The Role of Market Transformation Strategies in Achieving a More Sustainable Energy Future

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I. INTRODUCTION

The United States is plagued with a variety of environmental problems that are directly attributable to our energy consumption. We still rely heavily on fossil fuels to meet our energy needs, and the air emissions from power plants contribute significantly to climate change, acid rain, smog, and a variety of health afflictions such as respiratory disease. Global treaties on climate change, new U.S. Environmental Protection Agency (EPA) air quality standards, and growing scientific understanding of the health impacts of air pollution are now forcing us to look more closely at possible changes to our energy mix and consumption habits.

Energy is important for powering our economy but current evidence suggests that we do not consume it as efficiently as we could. A recent study prepared for the U.S. Department of Energy (DOE) by five national laboratories estimated that the United States could reduce its carbon dioxide emissions by more than 20 percent without increasing cost if we just made use of available technologies (Interlaboratory Working Group 1997). Research and development (R&D) efforts could improve technology options further and produce additional improvements in national energy efficiency and the environment.

Furthermore, energy-saving technologies contribute to a stronger economy. They lower the annual energy costs borne by businesses and consumers, thereby freeing up funds for other profitable purposes. A 1997 analysis estimated that implementation of a sustainable development energy strategy, instead of a business-as-usual strategy, would result in net gains of nearly 800,000 jobs, nationwide, by 2010 (ASE et al. 1997).

In addition, energy-saving technologies can help reduce dependence on energy imports. As experience with the 1973 oil embargo, the 1979 Iran-Iraq War, and the 1992 Kuwait-Iraq war showed, dependence on energy imports can be highly disruptive to the United States. Overall, Greene and Leiby (1993) estimate that our dependence on imports, and the partial monopolization of the world oil market that this abets, has already cost the U.S. economy $4 trillion over the 1972-1991 period. Unfortunately, in 1997, oil imports reached an all-time high, with net imports (imports minus exports) reaching 48 percent of total U.S. oil demand (EIA 1998).

The fact that there exists such a large potential for cost-effective energy efficiency investments implies that our markets are not operating effectively. A variety of factors have contributed to this unfortunate situation. After the energy crisis of the 1970's became a distant memory to most Americans, interest in our energy-consuming habits waned. Today most Americans do not think much about their energy use, nor are they aware of the significant environmental and social costs. A variety of institutional, transactional, and other barriers further hinder the market's ability to produce a logical outcome (for a discussion of these barriers, see Golove and Eto 1996; Hirst and Brown 1990).

Recognizing the inadequacies of the market with regard to energy-saving measures, governments have commonly used a broad array of regulatory and voluntary mechanisms to promote energy-saving investments and actions that are in the public interest. This has included education and technical assistance programs, utility rebates and other demand-side interventions, building codes, and minimum efficiency standards. However, in many cases, these past efforts have focused on short-term objectives and not on addressing underlying market barriers that hinder the long-term adoption of cost-effective energy-saving measures. And many of these activities have been conducted in isolation from similar activities conducted by others.

In order to address these limitations with traditional program approaches, a growing number of practitioners and policy-makers are adopting a "market transformation" framework that attempts to incorporate the best features of, and improve the coordination between, market-based and regulatory approaches. In fact, as discussed below, state policy-makers are increasingly 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.

This report is intended to help policy-makers and program implementers better understand the market transformation approach. It offers some principles for the design of market transformation strategies, and also includes some suggestions for improve the effectiveness of efforts already underway. We begin, in Section II, by defining the term market transformation and illustrating how the market transformation approach can work. In Section III we review market transformation policies in a variety of states and discuss some of the key players. In Section IV we discuss the different stages of planning and implementing a market transformation strategy, from selecting targets to exit strategies. In Section V, we present a variety of case studies to answer the question of whether market transformation strategies really work. Finally, in Sections VI and VII we discuss challenges/issues for the future and our overall conclusions and recommendations.

II. WHAT IS MARKET TRANSFORMATION?

A. Defining the Term

Market transformation means reducing market barriers to the adoption of cost-effective energy efficiency products and services in a sustained manner. If the most important and relevant market barriers have been addressed to the point where efficient goods and services are normal practice in appropriate applications, and these changes are sustained over time, then a market has been transformed.[1]

[1] For a discussion of more formal definitions of market transformation, see Eto, Prahl, and Schlegel (1996).

Due to the substantial effort required, generally, a market transformation strategy is designed to promote comprehensive changes across many parts of a market for a particular measure, not just at the margins. Measures are generally chosen that lend themselves to comprehensive changes (e.g., ultimately achieving market shares that approach 100 percent of appropriate applications). By choosing measures in this way, savings can be maximized while making efficient use of limited resources.

This concept of market transformation can be applied to any type of product or service, though, to date, it has been applied most extensively to the challenge of increasing the use of energy-saving technologies and practices.

A number of different terms are commonly used to describe different aspects of market transformation efforts. In order to clearly define what is meant, we offer the following definitions.

- *Measure*—Collectively used to denote both energy-saving technologies and practices.

- *Activity*—Applying a particular "tool" to accomplish specific objectives. This could include developing a training class that teaches air conditioner installers about proper installation techniques, or offering rebates for the purchase of products that meet a desired efficiency level.

- *Initiative*—Multiple activities designed to increase the market penetration of a particular measure such as an energy-saving product (e.g., 90% efficient furnaces) or an energy-saving practice. Often, more than one organization will be involved in implementing an initiative, and activities will evolve as the market development of a measure progresses.

- *Strategy*—A broader more strategic effort intended to affect dramatic changes across a market segment (e.g., commercial buildings or restaurants) and/or within a particular end use (e.g., residential cooling). A market transformation strategy will generally include a variety of organizations engaged in the delivery of a set of coordinated initiatives and their corresponding activities. Furthermore, a market transformation strategy can include initiatives that promote both energy-saving technologies and related installation and maintenance practices. The choice of whether to pursue an initiative or a strategy will depend on many factors including the synergies between related measures and whether chances of long-term success are best maximized with a broad or more narrowly focused approach.

The real benefits of market transformation are achieved when multiple activities are combined into coordinated initiatives and then into strategies . In general terms, a market transformation initiative or strategy for a specific market segment or end use should generally involve:

1. A careful analysis of the overall market, including an identification of the particular barriers that are hindering the development, introduction, purchase and use of the targeted measure;

2. A clear statement of the overall goal of the initiative or strategy as well as the specific objectives that will be accomplished along the way by the different initiatives or activities.

3. The development of a set of coordinated activities that will achieve the desired objectives and systematically address each of the identified barriers;

4. Successful implementation of the individual activities, including periodic evaluations and adjustments designed to respond to actual experience; and

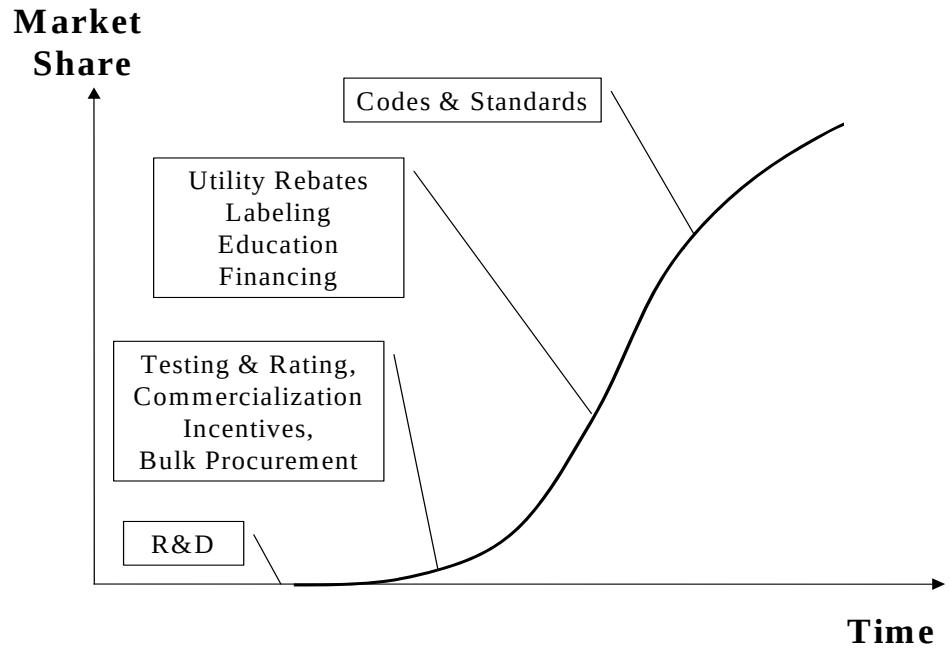
5. Development and execution of a plan for transitioning from extensive market intervention activities toward a largely self-sustaining market, i.e., an "exit strategy".

Market transformation efforts are different from most traditional utility demand-side management (DSM) programs in several respects. The primary difference is that the fundamental goal of market transformation is to change markets, not save energy in the short term. By changing markets, market transformation initiatives are designed to save substantial amounts of energy in the long term. As a result, market transformation activities are devised in direct response to identified market barriers. In fact, understanding the particular market barriers for a measure is very helpful for developing and implementing successful market transformation activities. In addition, market transformation initiatives generally are broader and longer-term than typical DSM programs. A market transformation initiative may have several phases, many players, and a variety of activities. Coordination among the relevant players is thus necessary to ensuring that a market transformation initiative or strategy is effective and the broad goals are accomplished. Since the primary goal of market transformation is to change markets, evaluation of market transformation programs emphasizes progress made in addressing market barriers and not precise measurements of program energy savings. While many traditional DSM programs include some of these attributes, few include all of these attributes that typify market transformation programs. However, market transformation is not a label that uniquely identifies certain energy efficiency program designs to the exclusion of others. It is instead an objective that all energy efficiency programs have at least a theoretical potential to achieve, although some programs are clearly more effective at achieving this objective than others.

B. How Does it Work

Frequently, a market diffusion or "S" curve is used to illustrate the market transformation process (see Figure 1). The market diffusion curve shows an idealized version of the process by which a new technology or practice evolves from market introduction to mass-market or wide-scale adoption. The market history of many technologies can be represented using this type of curve, e.g., microwave ovens, VCR's, etc. Market transformation initiatives typically

Figure 1: Accelerating the Market Adoption Process



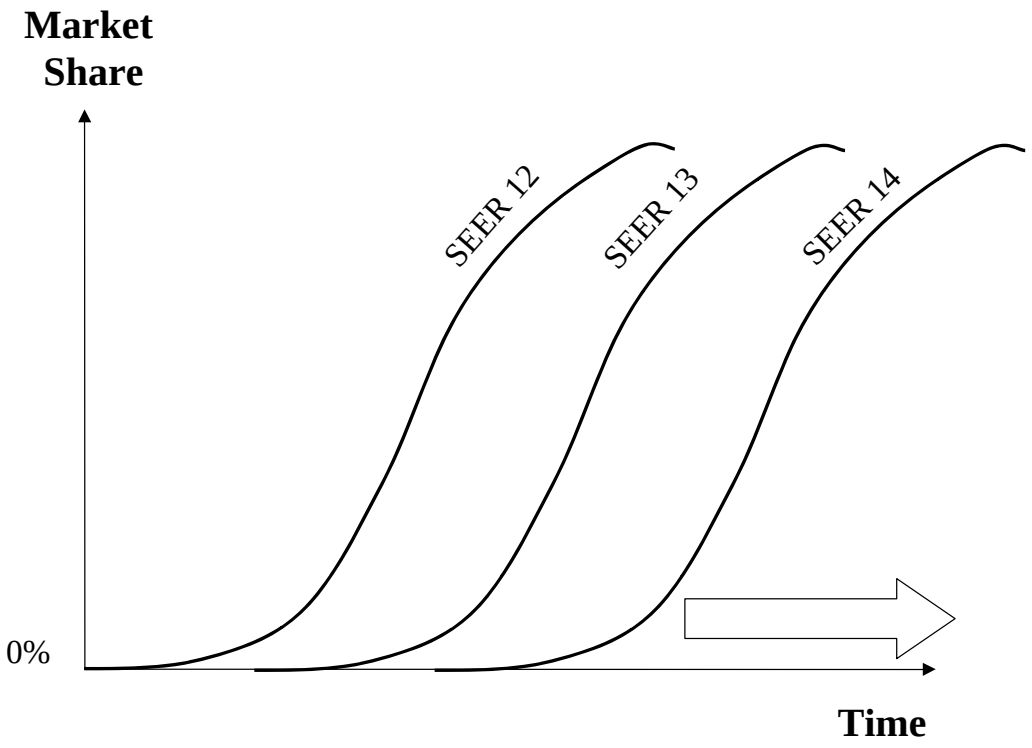
include activities designed to accelerate the market adoption of a particular energy-saving measure so that it becomes (and hopefully remains) common practice much sooner than it would otherwise. Accordingly, market transformation initiatives often include activities designed to: (1) stimulate the development and market introduction of new energy-efficient models, (2) strategically build the market share of these new products until they attain a niche position in the market, and then (3) change consumer purchasing practices in order to further expand the market adoption of these measures so they reach mass-market status and eventually become common practice.

Different activities or "tools" are appropriate at different points along this market diffusion curve, since barriers are often a function of product/market maturity (see Figure 1). For example, R&D and technology procurement efforts may be employed in the early stages of an initiative in order to stimulate the introduction of new high-efficiency measures. Rebates and targeted outreach to large purchasers (e.g., bulk purchases) may be used to strategically increase market penetration until the measure achieves "niche" status. Consumer education, loans/rebates, and other promotional activities such as ENERGY STAR® labeling may be used to expand a measure's market share to its full mass-market potential. And codes and minimum efficiency standards can be used to complete the transformation process by removing clearly inefficient

products and practices from the market. These tools are discussed in more detail in Section IV. See also Appendix B.

As the market share for a targeted efficiency level or practice increases, activities will need to evolve. Players may need to fine-tune their current activities (e.g., reduce the dollar value of a utility rebate), or actually "shift" their activities to address the next generation of product efficiency. Market transformation is a process, and it rarely ends after sales for one particular product are expanded. Accordingly, it is often appropriate to develop a broad market transformation strategy that will help orchestrate a number of related initiatives and activities over time. For example, if we consider residential air conditioners, there may be a variety of activities underway at any given point that target equipment with progressively higher seasonal energy efficiency ratio (SEER) ratings. This could include promotional and educational activities focused on SEER 12 air conditioning units, utility rebates targeted at higher-efficiency SEER 13 units, and a bulk procurement effort targeted at new SEER 14 units (see Figure 2). When such supporting activities are executed in a coordinated and well-timed fashion, the combined or "synergistic" results in the marketplace can be significant. Isolationist efforts that concentrate on only one activity, such as market introduction, without the support of

Figure 2: Market Transformation Strategies



complimentary activities that build the market for the new product, are unlikely to succeed in transforming the market in a sustained way. The market penetration of a desired measure may increase to a niche level, but additional activities will be required to pull the technology further into the market so that it actually becomes common practice. The specific activities and timing of market transformation initiatives and strategies will vary from measure to measure, and should be specified in a long-term market transformation plan that is periodically refined. The process of planning a market transformation initiative or strategy is discussed in more detail in Section IV.

III. MARKET TRANSFORMATION PLAYERS AND POLICIES

Due to the potential for large and cost-effective savings, federal and state policy-makers are increasingly embracing the market transformation concept. In conjunction with utility restructuring policies, a variety of states have developed policy positions on market transformation that will guide utility energy efficiency programs for the foreseeable future.

The California Public Utility Commission has stated that "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).

The New York Public Service Commission, in saying how public benefit funds established as part of restructuring should be spent, included "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" among a short list of eligible programs and services (NYPSC 1998).

The Wisconsin Pubic Service Commission states that "the primary goal of the Public Benefits effort in the area of energy efficiency is market transformation" noting that such efforts should include "facilitat[ing] the transformation of markets so that they effectively respond to customer's needs and public interests in increased energy efficiency" and "administer[ing], or otherwise insur[ing], delivery of services where market failures and/or barriers continue to exist" (WPSC 1997).

In the Pacific Northwest, the four regional governors appointed a Steering Committee to conduct a comprehensive review of the Northwest Energy System and make recommendations to the governors and state legislatures on restructuring issues. The Committee report "calls for the region's retail distribution utilities to mount a coordinated effort to transform markets for efficient technologies and practices." The Committee further notes: "Because markets invariably cut across utility and jurisdictional boudnaries, it makes sense to pursue these efforts regionally." (Steering Committee 1996).

And the Massachusetts Department of Telecommunications and Energy notes that: "Market transformation efforts are designed to create long-term changes that reap continuous energy efficiency savings at low cost." The Department then goes on to suggest that utility program plans "include participation in market transformation efforts sponsored by private industry, regulatory agencies, or other entities that aim to develop new energy efficiency technologies and upgrade building codes and standards" (MDTE 1996).

Given the 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. See Table 1. For a summary of ongoing activities and the key implementing organizations, see Appendix A.

IV. IMPLEMENTING A MARKET TRANSFORMATION STRATEGY

A broad market transformation strategy is designed to alter the market for a particular end use or market segment, and requires the input and participation of a variety of organizations and players. They also require a great deal of planning and market analysis. The sections that follow focus on the process for developing and implementing a market transformation initiatives and strategies.

A. Selecting & Screening Measures for Market Transformation Initiatives and Strategies

In the past year, Pacific Gas & Electric, Boston Edison, Northeast Energy Efficiency Partnerships, Northwest Energy Efficiency Alliance, and the Consortium for Energy Efficiency have conducted screening exercises to select targets for new market transformation initiatives. This type of screening process is useful in order to determine whether a potential measure is actually a good target for a market transformation initiative and to prioritize measures so that the most attractive measures can be targeted first. In general each of these exercises involved comparing energy-saving measures across several different parameters such as potential energy savings, measure cost-effectiveness, and likelihood of success.

Estimates of potential energy savings are important because in order to justify the substantial work and effort required to develop and implement a market transformation initiative, substantial savings must be achieved. All other things being equal, new market transformation initiatives with high savings will be more advantageous than initiatives with smaller savings. For measures with only small potential energy savings, it may not be worthwhile to devote the time and resources needed to develop and implement an initiative.

Information on measure cost-effectiveness is important for several reasons. First, measure cost-effectiveness is very important for convincing consumers to implement a measure. If measures are very expensive relative to the benefits, achieving substantial market share will be

near impossible. Second, prioritizing utility and public benefit DSM programs has typically relied on the Total Resources Cost (TRC) test; measure cost is a primary element in assessing

Table 1. Market Transformation Players

Organizations	Activities
National	
Federal Government (EPA, DOE, National Labs)	Coordinates national energy & environmental policies. Establishes priorities for future R&D and commercialization efforts. Manages mandatory activities such as the EnergyGuide information label and minimum efficiency standards. Conducts market-based activities such as ENERGY STAR® product labeling, retail partnerships, and other outreach, education, and training efforts.
Consortium for Energy Efficiency	Coordinates efforts among utilities across the U.S. Develops model specifications and programs for specific energy efficiency measures. Focuses primarily on "super-efficient" technologies. Undertakes coordinated bulk procurements and utilizes "tiered" rebate programs that promote continuous improvement. Programs are adapted and implemented by utilities, state and local governments, and regional organizations.
Regional	
Northeast Energy Efficiency Partnerships (NEEP) Northwest Energy Efficiency Alliance (NEEA)	NEEP operates in New England and the Mid-Atlantic states; NEEA operates in Pacific Northwest and western Montana. Both work with utilities and multiple states to plan coordinated regional market transformation activities. Both are funded primarily by local utilities. NEEP develops common programs that participating utilities can choose to implement, whereas NEEA plans and implements centralized programs that cut across utility boundaries.
State-level	
California Board for Energy Efficiency Energy Center of Wisconsin New York State Energy Research and Development Authority	Typically funded by "wires" charges or directly by utilities. Conduct RD&D. Some operate/administer programs.
Local	
Energy and Water Utilities	

Use ratepayer money to implement programs.

TRC costs. However, in assessing cost-effectiveness, the critical factor is not cost-effectiveness at current measure prices, because these prices may be high due to specific market barriers, but instead, the critical factor is likely future measure cost-effectiveness once market barriers have been addressed.

The likelihood that a market transformation initiative can be successful is perhaps the most critical factor in selecting market transformation targets. If an initiative is unlikely to be successful, it is generally not worth pursuing. As noted above, success is typically defined to mean substantial and lasting changes in the market. Likelihood of success in turn depends on an analysis of the major market barriers that are impeding each measure , the magnitude of these barriers, and the likelihood that program interventions can overcome them. Likelihood of success also depends on whether a viable exit strategy is available. For example, for high-efficiency residential clothes washers, the major market barriers are limited product availability, high first cost, and questions about consumer acceptance. However, there are recent signs these barriers are being addressed—new products have been announced, some manufacturers are reducing prices, consumer surveys show purchaser satisfaction to be very high, and growing numbers of rebate and promotion programs make it likely these trends will continue. Furthermore, DOE is actively working to develop a new clothes washer minimum efficiency standard; a standard which could provide a clear exit path for the initiative. For these reasons, recent screening exercises all assign a high likelihood of success to a high-efficiency clothes washer initiative.

Potential energy savings and measure cost-effectiveness are generally analyzed on a quantitative basis based on costs and energy savings in average applications. Likelihood of success is usually examined on a qualitative basis based on a careful assessment of market barriers and how easily these can be overcome, and consultations with industry experts. Of course, professional judgement must also be applied, as it is not possible to objectively quantify all factors that are important in selecting measures to target. For example, virtually all organizations use substantial amounts of staff and Board member judgement as they sift through options and select which programs to implement. One critical area requiring professional judgement is to identify which measures are sufficiently related and likely to succeed to lend themselves to a broad market transformation strategy rather than a more narrowly focused initiative. Further details on the approaches and results of recent screening analyses can be found in a report by Nadel and Suozzo (1998) that summarizes and contrasts different screening exercises.

B. Understanding the Market for a Measure

Whether developing a broad market transformation strategy, or an individual initiative, it is essential to begin with a clear understanding of the market, both in general terms, and with regards to the specifics of the measure being targeted. Some observations about basic market

mechanics, the process for analyzing a market, and the identification of market barriers are presented below.

Basic Market Mechanics

The operation of the competitive market is based on two driving forces:

1. Manufacturers and other actors in the supply chain (i.e., distributors, retailers, and contractors) make business decisions that they believe will maximize their profits.

2. Consumers make purchasing decisions that they believe will maximize their happiness or satisfaction, or serve their perceived needs at the least cost.

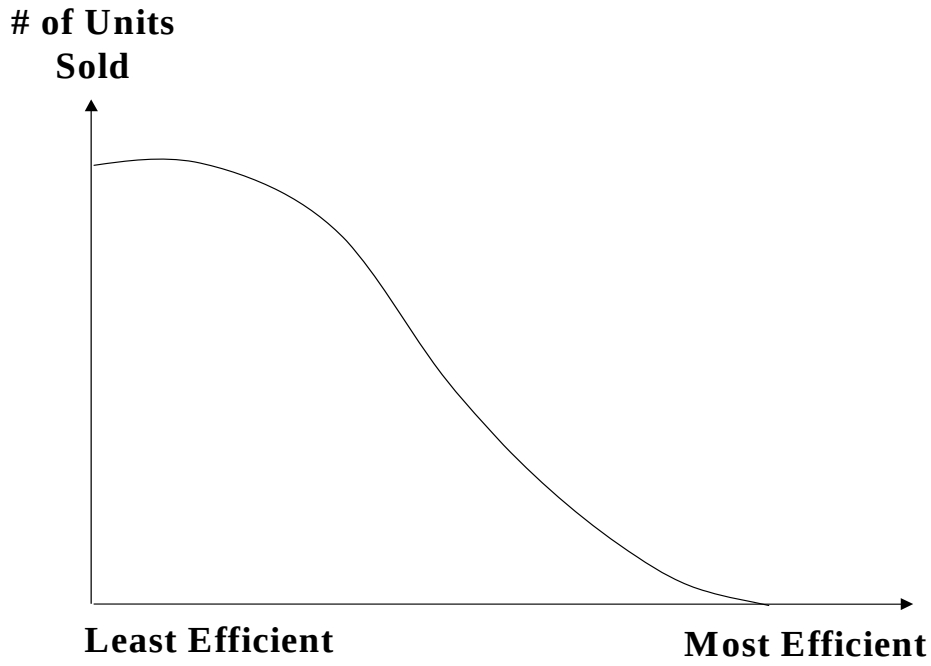
The market penetration of energy efficiency measures is determined through business transactions that occur between suppliers and consumers. To generate profits, suppliers compete for sales based on the product attributes they think are most important to consumers; usually characteristics such as price, features, and quality. While energy efficiency will contribute to lower operating costs over the life of the product, most consumers do not factor this economic value into their assessment of cost, and more importantly, they do not demand this feature from manufacturers. As a result, most manufacturers concentrate on designing products that include the most desirable features at the lowest possible cost. This type of design paradigm often leads manufacturers to avoid product changes that improve efficiency but also increase cost. Likewise, in an effort to limit costs and increase profits, many manufacturers produce "premium" products that contain many extra features, and improved efficiency, but at a significantly higher price. Basic units with better efficiency are not always available; instead efficiency and various "bells and whistles" are often packaged together, substantially raising the costs of improved efficiency products.

Consumer demand is a powerful and often underestimated tool with which to affect changes in the market place. If market transformation activities can produce substantial increases in consumer demand for a targeted measure, then the suppliers of the energy-efficient measure will earn more profit. Once it is clear that there is profit to be made (e.g., manufacturers and trade allies perceive that strong demand will continue), other suppliers will be induced to enter the new market and offer similar energy-saving measures. Thus, by working to change consumer purchasing practices, market transformation practitioners can put market forces to work for them and use them to help transform markets.

Analyzing the Market

When embarking on a process to develop a new market transformation initiative or strategy, it is useful to define the "market" that is being targeted for transformation. Is the goal to reduce the energy intensity of a particular end use, such as residential refrigerators, or to improve the overall energy efficiency of a particular market segment, such as multifamily housing? Once

Figure 3: Initial Frequency Distribution Curve



the particular end use or market segment is clarified, it is important to assess the current market penetration of the higher-efficiency models or energy-saving practices. For equipment, it is often useful to begin by looking at a distribution curve that plots current annual sales or market penetration against efficiency levels. (An example of such a curve is shown in Figure 3.) This image is a snapshot in time that provides insight into the overall market for the technology, in particular the current distribution of equipment sales. For a technology that is covered under existing federal minimum efficiency standards, it is typical to see the highest volume of sales concentrated around the lowest available efficiency level, with sales levels dropping significantly as you move towards the higher-efficiency models.

The next step includes defining the distribution channel or "value chain" through which a measure is delivered to the end user. This entails outlining the number and types of companies involved at each stage in the distribution process, and noting where national interests (like manufacturers), regional interests (like distributors), and local interests (like retailers or contractors) are involved. It is also important to understand the financial signals or incentives each player in the distribution channel is responding to when they make their individual decisions. For example, does a retailer earn more or less profit margin on an energy-efficient refrigerator relative to a standard-efficiency model? What are the financial tradeoffs associated with displaying a more efficient model on the showroom floor instead of a less efficient one?

Could HVAC dealers earn a higher profit margin on high-efficiency furnaces if only they knew how to install them faster? Accordingly, the market assessment process must be detailed, and usually involves significant data collection, analysis, and interviews with players throughout the distribution process, e.g., manufacturers, distributors, retailers, contractors, etc. In summary, this entails determining the following:

- Who is involved at each step in the distribution process?
- What role does each entity play?
- How do they operate?
- Why do they do it that way?
- What prevents them from promoting the more efficient alternatives?

Defining the Barriers

In addition to understanding the basic market structure for a particular measure, it is useful to discover and define all of the relevant barriers that are hindering the introduction and/or adoption of energy-saving alternatives. Two barriers appear to have a fundamental impact on the market penetration of most energy-efficient measures: (1) consumers are often unable to determine if a specific energy-efficient measure is a good investment for them since they lack information that is credible, easily-understood, relevant to their situation, and available at the exact time they are making a purchasing decision; and (2) consumers do not understand that their energy use has a direct effect on the environment, and so lack an important motivation to choose the environmentally-preferable alternative.

Layered on top of these barriers, are a variety of additional institutional or transactional barriers. Some of the more difficult barriers include: split incentives between landlords and tenants, and between homebuilders and homebuyers (where landlords and builders purchase low-cost, low-efficiency equipment while tenants and homebuyers pay the higher operating costs); the panic nature of many purchasing decisions (which means that only readily available models can be chosen); institutional purchasing practices that do not factor in lifecycle costs; the treatment of energy consumption as a cost center rather than a potential profit center; and the common use of differential investment hurdle rates (higher for efficiency investments than many alternative uses of capital). Other common barriers associated with new technologies include a dearth of available products, an absence of skilled installers familiar with the new technology, high price premiums for efficient products, and high transaction costs for investigating non-conventional products.

Additional barriers are often very specific to the particular measure under consideration, and can be found at all levels of the distribution chain through which that measure is delivered to consumers. That is why it is important to begin a market transformation initiative or strategy by completely analyzing the market for the measure in question—from the factory to the point

of sale—and identifying the particular barriers that hinder the energy-efficient measures at each phase of the process.[2]

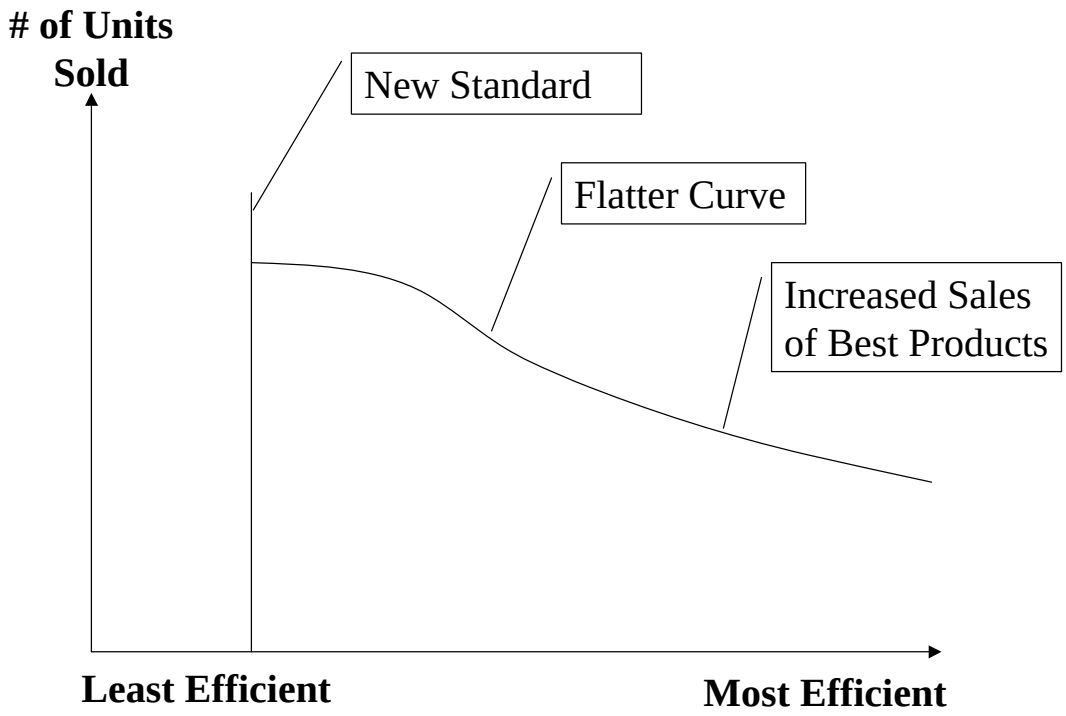
C. Planning and Developing the Market Transformation Strategy

Once a measure has been identified, the market analyzed, and barriers identified, the players can proceed to develop the overall market transformation strategy, and define its individual component activities.

Step 1: Define the Broad Goals and Objectives

All market transformation initiatives and strategies should have a clearly articulated goal, as this will guide the development of the individual activities. Each supporting activity within

Figure 4: The Transformed Market



[2] A good example of this type of analysis, as applied to the commercial building sector, can be found in Lovins (1992).

an initiative or strategy should also have its own clear objective. For example, a market transformation strategy may be developed to reduce residential sector cooling energy by significantly changing the distribution of residential air conditioning equipment sales. This general goal may be represented as shown in Figure 3 (above) and Figure 4.

In order to flatten and extend the initial frequency distribution curve, a variety of activities, each with their own objective(s), should be devised. For example, specific objectives for a residential air conditioner strategy might include raising the market penetration of SEER 12 units to 50 percent within three years; to increase sales of SEER 14 units so that they are regularly stocked and reasonably priced; and to develop and begin implementing a technician certification program on proper installation and maintenance procedures. Once defined, these specific objectives become the criteria upon which the overall strategy will be evaluated. It is thus important to define the goals and objectives in such a way to ensure that future progress can be measured. See the discussion on evaluation, below, for a more detailed discussion of this topic.

In order to ensure that the goals of each activity support the broader goal of the initiative or strategy, it is important for the appropriate players to work together in defining the common vision for the endeavor. This coordination can occur in a variety of ways. Sometimes a market transformation initiative or strategy can be crafted and implemented at a regional level by regional players; this will be most effective when the targeted market segment or end use is highly regional, e.g., new construction practices, evaporative cooling equipment, etc. Frequently national coordination will be necessary when targeting a widely used technology or an industry standard practice. Sometimes this national coordination will be facilitated by one or more national organizations as they work to integrate their efforts with those being developed or implemented by others. It is also possible that regional organizations may conduct the initial work that lays the groundwork for a broader national initiative or strategy.

For measures where programs are already underway, it will be necessary to approach this coordination and goal-setting step by first identifying the players currently focusing on the targeted end use or market segment. Once existing or planned activities are mapped out, it is possible to identify where additional activities would be most useful, and to flesh out a broader strategy. For example, if an organization is interested in developing a new initiative in the area of efficient commercial lighting, it is necessary to determine what else is underway and how all of the current initiatives relate to each other. Once the program planner has determined the "lay of the land" they can proceed to pinpoint where in the field additional efforts would be most valuable.

Step 2: Develop Program Activities that Address Key Barriers

After the goals are defined, a set of activities can be designed. Program design should be directly linked to barriers defined during the market assessment phase. Large and expensive programs that do not get to the root of the basic barriers are not likely to be successful, or to yield

sustained results. Since barriers often exist at many points along the product distribution chain, a variety of carefully crafted activities may need to be employed as part of a program. For example, in order to increase the market penetration of existing high-efficiency furnaces, a variety of efforts may be required, ranging from the training of local HVAC contractors on how to sell high-efficiency models, to development of attractive loan products that lower the monthly costs to homeowners. Sometimes these different efforts are best implemented sequentially, while other times they should be implemented simultaneously for greatest effect.

When developing potential activities, it is important to match the "tool" to the task or objective. A program planner has access to a variety of tools that can be applied to facilitate changes in the market. Different tools are appropriate for different tasks and at different stages in the market diffusion process, since the barriers are a function of product/market maturity. (See Appendix B for a more detailed summary of goals and their corresponding tools). Market transformation practitioners can directly stimulate the early movement up the S-curve by effectively utilizing a combination of proven intervention techniques. Research, development and demonstration efforts can be used to stimulate the development and sometimes the initial commercialization of new technologies. Organized bulk procurement efforts or commercialization incentives can also be used to stimulate the market introduction of the newly-developed products. Following up with aggressive outreach to other large purchasers and utility rebate or financing efforts can help the targeted product achieve "niche" status in the market.

Shepherding a targeted technology from niche status to a mass-market presence can be more difficult because it requires the involvement of more players in the value chain (some of whom may have been by-passed in the early phases of the initiative), and a significantly greater number of transactions that can not easily be combined into bulk procurements. Once a desired product has achieved some important market traction, program managers should generally begin to rely more on broad consumer demand to drive the remaining phases of the market adoption process. While this continued acceleration up the S-curve may happen naturally in some cases, educational or other promotional activities may be needed to facilitate changes in consumer purchasing practices and the preferences upon which these decisions are based. Outreach and promotional efforts targeted at the appropriate trade allies (e.g., retailers, distributors) are also often useful at this point in order to ensure the targeted products are available and the sales people are aware of their benefits. Financial incentives (rebates and financing) may have a role at this stage, but as market share increases, incentives can be first reduced, and then ultimately phased out. Codes and minimum efficiency standards can be used later in the market adoption process to capture the gains that have been achieved and to prevent any substantial backsliding.

Once tools are selected, it is also useful to ensure that they will be utilized by organizations whose institutional capabilities and mission are well suited to the task. Due to their scale, some tools are best suited for national use by a national organization, e.g., working with product manufacturers to label high-efficiency equipment. However, even for national products, there will generally be an important role for regional and local organizations to play in working with

the local distribution channel and local consumers. Also, for some climate-dependent products, regional organizations may need to take the lead as specific measures are not cost-effective nationwide but only in cold or hot climates. Likewise, for regional practices, there may be some common elements between regions that can be developed nationally and adapted to each region. At times, such as with personal computers, the market may even be international in scope, and call for international cooperation. In addition, some tasks, such as R&D, require significant technical expertise and access to necessary resources. It would be inappropriate for an organization without this type of experience to take on this type of activity. Likewise, some tasks require significant interaction with trade allies, retailers, and/or consumers and will be better suited to organizations with experience in marketing. See Table 2 for a summary of organization types and their typical sphere of influence and roles.

Table 2. Organizations and Typical Roles

Type of Organization	Typical Roles and Tools
Local Organization or Utility	Build on their direct link with customers by conducting outreach, delivering rebates & financing, and conducting training programs for local trade allies such as contractors. Can influence local stocking practices.
State Government or State-level Organization	Administer centralized training & certification programs. Adopt building codes. For large states, bulk procurement efforts can be effective Lead or co-fund RD&D efforts, especially for issues or end uses of particular local concern
Regional Organization	Provide a link between national and local efforts. Hire a centralized program administrator or pursue other cost-saving coordination efforts. A good forum to tackle climate-sensitive or regional products. Develop new programs/product specifications for areas of particular regional concern; where appropriate, encourage national adoption. Bulk procurement efforts can work well at this level if state purchasing procedures permit multi-state efforts. Can influence regional stocking practices (major wholesalers are typically organized on a regional basis)
National Government or National Organization	Address longer-horizon activities such as R&D, commercialization Address products distributed nationally; activities can include product labels, product testing guidelines, and minimum efficiency standards. Develop model programs, and foundation components that regional/state/local organizations can implement. Not typically suited to direct implementation at the local level, unless it is part of a specific pilot or demonstration project, or is coordinated with regional/local organizations.
International Organizations	Develop bulk procurements and other common specifications for products manufactured and sold in an international market (e.g., TVs and personal computers).

Another important part of program planning is coalition building. Since most market transformation initiatives involve many different players, ranging from governments and utilities, to equipment manufacturers, vendors, specifiers and installers, coalitions will often need to be developed. At times, formal coalitions can be formed, other times information sharing and tacit cooperation may suffice. For example, developing an initiative to improve the efficiency of

compressed air systems involved conversations and meetings among DOE, the Compressed Air and Gas Institute (CAGI—representing compressor manufacturers, the Compressed Air Efficiency Council (representing system design consultants), three compressed air distributor organizations, the Energy Center of Wisconsin and other state organizations, national and regional market transformation organizations and several electric utilities (McKane and Elliott 1998).

Step 3—Develop an Implementation Plan

Once the activities and tools have been chosen, and the responsibilities of each player clarified, each organization should develop its own implementation plan outlining how it will actually carry out its activities. This planning process includes preparing materials, talking to the appropriate trade allies, investigating potential delivery mechanisms, pinpointing specific areas for early targeted action, developing a strategy for communicating to customers and the press about the new activities, developing administrative and tracking mechanisms, and developing a marketing plan. While it is useful to develop a plan that will guide implementation and budgeting, it is important to remember that the plan will need to evolve over time in response to new information, new opportunities, or as a result of significant market shifts. At this stage, an evaluation plan also needs to be developed and baseline information defined so as to provide a pre-program benchmark upon which future evaluations can be pegged.

D. Implementing a Market Transformation Strategy

In one sense, implementing a market transformation initiative or strategy is similar to implementing traditional DSM programs and many of the same general lessons apply. These lessons include the following.

- Marketing strategies and technical support services have a large impact on program participation and savings.

- Equipment dealers, contractors and design professionals can be important allies in promoting programs.

- Marketing and other program materials should be easy to understand and designed with customers' needs in mind.

- A major determinant of program success is the quality of staff assigned to the program—staff need to be capable, creative, willing to take risks, and adapt to new information.

- Top management and regulator support is also important, for this support helps attract the best staff and encourage them to do the best job possible.

These and other lessons are discussed further by Nadel and Geller (1995).

However, implementing a market transformation initiative or strategy also involves continued coordination among the key players so that all of the ongoing activities remain harmonized over time. Therefore, regular communication among program managers, as well as occasional strategy planning meetings, are necessary conditions for ensuring that a common vision for the strategy is maintained and maximum market impacts are achieved.

Part of this coordination and harmonization process includes determining when it is time to phase out certain activities and ramp up new ones. For example, when should planners move to a new or different tool to promote the same measure (i.e., to move up the S-curve for the particular measure), and when should they shift their efforts to even higher-efficiency alternatives (i.e., to shift to the next S-curve). If players fail to move to new tools as market penetration increases—or they shift before the market is ready—their activities may be less successful as they will not be addressing the relevant barriers. In addition, if players shift prematurely to the next S-curve before ensuring a strong market position for the prior efficiency level, they face a significant risk that sales of the targeted products decline and manufacturers decide to remove them from the market.

When implementing a market transformation initiative or strategy that must evolve over time, it is important to execute shifts as smoothly as possible. This means that program planners should provide significant notice of future changes to manufacturers and other trade allies so that they can make their business decisions accordingly. This warning can be provided in a variety of ways, but one common method is to develop a timeline for future changes or improvement at the beginning of an activity so all players operate under a common understanding. For example, the Consortium for Energy Efficiency often develops programs that include multiple efficiency tiers. Similarly, ENERGY STAR® specifications for some products include a pre-defined schedule for when the efficiency requirements will be increased. It is important to develop such schedules in cooperation with the manufacturers that must design and introduce the next generations of products.

When multiple actors are involved, the logistics of executing a shift can become a bit more complicated. If an initiative or strategy is operating under the auspices of a single player, the shifts can be orchestrated centrally, either according to a prescribed schedule or in response to market conditions. If multiple players are involved, it is important to discuss planned changes, and to coordinate, to the maximum extent possible, changes or advancements in the strategy.

E. Evaluating a Market Transformation Strategy

Evaluations serve several purposes. First, they assure key decision-makers, such as senior management and regulators, that an initiative or strategy is making progress and is worthwhile. Second, they provide valuable information to program implementers that can be used to refine

programs in progress. For example, the Northwest Energy Efficiency Alliance used initial evaluation results for their Wash Wise program to help set rebate levels and budgets for the second year of the initiative. And its evaluation of a regional program to promote premium-efficiency motors was used as part of discussions that led to a substantial redirection of the program, as initial program results were disappointing.

Since market transformation initiatives and strategies are long-term, it is often difficult and not especially useful to evaluate them like other energy-saving programs. Conventional evaluation approaches tend to focus on energy-savings achieved and cost-effectiveness in a narrow context (i.e., from efficiency measures directly implemented during a specified time period). With market transformation initiatives, initial years are generally spent getting measures widely available in the market at reasonable prices. Until these points are reached, savings will be limited and narrow cost-effectiveness analyses inappropriate because money will be spent but the returns on the investment have yet to be realized. Instead, for market transformation, evaluation should focus on the following:

- Improvements in market share (for example, is market share going from 1 percent to 2 percent);

- Indicators of market development (for example, changes in stocking practices, product prices, and trade ally familiarity with the measure);

- Indicators that progress is being made to overcome other key market barriers (for example, are purchasers aware of the measure and do they perceive it to perform well);

- Indicators related to progress toward the desired exit strategy (for example, manufacturers actually begin to compete for customers on the basis of energy efficiency characteristics or progress on efficiency standards rulemakings and the influence the market transformation activities are having on these rulemakings); and

- Prospective analyses of cost-effectiveness, based on costs and market penetration to date and estimates of future costs and market penetration.

For example, the Northwest Energy Efficiency Alliance is using the following indicators to track progress with its Wash Wise resource-efficient clothes washer initiative:

- Market share
- Product offerings and availability
- Product prices
- Purchaser satisfaction
- Shopper and retailer attitudes towards efficient washers
- Progress towards new minimum efficiency standards

With market transformation programs, it is especially important to develop an evaluation plan at the beginning of a program, setting forth the indicators that will be tracked. Once indicators are developed, data need to be collected on baseline conditions for each indicator. These baselines can then be compared to subsequent evaluation studies, to track progress made since the baseline was compiled. Indicators should be tracked on a regular basis—typically annually.

Even in the long-term, trying to exactly determine energy savings and cost-effectiveness with high precision will be very difficult and of dubious value. With traditional DSM programs, detailed information was collected from program participants, allowing careful analysis of billing and other data for participants. With most market transformation programs, participants are not generally known and thus it is more difficult to analyze savings per participant and much more difficult to estimate total energy savings, since the total number of participants is not known. As an alternative, for market transformation programs, we recommend that cost-effectiveness analyses be approximate; such analyses will usually indicate whether a program is cost-effective or not. Only in the case of programs that are of borderline cost effectiveness may more detailed and exact cost-effectiveness analyses be needed.

Another important issue in the evaluation of market transformation programs is the question of attribution—have an initiative's interventions contributed to increased market share and progress with other indicators? Attributing progress to specific interventions and specific sponsors is very difficult, because many factors contribute to the market development of a measure and separating out the impact of specific interventions and sponsors is hard, if not impossible to do. However, some indications of attribution can be obtained from interviews and surveys of key stakeholders. These methods will generally allow broad impacts to be attributed to multiple interventions by many players. Furthermore, it will often be possible to find that specific interventions or sponsors contributed in significant ways to the market development of a measure. But more exact determinations will be very difficult to make and will often involve substantial evaluation expenditures that may not be worthwhile.

F. Transition/Exit Plan

A market transformation strategy may target several levels of product efficiency, as well as related practices, so it could take a long time to completely transform the market for an end use or market segment. Thus, it tends to be most useful to consider exit/transition plans for the individual initiatives within a broader strategy. A market transformation initiative is a multiyear effort designed to increase the market adoption of a particular product or practice. As the market adoption of the targeted measure increases to significant levels, program planners must consider their next steps. In some cases, there are no opportunities for further improvement and the planners can begin to "exit" from their activities, maintaining only those activities that are necessary to deter any backsliding or loss in market share. If significant opportunities exist to

pursue new more efficient products or advanced practices, program planners may "transition" their efforts to the next phase of their overall strategy.

If program planners determine that they can exit from their initiative, it is important to consider what type of follow-up or maintenance activities will be necessary in order to facilitate the continued market adoption of the targeted measures (and deter any unnecessary backsliding). Frequently, the exit strategy for an initiative is the adoption of new minimum efficiency standards or building codes. While they can clearly prevent backsliding below the level of the new standard, they must be maintained and enforced to be effective. Even in cases where demand for the measure is strong and on standards are implemented, sometimes it is necessary to continue some promotional or educational efforts at a maintenance level, in order to sustain the market demand for the measure. For example, market transformation activities in Wisconsin helped increase the market penetration of condensing gas furnaces in that state to more than 90 percent during the 1980s. Promotional efforts were discontinued in the early 1990s, but recent evaluations have found that the market share of condensing furnaces has declined to approximately 85 percent statewide, with the market share only 60 percent in the southeastern corner of the state (ECW 1997a; ECW 1997b), indicating that some follow-up efforts to maintain market share may be needed.

As noted above, it may be desirable in many cases to shift or transition efforts to the next generation of products, once targeted models reach a significant market share, or become required under a new efficiency standard. For example, if an initiative is successful in making SEER 12 residential air conditioners standard practice, then further initiatives can target SEER 13, 14 and 15 air conditioners and/or improved installation practices. In this context, "exit strategy" should perhaps be thought of as the end of an act, rather than the end of the show. In many cases, however, efforts to promote different efficiency levels may operate simultaneously, with lower efficiency levels partway up the diffusion curve while higher efficiency levels are much lower on the curve. Accordingly, while some players may transition to a new initiative focused on a higher efficiency level, others will remain focused on the initial product until it truly becomes common practice. The relationship between multiple initiatives for different efficiency levels on the same product was illustrated previously in Figure 2.

In planning an initiative, it is useful to define the objectives or goals that need to be accomplished in order to spur the exit or transition from the initiative. Common goals that can stimulate an exit or transition include: (1) successfully removing barriers associated with a measure so that consumers and trade allies recognize the value of the product and adopt it as common practice; (2) convincing dominant purchasers/specifiers or dominant manufacturers to adopt the new measure in all relevant applications thereby rendering the measure a de facto "industry standard" and (3) enacting new building codes or efficiency standards that will ensure the measure becomes the new minimum performance level or practice. The most appropriate exit strategy will vary from measure to measure. In the paragraphs below we describe these differations for which each may or may not be appropriate.

Removing market barriers so that a measure flourishes in the market is a textbook case of market transformation. Examples of such transformations include high-efficiency furnaces in Wisconsin (discussed below), T8 lamps used with electronic ballasts (more than 90 percent of electronic ballasts sold in 1996 were T8 ballasts, T12 electronic ballasts have been reduced to a minuscule market share), and improved-efficiency exit signs (new incandescent exit signs are rare in some parts of the country). In each of these cases, rebate and information programs, combined with other complementary efforts, have demonstrated that efficient technologies are reliable and clearly cost-effective, improved local stocking of these technologies, and contributed to economies of scale and lower prices. As a result, these measures have become standard practice and interventions can be reduced. However, for many measures, breaking down barriers is much more difficult—for example, returns on investment are too low for many purchasers or obtaining quality installations too difficult. In these cases other exit strategies and/or continued market interventions may be needed.

In some cases, a few dominant stakeholders influence a large portion of the market, and convincing these stakeholders to make efficiency measures routine can transform a market. For example, the ENERGY STAR® office equipment program convinced most manufacturers to make power management a standard product feature. Adding this feature was low-cost and the public relations benefits of ENERGY STAR® participation substantial, convincing most manufacturers to make the switch. Even still, EPA continues to actively promote the ENERGY STAR® program to consumers and manufacturers, in order to maintain the current market share, address new technical issues that arise in the rapidly evolving computer and electronics industries, and to encourage consumers to properly use the energy management features on their equipment. EPA is hoping for similar results with the just-announced ENERGY STAR® TV and VCR program. And an initiative now being planned to improve the efficiency of beverage vending machines is targeting Coke and Pepsi, because their product specifications largely drive the industry.

Codes and standards are very effective at fully transforming a market because following their adoption, measures become mandatory. Examples of measures for which this exit strategy has been employed include efficient magnetic ballasts, refrigerators, residential construction practices in the Pacific Northwest, and electric motors in British Columbia. On-going initiatives dealing with clothes washers and residential and commercial air conditioning are hoping to use new standards as an exit strategy. However, codes and standards are not appropriate for all measures (e.g., measures which are appropriate for some applications but not others) and in some cases adopting new codes and standards is controversial and not politically feasible. Often, success in building significant market share for a measure is needed before a code or standard becomes feasible. Such was the approach used for efficient magnetic ballasts, residential construction in the Northwest, and electric motors. In this way the code or standard is used to complete the transformation process by forcing the market laggers to follow in the path of the market leaders. Also, even when a new codes or standards are adopted, there are frequently higher levels of efficiency that can be targeted by subsequent phases of a market transformation strategy.

V. DOES MARKET TRANSFORMATION REALLY WORK?

As of this writing, there are now several documented and cost-effective market transformation initiatives that can be considered successes. The players were able to increase the market adoption of a targeted product efficiency level or practice, and then begin the process of exiting, or transitioning to the next phase. The success of these initiatives demonstrates that market transformation activities can be utilized to affect changes in the market. There are also a number of partial successes, where substantial progress has been made towards a transformed market.

A. Case Study Examples of Market Transformation

Among the early successes are:

- Condensing furnaces in Wisconsin
- ENERGY STAR® office equipment
- Residential construction practices in the Northwest
- Electric motors in British Columbia and ultimately the entire United States and Canada
- Efficient magnetic ballasts
- High-efficiency refrigerators

In addition some progress has been made with other market transformation efforts. In the paragraphs below, some of these successes and partial successes are profiled.

Condensing Furnaces in Wisconsin

Condensing furnaces include an extra heat exchanger to recover heat from the exhaust air, cooling the exhaust enough to condense water vapor out of the exhaust, increasing efficiency by more than 10 percent relative to the most commonly sold furnaces. In the early 1980's condensing furnaces had a very small market share, even in the cold climate of Wisconsin. By the early 1990s, condensing furnaces had a market share in Wisconsin of more than 90 percent. By way of comparison, the national market share is only in the 20-25 percent range and even in neighboring Michigan the market share is below 40 percent (GAMA 1997; HBRS 1995). During the intervening period, the Wisconsin low-income weatherization program installed approximately 16,000 condensing furnaces. In addition, Wisconsin gas utilities provided rebates for condensing furnaces during this period, further increasing the market. These programs created a market for these furnaces and provided training in proper installation technique. As a result, Wisconsin contractors became familiar and comfortable with condensing furnaces and stopped charging “learning” and “risk” premiums for the equipment. Condensing furnaces became a standard item subject to price competition, reducing prices even further. On average, the incremental cost of condensing furnaces declined from nearly $1000 to approximately $465.

In recent years, the market share of condensing furnaces in Wisconsin has declined to approximately 85 percent as some contractors install less efficient furnaces in an effort to cut costs. To address this problem, a consumer education program on the benefits of condensing furnaces has been suggested (ECW 1997b; Prahl and Pigg 1997; Suozzo and Nadel 1996).

Residential Construction Practices in the Northwest

Changing residential construction practices in the northwestern United States was an eight year effort (1983-1991) spearheaded by the Bonneville Power Administration (BPA) and involving many other utilities and agencies. The initiative included four steps: (1) developing model conservation standards; (2) sponsoring demonstration projects that showed builders how to build to the model standards and evaluated the costs and benefits of the model standards; (3) offering incentive programs to popularize the new standards and give them a significant share of the market; and (4) passing new building codes based on the model standards by the Washington and Oregon legislatures (Watson and Eckman 1993). The entire effort cost Bonneville and other utilities over $100 million, but an evaluation of the effort determined that the entire effort cost approximately $0.02 per kWh including a utility cost of less than $0.003 per kWh (Schwartz, Byers, and Mountjoy-Venning 1993). While this initiative is largely completed, code training and enforcement activities continue.

Electric Motors in British Columbia

The B.C. effort, which began in 1988, is an excellent example of how market transformation can work in the industrial sector. This initiative consisted of four components: (1) educational efforts to provide customers and dealers with information on high efficiency motors—their economics and availability; (2) customer incentives to pay part of the incremental cost of high efficiency motors; (3) vendor incentives, to encourage vendors to routinely stock and promote high efficiency motors; and (4) support for efforts to enact national minimum efficiency standards. As a result of the first three components, high efficiency motors had a 70 percent share of the new motor market in 1993, up from approximately 5 percent in 1987. In 1992 and again in 1993, the utility reduced the incentives by just over 10 percent; still market penetration held since by then dealers routinely stocked (and many customers routinely requested) high efficiency motors. In 1993 provincial efficiency standards were adopted. The new standards took effect in 1995, and B.C. Hydro was able to phase out their activities (Nadel 1996).

ENERGY STAR® Office Equipment

In most offices, PCs and copy machines are turned on all day and consume substantial energy when not in use. To address this problem, EPA worked with equipment manufacturers to develop an ENERGY STAR® program to recognize equipment that uses little energy (e.g., no more than 30 Watts) when not in active use. To meet the 30 Watt maximum, manufacturers typically use power management techniques to switch equipment to a low-power standby mode

when the equipment has been idle for a specified interval of time (e.g., 10 minutes). The equipment automatically reverts to active mode with the press of key. The EPA program has been aided by a variety of complementary efforts including researcher and utility efforts to publicize office equipment standby energy use, passage of the Energy Policy Act of 1992 which called for an office equipment information program, and an Executive Order requiring federal government agencies to purchase ENERGY STAR® products when they buy new equipment. As a result of these efforts, by 1995, 74 percent of personal computers, 93 percent of computer monitors, and 97 percent of electronic printers qualified for the ENERGY STAR® label; by 1997 the market share of ENERGY STAR® compliant copiers and fax machines was over 70 percent and 90 percent respectively (Dataquest 1996; Fanara 1997). These high market shares have been achieved because most manufacturers have made power management a standard feature on all or nearly all of their models. The costs of the change are very modest to manufacturers and power management has other advantages such as quieter machines and reduced internal heat buildup. As a result, it was relatively easy to convince manufacturers to make power management a standard feature. Still, despite high market penetration, continued efforts have been needed to make sure manufacturers ship equipment with the power management features enabled, to revise standards to accommodate new technical developments, and to educate consumers on the proper use of power management features.

Efficient Magnetic Ballasts

Efficient magnetic ballasts, were developed in 1976 in response to rising energy prices and growing interest in energy efficiency. Relative to a standard ballast, they reduce fluorescent lighting system energy use by about 11 percent. In the 1980s, many utilities offered rebates for the purchase of efficient magnetic ballasts, helping to establish a significant minimum efficiency standards on ballasts as the 1980s progressed, leading ballast manufacturers to support uniform national efficiency standards for ballasts. These standards were passed by Congress in 1988, and took effect in 1990, completing the transformation of the market for this particular technology. The loosely coordinated efforts of the different players did ultimately have a substantial market-transforming effect. And the success of this effort to promote efficient magnetic ballasts led many utilities to shift and increase their efforts to promote an even more efficient ballast technology—electronic ballasts.

High-Efficiency Refrigerators

The average energy use of new refrigerators has declined from 1726 kWh/year in 1972 to 660 kWh/year in 1993 (AHAM 1996). Since this time, refrigerator efficiency has stagnated. However, as a result of a multi-pronged market transformation initiative, refrigerator efficiency will soon increase again. The initiative included a contest among manufacturers to produce and commercialize high-efficiency products (the Super Efficient Refrigerator Program—SERP), conventional utility rebates, a bulk purchase by utilities and public housing authorities of highly-efficient small refrigerators, and adoption by DOE of a new minimum efficiency standard for

refrigerators, effective mid-2001. As the result, by 2001, the average energy use of new refrigerators will be reduced to less than 500 kWh/year. The various incentive programs contributed substantially to the new standard by demonstrating that high efficiency levels were technically feasible and economically justified. This example does not follow the idealized market diffusion curve in Figure 1, but instead used the federal minimum efficiency standards process to take a quantum leap from niche market status to complete transformation.

Partially Successful Efforts

In addition to the market transformation initiatives discussed above, a number of other initiatives have made significant progress. Electronic ballasts now have an approximately 50 percent market share (NEMA 1997) due to the combined influence of R&D, utility rebates, bulk purchases, state building codes, and educational/promotional efforts such as EPA's Green Lights program. Horizontal-axis clothes washers are now marketed by 4 out of 5 major U.S. appliance manufacturers, and the market share of this equipment has reached 12 percent in some regions of the country (PEA 1997). These changes were encouraged by a multi-utility rebate and promotion initiative coordinated by the Consortium for Energy Efficiency and by an on-going DOE rulemaking to set new minimum efficiency standards for clothes washers. High-efficiency residential air conditioners (20 percent more efficient than conventional models) and commercial air conditioners (10 percent more efficient than conventional models) now have approximately 15-20 percent market shares, driven largely by utility rebate programs (CEE 1998). For both products, current initiatives may be concluded with the adoption in the next few years of new commercial building codes and federal minimum efficiency standards. Other efforts now underway and their success to date are summarized in Appendix A.

B. Cost-Effectiveness of Past Market Transformation Efforts

The cost-effectiveness of market transformation initiatives is typically analyzed using the TRC test, a benefit-cost test that includes the costs and savings of the measure being promoted as well as program promotion and administrative costs.[3] Benefit-cost tests depend on the value of energy savings, which in the case of the TRC test are based on marginal energy and distribution costs. Marginal energy costs vary from region to region, but on a national average basis are on the order of $0.04/kWh and $0.30/therm.[4] Marginal distribution costs also vary from locality to locality but can add an additional 10-30 percent to marginal energy costs. To examine the cost-effectiveness of the six successful market transformation programs discussed above, we calculated the cost of saved energy, from the TRC perspective, of these six initiatives. The cost of saved energy is essentially the discounted average cost of an efficiency measure per kWh saved over its lifetime. As an approximation, the cost of saved energy can be compared to the

[3] For a fuller discussion of this benefit-cost test, see NARUC 1988.

[4] These figures are based roughly on data in EIA 1997. Marginal gas costs are generally higher in winter and lower in summer (on the order of $0.40 and $0.20 per therm respectively.

sum of marginal energy plus distribution prices to determine if an initiative is cost-effective. Results of this analysis are summarized in Table 3. Further details are provided in Appendix C. In general, all of the initiatives are cost-effective at the national average marginal prices discussed above. Furthermore, for all six of these initiatives, the total cost of saved energy is primarily attributable to the direct costs of the measure. The additional costs of initiative administration and promotion on average are only about 5 percent of measure costs. This is true because once a market is transformed, savings keep accruing while administrative costs essentially stop. Of course, these results apply only to this group of highly successful initiatives; the cost-effectiveness of less successful initiatives is not likely to be as rosy. Still these six examples imply an important lesson: that a key to cost-effective market transformation programs is to select measures that themselves are cost-effective, and for which the likelihood of success is high.

Another lesson from this analysis is that the total costs of successful market transformation initiatives (including measure, promotion and administrative costs) range from $1.8 to $130 million, and are commonly in the range of $2 to $20 million (ignoring the extremes which date back many years when DSM funds were more plentiful). At the lower end of this range, considering the multi-year nature of these initiatives, these budgets should be affordable at the federal, utility and state level. And even at the $20 million side of this range, such budgets should be affordable provided many entities (federal government, states and utilities) work together.

VI. CHALLENGES/ISSUES FOR THE FUTURE

While past successes and current market transformation efforts clearly indicate that the market transformation approach has "come of age," there are a number of issues and challenges that market transformation practitioners and policy-makers must face in the next few years. The most important challenge is to ensure that the public benefit money available at the state level is used in the most effective manner, such as developing and implementing highly successful market transformation initiatives and strategies, and addressing broad barriers that cut across multiple end uses or market segments. This will include improving our efforts in the following areas:

- Gaining a better understanding of how markets really work and what motivates key trade allies, such as manufacturers, contractors, and retailers, so that we can develop activities that correspond more directly with their business objectives.

- Working to integrate, at least at a conceptual level, the wide number of existing independent energy efficiency activities. This could entail grouping existing activities into end-use or market segment categories, and establishing an overall goal for the "new" strategies. This

grouping will allow practitioners and policymakers to identify additional barriers and develop new activities that fill in remaining gaps.

Table 3: Summary of Results and Cost-Effectiveness of Six Successful Initiatives

Initiative	Approximate Cumulative Cost (million 1997 $)		Result	Cost of Saved Energy from the TRC Perspective ($/kWh unless otherwise specified)		
	Society	Program Implementors		Measure	Admin.	Total
High-effic. furnaces in Wisconsin	$40	$1.8	85-90% market share	$0.27/ therm	$0.004/ therm	$0.27/ therm
ENERGY STAR® office equip.	Low	$3-4	70-97% market share	Low	$0.0002	Low
New homes in NW	$850	$130	Code covers >85% of new homes	$0.027	$0.003	$0.030
Electric motors in B.C.	$60	$10	New provincial efficiency standard look effect in 1995	$0.011	$0.0007	$0.012
Efficient magnetic ballasts	$2500	$67	New federal standard took effect in 1990	$0.014	$0.0001	$0.014
High-efficiency refrigerators	$680	$10	New federal standard takes effect in 2001	$0.027	$0.0001	$0.028

Source: ACEEE calculations detailed in Appendix C.

- Starting new market transformation efforts with an eye toward improved coordination and strategic planning. This means practitioners should work together in the early stages to define the overall strategy, and then devise the supporting initiatives and activities.

- Developing strategies that promote efficient practices as well as efficient equipment. For example, a strategy that combines activities targeted at high-efficiency residential air conditioning equipment with activities to improve air conditioner installation practices would be a useful endeavor.

- Continuing to refine and implement evaluation strategies and to educate policy-makers about reasonable evaluation expectations.

- Continuing work to keep codes and standards viable as an exit strategy. For some measures, codes and standards are the most effective exit strategy, but to be effective, they must be defended from periodic attacks by those philosophically opposed to regulation in all forms and from manufacturers and home builders who prefer to be unregulated.

In addition to improving the development and implementation of market transformation initiatives and strategies, we must work to spread the market transformation concept. While many activities are underway at the national level, regional and local efforts are concentrated on the west coast, the northeast, and Wisconsin. Other regions of the United States should learn about the market transformation concept and begin to apply it locally. In the northeast and northwest, regional market transformation organizations have helped popularize the market transformation approach. Perhaps similar organizations should be started in other regions of the country. Likewise, international technical assistance efforts can work to explain and adapt the market transformation concept to other countries.

We should also encourage the expansion of market transformation to improve energy efficiency in the natural gas and fuel oil sectors. Most current market transformation activities involve measures to reduce electricity use, although in pace-setting regions the concept is starting to be used for saving natural gas. These efforts need to be expanded and ways considered to set up mechanisms to support programs which save heating oil. Increasingly states are funding energy efficiency efforts, including market transformation, with small charges (e.g., 1-3 mils/kWh) on distribution service. Similar mechanisms should be considered for natural gas (funded through a small surcharge on natural gas distribution service), propane and heating oil (perhaps funded with a very small stage tax per gallon sold).

Lastly, we must begin to develop long-term funding sources. Most states that are establishing energy efficiency funds as part of electric utility restructuring are doing so for only

3-5 years. After this initial period, regulators and legislators will decide whether market barriers remain and funding should continue, or whether the market is functioning sufficiently well that publicly-funded energy efficiency efforts are no longer needed. In our opinion, some barriers cannot be surmounted in 3-5 years and policy-makers should begin planning now for longer-term efforts. In order to lay the groundwork for these longer-term efforts, market research will be needed on continued market barriers, initial public benefit programs will need to be evaluated, and efforts made to build public support for continued funding. Public support will likely be contingent on the extent to which consumers view energy efficiency as an important social issue, and also the extent to which they associate continued efforts with personal financial gain (see, for example, Kushler 1998).

VII. CONCLUSION AND RECOMMENDATIONS

The market transformation approach is gathering speed and many of the leading organizations active in the energy efficiency arena have adopted the new principles as part of their philosophy and activities. In this report, we have tried to describe the key components of successful market transformation initiatives and strategies, as well as some of the underlying principles that should guide design and implementation. In summary, successful market transformation initiatives and strategies should generally include the following:

- A careful analysis of the market and identification of barriers;
- The development of a long-term strategy that includes a progressive series of activities designed to surmount the identified barriers;
- The implementation of a variety of coordinated activities involving a number of different actors;
- Periodic evaluation of progress towards the long-term goals by observing various market indicators;
- Making necessary updates and revision to the different activities as a result of evaluation results or new market information; and
- The development and execution of an exit or transition plan that will ensure market changes are sustained after activities are concluded or the level of effort is reduced.

In order to follow this process, and achieve a greater number of successes, practitioners need to coordinate more and focus on initiatives and strategies, rather than isolated activities. Increased coordination will require the development of a common vision or consensus on the key market transformation concepts, tools, and activities, many of which we have tried to

describe in this report. A key area around which to begin coordination efforts is the diverse portfolio of existing activities—they should be better grouped into comprehensive strategies with common goals, clear objectives, and sound evaluation protocols.

Increasingly state utility commissions, or a related state organization, will be responsible for making significant funding decisions regarding state or regional program activities. They can play a useful role in promoting broader coordination among players and in requiring the development of truly integrated market transformation strategies.

State and federal policy makers, as well as non-profit groups and utilities, need to consider the steps necessary to carryout a key underlying activity that supports all market transformation strategies—public education. Outreach efforts to stimulate increased public understanding of energy use, its impact on society, and the benefits of using energy more efficiently are essential to ensuring the long-run success of all market transformation strategies. EPA and DOE are actively conducting outreach efforts to increase awareness and understanding of ENERGY STAR®, though these efforts also include background information on the environmental benefits of energy efficiency. While regional and local outreach efforts will likely be tied to the marketing of specific technologies, these organizations can still play a role in sounding broader common themes. Thus, regional and local organizations should consider tying in to this type of effort, repeating common themes, and utilizing common materials in order to help build broader consumer understanding. If we can succeed in creating a new conventional wisdom regarding energy use, it will contribute to changing fundamental consumer purchasing preferences. This type of shift will make it easier for program planners to address many of the remaining market barriers.

Since market transformation initiatives and strategies foster broad changes across the market for a measure, they have to be evaluated differently than traditional utility demand-side management programs. Setting clear discrete objectives and tracking simple market indicators are key elements of any evaluation effort for market transformation.

The market transformation approach is a sound policy framework for facilitating public energy efficiency and environmental goals. As a highly-strategic and cost-effective method, market transformation strategies are a wise use of public or private funds.

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Appendix A: Summary of National Market Transformation Initiatives Now Underway

Measure	Key Organizations	Elements of Initiative	Current Status
Compact fluorescent lamps and fixtures	EPA, NEEA, NEEP, PG&E, SCE, DOE, CEE	ENERGY STAR® spec for high quality dedicated residential CFL fixtures; utility rebate and price buydown programs; consumer education; research & procurements on lower-priced CFLs	Products are getting smaller and lower priced; annual sales in U.S. more than 60 million lamps; utility buydown programs being evaluated; fixture programs just starting
Clothes washers	CEE, NEEA, NEEP, PG&E, DOE	Common efficiency levels for high efficiency washers used for utility & govt. promotion & incentive programs including ENERGY STAR® and regional programs in NW and NE; minimum efficiency standards being considered	Four major U.S. manufacturers sell units; utilities serving 20% of population offer incentives; market share above 10% in NW; DOE analysis indicates high efficiency washer standard is likely to be cost-effective but controversial
Residential central a/c and heat pumps	CEE, EPA, NEEP	CEE eligibility levels used by ENERGY STAR® promotion program and utility incentive programs; new minimum efficiency standards being considered	A/C at ~12 SEER level now represent ~20% of sales; DOE standard-setting effort will begin in 1998
Residential elec. ground-source heat pump	EEI (GSHPC) with extensive cooperation with DOE and EPA	Support RD&D and commercialization of improved products; demonstrate innovative financing and incentive programs; technical training; development of improved design tools	Initiative began in 1996. In 1997 sales were ~22% above 1996 levels (preliminary estimate).

Measure	Key Organizations	Elements of Initiative	Current Status
Gas heat pumps	AGCC, DOE, EPA	Co-funded RD&D; commercialization incentives funded by gas utilities; investments in manufacturing facility; ENERGY STAR® label; tax credits considered	Engine-driven heat pump commercialized and selling ~1000 units/yr; GAX technology scheduled for commercialization in ~2000-2001
Energy-efficient new homes	EPA, DOE, EEI, utilities, states	Technical assistance to builders; national promotion effort; several utilities offering incentives or financing; demonstrations of innovative designs	More than 70,000 homes completed that exceed Model Energy Code by 25-30%
Residential furnaces and boilers	EPA, CEE	ENERGY STAR® promotion program; utility incentives based on EPA/CEE spec	>20% market share nationally including >80% in Wisconsin
TVs and VCRs	EPA	ENERGY STAR® spec and promotion	Program began 1/98; 11 manufacturers representing ~75% of sales are participating
Windows	DOE, NFRC, NEEA, states	NFRC certification and labeling;ENERGY STAR® labeling and promotion program; utility/regional promotion programs	Low-e windows ~34% market share in new homes; NFRC referenced in many state codes; other elements of initiative just beginning
Commercial packaged a/c	CEE, NEEP	CEE eligibility levels used for utility incentives; new ASHRAE std. which will become basis for new codes & minimum efficiency standards	High-efficiency equipment readily available; ASHRAE standard likely to be finalized in 1999

Measure	Key Organizations	Elements of Initiative	Current Status
Premium efficiency motors	CEE, DOE, NEEA, NEEP	Efficiency specs and incentives for "premium efficiency" motors; educational materials and software; promotions to large purchasers	Most manufacturers now offering full line of premium motors; products readily available in participating local areas
Dry-type transformers	CEE, NEMA, EPA	Efficiency specs for high-efficiency units; education & promotion efforts; limited incentives;ENERGY STAR® program being developed	Promotion efforts just beginning; Massachusetts has adopted minimum efficiency standards
Compressed air systems	DOE, ECW, CAGI	Educational and technical assistance materials; end-user training	Initial materials being prepared

Appendix B: Matching Goals, Barriers, Tools & Organizations

Goal	Typical Barriers	Typical Tools	Appropriate Type of Organization
Develop new super-efficient technologies and products	Manufacturers lack extra capital to invest in research and development. Manufacturers perceive risk of new product development is too high. Entrepreneurs lack capital and manufacturing capability.	Co-funding or joint cooperative research, development, and demonstration projects between manufacturers, entrepreneurs, and other federal/state/regional/utility entities.	Federal government R&D funding, CRADAs, national lab research State government R&D or demonstration projects. Utility joint ventures with manufacturers. Special state or federal funding, grants to small entrepreneurs.
Stimulate market introduction of super-efficient products	Manufacturers see limited size for potential future market. Market price at low projected sales volumes too high.	Set up a "mass purchase" with significant volume of orders to stimulate early volume and bring price down to reasonable level. (A related alternative is a public offer of rebates or a prize for new products, e.g., "Golden Carrot").	National or regional organizations, or a coordinated group of local/regional groups or utilities could work together to recruit purchasers.
	New technologies may require different distribution or installation practices.	Utility or local/regional org can distribute the product itself. (By buying or working out a deal to brand the new technology).	Regional or utility organization.
		Training programs for local contractors regarding proper installation of the new technology.	Regional or utility organization. Possibly get training materials from national organization.

Goal	Typical Barriers	Typical Tools	Appropriate Type of Organization
Increase sales of newly-introduced super-efficient products	No consumer or purchaser awareness of the new product or its value.	Targeted education/PR to "early adopters," purchasers who typically buy the newest technologies.	National, regional, local and utility organizations can help educate consumers.
		Targeted outreach to large purchasers.	National/regional can target very large purchasers. Regional/ local & utilities can more easily target medium to small purchasers.
	Distribution Channel may not understand, value, stock, or promote the product.	Rebates to consumers to spur demand and interest in the distribution channel.	Utilities, manufacturers, or retailers can offer rebates and financing. seasonal energy efficiency
		Stocking incentives to distributors. Training/ education regarding benefits of new products.	Utilities or manufacturers with help from state or regional organizations.
	Price may be prohibitive.	Rebates or special financing to subsidize the cost.	Utilities can offer rebates and financing. States can offer special financing or tax credits.
		Bulk purchases to increase production and achieve economies of scale.	National or regional organizations can organize these types of deals.
	Purchasers may assign some risk to purchasing a new technology.	Special leases or other ownership options that reduce perceived risk for consumers.	Manufacturers or retailers can offer special incentives, financing, and lease options for new products.
		Visible demonstration projects to show success.	National, regional and utilities may undertake demonstration projects.

Goal	Typical Barriers	Typical Tools	Appropriate Type of Organization
Increase sales of high-efficiency products already on the market	Consumers can't easily tell which ones are most efficient.	Recognize high-efficiency models with voluntary label, e.g., ENERGY STAR.	National organization should undertake labeling. Any one can target large purchasers, but specs should be consistent with labels.
		Develop model specs for large purchasers.	
	Consumers do not see benefits; can't compare them with the extra cost.	Education and other targeted outreach; retail tools.	National, state, regional, local organizations and utilities can undertake education.
	High-efficiency models include "bells and whistles" so they are more costly than necessary.	Rebates or financing to defray incremental cost.	Utilities or manufacturers can offer these.
		Encourage manufacturers to introduce new models.	National or regional groups might have best luck with this.
	Distribution channel lacks capability/ tools to promote the better products.	Sales training and other tools for retailers and contractors. Stimulate consumers to demand the better measures.	National/regional may develop tools. Regional, local or utilities can implement.
Eliminate Inefficient Products from the Market	Cheap to manufacture and have lowest market price.	Stimulate demand for better models so it is less profitable for manufacturers to offer low-end models.	National, regional, state and utility orgs. Can educate or build demand for better products.
		Set mandatory minimum efficiency standards.	National government, state governments (or groups of states) can set standards or codes.
	Consumers can't tell which ones are least efficient.	Mandatory disclosure label, e.g., FTC Energy Guide and point of sale education.	National government can require and modify information labels. Regional & local can educate.

Appendix C: Estimated Total Resource Cost of Six Successful Market Transformation Initiatives