

Market Transformation of Energy Efficient Windows in the Midwest

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ABSTRACT

The market for energy efficient windows is strong in the Midwest. Still, opportunities exist to further increase the performance of window products and to affect new market areas where cost is often the deciding factor in choosing window products. By removing barriers to manufacturer participation in the Energy Star® windows program and identifying peripheral issues that may affect market penetration of efficient windows, the marketplace for efficient window products in the Midwest can be expanded and transformed.

Introduction

There are more wood window manufacturers concentrated in and around Wisconsin than anywhere else in the United States. Encouraging the participation of Wisconsin window manufacturers and fabricators in the consumer-oriented Environmental Protection Agency's Energy Star® window program, aids in transforming not only the Wisconsin marketplace, but the national marketplace as well.

Several factors present barriers to manufacturers that choose to participate in the Energy Star windows program. For primary window manufacturers, minor changes in the design of products that are close to meeting Energy Star program requirements can be very costly. For replacement window manufacturers, participation in the National Fenestration Rating Council (NFRC) process, a requirement for the Energy Star program, is generally considered prohibitive as the total process cost per label is typically higher than for larger manufacturers. For all window manufacturers, the cost and complexity of NFRC/Energy Star product labeling is a barrier.

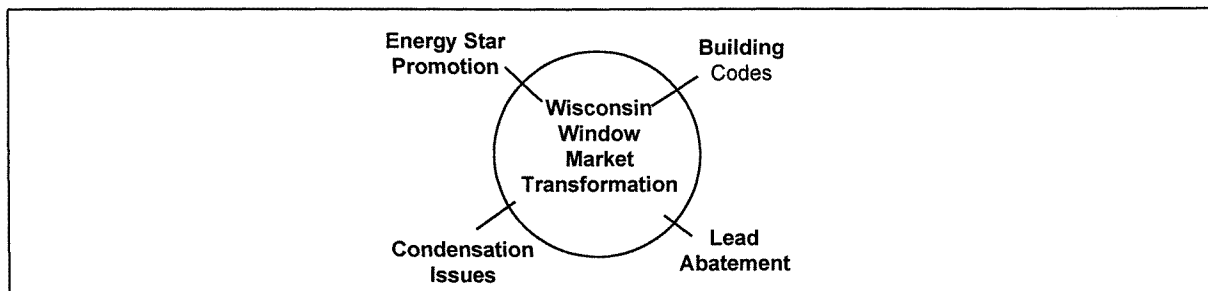


Figure 1. Window Market Transformation Influences

Regardless of these barriers, several forces have been moving window manufacturers and fabricators toward comparative performance labeling (figure 1). Extensive marketing surrounding the Energy Star program have begun to gain some traction with buyers. Recent

changes in several Midwest states' building codes, which mandate labeling and minimum performance criteria, are easily attained by participation in the highly visible, consumer-oriented Energy Star marketing program. Several incidental issues, not directly related to energy efficiency, are also working toward assisting market transformation. These currently include window replacement programs for lead abatement, which may mandate housing rehabilitation in many long-dormant markets, and condensation issues where a proposed condensation rating system may compel manufacturers to improve product performance. The development of these direct and incidental issues is crucial to product improvement, and helps to foster recognition of the benefits of energy efficient window products in Wisconsin, the Midwest and the nation.

In 1998, the Wisconsin Window Initiative, a program funded through the Wisconsin Department of Administration, Division of Energy and Public Benefits, was created to address the issues defined above. The program has two goals: to encourage and assist Wisconsin primary and replacement window manufacturers in increasing their participation in the National Fenestration Rating Council's rating program, and to facilitate product improvements that increase the share of their product line that qualifies under the Energy Star criteria. A total of \$95,000 has been awarded to provide both direct and indirect assistance to Wisconsin manufacturers.

The Window Marketplace in Wisconsin

Wisconsin is located in a widely forested area of the Midwest. From the 1880's, this provided an ideal primary resource for lumber and milling industries. Window manufacturing was a natural, high-value-added extension of these conditions. Although much of the lumber used for window manufacturing in Wisconsin is now imported from other states such as California, the Wisconsin window industry has thrived with over \$1 billion in annual sales¹, representing approximately 8% of national window sales. The long history of lumber milling developed a core of skilled craftsmen, suitable for manufacturing of high performance windows. In many communities, the lumber, millwright and window industries are major employers and represent a significant contribution to Wisconsin's economy. The cold winter weather, a history of the use of storm windows as a second window, and energy cost consciousness have supported the development of an energy efficient window industry.

Wisconsin's climate is dominated by long, cold winters. In recent years, however, peak consumption of electricity has tended to occur during the summer, and hot, humid spells and an increasing number of air-conditioners have threatened power shortages. From the perspective of utility companies, the cooling season performance of windows is at least as important as the heating season performance. With high demands on both heating and cooling performance, high-efficiency window products² have become popular in the marketplace. Other features such as low-maintenance window exteriors, better and more durable operating hardware, better weatherstripping and increased comfort are selling points

¹ Window & Door Magazine, 1998

² An energy efficient window would be defined as having a low-conductivity frame, high or low solar gain low-emissivity glass, Argon gas fill and a low-conductivity spacer.

for replacement windows. The majority of new Wisconsin single-family residences install high-efficiency window products. Still, many of these products do not meet the 0.35 U-factor that constitutes the Energy Star minimum performance requirements for the Northern region of the U.S. Additionally, many home improvement stores stock lower-performance products targeted toward cost-conscious consumers and builders.

New Construction

Windows for new construction in Wisconsin are typically wood-framed, with aluminum or vinyl exterior cladding to reduce maintenance. Often, metal cladding and other enhancements popular with consumers, such as dividers between the glass, degrade the overall performance of the window product so it will not meet the Energy Star requirements.

Manufacturers typically sell to builders through distributors, often lumberyards. Although every manufacturer offers energy efficient window products, manufacturers also have a range of lower-priced products targeted to budget builders or remodelers. Usually these products have clear, dual pane windows and will not meet the Energy Star criteria.

As of May 1, 1999, Wisconsin adopted language from the 1995 version of the Model Energy Code (MEC) that requires builders to use window U-factors rated in accordance with the NFRC 100 procedure. If the builder chooses to use products that have not been rated, code-default values can be used to represent a product's performance. These default values were derived from the MEC and do not give credit for unverified features such as Low-E glass and argon gas fill. This provides an incentive for builders to use NFRC rated products and for manufacturers to NFRC-label their products – a requirement in the Energy Star windows program.

Another primary concern for new construction in Wisconsin is window condensation. With the advent of sealed combustion appliances and tighter construction, moisture levels have risen in new homes. As windows represent the coldest indoor surface, condensation often forms around the edge of the glass unit, closest to the spacer where the greatest amount of heat is transferred. Excess water from condensation can cause damage to the window frame and surrounding structure. It also contributes to the growth of molds and mildew that can spawn allergens.

While consumers may or may not notice the higher (and far more healthy) winter humidity levels, they do notice the condensation. As one contractor put it, "I've never had a customer complain that the U-factor of their windows wasn't low enough but I sure have had complaints about condensation."

Because of a determination that there is a link between U-factor and condensation on windows, the State of Minnesota requires a maximum average NFRC-rated U-factor of 0.37 for all new homes built after April 1, 2000. This affects manufacturers in and around Minnesota, as they must insure that virtually all their products sold in Minnesota will meet the new code requirements. Note that a window with a U-factor of 0.37 typically must have low-E, gas fill, a good spacer and a low-conducting frame. Still, it does not quite meet the Energy Star criteria for the Northern tier of states, which requires a U-factor of 0.35 or less. Only a little additional effort is required to meet the Energy Star level. The new Minnesota building code is a first step toward market transformation to higher efficiency windows.

Note, however, that energy efficiency was not the motivating factor. Moisture condensation and its relation to building safety was the primary concern. It is these non-energy related attributes that often drive the success of market transformation efforts.

Existing Homes/Apartments

Existing homes and multi-unit dwellings in Wisconsin typically have double-hung, single-pane wood windows with separately operating aluminum or vinyl storm windows. These windows slide in wood or aluminum tracks and often have metal (or no) weatherstripping. Indoor air is forced between the window and storm and often condenses on the storm, obstructing view. Exteriors of the window are typically wood, and require maintenance. Glass is typically affixed to the window using glazing compound, which also requires maintenance.

Primary wood window manufacturers generally target the new construction market. In addition, new wood windows are sometimes used as replacements when natural wood is desired on the interior. However, due to the method in which wood windows are constructed, it is difficult to offer them in the non-standard sizes often required for replacement windows. With a range in age of existing housing stock from the 1860's to the present, replacement windows need to be available in a wide range of sizes and shapes. Vinyl windows satisfy this requirement and now dominate the replacement market.

Vinyl windows are constructed from lineal extrusions that can be cut to virtually any size. There are basically two types of replacement window: the full window replacement where the entire frame is removed and replaced; and sash replacement, where only where the frame is left intact. With sash replacement, the sash is removed and replaced with new jamb liners, hardware and weatherstripping. As modern replacement windows will typically reduce exterior maintenance, they are often sold in a package with other maintenance-reducing home improvements such as vinyl siding.

Another existing marketplace issue is lead abatement. A recent ruling by the Wisconsin Supreme Court holds apartment owners liable if their tenants are poisoned as a result of ingesting lead from paint. When windows slide during opening and closing, leaded paint, often present in homes built before 1978, is ground to dust that may be inhaled or ingested by occupants. This is a particular problem for infants who often are affected by lead paint dust obtained from floors, toys and pets where lead paint can accumulate. It is estimated that over eight million dollars annually worth of windows will be replaced in Wisconsin apartments to ward off possible litigation. Again, if the replacement windows are Energy Star or energy efficient, the driving factor for market transformation here is not an energy-related issue.

Identifying Barriers to Energy Star Participation

One of the primary requirements to participation in the Energy Star window program is that the product is labeled according to the NFRC procedures for U-factor and Solar Heat Gain Coefficient (SHGC). Nearly all large, primary window manufacturers in Wisconsin and throughout the nation have had the majority of their products certified through the NFRC

rating program. Still, labeling requires an additional manufacturing step and a supporting management system. Consequently, some manufacturers were only labeling in States that required NFRC ratings.

A goal of the Wisconsin Window Initiative was to identify the current status of NFRC labeling among Wisconsin window manufacturers and to identify barriers to NFRC labeling for meeting Energy Star compliance requirements. In June of 1999, a survey was sent out to 180 prime window manufacturers that sold products in the Midwest, including Wisconsin (initially we were not targeting replacement window manufacturers). We received approximately a 10% response (19 respondents – see Attachment A). However, the respondents were primarily the largest Wisconsin window manufacturers and represented over 600,000 window products sold annually in Wisconsin, which represents a majority of windows products sold. The survey showed that all were aware of the NFRC certification and labeling program (4.9/5.0 where 1=unaware, 5=fully aware). Fewer were aware of the Energy Star program (4.1/5.0). Participation in the NFRC labeling program was widespread among respondents. 17 of 19 respondents label products under the NFRC program. Nine claimed to label 90% or more of their shipment-weighted products. Only three of the respondents claimed to be labeling Energy Star eligible products. Seven claimed they plan to participate within a year. The questionnaire asked manufacturers to identify the barriers to labeling all qualifying products. Eleven of the respondents (58%) identified “Labeling complexity”, five (26%) cited “Products have not been rated by NFRC”, and four (21%) cited “Label costs” as barriers to Energy Star labeling. When asked to define areas of where the Wisconsin Window Initiative may be of assistance, “Design/simulation assistance,” “Workshop(s) on NFRC and Energy Star requirements” and “Labeling assistance” were the interventions that ranked the highest.

In response to this survey, a workshop was offered in November of 1999 and was well attended by Wisconsin and surrounding-state window manufacturers (approximately 40 participants). Representatives from NFRC, DOE/Energy Star Windows, the State of Wisconsin, and the State of Minnesota were invited to speak about their programs and the status of building codes. Plaques signed by the Governor of Wisconsin were awarded to manufacturers who chose to participate in the promotional program.

Recent Successes

Gas Fill

A major Wisconsin windows manufacturer experienced difficulties maintaining the integrity of their inert gas fill (i.e. argon, krypton) between glass panes. As a result, they discontinued use of this gas as a method of increasing the energy efficiency of their high performance window assemblies. Consequently they were unable to demonstrate their ability to meet the Energy Star criteria of $U \leq 0.35$. At the initial meeting of the Wisconsin Window Initiative, presentations by various representatives of NFRC and EPA were accompanied by informal information sharing with other manufacturers. This discussion reinforced the belief of most manufacturers that significant gas concentrations could be properly maintained and that industry actors could adequately protect itself from litigation. As a result, the window

manufacturer in question has decided, for various reasons, including maintaining their competitive position, to resume marketing of high performance windows with an inert gas fill. This addition will allow them to meet the Energy Star criteria for several more products, and to label their windows accordingly. They have also recently signed on as an Energy Star Windows Partner. We expect many of their products to be Energy Star-qualifying within a year. The WWI is currently assisting them in computer-modeling their window products and in obtaining Energy Star ratings.

Expanded Product Ratings

A second major window manufacturer had only limited NFRC ratings across their product lines. They believed NFRC certification to be a complicated, costly and time-consuming process. Informal discussions with representatives of NFRC at the initial meeting of the WWI brought out the ability of a manufacturer to group their product line into broad categories to simplify the certification process, reduce the certification time and limit certification expenses. As a result of these informal discussions, the manufacturer is working with the WWI contractor to obtain NFRC certification across the broad range of their products. It is anticipated that the majority of these products will attain Energy Star status.

Changing Perceptions

Once Energy Star becomes a recognized market standard, it may be more costly to purchase a substandard window. A major Wisconsin public housing authority, believing energy efficient windows to be more costly, specified less efficient windows. Upon review of the bids, it was determined that the inefficient window was a “special order” in that manufacturer’s line, and thus more expensive. Consequently this major purchaser of windows now specifies energy efficient models.

Labeling Assistance

Open discussions with some manufacturers raised the concern of the difficulty and extra expense of placing an additional label on a window. NFRC requires the label to be placed on each window sold. If the window meets the Energy Star criteria, manufacturers may affix an additional label that must be approved by the EPA Energy Star contractor, D&R International. Typically, the NFRC label and Energy Star labels are combined to form one long label. One manufacturer cited their reason for not participating was that the Energy Star label was too big and that the owners did not want to put another label on the window. As a direct result, the WWI contractor approached D&R International (DOE’s marketing contractor), to determine if the Energy Star label design could be minimized to approximately one-half the size of the typical label. D&R agreed to the concept and tasked the WWI contractor to design and provide electronic versions of the label for review and approval. The design was completed, approved and is now available for use. Figure 2 is an illustration of the approved design combining the NFRC and Energy Star labels. D&R International has

approved the Energy Star portion of the label for use by any manufacturer meeting both NFRC and Energy Star qualifying criteria. The WWI contractor (WESTLab) is making the label available for manufacturers who may wish to use it.

After making the condensed label option available to the concerned manufacturer, they have committed to expand their product line that meets the Energy Star qualifying criteria. Once again, in working with a manufacturer and providing assistance in surmounting a perceived barrier, the WWI is helping to transform the market toward greater energy efficiency.

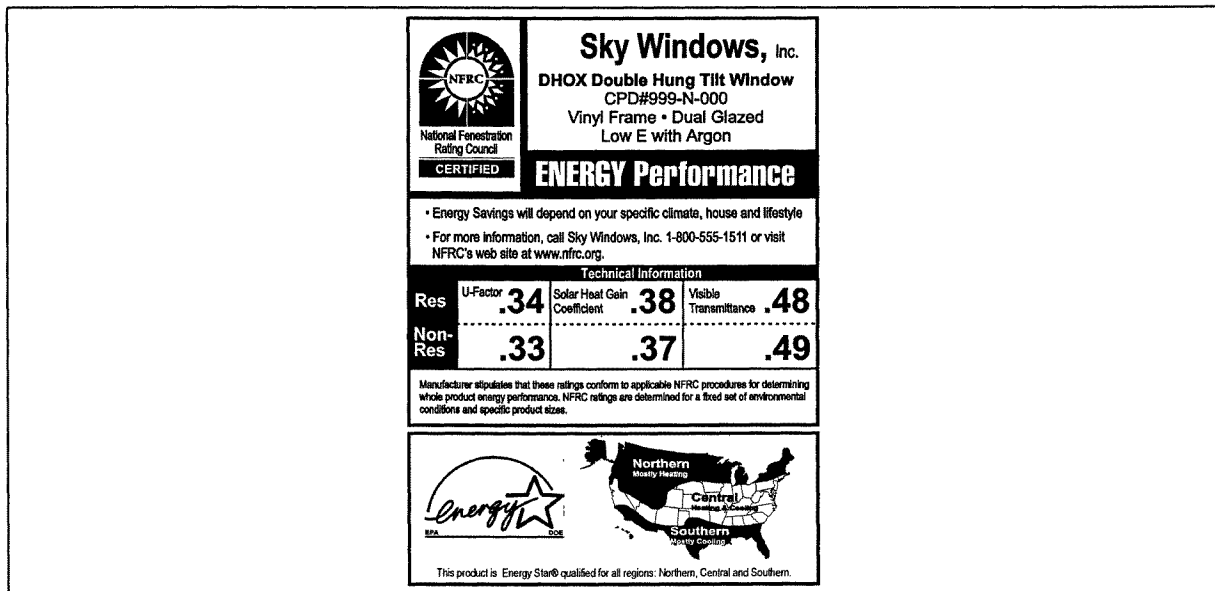


Figure 2. Re-designed (smaller) Energy Star Label with NFRC Label

Enhanced Energy Codes

The Wisconsin Window Initiative is also focused on efforts to assist Wisconsin window manufacturers in capitalizing on enhanced Midwest markets for energy efficient windows as other states modify their residential building codes to require NFRC-labeled windows or promote Energy Star windows into specifications or performance standards. Building energy code compliance software can play a role in promoting specific types of high performance windows.

As an example the WIScheck and REM/Rate™ software packages (used to demonstrate compliance with the revised Wisconsin residential building energy code) provides sufficient “credit” for high performance basement windows that one manufacturer is considering offering Energy Star basement windows. This illustrates an interesting point. A building standard does not just codify what has become common practice. When performance tradeoffs are allowed, a performance code can transform a segment of the market in a particular direction toward the incorporation of a new energy efficiency technology.

Lead Abatement

Market transformation can be driven by many factors. In the case of high performance energy efficient windows, much of the impetus has little to do with energy efficiency. The driver can be window replacement as a lead paint remediation measure. Several recent developments have greatly expanded the potential market for large-scale window replacement in Wisconsin. The Wisconsin Apartment Association may be going into the market to replace \$8,000,000 worth of windows annually as a lead-based paint remediation effort to address liability concerns. Recent legislation will provide liability relief if the owner/operator meets lead paint removal certification criteria, which frequently entails whole window replacement. To further this goal, the Wisconsin Legislature has committed substantial oil overcharge funding to lead-based paint abatement, and there is an effort underway to assure that any replacement windows meet Energy Star criteria. Public pressure may well require state agencies to commit substantial additional funds to further this abatement effort. Public Housing Authorities have also expressed concerns related to lead paint contamination. This presents an opportunity to work in cooperation with the apartment owners association to deliver a comprehensive program to the multi-family sector.

There are also care-giving facilities that are concerned about lead paint and improved energy efficiency. These include childcare providers, Community Based Residential Facilities, Adult Day Care facilities and nursing home facilities. Lead paint concerns as well as mold and mildew prevention are all health and safety issues helping to transform the market toward Energy Star windows.

Another recent development is the incorporation of utility funding of “public benefits” programs. The Wisconsin legislature recently passed a public benefits bill that allocated \$45,000,000 per year for energy efficiency, low-income energy assistance and clean power. One component of the public benefits is increased funding for low-income weatherization programs including whole window replacement with Energy Star windows.

Other Opportunities

It might be noise abatement along expressways and around airports. It could be the result of a measure to limit intruders, a safety or security concern. Moisture condensation limitation, as a mold and mildew prevention measure, may be the driving force. Once these concerns are incorporated into marketing and promotion, high performance energy efficient windows can be expected to dominate the factory built window market.

Conclusion

Building on the Energy Star program, and actively consulting with primary manufacturers about its goals, have allowed Wisconsin to greatly accelerate the transformation of the windows market toward energy efficiency. Once the market has transformed to high-efficiency window products, it is unlikely to back slide as consumers would have to pay the same or more for non-low-E “special order” windows, and

manufacturers discover the simplicity of choosing not to stock several glass types. Also, the non-energy benefits are attributes so desirable that a return to the old ways is extremely unlikely. Limited incremental cost, health and safety, reduced air infiltration, sound abatement and intruder prevention make the Energy Star Window Program a model in Market Transformation.

Attachment A: Wisconsin Window Initiative June 9, 1999 Survey Results

Mfgr #	Name	Co	Q1					Q2		Q3		Q4	Q5	Q6	Q7	Q8		Q9	
			%New Res	%New Com	% Retro	% Spec.	% Other	#Sold WI	% Total	NFRC Aware	E* Aware	NFRC Particip.	E* Particip.	E* Labels?	Help Rank*	Suggestions to Increase #Labels	Attend Wkshp?	Agenda Topics	
1			40%	34%	22%	4%	0%	3000	2%	5	5	c	d	a	d,c,e	None	N	N/A	
2			0%	0%	100%	0%	0%	1500	3%	5	5	b	b	b	h,g	None	N	N/A	
3			60%	0%	0%	40%	0%			5	5	b,c	b	b	e	None	P	N/A	
4			20%	15%	15%			1000	2%	5	2	b	e	d	a,b,c,e	The NFRC label sufficient to address energy req.	N	N/A	
5			30%	10%	10%	20%	30%		30%	5	5	a	d	d,b,c,a	i,a,d,c	E* value too low, incl. Air infiltration	Y	How to chg E* values, how to make it fair, cost/benefit eval.	
6			95%	0%	5%	0%	0%	85	60%	5	1	a	e				N		
7			60%	0%	30%	10%	0%	12000	20%	3	3	a	d	d	a,c,e		P		
8			83%	5%	2%	10%	0%		10%	5	5	b	b	b	a,b,c,g		Y	Requirements, incentive plans, future plans	
9			5%	0%	90%	5%	0%	2000		5	5	a	a				N		
10			85%	5%	10%	0%	0%			5	5	a	c	d	i	Use realistic U-value (.42)	Y		
11			50%	0%	50%	0%	0%			5	3	b	d	c,b,a	a,c,g,h	Skylys unrecognized. Not in best financial interests	Y		
12			90%	0%	10%	0%	0%	10000	9%	5	3	b	b	c,b,a	c,d,e,a		Y		
13			50%	20%	30%	0%	0%	55000	5%	5	5	a	b	b	e,b				
14								12500	12%	5		b							
15			80%	0%	20%	0%	0%	5000	8%	5	3	b	d	b,c,a	c,d,a,b				
16			65%	3%	33%	0%	50%	231000		5	5	b	a	b,c	c,d,e,f	convince prog. admin. to raise U-factor to .38	Y	What incentives offered for mfgrs to retool products to gain mere .01 in performance?	
17			60%	10%	25%	5%	0%	250000	5%	5	5	a	a	n/a	h,g,f,e	More education, enforcement of codes with building trades	Y		
18			60%	15%	15%	10%	0%		5%	5	4	a	b	b,c	c,d,a	consolidate labels, have NFRC, E* Hallmark, HUD, Dade co, NC & own - no more room!			
19			39%	0%	61%	0%	0%	16000	4%	5	5	a	b	b	f,g,e,a	Would like to see E* products mandatory part of bldg code	Y	NFRC labeling, E* info, WI building codes, Bldg inspection & enforcement	

Code key:

Q4: a = Prod. rated - > 90% labels; b = Prod. rated - < 90% labels; c = Not rated but will in 1 yr; d = Not rated, no plans

Q5: a = E* part. and currently label; b = E* part. but not labeling; c = E* part. - do not plan to label; d = Not E* part. - will participate 1yr; e = Not E* part. - no participation plans

Q6: a = Products have not been rated by NFRC; b = Labeling complexity; c = Label costs; d = Other

Q7: a = Workshops on NFRC & E* Req.; b = Workshops on WI Bldg Code; c = Financial assist for label costs; d = Design/simulation assist; e = Marketing (sale) literature for E*;

f = Radio/TV PSA's, articles; g = Direct cash incentives; h = Financing incentives; i = Other. *Only the first 4 rankings have been included.