Energy Efficient Windows in the Southern Residential Windows Market

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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.

[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.

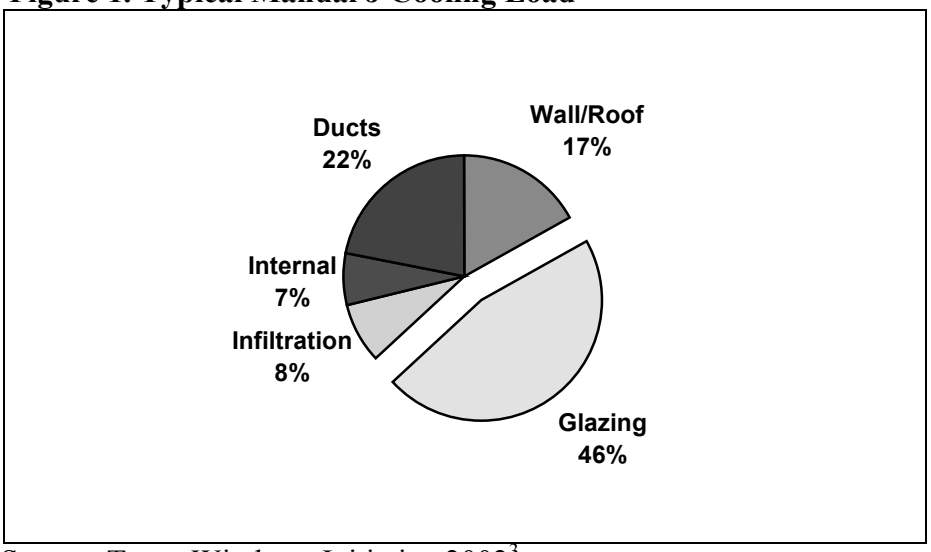
Of all the energy efficient technologies that can be applied to new construction, one of the most effective in terms of energy savings is the energy efficient window. Cooling homes in the South (4000 heating degree days or less) consumes 63 billion kWh of electricity every year, or 52 percent of all 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.

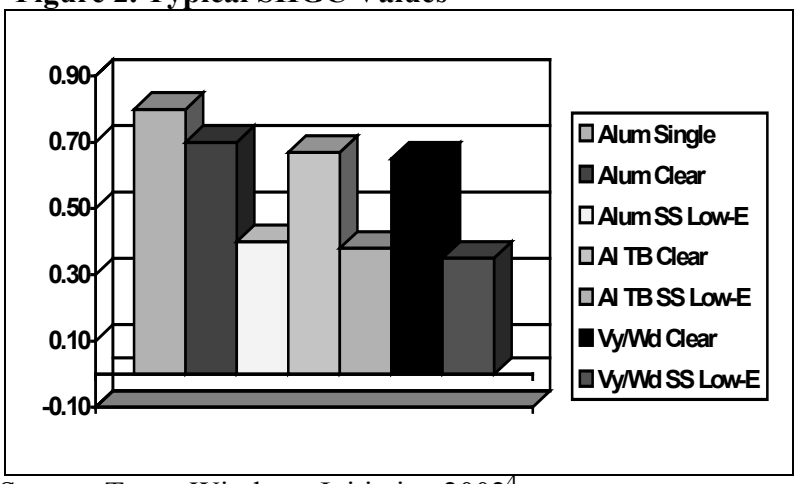
The National Fenestration Rating Council (NFRC) established voluntary standardized testing procedures for whole window performance for the following measurements: U-factor, solar heat gain coefficient (SHGC), air leakage (AL) and visible transmittance (VT). Window and skylight manufacturers voluntarily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

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.

[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]

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.

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

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

- 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

[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.

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 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.

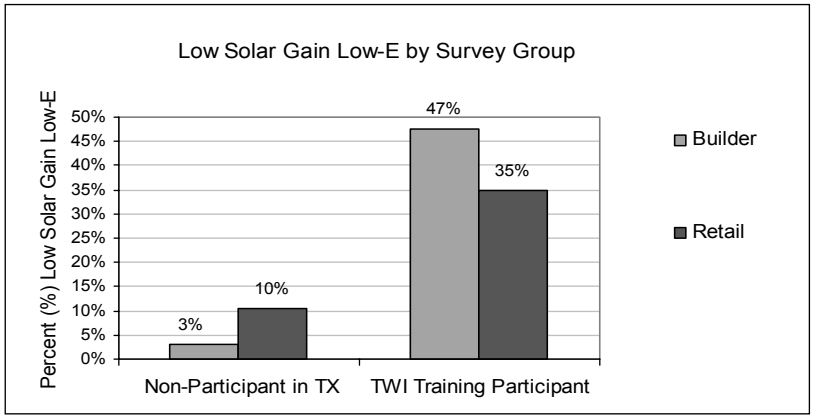
As indicated in Figure 3, builders and retailers that participated in the training program were much more likely to sell energy efficient windows than builders and retailers in Texas that did not complete the TWI training program.

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?

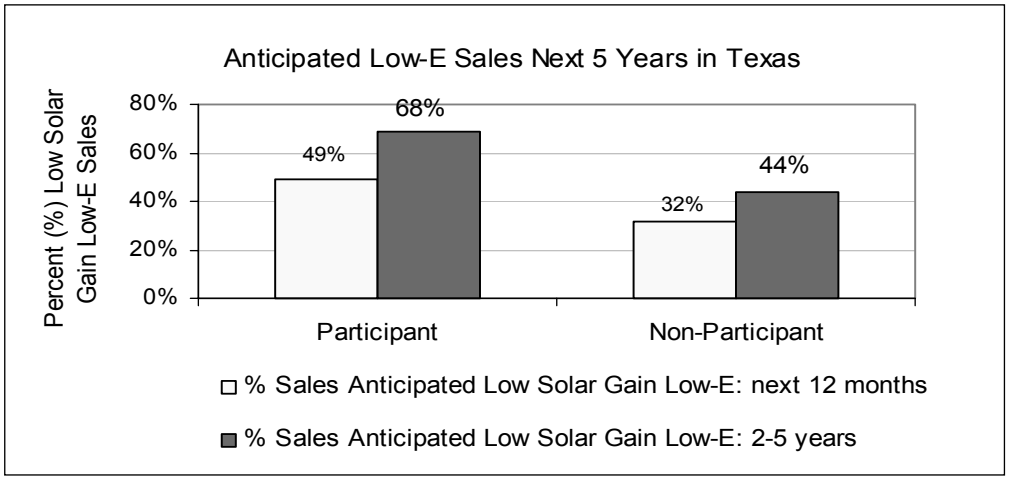
As noted in Figure 4, TWI training participants reported higher sales of low solar gain low-E glass and a higher anticipated percentage of future low-E window sales than did respondents that did not participate in the TWI training activities.

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



Source: Zarnikau & Campbell 2002

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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