Market Transformation Initiatives: Successes and Remaining Challenges

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ABSTRACT

Traditional regulatory and voluntary mechanisms to promote energy-savings investments and actions have often failed to address underlying market barriers that hinder long-term adoption of energy efficiency measures. In response, a growing number of practitioners and policymakers have embraced a "market transformation" framework, which attempts to incorporate the best features of market-based and regulatory approaches. This paper reviews the progress of eight market transformation initiatives. Based on a handful of market transformation program evaluations that have been conducted to date as well as interviews with a range of players, this paper summarizes the impacts that these efforts have had in the market and offers lessons learned to inform the development, implementation, and evaluation of future efforts.

Introduction

Market transformation activities are strategic interventions designed to reduce and effect positive lasting changes in the market for energy efficient goods and services, such that they are produced, recommended, and purchased in increasing quantity. A growing number of practitioners and policy-makers are adopting a market transformation framework in an attempt to incorporate the best features of, and improve the coordination between, market-based and regulatory approaches. Federal and state policy-makers are embracing the market transformation concept and a growing number of states have established special funding for new market transformation programs as part of utility restructuring policies (see sidebar and Kushler 1998).

Given interest in market transformation at both the national and state levels, a variety of players are now active in developing and implementing market transformation activities, including:

- The Consortium for Energy Efficiency (CEE);
- The Northwest Alliance (NW Alliance);
- Northeast Energy Efficiency Partnerships (NEEP);
- California Board for Energy Efficiency (CBEE) and California utilities;
- New York Energy Research and Development Authority (NYSERDA);
- The Wisconsin Energy Bureau, Energy Center of Wisconsin, and emerging Midwest Energy Efficiency Alliance; and

Policy Outakes

"Our focus for energy efficiency programs has changed from trying to influence utility decision-makers, as monopoly providers of generation services, to trying to transform the market so that individual customers and suppliers in the future, competitive generation market will be making rational energy choices." (CPUC 1997)

"[Public benefit funds established as part of restructuring should be spent at least in part on "programs that emphasize permanently transforming the market for energy-efficient products and services or reducing market barriers, rather than achieving immediate or customer-specific savings." (NYSPSC 1998)

"The region's retail distribution utilities [should] mount a coordinated [regional] effort to transform markets for efficient technologies and practices." (PNW Governors Steering Committee 1996)

Source: Nadel & Latham 1998

- The U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) ENERGY STAR® and other programs.[1]

Over the last few years, the market transformation field has witnessed many changes. The most important from the standpoint of understanding the impacts of market transformation efforts is the emergence of better-defined evaluation approaches and corresponding evaluation data. At this point, baseline studies and market evaluations have been completed or are underway for a range of initiatives offered by regional market transformation organizations and utilities. Furthest along is the NW Alliance, which has produced periodic market progress reports for most of its programs, and in turn, has used the results of these analyses to make mid-course program design changes. (A complementary paper in this panel reviews various organizations' approach to market transformation evaluation).

In this paper, following a brief overview, we present the latest available information on market progress for a number of products and services for which market transformation initiatives are underway, including: clothes washers, home lighting (both lamps and fixtures), windows, consumer electronics, air conditioning, geothermal heat pumps, exit signs, and premium efficiency motors. We have attempted to provide a good cross-section of activities for which progress is being demonstrated, as well as some for which considerable challenges remain. We conclude with a summary of lessons that emerge from these initiatives and have value for future program design and evaluation.

Overview of Market Transformation Initiatives

Most market transformation initiatives are comprised of several program elements, which collectively are intended to effect changes in the behavior of market actors. Typical program elements are outlined below.

- *Branding* — to differentiate energy-efficient products from other products; ENERGY STAR is the principal brand for the programs highlighted in this paper.
- *Financial incentives* — (e.g., consumer rebates, retailer sales person incentives, manufacturer buy-down payments or other financial incentives) frequently used to expose consumers or other market players to products, services, and information to stimulate market interest; they are often designed to be sizable at first, but reduced over time as market demand grows.
- *Retailer/distributor/installer recruitment, education and training* — to increase knowledge about, promotion, stocking and installation of energy-efficient products among mid-stream market actors.
- *Technology procurement and volume purchases* — to bring new products to market, increase market share, and promote cost reductions often by demonstrating and aggregating market demand.
- *Minimum efficiency standards and building codes* — to lock in energy savings achieved as energy-efficient product market share increases.

The key program elements that characterize the eight initiatives examined in this paper are summarized in Table 1. In addition, we include an indicator of non-energy benefits, since most "successful" market transformation initiatives often have sizable non-energy benefits.

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[1] ENERGY STAR® is a registered mark of EPA which is licensed to DOE. The ENERGY STAR logo is used throughout the United States to promote a variety of energy-efficient appliances and equipment.

Table 1: Key Program Elements and Non-Energy Benefits of Market Transformation Initiatives

Technology/Practice	Branding/Efficiency Tiers	Incentives	Training	Other	Non-Energy Benefits
Residential Clothes Washers	ENERGY STAR, CEE	C,R,Targeted (a)	R	P, STD	substantial
Residential Lighting	ENERGY STAR	C,R	D,R	P	moderate
Residential Windows	ENERGY STAR, NFRC	C,B	R	CODES	moderate
Consumer Electronics	ENERGY STAR	NA	NA	STD (b)	minimal
Residential HVAC	ENERGY STAR, CEE	C	D	STD	minimal
Geothermal Heat Pumps	GeoExchange, ENERGY STAR	B,O	Installer	DEM	minimal
LED Exit Signs	ENERGY STAR	U,O	NA	CODES	substantial
Premium Efficiency Motors	CEE (c)	U,D	U,D		minimal

Key:
Incentives/Training: C=Consumer; R=Retailer; D=Dealer/Distributor; U=End-user; B=builder; O=Building owner/op
Other: P=Technology Procurement/Volume Purchase; STD=Standards; CODES=Building Codes; DEM=Demonstration
Notes:
Key market barriers for many products and services include high first cost, and limited awareness, stocking, and infrastructure.
(a) Wisconsin Energy Bureau provides cash awards for the purchase of high-efficiency appliances by licensed child-care facilities and community-based residential facilities.
(b) Japan has established a minimum efficiency standard for several consumer electronics products.
(c) Preliminary discussions about an ENERGY STAR motors program are underway.

More detail on each of the initiatives follows.

Residential Clothes Washers

Most of the energy used for clothes washing goes to heat the wash water. Horizontal axis clothes washers and new vertical axis designs substantially reduce the water needed for clothes washing, and as a result, markedly reduce clothes washer energy use. More efficient clothes washers also often spin at higher speeds, which reduces the amount of moisture remaining in the clothes at the end of the cycle, and in turn, reduces dryer energy use. Efficient washers currently on the market save about half of the water and a third of the energy of conventional models (DOE 1999).

In 1997, approximately 1 percent of washers sold nationally were high-efficiency horizontal axis clothes washers. Limited product availability, high prices for those that are available, and limited consumer and retailer awareness about high efficiency washers have been cited as key barriers. National market transformation efforts (including CEE's Residential Clothes Washer Initiative, which defines efficiency levels for utilities to promote, and the DOE/EPA ENERGY STAR program which labels models that qualify for CEE's base tier) provide a platform for regional promotions. Utilities in a number of regions, including the Northwest, Northeast, Wisconsin, California, and New York have rallied around CEE efficiency levels and the ENERGY STAR label and promote these more efficient washers through marketing efforts, consumer and retailer incentives, and retail sales training. Customer rebates and retailer incentives typically range from $25 to $100, and $10 to $20, respectively.

Efforts to promote efficient washers throughout the country have contributed to the following market impacts:

- *Increased product availability.* In 1991, only one U.S. manufacturer produced washers meeting the CEE specification and imports of complying models were very limited. By 1999, all major U.S.

manufacturers had introduced high efficiency models, and 31 high-efficiency washer models representing 14 different brands, met the ENERGY STAR specification (CEE 1999; DOE 1999).

- *Improved retailer product knowledge and stocking practices.* Leading national appliance retailers, Sears, Circuit City and Wards, have joined the ENERGY STAR program as retail partners and in doing so have agreed to promote ENERGY STAR products. In a limited study conducted in the Northeast (with similar results in the Northwest), all major chains and most independent retailers surveyed stocked high efficiency washers (NEEP 1998a).

- *Greater consumer awareness and satisfaction.* A high percentage of customers are familiar with energy-efficient clothes washers. In the Northwest, 19 percent of customers surveyed are very familiar and 51 percent somewhat familiar with high-efficiency washers (NW Alliance 1998a). And the vast majority of consumers who purchase efficient clothes washers are highly satisfied (greater than 90 percent in a PG&E study, 85 percent in a NW Alliance study); and in the Northeast, virtually all consumers (96 percent) would recommend the product to others (Casentini 1999; NEEP 1998a; NW Alliance 1998a).

- *Greater market share for high-efficiency washers.* In the Northwest, clothes washer penetration averaged 13 percent in 1998, up from less than 2 percent when the program began in May 1997. This market share appears to be holding steady in the absence of rebates (NW Alliance 1999). Similarly, current DOE estimates suggest that efficient washers represent 8 percent of new sales nationwide. And manufacturers estimate that market share will continue to grow to as much as 40 percent within 5 years (NW Alliance 1999).

Early announcements by DOE that it was considering horizontal axis clothes washer technology as the basis for a federal standard helped to spur U.S. manufacturers to produce products. Once available, these products' substantial non-energy benefits (e.g., better cleaning performance, gentler on clothes, water savings, etc.) have made them easier for manufacturers and retailers to promote and sell. Initial results from the Northwest suggest that the market for efficient clothes washers can be maintained at a modest level even in the absence of rebates, although for market share to increase substantially more competition and greater product selection will likely be needed to drive prices down. As a result of the market progress to date, a minimum efficiency standard based on horizontal axis clothes washer performance is more likely. In December 1998, DOE proposed three possible efficiency scenarios, one of which meets CEE's base efficiency tier. DOE expects to have a final rule complete by June 2000, such that a new standard could go into effect as early as 2004. Such a standard could permanently secure market changes that have resulted from promotions of high efficiency washers.

Residential Lighting

In most homes, lighting accounts for 5 to 10 percent of energy consumption and costs about $50 to $150 per year in annual electricity costs. Homes are lit primarily with common incandescent "A-line" bulbs, which offer excellent light quality, but produce considerable waste heat. Compact fluorescent lamps (CFLs) are a highly efficient alternative that can cut electricity use by up to 75 percent and last up to 10 times longer than incandescent bulbs, but cost 10 to 20 times as much as standard incandescent lamps (Wilson & Morrill 1996).

Many individual utility, statewide, and regional efforts (e.g., California, New York, NW Alliance, and NEEP) rely on the ENERGY STAR Residential Fixtures specification as a platform for incentives and promotions. But until recently, there was no ENERGY STAR level for CFLs, so lamp programs were based on an early CEE specification or similar utility requirements. In these programs, high-value rebates (as much as $9 per CFL and $20 per fixture) or manufacturer buy-down payments (of approximately $2 to $3 per lamp) are typically coupled with extensive marketing, retailer training and catalog sales. These efforts are having some impacts:

- *Manufacturer participation is on the rise, product availability has increased somewhat, and in some markets prices have dropped.* Manufacturer participation in the ENERGY STAR Residential Fixtures program grew from 15 to 54 in the two years since the program's inception in June 1997. The increase is largely attributed to regional and statewide programs actively promoting ENERGY STAR (Banwell 1999). Nationwide CFL prices are somewhat declining and in the Northwest, average CFL prices dropped from $18 to $15 after a year and a half of implementing the LightWise program, although prices for non-program CFLs dropped as well (NW Alliance 1998b).

- *Retailer stocking practices have improved in some markets, but retailers continue to need attention.* (NW Alliance 1998c).

- *Consumers are more aware of CFLs, although purchases are still limited.* In the Northeast, for example, a baseline study for NEEP's Starlights program indicated that 84 percent of consumers are aware of CFLs, but only 30 percent have purchased CFLs (NEEP 1998b).

- *New products are being introduced.* Product development and technology procurement efforts at DOE national laboratories have resulted in new products (e.g., CFL torchieres) or more manufacturers marketing products (e.g., subcompact CFLs). In the latter case, four manufacturers are now selling subcompact CFLs at very reasonable prices (from $6.10 to $9.50 for the purchase of 6 or more) (Ledbetter 1999).

High prices, limited product availability, and limited consumer awareness continue to be significant barriers to increased market adoption of residential lighting products. High power quality is considered one factor that has contributed to high product prices (e.g., high power quality CFLs cost about 20 to 30 percent more to produce and cost consumers about $5 more to purchase than standard power quality lamps) (CEE 1999b; Stephens 1999). A consensus agreement on an ENERGY STAR CFL specification with relaxed power quality standards and a shorter lifetime requirement is anticipated to lead to greater product availability and price competition. Increased product availability from these changes is already apparent in the Northwest — the number of qualifying CFLs in the NW Alliance LightWise program increased from 17 in 1998 to 66 in 1999. Whether consumer demand will follow remains unclear. A number of program implementors are hoping to help raise consumer awareness and spur demand by promoting products in key market channels, such as lighting showrooms, big box stores (e.g., Home Depot) and grocery chains.

Residential Windows

In the typical home, windows account for 10 to 25 percent of the annual heating (Carmody, Selkowitz & Heschong 1996). Energy-efficient windows incorporating new technologies, including low-

emissivity (low-E) and solar control coatings and improved frame materials and designs can reduce home energy use by 15 to 25 percent.

Because of the highly technical nature of engineered, advanced window products, education of all market players has been central to market transformation efforts. Programs in California, Florida, the Northwest, and the Northeast work in collaboration with the Efficient Windows Collaborative (EWC) to promote ENERGY STAR labeled windows. EWC provides technical support and training materials to manufacturers, suppliers, builders, designers and others to enable them to effectively interpret the benefits of ENERGY STAR products and the variety of products available for their climate. In each region, EWC is working with local organizations to develop educational, training, and marketing programs that fit the needs of the region. Thus far, some success is evident:

- *Manufacturer participation in the ENERGY STAR program is substantial.* As of March 1999, the ENERGY STAR Windows program has 96 window manufacturer and 16 component manufacturer partners representing more than 60 percent of national sales (Curtis 1999). Twenty-nine retail partners and 5 utility partners have signed onto the program as well (DOE 1999).

- *More products are on the market and market share is increasing.* In the first year of the ENERGY STAR program, the percent of qualifying window products manufactured increased from 10 to 15 percent to 30 percent. Notable gains in market share are also evident, particularly in regions where efficient products are being heavily promoted. In the Northwest, for example, a draft one-year progress report indicates that the market share for efficient windows in that region more than doubled since the program's inception (Jennings 1999).

Significant cost-effective energy savings potential from efficient windows remains despite the fact that provide a number of non-energy benefits (e.g., improved comfort, less fabric fading). This suggests that consumers are not aware of the benefits, find them difficult to understand, or do not highly value them. A few studies confirm that there is very limited awareness of the ENERGY STAR brand, not only among consumers, but also throughout the distribution chain. These findings highlight the importance of continued education and training for manufacturers, retailers, builders and consumers. As market share for efficient windows grows, incorporating more aggressive efficiency requirements into building codes has the potential to permanently transform the market.

Consumer Electronics

Research into a variety of miscellaneous energy uses in homes demonstrated the large and growing nature of miscellaneous energy use. It also heightened awareness and understanding of energy use from standby and off-mode power consumption products, one component of miscellaneous electricity use. Findings indicate that standby and off-mode power is responsible for losses of at least 45 billion kWh annually (5 percent of annual residential energy use) in the U.S. alone (Thorne & Suozzo 1998).

To reduce this largely wasted energy, EPA worked with manufacturers to develop the ENERGY STAR Home Electronics labeling program. Initially, the program focused on labeling TVs and VCRs with low standby losses (3 Watts and 4 Watts, respectively). Research to support the program demonstrated considerable variation in the standby power of otherwise similar TV and VCR models (e.g., standby power for TVs and VCRs ranged from less than 1 Watt to more than 12 Watts). In January 1999, the program was expanded to include home audio and DVD products. For these products, the program specifies

maximum standby power of 2 Watts and 3 Watts, respectively. As of 2003, the specification will drop to a maximum of 1 Watt for all products. To date, the program has had a few significant market impacts:

- *Manufacturer participation is substantial and low standby loss products are now available.* When the program was launched in January 1998, 11 of the top 14 TV and VCR manufacturers, representing approximately 75 percent of the market had signed on for the program. By the end of the program's first year, 17 TV and VCR manufacturers (including all of the top 14) had joined and several major manufacturers upgraded most of their TV and VCR product line to be ENERGY STAR compliant. As a result, 21 percent of TVs and 38 percent of VCRs on the market now meet or exceed the ENERGY STAR targets (Sanchez 1999). Additionally, 6 major audio equipment manufacturers announced their participation in the home audio and DVD portion of the program.

- *The market for alternative technologies to reduce standby power has been spurred.* Manufacturers have incorporated new designs into their products and are building products that significantly exceed the program's specifications. Several Sony models, for example, consume as little as 0.5 Watts in Standby mode. New product innovations that reduce standby power, such as Power Integration's TinySwitch (a small, low-loss wall adaptor), are also gaining market recognition.

While the ENERGY STAR program has had a substantial affect in bringing about market transformation for high-value consumer electronics, such as TVs and VCRs, and the program is making good progress in changing the market for audio equipment, the extent to which labeling will impact the market for lower-value products is not clear. To date, it appears that the ENERGY STAR program has helped to identify a market for alternative technologies that reduce standby power, such as the TinySwitch, but it is too early to tell if these technologies will be adopted as the power supplies of choice in low-end electronics products.

Residential Air Conditioning

On average, air conditioning consumes over 11 percent of electricity used in homes, making it the third largest end user of electricity in the home. For those homes with central air conditioning it comprises a substantially larger share — typically one-third of electricity use (Neme Proctor and Nadel 1999). Further, in much of the country, residential air conditioning use closely coincides with utility system peaks. As a result, many utilities have sponsored efficiency programs for air conditioning equipment, although the approach and efficiency levels have varied considerably.

Two national initiatives, a CEE initiative and the ENERGY STAR HVAC labeling program, have responded to this diversity by establishing energy efficiency criteria and branding for promoting high-efficiency HVAC equipment. CEE's base tier (tier 1) and the ENERGY STAR program promote an efficiency of SEER 12. (The current national minimum efficiency standard is SEER 10.) The ENERGY STAR program, launched in Spring 1995, aimed initially to improve manufacturer high-efficiency product offerings and market share. At this point, all HVAC manufacturers have signed onto the program and produce products that meet the ENERGY STAR criteria. The program now focuses on increasing the availability of consumer financing products for HVAC equipment purchases and building infrastructure for high-efficiency equipment by providing distribution sales representative training. Several market observations follow:

- *Sales of high efficiency air conditioners have slowly progressed throughout the 1990s but remain*

limited. Data from the Air Conditioning and Refrigeration Institute on air conditioner and heat pump sales indicate that equipment rated SEER 12 and higher accounted for 13 percent of shipments in 1993 compared with 20 percent of shipments in 1998. This has been paralleled by an increase in product availability (Neme, Peters, & Rouleau 1998; Nadel 1999).

- *Utilities with aggressive promotions realize high market shares.* In several utility service territories where high efficiency residential HVAC equipment has been heavily promoted — often with substantial customer rebates — market shares for SEER 12 or higher equipment have reached 50 percent or more. A number of these utilities also successfully emphasized higher efficiency levels in their programs (Neme, Peters, & Rouleau 1998).

- *Manufacturers, contractors, and consumers appear receptive to shifts in the ENERGY STAR focus.* As of Fall 1998, several ENERGY STAR program partners, Honeywell, Carrier, Lennox, and ACCA, have linked with major financing companies to provide ENERGY STAR loans for qualifying equipment. ENERGY STAR loans were previously available from only one source. Also, many distribution sales contractors have received ENERGY STAR sales training; anecdotal evidence from this activity indicates that when consumers are presented with objective information on energy cost savings, they often select high efficiency products despite their higher first cost (Offutt 1999).

Emerging activities are attempting to capture the substantial savings associated with better installation and maintenance practices (e.g., 24 to 35 percent) (Neme, Proctor & Nadel 1999). Major electric utilities in New Jersey, for example, have coordinated on a statewide program that requires contractors to document proper installation in order to receive equipment rebates (Siegal, Neme, and Nickerson 1999). Similar installation and service efforts are underway in the Northwest and California.

High efficiency residential air conditioning systems cost a considerable amount of money and have few non-energy benefits that consumers care about, making these products harder to sell than many other energy saving measures. Sizable utility incentives and substantial promotions appear to be necessary to effect and sustain market shifts. However, these may not need to be a permanent program feature. In at least one utility's case (i.e., PEPCO), rebates were cut in half over a two-year period without adverse affects on program participation (Neme, Rouleau and Peters 1998). Efforts focusing on contractor training and expanding financing options also hold some promise for affecting market behavior, although the ultimate transformation is likely to come through a new minimum efficiency standard. A DOE rulemaking to determine a new standard is underway, with a final decision slated for mid 2001 and a new standard likely to take effect five years later.

Ground Source Heat Pumps

Ground Source Heat Pumps (GSHPs) or "GeoExchange" systems take advantage of relatively stable ground or water temperatures and their capacity as a heat source and sink to efficiently heat and cool residences and small commercial buildings. GeoExchange heat pumps can reduce energy consumption by more than 40 percent relative to air source heat pumps (EPA 1993). As a result of ongoing utility research and development efforts, GSHPs experienced reasonable growth in the 1990s (i.e., 10% annually) (Sachs 1998). But high initial costs of the loop system, lack of a market infrastructure for training and installation, and lack of consumer awareness and confidence continued to limit the market (GHPC 1995).

To spur GSHP sales, the Geothermal Heat Pump Consortium (GHPC), a collaborative of electric

utilities, DOE, EPA, and other public and private sector organizations, was formed in 1994. The GHPC set out to address these barriers and increase GSHP installations from 40,000 units in 1994 to 400,000 units by 2001. However, in the first two years of operation, the Consortium was not approaching these goals. Recognizing limitations, particularly in the residential market, and opportunities in the commercial market, the GHPC shifted its focus to the commercial sector.

To attract commercial customers, the GHPC is: focusing on strategic outreach to potential customers and market influencers (such as builders, developers, architects, and engineers); has begun offering design assistance and emphasizing infrastructure development; is co-funding small scale projects as opposed to the larger previously emphasized; and is building alliances with key trade groups including ASHRAE, AIA, and FEMP (L'Ecuyer & Sachs 1998). These activities have contributed to a number of market effects:

- *Increased awareness of the technology.* The GeoExchange Information Center has been fielding an increased number of inquiries and significant interest in the technology is evident at trade shows and conventions, particularly among large companies (L'Ecuyer & Sachs 1998).

- *Increased sales particularly in commercial markets.* Sales of GHPs from1995 to 1996 were flat, but from 1996 to 1997, unit sales increased by about 20 percent, and total tonnage supplied by GHPs increased by 23 percent, reflecting an increase in commercial applications. During the same period, sales of air source heat pumps and central air conditioners fell 6.5 percent and 1.5 percent respectively (Offutt 1999).

One of the key lessons of the GHPC's experience is that for products with high initial costs but cost-effective energy savings, commercial and institutional HVAC consumers are easier to reach and influence than residential consumers. Additionally, the added benefits such as substantial maintenance cost savings and the ability to serve other loads (such as refrigeration and hot water) make high-cost GSHPs more attractive in commercial markets. Furthermore, commercial customers are easier to reach with limited marketing and education funds than more diffuse residential consumers. Initial impacts in the commercial market appear positive, but whether GSHP market share can continue to grow and be maintained in this market remains to be seen.

LED Exit Signs

More than 100 million exit signs operate 24 hours per day every day in commercial and industrial buildings throughout the U.S. Prior to the mid-1980s, most of these signs used incandescent lamps that required 24 to 40 Watts to operate. In the late 1980s, in a move to save energy and increase reliability and visibility, manufacturers began incorporating compact fluorescent lamps and light-emitting diodes (LEDs) into exit signs. These light sources provide high visibility at a fraction of the energy (10 to 20 percent) of conventional exit signs. Electric utility incentive programs and the EPA Green Lights program gave these new products an entrance into the commercial market. And an ENERGY STAR labeling program was established in 1996 to distinguish high-quality, energy-efficient products. In helping to promote greater use of energy-efficient exit signs, these activities contributed to major and rapid market shifts:

- *Market share has markedly increased.* Prior to the mid-1980s, virtually all exit signs used incandescent lamps. As of 1999, only about a quarter of new exit signs continue to be illuminated

with incandescent bulbs (Dolin 1999). LEDs appear to be largely filling the gap. In 1994, for example, approximately 30% of the "energy-efficient" signs that manufacturers voluntarily submitted for testing to the Lighting Research Center (LRC) (an independent research organization) were LEDs; two years later, virtually all of the signs LRC tested were LEDs.

- *Manufacturer participation in the ENERGY STAR program is significant and qualifying products are widely available.* At the ENERGY STAR program launch in September 1996, 10 charter partners had signed onto the program. One year later, 28 manufacturers representing three-quarters of the exit sign market by volume had joined the program. Information gathered from a subset of ENERGY STAR partners (11 out of 28) reveals that, of the exit signs sold by these companies in 1998, 83% were energy-efficient LED exit signs. Three respondents also indicated that they produce *only* ENERGY STAR-labeled exit signs.

- *Product prices have come down.* Over the past few years, prices of LED exit signs have dropped considerably and the lifecycle cost has become even more attractive. This price shift is thought to be attributable largely to increased use of LEDs for automotive brake lighting. The automotive industry's use of a large volume of much brighter LEDs gave exit sign manufacturers an opportunity to use fewer, brighter LEDs for exit signs (Conway 1999).

Non-energy benefits, such as improved visibility and reduced maintenance, were instrumental in facilitating wide acceptance for the technology among building owners, operators and other stakeholders. And market demand for LEDs from the auto industry helped to drive down the price of LEDs, and hence improve the competitive position of LED exit signs. Building codes could complete the market transformation process, particularly given that a number of state codes and the current draft ASHRAE 90.1R commercial building standard (a model for many state codes) specify energy-efficient exit signs.

Premium Efficiency Motors

Electric motors consume more than half of the electricity in the U.S. and almost 70 percent of manufacturing sector electricity. As a result, even small efficiency improvements available from moving from "standard" to "premium" efficiency motors offer considerable opportunity for energy savings. However, a number of barriers to investments in more efficient motors exist: higher first costs, shorter time horizons, inadequate planning for motor replacement decisions, and lack of knowledge regarding actual performance and true savings (Gordon 1999; Friedman et al. 1996).

Building on the efforts of utility and statewide programs, CEE established a Premium Efficiency Motors initiative in 1994. This initiative helped to unify disparate utility programs across the country by establishing consistent efficiency levels (that exceeded EPAct) for utilities to promote. A number of regional programs (the NW Alliance, NEEP, and the emerging NYSERDA and California programs) and individual utility motors efforts support these levels in promoting the use of premium efficiency motors. These programs typically include incentives to dealers, distributors or end users, and some training, education, and marketing. The central element of the former NW program was a vendor stocking incentive. In contrast, NEEP's program, based on the experience of utilities in its region, relies on large end-user incentives promoted through suppliers, coupled with intensive supplier education. New York is providing vendor incentives and California is planning to provide stocking incentives to regional distributors.

To date, one program, the NW Alliance premium motors venture was abandoned because it was

having "little influence on motor sales, stocking or promotion" (NW Alliance 1998d). NW Alliance staff attribute the program's failure to shifts in the motors market and a lack of understanding of these shifts. Market confusion about premium motors, high incremental costs despite contrary expectations, and manufacturer moves to "just in time" product delivery rendered the market difficult to influence through vendor incentives (Harris 1999). The NEEP, California, and New York programs have reviewed experience elsewhere and have generally designed their programs to avoid pitfalls of prior efforts.

Historical programs have been able to achieve substantial market share for "efficient" motors by providing incentives to vendors and end users, however, the landscape has changed. Falling electricity prices, premium pricing by manufacturers, and a higher baseline (with implementation of EPAct) render premium motors less cost-effective than pre-EPAct "energy-efficient" motors. Success in transforming the current market will depend at least in part on manufacturer decisions on pricing as well as the ability of regional groups and utilities to effectively market to first-cost oriented purchasers.

Lessons Learned

Thus far, market transformation efforts are meeting with mixed success. While the markets for energy-efficient products are improving in some areas, as evidenced by increased availability of energy-efficient products or services, improved stocking, broader awareness, and greater market share, other markets have been slow to adopt particular technologies or approaches. Of the eight initiatives examined:

- clothes washers, home electronics, and exit signs are *moving toward market transformation*;
- residential lighting and windows are *making steady progress*; and
- residential air conditioning, ground source heat pumps (for residential customers), and premium motors are *making limited or little progress*.

From these efforts, a number of general lessons emerge:

1. Market transformation activities for products and services with high non-energy benefits, low incremental costs, and relatively simple market structures enjoy more success.

The relative ease or difficulty of transforming a market appears to be a function primarily of whether the product or service offers non-energy benefits, how costly the product is relative to standard alternatives, and the complexity of the market that the effort is attempting to transform. For a product to gain market acceptance, consumers have to be satisfied with its performance — which means it has to perform at least as well, and probably better than, existing products. The most pointed example of this is with energy-efficient clothes washers. In virtually all regions where consumer satisfaction has been gauged, consumers are extremely satisfied with a wide array of performance attributes of the new washers. Products with high incremental costs and few non-energy benefits (e.g., residential HVAC), without substantial financial incentives, tend to attract only a limited market. However, owner-occupied (and public) commercial customers are more receptive to products and services with these attributes. This has been the experience with GSHPs. Finally, complex markets with multiple market actors (e.g., the motors market) are generally more difficult to transform than simpler markets. A number of efforts have attempted to "simplify" more complex markets by working directly with manufacturers and other upstream market actors. Some, such as the ENERGY STAR consumer electronics, office equipment, and LED exit signs programs, have been quite successful. Others, such as manufacturer buy-downs for CFLs, for example,

have had mixed results, with progress limited by anemic consumer demand, or little manufacturer participation. Efforts to influence distributors, such as in California's premium-efficiency motors program are just getting underway.

2. National and Regional Coordination Can Facilitate Market Transformation

Coordinated national, utility, and regional efforts can capitalize on the relative strengths of each group to deploy pieces of an overall market transformation strategy, assure more efficient use of limited resources, and ultimately increase the likelihood of market transformation. National initiatives offer a platform and public education/awareness building that regional programs can rely upon as regional incentives "sunset." Utilities throughout the country or regionally can aggregate their market influence through coordinated efficiency targets, incentive levels, and promotions. Regional groups can provide better access to local manufacturer, distributor, and retailer partners and facilitate local data collection, which can be used to track progress of regional and national activities. National and state policies can also affect program success. Codes and standards, for example, can be used to motivate action and to complete a market transformation effort.

3. Improved Data Are Needed to Better Understand Market Changes

For a number of efforts, better national and regional sales tracking information is needed to assess the extent to which markets are being transformed. For exit signs, for example, no national data on the number of exit signs in place exists. To assess the market share of energy-efficient exit signs, researchers rely on manufacturer estimates. In the case of air conditioning equipment, manufacturers and their associations collect the data but are sometimes unwilling to share it. Recent coordinated regional/national data collection and evaluation efforts address this need to some extent, although broad-based national data collection efforts are appropriate and necessary for some end-uses.

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