# It's 2002: Do You Know Where Your Demand-Side Management Policies and Programs Are?

**Tom Eckman, Northwest Power Planning Council**
**Nancy Benner, Portland Energy Conservation, Inc.**
**Fred Gordon, Pacific Energy Associates**

For at least the past two decades, U.S. states, cities, utilities, the private sector and the federal government itself have been investing time and money in improving the efficiency of this nation's use of energy. State, local and federal authorities have upgraded building and appliance efficiency codes. Utilities have operated demand-side management programs as an alternative to building new electric power generating plants. And consumers and manufacturers have turned their attention to making their homes, businesses and products more energy conserving.

All of these actions have just scratched the surface of what can be accomplished if these entities work together. The goal of future efficiency efforts should be the transformation of the marketplace, not merely site-by-site energy savings. To accomplish that goal, the authors propose: more coordinated efforts, such as utility programs that work directly with product manufacturers rather than only with consumers; working with large commercial chains at the corporate level rather than with individual outlets; specifying technologies and practices for contractor-operated programs, but calling for bids on installation and upkeep costs; and timing major equipment changeouts and facility retrofits to coincide with scheduled industry upgrades or replacements.

The authors go on to outline which types of efficiency measures should be attempted first under specific load/resource conditions, and how program evaluations can be improved to help gauge utility success at transforming the market rather than just saving energy.

Finally, the authors suggest government and regulatory actions that will facilitate utility investments in energy conservation. Among the most important of these are regulatory changes that enable a utility to profit from saving energy rather than just from selling it.

## Introduction

It's been nearly two decades since the United States was rudely awakened to the fact that its economic system had been built on cheap energy, much of it imported fuels. During this 20-year period, the United States and other developed countries instituted policies and undertook programs to reduce their reliance on imported petroleum products and polluting domestic fuels. These policies and programs ranged from "burn America first" ( i.e., let's reduce our imports by using up our own supplies first) to "wear a sweater and things will be better" (i.e., if we just quit using as much of the stuff, maybe they'll drop the price). In these early days of energy conservation, making homes more efficient was seen as a social service provided to low-income households by states and the federal government.

As the American public was experiencing petroleum "sticker shock," the U.S. electric utility industry discovered "price elasticity." After decades of stable growth in demand for electricity and declining costs for its production, the 1970s caught the industry in the midst of ambitious power plant construction programs, rapidly inflating construction costs and an economic recession caused in part by steeply increased petroleum prices. When consumer demand for electricity slackened in response to real increases in the price of electricity, many utilities found themselves with significant excess generating capacity. Utility planners, faced with construction lead times of eight to 10 years for large central station power plants, had demonstrated their inability to predict that far into the future with precision. In response to this problem, policies were discussed and occasionally adopted that attempted to "reduce lead times" and/or "expedite siting and licensing for new power plants."

In the midst of all these politically expedient "solutions," some observers and power planners noted that perhaps we could (and should) attempt to provide the energy services society needed by doing "more with less" (i.e., accomplish the same task with less energy). They asserted that, unlike conventional generating plants, improvements in efficiency can be carried out with short "lead times" and tend to come in small pieces, so that the risk of overbuilding is reduced.

By the late-1970s, the notion that energy conservation could be substituted for new energy supplies was gaining broader political acceptance. In 1976, Congress passed the Energy Conservation and Production Act (PL 94-385), which, among other provisions required the federal government to establish national energy conserving building standards for buildings. Two years later, the National Energy Conservation Policy Act (PL 95-619) was enacted. This statute required large utilities to provide energy conservation audits for their residential customers. In 1980, Congress, after three years of debate, enacted a federal statute (PL 96-501) that defined the conservation of electricity as a "resource" that could be purchased by utilities in lieu of new electrical generation.

During the decade of the 1980s and early in the 1990s, the goal of energy conservation and demand-side management efforts evolved and expanded to encompass not only the provision of the energy services society needs at the lowest long-term cost, but also to minimize broader impacts of resource development (particularly environmental) in the process. To accomplish this economic and environmental goal, conservation programs were initiated by federal and state governments, utilities and the private sector. These programs had one or more of the following objectives:

- To acquire all cost-effective (i.e., less costly than new supply-side resources) energy-efficiency improvements;
- to secure the rapid market penetration of currently available energy-efficient technologies and products; and
- to develop and commercialize more energy-efficient technologies and products.

While there were and still are other reasons for undertaking energy conservation programs (e.g., to mitigate rapidly escalating electricity rates, to comply with state energy regulations, to satisfy a resource conservation ethic, etc.), the goal and objectives of the '80s and early '90s remain relevant. This paper does not challenge their validity. Rather, the purpose of this paper is to address how current policies and programs might evolve over the next decade to more effectively and efficiently achieve these goals and objectives.

This paper focuses first on how energy conservation policies and programs have evolved since the early 1970s and summarizes some of the major achievements to date. Then, based on the lessons learned and the experience gained over the past two decades, this paper sets forth what the authors believe to be the next phase in the evolution of these policies and programs. We maintain that strategies designed to produce transformations of entire markets will be more effective than site-by-site, unit-by-unit programs. Because there are certain market segments that are not subject to wholesale transformation, we also suggest modifications to current approaches, which should make demand-side management programs targeted at site-specific efficiency improvements more effective.

In developing strategies for market transformation, we have assumed that acquisitions of energy-efficiency improvements are treated the same as new energy supplies and, as a consequence, can be purchased/financed by those entities that traditionally acquire new resources (i.e., utilities). We also assume that, at least for the next decade, consumers will continue to turn to utilities as their primary source of energy services. Therefore, it is our view that utility policies and programs, rather than governmental actions, will dominate the conservation agenda of the next decade. This does not mean, however, that governmental actions are not critical to the success of utility demand-side management programs. Indeed, we believe that one of the key factors necessary to enhance the effectiveness of demand-side management efforts during the coming decade will be deliberate coordination of utility and governmental conservation policies and programs.

## What Kinds of Programs Have We Offered in the Past?

### Governmental Actions

Governmental policies and programs over the past two decades have been the major force promoting conservation, providing both financial and regulatory inducements for energy efficiency. The first government programs responded to fuel price increases by auditing and weatherizing the homes of low-income citizens. These programs were offered primarily by the Community Service Administration.

Federal and state tax credits for conservation and renewable resource investments, most of which have now expired, were aimed at encouraging private investments in demand-side management technologies.

While such programs and financial incentives prompted considerable activity, probably the most important actions taken by federal and state governments have been in the area of building codes and appliance efficiency standards.[1] Although the federal government was never able (or willing) to secure a national mandatory building energy code, the vast majority of states now have adopted more rigorous building energy codes. While energy code enforcement, particularly in commercial buildings, remains a significant problem, the existence of more stringent energy codes has transformed some segments of the building products industry. For example, when codes required that before a glazing product could be used in new construction its thermal performance had to be tested, window and door manufacturers agreed to national testing and certification standards. As a consequence, window manufacturers' claims of specific R-factors will now be based on the uniform testing and certification procedure.[2]

After several states adopted appliance efficiency standards, the appliance industry and conservation groups managed to forge an agreement that led to the adoption of the National Appliance Energy Conservation Act of 1987 (NAECA). Regulations adopted pursuant to this legislation have significantly improved the efficiency of new residential appliances and space-conditioning equipment. These new standards for refrigerators, freezers, water heaters, clothes washers, dryers, air conditioning and space heating equipment eliminated the most inefficient products from the market.

State and local governmental policies have also encouraged energy conservation through solar access protection and other land use planning criteria. In Ashland, Oregon, developers who agree to add certain energy conservation features to their buildings are granted "density bonuses," which in and of themselves can conserve both land and transportation resources.

In the late 1980s and early 1990s, state utility regulatory commissions became increasingly active in promoting conservation through adoption of least-cost integrated resource planning requirements. These requirements attempt to place conservation on equal footing with new generation as a resource alternative for the utilities. In some cases, conservation, due to its environmental benefits, is given both a preference and a cost advantage. Some state regulatory bodies also have adopted rules that financially reward a utility's stockholders for aggressive pursuit of conservation resources. As of March 1992, 15 states had approved incentive mechanisms to reward aggressive pursuit of demand-side management. These regulatory actions and the expected near-term need for new resources prompted many of the nation's investor-owned utilities, particularly in New England, New York, Wisconsin, California and the Northwest, to rapidly escalate their conservation and demand-side management programs.

## Utility Actions

Utility conservation initiatives over the last two decades evolved in three general phases. Early programs provided little more than consumer education. Programs that followed those offered site-specific design and engineering advice. Today's comprehensive programs are designed to enable utility purchases of conservation as resources.

In the 1970s, utility consumer education programs targeted the existing residential market with a focus on weatherization. By the mid-70s, many of the nation's largest utilities, partially in response to federal legislation, were offering residential customers free energy audits. In recognition that audit-only programs were not producing large energy savings, some utilities began to include in their residential programs financial assistance in the form of zero-interest or low-interest loans to carry out recommended conservation measures. As the 80s ended, residential weatherization programs, which provided financial assistance in the form of grants rather than loans, to reduce administrative costs, had reached maturity at many utilities.

Utility programs aimed at capturing conservation opportunities in new residential construction followed a pattern similar to retrofit programs. Information and design assistance programs offered through the Tennessee Valley Authority and other retail utilities made a transition to marketing programs, such as Southern Electric Inc.'s "GOOD CENTS." These marketing programs also offer consumers financial assistance to offset some of the cost of building more energy-efficient housing. In a few instances, such as in the Northwest, Maine and California, these marketing and financial assistance programs have been coordinated with programs to encourage adoption of more efficient energy codes (Nadel 1992).

Utilities began to provide similar information-based programs to their commercial and industrial markets in the early 1980s. For example, the Tennessee Valley Authority developed the Energy Design Guidelines and the Energy Nomographs for various building types (hospitals, schools, offices, retail) for its design community.

As was the case in the residential sector, the next step in the evolution of energy-efficiency programs for the commercial/industrial sector was to move from consumer education to site-based technical assistance. In one of these early programs, Northeast Utilities (NU) provided free, site-specific, hourly computer simulations to architects and engineering firms. The response from the design community was lukewarm at best. NU found that many architects and engineers did not care about energy efficiency; several participants did not trust the computer modeling; and even if they did, the results were often obtained too late in the process to allow for design changes.

Commercial and industrial programs that provided education and training also gave way to energy audits in these sectors. The Bonneville Power Administration's mid-80s Commercial Audit Program (CAP) conducted 3,800 audits, however, only 8 percent of the recommended measures were actually installed. The Commercial Incentives Pilot Program, which followed CAP, built on these lessons to successfully produce evaluation-verified commercial retrofit savings. Other utilities, such as United Illuminating, LILCO, SMUD, Consolidated Edison and Northern States Power, have experienced higher measure adoption rates than Bonneville has with CAP. The degree to which participants implemented audit recommendations depended on incentives and technical support in post-audit follow up. The highest rates of measure adoption were those where audits were provided free of charge to customers, and financial incentives (e.g., rebates and grants) also were offered.

At the same time that Northeast Utilities and others were offering site-specific information and rebate programs to their commercial and industrial customers, Bonneville sponsored its Northwest regional Energy Edge competition to design and construct new commercial buildings at levels 30 percent more efficient than the model conservation standards adopted by the Northwest Power Planning Council. This research and demonstration project challenged the Northwest design community to build some of the most energy-efficient structures in the country.

One objective of Energy Edge was to remove key barriers for building owners and developers, including increased first costs, lack of experience with energy-efficient technologies and construction schedule constraints. All participants in the program received detailed design assistance and extensive modeling of their buildings' potential energy use. They also received financial incentives to cover the incremental cost of design, time and equipment. In addition, Energy Edge began to look at the ongoing operation, maintenance and monitoring of buildings to provide information for modeling and to evaluate the quality of measure installation, the degree of acceptance and effectiveness of operation.

Wisconsin Electric initiated its Smart Money Program for commercial and industrial new construction in 1987 by contacting design team members directly. The program initially offered equipment rebates and technical assistance. Although the program was successful among large-use customers, participation from small-use customers remained slow. In 1989, Wisconsin Electric designed a new direct rebate program, distributing information and simplified applications to customers at the point of sale. After 15 months of operation, the program had achieved savings totaling 0.2 percent of the utility's peak demand (Nadel 1990).

The need for more energy resources in the Northeast, combined with increased regulatory and intervenor pressure, mandated a critical change in utility-offered energy-efficiency programs in that region. In early 1988, several New England collaboratives were formed to design the first full-scale conservation acquisition programs targeting "lost opportunities" (i.e., conservation opportunities that if not secured immediately will become technically, economically and/or institutionally impossible to achieve later) in the residential, commercial and industrial sectors.

As a result of Northeast Utilities' work with a collaborative, a new program, Energy Conscious Construction, was introduced in October 1988. Drawing on the experiences learned in Bonneville's Energy Edge program, financial incentives were offered to designers and building owners for designing, specifying and installing energy-efficient measures in new buildings.

Today, Energy Conscious Construction is recognized as one of the most comprehensive and successful programs in the nation. As of March 1992, the program has 753 signed contracts with over $17 million of obligated design and construction incentives. These 753 contracts represent 25.2 million square feet of floor space in Northeast Utilities' service territory. The average incentive is 68 cents per square foot. Out of the 753 signed contracts, approximately 350 have been built.

An example in the industrial sector is the Energy Savings Plan (ESP) piloted by Bonneville in 1988. After review and redesign, the program was marketed in August 1990 and has served 175 projects as of June 1992. As in commercial incentive programs, payment is based on incremental cost for new facilities and on 80 percent of total cost for retrofit of existing facilities. Bonneville expects to save 7 megawatts through this single program in 1992, with anticipated savings of 140 megawatts by the year 2003.

Like Energy Edge, the Advanced Customer Technology Test ($ACT^2$) project was conceived as a design challenge. Intended to achieve 1,550 megawatts of savings by the year 2000, $ACT^2$ is managed by Pacific Gas and Electric Company in affiliation with the Lawrence Berkeley Laboratory, the Natural Resources Defense Council, and the Rocky Mountain Institute. The project's objective is to "provide scientific field test information on the maximum energy savings possible, at or below projected competitive costs, by using modern high-efficiency end-use technologies in integrated packages acceptable to the customer" (PG&E 1990).

Five firms were chosen, and compensated, to complete pilot plans for a new commercial construction site. The best design was selected by a panel of architects, engineers and energy-efficiency experts. In addition to completing the initial building, the program plan has now been completed. Thirty-five site types, representing 14 residential, 13 commercial, 4 agricultural and 4 industrial sites, will be scheduled for implementation by the end of 1993 (PG&E 1991).

Shared savings programs also are used by utilities. In Portland, Oregon, the Pacific Power and Light Company, through its Energy FinAnswer program, offers design assistance and pays the incremental cost for installed energy-efficient equipment. Pacific finances the cost of all measures that meet the utility's cost-effectiveness criteria, charging prime interest rates. Pacific will also lend the customer additional funds at a higher interest rate for additional conservation measures the customer desires. Customers repay Pacific through an energy service charge included on their monthly bills. The duration of the loan is negotiated.

The newest utility demand-side management strategies support the implementation of all cost-effective efficiency measures. Programs based on these strategies typically target a particular customer-market (e.g., owner-occupied, large office buildings) and emphasize service delivery along with energy-efficiency acquisition rather than prescribing any one specific technology. Many of these aggressive programs pay the full cost of all measures, especially those considered lost-opportunities and those that go beyond current practice. As experience with programs of this scope grows, there will no doubt be further fine tuning to ensure their cost-effectiveness. Suggestions for these refinements are covered later in this paper.

Two issues that emerged from commercial sector programs have been concerns about whether the installed equipment operates properly and whether the equipment is maintained. For example, Bonneville's Energy Edge Program was designed to provide participants with operation and maintenance audits every six months for three years, although actual frequency of the audits varied by sponsor and building. The 80 audits that were performed revealed a variety of problems ranging from faulty installation to improper calibration of the controls.

Today, most comprehensive utility programs are at least requiring that an operation and maintenance manual be made available onsite, and that building operators be trained in the proper operation and maintenance of all installed energy-efficiency measures. Some utilities are offering higher levels of financial assistance if buildings participating in their programs are placed under an energy management operation and maintenance contract.

Commercial sector programs are also now beginning to "commission" both buildings and equipment. Commissioning includes specifying how the building and equipment are expected to work and following up with tests, metering and inspections to verify that the systems are working. Pacific Power for example, included a building commissioning function, as well as operation and maintenance elements, in its Energy FinAnswer program.

In 1990, Bonneville issued draft commissioning guidelines (PECI 1991) for its Energy Smart Design program. These guidelines are being tested and refined. The Los Angeles Department of Water and Power also is requiring and paying its commercial program participants to commission energy-efficient equipment and controls.

## Private Sector Actions

In response to government and utility conservation initiatives, the private sector also has taken on demand-side management activities. For example, in the residential sector, several entities have developed "home energy rating systems" so homebuyers can make more informed decisions regarding the efficiency of houses they purchase. In the commercial sector, load-management cooperatives have been established to take advantage of utility time-of-day rates. The three most important private sector conservation efforts have been the development of national energy-efficiency building standards, the rapid expansion of the energy service industry and the development of more efficient products, particularly in lighting.

In the mid-1970s, the American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE) issued its first recommendations for energy conserving design of new buildings. These design guidelines served as the basis for the development of the Council of American Building Officials (CABO) Model Energy Code and for the development of other state and local energy codes. Since 1975, ASHRAE has been updating its recommendations for energy conserving design. The most recent version was adopted in 1989, for non-residential buildings. New standards for residential buildings are pending. The ASHRAE standards and CABO energy codes serve a valuable role by setting the base line against which local building practice and utility programs can be measured. However, because these are "consensus" standards, they do not necessarily represent the level of energy efficiency that would be economically justified from consumers' or utilities' perspectives.

The second most important private sector contribution to energy conservation has been the development of an energy service industry. While the energy service industry is hardly mature, after a rocky start, it is becoming increasingly sophisticated and capable. As utility demand-side management activities continued to expand in the late 80s, energy service companies (ESCOs) became major players in utility competitive bidding resource opportunities. Many of these companies now offer a range of services from energy engineering to financing.

The third most important private sector response to government, utility and individual actions favoring conservation was to bring to commercial availability more energy-efficient products. This includes the development of compact fluorescent lighting, electronic ballasts, energy management systems with direct digital controls, significantly more efficient refrigerators and freezers, substantially more efficient HVAC equipment, and glazing technologies with superior insulating and solar control capabilities. The existence of these and other advanced technologies offers opportunities for conservation that did not exist five years ago.

One private sector response that *was not* forthcoming was the creation of an education and training infrastructure to supply qualified personnel for demand-side management activities. Given the rising and falling nature of expenditures for demand-side management programs in the past, the absence of such an infrastructure is somewhat understandable. But some utilities are now co-sponsoring the development of educational curricula and training programs for personnel in energy-efficiency fields. For example, California utilities, working with the California Energy Commission, the Illuminating Engineering Society of North America and the state's post-secondary educational system, have developed a multilevel program for lighting designers.

## How Do We Expect Future Energy Conservation Policies and Programs to Evolve?

Over the past two decades, government actions aimed at transforming an energy-inefficient economy into an efficient one have concentrated on measures that were cost-effective only from the consumer's perspective or were politically acceptable compromises. Rarely have government actions captured all of the savings that are cost-effective from the servicing utility's perspective, let alone from society's broader perspective, considering environmental consequences of other resources developed in the absence of efficiencies. While government endeavors have often targeted market transformations, such as more efficient appliances through national standards, in most cases, they have not resulted in a least-cost energy supply.

Programs designed by utilities, unlike those initiated by government, were not explicitly designed to secure transformation of a market. Instead, the bulk of utility programs were designed to secure efficiency improvements one building at a time. Moreover, with a few notable exceptions, utility conservation efforts were not coordinated with government actions, nor were they coordinated with the programs of other utilities.

Peering into the next decade we ask ourselves, "Can we achieve the demand-side management targets we've set using the same approaches that government and utilities have adopted during the last decade?"[3] We considered the likelihood of governments adopting regulations (i.e., energy codes and standards) based on efficiency levels that were cost-effective for society rather than just politically acceptable. We considered the labor intensity of current conservation programs vis-a-vis the willingness and/or ability of utilities and government entities to staff up to do the job. We considered the competition for qualified private sector contractors to carry out conservation projects when the level of activity expands $2 billion-per-year utility investment to a national industry spending $30 billion a year. We considered the nation's ability to effectively manage the immense logistical problem (and potential economic boon) embodied in the deployment of millions of energy-efficient products, ranging from faucet aerators to variable speed industrial motors.

Pondering these issues, it was apparent to us that an alternative to the site-by-site, unit-by-unit strategy of acquiring demand-side resources would have to be found if we were to ever meet our targets. The paradigm we were drawn to is based on deliberate coordination of government and utility efforts to bring about market transformation at the wholesale level. We also concluded that existing programs, with some additions and modifications, will continue to play a critical role in achieving conservation targets in those market segments that are not subject to transformation.

Let's turn first to opportunities utilities have to influence the energy efficiency of new appliances, equipment and buildings. In our view, these markets are the most susceptible to transformation. Furthermore, because these markets represent lost-opportunity resources, securing cost-effective efficiency gains from them should be pursued regardless of the current resource needs of a utility. Utilities can acquire energy-efficiency improvements in new appliances, equipment and buildings at lower costs than they would have to pay for new supply resources. By adopting a deliberate strategy of spending more on new efficiency technologies and designs than would be economical for individual consumers, a utility can rapidly and effectively transform both manufacturing and design markets. Consider the following three examples:

## Transformation of a Product by Coordinated Purchases

Nationally, the single largest use of electricity in the residential sector is refrigeration. In 1987, Congress adopted the National Appliance Energy Conservation Act, which set minimum efficiency requirements for residential refrigerators and freezers, as well as for other appliances. The standards adopted for refrigerators, in the view of some, do not begin to capture the technically achievable savings. Nor do they promote the adoption of technologies that reduce the use of gases which contribute to both the greenhouse effect and perforations in the earth's ozone layer.

To capture the potential conservation savings and environmental benefits of advanced refrigeration technologies, a consortium of utilities, government agencies and environmental organizations, the Consortium for Energy Efficiency, has established the Super Efficient Refrigerator Program (SERP). The objective of this program is to make commercially available by 1995 a refrigerator that is at least 30 percent more efficient than the National Appliance Energy Conservation Act's standards for 1993.

There are four components to the SERP strategy. First, utilities servicing a significant share of a particular product market specify the minimum levels of efficiency they want that product to meet in their service territory. Second, these utilities co-sponsor testing and development of a commercial prototype that will lead to the commercialization of the efficient product. Manufacturers wishing to participate in this research are asked to competitively bid their proposed approaches. Third, the utilities agree to purchase directly from participating manufacturers (based on the incremental savings from the product) a sufficient quantity of the product to warrant re-tooling by the manufacturers. The final, and perhaps most important, element of this market transformation strategy is to make use of the resultant commercial availability and market acceptance of the more efficient product as evidence that a more stringent federal standard should be adopted.

During the coming decade, the approach adopted by SERP should be applied to other products, in particular, those that represent significant energy use and which are, or could be, subject to federal standards. The most likely candidates are residential appliances covered by the National Appliance Energy Conservation Act and commercial space-conditioning equipment not covered by that legislation. For example, efforts are under way to establish a SERP-like program for rooftop air conditioners and heat pumps for commercial buildings.

However, because the federal appliance efficiency standards are based on consumer economics, it is possible that even revised standards may not capture all energy savings that would be cost-effective to utilities. Therefore, short-term payments to manufacturers, such as those offered under SERP or similar programs, should evolve into long-term contracts for acquisition from the product manufacturers of any savings that remain cost-effective beyond the federal standards. To accomplish this, the Consortium for Energy Efficiency should expand to include additional utilities, and the group should begin developing efficiency targets for other appliances and equipment.

## Transformation of Building Practice Through Coordination of Utility Programs and Government Actions

The potential to secure market transformation through the use of coordinated government actions and utility programs has already been demonstrated. When the Northwest Power Planning Council adopted its first regional power plan in 1983, it called upon the Northwest's state and local governments, the Bonneville Power Administration and utilities to initiate two programs whose goal was to dramatically change residential building practices. One program, the Northwest Energy Code program, was designed to encourage state and local governments to adopt substantially more-efficient energy codes. The second program was a utility marketing program (Super GOOD CENTS) to encourage builders to voluntarily adopt energy-efficient building practices.

The two programs were designed to complement one another. Where there were opportunities that made it possible to adopt the new standards as a local energy code, they could be seized. Where individual builders or buyers wanted to build to the new standard, they could do so with the assistance of their utility. Under both the code adoption program and the utility marketing program, payments were made to the homebuyer to cover some of the increased cost of building to the higher levels of energy efficiency. Utilities also covered increased building code enforcement costs for local governments.

As a result of these two programs, approximately 85 percent of the new electrically heated, single-family residential construction and 90 percent of the new electrically heated multifamily construction in the Northwest is now covered by energy codes that reduce space heating requirements by more than half of what they are in houses built to codes in 1983. This market transformation was accomplished in less than six years (Nadel 1992).

This approach is applicable to other areas of the country. It is also applicable to new commercial buildings. However, this strategy has been accused of paying for "free riders." Some participants would have built an energy conserving home with many of the measures called for in the program standards whether the program existed or not. Because the primary objective of the program is long-term market transformation rather than just immediate acquisition of savings, participation by the "already converted" should be tolerated. Before it is feasible to adopt statewide energy codes rigorous enough to reduce space heating energy requirements by more than half, the building industry has to gain familiarity with the techniques and products needed to achieve such savings. Because of these programs, roughly 25 percent of new electrically heated Northwest homes were already being built to the standards when the standards were adopted as codes.

Market transformation of site-built housing through the use of better codes and utility programs might be made even more effective if existing market players can be induced to cooperate in the effort.[4] For example, utilities could help provide more attractive financing for buyers of energy-efficient properties if they pooled program dollars to "buy down" interest rates for homes or commercial buildings that meet certain energy-efficiency standards. This would make energy-efficient properties more affordable, while encouraging the existing financial community to market the availability of these lower interest loans, potentially reducing the need for utility marketing efforts.

## Transformation of a Market Through Consortia Contracting

A third model for market transformation is similar to the SERP model. This model would result in the direct "wholesale" acquisition of energy savings from manufacturers. This model is based on the Manufactured Housing Acquisition Program in the Northwest. The energy-efficiency standards of new manufactured homes (i.e., mobile homes) are set by the U.S. Department of Housing and Urban Development (HUD). State and local governments are explicitly prohibited from imposing more stringent building requirements on manufactured homes regulated by HUD.

To overcome this problem, utilities in the Northwest formed a consortia to buy the energy savings available in new manufactured housing by contracting directly with the manufacturers. After about a year of negotiations, the utilities and the region's 18 producers of manufactured housing entered into a four-year contract to build all electrically heated manufactured homes destined for Northwest sites to the most energy conserving levels in the country.

The first step in the process was taken by the Bonneville Power Administration when it established a research, development and demonstration program for new residential construction. Under this program, approximately 150 new manufactured homes were built and sited throughout the region. The cost of adding the extra energy conservation features to these homes was covered by Bonneville. The homes' space and water heating usage was then metered for at least one full heating season (Baylon 1991). Based on cost data (provided by manufacturers) and energy consumption data (collected by the Washington State Energy Office for Bonneville), "product specifications" that achieved all cost-effective energy savings were established.[5]

Once program specifications were designed, the manufacturers worked with personnel from the state energy offices (under contract to Bonneville and the utilities) to devise an approach to meeting the specifications with the minimum disruption in production processes and at the lowest possible cost. The manufacturers and state staff also provided direct feedback to the utilities regarding issues that would arise when the program scaled up from 25-percent market penetration to 100-percent penetration.

The third element in the implementation of the manufactured housing acquisition program was the use of the existing quality assurance system. Each manufacturer has an independent state inspector in the plant as well as their own quality assurance inspectors. The utilities agreed to pay for the incremental cost of a more rigorous energy inspection by the existing independent inspector. And manufacturers agreed to contract terms that held them financially liable for meeting the product specifications.

The fourth element in the process was the implementation of an earlier consumer marketing and incentive program (Super GOOD CENTS), which established the market acceptability of efficient homes to consumers and the financial community. A final element in the strategy was the adoption and/or threat of adoption of hookup fees by utilities for homes that did not meet specific energy conservation standards. Consumers were offered rebates if they selected a home with the energy conservation features.

This model of direct acquisition of energy savings from manufactured housing, like the SERP model, clearly has the potential for broader application. The elements that appear most critical to these models' success appear to be: 1) the magnitude of the market, 2) the existence of a single contracting entity or "broker," and 3) the ability to negotiate with a limited number of potential suppliers/ distributors. For example, to implement the manufactured housing program in the Northwest, nearly all of the region's utilities had to agree to participate so that wherever the unit was sited in the region, Bonneville (the contracting entity) could be reimbursed by the servicing utility for payments it had already made to the manufacturers when the home was completed at the factory. Investor-owned utility participation in the program was contingent upon approval by the regulatory commissions in each state. Consequently, the Northwest's four public utility commissions had to agree that the program was cost-effective.

In the case of SERP, enough utilities must participate to ensure that the market for the efficient refrigerator is significantly large to justify the investments in re-tooling by manufacturers. Similar approaches to secure more efficient HVAC equipment, more efficient motors, better lighting controls, or more efficient chain stores and franchises will require research to define how these market segments are organized and where the leverage points in each market are located. With that information, utility and government "purchasing" contracts can be aggregated at a scale to match the market. For example, if a chain has stores located in three states, then utilities in those three states should join together to secure a single-source energy savings purchase from the chain.

## Demand-Side Management: The Next Generation

Even though the current generation of demand-side management programs has evolved from information and education to acquisition, many still fail to treat conservation as a resource acquisition from a management and budgeting perspective. These programs need to be refined to:

- Minimize costs by coordinating the timing of resource needs, market opportunities and conservation purchases.
- Take steps to ensure that all least-cost resources are acquired.
- Integrate efficient management with efficient quality control.
- Maximize effectiveness by designing marketing campaigns around the targeted markets and delivery mechanisms, not around utility infrastructure.

Each of these points is discussed below.

### Minimize Costs by Coordinating the Timing of Resource Needs, Market Opportunities and Conservation Purchases

*Capture Lost-Opportunities First.* The first principle of wise resource acquisition is to seek out those conservation opportunities that will occur only once, or once in a long time, and make them the top priority. Such opportunities occur when new homes, buildings and facilities are constructed or expanded, when new energy-using equipment is manufactured, and when equipment is replaced during renovation, retooling, planned maintenance, or unplanned replacement due to equipment failure. During these events, energy users are already going to make some investment in new equipment, so the "base" cost for new equipment is covered. All that is at issue is the "incremental" cost for added efficiency.

Most conservation programs have focused either on upgrading the efficiency of equipment without regard to when the equipment would have been replaced or enhanced, or on new construction. Recent studies (Katz et al. 1989, Skumatz et al. 1991, Brandis 1992) have shown that, in addition to being more expensive, this "catch-as-catch-can" approach may result in premature removal of efficient equipment during the next remodel or tenant change.

The next generation of demand-side management programs should: 1) work directly with manufacturers or vendors to influence existing transactions, not create new sales; 2) offer incentives to affect existing sales, not create new ones; and 3) provide promotional and technical assistance activities that are geared also to impact existing transactions.

Examples of this next generation of demand-side management programs include commercial and industrial remodeling and equipment replacement programs at Green Mountain Power and those being developed at Northeast Utilities, the New England Electric System, Boston Edison and many other utilities. These programs attempt to build alliances with trade allies selling different types of equipment and services (e.g., motor vendors, drive system vendors, lighting contractors), so the utilities can intervene at different places in the sales chain where key decisions are made. For example, in some regions, high-intensity discharge (HID) lighting is distributed by wholesale representatives. To incorporate HID lighting in conservation programs, utilities should work with manufacturer's representatives. For some types of remodeling, it's important to work with lighting designers.

Sometimes unique local opportunities can be the focus of special efforts. For example, new requirements for new fire sprinkler systems in Los Angeles' buildings are triggering a series of structure upgrades that is providing a fulcrum for a special comprehensive energy-efficiency program.

The most significant management implication of this resource timing approach is that budgets must be large enough to capture all available lost-opportunity resources.

*Schedule Retrofit Acquisitions to Meet Remaining Resource Needs.* Once programs to capture lost opportunities are in full gear, efforts to acquire additional resources should be timed to ensure that all cost-effective resources are acquired as they are needed. As the need for more resources becomes immanent and clear, retrofit programs can be accelerated. But conservation program lead times vary depending on the market segments, so some experience in each segment is necessary to project program timing. Small commercial and industrial retrofits, for example, require a long lead time. This market typically involves a large number of customers, but the savings from each site are small. It could take a large utility many years to saturate this market. Furthermore, there are only a few examples of successful, large-volume, comprehensive programs for this market (e.g., New England Electric). Consequently, it may take a utility a few years to perfect an approach.

Residential weatherization programs tend to have shorter lead times largely because there are proven procedures for running this type of program. However, for markets involving hundreds of thousands of customers, it will still take many years to get the job done.

If significant energy savings are needed in five to eight years, it is clear that utilities will need to move quickly on all fronts, since it will take longer than five to eight years to design and implement conservation programs. Programs targeted at acquiring large amounts of energy savings from larger consumers should be given top priority. Programs targeted at large-use customers can also be justified if there is a need to demonstrate early, large, visible successes to create local credibility for conservation as a resource. However, for utilities with a decade or more before new resources are needed, once program concepts are tested, the priorities should be: 1) lost opportunities; 2) slower and more difficult markets; and 3) big, easy, quick opportunities that can be picked up later.

## Take Steps to Ensure That all Least-Cost Resources Are Acquired

*Use Market Forces, But Guide Them.* If there is a significant need for resources, it is likely that all energy savings costing less than new supply options will be needed. Some utilities and agencies have made the mistake of using competitive mechanisms (all resource bidding, etc.) to bring them the least expensive resources. This may provide a least-cost acquisition for this year, but it could result in higher resource costs over the next several years. What these utilities really need is the least expensive delivery vehicle to acquire all cost-effective resources.

Competitive resource bidding encourages deliverers to provide the resources that can be secured at the lowest cost today. This can involve cheap products that break down quickly. It can also result in "opportunity sabotage," i.e., the installation of measures that get only a portion of the available savings, while rendering it uneconomical to get the remainder. For example, a low bidder may install six inches of insulation in a house attic where 12 inches are cost-effective. Because it will require a second visit to install the second six inches, the savings from the second six inches of insulation are no longer economical. A generating resource must be acquired at a higher cost than the cost of putting in the second six inches on the first visit. In the commercial sector, a frequent example of opportunity sabotage occurs when contractors install efficient bulbs and ballasts in a fixture where it is more cost-effective to totally redesign the lighting layout.

In addition to bidding programs, opportunity sabotage often results from rebate programs where utilities pay for equipment without analyzing whether it is the best equipment available. Under many rebate programs, contractors profit most from installing the highest volume of equipment. This leads them to promote measures that require minimal analysis and customer contribution, and are easiest to install. These are often not the measures that provide the most savings.

Instead, utility staff or contractors should specify their optimum treatment, then call for bids for hardware, installation and upkeep. This is most difficult to do for new buildings, new equipment and equipment replacement programs, where there is very little time to influence equipment selection.

However, as discussed earlier, these markets can be transformed. In the case of retrofit programs, where the transaction is driven by the utility, not the market, there is time to analyze alternatives and pick the retrofit that has the biggest impact on overall utility resource costs by offering the most savings. Even some equipment replacement markets provide this opportunity. Renovations and planned replacements of HVAC equipment often involve a design process where analysis of alternatives is feasible and useful.

*Plan to Reach a Diversity of Markets.* Many utilities are also failing to capture all resources because they do not understand their customers' diverse needs. A series of studies at the Bonneville Power Administration has identified four distinct commercial conservation markets with different needs: 1) active customers, who need programs that enhance their own conservation efforts; 2) centralized customers, who need programs that work across utility service territories; 3) middle markets, who need a variety of individualized services, but can contribute to conservation investments; and 4) disengaged consumers, who need the utility to do everything for them and pay for everything (Gordon 1986). Utilities need to undertake market research to identify customers with different informational, incentive and marketing needs, and test approaches that are effective in reaching these new groups.

The four customer markets Bonneville identified can be juxtaposed against the different building life-cycle opportunities, such as new construction, building expansion and remodeling, etc., to create a matrix of market needs. Programs must address each of these sets of needs, or significant markets will be lost, and total savings will decrease. There is often a need to differentiate programs to meet the need of diverse consumers while minimizing utility incentives and overhead costs. For example, the New England Electric System pays the full cost of measures for small commercial and industrial customers, but not for others. Many utilities pay higher incentives for low-income consumers. Higher program participation is usually associated with approaches that use direct contact with the key decision-makers in each customer organization, supported by a package of materials and services suitable to the needs of each customer group.

## Integrate Effective Management with Efficient Quality Control

*Work with Existing Market Mechanisms, Then Pick Up the Pieces They Leave.* Utilities tend to design efficiency programs that enable them to work directly with their retail customers. This approach parallels their traditional utility operations and is compatible with their non-conservation marketing needs. However, this approach isn't always effective because it doesn't utilize existing delivery systems. Sometimes the more sensible way to impact a market is through wholesalers (e.g., the manufactured homes program discussed above, or the program for refrigerators). Often the most effective tools to influence equipment selection are controlled by others. For example, local and state governments control building codes. Vendors have the greatest impact on choices of equipment.

A key precept of effective marketing for future demand-side management programs is to *find* the market instead of creating it. The programs noted above do this by working with the trade allies influencing sales of different equipment. Utility programs that support efficient building codes do this by working with those individuals with the authority to influence building design who are already working with builders and visiting buildings (code officials).

At the same time, it's important to recognize what these market-driven approaches *will not* achieve. As noted earlier, building codes rarely capture all cost-effective savings; they are too often political rather than economic choices. Vendors will always leave some conservation opportunities undone because, for them, conservation will always be a side business; equipment sales are primary. So, once utilities work as much as possible with primary market mechanisms, they need to develop programs that focus on the remaining pieces. For example, retrofit programs can be operated to make the existing stock of homes missed by manufactured housing programs more efficient.

***Accept the Importance of Quality Control, Then Organize Programs to Minimize Its Cost.*** Energy savings must be comprehensive, cost-effective and persistent to meet the needs of consumers. They should also minimize environmental impacts and play a role in long-term market transformation. Meeting these goals requires good designs, selection of quality materials, careful installation and conscientious upkeep. These elements inevitably increase the cost and complexity of conservation programs (Gordon 1986).

In addition to the commissioning activities noted earlier, utilities are exploring two paths to ensure effective conservation quality and persistence of savings: verification and implementation management. The verification path involves payment only for measured savings. For example, programs at Bonneville, Boston Edison, the New England Electric System and elsewhere have paid for savings only after they have been verified via load measurements.

At least four problems have arisen regarding verification of savings. The first is that verification is difficult, and becomes even more so as the time between measure installation and savings verification increases. Building-level metering often does not isolate the effects of efficiency measures caused by changes in weather, in building use, or in other equipment in the building. End-use submetering can isolate equipment, but tends to miss interactive effects (e.g., impact of lighting efficiency on cooling and heating loads), and, although lower in cost than five years ago, submetering is still too expensive for many measures. Furthermore, even submetering often cannot isolate efficiency measure impacts among a plethora of load influences. (Diamond 1990) On-site verification also does not account for whether the change would have occurred without utility intervention (whether it was a free rider). While free riders may signal market transformation, utilities benefit more when they do not have to pay for them.

The second problem with paying only for measured, or verified, savings is that it can take years to verify savings. Because most consumers and energy service firms must pay a higher interest than utilities to secure the money to complete installations, and utilities reimburse these contractors at the interest rate the contractors must pay, it is costly for utilities to carry finance charges while they await verification. The interest cost to the utility can be massive.

A third problem comes with the fact that most energy service firms won't even consider payments that extend over a 10- to 20-year period for energy savings. Instead, utilities that pay over time do so for no more than 10 years. If the energy savings are supposed to have a 20-year lifespan, and the utility has agreed to pay for it in the first 10 years, there is a risk that the savings may not persist, even though they are already paid for.

The fourth problem with the verification path is that the utility, if it surrenders detailed oversight in favor of paying only for performance, is likely to lose significant control over the goals of comprehensiveness, customer satisfaction and environmental impacts. While control over these factors can be built into a verification plan, this increases costs substantially.

The alternative path, that of implementation management, involves careful conservation analysis (energy audits), selection of quality measures, and installations and provisions to help consumers commission, operate and maintain the measures. This path has its own problems. Oversight must not become so cumbersome that it makes program marketing difficult or impairs program cost-effectiveness. For example, programs that involve either small buildings or small savings per site can tolerate only a limited budget for analysis. Even for large buildings, there has been a tendency in energy analysis to use expensive computer simulation instead of simpler analysis and direct-spot measurements. This is because program administrators tend to prescribe simulations everywhere, analysts rely on simulation so they can appear to be up-to-date, and novices mask their inexperience behind the mystique of the computer model. Unfortunately, real-world experience in buildings is even more important for using complex models than for using simple hand calculations.

More sophisticated utilities have designed analysis standards that, instead of requiring the same levels of analysis for all buildings, allow custom specification of analysis. For example, both Green Mountain Power's Vermont Energy Partners Program and New England Electric's Commercial and Industrial Comprehensive Pilot Project use building-specific walk-throughs to specify the technical requirements and budgets for large buildings. Other utilities, including Bonneville, have established simple "dipstick" methods for selecting measures for weatherization of existing homes. An important aspect of these simplified methods is that they are being applied selectively, and are in most cases rigorously evaluated.

Several smaller utilities are joining forces to reduce the cost of quality control and make it possible to employ sophisticated approaches. For example, several Washington State Public Utility Districts have banded together to form the Conservation and Renewable Energy System (CARES), an effort through the State Public Utility District Association to share program design and administration. Similar efforts are emerging elsewhere.

As noted earlier, quality control also is challenged when contractors are left to specify which measures will be installed. Contractors will naturally specify the measures with the largest profit margin for them. For situations where there is time for the utility or another contractor to select measures, installation contractors should not be specifying the measures and performing technical reviews. For example, Green Mountain Power's Vermont Energy Partners Program utilizes a quality control contractor ("energy agent") to establish the scope of energy analysis and perform quality control. A separate contractor performs the analysis and recommends the measures. A third contractor is selected, usually through a bidding process, to install the measures under the "energy agent's" review. This system minimizes the need for utility staffing while ensuring a high-quality, low-cost job. Simplified procedures are used in smaller buildings where the three-contractor system is too expensive.

*Evaluations Must Address the Questions of Policy-Makers and the Goals of Market Transformation.* The two classic tools of conservation program evaluation are the process evaluation and the impact evaluation. Today's process evaluations are designed to assess the effectiveness of the program's administration. To provide more comprehensive program understanding, tomorrow's process evaluations should also review the program's effect on specific market segments (e.g., leased buildings) and on the technical processes involved in the program (e.g., did the audit recommend the optimal strategy and provide reasonable savings estimates).

Similarly, today's impact evaluations provide an estimate of the overall energy savings from a program. In the future, impact evaluation techniques should also explain, to the extent and level of precision budget and methods allow, how the savings were secured and whether programs that are not cost-effective can be improved. Policy-makers are beginning to insist on answers to these more difficult questions.

The evolution of program evaluation in the future should include analysis of market transformations, verification (which was addressed in the previous section), technical process evaluations and evaluation of technologies.

Evaluation of market transformations. Traditionally, any efficiency improvements among non-participants (beyond fluctuations in load due to factors such as weather) are believed to indicate the free rider portion of the savings of program participants. But since conservation programs have existed long enough to begin to transform markets, it has become clear that some of the conservation actions of non-participants have also been driven by conservation programs. Thus, control group savings may be "free drivers," savings the utility influenced without directly paying for. It is very difficult for program evaluators to discern the difference between free riders and free drivers with any precision or certainty. Consequently, as markets are transformed, it will be important to gauge when certain efficiency levels are attained in the market in order to focus incentives at the appropriate levels of additional efficiency beyond what the market is providing. Evaluation of market transformation requires patience. Detailed feedback on technical and market success is important to provide "guideposts," while the likely impact of programs on markets is being assessed.

Another important aspect of evaluation of the market transformation is to have a good framework for assessing which markets are affected and the amount of the markets that have been reached. Evaluations need to look beyond program data to synthesize information about the overall size of markets. Utilities need to do base-line studies to make this sort of evaluation feasible.

Technical process evaluations. For technically complex programs, some of the best engineering information has come from design reviews, site visits and other activities that sought to assess the adequacy of the technical advice, the quality of measures and installation, and the operation and maintenance of the equipment. This type of information is not generally disclosed in evaluation interviews. It is worth the significant additional cost to incorporate such technical reviews in evaluations. Technical findings can be used to pinpoint which equipment to install in which types of buildings, what levels of service are needed, and how to improve performance of contractors and staff.

Evaluation of technologies. Sometimes the best engineering leads to poor matches between equipment and buildings because there isn't enough information about how specific equipment performs in specific environments. For example, if a variable speed drive motor is installed in a situation where loads are constant, savings won't materialize. Utilities have been hesitant to begin load research projects to address such questions comprehensively because there is too broad a diversity of equipment and applications. Work that was done was based on the interests of specific researchers. It often left unanswered the most important questions from the perspective of overall utility resources.

However, some utilities are beginning to systematically identify and seek answers for equipment performance questions that are most important to their overall resource acquisition efforts. Boston Edison has embarked on studies to identify which technologies are most critical to the future of their programs and which uncertainties about costs and savings from those technologies are equally important. Next, they intend to assess whether others have addressed these questions already, and whether a finite load research effort is likely to produce results that can be generalized to other sites. Instead of studying broad categories of equipment, the resulting studies are expected to focus on the most common types of settings for equipment (e.g., office floor area for lighting). The hope is that, by focusing on settings, variance between sites is reduced sufficiently to make meaningful research possible without a huge sample. Several other utilities are considering similar studies, and are also assessing ways to reduce overlap and spread the questions among utilities to cover a broader range of technologies.

A middle ground between aggregate program evaluations and specific technology evaluations is being explored by many evaluators who are using multivariate statistical techniques to attempt to differentiate savings among various program subpopulations. While these techniques are still in the developmental stage, they have the potential for beginning to address more detailed questions about why the savings and costs for programs are as indicated.

Many of these new evaluation directions are interdependent; good process evaluations now can synthesize results of technical reviews to assess the overall technical and administrative direction of programs. It is becoming increasingly important to view evaluations less as a series of discrete studies and more as an integrated process/impact/engineering package. One important need is to extend evaluation further into the realm of government programs. While evaluations of government-sponsored retrofit programs for institutions and low-income customers have occurred, evaluations of government technical assistance, research and regulatory efforts have been far less common.

## Summary and Conclusions

Governmental sector actions to promote energy conservation have established, through regulatory change, the minimum efficiency that new buildings, appliances and equipment must achieve. Utility sector initiatives to encourage adoption of more energy-efficient technologies have evolved from supplying consumers with information to supplying them with sophisticated technical help and all or a portion of the funds to take efficiency actions. Utilities have come to see these demand-side investments as preferred alternatives to spending those funds on new, more expensive and less environmentally acceptable supply options. The private sector has responded to the demand for more energy services and products by establishing energy service companies and advanced technologies.

To improve our ability to meet our conservation goals, the next generation of demand-side policies and programs must focus on the transformation of entire market segments while tailoring programs to meet the specific needs of those markets not amenable to transformation. The following summarizes the authors' recommendations for the design, management and evaluation of the next generation of demand-side management programs. It also sets forth guidelines for governmental policies that could facilitate utility demand-side management initiatives.

### Guidelines for Designing the Next Generation of Demand-Side Management Programs

Market transformation programs should be designed to make use of existing infrastructures (manufacturing, distribution and delivery) wherever practical; i.e., we should build bridges not bureaucracies. Acquisition of energy efficiency from manufacturers and distributors of major energy-consuming appliances and other products should be approached by utility consortia following the SERP and manufactured housing program models (linking utilities with key markets, e.g., chains and franchises, multisite industrial, motors, lighting equipment, etc.). The private sector needs to target its efficiency improvements at market segments that are not targeted by utility or government actions. The private sector will go where the profits are, so utilities need to work with customers to help make energy management profitable, and with contractors to make high-quality energy service profitable. To avoid "opportunity sabotage," particularly in competitive bidding and contractor-driven rebate programs, utilities should specify the demand-side measures, then call for bids for hardware, installation and upkeep. Quality control mechanisms, such as building commissioning and operation and maintenance requirements, should be inherent in program designs rather than imposed after-the-fact.

## Guidelines for Managing the Next Generation of Demand-Side Management Programs

Conservation acquisitions should be scheduled so that the type and pace of acquisitions can be matched to the resource needs of the utility and to minimize costs by taking advantage of market opportunities when they occur. Programs that acquire cost-effective lost-opportunity resources should receive top priority and should be budgeted on the level of new construction and major remodel/renovation activity. Programs that acquire efficiency improvements that can be deferred when a utility is in resource balance should be operated only at the level needed to build and maintain the infrastructure necessary to secure such resources. Programs that are targeted at market segments that will take considerable time to penetrate and transform should be started and paced with this characteristic in mind.

When a utility is in a period of resource surplus, it should use this time to build the capability to acquire conservation, including the development of cooperative agreements needed to take advantage of joint "purchasing power." When near-term resource needs are large, then governments and utilities should cooperate to secure the largest, most economical resources first. These resources typically are characterized as having centralized decision-making and contracting authority. An example is chain stores where energy management investment decisions are made at corporate headquarters.

Program administrative requirements must be weighed carefully against the impact they have on achieving a high volume of program activity. Acceptable requirements for pilot programs may be intolerable when programs are in full operation.

## Guidelines for the Evaluation of the Next Generation of Demand-Side Management Programs

Indices for monitoring conservation program progress should be consistent with those used to establish conservation targets, i.e., if the target is stated in terms of the gross penetration achieved by a specific technology, then progress should be based on the total penetration achieved by both program participants and non-participants. In some cases, free riders may be more appropriately viewed as "early adopters," and conservation actions taken by non-participants (free drivers) should count as additional program benefits, not as a reduction in program impacts.

Impact evaluation results should be used prospectively, to encourage innovation, unless all parties agree that acquisition payments are to be based on verified performance. Both process and impact evaluation findings should be communicated quickly to decision-makers so programs can be adjusted accordingly.

## Guidelines for Government Policies Regarding the Next Generation of Demand-Side Management Programs

Utilities must be given an intrinsic responsibility to aggressively pursue conservation. Institutional rules and policies that financially reward actions that result in efficiency improvements and market transformation should be set in place by utility regulatory agencies. These include the recognition of utility investments in conservation as equivalent to investments in generation for rate treatment and taxation purposes, and the decoupling of utility sales from profits. For market transformation programs, the cost-effectiveness of utility investments that result in free riders should also be adjusted to account for non-participating consumers who make efficiency investments on their own, i.e., free drivers. Federal and state governments must alter their institutional rules so that the incentive to do the right thing is transparent to decision-makers. Federal energy policies and utility demand-side activities should be coordinated with regard to improving appliance and equipment efficiency standards. State energy policies and utility demand-side management activities with regard to improving energy codes should follow the Northwest Energy Code and Super GOOD CENTS models.

# Endnotes

1. Although energy codes have improved over the last two decades, only a few states have adopted energy codes based on "life-cycle cost minimization" or some similar economic criteria. Indeed, more than two-thirds of the states have yet to adopt codes as stringent as the 1989 Council of American Building Officials *Model Energy Code*. For a comprehensive review of progress the nation has made toward greater energy efficiency in buildings, see U.S. Office of Technology

Assessment, "Building Energy Efficiency," OTA-E-518. Washington, D.C. (May 1992).

2. National Fenestration Rating Council Standard 100 - 91: Procedure for Determining Fenestration Product Thermal Properties (Currently Limited to U-values).

3. For example, the Northwest Power Planning Council has established a conservation target of 1,500 average megawatts by the year 2000 (Northwest Power Planning Council 1991), the Pacific Gas and Electric Company (PG&E) has set a target of 2,500 megawatts of deferred demand from conservation and load management (PG&E 1991). The New England Electric System has set a target of 800 megawatts of supply equivalent demand and 1,815 gigawatt-hours of energy by the year 2000 (Granite State Electric 1992).

4. One concept that could result in a potentially significant reduction in the cost of pursuing demand-side management activities in the residential sector would be to make use of funds supplied in the secondary mortgage market by the Federal National Mortgage Association (Fannie Mae). Since these funds carry interest rates that are lower than those that are available to investor-owned utilities, it would be possible to borrow funds for residential demand-side management programs to be repaid through rate revenues.

5. An ancillary benefit of this program and the research that aided in its development is that the cost, performance and technological development information obtained was used to support strengthening of the federal thermal standards for manufactured housing. When these standards are revised, the manufacturers and utilities participating in the program are bound by contract to renegotiate the utilities' acquisition payment.

6. Many utilities have "de facto" equipment replacement programs that pay enough to influence a replacement transaction, but not enough to persuade an equipment owner to retrofit a system that is still functional. However, unless the programs are deliberately designed to work with the replacement market by marketing through the appropriate vendors and manufacturers, these programs can be ineffective at capturing lost opportunities.

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