

Market Transformation Strategy for Windows and Doors in British Columbia

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ABSTRACT

Market transformation is an approach used to achieve a permanent adoption of energy efficient products by removing market barriers. The window and door market in British Columbia achieved transformation over a five year period through implementation of ten government, utility and industry measures that were mostly based on the ENERGY STAR[®] program. During the course of the market transformation strategy (2006-2009), the ENERGY STAR window market share increased from approximately 30% to 60%. A regulation under the *Energy Efficiency Act* will support universal market share of similar standards by 2011.

A manufacturer survey with 17 respondents was the basis for a preliminary policy evaluation of the ten measures. The results indicated that the ENERGY STAR program was the most impactful measure for motivating manufacturers, followed by the *Energy Efficiency Act* regulations and the provincial sales tax (PST) exemption. The ENERGY STAR brand is ideally suited to increasing customer awareness on energy efficiency due to its universality and simplicity. The program achieves manufacturer buy-in by providing third-party branding, access to rebates and incentives and an opportunity for differentiation in a competitive market.

Other survey questions and conclusions were related to the specific heat transfer coefficients (U-values) of product lines, readiness to meet the regulations and the impact of the regulations on manufacturing and certification costs, product warranties, staffing levels and manufacturing locations. The results indicated a high level of readiness among manufacturers to meet regulated levels, although it may have a disproportionate financial impact on smaller businesses due to relatively high, ongoing costs of certification.

Introduction and Background

The purpose of this paper is to summarize and evaluate the British Columbia (BC) government's market transformation strategy to promote energy efficient windows, doors, glazing, sliding glass doors and skylights¹. The evaluation includes results from a 2010 survey of product manufacturers on the effectiveness of such measures and a literature review on practices in other jurisdictions. For the purposes of this paper, an "energy efficient window" is assumed to have a maximum overall U-value of $2.0 \text{ W}/(\text{m}^2 \cdot \text{K})^2$.

A 2006 survey estimated the ENERGY STAR market share at 20%-30% (Hood 2007, 58). Of the approximately 65 BC-based window manufacturers, 17 had ENERGY STAR qualified products in 2007 (Bruce 2007) and 53 had qualified products in 2010 (Hopwood 2010). Market research indicates that 70% of the domestic window market has been provided by BC based manufacturers (Bridges 2005, 27).

¹ Fenestration products are referred to as "windows and doors" throughout the remainder of this paper.

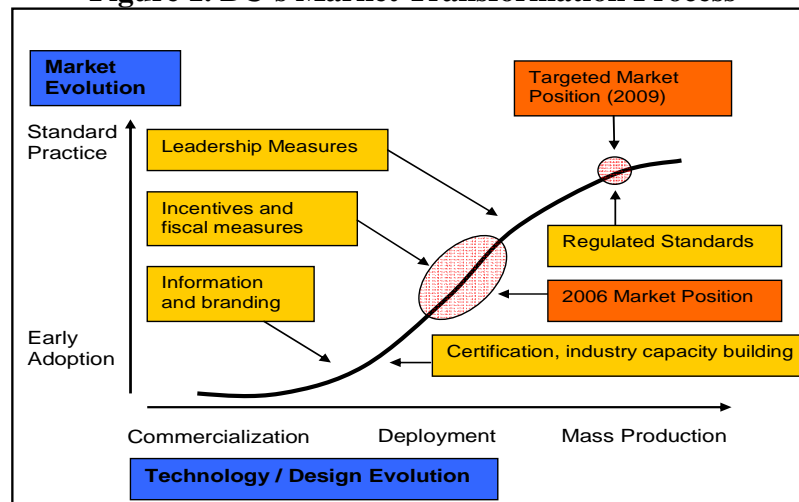
² $0.35 \text{ BTU}/(\text{hr} \cdot \text{ft}^2 \cdot \text{K})$ in Imperial units.

BC's Market Transformation Approach

In 2006, the BC Ministry of Energy, Mines and Petroleum Resources (MEMPR) aimed to permanently improve the energy efficiency of windows and doors by 2010. Eight temporary market measures were introduced over four years in concert with energy utilities, the industry association and the federal government. This was followed by two permanent regulations to backstop gains made through voluntary means. Figure 1 provides a graphic representation of the market transformation approach, including five steps aimed to address market barriers:

- Information and branding measures to improve consumer and industry awareness and acceptance of new technologies.
- Industry training, technical assistance and certification to support technology evolution and market acceptance.
- Incentives and fiscal measures to temporarily increase consumer demand for ENERGY STAR products and promote window upgrades as a part of whole house renovations, helping to increase availability across product types.
- Leadership measures to stimulate the market by having large consumers and builders specify ENERGY STAR windows and doors for volume purchases.
- Regulated minimum energy performance standards to level the playing field, enhance competition and improve affordability.

Figure 1. BC's Market Transformation Process



BC Hydro Power Smart Program

BC Hydro's Power Smart program has been instrumental in promoting and driving acceptance of the ENERGY STAR brand in BC since 2005 with the following measures:

- Consumer information, including materials enclosed with power bills.
- \$1/square foot (ft²) rebate on ENERGY STAR windows between until 2007, available to houses with all heating fuels (MEMPR covered costs for non-electric heated houses).
- Promotion of the provincial sales tax exemption and manufacturers' rebates, including co-op advertising with manufacturers and in all other windows-related communications.

- A “win your windows contest” where consumers submitted testimonials online.
- Point-of-purchase displays, in concert with participating manufacturers.
- Newsletter to manufacturers, support for Window and Door Manufacturers’ Association of BC (WDMA-BC) meetings and events.
- Promoting ENERGY STAR among builders, developers and property managers.

Fortis BC Power Sense Program

FortisBC provides electricity to customers in two regions of BC and has the long-standing PowerSense program to facilitate energy efficiency. They have provided information and incentives for ENERGY STAR windows since 2005, paying the incremental cost up to \$2.50/ft² of window area for new construction and \$0.50/ft² for consumer retrofits. FortisBC continued these incentives until the windows regulation came into effect in 2009. They have a strong emphasis on building relationships with regional window manufacturers, suppliers, builders and consumers.

Natural Resources Canada ENERGY STAR Program

ENERGY STAR was adopted in Canada for low-rise residential windows and sliding glass doors on April 2003 and for doors and skylights in April 2005. Qualifying criteria are based on four climate zones. Until May 2010 the ENERGY STAR criteria for windows and doors in Zone A were: $U\text{-value} \leq 2.0 \text{ W/(m}^2\cdot\text{K)}$, an “Energy Rating” alternative and air leakage less than 1.65 (m³/hr)/m (NRCan 2005). These were revised effective June 2010 (NRCan 2009), partly in response to BC’s market transformation efforts.

In addition to branding energy efficiency standards that simplify consumer choice, the ENERGY STAR program defines criteria for qualifying products, provides an online database of qualified products, hosts a steering committee to provide advice on a variety of technical and programmatic issues, undertakes national advertising and defines protocols for product labelling.

Capacity Building Coordinator

In 2006 and 2007, MEMPR hired a Capacity Building Coordinator to provide information and advice to BC-based manufacturers on the process to test products, certify manufacturing and apply for ENERGY STAR qualification. The Coordinator also provided confidential feedback on product designs and conducted informal surveys on stages of ENERGY STAR certification by manufacturers. The relationships established through these efforts opened new channels for MEMPR to effectively communicate its energy efficiency vision to the industry. The Coordinator also increased the credibility of WDMA-BC as an industry representative, including the interests of small manufacturers, as many technical and market barriers raised by manufacturers were passed on to WDMA-BC for follow-up (Jaugelis 2010).

ENERGY STAR Lab Testing Assistance

MEMPR invested \$200,000 to subsidize product testing for BC-based manufacturers at accredited laboratories. BC Hydro administered the funds and widely promoted the Assistance through WDMA-BC and other channels. The funding provided a maximum of 50% of the total

cost of testing, or \$10,000 maximum. Each of the 35 participating manufacturers selected the lab of their choice and provided proof of expenses associated with ENERGY STAR qualification. In late 2008, this Assistance was expanded to include testing for compliance with the regulation in advance of its March 1, 2009 effective date (for vinyl and fiberglass products), in addition to ENERGY STAR qualification.

Wood Door Thermal Performance Project

Early in the process of proposing a regulation for windows and doors, several BC-based, wood door manufacturers pointed out that their solid slab products were unable to meet the energy performance standard of U-value ≤ 2.0 . MEMPR signed a voluntary agreement with WDMA-BC in 2008 to exempt wood slab products from the regulations, provided the industry would investigate methods of increasing energy efficiency in concert with a research organization. That organization is performing a life-cycle assessment of a variety of products, including the embodied energy due to manufacturing. After this work concludes MEMPR will consider options for a regulated standard for wood doors.

British Columbia Provincial Sales Tax (PST) exemption

All ENERGY STAR qualified and listed windows and doors have been exempted from the PST (7%) since April 2007, valued at several million dollars per year in foregone revenue to the BC Government. This exemption will end on July 1, 2010 when a federal/provincial Harmonized Sales Tax (12%) comes into effect.

LiveSmart BC: Efficiency Incentive Program

Since 2008, MEMPR's LiveSmart program has provided "one-stop-shop" access to all energy utility and federal government rebates and tax credits for residential energy retrofits. BC Hydro, FortisBC, Terasen Gas and NRCan are program partners. It includes whole-house energy assessments by Certified Energy Advisors, advice on appropriate energy efficiency upgrades, rebates for energy efficiency improvements and an EnerGuide for Houses label with a performance rating between 0 and 100. Rebates for each ENERGY STAR qualified window and door are \$20-\$40, depending on where they are installed and the qualification zones of the products. Until early 2010, a separate payment of \$40 per ENERGY STAR window and door was provided by NRCan under the ecoENERGY Retrofit program, and tax savings of up to \$1,350 were available under the Home Renovation Tax Credit.

Statistics to October 2009 demonstrated that over 2,600 houses installed nearly 30,000 ENERGY STAR qualified windows and/or doors, representing 25% of all houses in the program. About half of installed products rated one ENERGY STAR zone up from their climate zone, illustrating the "up-sell" quality of the program.

Greening of the BC Building Code

The BC Building Code applies to new construction and major renovations, and is generally enforced by municipal building inspectors. Effective September 2008, residential buildings of 5+ stories, or non-residential buildings with 4+ stories or 600 m²+ of floor space

have been required to meet the ASHRAE Standard 90.1-2004. The Standard has differing energy efficiency standards for windows and doors that are reflective of the percentage of overall building glazing, climate zones, glazing frame materials and operability. There are three compliance options within the standard – a prescriptive path, trade-off paths for specific components, or the Energy Cost Budget (modelling) path. In March 2010 the Ministry of Housing and Social Development proposed to introduce new performance targets in the Building Code for the overall thermal resistance of the building envelope of houses, including windows.

Energy Efficiency Act Regulation

Table 1 summarizes the energy performance requirements for windows and doors, initially announced in 2006 and revised in 2008 and 2009. This includes products installed in both new construction and as replacement products.

Table 1. Regulations for Windows and Doors

Product		Energy Performance Requirement	Effective Date
Non-metal windows in low-rise and small buildings (e.g., less than 5 stories for residential, less than 600m ² floor space for others)		U-value $\leq 2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$ or $0.35 \text{ BTU}/(\text{hr} \cdot \text{ft}^2 \cdot \text{K})$	March 1, 2009
Metal windows in low-rise buildings		U-value $\leq 2.57 \text{ W}/(\text{m}^2 \cdot \text{K})$	June 1, 2009
		U-value $\leq 2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$	January 1, 2011
Wood windows in low-rise buildings		U-value $\leq 2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$	January 1, 2011
Skylights in all buildings		U-value $\leq 3.1 \text{ W}/(\text{m}^2 \cdot \text{K})$	March 1, 2009
Metal framed windows, sliding glass doors, curtain walls, window walls or storefront windows for high-rise and large buildings		U-value $\leq 2.57 \text{ W}/(\text{m}^2 \cdot \text{K})$ or $0.45 \text{ BTU}/(\text{hr} \cdot \text{ft}^2 \cdot \text{K})$	January 1, 2011
Non-metal products for high-rise and large buildings		U-value $\leq 2.0 \text{ W}/(\text{m}^2 \cdot \text{K})$	January 1, 2011
Non-wood door slabs		RSI $\geq 0.875 (\text{m}^2 \cdot \text{K})/\text{W}$ or $R-5 \text{ hr} \cdot \text{ft}^2 \cdot \text{K}/\text{BTU}$	June 1, 2009
Glazing for doors, sidelites and transoms	Must be multiple glazed with at least one low-E coating between glazing, a 90% argon gas fill level with a compatible edge sealant system and have spacer bars other than non-thermally broken aluminum box spacer bars.		June 1, 2009

Test standards for windows include either CSA A440.2 (2004) or NFRC 100 (2004), both applying to the overall assembly. Exemptions apply to products installed in designated heritage buildings, large buildings that are compliant with ASHRAE Standard 90.1, glazing installed in hung door assemblies that have a U-value ≤ 2.0 , decorative glazing and glazing replacements in an existing sash and frame. The multitude of effective dates was designed to address varying degrees of market readiness for different product types.

Two levels of labeling are required: (1) a permanent label, word mark, trademark or symbol from a CSA/NFRC accredited lab that verifies that the product complies with the requirements, and (2) a temporary label setting out the U-value in metric units. The latter is designed to educate consumers and encourage energy performance beyond the regulated levels, and can be removed by the end consumer.

Flexibility is provided for windows designed for structural support purposes in a specific building, where the design falls outside the scope of existing certification programs. This allows

for some products to be less energy efficient (e.g., large structural windows), provided that other products in the building exceed the requirements.

For the residential sector alone, the regulation is estimated to save about 10 gigawatt-hours (GWh) of electricity per year and 100,000 gigajoules (GJ) of natural gas. These savings were based on upgrading double-glazed windows to those with a low-E coating, saving 5.81 kWh per ft² of window area. Assuming an average replacement window area of 134 ft² per house and installation in 40,000 houses per year, the cumulative annual savings in 2020 is about 120 GWh/yr electricity and 1.2 million GJ/yr natural gas. Greenhouse gas emission reductions of 63,000 tonnes/yr are expected in 2020 (BC MEMPR 2005).

MEMPR hired an energy efficiency “Compliance Enhancement Coordinator” in 2009 to respond to complaints of non-compliance. The approach taken with non-compliant manufacturers is to recommend solutions to technical challenges and to provide information on testing and certification procedures. The coordinator has also presented to, and contacted a number of parties to promote compliance through education. These parties included standards organizations (e.g., CSA, NFRC), testing labs, energy utilities, and industry and regulatory associations such as the Building Officials Association of BC.

Manufacturer Survey

An online survey was conducted of companies who manufacture products that are sold in BC. The survey had 28 questions pertaining to key drivers for market transformation, manufacturers’ costs and approach to prepare for the regulations, energy performance and type of product lines, estimated market share of ENERGY STAR qualified products and impacts on the number of employees and location of manufacturing plants. A total of 17 companies responded to the survey out of 88 that were invited – a 19% response rate. The survey was conducted in an independent manner by Dian Ross, a University of Victoria researcher.

The survey did not include a control group for questions pertaining to changes in market share. As such, the impact of global conditions (e.g., increased awareness of energy issues) could not be netted out of the responses to determine the causality of BC based measures toward market transformation.

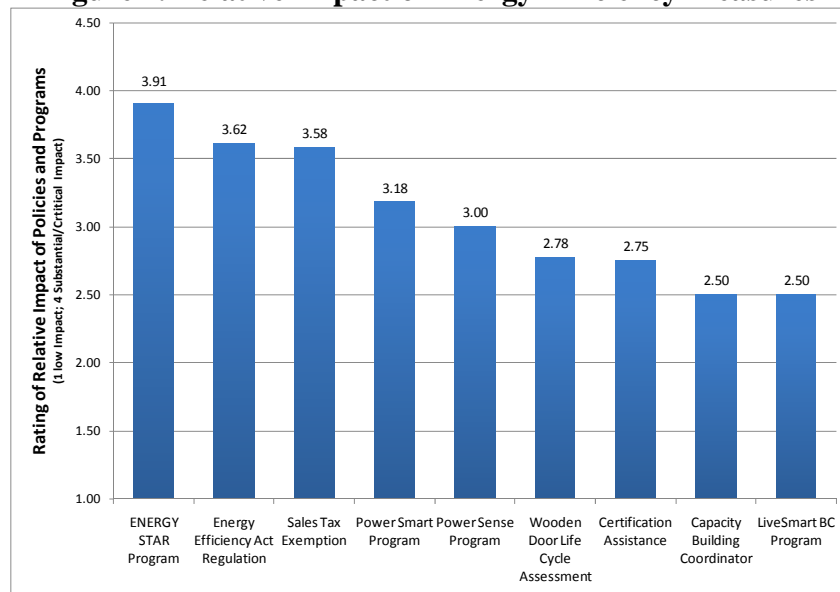
Policy and Program Drivers

Figure 2 summarizes the results of the key survey question – “Please rate the relative impact of government and utility policies and programs on motivating you to design, develop, certify and sell new energy efficient product lines”. The impacts of were qualitatively scored on a scale of 1 to 5, with 5 representing a “critical impact”, 2 representing “low impact” and 1, “not applicable or don’t know”.

The ENERGY STAR program was reported as having the greatest impact; followed by the Energy Efficiency Act regulation, the PST exemption for ENERGY STAR products and the Power Smart and PowerSense DSM Programs. These scores are reinforced by individual results whereby five respondents noted that the regulation was a “critical” measure, four noted ENERGY STAR, two noted the PST exemption and one noted each of the Power Smart, PowerSense, Wooden Door project and Certification Assistance as “critical”. Responses on the regulation were polarized, with five respondents noting it as “low-impact”, three as “high-impact” and five as “critical”.

Separate comments noted that requests from customers, contractors and designers for energy efficient products were a key driver. Customers' requests were reportedly tied to increased environmental awareness and a desire to save energy and money and qualify for window and door rebate programs. Further motivating factors for manufacturers included a desire to remain competitive by being an industry leader, participation in new construction programs such as Built Green BC (i.e., green house branding program based on EnerGuide for Houses energy performance label), and to have products that compare to European energy performance levels.

Figure 2. Relative Impact of Energy Efficiency Measures



Results based on the average of responses from 13 manufacturers

ENERGY STAR Product Line and Market Share

Of the 11 respondents that reported the percentage of their product lines that are ENERGY STAR qualified in early 2010, five reported 90-100%, three reported 60-80% and three reported 0%. Other results indicate that the average market share among respondents has increased from 38% to 60% of sales between 2006 and 2009. One respondent noted that, in 2009, 95% of company sales in BC were ENERGY STAR qualified, compared to 70% across Canada. This anecdote illustrates a difference between the BC market and other provinces that do not have such extensive market transformation measures. Another response of interest was that, in 2009, 100% of the manufacturer's vinyl window sales were ENERGY STAR qualified, but that 0% of its doors and wooden windows were (note: the regulation exempted wood products until 2011).

Average Energy Performance

Seven companies provided the make-up of their product lines' energy performance in terms of U-value. The results were as follows, illustrating that over half of product lines had energy performance levels exceeding the regulated requirement of 2.0 for most products:

- 12% of products have a U-value less than 1.6 W/(m²·K)
- 42% have a U-value greater than 1.6 and less than 1.8
- 13% have a U-value greater than 1.8 and less than 2.0
- 9% have a U-value of 2.0
- 25% have a U-value greater than 2.0 and less than or equal to 2.57

Product Changes to meet Energy Efficiency Act Performance Requirements

Most manufacturers chose to comply with the regulations by implementing the final required U-value in one step. Only one company stated that they had incrementally improved the U-values of their products over several years. Two manufacturers noted that they already met the performance levels with certain glazing options and window configurations when the regulation was introduced. Nevertheless, half of the respondents reported a significant change in their product lines as a result of the regulation. Specifically, three manufacturers reported either dropping or significantly altering their vinyl window product lines. Another respondent also noted that the high cost of low-E glass with argon gas fill, necessary to meet wooden door energy efficiency regulations, has driven consumers to consider cheaper products such as metal and fibreglass doors.

Energy Efficiency Act Implementation Costs

Three questions were posed on the cost of meeting the energy performance requirements – first, the incremental design and material costs compared with prior manufacturing costs; second, the one-time cost of product testing and certification by an accredited lab; and the third, the ongoing cost of maintaining certification.

Of the seven respondents to the first question, two reported a 5-9% increase; one a 10-14% increase; and four at least a 15% increase. Regarding the one-time cost of testing their products, four had zero cost and the others paid \$20,000, \$25,000 and \$50,000 – the first two having received the government financial assistance through their testing lab. Of the eight that reported the cost of maintaining certification, four reported an incremental cost of 0-4%; two a 5-9% increase; and two an increase greater than 15%.

Warranties

The authors wanted to determine whether product warranties changed as a result of the regulation. This was used as an indicator of product durability. None of the 18 manufacturers who responded to the survey reported a change in their product warranty due to energy efficiency measures.

Employment Implications

A question was posed on the number of employees for each company and whether the regulation affected that. Seven out of 12 manufacturers reported a decline in the number of staff, with five respondents attributing this reduction to the introduction of energy efficiency measures. Of the other five who reported employment growth over this period, one noted a potential adverse effect on employment in the future. Larger companies with more diversified product

lines reported either increases in employment (i.e., up to 67%) or minimal reductions, while smaller companies of less than 30 employees reported the greatest impact with reductions as high as 50%.

Characterizing the Respondent Manufacturers

Of the 11 survey respondents, three manufactured products with only wood frames, one with only metal frames and seven with multiple materials. Of those, two manufactured their own insulating glass units (IGUs), while the rest purchase pre-manufactured IGUs.

Regarding the location of their manufacturing plant(s), four specified locations in the Greater Vancouver area, three on Vancouver Island and the Sunshine Coast, two in the interior of BC and three in other Canadian locations. Only one indicated that their location of manufacturing changed as a result of energy efficiency measures.

Evaluation and Conclusions

The evaluation of BC's market transformation efforts was based on the following questions, using data from the manufacturer survey, literature review and experience of the lead author as the administrator of the government led measures:

- What are the most effective government and energy utility measures to support market transformation – measured in terms of their relative influence on changing market conditions and shifting manufacturers' product lines toward energy efficient windows and doors?
- How has the market share of ENERGY STAR qualified products changed, both in terms of consumer demand and variety of products available?
- What are the key indicators of a successful market transformation?
- What are the indicators of market readiness for the new regulation?

Effectiveness of Energy Efficiency Measures

The survey results indicated that the ENERGY STAR program was the most impactful measure for motivating manufacturers, followed by the Energy Efficiency Act regulations and the provincial sales tax (PST) exemption. The following factors likely contributed to the importance of ENERGY STAR:

- ENERGY STAR was the foundation of nearly all of the market transformation measures – it was the centre of the web that tied everything together.
- The brand is ideally suited to increasing customer awareness on energy efficiency, due to its universality and simplicity.
- The brand has credibility as an international standard, versus utility brands that have had limited success (Heschong et al. 2004, 2) or individual company branding schemes that are not independently verified. Future changes to the program, effective June 2010, will further enhance credibility by mandating labeling and reporting (NRCan 2009).
- The program achieves manufacturer buy-in by providing third-party branding, access to rebates and incentives and an opportunity for differentiation in a competitive market.

- It enables product research and innovation by creating a space for increased profit margins.

Jennings et al. (2002) concluded that ENERGY STAR was critical to move the supply side because it provided a simple mechanism with existing recognition to identify and promote qualified products between manufacturers and retailers, even where there was continual staff turnover. Also, there was broad national consistency and some leverage from other programs in California (Ibid., 2.154).

While ENERGY STAR was rated highly, it did not serve the entire industry in BC, as three manufacturers who responded to the survey have no qualified products, meaning that they were unable to benefit from all of the ENERGY STAR based measures. These manufacturers produce wood- and metal-framed products, have less than 10 employees and two had design and material costs exceeding 15% to meet the regulations.

Subsequent communications with the past president of WDMA-BC noted that the PST exemption, Capacity Building Coordinator and Lab Testing Assistance provided the necessary foundation for the success of ENERGY STAR (Jaugelis 2010). He noted that the “tide turned” with the PST exemption, as “... ENERGY STAR qualification was no longer seen as optional by manufacturers: it became a necessary cost of doing business” (Ibid.). Furthermore, he noted that the Coordinator’s leadership and relationships set the stage for the growth of WDMA-BC, as he helped shape the Association to become the manufacturers’ trusted advisor and spokesman. It grew from 15-20 members in 2005 to over 100 today, including small- and medium-sized manufacturers.

While the manufacturers rated the LiveSmart program as low- to medium-impact, their awareness of its impact may be limited. LiveSmart is a consumer oriented program that doesn’t include direct manufacturer outreach. The program statistics demonstrated that it created significant market pull for ENERGY STAR qualified windows and doors.

Market Share Impact

Based on the literature (Jennings et al. 2002) and anecdotal evidence, the increased market uptake of ENERGY STAR products in BC and in the Pacific Northwest can be attributed to government and utility measures. The market share of ENERGY STAR qualified windows in BC increased from about 20-30% in 2006 (Hood 2007) to 60% in 2009 (based on the survey).

Key Indicators of Market Transformation

An assessment of market transformation indicators using the “Five A’s of Market Transformation” (NRCan 2010) method illustrates the merits of BC’s strategy.

Product availability is widespread in all regions, with 53 out of about 65 window manufacturers offering ENERGY STAR products and a market share of about 60% among survey respondents. However, three small manufacturers that only produce metal and wood-framed products indicated they have no ENERGY STAR products. On the other hand, all survey respondents indicated progress on adapting to the regulatory requirements, indicating extensive availability.

Consumer and industry awareness was not measured for British Columbia, but Jennings et.al. (2002) reported high awareness among dealers and a significant increase among builders

(Ibid., 2.151) as a result of market transformation efforts. BC Hydro sent bill stuffers to nearly 1.7 million homes with information on ENERGY STAR windows and doors, likely improving awareness. Furthermore, the PST exemption inevitably had a significant impact on awareness, as products not qualified as ENERGY STAR were charged a 7% higher cost. On the other hand, installer price quotes and invoices do not always include a separate line for taxes – only the all-in price is quoted.

Accessibility refers to the wide distribution of energy efficient products and market segmentation for all types of applications. Survey respondents indicated a wide diversity of energy efficient products, though not always ENERGY STAR qualified. This would indicate a fair degree of accessibility.

Anecdotally, product affordability was improved through reduced costs of low-E coatings, presumably through increased competition and a shift by some manufacturers to purchase insulating glass units from larger producers. In addition, ENERGY STAR products were subsidized by the PST exemption, utility DSM programs and the LiveSmart BC: Efficiency Incentive Program.

With some exceptions, the survey indicated a high amount of industry acceptance of ENERGY STAR and energy performance requirements. Further research is required to gauge consumer acceptance, including the views of builders and end-users.

Indicators of Market Readiness for Regulation

The survey results indicated a high level of readiness among manufacturers to meet regulated levels, with all but one respondent indicating a one-time product modification to meet the energy performance requirement and no need for interim steps. This indicates that the requirement was achievable. However, less than 20% of known manufacturers responded to the survey.

The regulated standard was considered affordable for manufacturers, as the energy performance requirement of $U\text{-value} \leq 2.0 \text{ W/(m}^2\cdot\text{K)}$ is considered “low-hanging fruit” for all product types, only requiring a change of glass to low-E, with minimal impact on frames and assembly (Jaugelis 2010).

The regulation may have a disproportionate financial impact on smaller businesses, indicated by high, ongoing costs of certification. Two companies indicated that ongoing costs of maintaining certification exceeded 15%, over and above the materials cost of meeting the regulation. Further research is required to determine whether these costs are specific to energy efficiency and if they are widespread among manufacturers. For example, the US-Canada harmonized structural standards for windows, referenced in the 2010 National Building Code, may impose additional testing and certification costs.

On the other hand, material cost increases are more easily justified, as consumers will benefit from energy savings to compensate for product price increases. Furthermore, the initial cost of lab testing to demonstrate compliance with the regulation was temporarily supported by the Lab Testing Assistance and several small companies who produce specialty products enrolled.

Changes in employment for smaller companies was not conclusive, as three companies saw increased employment of 30-67%, while three companies saw reductions of 26-50%. It is noted that the global recession and reduced housing starts may have contributed to some

employment reductions. On the other hand, the Home Renovation Tax Credit was highly popular for retrofit projects, stimulating investment in energy efficient windows.

About half of the respondents reduced the number of product lines, having an effect of reducing consumer choice with fewer options. Some companies dropped non-ENERGY STAR qualified lines, rather than certifying everything.

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