

Market Transformation from the Bottom-up

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ABSTRACT

Market transformation is not a static state. It is never complete. Once a market has been “transformed,” technology and programs continue to progress until the market, once again, is to be transformed. The ability of manufacturing participants to adapt to technological and market changes is key to their participation and long-term success of improving energy efficiency in the marketplace.

Window manufacturers have an array of complications that present barriers to participation in the National Fenestration Rating Council (NFRC) and ENERGY STAR® programs. Providing assistance to window manufacturers to respond to changing performance criteria and program requirements will lessen the costs of participation, insures manufacturer cooperation and assures the future success of market transformation programs.

Introduction

A goal of the ENERGY STAR program is to increase brand-name recognition and promote the purchase and installation of energy efficient products. One of the vehicles for achieving this is to target highly visible consumer products that are associated with efficient use of energy. Because consumers make a strong connection between energy use and window products, publicizing the ENERGY STAR brand through energy efficient window products is an important aspect of the success of other ENERGY STAR programs.

Unfortunately, manufacturing and qualifying windows as energy efficient is not an easy task. Manufacturers participating in the NFRC/ENERGY STAR windows program are presented with several barriers ranging from product re-design to labeling complications. Likewise, the manufacturers range from small vinyl window fabricators that cater to the replacement market, to large, automated manufacturers that target new construction.

Based on a survey conducted by the Wisconsin Window Initiative and through conversations with manufacturers, we have determined the following to be barriers to ENERGY STAR program participation:

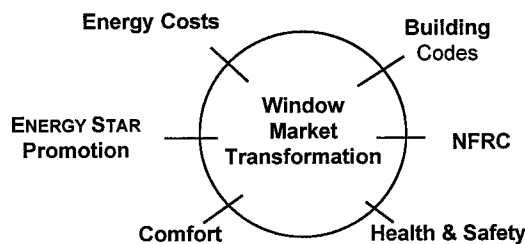
- Product design changes & cost
- NFRC program cost & time
- Staff education (point person)
- NFRC program complication
- NFRC label application costs (obsolete labels, application time)
- Label complication
- Product options which increase complication
- Labeling accuracy
- Label size

- Return on investment
- ENERGY STAR label recognition
- Product labeling is perceived as “post sale”

Even though these barriers are significant, 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 attention with buyers. The recent rising cost of home heating bills has put energy in the forefront of home remodeling projects and manufacturers are weighing their sales pitches heavily toward energy savings. Changes in several 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.

Figure 1. Window Market Transformation Influences



In 1998, the Wisconsin Window Initiative (WWI), a program funded through the Wisconsin Department of Administration’s, Division of Energy, was created to address the issues discussed 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 labeling of products, and to facilitate product improvements that increase the share of their product line that qualifies under the ENERGY STAR criteria and labeling of those eligible products. A total of \$95,000 has been awarded to provide both direct and indirect assistance to Wisconsin window manufacturers.

The Window Marketplace

Window manufacturers in the Midwest vary greatly in size and market focus. Due to the widely forested areas of this region and long harsh winters, wood window manufacturers have become national suppliers of attractive, high quality, energy efficient products for new construction. Prime windows from mid-sized manufacturers are often sold through lumberyards, specialty stores or directly to builders. Some brands are sold through big-box stores on a national or regional level.

Replacement windows have become popular as the housing stock ages and energy prices rise. Often times an existing wood window frame is retained and only the window sash is replaced. The new sash can either be inserted with new jamb-liners that contain new balancing hardware or via a “pocket” (frame within a frame) window. These pocket windows contain all the hardware necessary to operate the window. Vinyl windows dominate the replacement marketplace and have been the largest growing sector of the window industry since 1992¹. Vinyl windows are well suited for the replacement market as fabricators can miter cut extrusions to custom-fit existing window openings. Additionally, fabricators are smaller operations catering to this type of market and have set up their operations to respond to custom orders. The ordering and labeling systems for these types of manufacturers are quite different than a production-oriented national manufacturer.

Although the market penetration for high-performance Low-E windows is high for new construction many of these products do not meet the ENERGY STAR criteria (0.35 U-factor) and some first-cost conscious builders still install clear, dual-pane windows in new housing developments.

Barriers to NFRC/ENERGY STAR Program Participation

NFRC certification is required before manufacturers can participate in the ENERGY STAR program. This is a significant hurdle and is costly to manufacturers. These costs include initial simulation and testing of product lines, independent agency certification and inspection fees, NFRC program participation fees, label costs and personnel time. Certification hard costs for a small manufacturer would typically start at \$10,000 or more. A desire to participate in the ENERGY STAR program has been an incentive for smaller manufacturers to acquire NFRC ratings. However, many of these manufacturers are not familiar with the rating processes. Often, smaller manufacturers produce vinyl replacement windows that will meet ENERGY STAR requirements without design changes. Still, they may not have gone through the initial NFRC certification process so they cannot qualify for use of the ENERGY STAR label.

Larger manufacturers already participating in the NFRC program face a different set of difficulties. They must insure that their existing products meet ENERGY STAR requirements. One of the features of many wood window products is a low-maintenance exterior that saves homeowners the hassle of painting, scraping and caulking windows. A popular material for covering the exterior of window products is aluminum. Because aluminum is an excellent heat conductor, products with high-performance Low-E glass often have difficulty meeting the ENERGY STAR requirements due to heat conducted through the aluminum (see figure 2). Significant design changes are often necessary to modify the product so that it meets the ENERGY STAR requirements. Additionally, there are options that may degrade the performance causing products to miss the ENERGY STAR performance target. These include internal dividers and removal of gas-fills. Internal dividers (i.e. simulated divided lites) can transfer enough heat to affect overall U-factor performance by +0.01 to 0.02. A product on the verge of ENERGY STAR performance (0.35) may not meet the Northern region requirements with internal dividers. Likewise, if gas fill must be eliminated due to product shipment to high altitudes, product performance will drop. There may be legal exposure regarding gas retention over time. As new tools to measure these gas concentrations become available on the market, current gas concentration ratios may be altered to reflect long-term retention rates. Product design changes should take all these issues into account.

A primary requirement for participation in the ENERGY STAR window program is that the product is labeled according to the NFRC procedures for U-factor, Solar Heat Gain Coefficient (SHGC) and

¹ NFRC web site (www.nfrc.org).

Visible Transmittance (VT). This, in itself presents a large hurdle for many manufacturers, as several labels can be required for a single product line. For instance, if a manufacturer offers Low-E glass, the performance values may change when larger sizes are ordered (due to narrowing gap-width) or if dividers are offered. For any typical product line, manufacturers may have to apply 4-12 different NFRC performance labels. Keeping track of which products receive which labels is tedious and requires attention to detail. To add complication, various options, such as decorative internal dividers, can tip ratings above the ENERGY STAR threshold. While 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, labeling has only moved toward greater complication. Consequently, some manufacturers only label in States that required NFRC ratings or only label their best-selling products.

Adding to the complications are ENERGY STAR labeling requirements that are based on regional performance of window products. There are six variations of the ENERGY STAR windows label based on product performance. A product may meet compliance in all regions, the northern only, southern only, northern and central only, etc.

In addition to the requirements of the ENERGY STAR program, other performance labeling issues are on the horizon for manufacturers to consider. These include air infiltration, condensation index, UV transmittance and design pressure ratings.

One manufacturer involved with this program has a large three-panel display showing all the possible labels and stickers that could be applied to their window products. Among them are warning labels, installation instructions, certifications and state compliance notifications for performance.

There is a cost to supplying performance information to consumers and specifiers. Often times, manufacturers present performance data in sales brochures or on demand. There is a distinction between pre and post consumer product performance information as well. Consumers do not often see the NFRC or ENERGY STAR labels until the window is installed. Some manufacturers therefore see little incentive to emphasize labeling, even though the NFRC/ENERGY STAR programs require it. Often, in-store displays are not NFRC labeled which can create an additional barrier for educated and informed buyers looking specifically for the NFRC rating. Aware buyers face frustration of dealing with sales staff that are less aware of window efficiency rating tools than the consumer. Educating consumers will continue to be a barrier if the labels and ratings are not reinforced and present when shoppers are selecting windows for replacement, new construction or additions.

Successes

NFRC Product Rating Assistance

Many smaller replacement window manufacturers are recognizing the marketing potential of the ENERGY STAR program but are unfamiliar with the rating procedures. The WWI has provided direct assistance to these manufacturers with both consulting and direct cost reimbursement. As NFRC requires a significant investment, simulation costs and first-year inspection/certification fees are augmented by WWI program funds. The WWI has also served as a consultant to these manufacturers, explaining how the process works and acting as an intervener on their behalf.

Larger manufacturers also need product rating assistance. One major window manufacturer had only limited NFRC ratings across their product lines. The barrier to acquiring ratings was that they considered variations of their products to be separate product lines that would be very costly to rate. Informal discussions between representatives of NFRC and WWI brought out the possibility that the

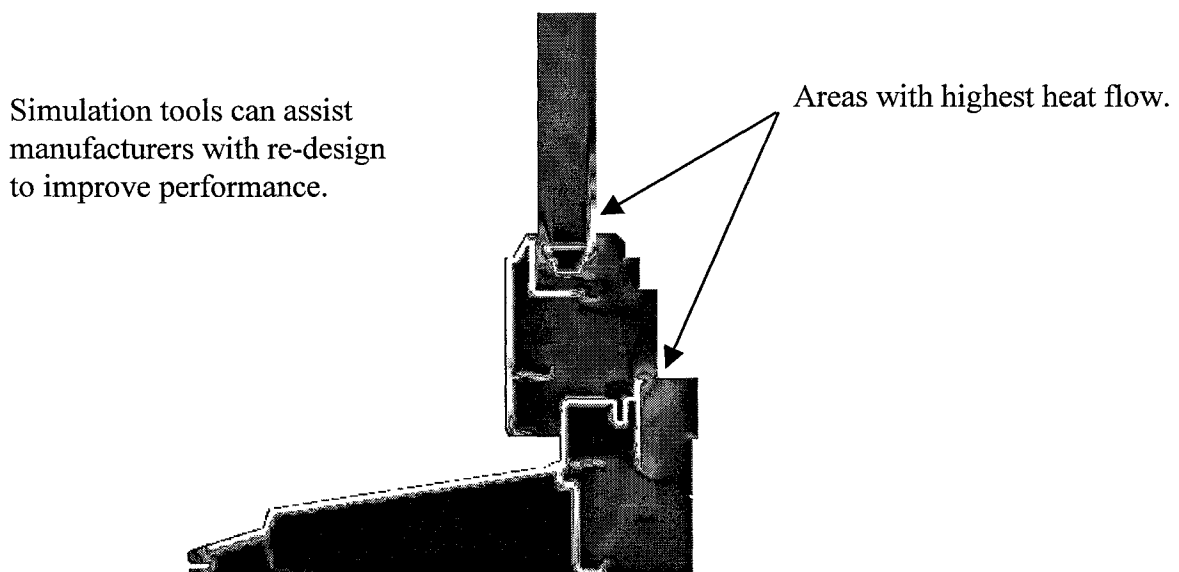
manufacturer would be able to group their product lines into broad categories to simplify the certification process, reduce the certification time and limit certification expenses. As a result of these informal discussions, the manufacturer is working with the WWI contractor to obtain NFRC certification across the broad range of their products. Initial ratings indicate that the majority of these products will attain ENERGY STAR status. So here was a manufacturer with a broad product line that qualified as energy efficient but was not able to participate in the market for energy efficient windows. Through intervention and certification assistance, the range of available ENERGY STAR window products is being expanded.

Design Assistance

Wood products that have aluminum clad exteriors often exceed the maximum ENERGY STAR threshold for the Northern Region (0.35 U-factor). This is due to the thermal transfer of the aluminum. Figure 2 illustrates how metals can transfer heat through a window cross-section. In this case, the lightest colors or shades in the diagram illustrate where the most heat is being transferred. Simulation tools such as Lawrence Berkeley National Laboratory's Therm simulation program, provides output that can illustrate where the greatest majority of heat is transferred through window sections. Manufacturers can then make design adjustments or material changes that will lower overall U-factors.

The WWI has assisted some manufacturers with product re-design and new product evaluation using simulation tools. Still, redesign is costly as new dies need to be cut and milling machines re-tooled to accommodate new designs. From a manufacturer's point of view, several thousand dollars are spent to make relatively minor (0.02 – 0.04) improvements in overall U-factor to meet the ENERGY STAR threshold. Therefore they need assurance that there will be return on their investment. This is why it is important to assure that products will qualify under ENERGY STAR if the improvement is made and that ENERGY STAR is a successful promotional aspect of their marketing programs.

Figure 2: Heat Transfer Through Window Frame Section (white = greatest heat flow)



Labeling

Discussions with several manufacturers raised the concern of the difficulty and extra expense of placing additional labels on windows. NFRC requires their 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. The two NFRC and ENERGY STAR labels can take up to 40 square inches on a window product (approximately 6% of the glass area of a typical window).

One manufacturer cited their reason for not participating in ENERGY STAR 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 (Department of Energy's marketing contractor), to determine if the ENERGY STAR label design could be minimized to approximately one-half the size of the NFRC 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 3 is an illustration of the approved design combining the NFRC and ENERGY STAR labels (total combined are now 24 square inches). 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. Approximately 50,000 of the re-designed labels were shipped to Wisconsin manufacturers (with instructions) for product labeling.

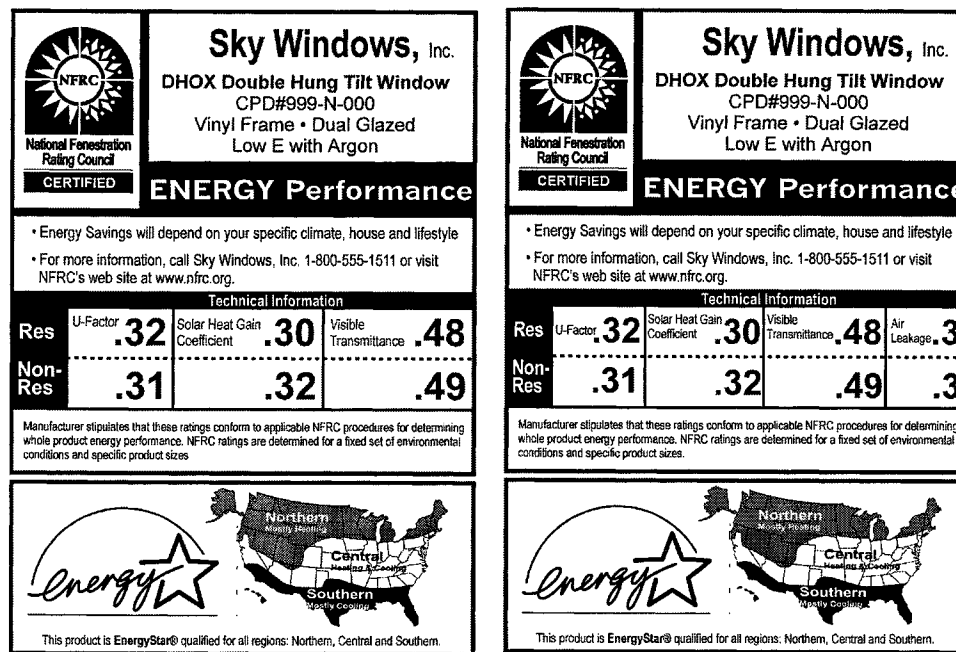
This effort immediately caused at least three manufacturers to begin labeling for ENERGY STAR where they were not previously labeling. This is another example of products that meet the ENERGY STAR qualifying criteria but who did not participate in the ENERGY STAR program. ***Through intervention and labeling assistance, the range of ENERGY STAR qualifying window products was expanded.*** Labeling, however, was limited to products that met the ENERGY STAR requirements in all climate regions (Northern, Central & Southern). Products not meeting these requirements were not labeled. Participating Wisconsin manufacturers using these labels have limited them to product lines where virtually all options meet the ENERGY STAR requirements – usually on their vinyl lines.

Although this effort was highly successful, it still did not address the label complication issue where products border the ENERGY STAR threshold with varying glass types, divider options, etc. While some larger window manufacturers with automated labeling/ordering systems have addressed these complications with on-demand labeling, smaller (and some larger) manufacturers typically order pre-printed labels and must stock several label variations for a single product line. Some manufacturers have as many as 12 label variations for a single product line. One manufacturer noted that a major expense of the NFRC program was replacing the many variations of NFRC labels when NFRC mandated label changes. Another drawback to pre-printed labels is that manufacturers are reluctant or slow to change label information as they have a significant investment in existing stock.

In order to address labeling complications, the WWI contractor developed a stand-alone labeling database designed to address the complication of NFRC/ENERGY STAR labeling. This database gives manufacturers the ability to print custom labels in-house in small batches. The database is designed to work by putting data into a spreadsheet, then transferring the data to the database. The data can be updated with new and additional information and can print various label information. For instance, when a manufacturer decides that they would like to include air-infiltration values on their label, they can print the style of label that includes air-infiltration with other typical NFRC data (U-factor, SHGC & VT). For the ENERGY STAR program the database automatically determines ENERGY STAR status and appends the appropriate ENERGY STAR label. The ENERGY STAR status and labeling program have been implemented by one manufacturer and will be adopted by two additional manufacturers before the end of the calendar

year. This database is still under development and is flexible enough to address various manufacturers' needs.

Figure 3. Combined NFRC/ENERGY STAR Label Variations



Another approach to labeling is to assist manufacturers with label automation systems. One large window manufacturer is proposing to develop an on-demand labeling system where several labels will be consolidated into a single, large label to be applied to the window. Not only will this system give the manufacturer the ability to quickly respond to label changes, it will save label application time and significantly reduce labeling errors.

Although most of this manufacturer's products have been rated by NFRC and would meet the ENERGY STAR requirements, only about 50% of their product lines actually were labeled for NFRC, primarily due to labeling complications. The manufacturer has not labeled for ENERGY STAR. As this manufacturer is a major seller in big-box chains, it is critical to have their products labeled for ENERGY STAR. WWI has offered a monetary reward for completion of an automated/consolidated labeling system prototype if completed within a time frame specified by the WWI. The manufacturer accepted this proposal and will have the prototype completed for a single, major-market product line within the time specified. These products, labeled as ENERGY STAR windows, will be sold in the Big-Box chain throughout the Midwest. *This is another example of when intervention and program assistance expanded the range of available ENERGY STAR window products.*

Semi-Permanent Labels

WWI is working with a large manufacturer and the ENERGY STAR windows contractor (D&R International) to develop a method whereby manufactures may apply a semi-permanent, transparent ENERGY STAR label to their products. This effort will be instrumental in selling the ENERGY STAR brand for other purposes. If successful, the WWI will work with D&R to prepare guidelines and documentation to allow other manufacturers to use these labels.

Inert Gas

A major Wisconsin window 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 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 joined on as an ENERGY STAR Windows Partner. The WWI is currently assisting them in computer-modeling their window products and in obtaining ENERGY STAR ratings. This is another example of intervention and information sharing that provided for the expansion of the range of available ENERGY STAR window products.

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.

Energy Codes & Rating Programs

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 MECcheck 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.***

One perspective on building a home to minimum energy code requirements is that one is constructing the worst performing building allowed by law. Statewide public benefits programs will soon be focusing on building homes that exceed minimum code requirements. These programs, already

underway in a pilot program, will require a stringent set of criteria including blower-door tests and on-site inspections. In order to meet these criteria, builders may choose to install windows meeting ENERGY STAR criteria.

Health & Safety

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.

Conclusion

Building on the NFRC/ENERGY STAR program, and actively assisting primary and replacement window manufacturers, has allowed Wisconsin to greatly accelerate the transformation of the windows market to ENERGY STAR rated products. The WWI program uses a different approach from the usual programs designed to overcome consumer acceptance of energy efficient products such as electronic ballasts. Prior to stimulating demand for energy efficient products through overcoming barriers to consumer acceptance or diffusing products into the market place through innovators and early adopters, the WWI started at the other end. Starting from the bottom up, the program assisted local manufacturers in overcoming barriers to expanding their product line that was certified under NFRC and qualified under ENERGY STAR. Several techniques for improving products such as the increase use of inert gas diffused through the spectrum of manufacturers. New technologies for certification and labeling dispersed through a range of manufacturers with the use of design assistance and computer software

adapted to flexible labeling. This has helped Wisconsin manufacturers stay competitive and remain competitive during an emerging need to educate buyers and builders on window efficiencies.

We are currently adopting this successful and innovative approach to other industries. Wisconsin has many manufacturers of energy efficient motors. Through working with these manufacturers we hope to assist in expanding their product lines that meet the ENERGY STAR criteria. We have also investigated a collaborative effort to expand product lines of Wisconsin manufacturers of ENERGY STAR qualifying transformers. Other products that may present expanding market opportunities include dehumidifiers, ventilation and ceiling fans and commercial HVAC equipment.

A unique feature of the windows market that may not be present for other products was the fact that many manufacturers' products already met the ENERGY STAR qualifying criteria. They had just not qualified their products under NFRC and ENERGY STAR. In addition, the availability of talented individuals with the expertise and manufacturer acceptance such as one of the author's enabled rapid acceptance of new technologies and processes. A final unique feature of the windows market is the broad range of smaller, family owned businesses who have a greatly reduced decision making process. Manufacturer customer acceptance and application is fast and transparent once a confidence level is achieved.

All of these features may not be present in large scale manufacturing operations such as motor manufacturers. The scale of the operation is larger. The decision making process is not transparent. The expertise to redesign an existing motor into an ENERGY STAR qualifying motor may not be available or the suggested design changes may not be readily adopted.

In spite of the difficulties, we have initiated several programs modeled on the current and highly successful Wisconsin Windows Initiative. The motto of the State of Wisconsin is FORWARD.