alliantenergy.com/stellent/groups/public/documents/pub/res_ia_ri_blaze_001857.hcsp http://www.alliantenergy.com/stellent/groups/public/documents/pub/bus_ps_pcf_ia_con_013407.hcsp#TopOfPage

Minnesota Minnesota Power	-Triple E New Construction	Up to $2,000 rebate for meeting thermal and performance standards in new constructions. High-performance windows are part of the deal.	http://www.mnpower.com/rebates_savings/triple_e.htm
Montana Glacier Electric Cooperative and ENERGY STAR	-Clear View Energy Efficient Window Program	$8 per square foot on ENERGY STAR qualified window retrofit.	http://www.glacierelectric.com/Doc/information/ratepamphlet_files/clearview.htm
Montana Mission Valley Power and ENERGY STAR	-Residential Windows Program	$1.50 per square foot on ENERGY STAR qualified window retrofit.	http://www.missionvalleypower.org/cons_prog_04.htm
Nevada Idaho Power	-Energy Star Homes Northwest	Incentives for home builders to build Energy Star homes.	http://www.idahopower.com/energycenter/energyefficiency/YourHome/ESHomesNW.htm

New Hampshire Granite State Electric	-Energy Star Homes	Incentives and technical support for building Energy Star homes.	http://www.nationalgridus.com/granitestate/home/index.asp
New Hampshire Public Service Company of New Hampshire	-Energy Star Homes	Assistance with building and certifying Energy Star homes	http://www.psnh.com/Residential/Efficiency/Energy_Star_Homes.asp
New Jersey Atlantic City Electric	-NJ Comfort Partners Program	Free-of-charge efficiency measures (do not specifically include window upgrades) for households with income below 175% of federal poverty guidelines.	http://www.njcleanenergy.com/html/1residential/4_comfort_partners.html
	-NJ Energy Star Homes	Incentive up to $3,100. High-performance low-E windows count toward eligibility criteria.	http://www.njenergystarhomes.com/

New York New York State Electric & Gas (NYSEG) and Rochester Gas & Electric	Assisted Home Performance with Energy Star -Weatherization Assistance -New York Energy $mart [SM] Loan Fund	Covers 50% of energy-efficiency improvement costs (up to $5,000 per household) Weatherization services (includes making doors and windows more air-tight) for people with low incomes in need. Low interest rate loans for home owners' energy efficiency projects.	http://www.getenergysmart.org/GES.portal;WL_GETENRGYSMART=DxJ5Phk7QKl7cLhTFWTQVT1SrV166VTFhKV8QFgvnwDFTW88qyL5!1778402060?_nfpb=true&_pageLabel=Energy_Efficiency_for_where_you_live

North Carolina Carolina Power & Light (Progress Energy – Carolinas)	-Energy Efficient Home Program -Energy Efficiency Financing Program (South Carolina)	Incentive (5% of energy bill) for improving household energy performance to Energy Star standards Low interest rates and access to approved contractors for energy performance improvements including storm windows and double-paned replacement windows	http://www.progress-energy.com/custservice/carres/energyhome/index.asp http://www.progress-energy.com/custservice/carres/financing/energyfinancing.pdf
North Carolina Duke Energy	-Energy Conservation Loans	Loans for high-efficiency heating/ cooling equipment and up to $3,000 for thermal conditioning (including windows, insulation, storm doors).	http://www.dukepower.com/forhome/products/energyloan.asp
Oregon Avista	- Weatherization Program	Rebates and loans for household weatherization. Cost effectiveness of measures is analyzed before program is started.	http://www.avistautilities.com/saving/conservation/rebates_or.asp

Oregon Central Electric Coop and ENERGY STAR	-window rebate	ENERGY STAR qualified windows are eligible for a $4 rebate per square foot.	
Oregon City of Ashland Conservation Division and ENERGY STAR	-Conservation Programs	ENERGY STAR qualified windows (retrofit only) are eligible for a $4 rebate per square foot or for a 0% interest loan.	http://www.ashland.or.us/Page.asp?NavID=1366
Oregon City of Bandon and ENERGY STAR	-ENERGY STAR windows rebate	ENERGY STAR qualified windows (retrofit only) are eligible for a $3 rebate per square foot.	
Oregon City of Forest Grove Light & Power and ENERGY STAR	-Conservation Services	ENERGY STAR qualified windows (retrofit only) are eligible for a $4 rebate per square foot.	http://www.ci.forest-grove.or.us/light1.html#Conservation%20Services

Oregon Clatskanie People's Utility District and ENERGY STAR	-Savings and Incentives	ENERGY STAR qualified windows are eligible for a $5 rebate per square foot (or 90% of cost for low income customers).	http://www.clatskaniepud.com/Savings%20Plus%20Incentive%20Program.htm
Oregon Columbia River PUD and ENERGY STAR	-Home Weatherization	ENERGY STAR qualified windows (retrofit only) are eligible for a $3.50 rebate per square foot.	http://www.crpud.net/residential/efficiency/weatherization-home
Oregon Consumers Power Inc. and ENERGY STAR	-Window Replacement Rebate	ENERGY STAR qualified windows (retrofit only) are eligible for a $3.48-5.33 rebate per square foot.	http://www.consumerspower.org/rebates/window.php
Oregon Emerald PUD and ENERGY STAR	-Residential Weatherization Program	Zero-interest loans for ENERGY STAR qualified windows.	http://www.epud.org/weatherization.htm

Oregon Eugene Water & Electric Board and ENERGY STAR		Zero-interest loans for ENERGY STAR qualified windows.	
Oregon McMinnville Water and Light and ENERGY STAR	-Conservation Rebates & Incentives	ENERGY STAR qualified windows are eligible for a $4 rebate per square foot (up to $1,100).	http://www.mc-power.com/rebate.html
Oregon Midstate Electric Cooperative and ENERGY STAR	-Weatherization Rebates	ENERGY STAR qualified windows (retrofit only) are eligible for a $2 rebate per square foot.	http://www.midstatecoop.com/ProductsAndServices/PSResidential/ConservationPrograms/default.aspx
Oregon Milton-Freewater City Light & Power and ENERGY STAR	-Weatherwise Windows	ENERGY STAR qualified windows are eligible for a $3.5 rebate per square foot.	http://www.mfcity.com/electric/conservation.html#windows

Oregon Springfield Utility Board and ENERGY STAR	-Weatherization Program	Zero-interest loans for ENERGY STAR qualified window replacements (48 months, $4,000 cap).	http://www.subutil.com/WxInfo.pdf
Oregon Energy Trust of Oregon	-Home Energy Savings – insulation and windows	Incentive of $1 per sq ft for low-E argon filled windows with a max. 0.35 U-factor.	http://www.energytrust.org/residential/hes/insulation_windows.html
Oregon Idaho Power	-Weatherization Assistance Program	Financial assistance to Oregon Community Action Partnership agencies to help cover cost for weatherization.	http://www.idahopower.com/pdfs/customerservice/Weatherization_05.pdf
	-Energy Star Homes Northwest	Incentives for home builders to build Energy Star homes.	http://www.idahopower.com/energycenter/energyefficiency/YourHome/ESHomesNW.htm

Oregon Oregon Department of Energy	-Rental Weatherization Tax Credits	Tax credits are given to owners of renal housing who improve overall energy efficiency by 10%. Efficient windows are listed as a possible measure.	http://egov.oregon.gov/ENERGY/CONS/BUS/docs/Rentals.pdf
Rhode Island Narragansett Electric	-Energy Star Homes	Incentives and technical support for building a new Energy Star home.	http://www.nationalgridus.com/narragansett/home/energyeff/4_new_constr.asp
	-EnergyWise	Incentives and low-interest loans to help pay for improved insulation and the installation of Energy Star lighting, refrigerators, and windows.	http://www.nationalgridus.com/narragansett/home/energyeff/4_energy_svcs.asp

South Carolina Carolina Power & Light (Progress Energy – Carolinas)	-Energy Efficient Home Program -Energy Efficiency Financing Program (South Carolina)	Incentive (5% of energy bill) for improving household energy performance to Energy Star standards Low interest rates and access to approved contractors for energy performance improvements including storm windows and double-paned replacement windows	http://www.progress-energy.com/custservice/carres/energyhome/index.asp http://www.progress-energy.com/custservice/carres/financing/energyfinancing.pdf
South Carolina Duke Energy	-Energy Conservation Loans	Loans for high-efficiency heating/ cooling equipment and up to $3,000 for thermal conditioning (including windows, insulation, storm doors).	http://www.dukepower.com/forhome/products/energyloan.asp
Texas American Electric Power	-Residential and Small Commercial Standard Offer Program -Hard-to-Reach Standard Offer Program	Performance-based incentives for energy service suppliers. Performance-based incentives for suppliers of energy service to households with max. income of 200% of federal poverty guideline	http://www.aephtrsop.com/

Texas TXU Energy	-Residential & Small Commercial Program	Incentives to suppliers of energy efficiency projects, including the installation of Energy Star windows	http://www.oncorgroup.com/electricity/teem/res/default.asp
Washington Clallam County PUD #1 and ENERGY STAR	-Home Weatherization Support	ENERGY STAR qualified windows (retrofit only) are eligible for a $4 rebate per square foot.	http://www.clallampud.net/conservation/guide-home-weatherization.html
Washington Franklin County PUD and ENERGY STAR	-Energy Conservation Low Interest Loans	Zero-interest loans for ENERGY STAR qualified window replacements	http://www.franklinpud.com/html/low_interest_loans.html
Washington Grays Harbor County PUD #1 and ENERGY STAR	-Heat Pump & Weatherization Rebate & Loan Amount Schedule	ENERGY STAR qualified windows are eligible for a $4 rebate per square foot (up to $1,000). Low interest loans for ENERGY STAR windows ($5,000 cap).	http://www.ghpud.org/Energy_Services/Residential/Heat%20Pump%20%26%20Weatherization%20Rebate%20%26%20Loan%20Amount%20Schedule/HEATPU_1.HTM

Washington Mason Co. PUD #3 and ENERGY STAR	-Residential Energy Improvement Programs	Rebates for qualified window measures.	http://www.masonpud3.org/Conservation/Residential/Improvement.asp
Washington Pacific County and ENERGY STAR		ENERGY STAR qualified windows are eligible for a $5 rebate per square foot.	
Washington Puget Sound Energy	-Manufactured Home Rebate	Rebates for purchase of Energy Star home with Super Good Cents or Natural Choice certification. Efficient windows are part of the qualification criteria.	http://www.pse.com/yourhome/rebates/manufacturedhome.html

Wisconsin Energy Finance Solutions	-Wisconsin Energy Conservation Corporation	Loan program to finance residential improvements including insulation and windows.	http://www.energyfinancesolutions.com/
Wisconsin Madison Gas & Electric	-Cash-back rewards	Incentives for homes built according to Energy Star requirements, as well as for home improvements.	http://www.focusonenergy.org/page.jsp?pageId=1243
Wyoming Lower Valley Energy	-Home Weatherization Incentives	Rebates for window replacement.	http://www.lvenergy.com/conservation.asp

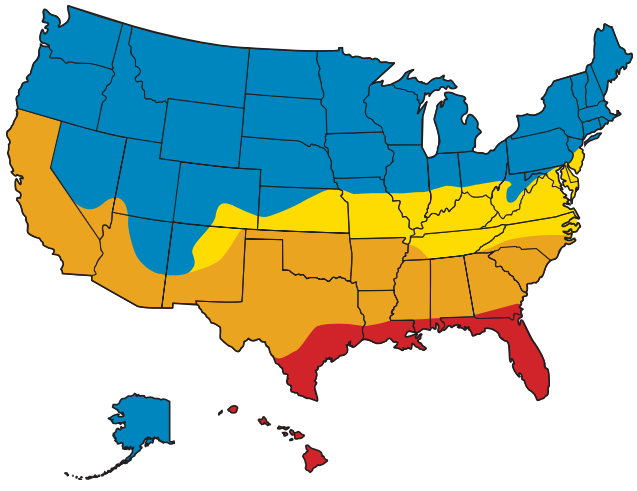
Efficient Windows Collaborative

Attachment 3

The Efficient Windows Collaborative Builder Toolkit

www.efficientwindows.org April 2006

Builders have much to gain by selling and installing energy efficient windows. Energy efficient windows are integral components in high quality homes and help homeowners save on heating and cooling costs. With efficient windows, homes can more easily meet energy code requirements, achieve Environmental Protection Agency (EPA) ENERGY STAR® Homes recognition, and meet utility incentive requirements. In many cases, using efficient windows allows for ~~the~~ increased amount of glazed area within a home—and marketing studies have shown that larger glazed areas appeal to prospective buyers.



ENERGY STAR® Zones

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

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.

Builder Toolkit Contents

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, 3rd ed. New York, NY: W.W. Norton & Company, 2006.

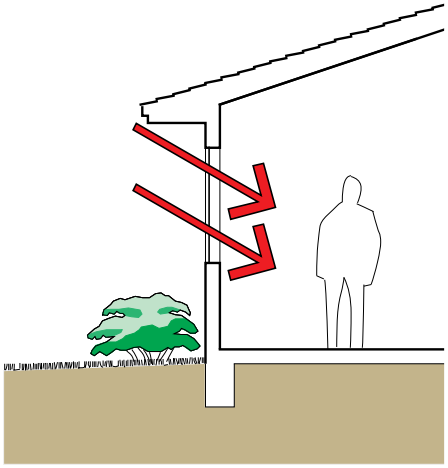
Why Energy Efficient Windows?

Energy and Cost Savings

Energy efficient windows are designed so that heat is kept inside the home in winter and outside the home in summer. This reduces heating and cooling costs, minimizes energy consumption that impacts the environment, and limits the size of the HVAC equipment required for keeping the home comfortable.

Cooling Season Savings

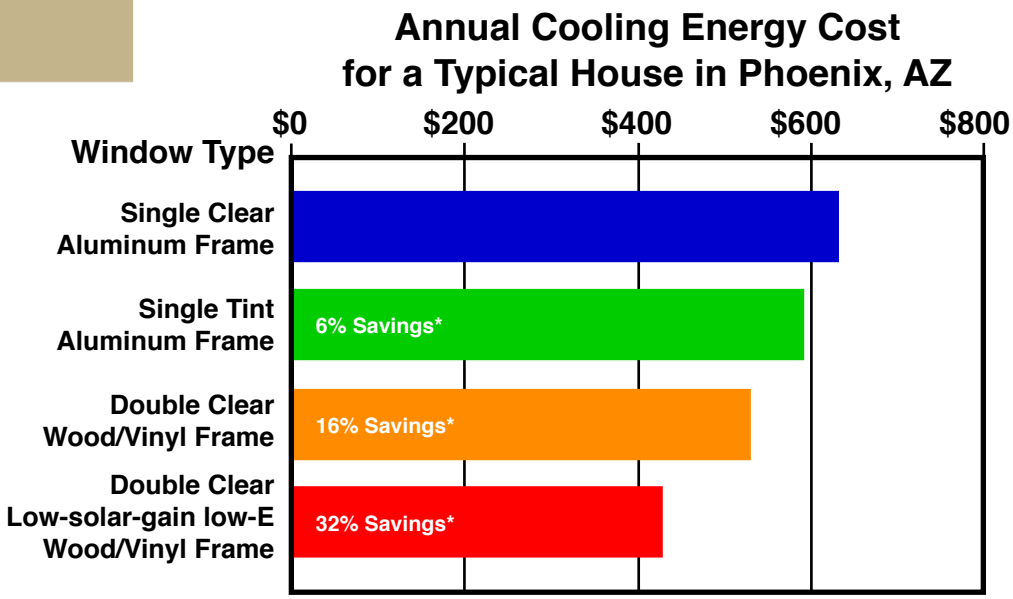
For example, installing double-glazed low-solar-gain windows instead of single-pane windows in a typical 2,000 square foot house in Phoenix, Arizona would reduce the air conditioner peak load from 600 kW to 400 kW, which reduces the size of the necessary air conditioner from 5 tons to 3.5 tons. This difference in window performance would save the homeowner about 32 percent in cooling costs.



Downsize HVAC systems

High-performance windows not only provide reduced annual heating and cooling bills; they reduce the peak heating and cooling loads as well. This means that smaller HVAC systems (including the furnace, heat pump, air conditioner, and fans) may be installed in energy efficient homes. Smaller HVAC systems costs less, consume less energy and are just as effective as larger systems if energy efficient windows keep peak demand low.

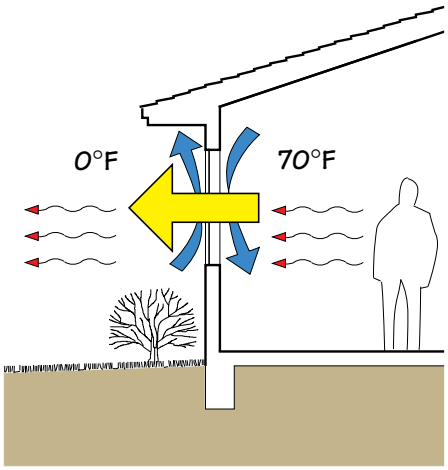
In climates that mainly require cooling, windows have represented a major source of unwanted heat gain. In recent years, windows have undergone a technological revolution. It is now possible to significantly reduce solar heat gain and improve comfort while providing clear views and daylight. The graph below illustrates the significant savings in cooling season costs associated with improved windows for a house in a cooling-dominated climate. In warm regions, this means that high-performance windows can face into the sun if desired without great energy penalties—although shading techniques remain important.



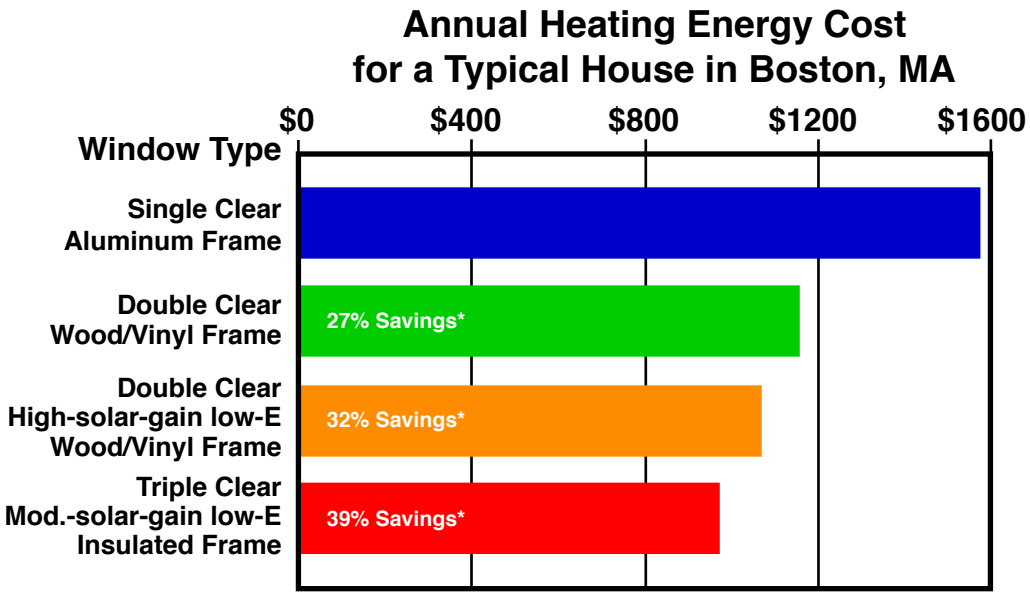
*Compared to the same 2000 sf house with clear, single glazing in an aluminum frame.

Heating Season Savings

In Boston, Massachusetts, clear double-glazed windows instead of single-pane windows in a typical 2,000 square foot house would reduce heating costs by 27 percent. Triple-pane low-E glazing for moderate-solar-gain in insulated frames would save as much as 39 percent.



In climates with a significant heating season, windows have represented a major source of unwanted heat loss, discomfort, and condensation problems. In recent years, windows have undergone a technological revolution. It is now possible to have lower heat loss, less air leakage, and warmer window surfaces that improve comfort and minimize condensation. The graph below illustrates the significant savings in heating season costs associated with energy efficient windows for a house in a heating-dominated climate. In cold regions, this means that windows are no longer an energy loser to be avoided—increasing glazing area with high performance windows can have little or no affect on total energy use.



*Compared to the same 2000 sf house with clear, single glazing in an aluminum frame.

Improved Comfort

Improved Winter Comfort

Energy-efficient windows improve comfort within homes by providing a warmer interior surface during the cold winter months, preventing that the living space near windows gets uncomfortably cold. If inefficient window performance cools down the air near windows, the cold air floats to the ground. This feels like a cold draft, even though the window may be perfectly sealed.

Improved Summer Comfort

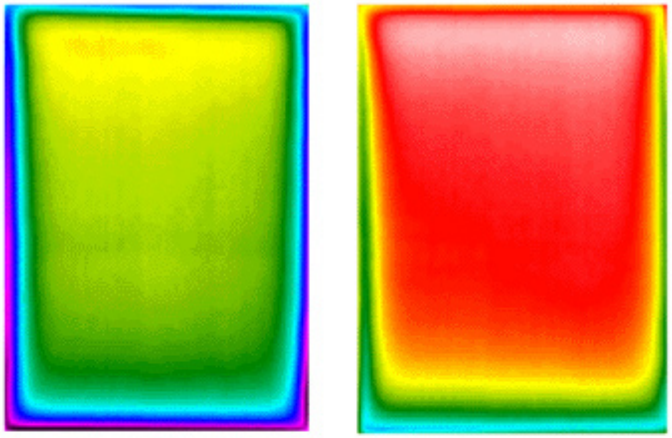
By reducing the need for air conditioning, energy-efficient windows that control solar heat gain also reduce the risk of possible health effects from air conditioning—for instance, the overuse of air conditioning can cause headaches or aggravate the effects of arthritis and neuritis.

Less Condensation

High-performance windows create warmer interior glass surfaces, reducing frost and condensation. High-performance windows with warm edge technology and insulating frames have such a warm interior surface that condensation on any interior surfaces is significantly reduced under all conditions.

Impact of Low-E Glass and Insulating Spacers on Condensation

The adjacent images show interior surface temperature patterns of a clear double-glazed unit (left) and an energy-efficient low-E insulated glazing unit with an improved spacer (right).



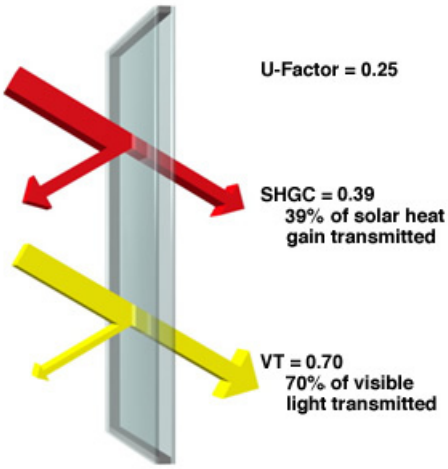
Source: Lawrence Berkeley National Laboratory

Under typical winter conditions, (i.e. 20°F outside), condensation on the glass under typical humidity levels is shown by purple and blue. With a conventional clear double glazing (left), condensation occurs in a band a couple inches wide along the edge of the sightline, with more condensation along the bottom than at the top. With the energy-efficient low-E insulated glass unit (right), condensation will be greatly reduced (a small strip less then 1 inch high along the bottom).

Under extreme winter conditions (i.e. 0°F outside), condensation is shown by purple, blue and green. With clear double glazing, there is condensation over the entire unit. With energy-efficient low-E glazing, there is only condensation on a band along the bottom and up along the edges.

Increased Light and View

Daylight and view are two fundamental attributes of a window. Unfortunately, windows are also the source of significant solar heat gain during times when it is unwanted. Traditional solutions to reducing solar heat gain, such as tinted glazing or shades, mean that the amount of light is reduced as well. New glazings with low-solar-gain low-E (spectrally selective) coatings can provide better solar heat gain reduction than tinted glass, with a minimal loss of visible light. This also means that views can be clearer and unobstructed.



Greater Protection from UV Fading

Many organic materials, such as carpet, fabrics, paper, artwork, paints, and wood may fade upon exposure to sunlight. Window selection can influence the type and intensity of transmitted radiation. The most harmful radiation in sunlight are the ultraviolet (UV) rays, which are the most energetic and thus most likely to break chemical bonds, leading to fading and degradation. Glass blocks all UV radiation below 300 nm, but transmits UV from 300-380 nm. Coatings on glass can reduce the UV transmitted by up to 75 percent. UV absorbers can be incorporated into thin plastic films in multilayer windows or as an interlayer in laminated glass. In both cases, the UV transmission can be reduced to less than 1 percent. However, it is important to note that the remaining visible light that is transmitted can still cause serious fading in some materials. Using low-E coated glass or windows incorporating plastic layers rather than clear uncoated glass will reduce fading for many modern interior furnishings.

How to Finance Energy Efficient Windows in New Homes

Of course, energy-efficient windows raise a cost issue. Windows are an expensive part of the building envelope, and although the extra cost of energy-efficient windows will be more than offset by energy cost savings, higher energy performance adds a premium to the upfront cost. There are options to deal with upfront costs if funds are limited.

Make Windows a Priority

Many other home improvements can be made later on, once a house has been completed and the homeowner has more funds available. Windows, however, should initially be installed in the best available quality in order to prevent later regrets. To replace windows later results in extra cost that is avoidable if the right decisions are made while the home is first constructed. Home builders can point out to homeowners that windows should be a priority—the garden decoration can be added later.

Energy Efficient Mortgages

Energy efficient mortgages (EEM) promote the design, construction, and purchase of more energy efficient homes. With EEMs, homeowners' qualifying ratios for higher loans increase if energy efficient features, such as high-performance windows, are added to their homes. The reason is that homeowners that save on heating and cooling or other energy expenses can repay loans far easier than the owners of less efficient homes. Energy efficient mortgages are one tool that allows homeowners to offset the financial constraints that might otherwise prevent them from considering the best quality for the windows in their new home.

Energy Efficient Mortgages

Energy efficient mortgages are offered through several different programs in the secondary mortgage market. Fannie Mae, Freddie Mac, the Department of Housing and Urban Development, Federal Housing Administration, and the Veteran's Administration offer programs to increase energy efficiency through EEMs. The number of banks offering this type of mortgage has grown significantly in recent years.

Fannie Mae offers information on EEM at: www.efanniemae.com/sf/mortgageproducts/fixed/energyefficient.jsp.

More information can be viewed at: www.natresnet.org/ratings/default.htm.

Tax Credits

Provisions in the federal Energy Policy Act of 2005 allow home builders to claim a tax credit for qualifying energy-efficient homes completed after December 31, 2005. The qualification criterion is the estimated heating and cooling energy consumption of the home. If this is at least 30 percent below the heating and cooling consumption of a comparable home that meets the standards of the 2004 supplement to the 2003 International Energy Conservation Code (IECC), the tax credit is $1,000. If the new home's heating and cooling consumption is 50 percent below the reference home, the credit is $2,000. Energy-efficient windows are crucial for achieving such low consumption of heating and cooling energy.

The credit goes directly to the home builder. In order to claim the credit, a builder must have the home's energy performance estimated and certified by an independent certifier that is accredited by the Residential Energy Service Network (RESNET).

If the tax credit is not extended, it can be claimed for homes placed in service until December 31, 2007.

State and Utility Incentives

Several states offer financial incentives for homes that are built according to ENERGY STAR standards.

Idaho and Northwest
ENERGY STAR Homes Northwest by Idaho Energy Division and Idaho Power
www.idahopower.com/energycenter/energyefficiency/YourHome/ESHomesNW.htm

Massachusetts
ENERGY STAR Homes incentives by National Grid
www.nationalgridus.com/nantucket/home/energyeff/4_new_constr.asp

Minnesota
Triple E New Construction by Minnesota Power
www.mnpower.com/rebates_savings/triple_e.htm

New Hampshire
ENERGY STAR Homes incentives by National Grid
www.nationalgridus.com/granitestate/home/energyeff/4_new_constr.asp

New Jersey
New Jersey ENERGY STAR Homes by the NJ Clean Energy Program
www.njenergystarhomes.com/

Rhode Island
ENERGY STAR Homes incentives by National Grid
www.nationalgridus.com/narragansett/home/energyeff/4_new_constr.asp

How to Make the Most of Energy Efficient Windows

In order to provide the best service to their clients, builders need to know which windows are best suited for which climates in order to provide for the most ambient indoor temperature. Specifying the proper window is particularly important where temperatures range from extreme highs to extreme lows.

Most windows and skylights now have labels that display energy ratings to help builders and homeowners choose energy-efficient products. These labels have been developed by the nonprofit National Fenestration Rating Council (NFRC), which operates a voluntary certification program that documents criteria corresponding to heat loss and gain methods, including U-factor and solar heat gain coefficient (SHGC).

The U-factor measures the rate a window conducts non-solar heat flow, representing the performance of the entire window, including the frame and spacer materials. The lower the U-factor a window has, the more energy efficient it is. Window U-factors generally range from 0.15 for high-performance triple-pane units to 1.20 for older single-pane units.

A window with a high solar heat gain coefficient (SHGC) is more effective at collecting solar heat gain during the winter. A window with a low SHGC is more effective at reducing cooling loads during the summer by blocking heat gained from the sun. SHGCs range between 0 and 1.

What is the difference between R-value and U-factor?

The R-value is used for most parts of the building envelope in order to indicate insulating performance. The U-factor is used to express the insulation value of windows. R-value and U-factor are similar in measuring non-solar heat flow. But the term R-value is usually used for wall or ceiling insulating value and does not translate well to windows and other fenestration products. Therefore, the U-factor is used for fenestration products. It is important to note that these ratings relate to each other inversely: A higher R-value means better insulated walls and ceilings, while a lower U-factor indicates better performing windows.

To determine the R-value equivalent of a window U-factor, divide 1 by the U-factor number. E.g.: a 0.25 U-factor equals a 1/0.25 = 4 R-value.

Low or High Solar Heat Gain?

In climates with a clear dominance of either cooling or heating energy use, the decision of whether to install windows with a higher or a lower SHGC is simple. A low SHGC helps reduce cooling loads, whereas a higher SHGC allows more passive heating and reduces winter heating needs. In climates where both heating and cooling consume significant amounts of energy, however, the question of which SHGC is preferable is not so easy to answer. Moderate SHGC values of between 0.30 and 0.55 are generally suitable for moderate climates, but which exact value would be the best depends on the specific climatic conditions of the house. Here are some rules of thumb:

- A higher SHGC can be considered for north and south facing windows. The latter are a good source of passive winter heating and can be shaded with overhangs in summer.
- East and west facing windows should provide good solar control because they are a source of much unwanted summer heat gain unless well shaded (but overhangs don't work well against the low morning and evening sun).
- Ideally the windows have a low U-factor. The SHGC can also be low then. The low SHGC would keep summer cooling loads down and the low U-factor would keep the home warm in winter.
- The Efficient Window Collaborative's Window Selection Tool helps you choose suitable window types for specific climatic conditions. Also, Lawrence Berkeley National Laboratory provides a computer program to calculate energy use based on window selection. The name of the program is RESFEN and can be download at windows.lbl.gov/software.

Window Orientation can Greatly Influence the Energy Efficiency of a Home.

Orientation in a northern climate (mostly heating)

It is generally accepted that orienting the majority of windows to the south in a heating-dominated climate will result in greater solar gain and less heating energy use. This is a very important consideration if less efficient windows with a higher U-factor are used. On the other hand, by using high-performance windows, the impact of window orientation on heating energy use is diminished. For example, north-facing windows with triple glazing and low-E perform about as well in keeping heating use low as south-facing windows with clear double glazing. With a greater window area, the difference between less efficient and more efficient windows as well as the difference between north-facing and south-facing windows becomes greater.

Orientation in a moderate climate (heating and cooling)

Orienting windows to the south will result in greater solar gain in winter while overhangs can be designed to reduce summer solar gain.

East and west window are more difficult to shade. Their glazing area should either be kept at a minimum or consist of highly energy-efficient windows with a low SHGC.

North facing windows perform the best in summer but are worse in providing winter heat gain. However, well-insulated windows with a low U-factor prevent heat loss and even in winter provide for energy efficient north-facing glazing. The difference between orientations is diminished when higher-performance windows with lower U-factors and SHGCs are used. The less external shading and the greater the window area, the greater the difference in energy costs between less efficient and more efficient windows, and between different window orientations.

Orientation in a southern climate (mostly cooling)

In predominantly cooling climates, the goal is to face most windows north, where there is little direct exposure, or to the south, where they can be designed with overhangs that will keep out most of the hot summer sun. Overhangs are much less effective against the lower angles of the east and west sun. Therefore, simply reducing the size and number of east and west windows can be the best strategy.

The orientation of windows has a significant impact when typical clear-glazed windows are used. Note that high-solar-gain low-E windows perform worse than low-solar-gain low-E windows. When higher-performance windows with low-solar-gain low-E coatings are used, window orientation and the size of the glazing area have a greatly diminished impact on energy use. Shading provided by overhangs or trees, however, should always be considered as an additional means of reducing cooling loads.

Appendix

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Improving Energy Performance in Low-Income Housing

There are many reasons for seeking energy efficiency improvements in low-income housing. The Federal government's Partnership for Home Energy Efficiency (**www.energysavers.gov**) estimates that in many households, cost-effective energy efficiency improvements could save 20 to 30 percent of the home's energy bills. Low-income housing has a particularly high potential for energy efficiency improvements because of the often poor conditions of buildings in this sector.

- HUD's annual utility bill for about 5 million units of affordable housing is above $4 billion
- The energy bills in most of these units could be reduced by 20-30 percent

Improvements such as better boilers, geothermal heat pumps, and energy-efficient windows would benefit low-income homeowners and considerably reduce HUD's annual utility bill. The funds thus freed could be used for further housing improvements.

This information sheet by the Efficient Windows Collaborative (EWC) aims to help decision makers in the low-income housing sector find options for financing and implementing energy efficiency measures. The EWC encourages Public Housing Authorities (PHAs) to look into different financing mechanisms for reducing energy consumption and providing residents with healthier and more comfortable homes.

Success Story: Ashville, NC

In 1999, the Ashville Housing Authority initiated the rehab of a 100-unit multifamily building (McCormick Heights). The energy efficiency measures included energy-efficient windows and doors, heat pumps, efficient lighting, efficient appliances, and water fixtures. These improvements lowered the building's energy consumption by about 30 percent.

Contents

The following pages give an overview of financing options for energy efficiency improvements in low-income housing.

Financing Mechanisms

To implement energy conservation measures in low-income housing, Public Housing Authorities (PHAs) have several financing options. An overview of available mechanisms is given below.

(Much of the information below is based on the article "How to Finance Your Energy Program" from Rebuild America's *Solution Center* – **www.rebuild.gov**)

- **Internal Funds –** Energy efficiency improvements are financed from PHA's own operating budget. >>**see page 3**>>
- **Debt Financing –** Energy efficiency improvements are financed with capital borrowed directly from private lenders. >>**page 3**>>
- **Lease or Lease-Purchase Agreements –** Energy efficient equipment is leased with no up-front costs, and payments are made on an annual basis. >>**page 4**>>
- **Energy Performance Contracts –** Energy efficiency measures are financed, installed and maintained by an Energy Service Company (ESCO). The ESCO guarantees savings, upon which payments it receives during the contract period are based. >>**page 5**>>

Incentives

- **Utility Incentives –** Rebates, grants, or other financial assistance are offered by an energy utility for the design and purchase of certain energy-efficient systems and equipment. >>**page 6**>>
- **State and Federal Assistance –** Financial assistance is available from the U.S. Department of Housing and Urban Development (HUD) and from several state governments. >>**page 6**>>

The Housing and Community Development Act of 1987 (HCDA)

The HCDA, amended in 1987, is meant to curtail the loss of safe, decent, and affordable urban and rural housing for low- and moderate-income families. It provides PHAs with the means to finance needed building improvements through the use of funds saved by improved energy performance and also invest them in other building upgrades. The act determines the terms according to which PHAs can finance energy performance improvements, including options such as financing with available operating and capital funds, debt financing and energy performance contracts. The Act also outlines several energy incentives by the Department of Housing and Urban Development (HUD).

For detailed information on the provisions of the HCDA, view **www.globalgreen.org/pha-energytoolbox/financing.htm** or contact Rebuild America (**www.rebuild.gov**) for assistance.

Internal Funds

The most direct way to pay for energy-efficiency improvements is to allocate funds from internal operating budgets.

Advantages of utilizing internal funds are:

- The full benefits of lowered energy costs can be retained
- Administrative burdens are kept to a minimum

The resulting cost savings may be used to decrease overall operating expenses or to support additional energy efficiency improvements from internal funds.

Problems are:

- Internal funds may be too limited for effective measures, or bound up by other priorities

Alternatively, however, internal funding can be used in combination with one or more of the other options discussed below.

Debt Financing

Direct borrowing can make funds available from private lenders or public bodies.

Advantages of debt financing are:

- The full benefits of lowered energy costs can be retained (less only the cost of financing the debt)

The debt can be repaid with the savings from reduced energy consumption.

Problems are:

- Debt financing is administratively more complex than internal funding
- Debt financing may be restricted by formal debt ceilings imposed by municipal policy, accounting standards, and legislation

Lease and Lease-Purchase Agreements

Leasing and lease-purchase agreements provide a means to reduce or avoid the up-front capital costs of new, energy-efficient building components.

These agreements are offered by commercial leasing corporations, financial institutions, investment brokers, or equipment manufacturers. The time period of a lease can vary significantly.

There are several different types of leasing agreements. Specific lease agreements vary according to lessor policies, the complexity of the project, whether or not engineering and maintenance services are included, and other factors.

Types of Leasing Agreements

Operating Leases
- Short term
- For accounting purposes, the lessor, and not the lessee, is considered owner of equipment and can claim tax benefits for its depreciation

Financing Leases
- Lessee essentially buys the equipment in monthly installments (usually over 5 to 10 years)
- Lessee is considered owner of equipment for accounting purposes and can claim tax benefits for its depreciation

Municipal Leases
- Available only to tax-exempt entities such as municipalities
- Lessor does not pay taxes on interest from payment
- Lower interest rate
- Lease must be renewed annually because of municipalities' restrictions against multi-year liabilities

Guaranteed Savings Leases
- Lessee is guaranteed annual energy savings that at least equal the annual lease payment
- If energy savings are worth less than payments, lessee receives credit for difference

Energy Performance Contracts

In an energy performance contract, an Energy Service Company (ESCO) installs and maintains retrofit measures and typically also provides the financing. The ESCO guarantees a specific amount of energy savings and in return is paid from the energy costs saved during the contract period, which usually lasts between 5 and 15 years.

Advantages of energy performance contracts are:

- ESCOs specialize in finding the best opportunities for improving energy efficiency
- The ESCO can provide the financing and does not have to be paid up-front

Problems are:

- The ESCO's responsibilities and the methodology for verifying the guaranteed savings must be clearly established in the contract. This requires administrative diligence
- The PHA can only profit from the full energy cost savings once the contract period has passed and the ESCO has received its payment

For more information on energy performance contracting, contact the National Association of Energy Service Companies (NAESCO) - **http://www.naesco.org**

The HUD Public Housing Energy Conservation Clearinghouse also helps with advice on energy performance contracts - **http://www.hud.gov/offices/pih/programs/ph/phecc**

Success Story (New York): Rochester Housing Authority

Through an energy performance contract with an ESCO (Siemens Building Technologies), the Rochester Housing Authority implemented energy performance improvements at 3,200 dwelling units in 2005. The effort required a $6.5 million investment and resulted in guaranteed savings of about $630,000 per year. The New York State Energy Research and Development Authority provided $571,610 toward the program. The period of the contract between the housing authority and the ESCO is 12 years, after which the investment cost will have been repaid and the housing authority can fully profit from the guaranteed savings.

The improvements include new boilers, insulation, new refrigeration equipment, elevator upgrades, replacement of electric dryers with natural gas dryers, efficient lighting, and low-flow toilets and showerheads. Together, these changes save about 3 million kilowatt hours of electricity, 40,000 therms of natural gas and 60 million gallons of water annually.

Utility Incentives

Several utilities offer incentives for residential energy efficiency improvements, particularly for energy efficient appliances. Many of these programs are specifically designed for the low-income sector.

Advantages of utility incentives are:

- They reduce the cost of energy efficiency improvements

Problems are:

- Utility incentives provide only partial financing
- Utilities concentrate their incentives on reducing peak-demand. This has limited effects on overall energy efficiency

A list of utility demand response programs, including several energy efficiency incentives, can be viewed at:
http://www.eei.org/industry_issues/retail_services_and_delivery/wise_energy_use/programs_and_incentives/progs.pdf

State and Federal Assistance

Financial assistance is available from the Federal government through the Department of Housing and Urban Development (HUD) or the Department of Energy (DOE), and from several state governments.

DOE and HUD also provide energy conservation guidance, outreach, training and technical assistance to PHAs and residents.

Some Examples of State and Federal Assistance Programs

For HUD's incentive programs please view
http://www.hud.gov/offices/pih/programs/ph/phecc/funding.cfm

View information on DOE's Weatherization Assistance Program at
http://www.eere.energy.gov/weatherization

Click on your state to view a partial listing of Insulation and Energy Incentive programs. Includes many low-income assistance programs
http://www.betterinsulation.org/energy/

View the choice of incentives by NYSERDA (New York) at
http://www.nyserda.org/incentives.asp

The Housing Partnership Program by the Texas State Energy Conservation Office
http://www.seco.cpa.state.tx.us/hp.htm

Vermont's Residential Energy Efficiency Program (REEP)
http://yosemite.epa.gov/oar%5Cglobalwarming.nsf/UniqueKeyLookup/RAMR5CYQWT/$File/VT_REEP.pdf

Energy-Efficient Windows for Low-Income Housing

Energy-efficient windows have a great potential to contribute to improving the energy performance of American homes, and of low-income homes in particular. Over their lifetime, energy-efficient windows bring significant energy savings and resident comfort. Yet window replacement costs more and has a longer payback period than measures such as weather-stripping and efficient lighting.

To encourage PHAs to invest in thorough home energy performance measures such as window replacement, heating system replacement, and wall insulation, the Energy Policy Act of 2005 includes the following provision: Subtitle D – Public Housing, Section 151 adds a new paragraph (iii) to Section 9(e)(2)(C) of the United States Housing Act of 1937. This paragraph extends the total term of a contract described in clause (i) to a maximum of 20 years to enable longer payback periods for energy conservation measures (ECMs), including the installation of energy-efficient windows.

HUD offers information on windows as part of energy conservation measures at:
http://www.hud.gov/offices/pih/programs/ph/phecc/strat_B2.cfm

In its *Public Housing Authority Toolbox*, Global Green USA offers great advice for PHAs interested in more energy efficient windows:
http://www.globalgreen.org/pha-energytoolbox/tech_windows.htm

Success Story (Canton, Ohio): Housing Authority increases senior citizens' comfort and reduces energy costs through combined financing

To improve living conditions and save energy costs at Cherrie Turner Towers, a 150- unit, 8-story building in Canton, the Stark Metropolitan Housing Authority chose to undertake a major overhaul of the building envelope and the heating, cooling and water supply system. The whole project, which also included a complete renovation of several rooms, cost $5 million. In order to finance this ambitious project, the housing authority referred to a combination of financing sources: a loan, a municipal community grant, sponsorship by the Ohio Office of Energy Efficiency for a Rebuild America energy audit, and an energy performance contract involving HUD, which picked up the amortization costs for the loan.

The implemented improvements included new roofing, energy-efficient windows, compact-fluorescent lighting, low-flow toilets, additional insulation, and a geothermal heat pump. In addition to increasing the comfort of the residents through this building overhaul, the housing authority also significantly reduced its energy costs. In 2000, after the completion of the improvements, the Stark Metropolitan Housing Authority received the Ohio Governor's Award for Energy Excellence for its achievements.

http://www.rebuild.gov/attachments/partnerupdates/NovDec2001.pdf

Useful Links

- *Energy Efficient Rehab Advisor*
  http://rehabadvisor.pathnet.org
  The Advisor presents HUD's guidelines for energy efficient housing rehabilitation.

- *Energy Conservation for Housing – A Workbook*
  http://www.abtassoc.com/reports/D19980034.pdf
  Comprehensive energy-saving guide aimed at PHAs interested in making energy conservation improvements.

- *Energy Efficiency Makes Homes More Affordable*
  http://www.southface.org/web/resources&services/publications/factsheets/sav_nrg$.pdf
  This is a great resource by the Southface Institute for advice on how to save energy in low-income homes.

- *The Campaign for Home Energy Assistance* by the Low Income Home Energy Assistance Program (LIHEAP)
  http://www.liheap.org/program.html
  Part of the campaign is directed at supporting weatherization efforts.

- *Financing Energy Efficiency Upgrades*
  http://www.globalgreen.org/pha-energytoolbox/financing.htm
  Global Green USA explains different energy efficiency funding types for PHAs

- *How to Finance Your Energy Program*
  http://www.rebuild.org/attachments/SolutionCenter/RBA_how_to_finance_energy_program.pdf
  Rebuild America of the US DOE provides an overview of methods of cost-benefit analysis, financing mechanisms, and other options

ALLIANCE TO
SAVE ENERGY
Creating an Energy-Efficient World

Opening the Window of Opportunity for Energy-Efficient Windows in the New Homes Market

A Strategy Report by the Alliance to Save Energy

Prepared By
Lisa Surprenant
Kelly Shall
Nils Petermann

"Opening the Window of Opportunity for Energy-Efficient Windows in the New Homes Market"

OPENING THE WINDOW OF OPPORTUNITY FOR ENERGY-EFFICIENT WINDOWS IN THE NEW HOMES MARKET

Lisa Surprenant, Alliance to Save Energy
Kelly Shall, Alliance to Save Energy
Nils Petermann, Alliance to Save Energy

ABSTRACT

Buildings in the US use more than one-third of all energy, and two-thirds of all electricity consumption. Home energy use accounts for more than half of the energy used in all buildings in the US[1]. According to a review of recent studies of energy-efficiency potential, overall building energy efficiency could be improved by 10 to 30 percent over the next 10 years, relying only on technologies that are already in the market and known to be feasible and cost-effective.[2] Even without mandatory policies, the potential for voluntary energy efficiency improvements is significant, because some of that potential is easily realizable in every home. In recent discussions with builders, many reported that the greatest opportunity to reap higher savings is through the use of energy-efficient windows. With an estimated 62.8 million units (2003) of windows sold in new homes[3], why then are energy-efficient windows not standard? As the total number of windows installed increases about 5 percent every year, the market for windows is growing faster than market penetration by energy-efficient windows. Low-e windows are at least 25 percent more efficient than standard double-paned windows, but they comprise only 45 percent of the new and replacement window markets whereas the latter comprise the majority of sales.[4]

In terms of global competitiveness, energy-efficient buildings make good financial sense. For example, the energy cost for building operations in the United States accounts for a far greater share of the gross domestic product than in Europe. To maintain its competitive edge in the global marketplace, the US will need to increase the energy efficiency of all existing and new buildings, including homes. That means using all strategies—from energy-efficient windows to energy-efficient design. Market failures and barriers are constraining widespread adoption of technologies like energy-efficient windows. To overcome the barriers and achieve the goal of significantly increasing market penetration of energy-efficient windows in the new homes market, those barriers must be identified and approaches tailored to overcome them.

[1] HUD Report, May 10, 2005
[2] See Steven Nadel et al., *The Technical, Economic and Achievable Potential for Energy Efficiency in the U.S. – A Meta-Analysis of Recent Studies*, ACEEE, Summer Study on Energy Efficiency in Buildings, 2004, pp.5-6, which reviewed studies for the US, California, Massachusetts, New York, Oregon, Southwestern states, Vermont and Washington.
[3] Drucker Research Company, Inc. *Study of the US Market for Windows, Doors, and Skylights*, American Architectural Manufacturers Association, Window & Door Manufacturers Association, Schaumberg Illinois and Des Plaines Illinois. April 2004
[4] According to EIA, *Buildings Energy Data Book*, August 2004, Table 7.3.5, a typical single family home still has single pane windows. Low-e windows market share data from AAMA-WDMA, 2003 Industry Market Studies, 2003 AAMA-WDMA National Statistical Review & Forecast, Page 5.

One key barrier to the use of energy-efficient products (like windows) often cited is that *builders seek to use the cheapest windows when they build.* This barrier does not tell the whole story nor does it suggest a tailored approach to overcoming the obstacle for builders or manufacturers. On the demand side, some programs to target consumers of energy-efficient windows have been undertaken and consumers seem to be motivated to install energy-efficient windows when retrofitting their homes, as evidenced by the 20 percent market penetration of low-e wood-framed windows in the residential market. (Wood frames tend to be the frame of choice for the retrofit market). What, then, is the key difference in the decision-making between the energy-efficient window markets for new and existing homes? And who are the real decision makers? This paper examines a new approach to energy-efficient windows adoption by studying the way technologies are diffused. It explores how various actors and their motivators have affected the penetration of energy-efficient windows into the new homes building market. It proposes a comprehensive, holistic approach to achieving changes in the key stakeholders' operating patterns vis-à-vis windows. The paper concludes with an outline of the program components required to overcome the barriers presently preventing widespread use of energy-efficient windows.

SECTION I. SETTING THE STAGE FOR THE PROGRAM

BACKGROUND

As early as 1992, researchers began to evaluate the barriers to energy-efficient buildings.[5] They found that these barriers also impeded the role that each of the diverse stakeholders involved in the process of building design could play in the market of energy-efficient windows (see Figure 1).

Figure 1 The Role of Each Key Player in Market Transformation

KEY PLAYER	THEIR ROLE
Governments	- Enact legislation - Be large-scale purchasers of energy-efficient products - Create regulation that supports market transformation through energy-efficient products - Set aside funds to support energy efficiency
Electric utility	Operate market transformation programs
National assistance agencies (like HUD)	Influence the types of projects funded and undertaken
Wholesalers, retailers, industrial associations	Be program allies
NGOs like the Alliance to Save Energy	Act as catalysts, honest brokers, and implementation agents to develop and implement various program elements
Energy efficiency business councils	Lobby for energy efficiency
Local, State, and National regulatory (code) organizations (like the International Code Council)	Regulate the industry, conduct surveys, be a conduit for information, convene conferences related to energy efficiency

Notice that electric utilities have historically held the role of operators of market transformation programs. (This fact will be reiterated in later discussion of entry points for program interventions). Even though various actors are involved in the purchase and installation of energy-efficient windows; the primary decision-makers for windows in residential construction are most often the builders.

Studies[6] have shown that:

- 92 percent of the time, builders make the window purchases and
- 68 percent of the time, builders have the most influence on the type or style of window, followed by 17 percent architects, 15 percent home buyers

Therefore, in order for the program to be successful, builders must be actively involved in transforming the new homes market for energy-efficient windows. When reviewing the challenges faced by

[5] E-Source, *Energy Efficient Buildings: Institutional Barriers and Opportunities*. 1992.
[6] Drucker Research Company, Inc. *Study of the US Market for Windows, Doors, and Skylights,* American Architectural Manufacturers Association, Window & Door Manufacturers Association, Schaumberg Illinois and Des Plaines Illinois. April 2004

decision-makers in the purchase of windows, researchers report that decision-making is often affected by subtler challenges[7], as seen in Figure 2.

Figure 2 Primary Decision Makers

Primary decision maker	Challenges they face	What is needed
Developers/Architects	Lack of information, lack of research hours	Information and billable hours
Builders	Competition in price, features, quality	Information about features and quality (particularly as windows relate to AC systems) Funding support for pricing and competitiveness (which can be translated into incentives like reduced entitlement time)
Home Buyers	Lenders know little about run costs	Information to present to lenders
	Home buyers don't care about energy costs	Cost needs to reflect externalities Information illustrating increasing energy costs over time and case studies illustrating cost-effectiveness and payback of energy-efficient windows
	Home buyers will trade windows for some other feature of the home	Energy efficiency must be treated better than energy supply Information demonstrating that energy-efficient windows increase property value as aesthetic features do

For builders, challenges revolve around competition in price, features, and quality. When researchers asked what would be needed to assist builders to buy energy-efficient windows more often, builders responded that information to change the perception that energy efficiency equals extra cost is required[8], along with information about the features and quality; and that funding support to maintain pricing and competitiveness were also paramount concerns. Builders reported that the quality of the product and features that address customer desires are also considerations.[9] They also reported that they spend a great deal of time educating consumers.

One builder said that they have a "design center" in which consumers select all options, including windows. However, consumers seem to be cyclical in paying attention to energy efficiency (that is, in the winter they tend to buy more efficient windows); that consumers tend to select **ENERGYSTAR®** double-hung low-e windows but not select more efficient options, and that it is easier to get

[7] Ibid.
[8] Conversation with Micah Mumford, Inland Pacific Builders, Inc., June 9, 2005
[9] Conversations with Micah Mumford, Inland Pacific Builders Inc., June 9, 2005 and a representative from Image Homes Corporation, June 8, 2005

homebuyers to opt for energy-efficient windows by presenting the windows as "preventing furniture fade" than "money or energy saving"[10].

Consumers need the same level of public awareness campaigns as insulation manufacturers (for example) have had. One Colorado-based building company has taken on the role of educating the owner throughout the building process—when a customer says they do not care how expensive their energy bill will be, the builder makes the case that energy inefficiency is also a global issue.[11]

When queried about their priorities in the decisions to purchase energy-efficient windows, builders rank-ordered the following factors. As seen in Figure 3, cost is most influential in a builders' decision to purchase windows.

Figure 3 Priority of Actor and Percent of Influence on Window

Builder (68%)	Contractor (1%)	Dealers (2%)	Homeowner (15%)	Architect (17%)
1. cost	1. cost	1. compliance	1. aesthetic	1. aesthetic
2. compliance	2. compliance	2. cost	2. function	2. function
3. availability	3. availability	3. margin	3. other	3. other
4. shipment	4. shipment	4. availability	4. cost	4. cost

The Alliance to Save Energy confirmed these priorities during discussions with builders-cost, compliance, availability and shipment time remain some of their highest-ranked concerns.[12] But the builders stressed that their view of "cost" is not only tied-in with the unit-cost of windows but also influenced by the ability to provide the home features buyers expect (such as pretty kitchens) whilst still offering energy-efficient options.[13]

UNDERSTANDING THE BARRIERS TO MARKET TRANSFORMATION

Builders have to deal with issues like technology credibility, socio-economic instability, protection of local manufacturing, limited capacity to enforce standards and codes, credibility of product labels, under-developed institutions and implementing arrangements, having realistic timetables to develop new markets, concerns over market aggregation, and augmenting consumer education. The most obvious barriers to widespread use of energy-efficient windows are connected to builders' priorities and performance objectives.[14] These barriers are:

Barrier 1: Lack of information, awareness, and know-how among builders about the cost of energy-efficient windows as it relates to HVAC;
Barrier 2: Decentralized building industry that negatively impacts cost, compliance, availability and shipment but that manifests itself in a system in which windows are ordered without HVAC design or specs being concluded;

[10] Conversation with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005
[11] Conversation with a representative at Image Homes Corporation, June 8, 2005
[12] Conversation with Micah Mumford, Inland Pacific Builders Inc., June 9, 2005
[13] Conversations with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005 and Micah Mumford, Inland Pacific Builders, Inc., June 9, 2005
[14] As found in countless studies, personal accounts, and as cited in Research Report No 10 Mar. 2000. Renewable Energy Policy Project

Barrier 3: Uncoordinated institutional relationships between builders and government officials that negatively affect energy efficiency as little is demanded of builders in terms of code compliance;
Barrier 4: High finance and transaction costs that affect builders' concerns about costs due to entitlement time.

When asked to elaborate on why energy-efficient windows are not widely used, builders often cite the "lack of market pull from consumers." When asked to elaborate on their ideas about how to break this cycle (illustrated as a "circle of blame", Figure 4), builders queried by the Alliance to Save Energy reported that buyers are the link to break first. This means that builders feel homebuyers seeking affordable homes tend to want "the excitement of the model home" and must be dissuaded from demanding the "bells and whistles"—decorative design features—at the outset.[15] Without consumer awareness, builders find it hard to caution consumers to add these features later and invest in energy efficiency instead. In the end, builders will let consumers' demands win the day—and more often than not, pretty carpet wins over energy-efficient windows.

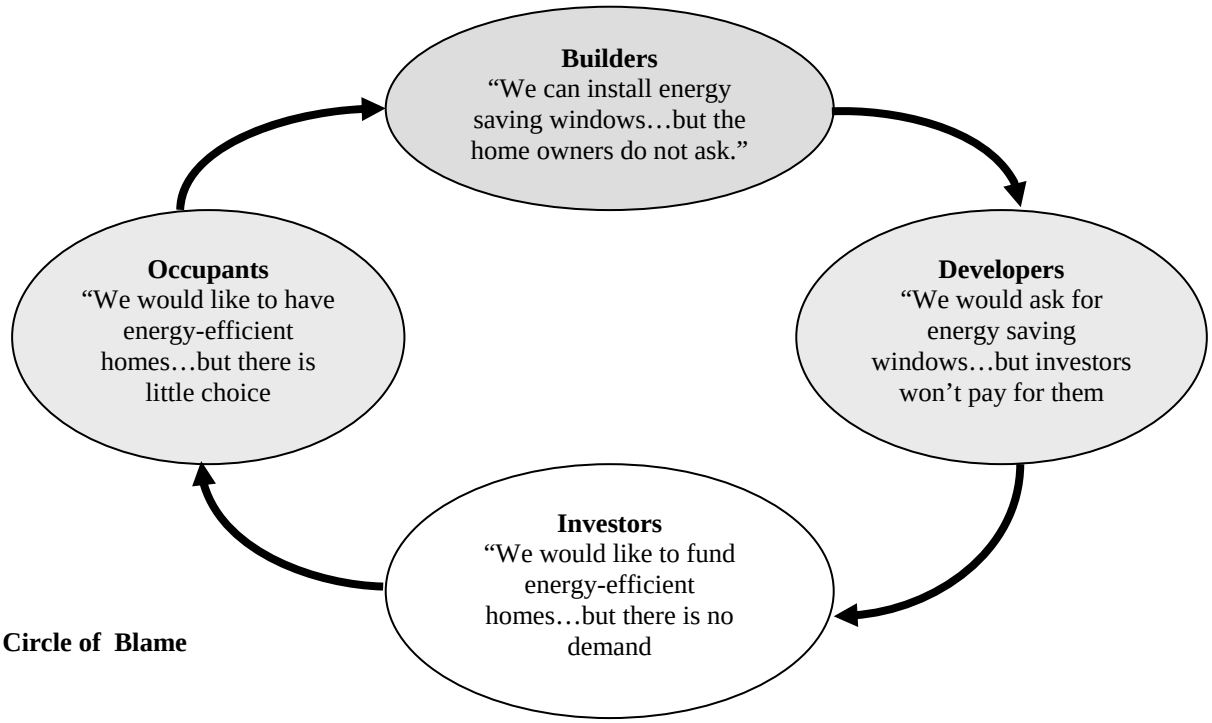


Figure 4 Circle of Blame

Of course, the barrier presented by lack of information manifests itself in every aspect of energy-efficient buildings, from architects, who may lack information on the most up-to-date glazing technologies, to the home owners, who lack information on the impacts of energy-efficient windows on their utility bills and therefore may not demand it. By not asking, they do not create a "demand" for energy-efficient windows. And builders are right, consumer demand must be sparked.

Not only are consumers lacking awareness of life-cycle economics but they also are unaware of high efficiency windows styles for homes. Remember, while builders buy the windows, they only influence the style 68 percent of the time. Architects and home buyers share the decision (17 percent and 15

[15] Conversation with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005

percent respectively). Some builders say that when consumers **do** make window-related demands, these demands are for window-styles rather than window-characteristics. For example, buyers may request "Palladian" windows (large arched center lite flanked by two sidelites)[16]. Yet this style of window is hard to glaze with energy-efficient glass. To do so will increase the risk to a builder through potential window failure. Since there is then a limited market demand for energy-efficient windows in the new homes market, manufacturers view production of these energy-efficient windows as "risky." Because of that risk, manufacturers do not produce or promote energy-efficient windows over products that have a secure, sure market placement. Builders will not install or promote them. And home owners will not get them. They will, however, demand and get single-glazed Palladian windows that have the coveted "curb appeal".

To address the lack of information on the part of home buyers, upgrading the home package to more energy-efficient windows (after advising buyers of the long-term costs of running the home) has proven effective in some parts of the country. One California builder says that by making energy-efficient windows, air conditioning, and lighting as part of their standard package, that they've been able to achieve real synergy.[17]

By using an engineering consultant (funded by NREL, DOE, and BIRA) this builder has been able to "right size" the air conditioning systems, integrate solar panel roofs and energy-efficient windows, and ultimately create a subdivision that sees a 60 percent savings on utility bills (when compared with the subdivision next door). In fact, even though the neighboring subdivision is 15 percent above Title 24 codes, this builder's homes (Premier Homes) consistently outshine its neighbors. It is clear that energy-efficient windows, when coupled with a holistic approach to home design, can make a marketing plan that reaches consumers and bring results that even outdo "plain vanilla" energy efficiency.

Increasing awareness among builders and creating partnerships is effective, as the previous example shows. Strong public-private partnerships involving electric utilities and incentives for using energy-efficient windows (and other upgrades) can lead to energy-efficient building. Public-private partnerships that engage the local government with building industry practitioners and building owners can also overcome some barriers to energy efficiency. Such partnerships have been most cost-effective in newly-launched programs where quick gains in market acceptance are desired. An example of this is Minnesota's Office of Environmental Assistance (OEA). This organization operates a Sustainable Building Program which teams with builders, other state and local governments, developers and community groups to promote sustainable building practices in Minnesota. The organization provides education, training and resources for participants.

In the early 1990s, utility company-based programs were highly successful in increasing the market penetration of measures such as insulation. Today, it is hard to think of insulation without thinking of the Pink Panther--a mascot seen at every football game's half-time. For air conditioning, utility-based programs also were influential in sensitizing consumers to the effects of appliances on their electricity bills. Most Americans know that thermostats impact their billing—and they turn them up or down accordingly—having made that mental connection. The same connection has yet to be made with windows.

[16] Conversation with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005
[17] Conversation with John Ralston, Premier Homes, June 9, 2005

Historically, energy-efficient technologies have been promoted through DSM offices of utility companies, as in the case of Austin Energy. Austin Energy heads up a Green Building program, which includes builders, architects, landscapers, etc. The Green Building program provides technical training seminars, green building guidelines, and other services to their members; and reportedly achieved 23 percent program engagement in the new single family homes market in 2004.[18] The same kind of market engagement could happen with energy-efficient windows.

Municipal incentives or enabling funds are suggested as ways to reduce the upfront costs, or "sticker shock," that often prevent builders from using energy-efficient windows. There must be training and a funding mechanism to encourage builders to undertake this "market push." For new home builders, installers of energy-efficient windows must be fully trained so they do not create "call-backs" for contractors or, worse, increase insurance liability through failed product performance. The building companies that the Alliance to Save Energy spoke with do not provide formal training for framers or installers, yet many claim that younger installers seem to understand vinyl frames readily.[19]

In the US, 90 percent of new homes are in large developments in suburban settings. There, large numbers of homes are built simultaneously, presenting an opportunity to incorporate energy efficiency into many homes at once through coordination between industry players and by taking advantage of economies of scale. Homeowners, report many builders, seek new homes in developments most likely to become neighborhoods. That means they are looking for features that are prominent, attractive, and distinctive. The type of glass does not add to curbside appeal, nor does it help create the look of a neighborhood over time[20]. Therefore manufacturers must be encouraged to create framing for energy-efficient windows that lends itself to capturing this sizable market.

A decentralized building industry means that many of those engaged in building design and construction have little meaningful interaction with one another on energy-efficient design strategies. Recent case studies (presented in a workshop held by the Alliance to Save Energy) underscored the tremendous importance of getting the building team together at the earliest possible design stage. With such coordination, the energy budgets can be known and targeted as the architectural components are selected. Builders (who often employ in-house architects) can use this strategy as well. Decentralization of the building process can be surmounted if there are efforts to match the energy budget to the building budget—while maintaining the builder's profit margin. In talks with the Alliance to Save Energy, some builders suggested that for this collaboration to work, the situation must be voluntary and a sense of commitment on behalf of the builder must exist.[21] Still others suggested that HVAC engineers, suppliers, and manufacturers must coordinate with window specifiers and manufacturers in order to create synergy that will allow right-sizing of AC systems while creating a market pull for energy-efficient windows.[22]

Another suggestion is to use legislation to encourage energy-efficient windows. If the law required lenders and developers to work together to leverage resources this would allow them to commit to

[18] Conversation with Richard Morgan, Austin Energy, June 9, 2005
[19] Conversation with a representative of Winchester Homes, June 8, 2005
[20] Conversation with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005
[21] Conversation with a representative at Image Homes Corporation, June 8, 2005
[22] Conversation with Chris Mathis, MC^2, June 8, 2005

mass deployment of efficient window technologies. This means that programs to accelerate the construction of energy-efficient homes must receive government funding. In fact, this acceleration is underway in California where Title 24 efforts have leveraged government and private funds to establish some of the nation's most energy-efficient suburbs (as the previous example with Premier Homes shows).

DO ALL INDUSTRY SPECIALISTS SHARE THE SAME MOTIVATORS?

Differing (and sometimes competing) motivators are the subtlest of all the barriers facing energy-efficient buildings. Differing motivators occur when the needs, goals, or desired outcomes of one specialist are at-odds with (or overshadow) those of another. For example, the architect may be considering the aesthetics of a building component or its energy performance, while the builder—who must order and oversee materials installation – may be primarily concerned with delivery lead times, budget ramifications, and the availability of a competent installer. How the material looks or performs is often *not* the contractor's **primary** concern. One of the best accounts of differing motivators was written by the Rocky Mountain Institute in a table first presented in the early 1990s, which has been revised since then (See Figure 5 below).[23]

Figure 5 Building Specialists and Their Performance Objectives

Specialist	Performance Measurement or Objective
Architect	Aesthetics/performance
Glass and glazing manufacturers	Materials cost/performance
Window component manufacturers	Cost
Window manufacturers	Cost
Window distributors, dealers, reps	Sales and margins
Window specifiers	Tables and modifications
Purchasing agents	Cost
Buyers (i.e., builders)	Dollars per square foot
Buyers (i.e., homeowners)	Cost/aesthetics/comfort
Developers	Dollars per square foot
Investor	Risk-reward ratio ROI
Asset manger	Net operating income
Contractor	Budget and schedule
Construction worker	Sign-off/ease of installation
Construction manager	Critical path/specification adherence
State and local inspectors and code authorities	Code section compliance
Industry trade groups	Project synergies/lobbying for issues
Utility and DSM programs	Avoided peak kW; saved kWh
Loan program	Net operating income

In the table above, the builder's main objective (as highlighted) is *"dollars per square foot,"* meaning profitability, or maintaining the margin for profit. In Alliance to Save Energy research, this contention

[23] Additional boxes of "specialists" and "performance measurements" were added by Surprenant Mar 2005.

was confirmed.[24] Builders and contractors are also prone to what is informally called "builder apathy" (meaning builders tend to do what they've done before to maintain profits and may be reluctant to change this "mix" of services). Builder apathy can be overcome with consistent information about the value of energy efficiency and its potential role in meeting the objectives of the key specialist in the chain.

MARKET FORCES ACTING ON BUILDERS

The next step is to determine which builders (or builders associations) are best-suited for ongoing technical assistance and know-how transfer. Selection criteria for choosing the preferred stakeholders are needed. These criteria could consist of identifying early adopters among the stakeholders. Other criteria that spur the market transformation process may also be used. Without such criteria, the process of selecting preferred stakeholder would appear opaque and program designers might select stakeholders with whom they have had previous contact or successes.

Energy efficiency improvements in the building envelope are further constrained the complexity of the market, which has varying investment decision practices, user purchase criteria, data limitations, as well as variations in locale, climate, construction costs, building codes, and standards. Considerations like having an active building stock and other economic conditions (like preventing accelerated depreciation) also drive builders' decisions and impact whether or not energy-efficient windows are installed. So the economic considerations of builders must be addressed. This was best illustrated by builders interviewed by the Alliance to Save Energy who said that the cost of the window to the builder is not a particular deterrent, unless one type of window is significantly more expensive than another – a small difference in price does not impact choice. However economic considerations for the owner, in terms of utility cost benefits, should be shared with the owner to explain the difference in cost.[25]

If there is no urgent economic or regulatory necessity to use energy-efficient windows and if there are no promotional campaigns that target the correct players and stakeholders, market penetration of new technologies will continue to be slow. Builders therefore must be given incentives to facilitate market transformation.

> ***"We don't make windows. We make selling windows more profitable."***
> ad for glass show

The most-often cited reason that energy-efficient windows are not widely used in new construction is that *builders seek to install the cheapest materials in order to increase profit margins.* Energy-efficient windows are not the cheapest windows to buy. Production builders are motivated by the profit margin of the windows, but also are highly motivated by windows that look good, cost little, are easy-to-install, and do not require call-backs. Cost, compliance, availability, and shipment were their rank-ordered priorities, as seen in Figure 3. Yet the competitive nature of the construction industry is not merely focused on increasing profits through decreasing material costs. There are subtler market forces acting on builders. A few of these are detailed below, and were confirmed by Alliance to Save Energy discussions with builders.

[24] Conversation with Micah Mumford at Inland Pacific Builders, Inc., June 9, 2005
[25] Conversation with Micah Mumford, Inland Pacific Builders, Inc., June 9, 2005

Developing Brand Equity

"A builder, for example, can market his homes as being safer and more energy-efficient by offering his own brand of windows that have tempered glass," said Tim Widner, director of glass operations for Republic Windows and Doors. *"He can also add V-grooving for curb-appeal. Whatever options this builder wants he can get as a package and have his own logo laser-etched right onto the window glass."*[26] New techniques like "branding" can often set one builder apart from the pack. Branding for energy-efficient windows can be leveraged, confirms one builder, who said that branding would help set his business apart, but that at this point in time, there is not enough incentive to do so. He mentioned that his California and Nevada counterparts are branding their windows as energy-efficient, and that energy-efficient windows are in demand in those states. This same builder believes that all builders in the industry will eventually use energy-efficient windows and use the windows to show their brand[27].

Other builders queried complained that the **ENERGYSTAR** "club" (meaning, those builders that qualify to produce **ENERGYSTAR**-labeled homes) is too inclusive to be desirable. In other words, they said, "the bar is too low".[28] That is why many builders are marketing themselves as "green", or as "LEED-certified"—because greening involves more factors for consideration which, they claim, resonate with homeowners.

The Impact of Liability on Builders

There is strong market pressure due to liability, insurance, and the need to be competitive, say many builders. In recent years, there has been substantial entry and exit into the home-building market among smaller firms who compete on price, features, and product quality. Small builders have seen higher insurance and compensation payments while manufacturers engaged in glazing have become "lean." Builders have historically run "lean" operations, so there is little room to advance in this area. However, one strong suggestion to incite builders was to reduce the entitlement time[29]. All builders queried concurred with this suggestion.

A decade ago, widespread installation of double-glazed energy-efficient windows added so many complicating factors that procedural bulletins for firefighters were changed as a result. At that time, the experience was that

a) these windows failed as readily as older single glazed windows,

b) in multifamily dwellings and community installations, the resistance to failure increased because of the use of heavier gauge aluminum or vinyl frames (as opposed to lighter gauge aluminum or vinyl frames), and because they resisted heat-induced failure, these windows hid the location of the fire from firefighters assigned to perform ventilation and search operation from ladders and fire escapes,

[26] Tim Widner, Director of Glass Operations for Republic Windows and Doors (as quoted in the article "Build Brand Equity with Window Logos", by Patrick O'Toole, Professional Builder Magazine, Newton. Sep 2003. Vol. 68, Issue 9, page 38.
[27] Conversation with representative from Winchester Homes, June 8, 2005
[28] Conversation with Chris Mathis, MC^2, June 8, 2005
[29] Originated at REEEP Workshop, March 9 & 10, 2005; Conversation with Carol Bowen, Quality Built Homes and Long & Foster, June 8, 2005

c) energy-efficient windows were extremely difficult to break with firefighting hand tools,

d) once the windows did fail or were vented, fire conditions often changed dramatically.[30]

And even though the same effects and complicating factors cannot be said to happen anymore, residential and commercial builders are aware of the pros and cons of energy-efficient glazing products that have a high impact resistance. Today's windows are impact-resistant too. On the pro side, HUD now cites energy-efficient windows as being hurricane-resistant and therefore preferable, in the wake of Hurricane Andrew. And the impact of global terrorism is causing many builders to consider glazing more carefully than ever before.

Homebuilders are trying to accommodate the health and psychological impacts of lack of daylighting in modern homes, which helps them to avoid litigation. ASHRAE's recent Addendum 90.1g revises the lighting power limits allowed in new construction. This could mean a 29 percent decrease in lighting power, some experts predict. The use of more daylighting will increasingly be a feature of residential as well as commercial buildings, as the addendum impacts residential codes. And as daylighting is introduced more widely, builders and architects will need to be mindful of the heat loads that may increase, which will mandate greater air conditioning costs. All the more reason to create communication between these two crucial trades.

These issues create challenges for builders. Builders will need to be supported by incentives to encourage them to forestall lawsuits related to daylighting while balancing the cons of fire-resistant windows with the pros of impact-resistance.

Warranty

In 2003, even though vinyl frames were used in 50 percent of the residential market,[31] the installers who worked with wood do not always understand vinyl and tend to install it poorly, thereby increasing the liability of the builders or contractors. From a market standpoint, customers are demanding tilt-in windows for cleaning but these are hard to install well, particularly given the need for establishing installation sightlines and avoiding creep. Since glass molecules "slip" faster with polyvinylchloride (PVC) frames, this is also causing builders liability and warranty insurance to rise. Often, older installers will toe nail (the "kiss of death") vinyl frames into place. To counter liability issues with the installation of vinyl and composite frames, builders need training programs for installers on this type of window technology.

Guarantees for Energy Efficiency

Inadequate contractual relationships between builders and other trades sometimes result in sub-optimal design for features like windows, resulting in energy inefficiency. As in all market transformation activities, it is recommended that the risks and rewards for all stakeholders are balanced and guarantees can be upheld. One homebuilder queried by the Alliance to Save Energy quipped that *"We aren't **guaranteeing** energy efficiency, we are **predicting** it."*[32]

[30] Quote from Deputy Chief James Murtagh of the Fire Department of New York City, 1994
[31] From "Study of the U.S. Market for Windows, Doors and Skylights", AAMA & WDMA Conducted by Ducker Research Company, Inc., pg. 59, 2004
[32] John Ralston, speaking on behalf of Premier Homes, June 9, 2005

Turn-Over Rates of Construction Stock

Turn-over rates of stock inventory in the buildings sector may be preventing rapid improvements that could be achieved if currently-available cost-effective technologies like windows were being acquired in inventories and made more readily available. Enhancement and attention to the turnover rates of stock necessary to builders must be addressed to further balance rewards with risks.

FINANCE FORCES ACTING ON BUILDERS

Finance and Transaction Costs that Affect Builders

Energy efficiency programs are vulnerable to macro-economic conditions (interest rates, inflation rates, etc.) and international energy prices. Macro-economic conditions affect energy demand, equipment sales, financing and credit, and can reduce the incentives and prioritization of energy efficiency investments like windows.

Transaction costs often determine if a home is to be built well or just built. If lender transaction costs are too high, the home (or commercial building) may suffer in quality, including its level of efficiency[33]. Recent ASE workshop discussions[34] demonstrated that buildings with "married technologies"—which are technologies that complement each other, as do structural insulated panels and geothermal systems[35]—greatly reduce transaction costs by affecting the funds mobilization, operating expenses, and general administration cost parts of the whole transaction costs equation. Another approach to lowering financial barriers is by combining building skin upgrades with efficient windows. This combination can reduce operating costs due to more efficient shell. The reduced operating costs offset the higher upfront costs. Leveraged funding, in which a builder may obtain rebates or incentives for using certain energy-efficient materials or systems could provide the "tipping point" for the decision to build efficiently and use energy-efficient windows.

Getting the house on the market as quickly as possible is usually one goal that builders' have. Therefore, another suggested approach is reducing transaction costs by moving a builder's energy-efficient homes projects to the "front of the line" for permits and plan reviews, thus reducing "entitlement time" hence, time to market. This will spur continued participation in energy-efficient construction. Builders queried by the Alliance to Save Energy responded that this would provide them with a financial incentive.[36]

Energy-efficient mortgages are currently provided by Fannie Mae to its partnering lenders. These tools allow home purchasers to increase the size of the mortgage they can carry by recognizing energy bill savings realized through efficiency, which creates greater financial means for monthly mortgage payments.

Tax incentives, too, can help "buy down" the premium price often associated with energy efficiency and sustainable design. Addressing market entry barriers through the tax code, by providing tax

[33] Retail lenders tend to define transaction costs as an equation – **LTC = LC + FC + GC + OC** – where LTC = lender transaction costs; LC = lending costs; FC = funds mobilization costs; GC = general administration costs; and OC = other operational expenses.
[34] During March 9 and 10, 2005 workshop in Washington, DC.
[35] As used by home builders Carl Franklin Homes, S. Brown comments Mar 2005
[36] Conversations with numerous builders, including Carl Franklin Homes, Premier Homes, et al.

incentives for the purchase and deployment of energy-efficient windows may also be used. Government grants to encourage energy efficiency upgrades to existing building stock (such as the Energy-efficient Mortgages or Energy-efficient Homes grants from HUD) are another avenue. When asked how much impact various programs have had on them, builders who talked with the Alliance to Save Energy said that programs that included financial incentives from utilities add credibility in addition to funds, and have been positive for their business.[37] During a discussion with a builder, the Alliance learned that rather than partner with entities outside the business, one building company is creating an energy-efficient program on its own.[38]

Policy, regulatory, and other tools that save money and time in the design and construction of buildings are being explored. All of these options should contribute to a reduction of transaction costs that encourages energy efficiency. However, the most effective option to-date appears to be a reduction of entitlement time.

Rebates Help Builders Focus on Their Core Business

"The main thing is to keep the main thing the main thing."
Old adage on how to run a business

The National Association of Home Builders' (NAHB) 190,000 members contribute more than $270 billion in annual construction revenue to the US economy. The NAHB members have been involved in the majority of the nearly 1.5 million housing starts in 1996 and have been responsible for the new homes built for nearly 760,000 families.

The NAHB takes its lead from the 1949 Housing Act that had the goal of a "decent home in a suitable living environment for every American family." In the past 50 years, private entrepreneurs have built 74 million new homes and apartment units and remodeled or rehabilitated millions more. Home ownership in the US went from 44 to 64 percent during that period. By 1996, it was beginning to look as if energy efficiency in new home construction might be increased substantially without additional government mandates. However, new home owners were challenged by upfront costs. ***"Although consumers want the lower utility bills that come with greater efficiency, we have found that they don't want to pay—and sometimes cannot afford to pay—for this benefit through increased upfront cost,"*** said Don DeLess, chairman of the association's energy sub-committee.[39]

Over time, builders have lost benefits as traditional DSM programs (by which utilities offered builders and remodellers incentives for energy efficiency considerations) no longer offered incentives (of $1,000 to $1,500) for each participating home in a builder's portfolio. When asked for their ideas on how rebates might be reinstated, most builders queried said that funding from government programs to support the engineering processes and consultation has helped greatly.[40] Fiscal incentives for builders need to be re-instated if increased market penetration of energy-efficient windows is the goal.

[37] Conversation with a representative of Image Homes Corporation, June 8, 2005
[38] Conversation with a representative of Winchester Homes, June 8, 2005
[39] Leslie A. Braunstein, Electric Perspectives. Washington. Jan/Feb 1998. Vol. 23. Issue 1, page 34. "Housing on Common Ground".
[40] Discussions with John Ralston, Premier Homes, June 8, 2005.

One suggestion to achieve market transformation is for the utility company to offer builders (who build to a certain level of energy efficiency) an extra ½ point on the mortgage. Proponents feel this utility company contribution could change the nature of energy-efficient home-building.

Lenders' Role in Energy Efficiency

In June 2005, the National Association of Realtors reported annual double-digit gains in 66 of 136 metropolitan areas—the highest number ever—as well as record sales[41]. During the Alliance to Save Energy's talks, mortgage companies were asked about information on energy-efficient mortgages or home energy efficiency benefits. Yet in the world of banking and finance, there is more information on the capital costs of investments than on the running costs of a home. Of the companies queried, most could provide energy-efficient mortgages, but none knew the statistics of home energy efficiency savings as related to mortgage retention. Banks and lenders must be trained since the capital markets for borrowers are incomplete and therefore, cost-effective homes hard to fund.

Mortgage companies must be supplied with information that helps them determine how an energy-efficient home represents a more sound investment than a home where the operating costs soon exceed the occupants' ability to pay. It may be arguable that these loans would be "lower risk" loans as a result. Yet during the Alliance to Save Energy's talks, no mortgage companies requested training in these impacts. However, one mortgage company[42] said that they regularly hold training to increase their knowledge and skill levels. Energy efficiency training could be incorporated with their ongoing training roster.

Energy-efficient Windows Increase Property Values

In 1998, the Appraisal Journal presented results of research that indicated the market values for energy-efficient homes reflect a rational trade off between homebuyers' fuel savings and their after-tax mortgage interest costs[43]. Using regression analysis, this research found that home values increase by about $20 for every $1 reduction in annual utility bills, reflecting after-tax mortgage interest rates of about 5 percent (for the years 1991 through 1996). Given the increasing fuel costs of 2005, it is likely that even greater property values would be achievable today.

The Metropolitan Statistical Average (MSA) showed that the average energy savings from replacing wood-frame, single-pane windows with clear glass double-pane windows is $200 per year, and the energy savings from replacing metal frame single-pane windows is $310 per year. Using high performance low-e replacement windows increases annual savings by an additional $114 per year.[44] This additional capital can mean the difference between home retention and mortgage default. Such statistics are useful in demonstrating the financial benefits to energy-efficient windows to industry influencers like mortgage lenders.

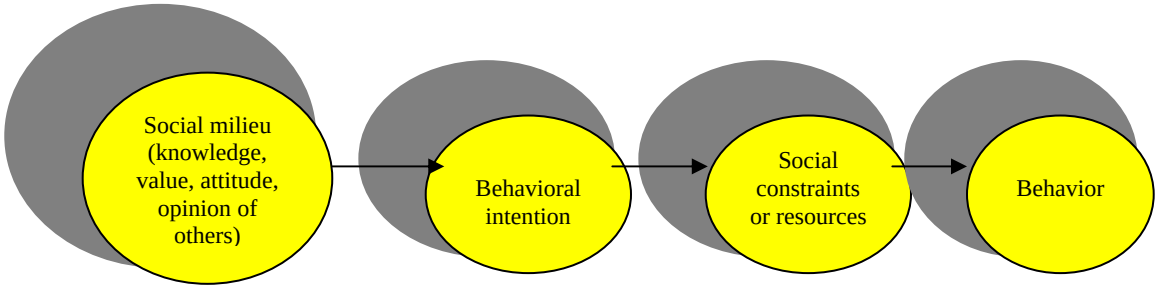
[41] Newsweek article "Beware These Home Loans" by Jane Bryant Quinn, June 6, 2005
[42] Long & Foster, June 8, 2005
[43] The Appraisal Journal, 1998
[44] Rick Nevin, Christopher Bender, Heather Gazen. The Appraisal Journal. Chicago. Oct 1999 Vol. 67, Issue 4, page 454. Article "More Evidence of Rational Market Values for Home Energy Efficiency"

SECTION II: BUILDING THE PROGRAM

CUSTOMER EXPECTATIONS

How are the energy efficiency options of home builders affected by buyers' expectations?

Figure 6 The Adaptation of the Modified Theory of Reasoned Action[45]



Home buyers perform actions from the realm of their milieu (which includes their attitudes) through their "intentions", then filter their behavior through their social and financial constraints. And finally, home buyers act in a certain manner. For energy-efficient windows, the key points for intervention are home buyers' "milieu" (that is, providing information) and in removing their financial resource constraints. And although builders adopted the Model Energy Code to reduce the costs of construction and maximize profits in this highly competitive industry, builders report that home buyers will often trade "unseen" benefits (like those accruing from energy-efficient windows) for "additional and obvious amenities" like high quality cabinetry or marble kitchen countertops. In short, homeowners do not always take "reasoned actions" when it comes to energy efficiency. In this example, the sway of "value" and "the opinion of others in their milieu" is greater than the unseen value inherent in energy-efficient windows.

Builders[46] tend to rank-order home buyers' "top of mind" priorities as:

1. Location
2. Price
3. Floorplan
4. Architectural feel
5. Features
   - Kitchen
   - Room count
   - Bathroom
   - Storage
   - Energy efficiency

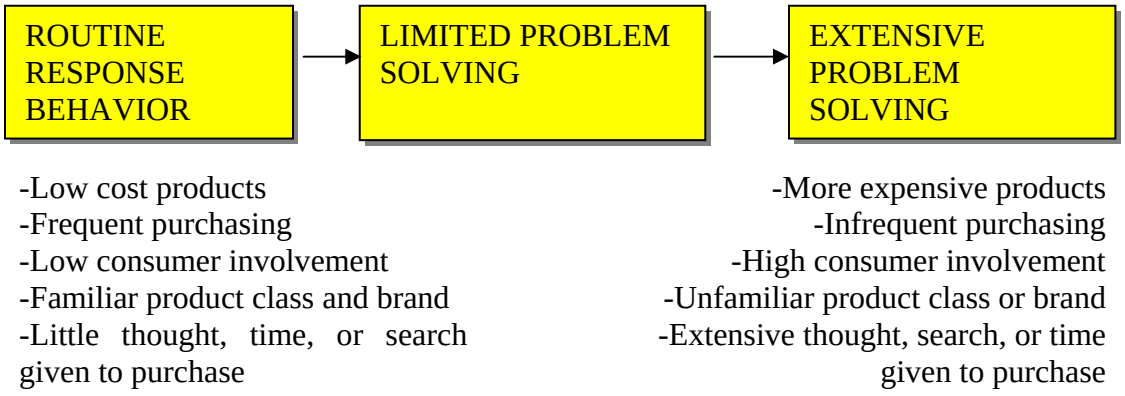
The connection between energy efficiency and price (rank-ordered second, as shown above) needs to be made, to move energy efficiency features (like windows) up in priority in the minds of consumers. Social scientists, on the other hand, have found that there are three types of consumer decisions[47]:

[45] Rogers, M. Everett. The Diffusion of Innovations, 4th Edition. The Free Press, New York, New York. 1995
[46] Such as John Ralston, Premier Homes, in conversation June 9, 2005.
[47] Rogers, M. Everett. The Diffusion of Innovations, 4th Edition. The Free Press, New York, New York. 1995

1) Extensive problem solving: Consumers use information from internal sources like memory or knowledge and outside sources
2) Limited problem solving: People use simple "decision rules" to choose among alternatives
3) Habitual decision-making: People make choices made with little or no conscious effort

Home owners must be presented with a package of base features that includes energy-efficient windows. The "amenities" options should not include energy-efficient alternatives in the building shell performance say green builders, or customers will opt out of energy efficiency. For builders, the same decision-making process holds true, that is, if given the choice to provide the customer with energy-efficient windows or very marketable bathrooms, builders too will opt out of energy efficiency. This dichotomy has been overcome by one builder, who is among the few who offer energy efficiency features as part of the standard package—not the options package.[48] Therefore the plan for market transformation must include moving the "use of energy-efficient windows" from the realm of "extensive problem solving" toward "limited problem solving" until someday, using energy-efficient windows becomes a "habitual decision" for both home buyers and builders alike.

Figure 7 Continuum of Buying Decision Behaviors



Homeowners seeking to retrofit their homes are already willing to undertake "extensive problem solving" which is why the retrofit market for energy-efficient windows currently holds the majority of the market share. However, when new home buyers are faced with the decision of whether or not to use energy-efficient windows, they may be unwilling to undertake such an extensive problem-solving adventure since they may be overwhelmed by the dearth of decisions requiring their attention. **Removing this decision from homeowners is the surest way to simplify the inclusion of energy-efficient windows in new homes, say builders.** By placing this decision with builders, the problem then becomes how to remove the risks to builders that are outlined in the "barriers" section of this paper. Therefore, the suggested interventions for builders must address money, function, and durability/installation/warranty risks in order to be effective.

[48] Premier Homes

Figure 8 Types of Perceived Risks

TYPE OF RISK	BUYERS MOST SENSITIVE TO RISK	PURCHASES MOST SUBJECT TO RISK
Monetary Risk	Risk Capital is money or property (rich and poor most sensitive)	High-ticket items
Functional Risk	Risk Capital is alternative means of performing the function and meeting the need (practical people are most sensitive)	If purchase and use requires buyers' exclusive commitment
Physical Risk	Risk Capital is vigor and health (old and infirmed are most sensitive)	Mechanical or electrical goods, foods, drugs, etc.
Social Risk	Risk Capital is self-esteem or self-confidence (the insecure are most sensitive)	Clothes, jewelry, cars, homes
Psychological Risk	Risk Capital is affiliations and status (those with low self-esteem or inferiority are most sensitive)	Expensive personal luxuries that engender guilt whose use demands self-discipline or sacrifice

MARKET TRANSFORMATION PLAN FOR ENERGY-EFFICIENT WINDOWS

Without a comprehensive plan to make sensible and obvious strategies like energy-efficient windows the norm in all homes, energy-efficient windows will not capture the additional 30 percent market share being proposed. It is imperative to take a fresh look at market transformation by studying what has succeeded before. In years of projects worldwide, development agencies have distilled effective practice principles for achieving market transformation.[49]

Eight central principles are:

1. Target supply and demand sides of the market
2. Take a holistic view of the market by examining all stages of the supply and demand chain
3. Leverage competitive market forces
4. Build flexibility into the program design
5. Consider which vehicles are best suited for technical assistance and know-how transfer
6. Emphasize standards, labeling, and building codes
7. Allocate a portion of the program dollars for replication and the dissemination of results
8. Begin monitoring and evaluation early, to measure pre-program baselines

[49] Like World Bank, UNDP, and USAID

SECTION III. SUGGESTED PROGRAM ELEMENTS FOR BUILDERS

To create a successful market transformation for energy-efficient windows through the avenue of builders, some of the tried-and-true principles of market transformation will be utilized. Various program elements (on both the supply and demand sides of the equation) are listed below, under the appropriate principle.

Principle 1. Target Supply and Demand Sides of the Market

The first principle recommends targeting the supply and the demand sides of the market simultaneously and thoroughly. For energy-efficient windows, that means understanding precisely how each intervention fits with each entity in the supply and demand chain for home building. Figure 9 illustrates the general categories of activities that could comprise a market transformation program, according to whether they constitute demand-side or supply-side activities. It also shows (in highlighted areas) where builders fit within the demand and supply sides of the market transformation equation for energy-efficient windows.

Figure 9 Supply and Demand Sides of the Windows Market

SUPPLY SIDE	DEMAND SIDE
Technical Assistance to Architects	Technical Assistance to Architects
Technical Assistance to Manufacturers	Technical Assistance to Builders
Technical Assistance to Builders	Technical Assistance to Consumers
Support to Architects	Use of EE Products by Consumers
Support to Manufacturers	Use of EE Products by Builders
Support to Builders	Use of Consumer Incentives for Windows
Development of Window Product Standards & Testing	Use of Architects Incentives for Windows
Development of Window Product Labeling	Use of Builders Incentives for Windows
Program Monitoring and Evaluation of Market Transformation	Monitoring and Evaluation of Market Transformation

Innovative glazing technologies can reach high market penetration levels in a relatively short amount of time provided there is a demand-pull. This demand-pull must be reflected in the market retail pricing and programs must pull on the right strings to move the market. The key initiatives for builders, given the conclusions drawn in this paper and the real-world study of market transformation programs are:

- Supply side technical assistance to builders in the form of collaboration between HVAC and window manufacturers
- Supply side support to builders in the form of funding to engineering consultants
- Demand side technical assistance to builders in the form of training and consumers' information
- Demand side use of energy-efficient products by builders in the form of pricing preference
- Demand side builder incentives for energy-efficient windows in the form of increasingly stringent codes

Principle 2. Take a Holistic View

A myriad of stakeholders are engaged in the windows industry. Consider that the primary players in the residential windows market are glass and glazing manufacturers (including float glass and plastics, glazing coaters, assemblers); window component manufacturers (vinyl and aluminum extruders, wood); window manufacturers who assemble finished windows out of glass and other components, window distributors (including independent dealers and sales reps); window specifiers or purchasing agents like architects, contractors, or home builders; and window buyers like spec homebuilders, homeowners, and rental owners.

Other stakeholders are state and local building code and enforcement agencies; industry trade groups and organizations; utility and DSM programs; and loan programs for residential new construction or retrofit. And although dealers/distributors and trade contractors have the least influence on the type or style, they are still actors in the decision on whether or not energy-efficient windows are installed. Consider Figure 1, which outlined the roles that each stakeholders play in the building industry, to review the number of differing perspectives.

To increase the diffusion of these technologies, a holistic view of everyone involved in the decision-making must be undertaken and that view must hone-in on the objectives of each actor. A clear understanding of the risks to these actors ought to be known and a comprehensive strategy to effect changes in the stakeholder operating patterns devised.

The principle (taking a holistic view of the market by examining the various stages of the supply and demand chain that relate specifically to builders) has been taken through this cursory study of builders' needs, barriers, and suggestions. Often, however, the program design is governed by (or contains) elements with which program designers feel most confident, or with which they have prior experience. This may explain the plethora of information for homeowners and architects (who are not the key decision-makers) and little information to builders. The latter tends to prevent innovation in program design while the former prevents taking a holistic view.

Ultimately, the market transformation program to encourage an increase in the use of energy-efficient windows for the residential market will need to be broadened to encompass not just builders, but also the manufacturers and the entire retrofit market.

Principle 3.Leverage competitive market forces

3.1 Position builders of energy-efficient homes by offering them advertising "piggybacks" through DSM programs, in exchange for their commitment to undergo training in how to better market energy-efficient windows.

3.2 Strengthening the "entry requirements" for a builder to be considered an **ENERGYSTAR** builder—which at the present time are too lax to be interesting to most builders. The "market pull" here would be to create homeowner demand for **ENERGYSTAR,** by causing the public to ask *"What do you mean you're not an **ENERGYSTAR** builder**?"***

3.3 Effectuate technology know-how transfer through study tours and exchanges between builders and professionals (such as HVAC manufacturers and engineers visiting windows

manufacturers and glazing engineers). (Manufacturers competitiveness concerns and proprietary knowledge must be protected, however).

3.4 Participating builders (meaning, those who are "energy-efficient") can be offered first-knowledge of changing market trends (or other ancillary benefits) which give them a competitive edge over their peers. This knowledge can be offered through professional trade organizations and cooperation between these diverse players.

3.5 Train builders in the use of "branding" as a motivator for them to promote energy-efficient windows to their clients.

3.6 Supply home buyers with information about energy-efficient windows, to the same degree that products like insulation, for example, are promoted. A communications campaign for the general public must be devised.

3.7 The transactions costs to builders must be reduced by moving energy-efficient builders "to the front of the line," (thereby reducing entitlement time) when energy-efficient windows are used. This incentive will help leverage competitive market forces, but will also energize builders to participate in the program.

Principle 4. Build flexibility into the program design

4.1 Prepare a program structure dynamic enough to allow different models and financing tactics to be undertaken as the program changes or when market penetration is achieved.

4.2 Establish realistic timetables for barriers-removal and market maturity, with various program approaches tailored to the various states (like California) who are already increasing the use of energy-efficient windows in new homes.

4.3 Phase the removal of barriers to builders so that barriers are removed with a holistic but focused approach.

Principle 5. Consider which vehicles are best suited for technical assistance and know-how transfer

The impact of home centers on the residential windows market has been substantial in the retrofit market. However, this has not affected the new homes market since builders do not get supplies or materials from these retail outlets. Still, the lessons learned from the paradigm of the home centers have been that opinion leaders play a substantial role as multipliers in market transformation, particularly in conveying information about new technologies like energy-efficient windows.

National chain stores typically sell both national manufacturers' windows and the local or regional manufacturers' products. Sales reps (different from distributors) sell in larger volumes and they are the ones who sell to builders. Their price premiums are dependent upon local conditions and are complicated by brand name, material and frame type. Distributors are interested in selling energy-efficient windows if they can profit from the mark-up on the manufacturer's price. Retail prices, then, reflect not only the special nature of energy-efficient windows, but also a bit of profiteering by those

who sell premium windows. Some suggested program components as vehicles by which to deliver the message are as follows:

5.1 Work through tried-and-true (and trusted) structures (like DSM programs) for mass deployment of energy-efficient windows.

5.2 Use participating builders to give direct promotional support to the program and work through their sub-contractors to harmonize promotional programs (to achieve a "multiplier effect") and raise "brand" awareness with consumers for energy-efficient windows.

5.3 Have DSM programs deliver some incentives to builders

Principle 6. Emphasize standards, labeling, and building codes

6.1 Work through all Federal agencies involved in housing (HUD, DOD, EPA, DOE, etc.) to increase the building codes, particularly in disallowing "trade offs" between windows (building skin) and equipment (like air conditioning).

6.2 Use participating builders, manufacturers, and other stakeholders to help develop standards for windows.

6.3 Achieve voluntary agreements (or MOUs) with suppliers or manufacturers (to cease production or supply of inefficient window products) to speed the penetration of energy-efficient windows into the market.

Principle 7. Allocate a portion of the program dollars for replication and the dissemination of results

7.1 Ensure that soft assistance is contributed by builders, and write the targets for this assistance into the program design. Such soft assistance can be in the form of dissemination of results.

7.2 Set aside a portion of each facet of the budget for public relations and marketing of the program and its results. Within that marketing ought to be a series of feedback mechanisms to continually refine the marketing approach.

7.3 Design a training program for builders that has a single, straightforward message to increase the market demand for energy-efficient windows and a training program for lenders that has a component designed to ensure replication.

Principle 8. Begin monitoring and evaluation early, to measure pre-program baselines

If energy-efficient projects are to be "sustainable" the retail price reductions for energy-efficient products must likewise be sustained after the project concludes. Similarly, high-efficiency windows must then become the norm in the market and in fact, dominate the market after the project concludes for the market transformation to be considered successfully sustainable. Some measures by which to ensure sustainability are:

8.1 Devise monitoring methods during program planning, to ensure that market transformation is achieved and to evaluate the timeline.

8.2 Design a plan to evaluate the windows market to establish the beginning baseline and measure long-term impacts.

Principle 9. Financing Strategies

Even though financing was not discussed in the principles for practice as outlined above, it is clear that payback, lifecycle, and cash flow costing are important to builders. Their challenge is that there is often a mismatch between the costs and benefits. This is exacerbated by the fact that the benefits of improving (a home) do not always accrue to the party that pays. From a lending perspective, high performance housing benefits are often indirect and housing lenders are motivated by "risk avoidance." Even though a project's higher up-front costs will result in lower operating costs, often the lender will not consider those savings during underwriting, and the property will not be able to support higher up-front costs. Some financing tactics are:

9.1 Install subsidies to achieve high leverage and reduce the retail prices of energy-efficient windows. Restrict the incentives and subsidies to defined, pre-determined promotional periods that have explicit sunset provisions.

9.2 Provide tax incentives to home buyers that are large enough to influence the decisions of residential customers. Make sure those tax incentives complement other efforts such as the federal energy and state market transformation incentives. The incentives should also target options that have a high potential market for some private-sector interests, and are cost-effective once they are adopted.

9.3 Make the economic incentives to builders simple and easy to implement.

9.4 Devise credit enhancements to builders (to ensure program participation) and methods to improve their credit and sustain it long-term.

9.5 Design clear exit strategies for guarantees, preferably with clear market indicators for when the exit procedures should be actuated.

9.6 Design training for banks and lenders that allows them to better judge loans for energy-efficient homes (and windows).

CONCLUSIONS

The market failures that prevent widespread adoption of technologies like energy-efficient windows are difficult to encapsulate because of the myriad of players and stakeholders involved in the home building process. However, creation of a ***market push*** (standards and codes) coupled with a ***market pull*** (from education, incentives, and consumer demand) delivered though market transformation tactics appears to stand the best chance for increasing the market penetration of energy-efficient windows through home builders. The widespread use of energy-efficient windows in the new homes market ought not be the difficult decision it remains today, some three decades after energy-efficient windows were first produced. Eliminating single- and double-pane clear glass windows from the marketplace in the US is the goal of any reasonable market transformation effort for windows. This paper has outlined some of the framework components for such an effort and highlighted some of the key barriers and challenges which must be overcome.

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ALLIANCE TO
SAVE ENERGY
Creating an Energy-Efficient World

Identifying barriers to NFRC participation by small manufacturers

A Strategy Report by the Alliance to Save Energy

Prepared By
Arlene Z. Stewart

Identifying barriers to NFRC participation by small manufacturers

TABLE OF CONTENTS

EXECUTIVE SUMMARY

While eighty-one percent of the US residential fenestration market participates in the National Fenestration Rating Council (NFRC) certification program, the non-participation by the remaining nineteen percent can severely hamper the implementation of efficient windows by actively opposing local market transformation efforts such as building codes and above-code, voluntary programs. The ability for consumers to identify whole window performance is the first step to increasing the selection and usage of efficient fenestration products beyond the current forty-one percent market penetration. Consequently, market transformers must address the concerns of those manufacturers not participating in NFRC certification.

Information compiled from over fifty discussions with window manufacturers and fenestration industry professionals indicates that NFRC certification can be complicated and daunting to small manufacturers with annual sales $5M and below. Moreover, manufacturers often associate NFRC certification with technology advancement advocated by government and market transformers. In addition to the testing and rating needed to identify efficient product performance, technology transformation can require restructuring not only to product lines, but also to business models and facility infrastructure. Some of these costs are absolute: they are the same regardless of the size of the company. Therefore, the whole process is ‘expensive’ for small manufacturers because a greater portion of the budget is needed to execute the transition as compared to larger companies.

Regulators certainly have a duty to the public good to make better use of limited natural resources, to reduce greenhouse gas emissions and air pollution and ensure a reliable power infrastructure. Conversely, government also recognizes that small businesses need to be fostered and nurtured, offering many state and local incentives through small business development initiatives. Therefore, regulators should seek to accommodate both sets of needs by developing and supporting localized initiatives to ease the market transformation burden on the small manufacturer minority.

Simplification and clarification of the NFRC certification program would remove significant barriers for early adopters, as many companies delay certification until they cannot avoid it any longer, simply due to time constraints. Additionally, regulators need to establish a reasonable implementation timeline that will allow manufacturers to make the transition without excessive strain on finances or staff. It is also extremely important that regulators implement that timeline as planned to reward manufacturers who made the effort to complete compliance. Regulators should also include media marketing in their regional transformation efforts. Cooperative marketing opportunities to companies with limited budgets should be coupled with independent public service campaigns to legitimize the market transformation for the consumer. Finally, NFRC should consider redefining small manufacturers who gross up to $5M and possibly as high as $10M for inclusion into its special rate programs.

1. BACKGROUND

Windows have long been identified as a weak link in the building envelope. Of course, as any chain is only as strong as that weakest link, it is reasonable to expect that increasing the energy efficiency of windows will increase the efficiency of homes, making the most of America's vital energy resources. In fact, the U.S. Department of Energy states that in 1990 alone, the energy used for offsetting the heat lost or gained through windows was $20 billion.[1] This cost may be considerably higher today, due to rising energy prices. However, studies have reported that by 2010 over $25 billion of the increasing annual costs could be avoided using efficient windows, a reduction of 2.5% of the nation's collective annual energy bill.[2]

How can America capitalize on this potential? The answer is intrinsically linked to identifying an "efficient window" that can minimize the amount of energy used in a home. But what does an "efficient window" look like? It used to be safe to say that wood was more efficient than metal. Today, that is not necessarily the case nor is the thermal performance of those two materials the only factors to be evaluated for determining efficiency. Over the last twenty years, numerous window technologies have emerged that have created varying degrees of efficiency depending on application, location and cost. Window manufacturers can mix and match a bevy of choices to meet the needs and wants of their customer, whether they are architects, builders or homeowners.

Yet, first and foremost, windows are meant to be transparent. They connected the occupants of a building with the world outside. If the only way to evaluate an efficient technology is to see it in the window, then the essential purpose of the window is defeated. If the user cannot see through the window, it is not a particularly good or useful window. Why use the window in the first place when there are much stronger 'links' (like insulated walls) available to use in the building envelope?

Therein lays the quandary. How can you be sure about the presence of an energy saving technology when you cannot see that it is actually present? How can you fairly accommodate all of the efficient technologies in the marketplace and continue to foster new ones if the only way to identify efficiency is by identifying the technology? Moreover, how can you know just how efficient it is, especially given the law of diminishing returns?

The industry answer to most of these questions was a 'measuring' system for thermal performance in fenestration products. The National Fenestration Rating Council (NFRC) was created in 1989 in response to Federal Trade Commission actions against the

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[1] Energy Efficiency and Renewable Energy Clearinghouse. *Energy Efficient Windows.* Washington, DC: Department of Energy, 1994.

[2] Gellar, H. and J. Thorne. *US Department of Energy's Office of Building Technologies: Successful Initiatives in the 1990's.* Washington, DC: American Council for an Energy Efficient Economy, 1999. For the purposes of this technical paper, efficient windows are defined by US Department of Energy ENERGY STAR™ criteria.

window industry in the Northwest brought about by erroneous claims of excessive energy performance and consumer return on investment. The founders of NFRC recognized the whole fenestration industry faced a serious risk of widespread confusion, federal intervention, and perhaps costly litigation without having a uniform way to make thermal performance claims.[3] In the subsequent sixteen years, NFRC ratings, procedures and certifications have grown across the United States with 280,000 certified products from more than 400 manufacturers. In their yearly analysis of the fenestration industry, Ducker Research Company reported that 81% of the 66.7 million window units in the residential, light commercial and manufactured housing market were NFRC-certified for 2003.[4]

Impressive as those statistics sound, NFRC ratings are still met with skepticism and resistance in the remaining 19% of the fenestration market. Nineteen percent may not seem significant, but these manufacturers can wield significant political and economic power in their localities, making it difficult to introduce building codes and above-code programs. They often perceive that NFRC ratings and certification pose an economic threat to their existence, actively blocking market transformation efforts toward more efficient windows with the universal cry “It’ll put me out of business.” Builders follow, adding to protests to legislators, about their fears of higher prices and reduced availability of the products they know and trust. With constant reports of off-shoring, governments and politicians are eager to protect local business, making them unwilling to implement mandatory codes or voluntary programs that might put local business at a disadvantage. Efficient window market transformations can be severely hampered or even stopped by these business concerns. Eventually, government needs to grapple with energy demands and air quality issues. Accommodating both energy and business needs can be stifling and frustrating, even with a sufficient understanding of the situation, process and possibilities.

As part of its market transformation mission of identifying barriers to efficient fenestration implementation, the Efficient Windows Collaborative (EWC) has sought out this disenfranchised small manufacturer audience over the past seven years. Through meetings, training sessions and general networking, we have heard numerous reasons and excuses on why small manufacturers "can't participate" or "are excluded" from NFRC. Our efforts have afforded us some intimate insights into why manufacturers are so resistant, petulant and defensive about NFRC as well as other efficient window implementations.

This technical paper is an attempt to organize these insights, ascertain the validity of the perceptions at large and provide some guidance as to how market transformation groups, state and local governments and manufacturers themselves can remove direct or indirect barriers to NFRC ratings. We also offer recommendations on how best to use resources to facilitate this integral first step in transforming America's building stock to efficient windows and bring about the 2.5% annual savings our world desperately needs.

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[3] National Fenestration Rating Council. 2005. The History of NFRC, http://www.nfrc.org/about.aspx
[4] Ducker Research Company, *Study of the U.S. Market for Windows, Doors and Skylights*. 2004. AAMA/WDMA: Chicago. Please note that Ducker also reported that only 41% were identified as ENERGY STAR windows.

2. APPROACH AND METHODOLOGY

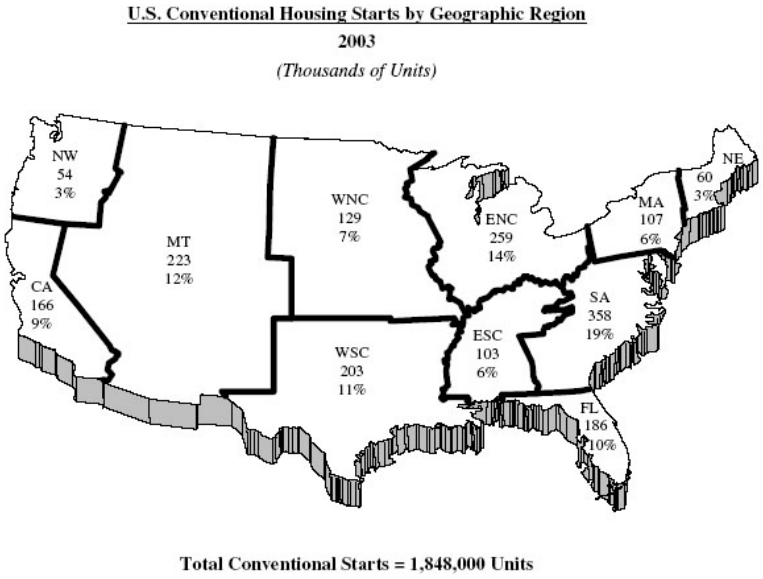
As mentioned above, EWC has had extended interaction with fenestration manufacturers over the past seven years. The first step in undertaking this paper was to organize our experience from those established relationships where we had watched, and at times assisted, small manufacturers in their certification efforts. Our observations served as our paper hypotheses from which discussion topics were derived. In brief, we expected that top concerns for manufacturers would involve a wide variety of costs and details on process changes like interference with daily operations, space to add more labels and the details of technology upgrades.

Next, we identified the target audience. We adopted NFRC's definition of "small" manufacturer as one with $1M or less in annual sales. However, we only found one company meeting this definition. Additionally, one of our developed hypotheses was that manufacturers with annual sales up to $15M consider themselves "small." There is some precedent for this line of thought as annual company showcases by fenestration industry magazines rarely include companies under $35M. Therefore we considered companies up to $15M in our target with more than 75% in the $3-7M range.

From NFRC, we obtained a list of new members as well as companies who had requested information yet had not signed the NFRC licensing agreement. Of 135 records provided by NFRC, we determined that 22 companies met the target parameters.

We then examined target audience location. Our observations were formed from our experiences with companies in Florida and Georgia, so we needed to determine what parts of their experiences were unique to the Southeast region and which were typical for any small manufacturer in the nation. While there were many ways to divide up the country, we opted to follow Ducker Research Company's breakdown which is based on the US Census (see Figure 1). Consequently, we found we needed to expand our list as we had an uneven distribution. Unfortunately, we did not discover a single list of all the window manufacturers in the US. However, two EWC component members were willing to provide clients that matched our paper profile, with the provision of confidentiality. With this larger pool, we sought to identify between ten and fifteen manufacturers per region to interview. We expected to only successfully talk to between three and five per region. When possible, we attended industry gatherings to meet with manufacturers in person.

Figure 1
Discussion Participant Profile by Region and Housing Starts



Used with permission from AAMA/WDMA

This figure provides an overview of the discussion list. The first number indicates the number of suitable manufacturers, while the second indicates the number successfully contacted.

Northwest: 3, 0

Washington
Oregon

California: 10, 0

Florida: 10, 4

New England: 11, 5

Maine
Connecticut
Vermont
Rhode Island
Massachusetts
New Hampshire

Mid Atlantic: 33, 8

New York
Pennsylvania
New Jersey

East South Central: 5, 2

Kentucky
Tennessee
Mississippi
Alabama

East North Central: 27, 5

Wisconsin
Illinois
Indiana
Ohio
Michigan

Mountain: 8, 2

Montana
Wyoming
Nevada
Utah
Colorado
New Mexico
Arizona

South Atlantic: 27, 5

Maryland
Virginia
West Virginia
Delaware
District of Columbia
North Carolina
South Carolina
Georgia

West South Central: 18, 8

Texas
Oklahoma
Arkansas
Louisiana

West North Central: 16, 3

North Dakota
South Dakota
Minnesota
Iowa
Missouri
Nebraska
Kansas

Once unique manufacturers were identified, we began doing research on the company. We cross referenced our candidates against American Architectural Manufacturers Association (AAMA), Window and Door Manufacturers Association (WDMA) and Fenestration Manufacturers Association (FMA) lists as well as contacts from EWC meetings and trainings. We also did internet research to familiarize ourselves with the company. We hoped to gain additional insights by comparing a company's public, impersonal profile against the personal impression we would develop in our phone call.

Once company research was completed, a call was made to schedule a time to talk. We thought it was necessary to give manufacturers some time to think about the topic before the actual call. We also offered them confidentiality to ensure that the most candid responses could be given. We confirmed company details and then started with the general question of what they thought of NFRC. From there, we were able to explore either pre-determined hypotheses or new issues. Forty-two manufacturer discussions were conducted with the average time ranging between five and twenty minutes (see Figure 1).

To augment manufacturer discussions, we also spoke with fenestration industry professionals from NFRC-accredited laboratories and inspection agencies as well as others with sustained contact with manufacturers. As we formulated our hypotheses, we realized these professionals would have garnered a similar body of knowledge about small manufacturers in a similar way and in other regions. Their insights would be more in-depth than the manufacturer ones, providing proof[5] to our more detailed hypotheses. We were able to interview ten professionals with an average time of thirty to sixty minutes.

Thus, two distinct sets of information were collected for this paper: manufacturer data and fenestration professional data. The set of manufacturer data had quantity, but the depth of the information was lower than the data garnered from the smaller group of fenestration professionals.

[5] Here, the concept of "proof" is extrapolated from the mathematical convention in which a conclusion may be drawn and accepted because a series of conditional statements (if this, then that) is shown to be true.

3. DISCUSSION OF BARRIERS AND IMPEDIMENTS

We have integrated the results from these discussions, including only hypotheses corroborated by the interviewees. We list manufacturers' concerns first, starting with ones that were mentioned most frequently and with the most agitation. They are followed by applicable observations from professionals in the subsection.

Observations and conclusions were drawn both directly and indirectly. Being that manufacturer interviews were brief, we looked for corresponding conclusions from professional interviews to provide more detail into the dynamics that actually led manufacturers to their conclusion. We accepted that correlated observations were reasonably true, given that the themes were consistent and repeated frequently.

In general, we found that regional differences could not be identified until a market transformation was underway. The following discussions should be relevant to any small manufacturer in the country. We also found that higher housing starts could not be correlated to number of small manufacturers in the region. That is, more construction activity does not necessarily support more small manufacturing companies for the region.

3.1 Rumors vs. Fact

First and foremost, market transformers must address common misconceptions, in order to proceed to discussions on more serious issues. For example, the creation of NFRC is one consistent misperception that is frequently raised when manufacturers first interact with EWC. They convey that NFRC was created by "Anderson, Marvin and Pella" to steal their business or as a way of gaining market share in the lucrative housing market. Only certain types of windows can be certified is another. One manufacturer in Georgia was under the impression that the company had to maintain a 'hot box' on site for unannounced inspections![6]

While these types of perceptions are clearly erroneous, rumors are, nevertheless, a barrier to market transformation. They prevent non-participating manufacturers from even thinking about NFRC participation because the manufacturers have a preconceived notion that NFRC is a club only for certain types of manufacturers…and they are not included. Consequently, when NFRC windows become 'required,' either through building codes, utility programs or successful marketing initiatives, non-participants feel forced, defensive and willing to fight to protect their perceived territory against a much larger competitor.

[6] A 'hot box' is actually the physical test chamber used to validate computer simulations for windows. No more than thirty exist nationwide.

3.2 Expense

As expected, the most frequent comments from manufacturers had to do with money. Some form of “it’s expensive” was made in sixty percent of our discussions. Yet, “it’s expensive” is a vague statement that does not provide any clue about how much money is actually at stake. Often, 'regulators' and efficiency advocates underestimate the money tied up in the NFRC process. It is easy to mistake “it’s expensive” for a rumor, especially if there is not an understanding of the certification and manufacturing process. Not only is there a specific dollar amount needed to cover the cost of the testing process, but there are also many ancillary costs that are necessary in order to implement and execute a product line that fits the parameters suggested by regulation.[7] The proportion of that expense in the company budget is even more significant. What is expensive to a small company, both in terms of cash flow and resource allocation, may not be to a larger one. Both the costs and the lack of understanding by market transformers are barriers to implementation.

3.2.1 The concept of Hard vs. Soft Costs

Unsurprisingly, there were many different facets to ‘expense.’ Consistent interaction over time was necessary to understand how manufacturers determined expense. Their thinking was distinctly different from those unfamiliar with manufacturing. In general, manufacturers do not compartmentalize expenses. Rather, they unconsciously group hard and soft costs together into one ‘expensive’ price. Hard costs are items with a fixed price that can be purchased, such as goods and services. Soft costs are indirect costs incurred during development, implementation, execution and maintenance of programs or products. Soft costs are more elusive, like the amount of staff time devoted to a project or inactive manufacturing plant time spent during a transition.

A misunderstanding often occurs at the onset of regional market transformation efforts as a result of the different thought processes of manufacturers and ‘regulators.’ When manufacturers make the blanket statement “it’s expensive,” regulators respond that hard costs such as the cost of testing or that of energy efficient technologies are a reasonable cost of doing business.

However, manufacturers know, almost unconsciously, that soft costs will be required as they are such an integral part of their livelihood. Some soft costs can be budgeted and often are, especially in larger facilities having incorporated project management principles. Smaller operations tend to be less formal or less tightly regimented. On one hand, this allows them to be

[7] Regulation is used to describe any criteria thrust upon the market. Many manufacturers include utility or voluntary code programs in the same category as building codes because the programs are so successful that participation by the manufacturer is necessary to remain competitive. The end result is the same: manufacturers must implement a parameter not of their own choosing.

very responsive to trying new things. On the other, it can be difficult to know exactly how much will be (or should be) spent until the project is underway or completed. Since multiple staff may be involved, it is also possible to lose track of how much each person has contributed. Section 3.3 and Section 3.4 present more detailed discussions on these soft cost processes that are not directly associated with the certification process.

It is important to note that soft costs are often overestimated at the onset of an NFRC project. In the absence of actual data, manufacturers will estimate high, preparing for the worst and hoping for the best. Several manufacturers who have completed the process reported that costs were not as bad as anticipated. Moreover, manufacturers competing in the same geographic region of a similar size may not be inclined to share actual soft cost figures since they fear that their competition may derive an advantage off their experience. They view their time and effort as a valuable commodity with an investment to be recaptured (see Section 3.6). They are not inclined to provide their competition an advantage of their experience. We speculate that they may provide higher cost estimates to their competition to intimidate them from introducing a similar feature or provide lower costs to undercut the competition financially.

3.2.2 Certification Costs

There are several distinct costs to certification:

1. simulation,
2. physical testing,
3. inspection,
4. labeling,
5. participation fees.

Manufacturers report that simulation, testing and inspection average about $5K per product line. Participation fees include $1,500 per year and $150 per product line for non-NFRC members and $0.01 per label.[8] The number of product lines being certified will determine that cost. These figures are relatively easy to calculate and budget for in the planning stage.

[8] For NFRC members, the participation fee is $1,000 and $100 per product line. Under the Small Business Program of the NFRC, manufacturers with annual gross sales of no more than $1 million pay $500 for participation and $50 per product line, while the fee per label is waived.

While $6.6K[9] may seem like a reasonable cost in the course of doing business, it is important to keep these costs in perspective. For many small manufacturers, their commodity is often their product flexibility. Many manufacturers interviewed are very responsive, able to fill orders in less than two weeks time. They may offer a range of product options to rival national manufacturers or they offer products customized for a job. Therefore, small manufacturers may have to bear similar testing and inspection costs as larger manufacturers because the number of product lines is similar. Certification costs in a single manufacturing facility for five product lines with thirty product options may total around $26K or 0.65% percent of a $4M company. This may not seem excessive to a regulator unfamiliar with window industry margins. However, consider that the same costs are only 0.065% of a $40M company and 0.0065% of a $400M company. Relatively speaking, it is more 'expensive' for a smaller company than a larger one with comparable product lines and offerings.

Even more significant to examine are certification costs as a function of profit. $4M can represent a production range of 20,000 to 30,000 window units. Profit margins were reported to be between $2.00 and $20.00 per window,[10] or between $40K and $600K annually for a $4M company. Certification costs of $26K then range between 4% and 65% of a company's profit.

3.2.2.1 Re-testing

Several manufacturers resented that testing had to be renewed every four years. Yet most credible certification programs, regardless of the product, require periodic re-testing. Unfamiliarity with certification processes is an informational barrier.

3.2.2.2 Labeling costs

Several manufacturers indicated labeling costs as a difficulty. Apparently, there is a reduction in costs for pre-printed labels once 10,000 labels are purchased. Small manufacturers indicated that they had bought volume to get the discount, but wound up wasting the money because they did not use all of them in a four year period or that NFRC had changed the label format. This does not appear to be as significant an issue for companies that print their own labels on demand.

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[9] $5K for one product line testing, simulation and inspection + $150 for a product line participation fee+ $1.5K program participation fee.

[10] Some industry professionals feel that custom millwork profit margins could be as high as $90 per window. Since we did not have data regarding how many custom millwork producers were part of our small manufacturer subset, we opted to not to include this extremely different estimate for a specialized sector in our cost analysis.

3.3 Labor

Labor, in this instance, refers to the work actually done by the manufacturer to obtain certification. For a majority of small companies, the people who are in upper management are generally wearing several hats when it comes to their responsibilities. It is not uncommon for the president of a small company to also be the head sales person and be involved in design decisions from an engineering standpoint, not to mention being the chief problem solver (probably part of the reason they get to figure NFRC out). Key manufacturing people will put off and delay the steps in the NFRC process in favor of the more pressing demands of daily business. NFRC certification only becomes important when there is a compelling need to complete certification (such as a code implementation date).

Also, the process of discerning exactly what the NFRC Product Certification Program (PCP) requires can take up so much time that it is impossible for the pivotal person to do it all. If the responsibility of paperwork is handed over to another member of upper management, then that staff person is “overburdened” as well. At this level, if any of these responsibilities are not met, this can create a precarious situation for the production line. The whole purpose of manufacturing is to make windows. Anything that interferes with producing windows is a detriment to the business. The extra time need for NFRC certification will not make production run smoother and is viewed as defeating the essential purpose of the business. This line of thought is particularly prominent among manufacturers with limited resources and cash flow. A slow or shut down of any time may indeed exhaust any reserve they may have.

Conversely, navigating the PCP may be given to someone with ample time but inadequate understanding across several aspects of the manufacturing operation. A person who has excellent organizational skills may lack the necessary technical knowledge to complete the task. Thus an investment in training would need to be made. This is where the equation "time = money" comes into play. Is it worth paying for the extra time it will take for someone to learn the technical aspects or for the increased time needed to update regularly? Unless certification is driven by a regulation date, the NFRC certification time line inevitably slows down as companies grapple with the responsibility questions.

3.4 Technology /Implementation to address regulation

The use of NFRC ratings in regulatory affairs rarely happens in a vacuum. They are often coupled with the desire by regulators to achieve some level of window performance. Unfortunately, manufacturers often ‘shoot the messenger,’ ascribing their regulatory woes to NFRC itself. Manufacturers reported three to one that they were forced into NFRC by regulations of either building codes or ENERGY STAR (see Section 3.4.6).

3.4.1 Technology Research

We live in a world where technology is changing at such a drastic rate that it is frequently necessary to have a person in the company assigned to keep abreast of these new innovations. A small company may not have the

manpower available to devote a person on this task. Few small manufacturers have the resources necessary to support research activities and therefore do not wish to show just how far behind the industry leaders their products actually are. At times, it is easier to say “we've made our windows the same way for years and it's worked for us so far.”

Certification needs are exacerbated by the fact that companies are forced to not only prove (through certification) that their products meet performance targets, but also to develop or adapt products to meet the performance target (at the same time as their competitor).

3.4.2 Design considerations and the dominance of vinyl

Regulators often assume that a manufacturer merely needs to certify what already exists in order to meet the desired level of performance. Yet, Ducker reports that only forty-one percent of the window market meets efficient window criteria. The next assumption is that it is a simple matter to adopt a new-to-the-company, but used-by-other-manufacturers technology. While the technologies used today have been around for some time, their implementation will vary with a company's individual practices.

However, the testing and certification process forces the manufacturer to look at products in a critical way, giving rise to changes in design. Sometimes the certification process can point out places where a window design can be improved. A frequent case is gap width. A 1/2 inch is optimal and is often reflected in sought-after performance levels. Many insulated glass units are only 1/4 or 5/8 inches. Manufacturers are left wondering why their products aren't getting the numbers they expect. Grumbling ensues, especially because this is a design issue, necessitating at the very least changes in dies.

Once again, a barrier arises. Why spend a significant part of the profits to label an inferior product? This may lead to more delays as the company rethinks strategy. Do they change the current product or do they implement new products from scratch? The time necessary to make adjustments so a window meets the specifications required for meeting certification is another factor in the expense equation.

This may explain the increasing market penetration of vinyl products. With wood and metal lineals, manufacturers are responsible for engineering their own design and improvements. With vinyl lineals, they purchase complete framing systems from suppliers. Then the manufacturer only has to fabricate the product, since most engineering has already been done by the supplier. Vinyl windows have a distinct NFRC advantage because most systems have already been tested. Vinyl is an extremely efficient window technology that meets most residential building codes and voluntary programs. Vinyl suppliers can not only tell their manufacturing customers how the window will perform, they can also

save them thousands of dollars by reissuing NFRC test reports on their behalf. We also understand that the profit margin on vinyl windows can be greater than other materials.

Such changes that may seem minuscule to outsiders may take months to implement. Such changes can snowball through the manufacturing process. What starts out as a discussion of how to NFRC certify may turn into a plan to add a vinyl product line. As mentioned above, manufacturers do not compartmentalize these costs when telling market transformers that NFRC is expensive. They have an innate sense of how complicated changes can be and therefore a sense for the cost range that such activity will cost, inspiring apprehensiveness toward change.

3.4.3 Sputter coat Low E

Sputter coat Low E glass deserves its own discussion because its use is surrounded by many rumors and misinformation. Ducker indicates that there has been a marked shift to soft coat Low E products. Adoption of sputter coat Low E glass requires significant thought about an individual company's production processes and manufacturing choices. Inevitably, the first cost is higher for companies that manufacturer their own insulating glass (IG) units. Although the glass costs are comparable to other types of specialty glazing, first costs to handle the delicate coatings can be formidable. Small companies need to decide if they wish to invest in building additional work areas, like a station for edge deletion and a special sealing chamber, for this delicate technology. Additionally, the handling time may also be affected, since the glass has to be adequately packaged before use. Such handling can affect how many units may be produced per day until the company codifies new procedures. Also, closer attention to detail is required during the manufacture to ensure durability and product performance.

Yet, once a company completes the transition to sputter-coat Low E, they seem to be unfazed. They often say "it turned out to be no big deal." This indicates the real barrier to sputter-coat Low E is lack of information on what to expect and how to transition to this energy efficient technology.

3.4.4 Workforce training

The cost to implement the design changes on the production line means workforce training. This training will take time, which can slow production. We believe it will not be instantaneous, as we do not think that management would shut-down a production line for training time. Rather, it will take place incrementally, to ensure production stability.

The issue of maintenance must also be addressed in manpower. Wide scale changes to a line must be maintained, so old ways are not resumed. Giving training about the company's new outlook will be wasted if the procedures are not followed up in proper manner. The establishment of a quality assurance system needed for NFRC Certification can be a huge

expense but one that may improve the overall product, proving valuable over time.

3.4.5 Cost of Failure

When discussing the cost issues of changing/implementing technology, one must address the reality of what happens when these changes are implemented and a) the product fails to meet the standards for certification or warranty or b) not enough of the product is sold. The cost in manpower and technology when making these changes must be recouped in some way so that it will not inhibit the bottom line and decrease profits. It is good business sense to have a cushion in the company budget in order to allow for catastrophic events that may inhibit the sale of one's product, but it is a reasonable fear that a company spends the capital for NFRC certification for an unmarketable product because it does not meet code or ENERGY STAR performance levels (see Section 3.4).

Many manufacturers decide to wait until they have completed this manufacturing transition before embarking on NFRC certification, especially if they are early adopters in their markets. If they obtain their NFRC simulation and test reports on a prototype window, they may find they have a violation even before they have completed their first certification because the plant systems do not meet the inspection criteria. They may also seek to delay any costs possible especially if NFRC testing is not mandatory in code.

3.4.6 ENERGY STAR

ENERGY STAR is another topic that deserves its own discussion. As highly successful market transformation program, it sets the bar above code for a variety of products. The design choices that manufacturers make for code compliant products may not be the same as for ENERGY STAR. Yet ENERY STAR often forecasts future code requirements. In the past five years, many code proposals, both on a national and state level, have cited ENERY STAR as the precedent for setting appropriate code compliance values. This essentially turns voluntary criteria into a mandatory one. Moreover, it inherently moves the market because it forces ENERGY STAR to re-evaluate its criteria because it is no longer an above-code program. This loop adds to the resentment by manufacturers who struggled to meet the original ENERGY STAR criteria.

3.5 Overall costs to small manufacturers

As mentioned earlier, by far the biggest issue raised by manufacturers was cost. Section 3.2.2 discusses the hard costs of certification that are the easiest to obtain, because laboratory prices list and NFRC fees are publicly available. Perhaps surprisingly, these are the lowest costs associated with the market transformation to efficient windows.

Overall soft costs have been very difficult to ascertain. One manufacturer indicated a $15K equipment cost in addition to certification costs. Another manufacturer indicated that sufficient changes would cost $100K including certification, labor, equipment and construction costs. Only one manufacturer we spoke was willing to provide us with a per window cost for the whole transition: $12-15 per window. If we recall Section 3.2.2, these costs easily exceed the profit margins for many small companies.

Understanding these costs has provided insight into manufacturer reactions to regulatory activities. If requirements are enacted too quickly, manufacturers may not be able to obtain capital to make the transition and will be left with an un-sellable product. If the company does not have healthy credit, time may not matter at all.

3.6 Lack of Return on Investment

One surprising comment occurred again and again in our discussions. Manufacturers continually stated that there was little or no return on investment for NFRC certification. While regulators may think of market transformation success over several years, businesses evaluate results every three months (that is, quarterly). Taking into account the above-mentioned costs, manufacturers expect sizeable returns. If results cannot be shown in one to two quarters, manufacturers do not think of the change as a worthwhile risk.

3.6.1 Demand as a function of profit

During market transformation discussions, small manufacturers often act like they expect that NFRC certification will increase profits-in essence, pay for itself. With the above understanding of their costs, their attitude is surely understandable. To companies with tight budgets, a few thousand dollars for testing may be very difficult to recoup in a timely fashion. The leveling of the industry playing field that comes with NFRC certification does not always increase profits in a time frame acceptable to their business model. Further, certification fees are not investments that provide the company some sort of tangible equity that can be amortized over the four years that they are valid. Their payment is a first cost that can not be delayed and thus finding such capital in the budget is a barrier to implementation.

3.6.2 Lack of Enforcement

Few companies can justify tying up such a large portion of profits on a voluntary program. There is slightly more justification for a mandatory regulation, but responsible manufacturers always voice serious concerns that all of their competitors will be facing similar requirements. Too often, they report that they have taken the financial steps to transition to NFRC certification and subsequent regulatory requirements, only to watch the market rewards their competition for non-compliance because there is not sufficient follow through on enforcement or market demand. Small

manufacturers gauge just how serious their markets are for transformation. One manufacturer undertook certification in preparation for a tax credit that ultimately died in the legislature. In effect, he was punished for being prepared and still has not recouped his transition investment.

3.6.3 Marketability

Regulators often argue that there is more marketability and more profit per unit available for certified products, offering up examples of other companies that successfully market energy efficiency. However, marketing is extremely individualized across companies. Many smaller companies do more 'sales' than marketing. They may view the need to actively market NFRC certification as an additional cost since marketing may not already exist in their business model. Furthermore, they may not have viable resources to pay both certification and marketing. Lastly, the absence of a label can allow the sales staff to perhaps make the window out to be more efficient than it actually is, the very behavior NFRC was created to reduce.

3.6.4 Reduction of legal liability

Small businesses are seldom aware of the truth in advertising risks the fenestration industry has coped with in the past. Even if they are, they may not take those risks seriously. They tend to think that they are too small to be considered by federal enforcement authorities such as the Federal Trade Commission or local ones such as building departments. Therefore this audience does not assign benefit to NFRC certification as a protection measure against potential future litigation in the case of an honest mistake in manufacturing. The lack of preparation for legal proceedings can be deadly for any small business on any subject. One small Florida-based manufacturer, which had been gathering resources to undertake NFRC certification, actually did go out of business in 2004 because of a $150,000 installation lawsuit.

4. RECOMMENDATIONS TO ADDRESS BARRIERS

In the course of this paper, we have identified many intersecting dynamics that set up a vicious cycle of barriers to implementing NFRC. At least half of them fall into a manufacturer's realm of responsibility. For example, each manufacturer has a unique way of storing glass. It would be inappropriate to make recommendations on how to optimize storage, even though this is a soft cost that can be a barrier to implementation. Consequently we have not made any recommendations regarding internal company barriers to NFRC certification, respecting the old adage "Your business is your business."

We can, however, make recommendations on how to facilitate external barriers. It is arguable that these recommendations require facilitation by a third-party like EWC who understands the NFRC process and window industry but without a financial self interest.

4.1 Clarify the NFRC certification program

The understanding needed to discern what is required in the Product Certification Program (PCP) guidelines can be equated to "the study of rocket science." Or at least that's the way many new initiates think when they receive the first set of NFRC documents or attend a meeting. One interviewee summed it up best: "How about 'PCP for Dummies'?"

By the very nature of what is required, the NFRC documents are very technical. This necessary level of detail can be very intimidating to even the most knowledgeable professional. So the learning curve takes time as well as just getting past the intimidation stage. Numerous attempts have been made, both by NFRC and private entities, to provide clear directions for manufacturers embarking on the process. Apparently, these efforts have been unsuccessful, according to the number of responses regarding the complexity of the NFRC process. All effort should continue by NFRC and others to make the certification system easier to understand and navigate.

4.2 Provide adequate training to regulators on the challenges facing manufacturers when implementing a new technology

As this paper illustrates, NFRC certification currently is quite complex. Meeting performance criteria is even more so. However, these challenges are not insurmountable and most can be overcome with time and planning.

Timing is perhaps the most important factor that regulators should address in transformation efforts. Interviewees report that two years is a reasonable implementation period when a manufacturer has to include a technology update along with NFRC certification. Market transformers need to work with manufacturers on realistic regulation implementation dates as well as sunset dates for older regulations. It will be extremely important to hold these negotiated dates. Those companies that adequately prepare for transformation need to realize a return on their investment, especially one that consumes so many resources. Few things frustrate manufacturers more than watching their competition garner

'rewards' for inaction. Interviewees conveyed much frustration at the expense spent on NFRC, only to have implementation dates delayed, denied or not enforced. Unfortunately, NFRC as an organization becomes the focus for all the problems in the system, even if it has not created the circumstance at all.

Training will also allow regulators to ensure that uniform implementation information is disseminated as well as to identify regional quirks to be addressed. They should consider working with economic development agencies to provide fiscal or marketing support to local companies as they make the transition to keep them economically viable.

4.3 Create and coordinate regional marketing efforts

The definition of marketing is the process or technique of promoting, selling, and distributing a product or service. What is lost in this definition is that marketing needs to have a broad basis to be successful. The sum of individual activities will certainly be greater than the influence of only one activity. Once again, there will be costs involved, but they should be born by several entities in the market transformation circle. Resources can be maximized by targeting key market transformation areas, especially in tandem with regulatory changes, like code implementations.

4.3.1 Support for small manufacturer marketing

For many small window manufacturers, this idea of promotion is at times a secondary idea. The task of getting the product out and meeting current contracts can overshadow the need to generate future business. But a key to a company's growth is in how well they get the company's name out into the market. Given small manufacturer's desire to see a return on investment, the manufacturer should take some role in promoting some feature of their new product. However, small manufacturers also need support to develop pertinent and appropriate marketing. They will not have a media budget to expend on a successful campaign, but may be able to contribute to a larger effort, especially if there is a way to customize materials for their own products. Cooperative advertisement and marketing has proven successful in the Northwest and should be explored as an essential part of the market transformation effort elsewhere.

4.3.2 Increased enforcement through market pull (otherwise known as "No company left behind")

The Ducker statistic of 81% NFRC participation begs the question of why resources should be allocated for a minority. However, another Ducker statistic needs to be addressed here. Only 41% of windows sold are classified as efficient. Clearly, there is more work to be done to move the overall market. Luckily, we believe, a media campaign helps support both needs.

Regulators should plan a media campaign on the market transformation independent of manufacturers. There is a certain legitimacy that comes

from a media campaign, especially when sponsored by a government or non-profit agency. It will accomplish several objectives across many audiences. It can create a buzz among consumers that will drive interest. This can be particularly powerful and pertinent with the rising costs of heating and cooling. Moreover, it can move the larger goal forward: the implementation of efficient windows.

For manufacturers, it will reinforce the idea that the change is "for real"; will not be a waste of time and money. Recalcitrant manufacturers may be inspired to join or risk being left behind. Small manufacturers gauge trends by how many consumer inquiries are received. "Media buzz" can certainly foster transformation, establishing positive benefits in the minds of consumers and supporting sales staff. ALL manufacturers will benefit from this type of marketing to support the market transformation to efficient windows.

EWC should coordinate more closely with market transformation organizations such the Responsible Energy Codes Alliance (RECA), the Building Codes Assistance Project (BCAP), ENERGY STAR, the National Association of State Energy Officials (NASEO), The Ad Council and regional energy efficiency organization to identify potential market transformation areas. EWC has often provided and should continue to provide support for regional marketing efforts through media support and organizing events.

4.3.3 Increased enforcement through education

Manufacturers often voice concerns that building officials know about upcoming code changes. Every effort should be made to support code training for building officials on the importance of NFRC certification as well as how to identify compliant windows. Enforcement entities should be targeted not only for in-depth training, but also for directed media campaign to reinforce the importance of their role in the process.

4.4 Adjust cost structure for certification.

Currently, NFRC offers a small business program for manufacturers with gross sales of $1M or less. We suggest raising that cap to $5M, possibly as high as 10% of the market leader's sales.

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ALLIANCE TO
SAVE ENERGY
Creating an Energy-Efficient World

The Challenges to Increased Use of Energy-Efficient Windows in Low-Income Housing

A Strategy Report by the Alliance to Save Energy

Prepared By
Lisa Surprenant
Kelly Shall
Nils Petermann

THE CHALLENGES TO INCREASED USE OF ENERGY-EFFICIENT WINDOWS IN LOW-INCOME HOUSING

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Lisa Surprenant, Alliance to Save Energy
Kelly Shall, Alliance to Save Energy
Nils Petermann, Alliance to Save Energy

ABSTRACT

Homeowners in the US spend over $160 billion a year just on heating, cooling, and lighting their homes. This represents about 21% of the nation's total energy expenditures and constitutes significant demands for electricity and natural gas. If left unchecked, this consumption is expected to rise to a cost of $200 billion by 2015, expending even more of the nation's resources. [1] The Office of Housing and Urban Development (HUD), the Department of Energy (DOE), and the Environmental Protection Agency (EPA) have partnered to create programs and policies aimed at reducing home energy use. One of their top priorities is energy efficiency in low-income housing. The newly announced ***Partnership for Home Energy Efficiency*** advocates increased adoption of ENERGY STAR products in low-income homes.

There are many reasons for the interest in energy efficiency in low-income housing. On the one hand, HUD, DOE, and EPA estimate that low-income households could save 20 to 30 percent of their energy bills through cost-effective improvements like envelope enhancements from insulation, air sealants, and high-efficiency windows.[2] Not only would these energy efficiency improvements impact homeowners, but they would reduce HUD's estimated annual utility bill of $4 billion for the approximately 5 million units of affordable housing provided throughout the country.[3] In addition, 10 percent of HUD's budget of 1.1 billion dollars goes to operating grants for public housing authorities, housing assistance payments, or utility allowances to renters. These could be re-directed to other programs if freed up through energy efficiency improvements.

Energy efficiency through weatherization represents an opportunity for Section 8 (assisted) housing as well. Section 8 states that local governments may enter into contracts with landlords whose buildings are used primarily for government-assisted housing. HUD provides a utility allowance to the landlords, which greatly contributes to the 10 percent of HUD's budget distributed for public housing (as mentioned above). This allowance sufficiently covers the energy costs for Section 8 landlords. These landlords pay the utility bills and are reimbursed by HUD.[4] In Section 8 cases, landlords are the decision-makers and the secondary stakeholders for weatherization efforts, but since they are reimbursed for utility bills, they lack incentives to initiate such efforts.

Many low income and subsidized housing programs could reap savings of an estimated 30 percent through "weatherization" programs and public housing energy programs. However, the implementing agencies contend there are economic, institutional, and practical obstacles that

[1] Data from: HUD, DOE, USEPA et al, "Partnerships for Home Energy Efficiency", Washington, DC. 2005.
[2] Ibid.
[3] Ibid.
[4] Ibid.

continue to prevent low-income families from pursuing energy efficiency strategies like better windows. DOE, HUD, and EPA have undertaken joint initiatives to overcome these remaining obstacles to increased energy efficiency.

Yet, to-date, these programs have been only marginally successful. Why? What prevents low-income and subsidized housing from being truly energy-efficient? And where does blame lie for continuation of these barriers? This paper aims to develop new methods for the adoption of energy-efficient windows and suggests ways to increase market penetration by exploring how some energy efficiency technologies and approaches are diffused in the low-income market. It explores how various actors and their motivators have affected the penetration of energy-efficient windows into the existing building stock of low-income and subsidized housing — looking primarily at single-family weatherization programs as a gauge. And it will propose a comprehensive, holistic approach to effecting changes in the operating patterns of this sector's key stakeholders vis-à-vis windows. The paper will conclude with an outline of the program components required to overcome the barriers presently preventing widespread use of energy-efficient windows in the low-income housing stock that is serviced through weatherization programs.

The findings of this paper are based on conversations with several implementers of weatherization programs, mainly during June and July 2005, as well as on printed and electronic resources, listed at the end of the paper.

SECTION 1: SETTING THE STAGE FOR THE PROGRAM

Background

As early as 1992, researchers began to evaluate the barriers to energy-efficient buildings.[5] They found that these barriers existed because of the diversity of stakeholders involved in the process of building design and construction. As Figure 1 shows, each primary decision-maker plays an important role in the market adoption of energy-efficient windows and yet, each face challenges in increasing their adoption of efficient windows.

Figure 1 Primary Decision Makers in Buildings

Primary decision maker	Challenges they face	What is needed
Developers/Architects	Lack of information, lack of research hours	Information and billable hours
Builders	Competition in price, features, quality	Information about features and quality (particularly as windows relate to AC systems) Funding support for pricing and competitiveness (which can be translated into incentives like reduced entitlement time)
Home Owners	Lenders know little about run costs	Information to present to lenders
	Home owners care about energy costs but lack information	Cost needs to reflect externalities Information illustrating increasing energy costs over time and case studies illustrating cost-effectiveness and payback of EE windows
	Home owners will trade energy-efficient windows for some other feature of the home	Energy efficiency must be treated better than energy supply Information demonstrating that energy-efficient windows increase property value as much as aesthetic features do

Homeowners of existing homes, for example, may care about energy cost but do not often understand how to decrease it. They may be willing to trade energy-efficient windows for upgrades to some other feature of their house. In new construction, home buyers tend to look at aesthetics, function, and cost in their purchases of things such as energy-efficient windows[6], but in existing homes, homeowners tend to rely on *weatherization* experts to help rank-order the decisions on what to do next. And the experts in low-income weatherization programs expressed some of the strongest opinions about the real barriers to increased use of energy-efficient windows in existing homes.

[5] E-Source. *Energy Efficient Buildings: Institutional Barriers and Opportunities.* Boulder Colorado, 1992.
[6] Conversation with Micah Mumford, Inland Pacific Builders, Inc. June 9, 2005.

One barrier mentioned was that if energy costs are paid by HUD (in assisted housing, for example), the landlords are not concerned with rising costs and therefore do not feel the need to introduce energy-efficient retrofits in their buildings. As long as residents do not have the influence to make these changes occur (or do not feel the need to cut energy use because they do not pay utilities) and as long as landlords do not pay for rising energy costs, increased use of technologies like energy-efficient windows remains difficult. HUD recognizes this problem and held several symposiums during 2005 that aimed at educating landlords on the benefits of energy efficiency[7]. The symposiums emphasized that money not used on utility bills (though not to be taken as landlord profit) can be used by landlords to make weatherization improvements. However, in order to start any weatherization investments, money would have to be made available first.

UNDERSTANDING THE BARRIERS TO MARKET PENETRATION

The Motivators of Low-Income Housing Specialists versus the Homeowners

Differing (and sometimes competing) motivators are the subtlest barriers facing energy-efficient homes. Differing motivators occur when the needs, goals, or desired outcomes of one specialist are at odds with (or overshadow) those of another specialist. For example, an architect may be considering the aesthetics of a building component (or its energy performance), while the builder – who must order and oversee materials installation – may be concerned primarily with delivery lead-times, budget ramifications, and the availability of a competent installer. How the material looks or performs is *not* the contractor's **primary** concern. One of the best accounts of differing motivators was written by the Rocky Mountain Institute in a graphic first presented in the early 1990s, although it has been revised over time (see Figure 2 below).[8]

[7] Discussion with HUD representative on June 30, 2005
[8] Additional boxes of "specialists" and "performance measurements" were added by Surprenant Mar 2005.

Figure 2 Building Specialists and Their Performance Objectives

Specialist	Performance Measurement or Objective
Architect	Aesthetics/performance
Glass and glazing manufacturers	Materials cost/performance
Window component manufacturers	Cost
Window manufacturers	Cost
Window distributors, dealers, reps	Sales and margins
Window specifiers	Tables and modifications
Purchasing agents	Cost
Buyers (i.e., builders)	Dollars per square foot
Buyers (i.e., homeowners)	Cost/aesthetics/comfort
Developers	Dollars per square foot
Investor	Risk-reward ratio ROI
Asset manger	Net operating income
Contractor	Budget and schedule
Construction worker	Sign-off/ease of installation
Construction manager	Critical path/specification adherence
State and local inspectors and code authorities	Code section compliance
Industry trade groups	Project synergies/lobbying for issues
Utility and DSM programs	Avoided peak kW; saved kWh
Loan program	Net operating income

In Figure 2, for example, a purchasing agent (for the purposes of this discussion, considered the *implementing agent of the weatherization program*) has a main objective (as highlighted) of *"cost,"* meaning the actual cost of the window, without considering profit margins. However, the homeowners' main objectives are likely to be comfort-aesthetics-cost, in that order. (This is because "cost" is overcome through the subsidized program and comfort has driven the decision to request weatherization). Therefore, "comfort" (meaning, prevention of cold or heat entering the home) is the main concern, as reported by the experts[9]. Given that these weatherization experts must weigh all the factors and determine on which options to expend their modest budgets, window replacement may not often be feasible. Limited budgets present one of the most significant barriers to increased market penetration.

MARKET FORCES ACTING ON LOW-INCOME HOUSING SPECIALISTS

Barrier 1: Limited Budgets

The market forces acting on entities like Sunset Park Redevelopment Committee, Inc. (SPRC) in Brooklyn, New York, revolve around the $1,600 per unit (meaning, per family home) allowance for all energy efficiency upgrades. The upgrades might include a strong case for insulation, boiler upgrades or tune-ups, pipe insulation, and building sealing. In the case of a test-house case visited during July 2005 (which is 75 years old), the unit also required sealing a 2'x 3' hole

[9] Conversation with James Crew et al, Weatherization Program of Sunset Park Redevelopment Committee, Inc., Brooklyn, New York. July 12, 2005.

that vented from the first floor into the attic air space, creating a chimney ***stack-effect***, which means that the difference in pressure between the indoor and outdoor air drew both heat and cooling from the home year-round.

Barrier 2: Internalized Labor Costs

From a strictly functional standpoint, weatherization programs like that operated by Sunset Park Redevelopment Committee (SPRC) must internalize all their labor costs (id est, they must *'do it themselves'* to keep costs down), and as a consequence, they tend to select **only** those energy efficiency retrofit items without which the occupants would suffer. In the test-home being audited, the SPRC experts chose a series of features that included retrofit of only one window which was presently wood-framed, single-pane, and poorly-sealed. There were other windows that could have been replaced, but for which the budget did not allow. SPRC selects the "worst offenders" in cases like this, and replaces only those windows.

Barrier 3: Window Manufacturers' Representations

At a "cost-to-the program" of $168 per window (installed), weatherization experts like those at SPRC confess that they must accept at face-value the manufacturers' claims that the windows perform to the exact specification and standards that the weatherization or low-income program (and the law) requires. After some probing, the weatherization experts admitted some reluctance about the veracity of the testing. *"Sometimes we wonder if the labels and specs of these windows are true. But given that we have the piece of paper to prove our due diligence in the matter, we accept the window's claims since we **need** that window and we need it **cheap**. After all, a bad window by today's standards is going to be better than an old window of 70-something years ago."*

Barrier 4: Installation Tactics

Weatherization experts also stated that leakage around the windows was often worse than the poor quality of the window glazing or framing. In fact, they claimed that they spend a good deal of their limited budgets on air-sealing the perimeters of poorly-installed (or just aged) windows.

FINANCE FORCES ACTING ON LOW-INCOME HOUSING SPECIALISTS

Barrier 5: Prescribed Savings Investment Rates

The financial calculations used by DOE's many implementers of Weatherization Assistance Program (WAP) are based on achieving an SIR (savings investment rate) greater than "1" in order for an item to be considered as a viable energy efficiency retrofit.

Very often, windows show only a modest SIR (approximately 1.1) whereas an item like insulation may show an SIR of 23[10]. An SIR of 1 is not very persuasive if compared with the list of contenders for items to retrofit under weatherization programs that ranges from hot water-based heating to lighting.

[10] Ibid.

Barrier 6: Existing Home Hazards

To make matters worse, in older homes, the retrofit costs for windows are increased by the presence of bio-hazards like lead-based paint and asbestos-based wall materials. In a typical window retrofit in New York, for example, the regulations regarding local lead laws state that lead containment must be undertaken using shrouds and HEPA-filtered vacuums and must include testing costs. The lead laws clearly mandate a minimum of three "wipes" per window to prove containment. Containment in this case would add $75 to the cost of each window, the weatherization experts claim[11], plus an additional $85 for "wipes" and testing. That means a window costing $168 (installed) would actually increase in installed cost to $328, or roughly a fifth of the **entire home energy efficiency retrofit budget**—for that single window. So it is easy to see that implementers of the weatherization and energy efficiency programs are forced to make some very tough decisions when dealing with lead or asbestos issues.

Barrier 7: Regional Cost Differentials

Another issue cited by weatherization program implementers is the broad range of variations in construction, materials, and installation costs in different parts of the country—variations which the program does not consider. For example, the experts of SPRC claim that DOE's Weatherization Assistance Program (WAP) receives funding for work within the city of New York equal to the amount given to areas upstate where construction costs are substantially lower. Effectively, this means that clients of weatherization programs in New York City "get less" than do residents of upstate towns.

SECTION II: BUILDING THE PROGRAM

WORKING WITH HUD'S ACTION PLAN

HUD's ***Action Plan for Energy-Efficient Homes for the 21st Century*** calls for a comprehensive strategy to address the cost of energy and promote energy efficiency in HUD-assisted, financed, or subsidized housing. HUD's goal is to capture a 5 percent savings, yielding $2 billion over the next ten years.

Given this goal and plan, Action 2 (under the heading of "strengthening interagency partnerships") suggests that HUD and DOE initiate joint multifamily weatherization partnerships in at least five states. The background research gained in this paper would suggest that before multiplying the program scale, problems (Barriers 1-7 above) with the current program be addressed.

Some of the most urgent problems are:

1. In order for the program implementers to apply energy efficiency in low-income housing units, the implementers must internalize what ought to be externalized costs (such as labor, construction, installation of energy efficiency measures or equipment).

[11] Ibid.

2. Building envelope issues are considered under the same program funding as mechanical systems upgrades. Yet the low SIR shown on most window calculations makes the retrofit of windows appear sub-optimal in cases wherein a retrofit *ought to be done* to ensure both building performance as well as occupant safety, health, and comfort.

3. The WAP program mandates that implementers use the ***"best priced best performance"*** criteria for windows, which means implementers may be forced to accept what might be spurious window credentials or testing certifications.

4. In buildings of the type found in Brooklyn, New York, common attic space is often shared and stretches the length of the block, effectively joining all these buildings as one. This represents a significant fire hazard that impacts the ability of a home to be energy-efficient since it disallows an air-seal of the building envelope. The actual cost of properly air-sealing one attic from another must be weighed by implementers against the myriad of other things they hope to do in the home. In the end, many opt to treat the attic (and often the basements) as areas isolated from the rest of the building envelope, and thus air-seal only the actual living space of the occupants.

5. Another oddity in the single-family homes is the conflicting requirements of different departments. The Fire Department requires that the home be air tight while the safety inspectors demand the home be ventilated in the presence of boilers. The effect may be that, to overcome this, implementers first ventilate the boiler area and get approved by the safety inspectors, only to then seal it up tightly and call for the fire department inspection.

Implementers should also consider these factors:

6. Sealing the perimeter framing around windows is often more of an issue than window replacement. As the director of the New York SPRC Weatherization program[12] said, *"Windows don't make the difference. Sometimes there's a 200 cfm drop due to the windows, but if you insulate around the windows, the drop recedes. That means that the drop can be due to lack of insulation or air sealing at the window installation point, not due to the windows themselves."*

7. Implementers often find situations in which there are more windows on the outside of the building than are visible on the interior[13]. This means that some windows have been sheet-rocked over, and concealed from the inside of the living space. Some experts reportedly have found windows that have been concealed behind sheet-rock yet were left in the open position—which means that the windows allow air infiltration into the building with no way for occupants to close the window!

[12] Ibid.
[13] Ibid.

In multi-family units the problems multiply:

8. Windows also used as fire escapes must be of a certain size. In old tenements, each window must be specially-built for each rough opening, none of which are standard, and none of which are of the same dimension. All three of these factors increase the cost of the windows. If there is lead-paint or asbestos present (as previously discussed) the cost of the retrofit increases even more.

9. For high-rise buildings, the regulations under DOE's Assisted Multifamily Program (AMP), administered through NYSERDA, nearly ensure that "urban renewal" will not occur in these buildings. For example, in a building of 53 units, 27 of them must qualify as low-income or the program will not apply to that building. (The AMP program will not cover lead abatement costs since it is not energy-saving, only health and safety-related. Health and safety measures do not have an SIR).

10. For high-rise high-density housing of the type found in many inner cities, the windows are often specified using "Master Specs", which specify very little in the way of windows. (The advent of the Master Specs system allowed architects to proceed without thinking deeply about windows, and so, instead of being *specific* the specifications for windows became generic and all-inclusive). Where specific tests are called for, says one manufacturer[14], both structural and thermal testing can allow PVC-framed windows to be tested with or without metal reinforcements. Metal reinforcements are often necessary for the higher design pressures required for structural stability in high-rise building, but yield higher thermal U-factors because the metal forms thermal bridges. Test results without the metal reinforcements yield more efficient results. Yet often in practice, when that same window is prepared for installation, it has the metal reinforcement in the cavity with a less energy-efficient field performance. Therefore, some experts[15] suggest that more education is needed to cross check structural and thermal testing and labeling to reduce this type of 'gaming' between these important requirements.

11. Probably the greatest barrier to widespread adoption of energy-efficient windows in the low-income housing market is a lack of awareness about the program itself. As the marketing manager for WAP[16] said, *"Can you imagine what would happen if we announced publicly that we have $1,600 available for each low-income homeowner to upgrade their house to be energy-efficient? The program would have to multiply its money a thousand-fold!"* Clearly, there isn't enough money in the program.

12. Lastly, the minimal funding for the program ($1,600 per unit) forces implementers (who want to do the best job for the least money on behalf of their clients) to internalize costs and agree to **not publicize** the program (thereby being reliant on word-of-mouth or walk-

[14] Conversation with New York-based window manufacturer, July 10, 2005.
[15] Ibid. Based on informal EWC staff conversations with inspection agencies, sales representatives and field observances.
[16] Ibid.

ins) or else they will be inundated with calls for which they have neither the funding nor the manpower to answer.

MARKET TRANSFORMATION PLAN FOR ENERGY-EFFICIENT WINDOWS IN LOW-INCOME HOUSING

Without a comprehensive plan to make sensible and obvious strategies like energy-efficient windows the norm in all low-income homes, energy-efficient windows will not capture a large market share in this sector. It is imperative to take a fresh look at market transformation by studying what has succeeded before. In many years of experience implementing projects worldwide, development agencies[17] have collected effective practice principles for achieving market transformation.

Eight central principles are:

1. Target supply and demand sides of the market
2. Take a holistic view of the market by examining all stages of the supply and demand chain
3. Leverage competitive market forces
4. Build flexibility into the program design
5. Consider which vehicles are best suited for technical assistance and know-how transfer
6. Emphasize standards, labeling, and building codes
7. Allocate a portion of the program dollars for replication and the dissemination of results
8. Begin monitoring and evaluation early, to measure pre-program baselines

If practiced, these principles can increase the market penetration of energy-efficient windows in low-income programs like weatherization.

SECTION III. SUGGESTED PROGRAM ELEMENTS FOR LOW-INCOME PROGRAM IMPLEMENTERS

To create a successful market for energy-efficient windows through the avenue of low-income weatherization implementers, some of the tried-and-true principles of market transformation will have to be utilized. Various program elements (on both the supply and demand sides of the equation) are listed below, under the appropriate principle.

Principle 1. Target Supply and Demand Sides of the Market

The first principle recommends targeting the supply and the demand sides of the market simultaneously and thoroughly. For energy-efficient windows, that means understanding precisely how each intervention fits with each entity in the supply and demand chain. Figure 3 illustrates the general categories of activities that could comprise a market transformation

[17] Such as the World Bank, USAID, and UNDP

program, according to whether they constitute demand-side or supply-side activities. It also shows (in highlighted areas) where low-income weatherization implementers fit within the demand and supply sides of the market transformation equation for energy-efficient windows.

Figure 3 Supply and Demand Sides to Be Addressed in the Windows Market

SUPPLY SIDE	DEMAND SIDE
Technical Assistance to Architects	Technical Assistance to Architects
Technical Assistance to Manufacturers	Technical Assistance to Builders
Technical Assistance to Builders	Technical Assistance to Consumers
Support to Architects	Use of EE Products by Consumers
Support to Manufacturers	Use of EE Products by Builders
Support to Builders	Use of Consumer Incentives for Windows
Development of Window Product Standards & Testing	Use of Architects Incentives for Windows
Development of Window Product Labeling	Use of Builders Incentives for Windows
Program Monitoring and Evaluation of Market Transformation	Monitoring and Evaluation of Market Transformation

Innovative glazing technologies can reach high market penetration levels in a relatively short amount of time provided there is a demand-pull. The demand-pull will not be felt unless specific initiatives deal with barriers such as those previously described.

The key initiatives for low-income housing weatherization implementers, given the conclusions drawn in this paper and the real-world study of market transformation programs are:

- Supply side support to implementers
- Supply side development of sensible real-world situation testing and labeling
- Supply side monitoring and evaluation to track results
- Demand side use of consumer incentives for energy-efficient windows
- Demand side information to architects on how to specify an energy-efficient window
- Demand side use of installer incentives, giving them credits for using better windows
- Demand side monitoring and evaluation of energy-efficient windows programs

Principle 2. Take a Holistic View

A myriad of stakeholders are engaged in the windows industry. Consider that the primary players in the residential windows market are a diverse group of glass and glazing manufacturers (including float glass and plastics, glazing coaters, assemblers); window component manufacturers (vinyl and aluminum extruders, wood); window manufacturers who assemble finished windows out of glass and other components, window distributors (including independent dealers and sales reps); window specifiers or purchasing agents like architects, contractors, or home builders; and window buyers like spec homebuilders, homeowners, and rental owners.

Other stakeholders are state and local building code and enforcement agencies; industry trade groups and organizations; utility and DSM programs; and loan programs for residential new construction or retrofit. The various actors and their differing ***motivators*** significantly affect the market penetration of energy-efficient products like windows. To increase the adoption of these technologies, a holistic view of each set of actors involved in the decision-making must be undertaken and that view must hone-in on the objectives of each actor. A clear understanding of the "risks" to these actors must also be gained and a comprehensive strategy to effect changes in the stakeholder operating patterns must be devised.

The principle (taking a holistic view of the market by examining the various stages of the supply and demand chain that relate specifically to builders) has been taken through this cursory study of low-income weatherization program implementers' needs, barriers, and suggestions. Often, however, the program design is governed by (or contains) elements with which program designers feel most confident, or with which they have prior experience. This may explain the plethora of information for new homeowners and architects (who are not the key decision-makers for the technical implementation of home weatherization) and little information to those who retrofit old homes. The latter tends to prevent innovation in program design while the former prevents taking a holistic view.

Ultimately, in order to increase the use of energy-efficient windows in the residential market the program will need to be broadened to encompass not just low-income weatherization experts, but also encompass the manufacturers and the entire retrofit market with technical assistance and financial support. Additionally, demand-side education and encouragement to homeowners and landlords must be undertaken. By educating residents on how these weatherization and Section 8 programs work (and by informing them that left-over money may be put into the building to make it more comfortable for residents) the demand for successful weatherization efforts will increase. If residents are aware and make these requests, this demand will encourage energy conservation and hopefully promote a sense of responsibility to the tenants among landlords. On the other hand, in order for an increasing number of requests to be met, more funds are required for the program (see problem 11 on page 10).

Principle 3. Leverage competitive market forces

3.1 Externalize the labor costs and other "real" costs inherent in the weatherization programs. In doing so, establish a program for the support of local installers in the neighborhoods.

3.2 Coordinate the health and safety inspections so that implementers are not caused to circumvent laws that stand at cross-purposes.

Principle 4. Build flexibility into the program design

4.1 Prepare a program structure dynamic enough to allow different models and financing tactics to be undertaken as the program changes or when market penetration is achieved.

4.2 Establish realistic timetables for barrier-removal and market maturity, with various program approaches tailored to the various states (like New York) that are already increasing the use of energy-efficient windows in older homes.

4.3 Phase the removal of barriers to weatherization program implementers so that barriers are removed with a holistic but focused approach.

Principle 5. Consider which vehicles are best-suited for technical assistance and know-how transfer

Some suggestions for "vehicles" by which to deliver the message are as follows:

5.1 Work through tried-and-true (and trusted) structures (like low-income weatherization programs) for mass deployment of energy-efficient windows.

5.2 Achieve a multiplier effect by giving promotional support to market actors through programs that invite their participation. If such programs are harmonized, this will raise "brand" awareness with consumers for energy-efficient windows.

5.3 Have DSM programs deliver some incentives to weatherization programs.

Principle 6. Emphasize standards, labeling, and building codes

6.1 Work through DOE to increase the building codes, particularly in disallowing "trade offs" between windows (building skin) and equipment (like air conditioning).

6.2 Obliterate 'grandfather' clauses that allow such things as common attics from local building code exceptions.

6.3 Engage participating builders, manufacturers, and other stakeholders in developing standards for windows to be used in low-income housing.

6.4 Achieve voluntary agreements (or MOUs) with suppliers or manufacturers to cease production or supply of inefficient window products and speed the penetration of energy-efficient windows into the market.

6.5 Consider training architects in the use of Master Specs and include more guidelines for window installation.

6.6 Window testing must include "actual installed testing" under real-world conditions particularly for products that are PVC-framed.

Principle 7. Allocate a portion of the program dollars for replication and the dissemination of results

7.1 Include targets for soft assistance into the program design, such as the dissemination of results. Such soft assistance should not be directed at construction costs or labor costs as is currently the case.

7.2 Set aside a portion of each facet of the budget for public relations and marketing of the program and its results and publicize the program widely to increase awareness.

7.3 Increase the budget for low-income weatherization programs and at least double the amount given to each home — to allow for windows.

Principle 8. Begin monitoring and evaluation early, to measure pre-program baselines
High-efficiency windows must become the norm in the low-income retrofit market. In fact, they should dominate the market after the project concludes for the market transformation to be considered sustainable. Some tactics by which to ensure sustainability are:

8.1 Devise monitoring methods and a timeline during program planning to ensure achievement of market transformation and the desired 30 percent penetration rates.

8.2 Design a plan to evaluate the windows market to establish the beginning baseline and measure long-term impacts.

Principle 9. Financing Strategies
Even though financing was not discussed in the eight principles for practice as outlined above, it is clear that payback, lifecycle, and cash flow estimates are important to low-income weatherization programs. However, there is often a mismatch between the costs and benefits and program implementers must choose how to get the most for a very limited budget. Some financing tactics are:

9.1 Consider adding subsidies for lead and asbestos abatement and/or containment to each low-income unit budget.

9.2 Make the economic considerations and incentives for the low-income weatherization program simple and easy to implement.

CONCLUSIONS

Low income and subsidized housing programs may achieve savings of an estimated 30 percent through weatherization programs and public housing energy programs. However, the diffusion methods for technologies like energy-efficient windows present a challenge yet-to-be-met. The first avenue by which to increase the market penetration for windows is offered by single-family weatherization programs, which present the most practical option to date. Support for these replicable programs must include increased funding. It must also go in hand with a re-visitation

of the SIR (savings investment rate) calculations, so that the long term benefits of better windows are taken more into account. In addition, a renewed interest in creating specifications that are **specific** enough to employ energy-efficient windows is required as well as a holistic review of the codes and standards that often stand at-odds with comprehensive envelope strategies. Beyond these suggestions, the market-pull of consumer incentives and awareness programs must be utilized to better advantage. Further monitoring and evaluation of existing weatherization programs (including re-commissioning plans) will reveal innovations and strategies that are realistic and achievable.

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Appendix

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Energy Efficient Windows in the Southern Residential Windows Market

Alison Tribble, Alliance to Save Energy
Kate Offringa, Alliance to Save Energy
Bill Prindle, American Council for an Energy-Efficient Economy
Dariush Arasteh, Lawrence Berkeley National Laboratory
Jay Zarnikau, Frontier Associates
Arlene Stewart, AZS Consulting
Ken Nittler, Enercomp

ABSTRACT

The greatest potential in the U.S. for cost-effective energy savings from currently available energy efficient residential windows and skylights[1] exists in the southern market.[2] Prindle and Arasteh recently reported that ten southern states could save over 400 million kWh and 233 MW of peak electricity generating capacity annually by adopting the International Energy Conservation Code (IECC) standard of 0.40 (or less) solar heat gain coefficient (SHGC) for new construction (Prindle & Arasteh 2001). In 2000, Anello et al. demonstrated savings of 14.7 percent in reduced cooling load with high-performance windows (Anello et al. 2000). In 2002, Wilcox demonstrated savings of 20 percent while simulation analysis estimates cooling energy savings in the 30 percent range (Wilcox 2002).

In the southern market, there is significant opportunity for reducing cooling energy use with low solar gain low-E windows. Yet, the southern market has been slow to embrace this new technology. Market research shows that while low-E products have achieved up to 70 percent of the market share in some colder climates (Jennings, Degens & Curtis 2002), they have gained less than 10 percent of the southern windows market (Prindle & Arasteh 2001).

This paper will explore the residential windows market by considering the following: market barriers unique to the southern market; distribution channels in the South; the roles of utilities, codes officials, and other organizations; and other indirect factors that influence this market. This paper will profile current market transformation efforts with case studies of the Florida Windows Initiative, sponsored by the Efficient Windows Collaborative at the Alliance to Save Energy, and the Texas Windows Initiative, sponsored by the American Electric Power Company. Finally, this paper will identify the next steps that will be critical to transforming the southern residential windows market to more efficient window and skylight products.

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[1] For the purposes of this paper, "energy efficient windows" for the Southern market are defined as windows attaining a solar seat gain coefficient (SHGC) of 0.40 or less, as identified by the 2000 International Energy Conservation Code (IECC) and the ENERGY STAR® windows program. The authors use several terms to signify "energy efficient windows" including "high performance windows" and "efficient windows."

[2] For our purposes, the "South" and the "southern market" consist of the 10 states listed in the Prindle and Arasteh 2001 analysis. These are South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Texas, New Mexico, Arizona, and Nevada. However, some of the data reported in this paper is based on U.S. census regions, which include different groupings of states.

Introduction

Opportunities abound for saving cooling energy in the southern residential buildings market. New construction in the South has outpaced construction in the rest of the nation. The South accounted for 50 percent of all new housing starts in the U.S. in 1999, or approximately 1 million new starts (Ducker 2000). That share of national housing starts is expected to hold through 2003. Moreover, central air conditioning is nearly universal in new construction. Applying efficient technologies in new construction can dramatically decrease energy use in the southern market. Of course, decreases in cooling energy consumption generally result in lower utility bills, reduced emissions from power plants, decreases in peak demand and potential increases in our national energy security.

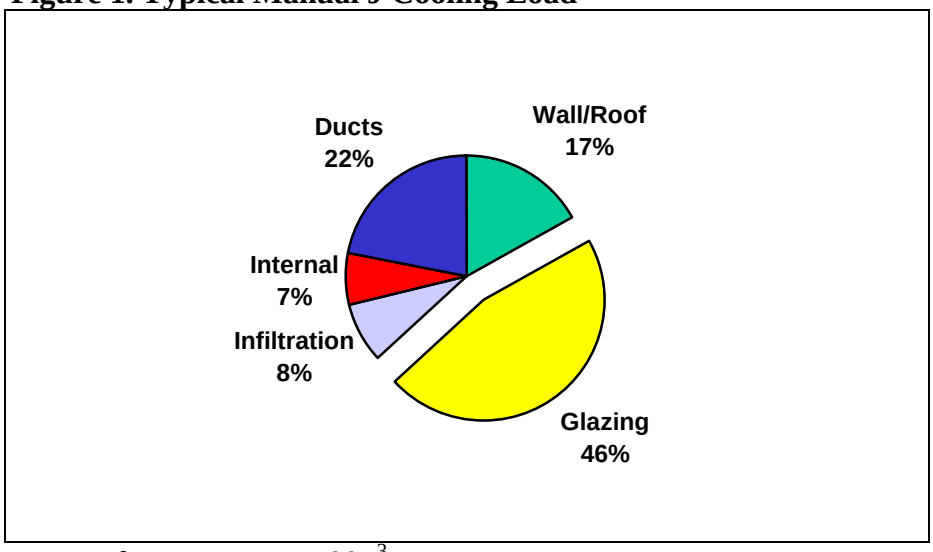
Of all the energy efficient technologies that can be applied to new construction, one of the most effective in terms of energy savings is the energy efficient window. Cooling homes in the South (4000 heating degree days or less) consumes 63 billion kWh of electricity every year, or 52 percent of all electric air conditioning consumption in the residential United States (EIA 1997). Various studies have analyzed window impact on cooling loads. Reported impacts suggest efficient windows and skylights may reduce cooling loads by 12 percent to 26 percent (Prindle & Arasteh 2001). High performance windows help to reduce cooling demand in homes with recently developed window component technologies.

Technology

One of the largest components of residential cooling loads is solar heat gain through windows. Traditionally, homeowners and builders in the South have attempted to block solar heat gain in homes with shading from vegetation, awnings, and screens. The drawback of these shading features is that they reduce visible light transmitted through the window. Also many of the shading features are not permanent fixtures. Tints applied to windows also can reduce solar gain, but again visible light is sacrificed. A new generation of low-E coatings is now able to reduce solar heat gain significantly with minimal loss of visible light transmittance. Windows and skylights with low solar gain low-E coatings can help reduce residential cooling loads in the South and improve comfort in homes.

Low solar gain low-E windows can reduce cooling loads further when coupled with properly sized air conditioners. Properly accounting for the low solar gain low-E glass in industry standard cooling equipment sizing calculations like ACCA Manual J often results in half-ton, one-ton or even larger reductions in the size of the equipment required to maintain comfort. This not only reduces demand (a 3 ton air conditioner typically has a demand about 1.2 kW less than a 4 ton air conditioner), it also helps to offset the cost of high performance windows as smaller units cost less. Figure 1 shows that 46 percent of a typical Manual J cooling load is due to solar gain through windows and illustrates that cutting solar heat gain can have a measurable impact on the size of the air conditioner. While many builders and contractors may not use Manual J themselves, this calculation illustrates the importance of bringing the energy efficiency message to them through other media.

Figure 1. Typical Manual J Cooling Load



Source: Texas Windows Initiative 2002[3]

Educating the Industry and Consumers

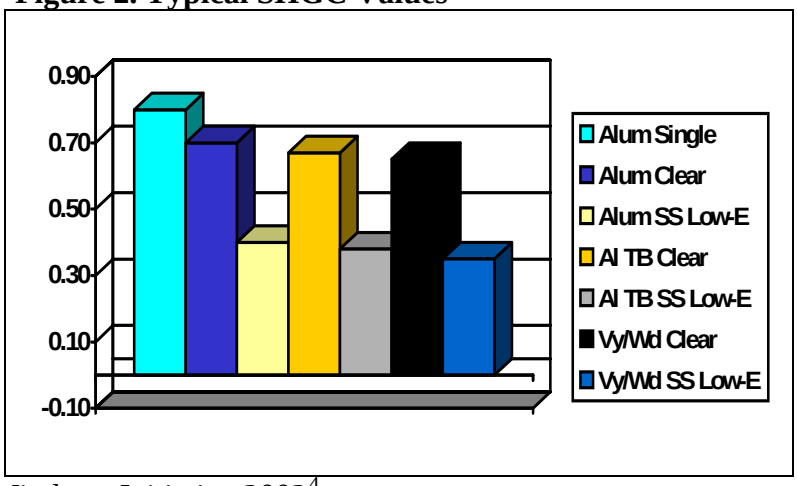
One of the first steps to transforming a market to more energy efficient products is to develop a standardized rating system for measuring energy performance. This allows manufacturers to effectively promote efficient products, and it helps consumers to select energy efficiency for their homes.

The National Fenestration Rating Council (NFRC) established voluntary standardized testing procedures for whole window performance for the following measurements: U-factor, solar heat gain coefficient (SHGC), air leakage (AL) and visible transmittance (VT). Window and skylight manufacturers voluntarily select to have their windows rated and labeled with these energy performance measurements.

The most important factor for efficient windows in southern climates is the use of products with low SHGC values. The SHGC measures the fraction of solar energy striking a window that is transmitted through the entire window assembly including glass, frame and other window components. Windows with dual glazed low solar gain low-E glass typically have SHGC values below 0.40. Clear dual glazed products have SHGC values as high as 0.70. SHGC values go lower with low conductance frame materials like wood or vinyl, but the most important factor for achieving the low SHGC is the low solar gain low-E glass. Typical SHGC values are shown in Figure 2.

[3] This example is for a 1,854 square foot home in San Antonio that has clear dual-glazed aluminum framed windows.

Figure 2. Typical SHGC Values



Source: Texas Windows Initiative 2002[4]

Publishing energy performance data is crucial to market transformation initiatives. NFRC testing is the performance measure used by the ENERGY STAR® windows program, co-sponsored by the U.S. Department of Energy and U.S. Environmental Protection Agency. The ENERGY STAR® labeling program denotes products that meet elevated energy performance levels as determined by DOE and EPA.

The Efficient Windows Collaborative

With an effective independent rating and labeling system established, the next step in transforming the windows market is to provide education and resources to the industry and to consumers. In 1997, the Efficient Windows Collaborative (EWC) was formed to address these needs. The EWC, a project of the Alliance to Save Energy, is a collaboration of manufacturers, component suppliers, distributors, researchers and others interested in transforming the residential window market to more energy efficient products. Its goals are:

- To double the market share of energy efficient windows in the United States
- To make NFRC labeling near universal
- To educate the industry and market audiences on energy efficient technologies
- To support the ENERGY STAR windows program

The EWC encourages NFRC labeling by creating demand for energy performance information through consumer education. The EWC collaborates with Lawrence Berkeley National Laboratory (LBNL) and the University of Minnesota to provide the latest information and research on energy efficient windows and skylights in formats that are easy to understand. It presents educational seminars to manufacturers, builders, utilities and consumers about the benefits of energy efficient windows and how to use labels to select energy efficient products by climate. The EWC supports the ENERGY STAR windows program in two ways: 1) encouraging manufacturers to participate in ENERGY STAR labeling and marketing activities, and 2) educating consumer audiences about the technologies and energy performance measurements represented by the program.

[4] Alum and Al signify aluminum. SS signifies spectrally selective. TB signifies thermal break.Vy/Wd signifies vinyl or wood.

The EWC provides a number of tools to market audiences including:

- Residential Windows: A Guide to New Technologies and Energy Performance—a comprehensive resource for understanding more about windows and energy performance (Carmody et al. 2000)
- RESFEN software, developed by LBNL, which allows users to model window energy performance
- Fact sheets which help consumers select efficient windows and skylights for particular climates
- A web site, www.efficientwindows.org, developed by the University of Minnesota, which provides information about energy performance in residential windows, including how windows work, understanding the benefits of energy efficient windows, and how to select windows by comparing energy performance

Southern Market for Residential Windows

The efforts of the EWC, NFRC and ENERGY STAR, along with regional initiatives, have resulted in successful market transformation in some areas of the country, while progress has been slow in other areas. For example, in the northwestern U.S., the Northwest Energy Efficiency Alliance has helped increase regional sales of qualifying ENERGY STAR products from 10-15 percent in 1997 to 70 percent by the end of 2001 (Jennings, Degens & Curtis 2002). A baseline study conducted in 1996 by Ducker Research Company reported approximately 34 percent national market penetration of efficient windows (defined as insulated glazed units with a low-E coating) (Ducker 1997). In the southern market, adoption of more efficient window technology has been much slower. Ducker Research reported less than 10 percent market penetration of efficient windows in 1997 in parts of the southern region (Ducker 1997).

With nearly half of all new construction in the US taking place in the South, critical opportunities for reducing energy demand exist in this region, especially with the adoption of efficient windows. Over 12 million windows were sold in the southern market in 1999, with new construction accounting for approximately 55 percent of those window sales (Ducker 2000).

National and regional market transformation efforts have a broad and diverse audience for education in the windows market. The window industry is fragmented and intensely competitive. The distribution channel includes parts suppliers, manufacturers, distributors, and retailers. Trade groups and organizations that establish testing procedures influence this market. State codes officials and energy offices are in a position to influence this market, as are research organizations. Builders and homeowners both affect purchasing decisions. Real estate agents and insurance companies also may influence the windows market.

In many parts of the country, utility companies have played an important role in promoting energy efficient windows. Typical utility programs have included consumer/builder education and financial incentives. Some of these programs have promoted NFRC and ENERGY STAR labeling. Such support from utility companies has been non-existent in the southern market until very recently.

Market Barriers

Several critical barriers have hindered adoption of efficient window technology in the southern market. First cost has been the greatest overall barrier. However, another primary barrier is lack of awareness about window energy performance. Builders and homeowners have historically associated efficient windows with cold climates. It has been observed that many window sales people are unfamiliar with energy performance in windows and are thus unable to educate their consumers on this topic. Consumers, when lacking this knowledge, do not ask for windows with NFRC labels or for ENERGY STAR qualified products.

The cost of testing and labeling presents another barrier.[5] For the many small window shops that mark the southern landscape, the perceived and actual costs and the logistical hurdles of testing and labeling can make the idea seem prohibitive. In some areas of the southern market, such as Texas, production builders use windows from high-volume low-cost manufacturers. In other areas in the southern market manufacturers are small shops producing low-priced windows locally. Most of these small shops do not produce windows that meet the ENERGY STAR requirement of 0.40 SHGC for the southern zone. Small manufacturers perceive that producing windows with low solar gain low-E coatings is beyond their capabilities because they do not know how to handle the coatings and because they do not get enough business to justify the equipment/space investment.

A number of southern states or jurisdictions have implemented "hurricane" codes that create new wind resistance properties for windows. The structural integrity of buildings is compromised when a building envelope is broken during intense storms because of the difference in pressure inside and outside the structure. Unprotected windows and doors have been identified as vulnerable points when strong winds propel debris against structures during storms. Some regions now require impact resistant windows or other protective components. Although technology for integrating low SHGC values into impact resistant windows exists, integrated products have been slow to reach the marketplace.

Market Push: Opportunities for Energy Savings through Building Codes

Some progress towards market transformation for windows in the South is being made in the building codes arena.

Codes Background

One of the best ways to ensure adoption of new technology is to enact laws or regulations that require or are favorable to technology adoption. A good example of this strategy can be found in state energy codes. In Georgia, implementation of the Model Energy Code (MEC) during the 1990s caused basic new construction window practice to shift from single-pane to double-pane.

The Energy Policy Act of 1992 requires that all states must consider adoption of the MEC or any successor codes that the U.S. Department of Energy (DOE) determines are more stringent. On January 1, 2001, DOE issued a determination that the 1998 and 2000 editions

[5] Note that in states requiring that windows be tested according to an NFRC procedure, NFRC certification may or may not be legally required for code compliance.

of the International Energy Conservation Code (IECC is the successor to the MEC) will improve energy efficiency in residential buildings.

The IECC was developed by the International Code Council. One of the most significant changes established in the 1998 and 2000 IECC is the prescriptive standard of a solar heat gain coefficient (SHGC) of 0.40 or less in climates with 3500 heating degree days or fewer. The International Residential Code (IRC), which has its own energy efficiency chapter, is consistent with the IECC's requirements, and allows use of the IECC as a compliance option.

Adoption of the IECC/IRC does not guarantee adoption of new window technology. The codes provide multiple paths to compliance. Additionally, some states and local jurisdictions "customize" adoption, making their own amendments. Finally, enforcement methods and vigor vary from state to state. For example, some states allow private experts such as home energy raters or consultants to verify compliance, typically demonstrating compliance through software tools. Others rely on simple, prescriptive tables or other fixed formulas.

Implementation has proven to be a challenge for some states that have adopted the 2000 IECC. This is particularly true in states where the SHGC requirement applies, such as Texas, because the change in window practice is substantial. In some cases, builders and window suppliers have sought exemptions, implementation delays, or tradeoff options for the low solar gain window standards.

Table 1. Status of Energy Code Adoption in the South

South Carolina	Adopted 2000 IECC
Georgia	Considering adoption of 2000 IECC
Florida	Adopted code based on 1998 IECC
Alabama	Local adoption of 1993 MEC
Mississippi	No code, or weaker than 1992 MEC
Louisiana	Considering adoption of 2000 IECC
Texas	Adopted 2000 IECC
New Mexico	Still uses 1992 MEC
Arizona	Adopted 2000 IECC as voluntary
Nevada	No code, or weaker than 1992 MEC

Source: Efficient Windows Collaborative 2002

Opportunity for Energy Savings with Adoption of the 2000 IECC

In a recent report entitled *Energy Savings and Pollution Prevention Benefits of Solar Heat Gain Standards in the International Energy Conservation Code*, Prindle and Arasteh explored the potential impact on energy savings and pollution prevention from the SHGC standard of 0.40 in the IECC. The authors used RESFEN, an LBNL-developed simulation model specially designed to calculate the effect of different window types on residential energy use. RESFEN is based on a DOE-2 simulation model. It allows the user to vary location, size and type of home, type of HVAC system, energy prices, type of window, amount of window area, window area by orientation and internal and external shading options.

Prindle and Arasteh modeled homes in the ten southern states that would be most affected by the IECC solar heat gain standard (see Table 1 above for list of states). The baseline window was a single-pane clear metal frame window in the warmest climates, such as Miami, and a double-pane clear metal frame window in climates with more heating, such as Albuquerque, NM. The authors compared the performance to a double-pane unit with a low solar gain low-E coating, which satisfied the IECC requirement.[6]

The authors found that in these ten states, adoption of the IECC could save annually 400 million kWh, $38 million in electric bills, and 233 MW of peak electricity generating capacity. In the 20th year, savings would increase to 8 billion kWh, $760 million, and 4,660 MW. The electric energy savings would also prevent the emission of 20,000 tons of nitrogen oxide and over 1.5 million tons of carbon equivalent. Over the 20-year period, cumulative savings would be 80 billion kWh, $57.6 billion in electric bills, and 4,660 MW of generating capacity (Prindle & Arasteh 2001). The average annual savings per home were 995 kWh in energy, $89 in energy costs, and 0.52 kW in demand savings.

Prindle and Arasteh estimate over 600 MW in peak electricity demand savings could be achieved in the ten states analyzed in the study, when savings opportunities from the replacement and remodeling market are included.

Table 2. State Total Energy, Dollar, and Demand Savings Annual Impacts for Each Year's New Home Production

State	Housing Starts	kWh	Dollars	kW
South Carolina	24,467	13,261,114	$1,088,537	11,499
Georgia	67,879	31,427,977	$2,521,705	25,794
Florida	97,889	140,617,549	$10,873,021	66,565
Alabama	14,655	1,192,477	$1,192,477	7,914
Mississippi	8,671	9,295,312	$705,559	4,682
Louisiana	13,875	19,119,750	$1,491,701	5,273
Texas	99,831	88,949,421	$9,818,379	60,897
New Mexico	9,217	10,101,832	$949,535	3,595
Arizona	50,540	59,283,420	$6,994,736	32,851
Nevada	24,445	34,614,120	$2,353,565	14,667
TOTALS	411,469	407,862,972	$37,989,215	233,736

Source: Prindle and Arasteh 2001

Market Pull: Education and Training through Regional Window Initiatives

Two state-specific market transformation initiatives have been working to move the southern windows market towards energy efficient products. These are the Florida Windows Initiative and the Texas Windows Initiative.

[6] There are various window frame options available which meet this SHGC requirement.

Florida Windows Initiative

Of all the southern states, Florida presents one of the best opportunities for energy savings with energy efficient windows and one of the greatest challenges. The Efficient Windows Collaborative Florida initiative has encountered several barriers to energy efficient windows in its efforts to transform that market. Florida's residential window market is dominated by single-pane clear glass products with non-thermally broken aluminum frames. Florida window costs have remained flat, allowing Florida window manufacturers to keep their market advantage against national companies that no longer produce a single-pane product. Moreover, builders prefer single-pane metal windows, because they are typically less expensive per square foot than opaque wall, allowing builders to offer a high percentage of window area per home while keeping housing prices down.

Energy experts (utility auditors, energy raters and the like) in Florida have perpetuated this market choice by advising against double-insulated glass windows as not cost effective. While the reference home for Florida's performance based code used double-pane clear windows, single clear windows were the standard for most of central and south Florida, with other energy measures making up the lost portion of the energy budget because windows were not viewed as cost effective (Glenn 2001). Moreover, electric prices in the state average 8 cents/kWh, providing little incentive to look beyond first cost. In other states, efficient windows can be cost effective at lower electricity prices, but the prevalence of single-pane windows in Florida translates into a higher first cost for efficient windows there than elsewhere.

The window industry in Florida is also facing a major new challenge because of cost implications of the new hurricane codes. In 1998, the Florida Legislature created the Florida Building Commission to create a single construction code and incorporate the numerous recommendations that came out of the study of Hurricane Andrew of 1992. Development of impact resistant windows became a priority for many companies when municipalities increased the structural stringency as a result of these studies. ENERGY STAR impact resistant units are just now entering the market place (Haas 2002).

In 1999, several forces converged to begin transforming the Florida windows market. The Efficient Windows Collaborative (EWC) identified Florida as a pivotal state due to its large market and low efficiency of current practice. The Florida Solar Energy Center, with its respected fenestration research program, recognized the need for a baseline study of the current market situation in Florida, especially with respect to utilities. The Florida Energy Extension Service at the University of Florida (FEES) developed specialized modules for its "Build Green & Profit" contractor education program. These entities worked together to start a local market transformation initiative to adapt the EWC's goals to Florida's unique needs.

In December 1999, the Efficient Windows Collaborative hosted the pilot test for the Build Green & Profit Windows module, which was attended by 20 builders and remodelers from the Tampa Bay area. Beginning in 2000, FEES and EWC staff have conducted 41 trainings for 655 builders, industry representatives and architects through the Build Green & Profit program. Attendees were introduced to the NFRC label and the ENERGY STAR southern region criteria and participated in EWC training on energy performance in windows.

The broad reach of this training was possible due to an EWC train-the-trainers session held at the University of Florida in May 2000 for Florida Cooperative Extension Service county faculty. The primary goal of the meeting was to provide current information and

resources that these attendees could in turn use to educate their audiences. National EWC members, local window manufacturers, utilities and builders were invited to attend. Representatives from the Fenestration Manufacturers Association (formerly Architectural Manufacturers Association of Florida) provided key insight into the next steps that the EWC Florida initiative needed to take. FEES also incorporated the energy efficient windows message into its "Buy Green & Save" consumer home buying course in spring 2000. Consumers were attracted to the comfort benefits of high performance windows in demonstrations, but found that the only companies offering such low solar gain windows were premium brands. Thus, first cost issues remained a hurdle.

The EWC adapted fact sheets and other materials to reflect the energy savings available to consumers using low solar gain low-E glass in aluminum products. The relationship between low solar gain low-E windows and code compliance was demonstrated in subsequent meetings with manufacturers. These meetings revealed that most had not understood the role that windows played in these pivotal calculations. While many understood the need for low solar gain low-E windows, their sales forces were unable to close the sale to builders because they had not provided the information at the correct point in the decision making process (at plans development, rather than product procurement). Manufacturers were reluctant to undertake NFRC certification without corresponding market demand to justify testing costs and capital costs associated with manufacturing low-E products.

The Efficient Windows Collaborative sponsored 9 training classes on code compliance methodology for 143 window sales people and energy raters in Florida as an attempt to 'pull' the market more directly in 2001. Participants ranked their percent change in knowledge of energy efficient windows at 34 percent on average. Informal feedback from those who participated in 2001 training has indicated a dramatic change in the sales of low solar gain low-E windows. This movement among manufacturers has been a measurable success of the EWC initiative in Florida.

Over the course of 2001, two Florida manufacturers became NFRC certified and ENERGY STAR qualified, with four more committed to follow in 2002. Energy efficient product availability will be a key factor in moving demand. Much remains to be done for the EWC in Florida, as it moves forward in its outreach to builders and homeowners in that market. New product availability must be met by demand-pull to encourage further market transformation. This will require stepped-up efforts to educate all market players.

Texas Windows Initiative[7]

Texas has lagged behind other states in the adoption of energy efficient window products due to the absence of a statewide building energy code (until 2001), and relatively low retail energy prices. Recognizing the enormous potential for energy and dollar savings, emission reduction, and peak demand reduction in the nation's leading state in electrical energy consumption, American Electric Power Company (AEP) launched the Texas Window Initiative (TWI) in early 2000.

The goal of the TWI is to promote the installation of high performance windows in the residential new construction and remodeling markets. The program's focus is to provide training and education to window manufacturers, distributors, retailers, building product

[7] Some of the material presented in this section comes from Zarnikau and Campbell 2002.

sales professionals, homebuilders, replacement contractors, and other upstream and midstream decision-makers. The TWI pilot program has focused its efforts in AEP's three service areas in Texas (Central Power and Light Company, West Texas Utilities Company, and Southwestern Electric Power Company). Enercomp of Auburn, California, heads the TWI training efforts; while Frontier Associates of Austin, Texas, provides program administration, measurement and verification of savings, and assists in some promotional efforts.

A baseline study was conducted in early 2000 and the results indicated that a typical window sold in AEP's three Texas service areas was a double-pane window with clear glass (i.e., no low-E coatings) with an aluminum frame (Zarnikau & Campbell 2002). The survey results also discovered that of all homebuilders, window retailers, and window manufacturers surveyed, only about 8-10 percent of the windows sold in those service areas had low-E coatings. An even smaller share of the windows sold, approximately perhaps 2-3 percent met the ENERGY STAR standards for solar heat gain and insulation properties established by the U.S. EPA and DOE.[8] Consequently, a great potential for improvement was obvious.

AEP and the program implementation team identified a number of barriers to the transformation of the existing windows market to high performance windows (Zarnikau & Campbell 2002):

- Many window suppliers in Texas did not stock high performance window products.
- Regional window manufacturers, retail sales personnel, and homebuilders were generally not familiar with the recent advances in window technology and their associated energy efficiency benefits.
- Many consumers and building product sales professionals in Texas were not familiar with the window rating system of the national ENERGY STAR windows program and the National Fenestration Rating Council (NFRC). .
- Consumers and sales professionals were often unaware that the higher initial cost for energy efficient windows would be offset by lower energy bills within a reasonable payback period.
- Homebuilders often wish to minimize construction costs and have little incentive to minimize long-term energy costs unless they are assured that homebuyers will value energy efficiency features appropriately.

The TWI program sought to address these market barriers through a variety of educational and promotional efforts:

- Over the past two years, 177 training sessions were delivered to 577 participants in six business categories.
- Meetings were held with a number of window manufacturers to ensure that high performance window products would become widely available in the future.
- To reinforce existing national energy efficiency programs, the TWI training emphasized the benefits of NFRC window ratings/labels and the federal ENERGY STAR windows program. Trainees were taught to look for these program labels as a way to identify high performance window products.
- Many window retailers, especially home centers, were not aware whether their window suppliers offered appropriate high performance window products; therefore, sales people

[8] ENERGY STAR certified windows require a U-value of 0.75 or less and a solar heat gain coefficient of 0.40 or less for the southern region, which includes all but the most northwestern part of Texas.

were taught how to identify improved products and how to order and recommend the best products for their customers.

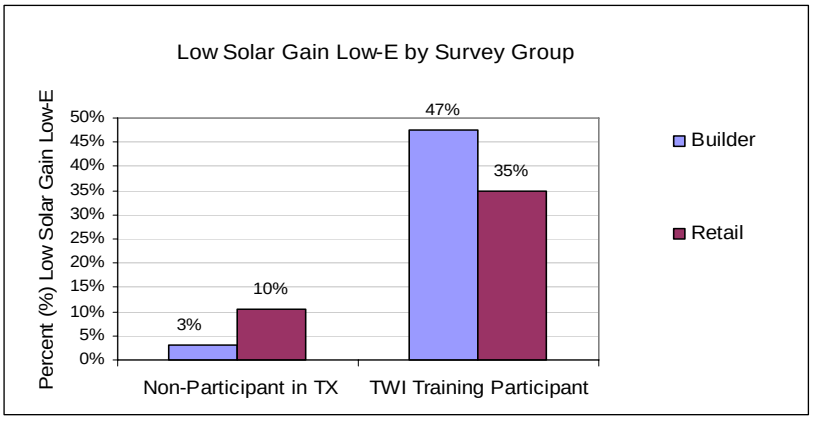
- To address consumer concerns about the additional cost of efficient windows, the training materials presented demonstrated the cost-effectiveness of choosing high performance windows over standard products through several scenarios.
- A number of promotional activities took place in cities served by AEP during 2001. These included newspaper advertisements, point of purchase TWI brochures for retailers and builders, establishment of an informative web site, and home and garden show displays. TWI also sponsored and coordinated three "home demonstration" projects with builders and suppliers.

The Efficient Windows Collaborative and TWI coordinated efforts to provide a consistent message and to share materials and information.

In late 2001 measurement and verification activities were conducted to determine the changes that had occurred in the windows market since the initial baseline study, and to identify those market changes that appeared to be attributable to the TWI program (Zarnikau & Campbell 2002). 155 telephone or written surveys were completed in the fall of 2001 with glass and window manufacturers, window retailers and homebuilders in Texas, Louisiana, Arkansas, Oklahoma, and New Mexico. To assist in isolating the impacts of TWI from other "naturally-occurring" changes in the market for windows those survey's involving companies in the window market outside AEP areas were designated as "control group" surveys to serve in comparison with surveys conducted within AEP areas. When interpreting the results, it should also be noted that when the surveys began in November of 2001, training sessions were still being held, accompanied by recently published TWI program advertisements, indicating that the full impact of the TWI program may not be fully reflected in the measurement and verification results.

As indicated in Figure 3, builders and retailers that participated in the training program were much more likely to sell energy efficient windows than builders and retailers in Texas that did not complete the TWI training program.

Figure 3. Low Solar Gain Low-E by Survey Group



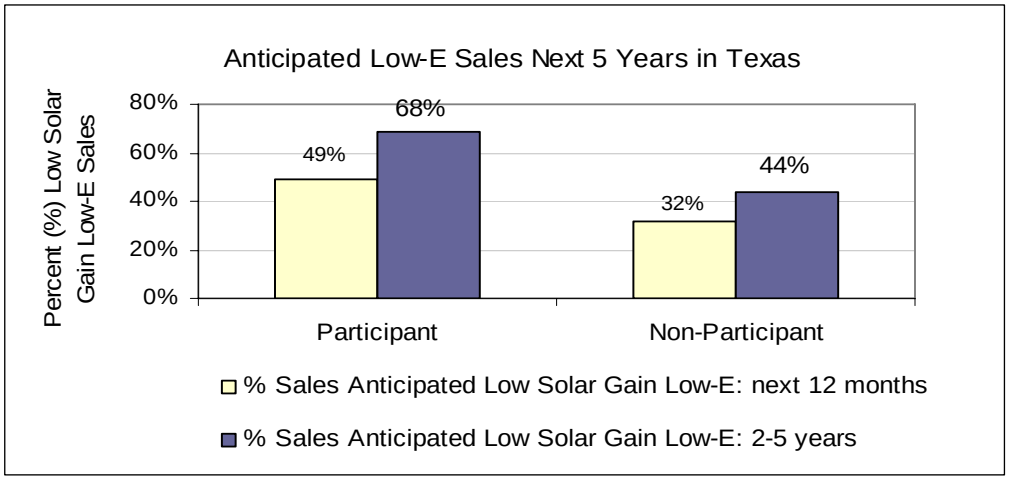
Source: Zarnikau & Campbell 2002

Survey participants in Texas were asked two questions regarding the potential of future sales of low-E products:

- What percent of your window sales next year do you expect to be low solar gain low-E glass?
- What percent of your window sales in the next 2-5 years do you expect to be low solar gain low-E glass?

As noted in Figure 4, TWI training participants reported higher sales of low solar gain low-E glass and a higher anticipated percentage of future low-E window sales than did respondents that did not participate in the TWI training activities.

Figure 4. Anticipated Low Solar Gain Low-E Sales Next 5 Years in Texas



Source: Zarnikau & Campbell 2002

According to Zarnikua and Campbell, the results of the 2000 Baseline Survey indicated only 33 percent of manufacturers surveyed were aware of ENERGY STAR®, retailers were slightly less at 30 percent and builders reported only 2 percent were aware of ENERGY STAR®. The 2001 Survey results suggest that Texas has become more aware of the national ENERGY STAR program, with 73 percent of the respondents stating they are aware of ENERGY STAR.

Zarnikua and Campbell estimate that market share of energy efficient windows in AEP's three Texas service areas has increased from 2-3 percent of all windows sold in these areas in 2000 to approximately 25 percent of all windows sold in late 2001. They estimate a "gross" lifetime energy savings from recent changes in the window market in the AEP service areas of 162,725 MWh (assuming the 10-year energy efficiency measure life that the Public Utility Commission of Texas typically uses in cost-effectiveness calculations) and annual peak demand reduction of 8 MW per year. Assuming a more-realistic 20-year life for windows, the lifetime savings from first-year impacts would be about 325,451 MWh (Zarnikau & Campbell 2002).

The TWI program has achieved considerable success in educating and demonstrating the benefits of high performance windows to Texas window manufacturers, window retailers, and builders. Considerable progress has been made in transforming the Texas window market, However, there still remains significant potential for energy conservation and electrical peak demand savings in the Lone Star State.

Conclusion and Critical Next Steps for Market Transformation in the South

Southern residential windows and skylights represent one of the largest opportunities for energy savings in the U.S. buildings sector. These energy savings are particularly important because they save electricity during peak cooling season. That means energy efficient windows have maximum benefit for reducing greenhouse gas emissions and peak cooling capacity needs.

Market transformation efforts can have positive effects in the South. Results from the EWC Florida Windows Initiative indicate information dissemination encourages manufacturers to test and label products. Through training, builders and others in Florida increased their knowledge about energy efficient window products. The Texas Windows Initiative trainings helped move market penetration of energy efficient windows from 2-3 percent to 25 percent in those parts of the state where TWI has been operating. Market transformation efforts in Florida and Texas have demonstrated that educational efforts can increase consumer/builder demand and increase supply of efficient window products in the southern market.

Market transformation efforts in building energy codes that promote high performance windows have also proven successful in some parts of the South. Building Codes Assistance Project, the Alliance to Save Energy, and others worked in Texas to promote adoption of the 2000 IRC and IECC. Georgia is poised to adopt the 2000 IECC at the time of this publication, and has received support from these and other organizations.

Efforts in both codes and in residential windows market transformation have demonstrated that educational efforts can effectively move the market. However, much work remains to be done to realize this market's energy savings potential. Market transformation efforts in the South need to develop further in broader and in more strategic ways. Critical next steps to market transformation in the South include:

- Development and deployment of a Southern Windows Initiative that works across states in the South to leverage resources and lessons learned
- Increased efforts to involve local manufacturers in NFRC labeling and the ENERGY STAR windows program
- Development of communications tools for different market sectors that clearly demonstrate immediate and long-term benefits of energy efficient windows
- Consensus-building among researchers to address inconsistencies in analyses
- Improvement in code advocacy and education with efforts focused on states where the IECC and ENERGY STAR windows criteria converge
- Development of financial incentives for the purchase of energy efficient windows with utilities and state energy offices
- Development of an HVAC Program to educate contractors about high performance windows and proper cooling equipment sizing

Market transformation efforts have made inroads into the southern windows market. But the potential for energy savings in this part of the nation remains significant. A combination of innovative programs and codes advocacy will ensure future success in this important endeavor.

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Appendix

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The Tax Credit for the Installation of Energy Efficient Windows:

Does the ENERGY STAR Help Consumers Find Products that Qualify?

Presented by Harry Misuriello, Kipp Rhoads and Nils Petermann
Alliance to Save Energy and the Efficient Windows Collaborative

November 9, 2005

With the passage of the Energy Policy Act of 2005, signed into law on August 8, the first nation-wide tax incentive for purchasing energy-efficient windows, skylights and doors has been established. The provisions for the tax credit are comprised in *Sec. 1333 Credit for Certain Nonbusiness Energy Property*. The credit offers cost-based incentives of 10 percent of the amount expended by the taxpayer for "Qualified Energy Efficiency Improvements" up to a maximum credit limit of $500 for all improvements. Up to $200 of this can be claimed for qualifying exterior windows and skylights. Qualifying exterior doors are not subject to this $200 cap. To be eligible for the tax credit, the windows must be placed in service between Jan. 1, 2006 and Dec. 31, 2007. The credit is received in the tax form filed by April 15th of 2007 or 2008.[1]

In order to qualify for the tax credit, a window must, in the language of the legislation, be an

> *"energy efficient building envelope component which meets the prescriptive criteria for such component established by the 2000 International Energy Conservation Code, as such Code (including supplements) is in effect on the date of enactment of this section".*

The purpose of this paper is to examine how a consumer-friendly way of complying with the tax-credit provision can be implemented. Therefore, the paper

- Examines which version of the International Energy Conservation Code (IECC) might be used as criteria for whether window products qualify for the tax credit,
- Compares these IECC criteria with the criteria for ENERGY STAR windows,
- Discusses whether the ENERGY STAR label is an effective guide for consumers to find windows that qualify for the tax credit, and whether it would be reasonable to integrate the ENERGY STAR criteria into the tax credit criteria.

In preparing this paper, the Alliance to Save Energy conducted a county-by-county comparison of the IECC criteria to ENERGY STAR fenestration labeling criteria. This allowed us to determine where ENERGY STAR criteria met or exceeded IECC requirements, or in some cases fell short. **On a national basis we found that an "all zones" ENERGY STAR rating provides a "safe harbor" for meeting either the IECC 2000 or IECC 2004 requirements in every US jurisdiction.** As we describe later on, ENERGY STAR windows criteria can meet the 2000 International Energy Conservation Code (IECC 2000) replacement windows criteria in virtually all US counties. Out of 3,111 US counties and jurisdictions, the basic ENERGY STAR windows criteria are less than that of the IECC 2000 in only 57 counties. These differences are largely attributed to the way the IECC and ENERGY STAR climate zones were drawn. When the new 2005 ENERGY STAR "Equivalent Energy Performance Amendment" criteria are evaluated, we find only 115 US counties where IECC 2000 criteria are not met. Similar results were found with respect to the IECC 2004. DOE has determined that the equivalent energy performance criteria offer the same or better energy efficiency as compared to the basic ENERGY STAR criteria. The details of this analysis are discussed throughout the paper, and summary results are shown in Attachment 1.

In light of these findings, the Alliance to Save Energy offers the following recommendations for implementation of the residential windows tax credits:

- If the 2000 IECC is deemed to be the correct reference standard, the IECC 2000 replacement window table (502.2.5) should be adopted as the fundamental criteria for the residential tax credits. In the 2004 IECC, Table 402.1 would be the appropriate criteria.
- The "All Zones" ENERGY STAR label (see Figure 1 on page 8) should be promoted as the primary indicator for qualifying windows, since it provides a "safe harbor" for fulfilling the IECC criteria for windows.
- If it is within the discretion of the IRS, we recommend:
    - Fenestration products with any ENERGY STAR label should be deemed to meet the IECC windows requirements in the regions indicated on the respective label;
    - The acceptance of the ENERGY STAR label for tax credit compliance should also be extended to the new DOE Equivalent Energy Performance Amendment criteria effective on September 19, 2005. DOE has come to the conclusion that windows conforming with this amendment perform equally good or better than envisaged by the standard ENERGY STAR criteria. Moreover, this amendment sends positive market signals by allowing more hurricane windows to qualify in the South.
- Campaigns to promote the residential windows tax credits should focus on an ENERGY STAR message for consumers. This will build on the existing significant public awareness of the ENERGY STAR label and the established network of ENERGY STAR partners. Embracing the ENERGY STAR label for this purpose will eliminate market confusion about qualifying fenestration products, simplify tax rule compliance and provide for simple messaging to the public for maximum participation.

The Importance of Energy Efficient Windows

Due to growing energy prices, the heating costs for the winter of 2005/06 are expected to surpass those of last winter by a wide margin – by an expected 32 to 48 percent for oil and gas heating, for example[2] - while the share of cooling costs among residential energy expenditures has been on the rise for years. Increased use of energy-efficient windows, on the other hand, can help to significantly reduce these costs. A 2003 study by the Lawrence Berkeley National Laboratory estimated that the total energy used for heating and cooling in the U.S. could be reduced by 11 to 12 percent if all windows in the current stock added low-e coatings.[3]

It is crucial that the criteria for the tax credit ensure that consumers are given an incentive to purchase the most efficient windows while not being too complex for consumers to easily find windows that qualify. A purpose of this paper is to examine whether consumers can be assisted by the ENERGY STAR label as an easy means to identify windows that qualify for the tax credit.

What Makes Windows Energy Efficient?

Standard elements of energy efficient windows are:[4]

- multiple glazings,
- low-e coating,
- gas fill (e.g. with argon or krypton),
- warm edge spacers and improved frame material.

The most widely-used codes and standards for energy efficient windows, however, do not require any of these specific elements for qualified windows. Instead, in the building energy codes that are relevant for the Energy Bill tax credit the required energy performance of windows is expressed through the *U-factor*, which indicates the window's insulation value, and the s*olar heat gain coefficient (SHGC)*, which indicates the window's ability to control the heat gain from solar radiation. Normally, the lower either value is, the more energy efficient the window. To reach a low U-factor or SHGC, manufacturers may combine any of the above elements.

The International Energy Conservation Code

Among criteria for energy efficient buildings the 2000 International Energy Conservation Code (IECC 2000) includes criteria for window U-factors and SHGC values depending on U.S. climate zones. The IECC 2000 is the successor to the first national energy codes - the Model Energy Codes of the 1990s and the IECC 1998. The IECC 2000 established 3-year cycles of code changes, after each of which new versions of the code are published. In addition, supplements have been added during the cycles, such as the 2001 supplement to the 2000 edition and the 2004 supplement to the 2003 edition.

Overview of the relevant IECC revisions

- **IECC 2000** Edition – starts the 2000-2003 cycle of code changes, declares that new editions will be published in 3-year intervals
- **IECC 2001** Supplement
- **IECC 2003** Edition – begins the 2003-2006 cycle of code changes
- **IECC 2004** Supplement – simplifies the rules of the previous versions substantially

According to the language of the Energy Policy Act (EPAct 2005) the criteria for the tax credit are those included in the IECC 2000 and its supplements. The 2001 supplement does not change the U-factor and SHGC criteria set by the IECC 2000. In the 2004 supplement, however, the requirements for window U-factors and SHGC differ considerably from those of the earlier versions.

Some observers interpret EPAct 2005, Section 1333 in a way suggesting that the IECC code in effect on the date of the bill's enactment (August 2005) is the IECC 2004 supplement. This interpretation may be contested on the ground that Sec. 1333 refers to the IECC 2000, whereas the IECC 2004 is a supplement to the IECC 2003. Yet an examination of whether the IECC 2004 was intended to set the tax credit criteria is worthwhile. Which version of the IECC will be applied will have some impact on the stringency of the requirements and on the suitability of the ENERGY STAR label as a designation for qualifying windows.

In the following, major differences between the prescriptive requirements for windows in the different IECC versions are compared.

The IECC 2000

Which requirements in the IECC 2000 are relevant for the tax credit?

The 2000 edition of the International Energy Conservation Code includes several methods to determine window requirements for residential buildings. These requirements generally set standards for the construction of new buildings. However, it is not likely that the tax credit in Sec. 1333 of the Energy Bill is intended for windows in newly constructed homes. EPAct 2005 specifies that the tax credit applies for "energy efficiency improvements" to be installed in a residence "owned and used by the taxpayer", which does not read as if it can be applied to new construction. Furthermore, new homes are already covered by the Energy Bill provisions in *Sec. 1322, Credit for Construction of New Energy Efficient Homes*.

Nevertheless, Sec. 1333 does not explicitly exclude the possibility that the tax credit might be given for windows in newly constructed homes. Therefore, though unlikely, it may be that in certain cases the IECC 2000 requirements for new construction are relevant for the tax credit. The window requirements for new home construction can only be determined if the home's glazing area relative to the gross exterior wall area is taken into account, no matter if the Component Performance Approach is taken or the Simplified Prescriptive Requirements are used. Moreover, a distinction is made between detached one- and two-family dwellings and buildings containing three or more dwelling units. Since these building characteristics need to be considered, simple labels like the ENERGY STAR do not tell whether windows fulfill the IECC 2000 criteria for new homes if the window-to-wall ratio needs to be taken into account.

With that in mind, this paper will concentrate on what is more likely, namely that the tax credit will be given for improved glazing installations for existing homes. For replacement windows, the IECC 2000 includes separate criteria (Table 502.2.5, page 87) that are independent of building characteristics and depend only on the climate zone of the building's location. The IECC 2000 features 19 US climate zones for new construction criteria. For replacement windows, the IECC 2000 specifies 5 heating degree day "bins" for the U-factor and SHGC requirements.

On the following pages, IECC 2000 refers to the criteria for replacement windows in this code, since these are the IECC 2000 criteria most likely to apply to the tax credit, and since the compliance with these criteria can - to a certain extent – be measured by whether a window is ENERGY STAR labeled or not.

The IECC 2004

The IECC 2004 supplement substantially revises the 2003 edition of the IECC, which in turn is based on the IECC 2000 and its 2001 supplement. The IECC 2004 includes is the first part of a major set of changes to the IECC codes that will shrink the 2006 edition of the codes to less than half the volume of the 2003 edition and is predecessor, the 2000 edition.

The purpose of the 2004 revisions is to produce a code that will be easier to understand, use and enforce. The Building Energy Codes Program of the U.S. Department of Energy states the following advantages to the revisions included in the supplement:[5]

- Easier compliance due to redefined climate zones that:
    - are fewer in number than in previous versions (8 instead of 19)
    - take political boundaries into account
- Better integration of cooling considerations into climate zone criteria.
- Glazing requirements that are independent of window area, eliminating the majority of calculations needed to show compliance.
- U-factor requirements for individual windows are stricter.

The IECC 2004 requirements do not discriminate between different window-to-wall ratios. For central and northern regions the U-factor requirements of the IECC 2004 are slightly more stringent than the IECC 2000 requirements for replacement windows. In much of the warm south, however, the IECC 2004 requirements are less strict. This is most likely due to the fact that the IECC 2004 is most concerned with cooling requirements throughout the warm regions, for which the SHGC is seen as more crucial than the U-factor.

Shortcomings of the IECC in Terms of Consumer-Friendliness

For the purpose of implementing the tax credit, both versions of the IECC windows criteria have serious shortcomings in terms of consumer-friendliness:

- Many homeowners may never have heard of the IECC,
- It is not easy for consumers and retailers to find exact information about the IECC criteria, whether on the internet or as hard copies of the code,
- The IECC codes may confuse many readers since among their criteria for energy efficient buildings, window criteria are just one part. The IECC 2004, however, is less complex than the IECC 2000.

Compared to the IECC criteria, the ENERGY STAR criteria for windows have the following advantages:

- The ENERGY STAR logo is widely known and can easily be recognized by consumers,
- Consumers can make their purchase decisions by referring to the ENERGY STAR label without having to research the ENERGY STAR criteria themselves.

The ENERGY STAR criteria for windows follow the same principles as those of the IECC. However, several differences in detail exist. Therefore the ENERGY STAR criteria are described more closely in the following.

The ENERGY STAR Label

With the ENERGY STAR label, energy efficient windows can easily be recognized by consumers. The criteria for obtaining an ENERGY STAR label basically follow the same logic as the IECC criteria: Windows installed in the colder north require lower U-factors in order to keep homes warm, whereas windows in the warm south have less strict U-factor but stricter SHGC requirements. Due to these similarities, it can be assumed that ENERGY STAR labeled windows are more likely than other windows to qualify for the tax credit, regardless of which IECC version

determines the criteria. Indeed, the ENERGY STAR climate zones and criteria are inspired by the IECC model, so that there is considerable similarity. Nonetheless, some differences exist in the details if either IECC version is compared with ENERGY STAR.

How Good a Guide for the Tax Credit is ENERGY STAR?

The requirements for fenestration products to qualify for the ENERGY STAR label can generally be considered more stringent than the IECC requirements. Therefore, it is reasonable to assume that the installation of windows with the ENERGY STAR label would typically also qualify for the tax credit. Nevertheless, for each IECC version there are at least some jurisdictions where the requirements are stricter than those of ENERGY STAR. However, an ENERGY STAR "All Zones"-rated window qualifies for the tax credit in US jurisdictions for either the 2000 or 2004 IECC.

Most obviously, the ENERGY STAR label cannot guarantee that the IECC 2000 requirements for windows in new construction are met, since these requirements are subject to factors such as the window-to-wall ratio and the building type, which are not considered when windows are given the ENERGY STAR label. According to these criteria for new construction, houses in northern regions with window-to-wall ratios of more than 18 percent have stricter U-factor requirements than any ENERGY STAR requirement demands. It is not very likely that these complicated building-specific criteria can be used for the tax credit, which is after all designed to provide incentives for retrofits instead of initial construction. Concerning the IECC 2000 replacement window criteria or the IECC 2004 criteria, on the other hand, the ENERGY STAR is a far more helpful guide as to whether windows qualify.

The ENERGY STAR criteria are generally as strict as or stricter than those of the IECC. However, in some cases, most notably in New Mexico, Texas and North Carolina, the ENERGY STAR climate zones diverge considerably from the IECC zones. In other cases such as Oklahoma and California, the ENERGY STAR climate zones follow state boundaries, whereas the IECC zones are more accurately tuned to the climatic situation. The result is that ENERGY STAR does not meet the IECC 2000 or IECC 2004 requirements for a number of counties in these states. On a national basis, however, ENERGY STAR windows meet or exceed the IECC 2000 requirements in all but about 30 counties.

The Equivalent Energy Performance Amendment

Another problem for the compatibility between the IECC and ENERGY STAR standards is that the ENERGY STAR U-factor requirements for the southern regions provide a flexibility that the IECC does not directly accommodate.

Due to an amendment made in May 2005 (effective September 19, 2005), the ENERGY STAR requirements for windows in the South/Central (excluding California) and Southern climate zones can also be met with slightly higher U-factors than required by the standard criteria. As a trade-off, the windows must have lower-than-standard SHGCs. This is so because many impact-resistant hurricane windows using laminated low-e glass have higher U-factors but can save as much or more energy due to lower SHGCs. This trade-off is only possible in the warmer regions, since this is where the SHGC plays a similar or stronger role than the U-factor. The increased flexibility that the trade-off allows is intended to help create a greater market for windows that are both hurricane-resistant and qualify for the ENERGY STAR.[6] If related to the IECC standards, however, this has the effect that in many counties of the South the U-factor of ENERGY STAR qualified windows does not meet the requirements of IECC 2000 and/or IECC 2004.

Windows that bear the ENERGY STAR label for the South/Central (excluding California) and Southern zones only qualify for the ENERGY STAR because of the trade-off. Therefore, consumers should generally seek further information before assuming that windows with this label qualify for the tax credit. However, it is possible that DOE and the Treasury Department can deem the Equivalent Energy Performance Amendment as meeting the tax credit criteria.

On the following pages, the ENERGY STAR labels for the different climate zones are shown, followed by lists that illustrate the locations and the number of the cases where the different labels are not suitable as an indicator that the labeled window products qualify for the tax credit. The first set of lists is based on the assumption that the IECC 2000 criteria for replacement windows form the basis for the tax-credit, while the second list assumes the IECC 2004 as the basis.

ENERGY STAR labels show in which climate zones windows fulfill the ENERGY STAR criteria. The following ENERGY STAR labels exist:[7]

Figure 1

All Zones

Northern Only

Northern and North/Central

North/Central Only

North/Central, South/Central and Southern

South/Central and Southern

Southern Only

How to Find Out if the ENERGY STAR Requirements Meet the IECC Requirements?

Table 502.2.5 of the IECC 2000 and the ENERGY STAR criteria for residential windows, doors and skylights on the energy star website[8] can be consulted to compare the two standards. The IECC 2004 requirements for windows can be found in table 402.1 of the 2004 code. The ENERGY STAR and IECC 2004 tables include U-value and SHGC requirements, whereas the IECC 2000 requirements for the SHGC are stated separately in paragraph 502.1.5.

The different requirements for windows (excluding skylights) are summarized here:

Figure 2

IECC 2000 replacement window table		
Climate Zones (heating degree days in brackets)	U-factor	SHGC
1-4 (0-1,999)	0.75	0.40
5-7 (2,000-3,499)	0.50	0.40
8 (3,500-3,999)	0.50	N.A.
9-12 (4,000-5,999)	0.40	N.A.
13-17 (6,000-12,999)	0.35	N.A.

Figure 3

IECC 2004		
Climate Zones	U-factor	SHGC
1	1.20	0.40
2	0.75	0.40
3	0.65	0.40
4	0.40	N.A.
5-8	0.35	N.A.

Figure 4

ENERGY STAR		
Climate Zones	Fenestration U-factor	Fenestration SHGC
Southern	0.65-0.75*	0.33-0.40*
South / Central	0.40-0.43*	0.24-0.40*
North / Central	0.40	0.55
Northern	0.35	N.A.

*These numbers are variable due to the Equivalent Energy Performance Amendment

The climate zones of the different standards roughly correspond in the following way:

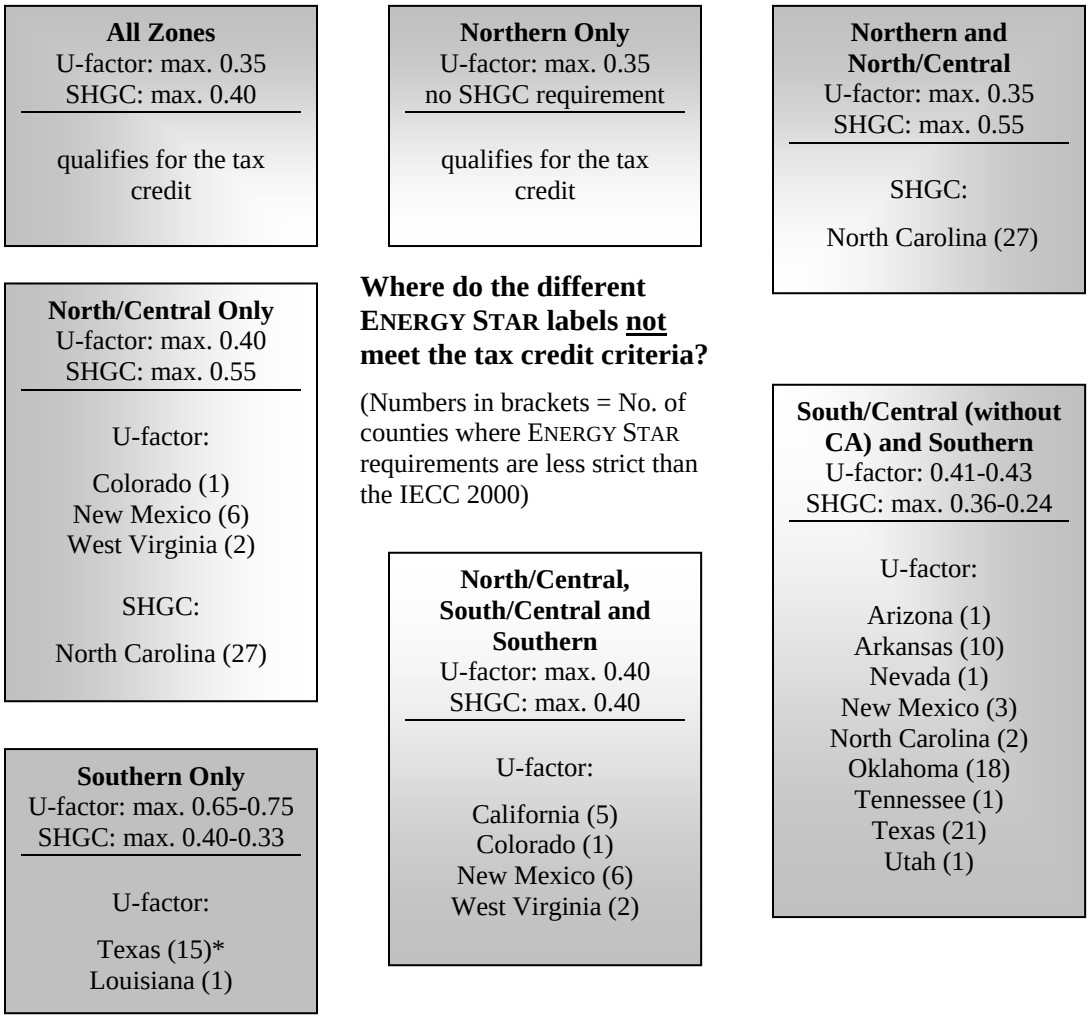
Figure 5

IECC 2000	IECC 2004	ENERGY STAR
zone 1-4	zone 1-2	Southern zone
5-7	3	South/Central
8-11	4	North/Central
12-17	5-8	Northern

Wherever the climate zones correspond as shown above, the ENERGY STAR standards are at least as strict as those of the IECC codes. However, there are also many areas where the climate zones do not correspond like this, and where a county-by-county comparison is required in order to verify that the ENERGY STAR criteria meet those of IECC 2000 or IECC 2004. The Alliance to Save Energy did such a county-by-county comparison of IECC 2000, IECC 2004 and ENERGY STAR windows criteria. The results of this comparison are summarized in the tables in Attachment 1.

ENERGY STAR and the IECC 2000 Criteria (for replacement windows)[9]

Figure 6



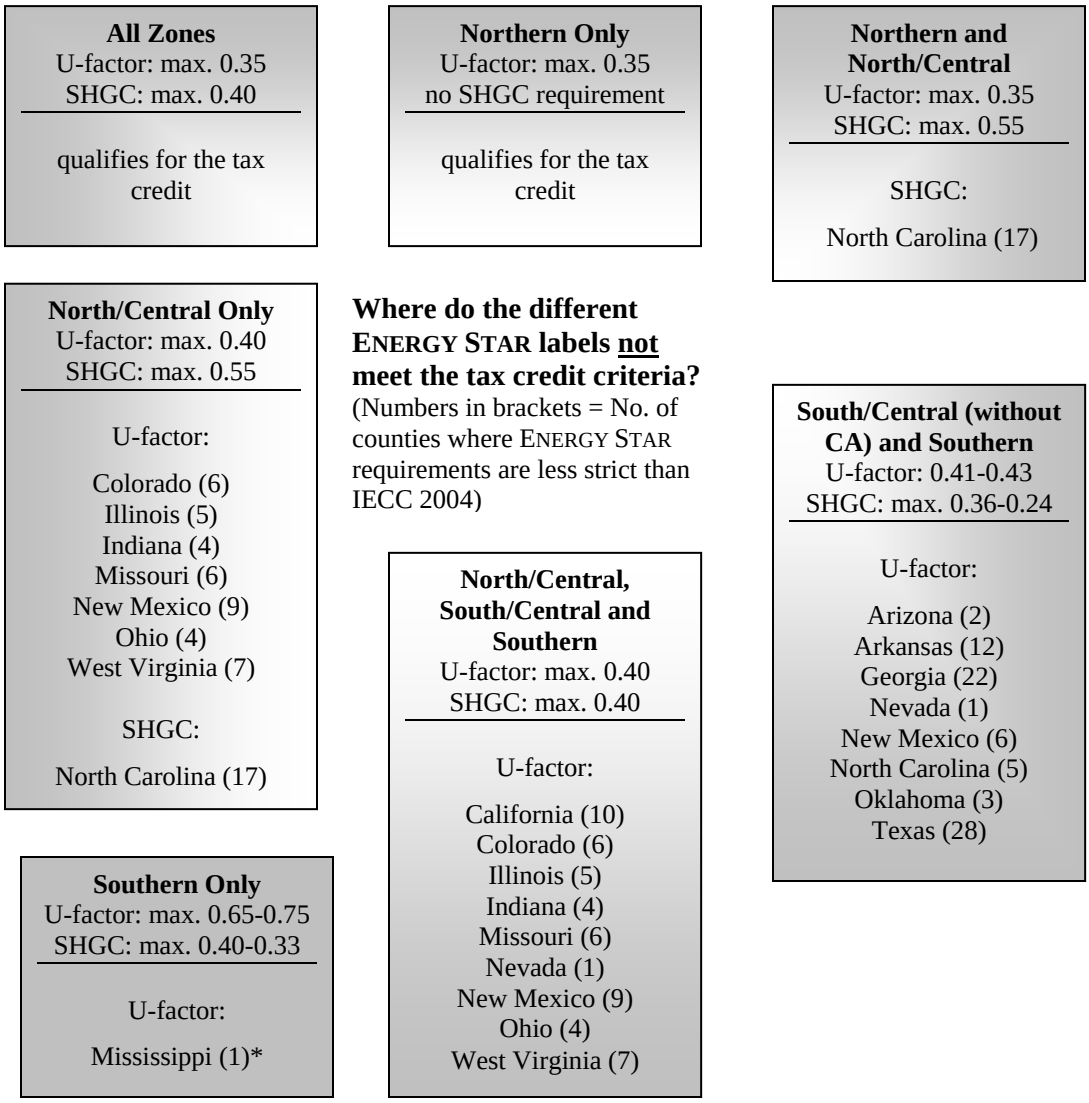
* In 15 Texas counties, not only windows but also skylights with the Southern label might fail to qualify under the IECC 2000 criteria.

From the above lists it can be seen that the label for the South/Central and Southern climate zones have the greatest challenge in meeting the tax credit criteria. This label is issued for windows that receive the ENERGY STAR due to the Equivalent Energy Performance Amendment. The amendment allows for windows in the Southern and South/Central climate zones (excluding California) to have slightly higher U-factors than the usual 0.40. Consequently, in many parts of the region windows with this label do not meet the published IECC criteria.

The other ENERGY STAR labels are better suited for indicating that windows qualify for the tax credit. Both the label for all climate zones and that for the Northern zone meet and exceed the tax credit criteria, and windows with the other labels meet the tax credit criteria unless they are installed in a number of counties where the IECC 2000 climate zones are based on different assumptions than the ENERGY STAR climate zones.

ENERGY STAR and the IECC 2004 Criteria

Figure 7



* In addition to windows, skylights with the Southern label might also fail to qualify under the IECC 2004 criteria for Anacoco County in Mississippi.

If the IECC 2004 is used for the tax credit criteria, windows that receive the ENERGY STAR designation through the Equivalent Energy Performance Amendment are even less likely to qualify than if the criteria are based on the IECC 2000. This is because the IECC 2004 has slightly more rigid criteria, requiring a 0.40 U-factor for many counties where the IECC 2000 only requires a 0.50 U-factor. However, the respective ENERGY STAR labels for the Northern, for the Southern (with the exception of one Mississippi county), and for all climate zones meet the tax credit criteria based on the IECC 2004.

Comparing the compatibility of the ENERGY STAR criteria with both the IECC 2000 and the IECC 2004 criteria, a slightly better match with the IECC 2000 is apparent. However, both sets of IECC

criteria have in common that only two ENERGY STAR labels provide definite information about whether windows qualify. Windows with the other ENERGY STAR labels may require customers to verify that their home is not situated in a county where ENERGY STAR is less stringent than the applied version of the IECC, unless DOE and the Treasury Department rule that they are equivalent.

Conclusion

If compared with the IECC 2004, the IECC 2000 requirements for replacement windows are slightly more compatible with the ENERGY STAR requirements. Consequently, the ENERGY STAR will indicate more accurately whether windows qualify for a tax credit if it is based on the IECC 2000 replacement window criteria than if based on the IECC 2004. The IECC 2004 version, on the other hand, has its own advantages: it is easier to apply, takes the growing demand for cooling into account, and sets slightly more stringent standards. In addition, the IECC 2004 standards form the basis of the criteria for the *Sec. 1333 New Energy Efficient Home Credit* in the Energy Policy Act. Since it is desirable to achieve a certain consistency among the standards for the different national programs for residential energy efficiency, the advantages of applying the IECC 2004 standards may outweigh the slightly higher effort necessary to verify the qualification of ENERGY STAR labeled windows. However, it is the IECC 2000 that is explicitly written into the legislation.

Regardless of which IECC version is applied, consumers will need further information in order to verify that the tax credit requirements for their county are really met by ENERGY STAR windows. This is regrettable, since the ENERGY STAR label otherwise provides consumers with a simple means to assess the energy performance of products. Nonetheless, as long as the tax credit is based on the fairly straightforward IECC 2000 replacement window or IECC 2004 criteria, an ENERGY STAR label does at least indicate that the labeled window qualifies for the tax credit in virtually all of the 3,111 US counties and jurisdictions. Consumers in nearly all U.S. counties may be encouraged to install ENERGY STAR windows and profit from the incentive in the Energy Bill. The task ahead will be to provide salespeople and consumers with information about the few counties where this is not the case, so that a good level of clarity about the location-specific requirements can be reached before the tax credit takes effect in January 2006.

Outlook: Can the ENERGY STAR Standards Reasonably be Integrated with the Tax Credit Criteria?

The concept of the IECC 2000, IECC 2004 and ENERGY STAR criteria for energy efficient windows follow the same principles: The maximum U-factor and SHGC of windows are set according to the cooling and heating needs of the different climatic regions of the nation. Does this mean that the ENERGY STAR criteria could be a reasonable part of the tax credit criteria in addition to the IECC? Would it diffuse the purpose of the tax credit if all ENERGY STAR windows were to qualify?

In general, the U-factor and SHGC standards are similar among the IECC codes and ENERGY STAR, with the latter being slightly more stringent in many areas. Therefore it can be said that the intentions behind the IECC codes are fulfilled if consumers buy ENERGY STAR windows, and that these often offer a higher standard than required by the IECC. If the Equivalent Energy

Performance Amendment is left aside, there are only some 30 odd counties in the U.S. where the IECC 2000 requires a stricter U-factor than ENERGY STAR, and 27 counties where it requires a stricter SHGC (see the tables in Attachment 1 for details). This is due to slight differences in the way the borders between climate zones are drawn, such as the fact that the borders of the ENERGY STAR climate zones follow state borders wherever practical as opposed to the more detailed IECC climate zones.

As can be seen on the previous pages, if ENERGY STAR windows do not meet the IECC standards this is mostly due to the Equivalent Energy Performance Amendment. However, this does not mean that the amendment makes the ENERGY STAR standards less effective. On the contrary, after in-depth stakeholder discussions the Department of Energy concluded that the higher SHGC requirements that are part of the amendment ensure that windows offer the same or better energy efficiency after the trade-off. [10]

The IECC and ENERGY STAR are similar in purpose – to set standards for efficient windows according to climatic conditions. Moreover the ENERGY STAR label offers an advantage that the IECC does not offer: it is a simple and effective tool to make the market for efficient windows transparent to consumers. There are several advantages of the ENERGY STAR compared to the IECC when it comes to recognizing whether windows qualify for the respective standards:

- ENERGY STAR: Qualified windows can easily be recognized due to their labels. This way, customers can find qualified windows even if they are not informed about the qualification criteria.
  - IECC criteria: In order to verify that windows qualify, customers must know the criteria. It is not realistic to assume that customers sort through the detailed IECC codes, even less so since these are not widely available. Web resources such as the Efficient Windows Collaborative website[11] can help consumers find out what the criteria for specific regions are, but the practical problem here is that consumers do not necessarily know about these websites.
- The ENERGY STAR label includes a map that shows where a window qualifies. If a window qualifies only in parts of a state and it is not clearly visible whether this includes the consumer's home county, more detailed information can be found on the ENERGY STAR website. This website is widely known among window salespeople and many consumers.
- Only 20 states are divided by multiple ENERGY STAR climate zones. In the other 30 states, retailers and customers can be sure that the same criteria for Energy Star windows apply throughout the state. In contrast, the IECC 2000 divides all states except Hawaii into multiple climate zones. The IECC 2004 climate zones divide 39 of the 50 states.

To sum up, if all ENERGY STAR were to qualify for the tax credit, the same general purpose as with the IECC criteria alone would be served: consumers receive an incentive to install energy efficient windows according to strong criteria. However, the important first step – that consumers find out which these efficient windows are – is far easier and more straightforward with an established and widely-known label such as the ENERGY STAR.

In light of the analysis and findings presented in this paper, the Alliance to Save Energy offers the following recommendations for implementation of the residential windows tax credits:

- If the 2000 IECC is deemed to be the correct reference standard, the IECC 2000 replacement window table (502.2.5) should be adopted as the fundamental criteria for the residential tax credits. In the 2004 IECC, Table 402.1 would be the appropriate criteria.
- The "All Zones" ENERGY STAR label (see Figure 1 on page 8) should be promoted as the primary indicator for qualifying windows, since it provides a "safe harbor" for fulfilling the IECC criteria for windows.
- If it is within the discretion of the IRS, we recommend that:
    - Fenestration products with any ENERGY STAR label should be deemed to meet the IECC windows requirements in the regions indicated on the respective label;
    - The acceptance of the ENERGY STAR label for tax credit compliance should also be extended to the new DOE Equivalent Energy Performance Amendment criteria effective on September 19, 2005. DOE has come to the conclusion that windows conforming with this amendment perform equally good or better than envisaged by the standard ENERGY STAR criteria. Moreover, this amendment sends positive market signals by allowing more hurricane windows to qualify in the South.
- Campaigns to promote the residential windows tax credits should focus on an ENERGY STAR message for consumers. This will build on the existing significant public awareness of the ENERGY STAR label and the established network of ENERGY STAR partners. Embracing the ENERGY STAR label for this purpose will eliminate market confusion about qualifying fenestration products, simplify tax rule compliance and provide for simple messaging to the public for maximum participation.

Attachment 1

Attachment 1: Comparison - In how many counties per state do the ENERGY STAR requirements not meet the different IECC standards?

STATE	no. of counties or equivalent	IECC 2000							IECC 2004		
		U-factor						SHGC (replacement + new contruct.)	windows		skylights
		new construction, window area				replacement					
		25%	20%	18%	15%	windows	skylights		U-factor	SHGC	U-factor
Alabama	67	12	12	0	0	0	0	0	0	0	0
Alaska	36*	36	36	36	16	0	0	0	0	0	0
Arizona	15	5	4	3	0	1	0	0	2	0	0
Arkansas	75	31	31	10	0	10	0	0	12	0	0
California	58	12	12	8	5	5	0	0	10	0	0
Colorado	64	64	64	64	1	1	0	0	6	0	0
Connecticut	8	8	8	4	0	0	0	0	0	0	0
Delaware	3	3	3	1	0	0	0	0	0	0	0
DC	1	1	1	1	0	0	0	0	0	0	0
Florida	67	67	34	34	0	0	0	0	0	0	0
Georgia	159	42	42	23	0	0	0	0	22	0	0
Hawaii	5	5	0	0	0	0	0	0	0	0	0
Idaho	44	44	44	38	0	0	0	0	0	0	0
Illinois	102	102	101	77	0	0	0	0	5	0	0
Indiana	92	92	80	60	0	0	0	0	4	0	0
Iowa	99	99	99	99	0	0	0	0	0	0	0
Kansas	105	105	104	83	0	0	0	0	0	0	0
Kentucky	120	120	120	77	0	0	0	0	0	0	0
Louisiana	64	36	36	36	0	1	0	0	0	0	1
Maine	16	16	16	16	0	0	0	0	0	0	0
Maryland	24	24	24	11	0	0	0	0	0	0	0
Massachusetts	14	14	14	9	0	0	0	0	0	0	0
Michigan	83	83	83	83	0	0	0	0	0	0	0
Minnesota	87	87	87	87	0	0	0	0	0	0	0
Mississippi	82	6	6	6	0	0	0	0	0	0	1
Missouri	115	97	97	83	0	0	0	0	6	0	0
Montana	56	56	56	56	0	0	0	0	0	0	0
Nebraska	93	93	93	93	0	0	0	0	0	0	0
Nevada	17	16	16	8	1	1	0	0	1	0	0
New Hampshire	10	10	10	10	0	0	0	0	0	0	0

*Although Alaska consists of only 27 boroughs, IECC 2000 divides it into 36 parts for the sake of climate measurement.

Attachment 1

STATE	no. of counties or equivalent	IECC 2000							IECC 2004		
		U-factor						SHGC (replacement + new contruct.)	windows		skylights
		new construction, window area				replacement					
		25%	20%	18%	15%	windows	skylights		U-factor	SHGC	U-factor
New Jersey	21	21	17	11	0	0	0	0	0	0	0
New Mexico	33	26	25	14	6	9	0	0	15	0	0
New York	62	62	55	51	0	0	0	0	0	0	0
North Carolina	100	43	43	8	0	2	0	27	5	17	0
North Dakota	53	53	53	53	0	0	0	0	0	0	0
Ohio	88	88	87	65	0	0	0	0	4	0	0
Oklahoma	77	40	40	18	0	18	0	0	3	0	0
Oregon	36	32	18	13	0	0	0	0	0	0	0
Pennsylvania	67	67	58	42	0	0	0	0	0	0	0
Rhode Island	5	5	5	5	0	0	0	0	0	0	0
South Carolina	46	0	0	0	0	0	0	0	0	0	0
South Dakota	66	66	66	66	0	0	0	0	0	0	0
Tennessee	95	65	65	11	0	1	0	0	0	0	0
Texas	254	109	100	90	15	36	15	0	28	0	0
Utah	29	29	27	19	0	1	0	0	0	0	0
Vermont	14	14	14	14	0	0	0	0	0	0	0
Virginia	95	72	72	43	0	0	0	0	0	0	0
Washington	39	39	21	9	0	0	0	0	0	0	0
West Virginia	55	55	52	36	2	2	0	0	7	0	0
Wisconsin	72	72	72	72	0	0	0	0	0	0	0
Wyoming	23	23	23	23	0	0	0	0	0	0	0
total	3111**	2367	2246	1779	46	88	15	27	130	17	2
%age of total		76%	72%	57%	1.5%	2.8%	0.5%	0.9%	4.2%	0.5%	0.06%

Results, if the Equivalent Energy Performance Amendment is not taken into account (i.e. if just the standard ENERGY STAR criteria are compared with the IECC):

total	3111**	2200	2052	1576	30	30	15	27	52	17	2
%age of total		71%	66%	51%	1%	1%	0.5%	0.9%	1.7%	0.5%	0.06%

** At present, the U.S. consists of 3,086 counties. However, for the purpose of the ENERGY STAR and IECC standards, a total of 3,111 jurisdictions are taken into consideration, including the Alaska boroughs and the District of Columbia.

[1] http://www.energystar.gov/index.cfm?c=products.pr_tax_credits
[2] Blum, Justin. "Oil and Gas Heating Costs to Soar This Winter". *The Washington Post*. October 13, 2005. Page D02. Available at: http://www.washingtonpost.com/wp-dyn/content/article/2005/10/12/AR2005101202199.html
[3] See: Apte, Joshua, Arasteh, Dariush and Yu Joe Huang. *Fututre Advanced Windows for Zero-Energy Homes*. 2003. Available at www.lbl.gov: 1.
[4] *ENERGY STAR Qualified Windows, Doors & Skylights: The Basics*. Available at: http://www.energystar.gov/ia/partners/manuf_res/windows/ENERGY_STAR_BASICS_7-18-05-final.ppt#256,1,ENERGY STAR® Qualified Windows, Doors & Skylights: The Basics
[5] U.S. Department of Energy. Building Energy Codes Program. *2006 International Energy Code: Easier to Use and Enforce*. September 2005. Available at: http://www.energycodes.gov/implement/doe_2004_proposals.stm
[6] Department of Energy. May 2005. Available at: http://www.nfrc.org/documents/EEPAmendmentAnnouncementLetter-Final-51705.pdf
[7] The labels are available on the ENERGY STAR website at http://www.energystar.gov/index.cfm?c=windows.display_unit_labels
[8] http://www.energystar.gov/index.cfm?c=windows_doors.pr_crit_windows
[9] The ENERGY STAR criteria and climate zones for each state and county can be found in *ENERGY STAR Climate Zones By State, County and City*. Available at: http://www.energystar.gov/ia/partners/manuf_res/windows/ES_Climate_Zones_by_County.xls
[10] Department of Energy. May 2005. Available at: http://www.nfrc.org/documents/EEPAmendmentAnnouncementLetter-Final-51705.pdf
[11] www.efficientwindows.org/code.cfm

Appendix

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Energy Efficient Mortgages Help Reduce the Energy Consumption of Homes

Presented by the Efficient Windows Collaborative

Financial and Environmental Benefits

Consumers looking to buy or renovate a home have every reason to consider including energy efficiency in the design. Fuel prices are at record highs, and the impact of this is only just beginning to hit consumer pocketbooks. Meanwhile mortgage rates are on the rise, meaning that the amount of money for which a consumer may qualify is declining. However, consumers can actually lower their energy bills and qualify for larger loans by adding energy efficient home features financed through energy efficient mortgages (EEMs). Energy-efficient windows for example can reduce heating and cooling energy costs by up to 30%, so they are perfectly suited to be financed through EEMs. Energy efficiency features in new and existing construction save energy, raise the value of the home, and help mitigate the growth of energy consumption that affects human health and the environment.

Growing demand for electricity is putting a strain on human health and our nation's resources. The residential sector plays a significant role in this regard. According to the Energy Information Administration, residential CO_2 emissions grew by 28 percent between 1990 and 2003[1]. This pollution contributes to global warming, increasing the danger of coastal flooding in the Gulf of Mexico, heat related health hazards, and species extinction.[2] Air pollution from electricity generation can also cause respiratory diseases and chronic illnesses such as asthma and bronchitis, especially among children and the elderly. Power generation also decreases the available water supply. For every kWh of electricity generated, coal-fired plants use 2/3 gallon of water and natural gas-fired plants use 1/3 gallon of water. By reducing the growth in electricity demand, energy efficiency in the residential sector can improve human health and preserve valuable resources.

Energy efficiency as a resource that is quick to employ and can help meet the growing demand for energy while reducing the problems produced by electricity generation. The experience of the Alliance to Save Energy shows that available energy efficiency technologies can reduce residential energy consumption by 20 to 50 percent. However, the cost of energy efficient technologies poses a considerable barrier to their large-scale adoption in homes. Energy efficient mortgages are an important tool in overcoming these barriers, and give consumers financial incentives to apply the energy efficiency options available.

[1] U.S. DOE. Energy Information Administration. www.eia.doe.gov/oiaf/1605/flash/flash.html. July 2004.
[2] NRDC. www.nrdc.org/globalWarming/f101.asp. July 2004.

How EEMs Work

Banks offering EEMs recognize that energy efficiency will lower a consumer's energy bill, and that consequently a consumer will have more cash available for a larger mortgage payment. "After the mortgage payment, the monthly utility bill is usually a family's next largest housing-related expense," reports Michelle Desiderio, Senior Product Developer at Fannie Mae, the nation's largest source for home mortgage funds. EEMs also encourage the use of utility and manufacturer rebates, by allowing these rebates to be applied toward the loan transaction under some programs. Below is a comparison of a regular mortgage and an EEM from Fannie Mae:

Comparison of Standard and Energy Efficient Mortgages

	Non Energy Efficient Home	**Energy Efficient Home**
Purchaser Price	$200,000	$203,000
Borrower Contribution	$6,000	$6,090
Loan Amount	$160,000	$162,400
Interest	5.85%	5.85%
Monthly PITI	$1673	$1698
Average Electric Bill	$186	$93
Total Expenses	$1859	$1791
Qualifying Income	$49,000	$48,584
Monthly Savings		**$68**

Source: Fannie Mae

Although this example assumes that it will cost more to build an energy efficient home, Fannie Mae has found that many builders are able to build efficient homes with little additional expense. This means the savings to the consumer could be even greater.

The Benefits of EEMs

There are a number of benefits to EEMs according to Steve Baden, Executive Director of Residential Energy Services Network (RESNET). This organization is dedicated to qualifying more families for home ownership and improving the energy efficiency of the nation's housing stock by expanding the national availability of mortgage financing options and home energy ratings. Baden reports that increasing the number of energy efficient homes through EEMs helps to:

- Reduce the cost of home ownership
- Reduce America's dependence on imported oil
- Qualify more first-time home buyers for mortgage loans

Baden reported that a recent analysis by the Environmental Protection Agency found that an average of 6.8% more families would be able to qualify for a mortgage through the energy efficient mortgage model.

Other benefits are:

- Quality assurance with required third-party energy rating report
- More comfortable homes in all climates

Greater Accessibility to EEMs

EEMs are offered through several different programs in the secondary mortgage market. Fannie Mae, Freddie Mac, the Department of Housing and Urban Development (HUD) Federal Housing Administration, and the Veteran's Administration offer programs to increase energy efficiency through EEMs.

Energy efficient mortgages are a critical but underutilized vehicle that can yield significant energy savings. Sadly, many homebuyers and homeowners are not yet aware of this resource available to them. Information campaigns that include the community level are highly desirable to raise awareness of EEMs among realtors, counselors, builders, contractors and homeowners alike. A further spread of pilot EEM projects will solidify the experience with this financing mechanism and educate homeowners about its benefits.

Luckily, the availability of EEMs is increasing. The number of banks offering this type of mortgage product has grown significantly in recent years. Michelle Desiderio at Fannie Mae reports a trend that larger banks now offer EEMs. Countrywide Home Loans and Wachovia have been strong partners in promoting energy efficient mortgages, and Citibank has recently joined the ranks of companies offering EEMs. As Desiderio points out, "Fannie Mae is excited that Citibank—a financial leader—is promoting EEMs. This is helping to increase accessibility to EEMs for homeowners across the nation."

Resources for Manufacturers

For consumers looking to add energy efficiency features such as energy efficient windows to a new design or to an existing home, cost is an important part of the decision process. Sales forces can help consumers make the decision for energy efficiency by educating them about the availability of EEMs.

Fannie Mae has a wide range of products to choose from. The company has designed a brochure that can be downloaded from the web or is available for bulk ordering that makes EEMs easy for consumers to understand. You can find out more about these products at http://www.efanniemae.com/sf/mortgageproducts/fixed/energyefficient.jsp.

RESNET has compiled information on available products into one location online at www.natresnet.org/ratings/default.htm. RESNET also provides a searchable list for home energy raters who can help consumers identify home energy efficiency improvements needed and evaluate the performance of the home to help qualify homeowners for EEMs.

Appendix

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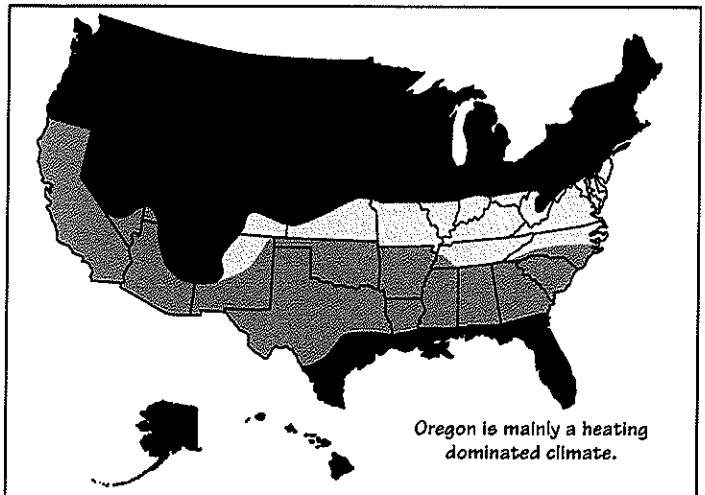
Efficient Windows Collaborative

Fact Sheet: Selecting Energy Efficient Windows in Oregon

www.efficientwindows.org March 2006



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®

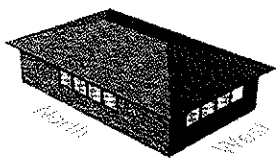
The Department of Energy (DOE) and the Environmental Protection Agency (EPA) have developed an Energy Star (www.energystar.gov) designation for products meeting certain energy performance criteria. Since performance of windows and skylights vary by climate, product recommendations are given for the four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

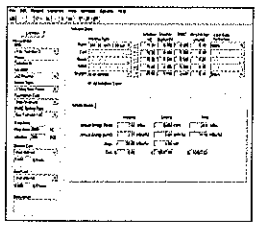
3. Compare Annual Energy Costs for a Typical Housew

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.

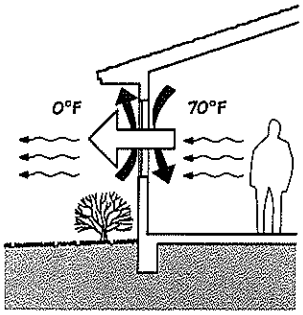


4. Customize Energy Use Calculations for a Specific House

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.

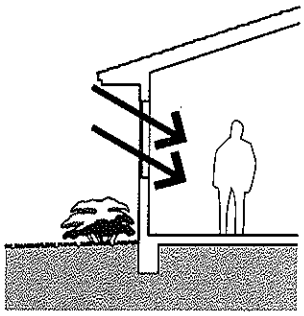


Look for Efficient Window Properties on the NFRC Label



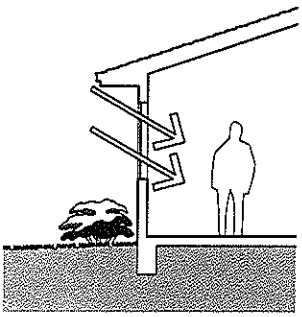
U-Factor

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.



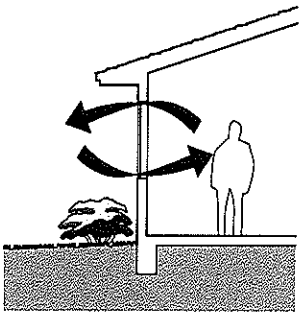
Solar Heat Gain Coefficient (SHGC)

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.



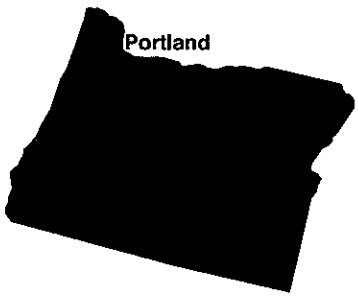
Visible Transmittance (VT)

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)

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.

* 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.

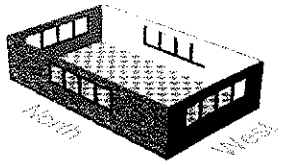
Efficient Windows Collaborative
This fact sheet was produced with funding from the Windows and Glazings Program at the U.S. Department of Energy (www.eren.doe.gov) in support of the EWC. For more information, contact:

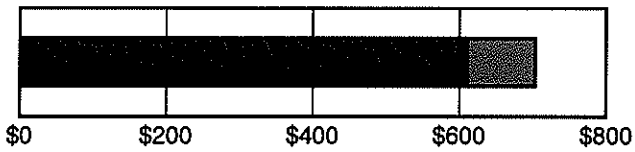
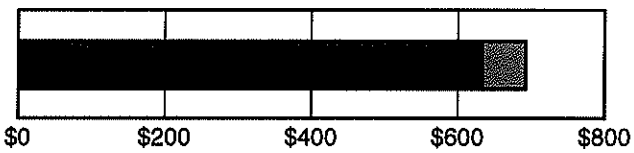
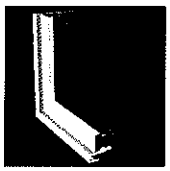
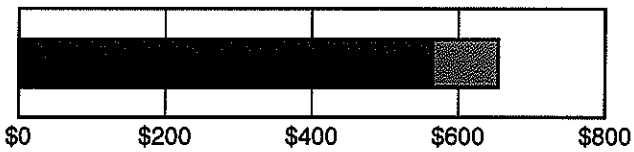
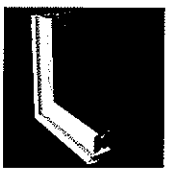
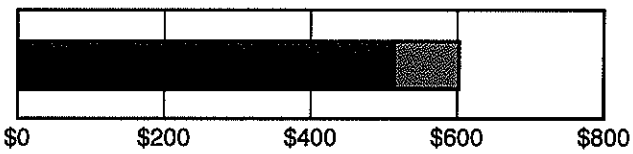
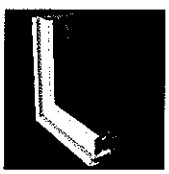
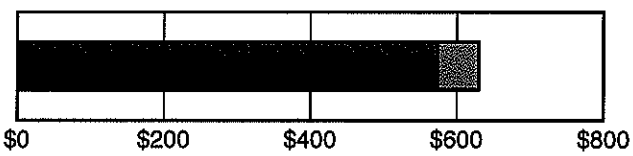
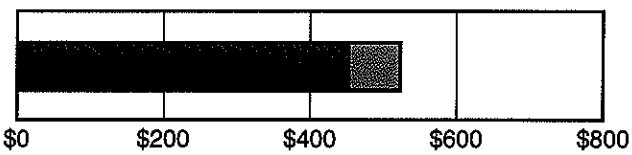
EWC/Alliance to Save Energy
1200 18th Street NW, Suite 900
Washington, D.C. 20036
phone 202-857-0666
fax: 202-331-9588
www.ase.org
www.efficientwindows.org

Residential Windows Book
Carmody, J., S. Selkowitz, D. Arasteh, and L. Heschong. Residential Windows: New Technologies and Energy Performance, 3rd ed. New York, NY: W.W. Norton & Company, 2006.

Comparing Window Performance in Medford, Oregon

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). *

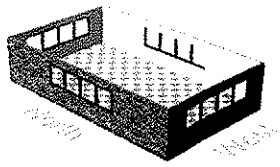


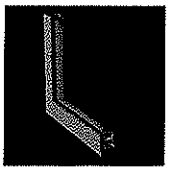
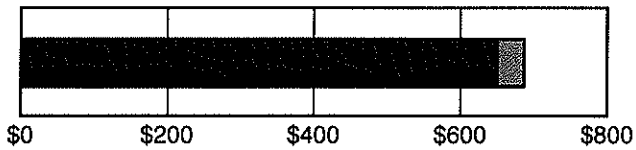
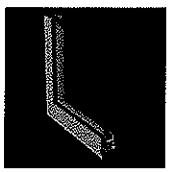
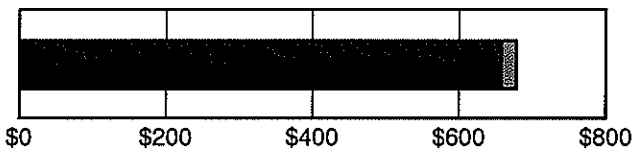
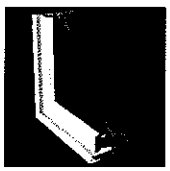
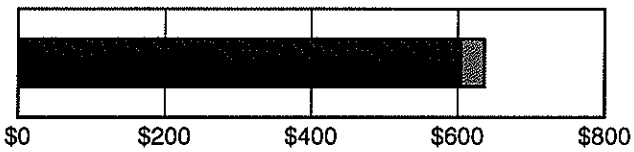
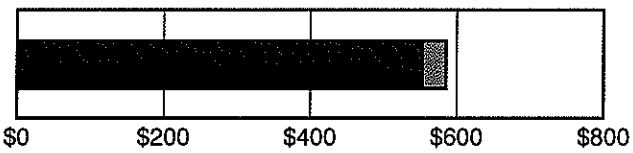
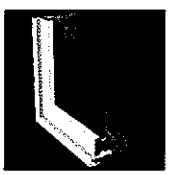
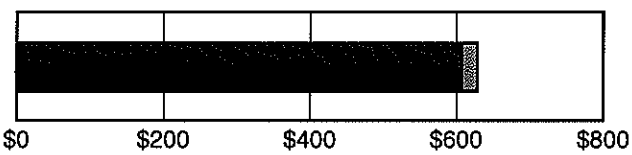
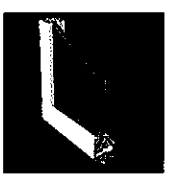
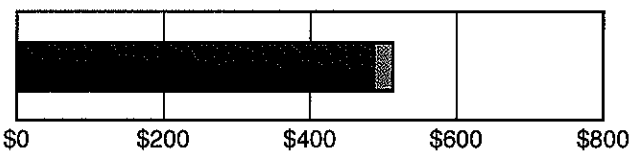
Case Studies	Properties	Annual Energy Use	Costs
 **CASE 1** double glazing clear glass aluminum frame w/ thermal break	U = 0.63 SHGC = 0.62 VT = 0.62		Heating $610.08 Cooling $93.23 Total $703.31
 **CASE 2** double glazing low-E coating (low solar gain) argon gas fill aluminum frame w/ thermal break	U = 0.47 SHGC = 0.33 VT = 0.53		Heating $632.92 Cooling $59.71 Total $692.63
 **CASE 3** double glazing clear glass vinyl/wood frame	U = 0.49 SHGC = 0.56 VT = 0.58		Heating $566.39 Cooling $86.88 Total $653.27
 **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 $518.32 Cooling $84.48 Total $602.80
 **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 $577.02 Cooling $57.36 Total $634.38
 **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 $454.97 Cooling $71.18 Total $526.15

*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 costs shown here are annual costs for space heating and space cooling only and thus will be less than total utility bills. Costs 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 2005 average costs for electricity and natural gas (natural gas, $1.328/therm and electricity, $0.072/kWh). All data is provided by the Energy Information Administration (www.eia.doe.gov). RESFEN is computer program for calculating the annual cooling and heating energy use and costs due to window selection. It is available from Lawrence Berkeley National Laboratory (windows.lbl.gov/software/resfen).

Comparing Window Performance in Portland, Oregon

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 $650.32 Cooling $37.57 Total $687.89
 **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 $662.80 Cooling $20.86 Total $683.66
 **CASE 3** double glazing clear glass vinyl/wood frame	U = 0.49 SHGC = 0.56 VT = 0.58		Heating $603.18 Cooling $34.75 Total $637.93
 **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 $553.24 Cooling $33.85 Total $587.09
 **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 $605.83 Cooling $20.56 Total $626.39
 **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 $488.17 Cooling $27.71 Total $515.88

*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 costs shown here are annual costs for space heating and space cooling only and thus will be less than total utility bills. Costs 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 2005 average costs for electricity and natural gas (natural gas, $1.328/therm and electricity, $0.072/kWh). All data is provided by the Energy Information Administration (www.eia.doe.gov). RESFEN is computer program for calculating the annual cooling and heating energy use and costs due to window selection. It is available from Lawrence Berkeley National Laboratory (windows.lbl.gov/software/resfen).

Word On Windows
a publication of the Efficient Windows Collaborative and the Alliance to Save Energy Fall 2001, Volume 4 Number 2

Texas Prepares to See Cleaner Air With High Performance Windows

State adopts building energy performance standards based on International Energy Conservation Code (IECC)

With the innovative leadership of some of its major cities, the state of Texas has agreed to establish energy codes that will save money, reduce fossil fuel consumption and, most importantly, help improve air quality. While it may seem a leap to think of efficient windows as a strategy for reducing nitrogen oxide emissions, the Texas experience pioneers the concept of using energy standards as a compliance tool to meet federal air quality standards.

The new laws set the 2000 International Energy Conservation Code (IECC) as the Lone Star State's first state energy code, and also adopt the 2000 International Residential Code (IRC.) With the new laws, the entire state catches up to some of its leading cities such as Austin, Texas that have been at the forefront of promoting more efficient construction.

Earlier this Spring, EWC members provided technical assistance and other support for local groups of politicians, builders, code officials and other stakeholders in the Dallas/Ft. Worth Metroplex and Houston as they considered the benefits of using high-efficiency windows in meeting code requirements. The IECC requires that windows in most Texas cities meet standards for reducing solar heat gain. (SHGC must be less than or equal to .40 in climate zones with less than 3500 heating degree days.) The IECC standard is expected to reduce cooling energy use by as much as 25%. Since electricity generation is a major contributor to nitrogen oxide emissions, and since electric air conditioning loads peak during the summer ozone season, the IECC appears to be a reasonable tool for improving air quality in cooling-dominant states like Texas. With Dallas, Ft. Worth, Houston and other major cities looking to tighten energy requirements, it made sense for the state to make the codes uniform.

In Texas Senate Bill (SB) 5, the new energy codes are expected to help reduce air pollutant emissions affecting health, moderate future peak electric power demand assuring reliability, and to control energy costs for residents and businesses in the state. With the headlines about blackouts in California and air quality issues, the timing may be right for some new thinking about how to balance energy needs. "An ounce of prevention is worth a pound of cure," said Tom Fitzpatrick, executive director of the Texas Building Energy Institute and a strong promoter of the code adoption. "Any state or local economy trying to compete in a global marketplace while its building sector is wasting energy is shooting itself in the collective foot — with unnecessary burden on its manufacturing costs and family budgets, increased health care costs, and the downstream cost of repairing environmental damage that could have been avoided."

The 2000 version of IECC references the use of NFRC ratings to verify code compliance, with default table values as the only option to certification. The new laws require that municipalities establish procedures for energy code administration and enforcement and ensure that code-certified inspectors perform inspections. Local procedures must be in place by September 2002.

I N S I D E

Looking Beyond Texas

The Alliance to Save Energy, working with Lawrence Berkeley National Laboratory, recently completed a study of the International Energy Conservation Code's (IECC) window standards in the ten most affected southern states. The analysis found that in these ten states, adoption of the IECC could save approximately 400 million kWh, $38 million in electricity bills and 233 MW of peak electric generating capacity each year.

Over 20 years, savings would accumulate to 8 billion kWh, $760 million in savings and 4660 MW. This 20-year electric energy savings would also prevent the emission of 20,000 tons of nitrogen oxide and over 1.5 million tons of carbon equivalent.

A copy of the analysis is available on the Collaborative website at www.efficientwindows.org under "What's New."

EFFECTIVE ENERGY CODES: PART II

WINDOW PERFORMANCE REQUIREMENTS FOR NEW HOME CONSTRUCTION IN MODERN BUILDING ENERGY EFFICIENCY CODES

By Garrett Stone and Eric DeVito

[This article is the second in a series related to effective window-related provisions of energy codes.]

Specific fenestration energy performance requirements in codes have evolved remarkably over the past few years as the perception of the role of fenestration in energy efficient buildings has changed. Prior to the advent of NFRC, fenestration was generally viewed in codes as something to be limited or offset by increased wall, floor and roof R-values.

However, much of this perception changed in the 1990s as the national model codes were revised to recognize the crucial role of windows in building energy efficiency. With NFRC as a foundation, modern building energy efficiency codes have established performance levels for fenestration products, incorporated solar heat gain coefficient into the codes, and developed simplified paths to code compliance that do not require complex energy trade-off calculations.

The culmination of all of these efforts is the 2000 International Energy Conservation Code (IECC), which is the current, nationally accepted model energy code. The 1992 Energy Policy Act requires that states must review the 2000 IECC when considering adoption of an energy code. This code also serves as the basis for the energy requirements of the International Residential Code ("IRC"), which has a simplified energy efficiency chapter.

What Are the IECC/IRC Window Requirements for New Homes?

For those jurisdictions that have adopted the 2000 IECC and/or IRC, builders must comply with window U-factor, SHGC and air infiltration requirements. (With a few notable exceptions, most states do not develop their own unique energy codes, instead relying on model codes.)

IECC/IRC SHGC requirements do not vary with the amount of windows in the home. The IECC and IRC simply establish a single standard for warm-weather climates (below 3,500 heating-degree days). This standard requires that fenestration products in these climate zones have an SHGC less than 0.4. (See Figure 1.)

Similarly, the IECC/IRC's maximum air infiltration rate does not vary by number of windows, nor does it vary by climate. The IECC and IRC set a maximum 0.3 cfm/ft2 for windows and sliding doors and 0.5 cfm/ft2 for swinging doors.

The IECC's U-factor requirements vary by climate and primarily depend upon the quantity of windows (ratio of square footage of window rough opening to opaque wall) installed in the home. The U-factor requirements also can be fairly easily "traded-off" or reduced by the use of greater insulation. On the other hand, the simplified prescriptive paths of the IECC/IRC, which are the most likely paths to be used by most builders, do not allow trade-offs against other building components.

Chapter 6 of the IECC contains a simplified energy chapter that incorporates the entire IECC in four pages and one key table (this same simplified chapter is Chapter 11 in the IRC). This table is for basic home designs with no more than 15% of the wall area containing windows. It lists, line-by-line, maximum window requirements depending upon: (1) where the house is located, i.e., which "climate zone"; and (2) the quantity of windows installed in the house, i.e., the "window-to-wall ratio." (See Figure 2.) For single-family homes with window area greater than 15%, Chapter 5 of the IECC contains tables similar to the Chapter 6 table with further options (up to 25% glazing). The IECC also has options for more complex designs, which are beyond the scope of this article.

To verify code compliance, a builder or homeowner would simply look for the NFRC label, which contains both U-factor and SHGC performance ratings (and in the future will carry the air infiltration rating). A limited default table is provided in the code to determine U-factor and SHGC values for products that do not have NFRC labels.

Heating Degree Days	Maximum Fenestration U-factor	Maximum Fenestration SHGC
0 – 499	*Any*	*0.40*
500 – 999	*0.90*	*0.40*
1,000 – 1,999	*0.75*	*0.40*
2,000 – 2,499	*0.65*	*0.40*
2,500 – 2,999	*0.60*	*0.40*
3,000 – 3,499	*0.55*	*0.40*
3,500 – 3,999	*0.50*	*Any*
4,000 – 5,499	*0.45*	*Any*
5,500 – 5,999	*0.40*	*Any*
6,000 – 12,999	*0.35*	*Any*

Garrett Stone and Eric DeVito are with the law firm Brickfield, Burchette, Ritts & Stone, P.C. in Washington, D.C. They are regulatory consultants who represent manufacturers of building products and other interested stakeholders regarding energy efficiency, building codes and standards, and other regulatory issues related to building construction. Mr. Stone is a member of the National Fenestration Rating Council Board of Directors and Chairman of the NFRC Regulatory Affairs Committee.

DOE Celebrates Roadmap Efforts: Task Forces Will Pave the Way

The US Department of Energy recently brought together industry players to celebrate the completion of two landmark roadmap efforts: the Window Industry Technology Roadmap, and the Building Envelope Technology Roadmap. DOE also conducted the first implementation workshop to develop a process for assisting industry in realizing the technology envisioned in the roadmaps.

The implementation workshop was an opportunity for members from industry and from other interested organizations to brainstorm about the next steps in the roadmap process. A structure was proposed to create a steering committee that will develop and oversee implementation strategy, and to create task forces to focus on the different components of the roadmaps. DOE's Office of Building Technology, State and Community Programs (BTS) is working out details and hopes to communicate with participants about the task force structure within a month, according to Brian Card at DOE.

Technology Roadmap Will Guide Government Funding

The Window Industry Technology Roadmap (WITR) evolved through a series of meetings beginning in 1998 that included window industry professionals, members of non-profit groups, research organizations and government groups. The WITR is a 20-year industry plan for window technology that will help guide government and private sectors in planning future investments and initiatives, according to DOE.

Five industry-government research projects are already in progress to support the technology goals established in the WITR. These cost-shared projects were selected under competitive solicitation based on a number of factors that include energy and dollar impact; potential for success; and consistency with the technology roadmap.

Aerodyne Research, Inc., Billerica, Mass., is developing a sensor which can verify the proper gas filling of insulated glass windows, and which will determine if window seal damage has occurred after installation.

Aspen Systems, Inc., Marlborough, Mass., is developing a process and the equipment to produce continuous sheets of a transparent, insulating gel which will be used to produce clear glass double-glazing windows with an R-10 per inch rating.

Schott Donnelly LLC, Tucson, Ariz., is developing durable large-area electrochromic glazing to improve the clarity and durability of occupant-controlled electrically-tinted windows.

SAGE Electrochromics, Inc., Faribault, Minn., is developing and implementing real-time process monitoring to improve the manufacturability of static glazings and dynamic high-performance, thin-film electrochromic glazings for energy saving window coatings.

Aspen Research Corporation, White Bear Lake, Minn., is developing integrated energy efficient window and wall systems (DOE press

Interior view of Oberlin College)
The glazing in the Adam Joseph Lewis Center for Environmental Studies at Oberlin College in Oberlin, Ohio uses double-glazed, high-R-value, argon-filled glass with a low-e coating. Daylighting and winter heating are maximized to reduce energy consumption. Photo by Oberlin College, provided by U.S. Department of Energy.

exterior view of the Solar Energy Research Facility
NREL's Solar Energy Research Facility in Golden, Colorado contains motorized window shades operated by photovoltaic sensors. Photo by Warren Gatz, provided by U.S. Department of Energy.

release no. R-01-071, May 2001).

Consumer Education is a High Priority

This is a great opportunity for the EWC to focus its efforts on consumer education. Among the five market barriers detailed in the WITR, lack of educated demand was identified as the most critical barrier. Education will be vital to ensure the increased development and adoption of new technology in the windows market. The WITR identifies actions to overcome this barrier:

- Understand the market by clearly identifying the audience.
- Create and use tools.
- Understand current technology and potential applications and specify technology needs as identified by user expectations.
- Establish partnerships through collaborative work between multiple stakeholders and resource groups (DOE Window Industry Technology Roadmap, April 2000).

The EWC is active in all of these areas, and new tools are being developed to help builders and homeowners choose energy efficient fenestration products.

The EWC encourages readers to review the WITR, which is available online atatwww.eren.doe.gov/buildings/technology_roadmaps/.

On the Hill: House Approves Tax Credits for Energy Efficient Windows

The U.S. House of Representatives recently passed a bill that includes provisions for tax credits for energy efficiency upgrades in residential buildings. The SAFE (Securing America's Future Energy) Act 2001 (bill number H. R. 4) proposes tax credits of up to $2000 for certain energy efficiency measures in existing homes and new residential construction. The energy efficiency measures include the energy efficient windows, skylights and doors that meet certain criteria.

Now that this bill has passed in the House, the Senate will begin to put together its own version of an energy bill. There are a number of proposed bills that will be reviewed at the committee level beginning this September in the Senate (see adjoining sidebar). The Senate committees will work to meld these proposals into one bill, which will then be voted on by the Senate. The Senate is expected to vote sometime this fall. Differences in the two pieces of legislation (HR4 and the final Senate energy bill) will be addressed in conference after which both the House and the Senate must vote again to complete the legislative process.

Existing Homes

This bill authorizes a tax credit of 20% of expenditures on "qualified energy efficiency improvements" for existing homes. Building envelope components are "qualified" if they meet "the prescriptive criteria for such component[s] established by the 1998 International Energy Conservation Code (IECC)," with other stipulations about the existing home, and the life of the components. The total credit may not exceed $2000 and is credited to the homeowner.

There are considerable limitations detailed in H.R. 4. Please refer to the bill directly for the full text (details in Senate sidebar).

This homeowner credit, if approved in the Senate, would be effective after December 31, 2001.

New Construction

Business credits for new construction are available to the contractor or the manufactured home producer (in the case of manufactured housing). The credit is "an amount equal to the aggregated adjusted bases of all energy efficient property in a qualified new energy efficient home" not to exceed $2000. Energy efficient property is defined as "any energy efficient building envelope component, and any energy efficient heating or cooling appliance."

As in the case for existing homes, there are a number of limitations on the application of this credit. "Qualified new energy efficient home" is defined as (among other things) a home "which is certified to have a level of annual heating and cooling energy consumption that is at least 30 percent below the annual level of heating and cooling energy consumption of a comparable dwelling constructed in accordance with the standards of the 1998 IECC."

The certification requirements for new construction projects will be based on a variety of elements including technical specifications, ratings, labeling, or energy performance software. Certification is subject to third party verification and other limitations.

The business credit would apply to taxable years ending after December 31, 2001.

This bill includes a number of other tax revisions, including a tax deduction for energy efficient expenditures in new or reconstructed commercial buildings.

To locate a copy of the complete bill on the web, go to http://thomas.loc.gov-and search for H.R. 4, then select the version labeled "Engrossed in House".

Senate Considers Multiple Energy Proposals

There are multiple proposals in the Senate that will come before committee in September and October. A number of these proposed bills offer some sort of tax credits:

- S. 196
- S. 207
- S. 389
- S. 596
- S. 597
- S. 686
- S. 760
- S. 828

For a copy of any of the bills, visit http://thomas.loc.gov.

Collaborative *News*

New EWC Members

We'd like to extend a warm welcome to our newest EWC members:

- Architectural Glazing Consultants
- Clawson Windows
- Hansons' Window and Siding
- Honeywell DMC
- K & H Windows & Exteriors
- Keystone Certifications, Inc.
- KINCO Ltd.
- RJI Industries, Inc.
- Thermotech Windows, LTD
- VPI Quality Windows

Changing of the Guard

We would like to extend a sincere Thank You to Karen Anderson for all of the great work she has done as editor of Word on Windows. Karen has been the WoW editor since the very first issue hit the press in January 1998. Her creativity and enthusiasm have been a real asset to the project. Karen will continue her work as Program Manager for Energy Education at the Alliance to Save Energy.

We are happy to report that Alison Tribble will become editor of the EWC newsletter beginning this Fall. Alison has been working for the EWC for two years as a program associate. Please be sure to contact Alison Tribble with ideas, submissions and questions regarding the newsletter at atribble@ase.org.

Consumers in NW Choose Energy Star Windows

Some markets, it appears, are just ripe for transformation. The Northwest Energy Efficiency Alliance (NEEA) has good reason to be proud of its efforts to promote Energy Star windows. Since 1998, regional sales of the qualifying products have increased from 15% to 60%.

The Alliance, a non-profit group, worked closely with window manufacturers and retailers to educate consumers in its four-state region about the benefits of high energy performance windows.

Those purchasing Energy Star windows for all their homes windows will save an average $500 per year on their electric bills, according to Alliance Executive Director Margaret Gardner. And, across the region, that level of investment in energy efficient windows has resulted in about 6 average megawatts saved.

Learning About Energy Efficiency Helps Fund Other Efficiency Projects

It's now easier than ever to save energy. Simply click the leaf icon at www.environmentsite.org (The Environment Site) once a day, and your small investment of time will yield huge dividends for a project run by the Alliance to Save Energy that provides for school children in the Ukraine.

The Environment Site is a click-and-donate website that raises funds to support projects reducing greenhouse gas emissions. There is no charge to the visitor and no personal information is required. Rather, sponsors, including Whirlpool, Johns Manville, and Osram Sylvania, contribute 1 cent each time a user clicks on the leaf. Every user can click the leaf once a day.

100 percent of the donations are forwarded to specific Alliance programs for energy efficiency at schools, orphanages, and hospitals in Ukraine—simultaneously helping kids and combating global climate change. The improvement of heating systems, replacement of broken and missing windows, and other energy-efficiency measures will cut green house gas emissions, lower energy costs, and also help children who otherwise would not have enough heating or decent air quality.

Texas Wins with Efficient Windows

Lone Star state residents interested in conserving cash, energy and preventing pollution are checking out www.TexWin.com. It is the website of the Texas Window Initiative, a group of utilities, window manufacturers and other stakeholders who share one goal: to inform homebuilders, glass manufacturers and window retailers of the many advantages of using energy efficient, high performance windows in the home. Sponsoring utilities are American Electric Power companies: West Texas Utilities, Central Power and Light and Southwestern Electric Power.

The organization offers training to window manufacturers and dealers and homebuilders. "We are not going directly to the public with our message; we expect our trainees to take this information to the consumers who are their customers," said Jay Zarnikau, director of the Initiative.

The Efficient Windows Collaborative supports the work of the Texas Window Initiative, cooperating on regional efforts and providing informational materials for presentation and distribution.

WORD ON WINDOWS was produced with funding from the Windows and Glazings Program at the U.S. Department of Energy in support of the Efficient Windows Collaborative. For more information on the Collaborative, contact:

Kate Offringa, EWC Program Manager
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036
phone: 202-530-2245; fax 202-331-9588
email: koffringa@ase.org

For editorial submissions and questions:
Alison Tribble, Program Associate
phone: 301-938-0192; fax: 202-301-9588
email: atribble@ase.org

Arlene Stewart,
Regional Representative, Florida
phone: 352-392-7124;
fax: 352-392-9033
email: astewart@energy.ufl.edu

SPOTLIGHT *On Collaborative Members*

Great Lakes Window, Inc.

Great Lakes Window, Inc., a manufacturer of high performance vinyl windows, is focused on energy efficiency. Great Lakes Window joined the Efficient Windows Collaborative this past spring in order to help play a larger role in transforming the residential windows market to more energy efficient products.

All three of the Great Lakes Window product brands—Great Lakes Gold, PlyGem Window and Uniframe Windows—have been tested according to NFRC standards and are Energy Star qualified for all three climate zones. PPG's InterceptTM insulated glass system is standard on most Great Lakes Window products and, Great Lakes Window's own patented R-Core® Insulated frames provide increased comfort and high efficiency.

Great Lakes Window's commitment to energy efficiency began as a desire to produce quality windows. Quality and high performance generally go hand in hand with energy efficiency, so it's no surprise that Great Lakes Window products are energy efficient. Energy efficiency is now a central part of the company's product development and marketing program.

Great Lakes Window recently became an Associate Member of the Alliance to Save Energy, the EWC parent organization, allowing Great Lakes Window to play a larger role in energy efficiency and energy policy. According to Chris Traxler, VP of Sales and Marketing, "We feel that the partnership between the Alliance and Great Lakes Window is a natural fit. We have always worked to develop the most innovative and efficient products in this industry, and we expect that trend will continue. Alliance participation helps not just with our image but with our products." Great Lakes Window is working with the Alliance to Save Energy to improve its own energy efficiency in production processes.

Florida Unifies Building Code in 2002

The new Unified Florida Building Code will go into effect on January 1, 2002. Four years in the making, this code melds all of Florida's previous codes and amendments into one document. http://www.floridabuilding.org/

Energy code compliance will become more stringent. Builders will have to demonstrate via plan evaluation that homes are 5%, 12% or 18% more stringent than the previous code, in the northern, southern and central regions respectively. Reference home baselines for windows will be reduced to 0.40 Solar Heat Gain Coefficient (SHGC) in all three regions. The U-factor baseline will be reduced in the central and northern regions to 0.47, but will be raised to 0.74 in the south. The 1998 baseline for all three regions was double-pane, clear glass which has a default value of 0.5 U-factor.

These levels are not mandated. Florida's performance-based code allows builders to trade around baseline references. Still, windows with National Fenestration Rating Council (NFRC) certification are poised to become more important than ever. Florida code references NFRC testing so builders can get more energy credit than default values provide. There is no default option for the 0.40 SHGC reference point. Therefore, it is important that sales staff provide NFRC values, as early in the energy calculation process as possible, so builders are not forced to upgrade other materials because of missing information.

Great Lakes Window, Inc. as part of the Nortek family of building products was recognized by Window and Door Magazine as one of the top 100 manufacturers for 2001. Nortek ranked in the $500 million to $1 billion category. Nortek, which is based in Providence, RI, manufactures and distributes building products throughout the US and around the world.

Word On Windows
a publication of the Efficient Windows Collaborative and the Alliance to Save Energy
Fall 2002, Volume 5 Number 2

New Market Data and Movement in the Northeast

While most fenestration manufacturers selling in the Northeast are ENERGY STAR® partners, most retailers and wholesalers in New England, New York and New Jersey are not familiar with ENERGY STAR® windows. According to a recent study commissioned by the Northeast Energy Efficiency Partnerships, Inc. (NEEP), significant confusion exists among retailers regarding the differences between ENERGY STAR®, state codes, manufacturer brands, NFRC requirements, and high efficiency techniques (e.g., low-e and argon). NEEP has found that retailers are willing to educate their customers about ENERGY STAR®, but the majority lack training.

In response to this situation, NEEP and its sponsors plan to develop and implement a regional ENERGY STAR® windows initiative in 2003. This new program will be based on the results of their 2002 market study.

Market Data

The study, funded through a U.S. Department of Energy (DOE) grant to NEEP, sought to characterize the residential windows market in the Northeast (six New England states plus New York and New Jersey). As part of this characterization, NEEP contracted Quantec to develop baseline market share estimates for ENERGY STAR® windows for the Northeast region, and individually for the eight states in the study area. The overall regional penetration rate for ENERGY STAR® windows based on manufacturers' data was estimated at 43 percent. Data for these market share estimates were collected primarily by D&R International as part of their work for DOE to develop a national market share estimate for ENERGY STAR® windows.

The Quantec team completed two primary data collection efforts directed to upstream market actors. Manufacturer interviews - A sample of 11 manufacturers were interviewed. The sample included a mix of regional and national manufacturers with regional distribution. Ten of the 11 interviews were conducted with ENERGY STAR® partners; only one non-partner serving the Northeast region could be identified. This survey represents at least 60 percent of the total windows market in the eight-state region. Retailers/Wholesaler Interviews - Quantec completed 100 telephone interviews with retailer and wholesaler representatives.

Preliminary results from the study show the total market size for windows in the area to be 5.4 million units. In the Northeast, approximately 34 percent of windows are for new construction and 66 percent are for remodeling/retrofit applications.

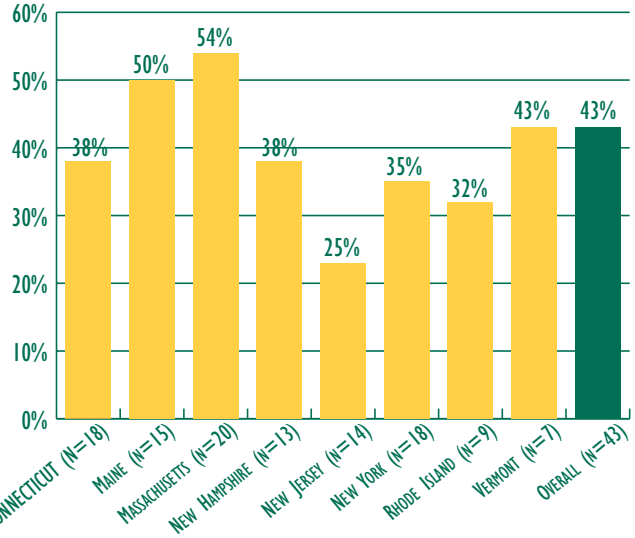
Program Development

Beginning in 2003, NEEP is planning to undertake a regional initiative with a two-year objective to increase the market share of ENERGY STAR® windows to at least 70 percent in New England, New York and New Jersey. This regional initiative will be developed through a partnership involving ratepayer-funded programs, window manufacturers and retailers, and state energy offices.

NEEP plans to educate retailers so that they can properly explain the energy and non-energy benefits of ENERGY STAR® windows to their customers.

Continued on page 4

Penetration of Energy Star® Windows, by State and Overall



Source: Baseline Characterization of the Residential Market for ENERGY STAR Windows in the Northeast, prepared for Northeast Energy Efficiency Partnerships, Inc.by Quantec, LLC and Nexus Market Research. Draft Report, 2002

I N S I D E

www.efficientwindows.org

En-lightening School Children through Natural Light

Are the costs too high to bring natural daylight in our children's classrooms? A new study from the New Buildings Institute, *Daylighting in Schools: Additional Analysis*, begs a different question: What are the costs of not daylighting our children's classrooms?

The study demonstrates that elementary school students in classrooms with the most daylight showed a 21% improvement in learning rates as compared with students in classrooms with the least daylight. This analysis confirms the results of an earlier study that showed for the first time that there was a correlation between student performance and daylight.

Webster City Middle School in Webster City, Iowa, is 25% larger than the old school yet the annual energy cost remains the same compared to the old school. Photo: Dr. E. F. Brown, courtesy of US DOE/NREL.

This new study is actually a reanalysis of data collected by the Heschong Mahone Group (HMG) as part of the Public Interest Energy Research (PIER) program administered by the California Energy Commission and managed by the New Buildings Institute funded through the state's public benefits fund. The original study, funded by Pacific Gas and Electric Company in 1999 and conducted in three school districts in California, Washington and Colorado, concluded that there was a strong statistical correlation between the amount of daylight in elementary school classrooms and the performance of students on standardized math and reading tests.

A panel of experts from Lawrence Berkeley National Laboratory, who reviewed the study, was generally satisfied by the methodology and statistical analysis used in the study. However, two major concerns were expressed that prompted this reanalysis: Is there a potential bias where "better" teachers are given rooms with more daylighting? And would the analysis be more accurate if performed grade by grade rather than aggregating data from four grade levels?

To better address these concerns, the reanalysis effort consisted of four research tasks:

- Survey of teachers
- Bias analysis
- Grade level analysis
- Absenteeism analysis

The teacher survey determined that while teachers prefer classrooms with windows, daylight and views, they consider other factors, such as adequate space, a good location, a quiet location, and water in the classroom, to be far more essential. The bias analysis revealed that there is no significant relationship between a teacher's experience level and educational background and their assignment to a classroom with better daylighting. By separating aggregated data for students in grades 2 through 5, the researchers show that there does not seem to be any progressive effects as the children get older and younger children do not seem to be any more sensitive to sunlight than older children.

The design for Durant Road Middle School in Raleigh, incorporated an extensive daylighting strategy contributing to annual energy cost savings of $77,000. Photo: Robert Flynn, courtesy of US DOE/NREL.

In order to measure the relationship between student health and daylighting, the study used an absenteeism analysis to see if there was a correlation between student health and classroom characteristics including daylighting. The absenteeism analysis revealed that there was no significant relationship between student health and classroom characteristics indicating that other factors most likely affect students' attendance.

Through this reanalysis the results of the original study were confirmed and expanded. Overall the reanalysis confirmed that an increase in student performance and learning rate can be reliably correlated with increased daylighting conditions in classrooms. On average, there is a 21% general improvement between children in classrooms with the least daylight and students in classrooms with the most. The study also found that if an average student were moved from a classroom with an average amount of daylight to a classroom with the maximum amount of daylight an 11% improvement rate could be expected.

Daylighting in classrooms can now be viewed as an essential characteristic for a productive learning environment. Efficient windows can go a long way in meeting the seemingly unlimited needs of students and the often-times limited means of school budgets.

See the full text of the study, *Daylighting in Schools: Additional Analysis*, online at http://www.newbuildings.org/pier/.

Combining daylighting and lighting retrofits provides an airy and comfortable space in Roy Lee Walker Elementary School, McKinney, Texas. Photo: Scott Milder, courtesy of US DOE/NREL.

Energy Efficient Design

Changing the Floor *in Energy Efficient Design:*

DOE Seeks Major Revisions to Fenestration Requirements in IECC

The US Department of Energy (DOE) has drafted a proposal for the International Energy Conservation Code (IECC) with plans to submit the changes to the International Code Council in early 2003.

A significant change proposed by DOE would eliminate the current window-area restrictions for residential buildings. In a white paper, Eliminating Window-Area Restrictions in the IECC, published by Pacific Northwest National Laboratory authors Z.T. Taylor, C.C. Connor and R.G. Lucas describe the rationale and research behind this proposal. The authors suggest that although window-area-dependent codes provide some energy savings, such codes present barriers to adoption and implementation. The authors argue that simplifying the code with respect to windows will lead to greater adoption and implementation of the code, and consequently lead to greater energy savings than those savings offered by window-area-dependent codes.

The authors conclude in their report that eliminating window-area restrictions will:

- Increase code adoption, compliance, and enforcement
- Have no detrimental impact on energy use
- Increase energy savings overall.

The authors also concluded that based on available data, window-area restrictions do not seem to have a substantial impact on the amount of glazing used in homes.

DOE is interested in your comments on this proposal. The draft proposal and white paper are currently available for review online at: www.energycodes.gov/implement/doe_2004_proposals.stm.

Raising the Ceiling *in Energy Efficient Design:*

New Buildings Institute Releases Draft on Voluntary Guidelines

The New Buildings Institute (NBI) has recently released a draft of the Advanced Building Guidelines which are designed as a new set of voluntary guidelines for non-residential buildings. This set of guidelines aims to assist utilities, nonprofit organizations, government agencies and others in establishing guidelines for voluntary energy efficiency programs.

The Guidelines were developed by NBI and a "team of national esteemed experts in building performance." According to NBI, the objectives of the Guidelines are to:

- Provide measurable energy targets for high-performance commercial buildings. The target efficiency levels will be 30% (Tier 1) and 50% (Tier 2) better than ASHRAE/IECC.
- Provide two options for demonstrating the buildings meet or exceed the targets: a prescriptive based method (Tier 1), and performance-based method (Tier 1 or Tier 2).
- Provide staff at utilities, non-profits and government agencies that plan and implement voluntary programs an effective way to promote more efficient building design and construction practices.
- Provide an alternative for state and local jurisdictions interested in considering building code changes that go beyond the conservative, consensus levels contained in the ASHRAE and IECC model codes.

NBI is interested in your comments on this proposal. The draft of the Guidelines and other information about this project can be viewed online at: www.newbuildings.org/ABG.htm.

New Buildings Institute

Founded in 1997, the New Buildings Institute is a not-for-profit corporation dedicated to making buildings better for both people and the environment. With a goal to promote energy efficiency in buildings through policy development, research, guidelines and codes, the Institute uses market-based strategies and regulatory strategies to achieve this goal.

The market-based approach promotes education, technical information, design assistance, financial incentives and other tools to promote voluntary adoption of energy efficient building practices. The regulatory approach promotes efficient building energy codes as a comprehensive and long-lasting solution.

The Institute collaborates with a diverse group of stakeholders including non-profits, government agencies, and utilities. This year it is sponsored by such organizations as the CA Energy Commission, Energy Foundation, Iowa Energy Center, NYSERDA, NEEP, NEEA, Sacramento Municipal Utility District, San Diego Gas & Electric, and Southern California Edison. For more information on the New Buildings Institute please visit their website at http://www.newbuildings.org/.

SPOTLIGHT *On Collaborative Members*

TRACO

TRACO, an EWC member headquartered in Cranberry Township, PA, is a manufacturer of high performing energy efficient windows and doors. Founded in 1943, TRACO is known for its innovative designs that exceed industry standards and customer expectations, particularly in the area of energy efficiency. All of TRACO's residential and light commercial vinyl products qualify for ENERGY STAR® and are NFRC certified.

To highlight TRACO windows' energy efficiency, the company has been

engaged in Energy Star labeling since February of this year. Owners can obtain rebates for the use of TRACO windows through local utility companies, though the amount of rebate available varies from state to state.

"At TRACO, we're continually looking for ways to enhance our products with innovative technologies, including glazing and product materials that will make the home more comfortable and energy efficient," according to Mike Manteghi, Manager of TRACO's Research and Innovation.

> *"We're pleased that we are able to have comfort and energy efficiency work hand in hand."*

TRACO's Residential Group has developed one of the most comprehensive residential offerings on the market today with high-performance Low E and Heat Mirror" glass and custom-designed products featuring exclusive TRACO View-Safe" Tempered glass that's four times stronger than ordinary glass.

As a result of the company's in-house capabilities, extensive research and testing, TRACO's line of energy efficient windows has a long track record of instantly showing a savings in energy costs. The effective combination of insulating glass units, state-of-the-art glass coatings, and improved weatherstripping dramatically reduces fuel bills and maintenance.

TRACO's broad product line includes windows, doors, sunroom, and the next generation Power Two Window System – a composite window system that delivers the strength and durability of aluminum on the outside, the warmth and comfort of vinyl on the inside, and two-in-one custom coloring.

Manteghi goes on, "TRACO is committed to helping homeowners expand the enjoyment of their homes through energy-efficient products."

New Market Data: continued from page 1

The Efficient Windows Collaborative, a national market transformation initiative, will provide informational tools for incorporation into NEEP's educational programs. NEEP and its sponsors will consider sales awards or competitions to increase salespersons' incentives to sell ENERGY STAR® and to spend the time to educate their customers. The high turnover rate, particularly at big box retailers, may require financial incentives or periodic reports/awards to encourage retailers to continue to push ENERGY STAR® products. NEEP will focus primarily on the remodel/retrofit market but may include some new construction market activities in its program.

NEEP may also consider a long-term goal of establishing energy efficient/ ENERGY STAR® windows as the residential building energy code minimum for new and replacement windows in Northeast states. The specifics of the program approach depend in part on the participation of energy efficiency program administrators in the Northeast as well as the fenestration industry.

For more information about NEEP's regional market transformation initiative, contact Glenn Reed or Elizabeth Titus at (781) 860-9177.

This article was originally published in Door & Window Maker Vol 3, Issue 5, (Nov/Dec 2002) on page 10.

Do You Have News You'd Like to Share?

We're always interested in reporting on new technology and research in residential windows. If you have something you would like to share with us please contact Alison Tribble at atribble@ase.org.

Collaborative *News*

Changing of the Guard

Kate Offringa has recently been promoted to expand her portfolio of projects at the Alliance to Save Energy. In addition to her involvement in the EWC and her windows project in China, she will be developing a new program which will work with states to develop local energy efficiency initiatives.

EWC Program Mangers-past and present: Alecia Ward, Alison Tribble and Kate Offringa

Alison Tribble has been promoted to manage the EWC, and will continue to work closely with our EWC members and friends to promote energy efficiency in the residential window market. Alison has been working with the EWC for three years and will be leading the program in new directions in the coming year.

Database Details

We have received countless compliments from consumers on the valuable information we provide on our website (www.efficientwindows.org). However, the biggest concern that we hear is that consumers don't know where to find the products that are generically listed on our website.

We have been working to address this problem by developing a products database that will link consumers to qualified window products of EWC member manufacturers. At the NFRC meeting in Alaska, we demonstrated a prototype of this database. We will be contacting our members in the coming month to describe this project in more detail and to solicit feedback. If you are interested in learning more about this project please contact Alison Tribble at atribble@ase.org or (202) 530-2231.

On the Road Again…

The EWC will be hitting the road to get the word out about window energy performance and efficiency. We will be participating in a series of seminars designed to educate small to midsize manufacturers sponsored by Ashlee Publishing, publishers of Glass Digest, Fenestration and other publications. The conferences will be held in NYC, Boston, Sacramento, LA, Chicago and Steubenville, OH over the next six months. We will also be participating in the US Green Building Council's first conference in Austin, TX in November. In January we'll travel to Philadelphia for the NWDA Winter Meeting, Chicago for the ASHRAE Winter Meeting and Texas for the NFRC Task Force Meeting. You can find more details about these and other events on our website. Contact Alison Tribble at (202) 530-2231 if you are interested in scheduling a seminar for your in-house sales staff or for your clients.

New EWC Members

The Efficient Windows Collaborative welcomes the following new members to its ranks:

- AMSCO Windows
- Champion Window Manufacturing
- Comfort Line LTD.
- Eagle Window and Door, Inc.
- Glass Equipment Development, Inc.
- Great Plains Restoration, Inc.

The EWC encourages manufacturers, suppliers and others interested in promoting energy efficient windows to become more involved in our activities by becoming a member of the Collaborative.

The EWC works with members to transform the window market in several ways:

- By changing consumer and trade ally perceptions of fenestration performance, it increases the growth potential for the industry overall.
- By offering training and education to company sales forces and trade ally audiences, the Collaborative builds the core awareness needed to sell efficiency in the marketplace.
- By working for recognition of efficient window technology in the national and state building codes arena, EWC helps transform the market and expand sales of efficient products in basic building practice.
- By creating a communications network the Collaborative enables participants to learn more about market trends, technical information, training opportunities, and demonstration results.

For more information on our members and membership, go to www.efficientwindows.org/members.html.

Sign Up to Receive Word on Windows Electronically

Did you know that *Word on Windows* is available in electronic format? Most of our readers currently subscribe to receive the paper version of our newsletter. However, there are several ways to receive the electronic version.

You can request the newsletter be sent to your email address by sending an email to: ewc@ase.org. If you prefer to receive only the electronic version and to discontinue the paper version, please indicate this in your email.

Additionally, you can download the latest copy of the newsletter on our website at: www.efficientwindows.org.

Word on Windows was produced with funding from the Windows and Glazings Program at the U.S. Department of Energy in support of the Efficient Windows Collaborative. For more information on the Collaborative, contact:

Alison Tribble, EWC Program Manager
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036
phone: 202-530-2231
email: atribble@ase.org
www.efficientwindows.org

Rating and Labeling in China: Update on EWC Work

With funding from the Energy Foundation, the Efficient Windows Collaborative (EWC) is conducting an ongoing series of workshops in China, to advise and help to organize the Chinese fenestration industry in such a way that it is able to influence emerging building energy codes and construction practices to include energy efficient fenestration products.

The opportunity to promote energy efficient products in China is at an all-time high. Building construction is the third largest player in the Chinese economy. Recently, Chinese code officials have begun to write energy requirements into building codes. The EWC workshops in China are centered on issues of product rating and labeling for energy performance, a practice not yet standardized in the Chinese fenestration industry.

A workshop was held in Shenzhen earlier this year. Kate Offringa, Alliance to Save Energy, John Hogan, City of Seattle codes expert, and Joe Huang, Lawrence Berkeley National Lab, presented information on fenestration product rating and labeling practices, codes issues, and market transformation initiatives. Specifically, they highlighted the National Fenestration Rating Council, ENERGY STAR®, and Efficient Windows Collaborative programs that have been so successful in moving the windows market in the U.S.

Kate Offringa (center) prepares to tour a multi-family construction site in Shenzhen with Mr. Chen Guoyi (left), Ministry of Construction of P.R. China, and Mr. Lang Siwei (right), China Academy of Building Research.

The next workshop will be held in Beijing this fall. It will include the participation of the Chinese Ministry of Construction, the fenestration industry, representatives of design institutes, the construction industry, codes officials and other relevant parties. The heart of the workshop will be an open discussion among all players of desirable courses of action.

For more information on this project, please contact Kate Offringa at koffringa@ase.org.

Efficient Windows Collaborative
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036

www.efficientwindows.org

Word On Windows
a publication of the Efficient Windows Collaborative and the Alliance to Save Energy Summer 2004

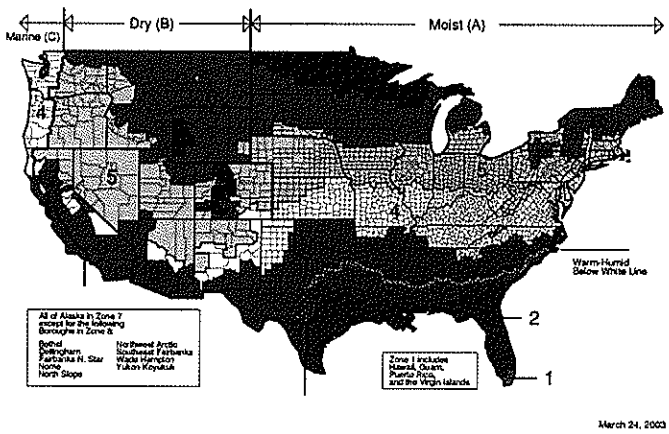
Sweeping Changes to the 2003 International Energy Conservation Code

The International Codes Council (ICC) recently approved significant changes to the 2003 International Energy Conservation Code (IECC). These changes were designed to simplify the prescriptive path and create a robust performance path of the residential 2003 IECC, the national model code that is the basis for many state energy codes. These changes eliminate the window to wall ratio requirement in the prescriptive path and authorize certification in "beyond code" programs to demonstrate compliance with the code.

Simpler Prescriptive Requirements for Windows

The code change eliminates the window-area requirement from the 2003 IECC. The change, proposed by Pacific Northwest National Laboratories (PNNL) was based on studies which indicated that the cumbersome window-area requirement was leading to poor compliance. PNNL presented compelling arguments that simpler codes with fewer variations would yield far better field compliance and enforcement rates. The IECC supplement, due to be released in August 2004, requires a single, stricter, U-factor for windows, regardless of glazing percentage for each climate zone (see map). Additionally, it places limits on window U-factors and SHGC when trade-offs are used in compliance (see chart).

Map of DOE's Proposed Climate Zones



These changes melded together interests across a wide range of industry and public groups to create an easily understood, flexible code. This change was greeted positively by builders—who favor simplicity—and window manufacturers—who felt more stringent window U-factor requirements and simplified compliance would bolster sales of more energy efficient products.

Integrating "Beyond Code" Programs

The modification of the Chapter 4 performance path help set the stage for harmonization between the IECC and the Home Energy Rating System (HERS). The HERS system, the IECC and the ENERGY STAR Homes program are interconnected: ENERGY STAR-qualified homes must be validated by a HERS certified home energy rater to be 30% more efficient than the 1995 Model Energy Code. However, the basic assumptions for the IECC and the HERS system are different, and there have

Continued on page 6

I N S I D E

Climate Zone	Fenestration U-factor	Skylight U-factor	Glazed fenestration SHGC	Ceiling R-value	Wood Frame Wall R-Value	Mass Wall R-value	Floor R-Value	Basement Wall R-Value	Slab R-Value and Depth	Crawl Space Wall R-Value
1	1.20	0.75	0.40	30	13	3	13	0	0	0
2	0.75	0.75	0.40	30	13	4	13	0	0	0
3	0.65	0.65	0.40	30	15	5	19	0	0	5/13
4 except Marine	0.40	0.60	NR	38	15	5	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.35	0.60	NR	38	21 or 15+5	13	30	10/13	10, 2 ft	10/13
6	0.35	0.60	NR	49	21 or 15+5	15	30	10/13	10, 4 ft	10/13
7 & 8	0.35	0.60	NR	49	21	19	30	10/13	10, 4 ft	10/13

ATTACHMENT 14

Energy Efficient Mortgages Can Counter the Effects of Increasing Mortgage Rates and Soaring Energy Prices

Consumers looking to buy or renovate a home have every reason to consider including energy efficiency in the design. Fuel prices are at record highs, and the impact of this is only just beginning to hit consumer pocketbooks. Meanwhile mortgage rates are on the rise, meaning that the amount of money for which a consumer may qualify is declining. However, consumers can actually lower their energy bills and qualify for larger loans by adding energy efficient home features financed through energy efficient mortgages (EEMs). Energy efficient windows can reduce heating and cooling energy costs by up to 30%, so EEMs are the perfect vehicle for financing window upgrades in both new and existing construction.

How EEMs Work

Banks offering EEMs recognize that energy efficiency will lower a consumer's energy bill, and that consequently a consumer will have more cash available for a larger mortgage payment. "After the mortgage payment, the monthly utility bill is usually a family's next largest housing-related expense," reports Michelle Desiderio, Senior Product Developer at Fannie Mae, the nation's largest source for home mortgage funds. EEMs also encourage the use of utility and manufacturer rebates, by allowing these rebates to be applied toward the loan transaction under some programs. Table 1 provides a comparison of a regular mortgage and an EEM from Fannie Mae.

Although this example assumes that it will cost more to build an energy efficient home, Fannie Mae has found that many builders are able to build efficient homes with little additional expense. This means the savings to the consumer could be even greater.

The Benefits of EEMs

There are a number of benefits to EEMs according to Steve Baden, Executive Director of Residential Energy Services Network (RESNET). This organization is dedicated to qualifying more families for home ownership and improving the energy efficiency of the nation's housing stock by expanding the national availability of mortgage financing options and home energy ratings. Baden reports that increasing the number of energy efficient homes through EEMs helps to:

- Qualify more first time home buyers for mortgage loans
- Reduce the cost of home ownership
- Reduce America's dependence on imported oil

Baden reported that a recent analysis by the Environmental Protection Agency found that an average of 6.8% more families would be able to qualify for a mortgage through the energy efficient mortgage model.

Greater Accessibility to EEMs

EEMs are offered through several different programs in the secondary mortgage market. Fannie Mae, Freddie Mac, the Department of Housing and Urban Development Federal Housing Administration, and the Veteran's Administration offer programs to increase energy efficiency through EEMs.

The number of banks offering this type of mortgage product has grown significantly in recent years. Desiderio reports a trend in larger banks now offering EEMs. Countrywide Home Loans and Wachovia have been strong partners in promoting energy efficient mortgages, and Citibank has recently joined the ranks of companies offering EEMs. "Fannie Mae is excited that Citibank—a financial leader—is promoting EEMs," Desiderio reported. "This is helping to increase accessibility to EEMs for homeowners across the nation."

Resources for Manufacturers

For consumers looking to add energy efficient windows to a new design or to upgrade existing windows, cost is an important part of the decision process. Sales forces can help consumers make the decision for energy efficiency by educating them about the availability of EEMs.

Fannie Mae has a wide range of products to choose from. The company has designed a brochure that can be downloaded from the web or is available for bulk ordering that makes EEMs easy for consumers to understand. You can find out more about these products at www.efanniemae.com.

RESNET has compiled information on available products into one location online at www.natresnet.org. RESNET also provides a searchable list for home energy raters who can help consumers identify home energy efficiency improvements needed and evaluate the performance of the home to help qualify homeowners for EEMs.

Table 1. Comparison of Standard and Energy Efficient Mortgages

	Non Energy Efficient Home	Energy Efficient Home
Purchaser Price	$200,000	$203,000
Borrower Contribution	$6,000	$6,090
Loan Amount	$160,000	$162,400
Interest	5.85%	5.85%
Monthly PITI	$1673	$1698
Average Electric Bill	$186	$93
Total Expenses	$1859	$1791
Qualifying Income	$49,000	$48,584
Monthly Savings		**$68**

Source: Fannie Mae

Do You Have News You'd Like to Share?

We're always interested in reporting on new technology and research in residential windows. If you have something you would like to share with us please contact Kipp Rhoads at krhoads@ase.org.

New Initiative Transforms the Commercial Fenestration Market

Tremendous opportunities to save energy in the commercial sector exist with the use of high performance fenestration systems. Heating and cooling losses through windows in U.S. commercial buildings account for approximately 2 quadrillion Btus of energy—over 2 percent of the nation's total annual energy consumption—according to the authors of Window Systems for High-Performance Buildings (see related article in this newsletter). Meanwhile, the amount of glazing in new commercial buildings has been increasing, meaning that energy use attributable to windows in commercial buildings could climb even higher unless energy efficient glazing systems are incorporated into the designs.

Commercial Windows Inititive

The Northwest Energy Efficiency Alliance's (NEEA) Commercial Windows Initiative (CWI) captures some of the energy savings available through new commercial fenestration technologies. The CWI is seeing impressive results from its activities aimed at transforming the northwest commercial window market to more energy efficient products.

Windows are not a new arena for NEEA—this organization led the nation in residential window market transformation with a project in the late 1990s. The program has resulted in over 70% market penetration of ENERGY STAR qualified residential products in that region today.

Banking on success in the residential sector, NEEA has launched a $1.5 million project with the goal of increasing the market share of efficient commercial glazing from 12% to 50% by 2005. According to John Jennings, project coordinator for NEEA, the initiative was launched for two reasons. First, it supports a larger effort undertaken by NEEA, to increase energy efficiency in commercial buildings. Second, results from a NEEA-sponsored study (A Characterization of the Nonresidential Fenestration Market, by Eley Associates, available at www.commercialwindowsinitiative.org) indicated that some of the best opportunities for market transformation could be found in this market.

Establishing Guidelines

One of the first challenges that CWI faced was establishing energy performance criteria that would be both achievable in the market place and produce significant energy savings, according to Gary Curtis, President of the West Wall Group, which administers the CWI project. By working closely with the industry and developing a broad-based steering committee, including representatives of the Alliance to Save Energy, CWI has developed a two-tiered set of criteria which allows all framing material manufacturers to participate in this program. All products must be tested and certified according to standards established by the National Fenestration Rating Council.

Window Type	U-Factor [1]	SHGC	VT
Non-metal, Fiberglass, Wood, Vinyl	0.35 or lower	0.40 or lower	0.50 or higher
Metal	0.42 or lower	0.40 or lower	0.50 or higher

Early Results

In the commercial market, some sectors are more responsive to the message of efficiency than others, according to Curtis. "Multi-family housing is just kicking," said Curtis, "because the owners are very price-sensitive and the smaller buildings can accommodate vinyl windows which are easily available in the Northwest." CWI is also getting a good response from designers and developers of mixed-use and health facilities. Office buildings have been slower to respond. Curtis attributes this to the fact that buildings in this sector typically come in significantly over budget.

CWI is also achieving results through education, technical assistance, and by highlighting success stories. CWI has trained over 300 architects through its Design Intent program, an hour-long AIA CES-approved course. CWI staff work one-on-one with developers and designers to craft projects that incorporate efficient fenestration into new designs and retrofit projects. Resources are available from CWI to help designers choose efficiency and to help window manufacturers market energy-efficient products. The CWI web site has many of these resources, and it provides profiles of projects under development to share lessons learned.

Looking Ahead

CWI is currently focused on projects using factory built windows, which account for 40% of the Northwest market. According to Curtis, the next step is to look at site-built fenestration systems. The success of the current project will guide the next steps for Curtis and his colleagues.

Although the program is funded to address regional energy issues, many of the resources can be applied in other parts of the country. The energy performance criteria were developed with an eye to developing a national standard for commercial fenestration. As CWI builds success in its current program, it is continuously looking for opportunities to partner with industry.

[1] For more information about how energy performance is measured go to www.efficientwindows.org.

WORD ON WINDOWS is produced with funding from the Windows and Glazings Program at the U.S. Department of Energy in support of the Efficient Windows Collaborative. For more information on the Collaborative, contact:

Alison Tribble, EWC Program Manager
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036
phone: 202-530-2231 email: atribble@ase.org
www.efficientwindows.org

Kipp Rhoads, Program Associate
phone: 202-530-2234
fax: 202-331-9588
email: krhoads@ase.org
www.efficientwindows.org

SPOTLIGHT *On Collaborative Members*

NEEP Launches Pilot Workshop in Massachusetts, Plans for More

In 2002 a study, *Baseline Characterization of the Residential Market for ENERGY STAR Windows in the Northeast*, completed for the Northeast Energy Efficiency Partnerships, Inc. (NEEP), outlined the benefits of designing ENERGY STAR marketing and education tools for retailers. This past April NEEP facilitated the development and delivery of such tools in the form of "Energized Sales Training for Window Retailers." Working with Applied Proactive Technologies, Inc., NEEP delivered two ENERGY STAR windows training sessions to over 50 retailers from specialty stores in a Massachusetts pilot project. The sessions were held in the Massachusetts cities of Westwood and Waltham. This project was co-funded by grants from the DOE and KeySpan Energy Delivery.

The primary objective of this training is to teach retail sales staff how to sell ENERGY STAR windows to different types of customers based on the customers' personal communication styles. The pilot project includes an evaluation that will be completed by the end of 2004, comparing window sales for three-month periods before and after the trainings. Participants found the sessions gave them "greater confidence in ENERGY STAR signature products and strategies in selling them." Some said they "never realized so many people focused on ENERGY STAR labels" and the trainings will "help sell to the right people and use ENERGY STAR to [their] advantage."

A survey after the training confirmed that the retailers had a good understanding of specifications for ENERGY STAR windows in the Northern Climate Zone, which includes Massachusetts, as well as a good understanding of the Massachusetts building energy code requirements for windows.

Future plans include additional sales training sessions in the Northeast. Some of the sessions, co-sponsored by utilities which are members of the GasNetworks in Massachusetts, will start this summer. The sessions will accompany the May 1, 2004 introduction of customer rebates on ENERGY STAR windows by many gas utilities in Massachusetts.

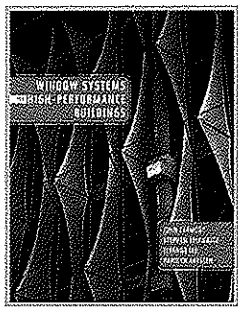
NEEP is interested in providing additional training sessions to retailers in all market channels in the Northeast region. Trainings in collaboration with the Alliance to Save Energy and the Maryland Energy Administration are currently being developed. NEEP's plan also includes outreach to building code officials and policymakers throughout the Northeast regarding opportunities to upgrade building code requirements for new and replacement windows.

In 2001, the Baseline study found market share for ENERGY STAR Windows in the Northeast was 43%. With the cooperation of ENERGY STAR's manufacturer partners, energetic retailer support, and updated building codes, opportunities to increase the presence of efficient windows in the Northeast abound.

Hot Off the Press: Companion Hand Book for the Commercial Sector

Efficient Windows Collaborative partners at the University of Minnesota and Lawrence Berkeley National Laboratory have released the commercial companion to the highly regarded *Residential Windows: A Guide to New Technologies and Energy Performance*. The new book, *Window Systems for High Performance Buildings*, spotlights the correlation between advanced window technologies and sustainable building design. "Windows are a critical component in making progress toward future buildings that have very low energy use and high quality interior environments. This book attempts to guide designers to optimize window performance to meet these goals," says John Carmody, a co-author of the book and the Director of the Center for Sustainable Building Research at the University of Minnesota.

The book addresses complex design issues connected with new and existing high-performance building window applications. By highlighting innovative uses of window technologies, the authors promote thinking and discussion on the issues involved. In addition to high-performance windows, the authors include a section on fresh and innovative façade and window design in commercial structures. "This addition to literature on efficient fenestration systems is an excellent compliment to the work the Alliance to Save Energy is doing to promote energy efficiency, because it spotlights windows as a key element in the overall design of commercial structures," says Alison Tribble, Program Manager for the Efficient Windows Collaborative.



Window Systems for High-Performance Buildings is available for purchase at online booksellers or from the publisher's website, www.wwnorton.com.

CollaborativeNEWS

EWC Gears up for 4 New Initiatives

The EWC will soon launch the new **EWC Window Selection Tool**, designed to link consumers to qualified energy-efficient window products on the EWC web site. Consumers frequently ask us where they can find efficient products that are described generically on our site. John Carmody and Kerry Haglund of the University of Minnesota (UMN) have developed the new **EWC Window Selection Tool** to help consumers find energy efficient products.

The EWC is also undertaking a reevaluation and renewed focus on transforming the new construction sector to more energy-efficient products. According to ENERGY STAR®, this sector lags behind the retrofit market in penetration of qualified products—it is estimated that only 20% of the products in residential new construction market qualify for ENERGY STAR, compared with 60% of the products in the retrofit market. The EWC will conduct research to identify more effective methods to reach this sector with the message of energy efficiency.

The EWC will target the low-income market in the coming year by undertaking new research to identify opportunities for increasing efficiency in this sector. Considering the age of existing housing stock—over 70 million homes in the US are at least 20 years old (US DOE EIA)—we believe there are untapped opportunities for increasing market penetration of efficient window products in the low-income sector.

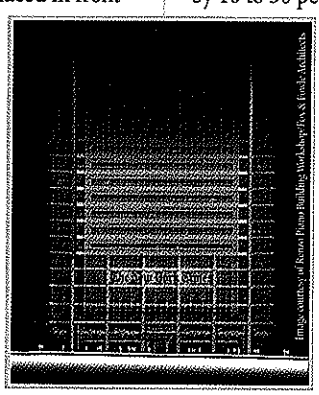
As always we will continue to partner with and provide outreach to manufacturers and suppliers. However, in the coming year the EWC will target small window manufacturers. The EWC is interested in helping to increase the number of small manufacturers that participate in NFRC testing and certification and ENERGY STAR partnership across the nation.

We will keep you updated on our activities through our newsletter and email announcements. We are always interested in feedback from the industry, so we hope that you will share your insights and goals with us at atribble@ase.org.

New York Times Makes Headlines with Energy Efficiency

For its first new headquarters since 1913, the New York Times Company (NY Times) wanted a comfortable, productive, and energy-efficient workspace. The resulting 52-story transparent glass tower designed by architect Renzo Piano will bring in daylight and will also serve as a reminder of the company's mission to provide transparency of information through its reporting. Construction will start later in 2004, and the building is expected to be completed in mid-2006.

To maximize use of natural light, the building will feature an integrated glazing and lighting control system. Horizontal ceramic tubes on a metal framework will be placed in front of the double-glazed, low-E, spectrally selective glass exterior wall. An advanced, automated interior roller shade system will control glare and cooling, and a dimmable fluorescent lighting system will automatically maximize interior light efficiency.



In coordination with the Environmental Energy Technologies Division of Lawrence Berkeley National Laboratories (LBNL), the NY Times constructed a 4,500 square foot mock-up with window products from many different manufacturers. Tests running from December 21 to June 21 (the shortest and longest days of the year, respectively) measure sun penetration and light levels throughout the facility each minute of every day and also track a variety of power and system performance indicators. The goal is seamless integration of the automated shades and the dimming-controlled lighting systems.

LBNL research indicates that for many buildings, overall energy use can be reduced by 10 to 30 percent through use of daylighting. Additional savings come from reduced cooling and heating loads achieved through efficient glazings and shading. The NY Times project will serve as an example, providing valuable data which may spur market development of these systems for future construction.

Stephen Selkowitz, leader of LBNL's Windows and Daylighting Group, notes that the NY Times and LBNL make a powerful partnership. "We hope that the detailed engineering data we have collected and analyzed with the vendors, coupled with the market power of a major purchase for a landmark building will have a marketplace impact that neither of us individually could have achieved."

The NY Times gives tours of the mock-up facility to promote the long-term economic benefits of these integrated control systems. This research received a $250,000 daylighting contract from the New York State Energy Research and Development Authority, with cost share provided by the U.S. Department of Energy, the California Energy Commission, and various hardware vendors.

Sweeping Changes continued from page 1

been challenges to harmonization. First, the HERS standard home has been developed and updated in a separate forum from the IECC, so changes to one set of assumptions has not kept pace with the other. Additionally, multiple compliance paths under the IECC have made it difficult for the National Residential Energy Services Network (RESNET), which administers the HERS system, to develop a single yet equivalent set of assumptions.

The modification of the 2003 IECC makes it possible for RESNET to adopt one set of assumptions. According to Steve Baden, Executive Director of RENEST, "Our members are in the process of integrating the new IECC assumptions into our HERS standard."

Another critical change to the 2003 IECC allows "beyond code" programs to be used to demonstrate code compliance. This change, which was advocated by Steve Baden and Philip Fairey of the Florida Solar Energy Center, creates greater opportunities for ENERGY STAR Homes and other programs as well. It creates an incentive for builders to consult with third party programs such as the HERS system for compliance. The third-party verification provided by the rater ensures that efficient measures are not only planned but actually built. National mortgage power-house Fannie Mae recognizes the value in the system, requiring HERS certification for participation in numerous financing programs developed to foster energy and resource efficient housing.

Texas had already implemented a similar code amendment allowing 'beyond code' certification programs as a means of compliance. Since its adoption, the number of ENERGY STAR homes has grown significantly—one in four homes in Texas now qualify for ENERGY STAR status.

The changes are in the 2004 Supplement to the International Codes at www.iccsafe.org

EWC Offers New, Energy-efficient Word on Windows Newsletter

The EWC is always striving to improve. In an effort to save energy and decrease pollution, we now offer our Word on Windows newsletters in e-mail format. Although we will still produce limited numbers of printed copies, we urge you to sign up for the electronic version. Please e-mail us at ewc@ase.org to be added to the newsletter list. Include your name, address, phone number, and email address in your e-mail. Thank you for your cooperation and for doing your part to save energy!

The EWC does not send spam or share e-mail addresses with third parties.

Efficient Windows Collaborative
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036

www.efficientwindows.org

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Windows and Energy Codes: The Future Looks Bright

By: Eric DeVito
Chairman, The Responsible Energy Codes Alliance (RECA)
www.RECA-codes.org

As chairman of the Responsible Energy Codes Alliance, I am often asked about RECA's opinions and policies on energy-efficient windows and energy codes. To RECA, the most effective approach is quite simple. Local adoption of a mandatory building energy code, based upon the national model International Energy Conservation Code (IECC), is far and away one of the best ways to ensure that homes and commercial buildings are built and remodeled using energy-efficient windows.

Today, IECC-based energy codes require NFRC ratings and certification, appropriately recognizing many benefits of high-performance, energy-efficient windows. To maximize energy use and minimize discomfort, IECC utilizes maximum prescriptive requirements to set clear and concise targets for installation of windows in homes and commercial buildings. The requirements focus on two mechanisms:

- Solar control - to reduce cooling energy use and summer peak demand (maximum 0.40 SHGC), and
- Insulation benefits - to reduce heating energy use (maximum U-factors).

These requirements ensure homeowner comfort year-round and have led to more durable and better quality products. RECA has developed a series of "Builder Guides," posted on our website, that simplify the code even further and focus on these primary window (and insulation) code values that builders and homeowners must know. Also, please see our website for a current summary of the energy codes adopted and implemented across the U.S. (www.RECA-codes.org).

Despite this progress and the clear importance of energy-efficient windows in the IECC, there is still much road left to be traveled and many holes left to be fixed, in both the code and "on the ground" in the states.

2004 IECC
Prescriptive Fenestration Requirements

	Climate Zone	Fenestration Factor	Skylight U Factor	SHGC Value
	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	NA
	Marine 4 – 8	0.35	0.60	NA

Low SHGC Low -E

Low U - factor Low -E

For more information and zone maps, go to www.reca-codes.org

What Do Next-Generation Energy Codes Have in Store for Fenestration?

The next generation IECC – the 2004 Supplement version – takes a big step forward with its requirements singling out low-E windows as the best option for code compliance across the country. With this new code, RECA believes the future for fenestration looks promising.

In an article originally published in Door & Window Maker Vol. 3, Issue 5, (Nov/Dec 2002) in page 10.

RECA's primary objective is to support and encourage all states and localities to adopt and implement the 2004 IECC. This code is in the best interest of building and home owners, operators and builders, manufacturers, and the general public welfare.

As surprising as it may sound, RECA believes that one impediment to nationwide acceptance of low-E historically has been the code itself. First, a number of loopholes remain in the 1998-2003 IECCs and their accompanying compliance materials (RESCheck®). These "holes" make it far too easy to trade off

Continued on page 2

I N S I D E

Berkeley Lab Wins Award for Breakthrough in Electrochromic Windows

Lawrence Berkeley National Laboratories (Berkeley Lab) was recognized with a 2004 R&D 100 Award, given by *R&D Magazine*, for a significant advance in energy-saving electrochromic windows. For over 40 years, these awards, called the "Oscars of technology," have been given to the "100 most technologically significant new products and advancements over the past year." Winners are selected based on their potential to "change people's lives for the better."

Berkeley lab's award-winning Transition Metals Switchable Mirrors technology, invented by Tom Richardson and Jonathan Slack of the lab's Environmental Energy Technologies Division, improves upon current electrochromic technology. It uses a thin film coating on the window glass made from an alloy of magnesium and one or more transition metals, such as nickel or manganese. The window can be reversibly changed from a reflective state back to a transparent state by applying an electrical current or exposing it to hydrogen gas. By using transition metals rather than the rare earth metals, used in current electrochromic products, the Berkeley windows can absorb and reflect both visible and infrared light (heat). Avoiding the more costly rare earth metals should also significantly lower costs, making "smart" windows a truly intelligent choice for consumers.

The window can also be programmed to self-adjust to sunlight or weather conditions. It can reflect light and heat when it is hot and can absorb light and heat when it is cold. The Solar Energy Industries Association claims that electrochromic windows can save up to 50 percent of a building's energy use. This can lead to significant savings, with heating and cooling from energy losses through windows costing U.S. consumers about $9.3 billion annually.

Richardson and Slack are already working with two companies to get this technology on the market.

Windows and Energy Codes:
continued from page 1

energy-efficient low-E windows for HVAC equipment upgrades and other envelope components that do not offer equivalent savings and benefits. In other words, despite the prescriptive code requirements for low-E windows in most areas, clear glass windows can be used relatively easily after inadvisable trade-offs are applied. Another problem is that there are still some pockets of the country where even the prescriptive requirements in the 1998-2003 IECCs specify an inefficient clear glass double pane window.

Fortunately, the 2004 IECC Supplement ties up a number of these loose ends and helps solidify low-E as the baseline compliant window option across the country. The 2004 IECC also contains mandatory performance caps (maximum SHGC and U-Factor tradeoff limits) to ensure that efficient, cost-effective and comfortable low-E windows are never traded away for other envelope components or with equipment that cannot offer equivalent benefits.

2004 IECC Efficient Window Highlights:

Low prescriptive U-factors in the North and North Central U.S.

Maximum prescriptive 0.40 SHGC in the South and South Central U.S.

The 2004 IECC has published the International Code Council, which is available for adoption everywhere. Its prescriptive window requirements are identified in the accompanying maps and table.

The Fenestration Future is Bright

Eventually, the next innovation in window technology will be commercially available and ready to begin the process of education, transformation, and ultimate adoption in the IECC. However, until then, a lot of work is necessary to ensure that energy-efficient (low-E) windows are universally accepted across the country. RECA believes state and local adoption of the 2004 IECC is the best mechanism available to make that happen, and we will continue our mission to support its adoption and implementation. Though a considerable amount of work remains, the state of our energy codes for fenestration is strong, and the future appears bright.

NextGen Home Incorporates Efficiency, Affordability, and Safety

Today's new homes are more technologically advanced and efficient than ever before. What technologies will improve the homes of tomorrow? NextGen incorporated a number of these advances in its 2004 NextGen Demonstration Home, unveiled in January outside the Las Vegas Convention Center. The NextGen home will be donated to Opportunity Village, a Las Vegas charity that serves people with intellectual disabilities.

The NextGen home was produced in coordination with the Partnership for Advancing Technology in Housing (PATH), a public-private initiative supported by HUD. PATH worked with NextGen to ensure a "whole house" approach that would incorporate technologies to maximize durability, safety, energy efficiency, and affordability, while minimizing waste.

The project's theme, *The Evolution of the American Home,* reflected NextGen's attempt to reconcile what it views as "tension between progress and permanence." While consumers desire the benefits of new technologies, these innovations must be integrated seamlessly into traditional home design.

Many concept homes are very large and serve more as an elaborate product showcase than a concept for a potential house. The NextGen home features many product innovations and sticks to the goals of "whole house" planning and affordability. At 2,300 square feet, the home boasts three bedrooms, two bathrooms, a kitchen, and a formal dining room, in addition to a breakfast room, great room, covered patio, and two-car garage. Rather than showcase new technologies, this average-sized home features key advances in energy-efficiency, automation and safety.

Energy Efficiency

The NextGen home, once placed on a permanent foundation, will be an ENERGY STAR® home, qualifies for the ENERGY STAR designation and saves from $200 to $400 each year on utility bills. The NextGen home's energy-savings features include:

- Icynene spray insulation that resists mold and has a higher insulating value than fiberglass and fills all framing cavities;
- Radiant barrier roof sheathing that reduces air conditioner load;
- High velocity HVAC with small-diameter duct work that fits in the home's insulated space and reduces heating and cooling loss;
- Low-flow plumbing fixtures that reduce water use;
- Tankless water heaters turn that on only when you need hot water, and
- ENERGY STAR-rated appliances that save energy.

Windows

Much of the efficiency possible in the NextGen home is due to its use of ENERGY STAR-rated windows, with low-E, spectrally selective glass. The windows, produced by Milgard, contribute greatly to the home's overall efficiency, saving a great deal in heating and cooling costs. In addition, windows enable the advanced lighting systems by providing ample daylight without great energy losses.

Automation

In the NextGen home, lights can be set to brighten as the sun sets and dim as it rises. Looking for a midnight snack? Lights can automatically light a path from bedroom to kitchen, shutting off three minutes after you're back in bed. In the kitchen, the oven can refrigerate food and start cooking it in time to have dinner ready when you get home.

Safety

The 2004 NextGen home also displays many safety features. The security system can be monitored over the Internet. The Water Cop Flood Prevention system automatically shuts off the house's water if a pipe breaks. The house also uses hardware to secure the roof to the walls and the walls to the foundation, helping prevent damage from high winds.

Building on the success of the current NextGen home, the 2005 NextGen home is on the way! Titled the Safe & Sound Demonstration Home, the project will be the third generation of NextGen homes. The design is focused on providing a strong and safe home to consumers in severe weather areas. It will demonstrate that safety does not necessarily mean increased cost and can be provided while achieving maximum energy efficiency.

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Kipp Rhoads
Program Associate
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036
Email: krhoads@ase.org
Phone: 202-530-2234
Fax: 202-331-9588
www.efficientwindows.org
www.ase.org

SPOTLIGHT *On Collaborative Members*

CHPS Gives California Schools Lesson in Energy Efficiency

It is well known that schools and educators often struggle to provide the highest level of education possible with limited resources. With burgeoning student populations, teachers frequently need to augment classroom supplies with their own resources or ask students to bring some items from home. However, in many schools throughout the United States, more money is spent on energy than on books and supplies combined! In California, a state that educates one of every eight K-12 students in the United States, the Collaborative for High-Performing Schools (CHPS) is taking action.

Started in 2000, CHPS aims to make California's public schools more energy-efficient through information and incentive programs marketed directly at school districts and building designers. The group, comprised of members from a wide array of government, private industry, and nonprofit organizations, hopes to increase the number of "high performance" schools, which provide energy-efficient, healthy, well-lit and comfortable learning environments.

To achieve these goals, the CHPS program designs schools using an integrated design strategy. By viewing each construction element—windows, walls, insulation, and heating and cooling systems—as parts of the whole, CHPS schools provide comfort for students while meeting the constraints of tight budgets.

Certification

Part of the CHPS program involves certification of schools meeting the high performing school criteria. Certification requires that schools meet all the program's prerequisites and earn at least 28 of 81 possible points for other improvements.

The prerequisites include complying with environmental codes; creating a water-use budget; storing and collecting recyclables; and meeting indoor air quality, climate control, and acoustical standards. Points are awarded for schools located near public transportation, exceeding California's energy standards by 10 percent, using building materials with certain levels of recycled content, incorporating natural ventilation, and using ENERGY STAR® products. The point system facilitates compliance with high performance designation standards. Beyond the prerequisites, CHPS gives great flexibility to schools for improving the efficiency and comfort of their buildings.

Problems, Solutions, Benefits

A crucial area of the program is the use of daylighting and windows. A study by the consulting firm Heschong Mahone Group of student performance in one school district with diverse daylighting conditions showed significantly dissimilar results. The study found that the students with the most daylighting in their classrooms progressed 20 percent faster on math tests and 26 percent faster on reading tests than those with the least daylighting. Those with the largest window areas were found to progress 15 percent faster in math and 23 percent faster in reading than the students with the least window area.

Air quality is another important consideration. Children are believed to be much more vulnerable than adults to environmental contaminants. Inadequate ventilation can lead to the buildup of carbon dioxide and other pollutants. Continued exposure to volatile organic compounds has been linked to increasing rates of asthma, which is especially common in urban schools. The CHPS program encourages schools to focus on preventing air quality from becoming a problem, which is less costly than taking corrective actions later.

For more information on California High Performance Schools, check out the website, http://www.chps.net/overview/.

The Clear Incentive For Energy-Efficient Windows

Installing new energy-efficient windows may be more beneficial than you know. Many states offer rebates or other incentives promoting the purchase of energy-efficient windows, doors, and skylights. The table below lists the number of such incentive programs in each state:*

Check out http://efficientwindows.org/new.cfm for a complete list and description of the programs offered:

	Programs
California	13
Colorado	1
Idaho	3
Iowa	3
Maryland	1
Massachusetts	3
Montana	2
New Hampshire	1
New Jersey	1
New York	1
Oregon	27
Washington	15
Wisconsin	1
Wyoming	1

**DOE fact sheet, September 2004, "ENERGY STAR® for Windows, Doors and Skylights State and Utility Incentives and Activities"*

Do You Have News You'd Like to Share?

We're always interested in reporting on new technology and research in residential windows. If you have something you would like to share with us please contact Kipp Rhoads at krhoads@ase.org.

Collaborative *News*

The EWC has launched the new **EWC Window Selection Tool**, designed to link consumers to qualified energy-efficient window products on the EWC web site. Consumers frequently ask us where they can find efficient products that are described generically on our site. In response, the EWC designed the **EWC Window Selection Tool**.

The EWC is also undertaking a renewed focus on transforming the new construction sector to more energy-efficient products. According to ENERGY STAR®, this sector lags behind the retrofit market in penetration of qualified products—it is estimated that only 20 percent of the products in residential new construction market qualify for ENERGY STAR, compared with 60 percent of the products in the retrofit market. The EWC will conduct research to identify more effective methods to reach this sector with the energy efficiency message.

The EWC also will target the low-income market in the coming year, undertaking new research to identify opportunities for increasing efficiency in this sector. Considering the age of existing housing stock—over 70 million homes in the US are at least 20 years old (US DOE EIA)—we believe there are untapped opportunities for increasing market penetration of efficient window products in the low-income sector.

As always we will continue to partner with and provide outreach to manufacturers and suppliers. However, in the coming year the EWC will target small window manufacturers. The EWC is interested in helping to increase the number of small manufacturers that participate in NFRC testing and certification, as well as ENERGY STAR partnerships among small manufacturers across the nation.

We will keep you updated on our activities through our newsletter and email announcements. We are always interested in feedback from the industry, so we hope that you will share your insights and goals with us at krhoads@ase.org.

Check out the following link on the EWC website to see when we will be in a city near you: http://efficientwindows.org/new_activities.cfm.

The Low-E Revolution

The fenestration industry has come a long way from the days of the single pane, uncoated window. New window technology has transformed the fenestration market with innovations such as high-tech spacers, low-E glass and gas-fills. All of these technologies aim to improve insulation and energy-efficiency, maximize personal comfort, and reduce energy costs for consumers. Notably, windows with low-E (emissivity) glazing are making a big hit.

One cutting-edge low-E technology is the Heat Mirror – a high-tech glazing system that can match or exceed the energy efficiency of triple pane windows. It is constructed by suspending a sheet of low-E film between panes of insulated glass. Two layers of Heat Mirror may also be suspended between panes of glass with gas-filled spacers to form Superglass, the most expensive glazing system on the market, but one of the best insulators.

Another new technology, developed by Lawrence Berkeley National Lab's (LBNL) Environmental Energy Technologies Division, is the Transition-Metal Switchable Mirror (TMSM). TMSMs are dynamic glass panels with a magnesium alloy-transition metal coating that can switch back and forth between a transparent state and a reflective state. This is done by application of an electric field (a process dubbed electrochromic switching), or by exposure to dilute hydrogen gas (gasochromic switching). According to the April 2004 issue of Science Beat, unlike Absorbing Electrochromic (AE) windows, TMSMs reflect visible and infrared light and heat, have a greater range in transmitting (50% to 0.5% or lower) and reflecting (75%-10%) heat and light, and provide better privacy.

Low-E coated and ENERGY STAR® rated windows can cost from 5 to 15 percent more than their less energy efficient counterparts. However, the extra costs are minimal compared to the long-term energy savings and the added benefits of low-E windows. These benefits include: reducing fading in furniture and carpets, reducing glare, and providing extra security in wind, seismic and other high-hazard zones. Low-E windows keep you safer, warmer and more comfortable in any given season.

EWC Offers New Energy-Efficient *"Word on Windows"* Newsletter

The EWC is always striving to improve. In an effort to save energy and decrease pollution, we now offer our Word on Windows newsletters in e-mail format. Although we will still produce limited numbers of printed copies, we urge you to sign up for the electronic version. Please e-mail us at ewc@ase.org to be added to the newsletter list. Include your name, address, phone number and email address. Thank you for your cooperation and for doing your part to save energy!

The EWC does not send spam or share e-mail addresses with third parties.

New online Energy Codes Resource Center Offers a One-Stop Source For Information on Building Energy Efficiency Codes

The U.S. Department of Energy (DOE) recently launched a new building technology website, the Building Energy Codes Resource Center, a comprehensive, online resource that links users to energy codes, construction techniques, and technologies. The interactive website, which went live October 1, offers detailed information on topics ranging from techniques for framing window headers and on insulation to the latest research on mold and moisture. The site's major focus is residential codes and beyond-code construction.

The Resource Center provides information on hundreds of topics in a variety of different formats, including:

- Articles—Fact sheets, reports, and general information about energy codes and code resources.
- Graphics—Diagrams and photos that illustrate concepts related to energy codes and beyond-code construction.
- Online tools—Interactive web-based applications that guide users through energy code and related processes. An example is online energy code compliance or energy advisors.
- Presentations—PowerPoint documents detailing energy code topics and presentations.
- Videos—Short clips that discuss subjects ranging from building science to energy codes.

The Resource Center gathers content from the Building Energy Codes Program's (BECP) archives, as well as from resources across the Internet, such as ENERGY STAR®, Building America, building scientists, and code groups. Users can search topics by category using the "browse" menu, or by keyword using the "search" feature. While visiting the Resource Center, users also can link to RES*check*™, BECP's energy code compliance software, now in use in many states.

The Resource Center content is the product of years of work by DOE's Building Energy Codes Program, and it has been developed to provide a central point of access to energy code and construction information.

Look for the Resource Center by linking from BECP's website at www.energycodes.gov.

Efficient Windows

Efficient Windows Collaborative
Alliance to Save Energy
1200 18th Street, NW, Suite 900
Washington, DC 20036

www.efficientwindows.org