Strategies for Improving the Market for Energy-Efficient Technologies

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This paper, is an excerpt from a larger report prepared for the U.S. Department of Energy's (DOE) Integrated Resources Planning Program. The larger report is the third in a series examining how utility demand-side management (DSM) programs can expand the market penetration of emerging technologies. The first two papers examine utility marketing efforts for gas and electric heat pumps and solar domestic hot water heaters.

Utility DSM programs have emerged as a major vehicle for increasing the market penetration of energy-efficient technologies. While many established technologies have been incorporated into DSM programs, utilities have been slower to recognize the value of emerging technologies. The focus of this paper is to examine the analytical methods employed by utilities in formulating DSM programs and to explore strategies for promoting the establishment of DSM programs that include emerging technologies.

Introduction

Utility DSM programs have emerged as a major vehicle for increasing the market penetration of energy-efficient technologies. While many established technologies have been incorporated into DSM programs, utilities have been slower to recognize the value of emerging technologies. Therefore, the focus of this paper is to examine the analytical methods employed by utilities in formulating DSM programs and to explore strategies for promoting the establishment of DSM programs that include emerging technologies. "Emerging technologies" are defined as technologies that are not widely promoted to consumers today and which have been commercialized or are likely to be commercialized over the 1991 to 2002 time period.

Methodology

Promoting Technology Through DSM: A DOE Opportunity

There is enormous potential for cost-effective energy efficiency improvements in the building sector. In 1990, the U.S. building sector consumed 31 quads of energy, or 35.3 percent of the total energy produced in the U.S. It has been estimated that it is possible to reduce energy consumption in the U.S. buildings sector by 10 Quads.[3] However, the market penetration of many efficient technologies introduced during the past decade has been slow. This has been noted in a recent DOE-sponsored review of energy efficiency potential that concluded: *"The constraint on efficiency improvements in the short term is not primarily technological. The primary barrier is insufficient implementation of cost-effective technologies."*[2]

DSM programs have become national driving forces behind a move towards energy efficiency in an attempt to provide more affordable energy services rather than solely producing more energy. Some product manufacturers are realizing that they can gain a market edge, increase sales, and increase the value of their products by emphasizing energy efficiency. However, they are faced with the same problems that have always plagued energy-efficient products—higher first cost, lack of technical and durability information, and lack of an instant market. DSM programs are extremely important to those companies because they remove many impediments.

The link between utility demand-side management and energy efficiency provides a valuable tool for DOE to move beyond its historical research and development activities, especially in the buildings and industrial sectors. By providing technical or financial support for implementation efforts, DOE can help to increase their impact and effectiveness. At the same time, DOE can develop better information on the performance of energy efficient

technologies in field settings. This information is critical to utilities as they design DSM programs.

The financial resources available for expanding the market penetration of energy-efficient products and services through utility DSM programs are immense in comparison to DOE's funding for similar programs. Therefore, DOE must act as a catalyst for change by providing national leadership in stimulating utilities to expand and improve energy efficiency services. Because DOE funding is only a small fraction of the total industry and private sector investment in renewable and efficient technologies, it must leverage the resources of others. This is done in several ways.

First, by involving manufacturers and utilities more closely in market assessment research and development activities, DOE will create a better understanding of new technologies and the dynamics of the market it wants to affect. It will also stimulate industry expenditures, which will push technologies into the marketplace more quickly. By involving these groups in developing new technologies, system integration strategies, complementary technologies and by impartially evaluating technologies, DOE will help build confidence in emerging technologies as they are ready for the marketplace. In addition, DOE can act as a catalyst by developing and promoting model standards; by educating and training designers, builders, energy managers, and technicians; and by forging alliances with businesses, utilities, and others into consortiums with the goal of expanding the markets for emerging energy-efficient technologies. DOE must be aggressive in its role of catalyst. It must attack the difficult role of bringing often disparate groups together in the pursuit of a common goal. DOE has more recently been effective in such roles, as is evidenced by the consortia building activities.

Next, DOE can provide credible, impartial performance validation of technologies and processes. With the exception of the largest utilities, individual utilities do not attempt significant technology assessments. Thus, many lack credible information on the field performance of technologies, and may implement programs based on faulty information, if at all. A lack of performance information hinders the inclusion of emerging technologies in DSM programs. DOE is considered an impartial source of information that can provide credibility to the technology commercialization process.

Finally, DOE can provide information and education to program participants and the general public on energy-efficient technologies and the results of any efforts to increase the use of these technologies. A recent DOE report to Congress stated, "One area of technology transfer that could be expanded, especially within the buildings research program, relates to consumer education. Achieving a better understanding of consumer decision processes, and providing the educational information necessary to increase awareness of the benefits associated with energy efficiency, could substantially improve the ultimate marketability of Federally-funded research efforts."[4] DOE can work within the technology commercialization process to educate all interested groups.

Utility DSM Program Methodologies

In order to increase the use of emerging-underutilized technologies in utility demand-side management programs it is important to first understand how utilities develop their programs. Although there has been little widely disseminated documentation of the methods used by utilities in developing specific DSM programs, one study differentiates between two methods utilities use to develop DSM programs; "technology-oriented" and "customer-oriented" programs.[1] Customer-oriented programs place emphasis on matching demand-side measures to customer or market needs. Technology-oriented programs focus on how specific technologies may assist the utility in achieving its energy-related goals, such as peak reduction or energy savings. In each case, the utility screens demand-side measures for technical feasibility, but the time at which this is done differs depending on the methodology that is used by the utility.

The methodology employed is critical for determining which technologies will be included in a DSM program. For example, a technology with high potential energy benefits to the utility but little market potential may be included in a technology-focused program. However, given the inherently small market, this program is unlikely to be "successful"—where success is defined as significant energy benefits, a function of the energy potential of the technology multiplied by its market penetration. A utility that employs a customer-oriented program may choose to promote a product having lesser energy potential, but having a significant potential in the market. Interestingly, a utility may begin with a technology focus, but shift to a customer focus over time to refine the delivery of a mature DSM program after it has been in place several years.

The Problem of Emerging Technologies

Emerging technologies present a problem for utilities, regardless of the program development methodology. If the utility is customer-oriented, market barriers, such as product knowledge and understanding, resistance to change, and potential high cost or unavailability, become greater than those for fully mature products. The costs of overcoming these barriers are likely to be higher than for an established technology, and thus many

emerging products may fail when compared with competing existing products.

Utilities employing a technology orientation may be even more resistant to emerging technologies. There are several computer modeling programs used to perform detailed load-shape analysis, end-use forecasting, and resource planning when developing DSM programs. These computer programs analyze a number of different variables including technology characteristics, end-use loads, hourly-load shapes, utility rate structures, program costs and incentives, benefits/cost ratios, and rate and bill impacts. However, these software tools are unlikely to include data on emerging technologies. The data necessary for input into a computer simulation tool may not be available simply because the technology is new. To overcome this information gap, the utility would have to acquire both a technical and financial analysis of the technology in question

Strategy for Promoting Emerging Technologies

Criteria for Utility Promotion Emerging Technologies. Three criteria are the primary influences on utility adoption of emerging technologies:

- Demonstrate Potential - A manufacturer must be able to demonstrate the potential advantages of an emerging technology to a utility. To do this, the technology must offer significant energy benefits as well as significant market potential, since total energy benefits are a function of the combination. [5]

- Verifiable Performance - Credible data on technology performance in a field situation must be available. Verified, real-world performance is absolutely essential. DOE can play a central role by ensuring that third-panty testing validates the estimated levels of performance.

- Identify Risks and Costs - To overcome the uncertainty associated with an unfamiliar technology, the risks and costs of emerging technologies should be assumed by a third-party such as DOE, manufacturers, lenders or utilities. The most prevalent source of funding for this activity currently comes from utility DSM programs. Therefore, a DSM program must be structured with the selected technology as the focus.

Strategies for Improving Technology Adoption. To significantly expand its efforts to promote the implementation of cost-effective energy efficiency and renewable energy technologies, DOE must form partnerships with organizations that influence the marketplace. Market development and implementation projects can take a number of forms, including:

- Consortia with industry that include manufacturers, users, utilities, state and local governments, and advocacy groups to evaluate and promote emerging technologies, and which develop test procedures, model standards, and labeling programs, and assist in defining research and development agendas.

- Demonstration programs and publicity that promote emerging technologies, design strategies and construction concepts, and which employ innovative marketing strategies.

- Alliances with state and local governments to revise and strengthen codes and standards, help adopt and implement energy conservation ordinances, and help adopt and revise public utility commission requirements placed on utilities.

- Joint assistance programs with utilities to improve the performance of federal buildings and facilities, including test bed programs that prove the viability of emerging technologies.

- Collaborative projects with private building and industry owners, state and local governments, utilities, and other federal agencies to: measure field performance; maintain an information base on energy saving and renewable energy measures and strategies; and determine how choices are made on the selection and operation of energy systems and equipment.

A Recommended Strategy for Promoting Technology Adoption by Utilities. The recommended method for promoting technology adoption is a combination of the strategies described above. The basic premise is the establishment of consortia to promote individual technologies. The strategy combines mechanisms currently used by utilities to formulate DSM programs with proven private and public sector technology adoption strategies. DOE's main role is as the catalyst for the technology consortiums whereby DOE would work with individuals and organizations in organizing a collaborative venture that would provide funding and technical support for emerging technology market development. The players in these consortia include DOE, other government entities, utilities, industry trade associations, energy and environmental advocacy organizations, design and builder organizations, and manufacturers.

Consortiums are recommended for several reasons:

- Unified Goals and Objectives - They focus attention on one particular product or class of products and specific goals and objectives.
- Collaborative Nature - They are a collaborative comprised by the groups with a vested interest in the technology and are working towards one purpose.
- Balance - Through a collaborative approach, a balance of interests is maintained. No single interest or group controls the activities or decisions.
- Fairness - All voices are heard. Small manufacturers have the same opportunity as large corporations, regulators, and others. Public interest groups can also have a say.
- Division of Responsibility - Responsibility for action can be spread among many members thus disbursing effort and resources.
- Quality - Diversity among consortium members breeds greater questioning and more discussion, providing a variety of perspectives to each decision. The resulting decisions are typically of greater quality, both scientifically and operationally.
- Diversified Funding Sources - Funding can be obtained from many or all vested interest groups, not just federal sources.
- Research Partnerships - Consortium partnerships help make better use of limited research, development and demonstration funds in both the public and private sectors. Unnecessary duplication can be eliminated and pooled resources can better address specific needs.
- Problem Solving - Because so many groups are involved and have differing points of view, problems are easier to anticipate and resolve.
- Regulators and the Regulated - Dialog is key to the consortium approach. Regulators can explain their objectives and desires in a forum where those most impacted can assist with decisions and procedures to accomplish those objectives.
- Timeliness - Working together on a common set of objectives, a consortium is more quickly able to: resolve critical issues; bring needed resources to bear; build compromise; organize research, development and demonstration; and, provide needed services.

There are, of course, problems associated with creating consortia. They require substantial effort in organizing disparate groups and developing common understanding and goals. They require a lot of forethought on suitable membership, strategic planning, and identification of objectives and resources. Finally, they require management by an organization that is capable of handling the "political" issues that are common with consortia.

The strategy provided below is written in general terms and does not apply to any one technology. Each consortium formed requires distinctive planning and organization.

Six Steps in the Technology Commercialization Strategy

Select Candidate Technologies

DOE has developed, or assisted in the development of, a number of technologies that have never quite reached their market potential. However, with several different mandates to improve the nation's energy efficiency, one of the most profitable exercises can be assistance to technology manufacturers and providers in expanding markets. The first step in this process is the selection of candidate technologies from among those that are potential "winners" in the market place.

Establish a Consortia

a. Identify possible participants

The first step in developing a commercialization consortia is to form a core group of individuals, representing affected organizations, that can help set policy and direction for the consortia.

b. Develop organizational needs and scope of work

Once the initial program participants have been selected, they must establish a "game plan" for the commercialization of the selected technology(ies). There are several issues regarding the scope of the project that need to be addressed including finding, marketing, organizational structure and scope.

Once the technology selection process has been finalized, the initial program participants should begin formulating plans for adding additional members, developing an organizational structure, and generating funding. However, since the marketing plan for each technology will likely differ, many of the questions concerning the agenda for the rest of the program are dependant on the outcome of the technology selection process.

It is important at this point in the program to identify the financial and other resource costs of achieving the goals and objectives of the consortium in a timely and efficient manner. Unrealistic expectations and a lack of resources will stifle a consortium very quickly.

Establish Consortia Goals and Objectives and Develop an Information Database

The consortium's main goal is to increase the market for a specific technology(ies). There are several ways this can be accomplished. A technology marketing program could be established that would target particular utilities. However, this is difficult because of the differing needs of utilities and the differing mandates set by public utility commissions and state law. An easier way to establish a program is to target certain utilities based on their size, aggressiveness and openness to including emerging technologies in their programs. One factor that has been readily apparent since the beginning of DSM programs is that most utilities will establish programs only after the more aggressive utilities have operated a program and proved it successful. In addition, the consortia should be careful to address the most appropriate market for the selected technology and initially concentrate its activities with a small, but influential segment of the market.

The consortia should not look just at financial incentives or disincentives as a means for market promotion. Other activities, such as revising building codes or developing educational programs. can have the desired effect if planned correctly.

The next step for a utility in developing a DSM program is to consider what technologies would best match the utility's load shape and objectives. Selection of the appropriate technology is the most critical question that a utility faces.

The third step for a utility is to complete a cost/benefit analysis of prospective technologies and/or strategies to determine the probable effect on future revenue and rates.

Target a Potential Market

a. Identifying the issues

Each emerging technology will require a different delivery mechanism based on the market sector to which it is directed; industrial, commercial, or residential. Identifying the market for a particular technology is the first step in developing a commercialization plan.

b. Recognizing consumer value

Recognizing the need to provide value to the end-user is essential in designing DSM programs. To the consumer, the term value may be perceived very differently than for the utility, manufacturer or other interested parties. For example, utilities are primarily concerned with their peak and base loads, while consumers tend to be most concerned with their monthly bill.

In their 1992 study entitled, *Building Energy Efficiency*, the U.S. Office of Technology Assessment listed several reasons why consumers do not purchase energy-efficient technologies without some incentives. They include the following:

- There is often a separation between those who purchase energy-using equipment and those who pay to operate the equipment, which undermines existing incentives for efficiency. For example, one-third of housing, and one-quarter of commercial building floor space, is leased or rented rather than owned.

- Decisions on purchasing energy-using equipment require comparisons across many attributes, such as first cost, performance, appearance, features, and convenience. These other attributes often overshadow energy efficiency considerations.

- Individuals pursue several goals when making energy-related investment decisions—for example, minimizing the time to make a decision, spending the least amount upfront, or minimizing risk by obtaining the same item that worked before. Very few pursue the goal of minimizing life-cycle costs, which energy-efficient technologies achieve.

- When trading off first cost and energy savings, consumers will not invest in efficiency unless it offers very short payback periods—less than two years for home appliances, for example. In contrast, personal financial investments generally offer much lower returns.

- Energy costs are relatively low, so those concerned with cost reduction often focus elsewhere.

- Energy efficiency is often misperceived as requiring discomfort or sacrifice, limiting its appeal.

c. Identify barriers and incentives for the commercialization of technologies

Finally, the consortium participants should objectively assess the barriers to market penetration for a given technology. Each barrier should be evaluated for its potential effect and solutions to overcome these barriers should be explored.

At this stage in the process there should exist a tremendous amount of information on the technology. The next step is to design a marketing and advocacy program to overcome the barriers that have prevented the technology from achieving full market penetration.

Implement Product Specific Strategies

a. Designing Utility Demand-Side Management Programs

Each technology is likely to face different barriers. When a utility DSM program is being designed to overcome these barriers, the program should be designed to reflect the difference between technologies and to maximize market potential. There are a number of program options available for utilities to promote technologies. Some of the more common options include:

- Direct rebates from the utility to the consumer;
- Loans/leases from the utility or a third party to the consumer;
- Direct utility installation of the technology on-site; or
- Educational information on efficiency and efficient products from the utility or third-parties to consumers.

b. Assisting in the implementation of Utility DSM Programs

Once an implementation strategy has been chosen to promote a technology, consortium members must assume their role in helping implement the DSM program. The successful delivery of technology marketing programs is based on carefully designed and applied programs that offer strong incentives, use other groups as allies, and focus on specific markets.[7] It should be noted that the strategies developed in this paper are not intended as text book solutions to the issues involved in increasing the use of efficient technologies, but as a resource from which to develop solutions. The program participants should develop demand-side management programs for the technologies that maximize market penetration.

Evaluation and Information Dissemination

Evaluation and dissemination ensures that the results of the program are critically analyzed, and that the lessons learned from these results are reincorporated in the program as well as serving as a guide for future efforts. Four components to successful evaluation and dissemination include:

- monitoring and reporting regularly during program implementation;
- evaluating both process and performance;
- disseminating information on process and performance; and
- incorporating results into future prioritization.

a. Process and performance review

Both the performance and process of the program should be evaluated. A review of the implementation process will be useful in designing future programs, as well as evaluating DOE's role in comparison to the perceptions of that role by other participants. Several questions should be asked to evaluate the program implementation process, including: Were participants correctly identified and incorporated into the program? Were adequate resources devoted to the program given its intended benefits? and Were all of the participants satisfied with the results of the program? An evaluation of the market performance of the selected technology should also take place.

b. Program monitoring and evaluation

Regular and timely monitoring should be conducted throughout the course of the consortium process, from inception to implementation. Monitoring may take place through regular meetings of the participants, by a select group of participants, or by a group of outside advisors. Evaluation is a necessary component of the process to ensure that the program implementation strategies are accomplishing their intended goals.

Lessons Learned in Similar Technology Transfer Efforts

There are several collaborative or consortia initiated by DOE that have been successful in enhancing the commercialization of emerging technologies. Some of these consortia have been established directly through utility programs. Others have been formed for reasons other than technology marketing, such as rating, labeling and product certification. However, they all strive for the same results, expansion of the market for a given technology. The following is a description of six successful consortiums:

The USH_2O Program was established in 1991 to promote the commercialization of solar domestic hot water heaters through utility DSM programs. The USH_2O program goal is to improve the commercialization of solar domestic hot water heaters by helping utilities assess the potential of solar hot water heating in their mix of demand-side

services and by reducing the cost of the systems through utility bulk purchases.

In order to accomplish this goal, the USH_2O program has a threefold agenda, including:

- identifying the data needed to determine the viability of solar hot water heating in utility plans including cost effectiveness for specific service areas;
- assessing the impact of solar water heating on electric utility peak demand; and
- evaluating solar water applications for high value applications.

Over 55 utilities have shown interest in the USH_2O program to date. DOE provides some technical and financial support, however, for the most part the program is participant driven and funded.

The Utility PhotoVoltaic Group (UPVG) is a utility consortia established to exploit current cost-effective uses of PV systems and to develop strategies to promote "higher-value" higher-volume applications. The goals of the UPVG are to promote applications for PV systems that are currently cost-effective, such as remote water pumping, and to work with utilities to develop the large high-value, high-volume application, such as residential and commercial load shaping installations, and power generation facilities that are not yet cost-effective.

The Super Efficient Refrigerator Program (SERP) is a consortia of 24 utilities that formed to accelerate the development of a refrigerator that is CFC free and 25 percent more efficient than 1993 Federal standards. The consortia's founding members include Pacific Gas and Electric, the Natural Resource Defense Council, the American Council for an Energy Efficient Economy and the U.S. Environmental Protection Agency.

U.S. manufacturers competed against one another to see who could develop the most efficient refrigerator. The manufacturers were judged on their ability to produce a highly efficient refrigerator, the companies ability to deliver the product to market and their ability to track customer purchases. The 24 utilities committed between $150,000 and $7 million apiece ($300 million total) that is to be awarded to consumers, in the form of rebates, when the SERP refrigerator reaches the marketplace. In September 1993, Whirlpool was named the winner of the SERP contest. In order to collect the money, Whirlpool will have to produce and distribute 250,000 of the SERP refrigerators between 1994-1997.

The commercialization of the York natural gas heat pump is another example of a consortia developed by private industry to promote an emerging technology. In this case the American Gas Cooling Center (AGCC) developed the consortia. AGCC is a coalition of gas utilities, air conditioning manufacturers, the Gas Research Institute, and the American Gas Association that have banded together to enhance the marketability of the York heat pump through field-testing and buying-down the cost of the units to initial purchasers. To date, utilities have contributed a total of $14.7 million to field testing and the initial purchase of the heat pumps for consumer use. Utilities will be paid back in time through a system of royalties received from the manufacturers.

In order to create incentives to purchase energy efficient homes for the average American, a group of companies, utilities, financial and real estate concerns and environmental organizations has formed and organization called the Home Energy Rating Systems (HERS) Council. The Home Energy Rating Systems Council was formed to address these issues and develop workable HERS/EEMs systems across the nation, in a forum where a broad range of affected groups could contribute. The HERS Council was incorporated in February 1993 and met in March to adopt a set of bylaws, a mission and goals, and to establish a Council Board of Directors that would equitably represent the diverse membership.

The National Fenestration Rating Council (NFRC) was formed in December 1989 to establish a voluntary, national energy performance rating system for fenestration products and a corresponding product certification and labeling program. The Council is a collaborative of the fenestration industry, other segments of the building industry, government, utilities, and consumer groups. Over time, the Council will establish thermal, solar heat gain, optical properties, air infiltration, and condensation resistance rating procedures for residential and commercial windows; that will be used by States, utilities, and the fenestration industry in setting building codes and standards and conservation program marketing criteria; and an accreditation, certification and labeling program that will govern the process.

The main goal of the Council is to establish a fair, credible and uniform system by which all fenestration products, e.g., windows, doors and skylights, can be rated for energy performance. Since January 1, 1993, the starting date for the product certification program, over 60 fenestration manufacturers have been authorized to list their products as NFRC-certified. This represents over 3,000 product lines.

Conclusion

Utility DSM programs have emerged as a major vehicle for increasing the market penetration of energy-efficient technologies. However, while many established technologies have been incorporated into DSM programs, utilities have been slower to recognize the value of emerging highly efficient technologies. In addition, with the uncertain future of many utility DSM programs it is important to leverage resources as much as possible.

The formation of consortia to promote emerging underutilized technologies serves several purposes. Not only does it provide a valuable tool for DOE to move beyond its historical research and development activities, at the same time, it helps by providing support to utilities in the development of DSM programs.

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Endnotes

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