LBNL-39931
UC-1322

Ernest Orlando Lawrence Berkeley National Laboratory

The Past, Present, and Future of U.S. Utility Demand-Side Management Programs

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December 1996

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The work described in this study was funded by the Assistant Secretary of Energy Efficiency and Renewable Energy, Office of Utility Technologies, Office of Energy Management Division of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

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Acknowledgments

The work described in this paper was funded by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Utility Technologies of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098. I would also like to express my appreciation for the helpful comments of my colleagues Chuck Goldman, Steve Wiel, and Lorenzo Pagliano.

Acronyms and Abbreviations

CPUC	California Public Utilities Commission
DISCO	Distribution Company
DSM	Demand-Side Management
ESCO	Energy Service Company
GENCO	Generation Company
HVAC	Heating, ventilation, and air conditioning
IRP	Integrated Resource Planning
PUC	Public Utility Commission
RESCO	Retail Energy Service Company
RISE	Rhode Islanders Save Energy
TRC	Total Resource Cost

Abstract

Demand-side management or DSM refers to active efforts by electric and gas utilities to modify customers' energy use patterns. The experience in the U.S. shows that utilities, when provided with appropriate incentives, can provide a powerful stimulus to energy efficiency in the private sector. This paper describes the range and history of DSM programs offered by U.S. electric utilities, with a focus on the political, economic, and regulatory events that have shaped their evolution. It also describes the changes these programs are undergoing as a result of U.S. electricity industry restructuring.

DSM programs began modestly in the 1970s in response to growing concerns about dependence on foreign sources of oil and environmental consequences of electricity generation, especially nuclear power. They grew rapidly during the late 1980s as state regulators provided incentives for utilities to pursue least-cost or integrated resource planning principles. Electric utility DSM programs reached their largest size in 1993, accounting for $2.7 billion of utility spending or about one percent of U.S. utility revenues. The foundation for the unique U.S. partnership between government and utility interests can be traced first to the private-ownership structure of the vertically integrated electricity industry and second to the monopoly franchise granted by state regulators.

Electricity industry restructuring calls into question both of these basic conditions, and thus the future of utility DSM programs for the public interest. Restructuring does not, however, call into question the basic rationales for public policies to promote energy efficiency; the environmental consequences of electricity generation in particular, remain a strong argument for continuing energy-efficiency programs. In many parts of the U.S., broad public support for energy-efficiency programs will lead to continued ratepayer funding for them. At the same time, many utilities are interested in using DSM programs to further their unregulated business interests in a restructured electricity industry. Thus, future policies guiding ratepayer-funded energy-efficiency DSM programs will need to pay close attention to the specific market objectives of the programs and to the balance between public and private interests.

1. Introduction

Demand-side management or DSM refers to active efforts by electric and gas utilities to modify customers' energy use patterns. In the United States, utility DSM programs have aggressively promoted the adoption of energy-saving technologies and practices. U.S. utility DSM programs began modestly in the 1970s in response to growing concerns about dependence on foreign sources of oil and environmental consequences of electricity generation, especially nuclear power. Utility DSM programs grew rapidly during the late 1980s as state regulators provided incentives for utilities to pursue least-cost or integrated resource planning principles. Electric utility DSM programs reached their largest size in 1993, accounting for $2.7 billion of utility spending or about one percent of U.S. utility revenues. Aggregate DSM spending was about the same in 1994, and preliminary information suggest a modest spending decline in 1995. We expect DSM programs to continue on two parallel paths reflecting the changing business interests of electric utilities in a restructured industry as well as continuing public interest in the environmental consequences of electricity generation.

This paper focuses on the changes U.S. electric utility DSM programs are undergoing as a result of U.S. electricity industry restructuring. DSM programs undertaken by regulated utilities are a unique public-policy response to perceived shortcomings in energy service markets. Unlike some public policies, such as government standards that mandate efficiency levels for products, utility DSM programs are, from the customer's point of view, a non-coercive way to promote energy efficiency. In addition, DSM program funding has indirectly contributed to the development of a private-sector energy-efficiency industry. Hence, unlike energy taxes whose effects only continue as long as the taxes continue, DSM programs could make lasting changes in the creation of private-sector entities whose livelihood depends on improving customer energy efficiency. Utility DSM policies have often relied on private sector entities to achieve energy-efficiency goals that were in the public interest. These policies required regulators to determine that there was sufficient benefit to justify distributing public funds to private entities. However, electric industry restructuring in the U.S. is questioning many of the basic assumptions underlying the balance struck between these public and private interests in the past. The future calls for a reassessment of the continuing need for energy-efficiency policies, the form these policies should take, and the roles utilities might play in implementing them.

This paper describes the range and history of DSM programs offered by U.S. electric utilities, with a focus on the political, economic, and regulatory events that have shaped their evolution. Today, utilities' interest in DSM is changing as the industry restructures. Although restructuring will likely render the traditional monopoly franchise obsolete, utility DSM programs will not become obsolete. Many utilities will increasingly rely on DSM as an integral business strategy to gain new and retain old customers. However, electricity industry restructuring may call for new institutional approaches to promote energy-efficiency programs that serve the broad public interest. To set the stage for a discussion of these new approaches, we assess the extent to which the historic rationales for utility DSM programs in the public interest remain relevant today. We conclude that the most important of these rationales remain compelling and then speculate on the future of energy-efficiency DSM programs in a restructured U.S. electricity industry.

2. What Is Utility Demand-Side Management?

DSM encompasses a variety of utility activities designed to change the level or timing of customers' electricity demand (Battelle-Columbus Division and Synergic Resources Corporation 1984). U.S. utility DSM programs can be divided into seven categories: (1) general information to increase customer awareness of energy use and of opportunities to save energy; (2) technical information, including energy audits, which identify specific recommendations for improvements in energy use; (3) financial assistance in the form of loans or direct payments to lower the first cost of energy-efficient technologies; (4) direct or free installation of energy-efficient technologies; (5) performance contracting, in which a third party contracts with both the utility and a customer and guarantees energy performance; (6) load control and load shifting, in which the utility offers financial payments or bill reductions in return for controlling a customer's use of certain energy-using devices (such as electric water heaters and air conditioners) or in return for customer adoption of technologies that alter the timing of demands on the electric system (such as thermal storage); and (7) innovative tariffs, such as time-of-day and real-time prices, price signals that can enhance the effectiveness of other DSM programs (Nadel 1992). The first five types of programs are intended to promote energy efficiency. The last two types are intended to promote specific load-shape objectives, such as peak-load reduction, load shifting, or off-peak load building. In the section below, we briefly describe these programs.

Almost all utilities provide general information to customers, ranging from educational and product-oriented brochures to inserts sent out along with customer bills. General information is also distributed directly to customers by utility representatives and indirectly through newspaper, radio, and television advertisements.

Many utilities also offer technical and site-specific information, usually in the form of recommendations following an audit of a customer's energy use. Audits have typically been provided free of charge in response to customer requests. Some utilities are now experimenting with charging fees for audits and technical advice.

Financial assistance, typically a cash payment or rebate, has been the most popular type of utility DSM program in the U.S. The rebate reduces some or all of the incremental first cost of purchasing and installing an energy-efficient technology. Rebates are structured either as fixed payments per unit (e.g., $10 per electronic fluorescent ballast) or as payments designed to lower the first cost of a technology to some predetermined level (e.g., to ensure a payback to the customer within three years). In recent years, many utilities have reduced rebate levels, and customers have been asked to pay a greater share of the incremental first cost of energy-efficient technologies. Some utilities also offer low-interest loans in place of or in conjunction with rebates (e.g., for certain market segments or activities, such as residential weatherization). When customers have been given a choice, they have tended to opt for rebates over loans. As a result, loan programs have not represented a significant share of a utility's DSM budget, whereas rebate programs have.

Direct installation programs send utility staff or contractors to provide free audit, purchase, and installation of energy-efficiency technologies at a customer's premises. Because the utilities underwrite the entire cost of the installation, these are frequently the most expensive DSM programs for utilities to operate, as measured by the cost of energy saved. Utilities have typically offered direct installation programs either as a last resort— for example, when there is an imminent threat of supply shortfall— or to serve market segments (e.g., low-income residential) that have proven difficult to reach with other DSM programs.

Performance contracting generally involves either an energy service company (ESCO) or a customer offering a guaranteed level of energy savings to a utility for an agreed price (Cudahy and Dreessen 1996). U.S. utilities have operated performance contracting programs either through competitive solicitations, called DSM bidding, in which ESCOs and customers tender offers to the utility (Goldman and Dayton 1996), or through "standard offers" in which the utility agrees to pay for energy-saving projects offered at a fixed price per unit of energy saved (Goldman, Kito, Moezzi 1995). Payment by the utility is contingent upon verification of ongoing energy savings by the ESCO or customer. When an ESCO enters into a performance contract with a utility, the ESCO must recruit utility customers and enter into a separate contractual relationship that allows the ESCO to identify, finance, and install energy-saving technologies and verify their performance. Utility experience with performance contracting has mainly involved commercial and large industrial sector customers.

In load control programs, utilities directly control some customers' appliances during times of high system demand. The programs cycle groups of appliances (typically, water heaters or central air conditioners) off for short periods of time and then on again, on a rotating basis. This cycling reduces net loads on the generation system. Appliance cycling load control programs have usually involved residential customers. Sometimes load control means customers adopt a load-shifting technology, such as thermal storage, to alter the timing of the customer's load. "Valley-filling" is the term for programs such as these, which shift customer loads to times when utility system loads are low and thus the variable cost of production is low.

The final category of DSM program includes three innovative tariff designs: interruptible rates, time-of-use rates, and real-time pricing. An interruptible rate is similar to a load-control program; in return for a lower rate, customers agree to curtail loads when requested by the utility. The customer rather than the utility determines which loads to shed. Time-of-use rates set different prices for energy used during different times of day. The price differences are based on the utility's costs of generation at those times. This price signal induces the customer to alter the timing of energy demand. Real-time pricing is a sophisticated form of time-of-use rates; a utility typically gives customers a forecast of hourly energy prices one day in advance. With both time-of-use rates and real-time pricing, the customer initiates changes in energy use in response to the utility's price signal. All three innovative pricing programs have targeted primarily industrial and larger commercial sector customers.

3. The History of U.S. Electric Utility DSM Programs

U.S. utility DSM programs are just one manifestation of the profound changes in the utility industry during the past twenty years. We start our history by reviewing the unique structure of the U.S. utility industry— one that is dominated by privately owned companies operating under monopoly franchises granted by state governments. We then describe several stages in the development of U.S. DSM programs.

3.1 Regulation of the U.S. Electric Utility Industry

Historically, electricity service was considered a natural monopoly; it was thought that only one company within a geographic region could efficiently capture the significant economies of scale offered by electricity generation, transmission, and distribution technologies. In the U.S., two institutions arose to secure the public benefits associated with electrification. Some large cities established publicly owned municipal utilities governed by a city council. Many privately owned utilities also arose, governed by state regulatory authorities. More than 80 percent of the electricity produced and sold in the U.S. comes from privately owned, vertically integrated utility companies (EIA 1996). The history of DSM in the U.S. is dominated by the activities of these companies.

State regulation of these companies is an integral part of the history of U.S. utility DSM. State regulatory authorities, usually called public utility commissions or PUCs, grant privately owned utilities a geographic monopoly franchise or service territory; in return, the utility assumes an obligation to serve all customers within the service territory at regulated rates. Rates are established in an open administrative law forum (called a rate case), sponsored by the PUC, in which customers (called "ratepayers") may participate (Phillips 1993).

PUC-approved rates are intended to give the utility a reasonable opportunity to earn a fair profit while protecting customers from unfair prices. Rates are based on a target rate of return applied to the utility's undepreciated capital expenditures. This form of rate regulation, sometimes called "rate-of-return regulation," was especially well suited to the capital needs of the electricity industry in its early years. The electricity industry is one of the most capital-intensive in the world; to raise capital, utilities turned to private markets. Rate-of-return regulation was intended to facilitate the servicing of these debts. As a result, the U.S. electric utility industry is also one of the most highly leveraged industries in the world.

The history of the electricity industry up to the 1970s is characterized by harmony among utility, government, and individual interests. Increasing economies of scale in the technologies for power generation meant that increased electricity use led to lower prices for all. As mentioned, rate-of-return regulation was created specifically to support the utilities in increasing debt to finance new power plant construction, which was necessary to capture these economies of scale. The primary challenge for regulators was to ensure frequent rates cases in order to lower rates as these economies of scale were realized. Utilities responded by actively promoting new uses of electricity in order to increase their profits; for example, advertising campaigns for all-electric homes were common in the 1960s. The federal government also promoted expanded use of electricity through subsidized electrification projects to bring electricity to rural areas. Electric utilities enjoyed a favorable public image.

3.2 The Beginning of the End for the Electric Utility Industry and the Birth of DSM

A long period of financial health for U.S. electric utilities ended in the 1970s (Roe 1985, Kahn 1988). A dramatic rise in world oil prices resulted in price increases by utilities that relied on oil and gas. Public concerns about high electricity bills led to increased regulatory scrutiny of utility operations. In the late 1960s, the federal government passed a series of strict laws regulating air emissions from electricity generation; these laws increased the cost of new power plants. In addition, public awareness of the environmental impacts of electricity generation heightened, particularly after the nuclear reactor accident at Three Mile Island. Difficulties experienced by utilities trying to obtain sites and construct new nuclear power plants became front-page news as the price increases associated with bringing these new plants on line became apparent.

The energy crises of the 1970s also triggered public awareness of energy conservation. Two laws passed by the federal government changed the electric utility industry forever. The first, called the Public Utilities Regulatory Policies Act of 1978 (PURPA), required utilities to purchase power from nonutility generators at posted prices equivalent to the cost of power that the utility would otherwise generate. This law was an acknowledgment that the economies of scale underlying the natural monopoly in electricity generation had been exhausted and that utilities' power to keep new generators out of the market was not in the public interest. The second law, the National Energy Conservation Policy Act of 1978 (NECPA) required utilities to offer on-site energy audits to residential customers. This law was an acknowledgment that saving energy could be cheaper than producing it.

We now recognize NECPA as the beginning of modern utility DSM programs.[1] Although many utilities vehemently fought against the PURPA requirement to purchase power from nonutility sources at non-discriminatory prices (because the threat to their hegemony was clear), they viewed the energy audit law as simply another, benign obligation undertaken for

1 As noted later, California and Wisconsin authorized utility DSM programs as early as 1975; these programs were the very first DSM programs, predating NECPA.

the public good as part of the regulatory "compact" that gave them their monopoly franchise. The energy audit legislation encouraged utilities to create, staff, train, and maintain internal organizations devoted to helping customers manage electricity use.

The cost of producing electricity in the late 1970s and early 1980s also led many utilities to experiment with DSM programs to reduce operating and capital costs. Under rate-of-return regulation, electricity prices are fixed between rate proceedings. If the marginal cost of generation exceeds this fixed retail price (and there is no offsetting rate adjustment, such as a fuel adjustment clause), then a utility loses money with each additional sale. At the same time, high interest rates created capital constraints for utilities trying to finance investments in new power plants. In response, utilities initiated a variety of load-control programs to save energy during times of peak energy demand (i.e., when the marginal cost of generation was high). These load-control programs demonstrated that cost conditions of the time, coupled with the existing system of regulation, could provide powerful incentives for utilities to actively manage customer loads. Changes in these cost conditions and other incentives inherent in the ratemaking process later discouraged utilities from pursuing energy-efficiency DSM programs; we discuss this issue in Section 4.

3.3 The Rise of Least-Cost Utility Planning

In the late 1970s and early 1980s, state regulators began limiting the amount of money utilities could recover from nuclear power plant construction projects, which had often cost many times more than originally budgeted. These "disallowances," based on the regulators' conclusion that utilities had imprudently incurred excess costs, reached an estimated total of more than $20 billion and placed many utilities under severe financial stress. Although utility stock had traditionally been regarded as a safe investment, paying modest but regular dividends, hemorrhaging nuclear power plant construction budgets forced many utilities to borrow funds in order to continue paying dividends. Tensions between utilities and state regulators were very high; the comparatively amicable relations that once characterized utility rate proceedings became acrimonious, highly publicized battles in which hundreds of millions of dollars were at stake.

In response to the increasingly contentious nature of the regulatory process, several areas of the U.S. (California and Wisconsin in 1975 and the Pacific Northwest in 1980) initiated active, semi-public planning processes for new power plants. We now recognize these planning activities as the first institutionalized efforts at least-cost utility planning.

The term *least-cost planning* was introduced by energy-efficiency advocates to describe a planning process different from the one traditionally employed by utilities. In the traditional process, a utility planned for and acquired new resources without involvement of regulators or the public (except in choosing power plant sites), and only justified its projects after they were built, in order to recover costs. The traditional process was based on the assumption that economies of scale in generation technology would continue to increase; as we have described earlier, this assumption led to a system of regulation that rewarded utilities for capital investment. That is, utilities had a powerful financial incentive to increase earnings by increasing load and constructing capital-intensive, new power plants. Any overbuilding or excess capacity would soon go away as loads increased.

Least-cost planning, in contrast, was based on the perception that alternatives to new power plant construction— especially those available from managing customers' energy demands— could meet customers' energy service needs at lower cost (Lovins 1976). In practice, least-cost planning meant that utilities would have their planned resource acquisitions scrutinized by regulators and the public in advance and would need *prior* approval for their acquisition (Hirst and Goldman 1991). Conceptually, least-cost planning differed from traditional planning by treating future load growth as an *outcome* of a planning process rather than as a fixed *input* to that process. Thus, planners had to give equal consideration to both supply- and demand-side options.

Underlying the basic conceptual shift of least-cost planning was growing evidence of the low cost of demand-side technologies. Energy-efficiency advocates conducted numerous technical analyses showing that substantial amounts of energy could be saved, for much less than the cost of building new plants planned by utilities (SERI 1981). A variety of market barriers were identified as hindering the adoption of energy-efficient technologies that would be highly cost effective for customers (Blumstein et al. 1980). These market barriers included regulatory practices that priced electricity at less than its marginal cost of production, the high cost and limited availability of information on energy-saving technologies, split or misplaced incentives (e.g., between landlords, who would have to pay for energy-saving technologies, and renters, who would reap the rewards on their utility bills), unaccounted for environmental costs associated with electricity generation, and business or homeowner practices that worked against adoption of economically attractive energy-saving technologies and operating practices.[2]

Least-cost planning advocates argued that, in view of the availability of lower cost energy-saving alternatives for meeting customers' energy service needs, and in view of the utilities' obligation to serve at lowest cost, utilities should pursue demand-side options whenever these options were less expensive than supply-side alternatives (Cavanagh 1988).

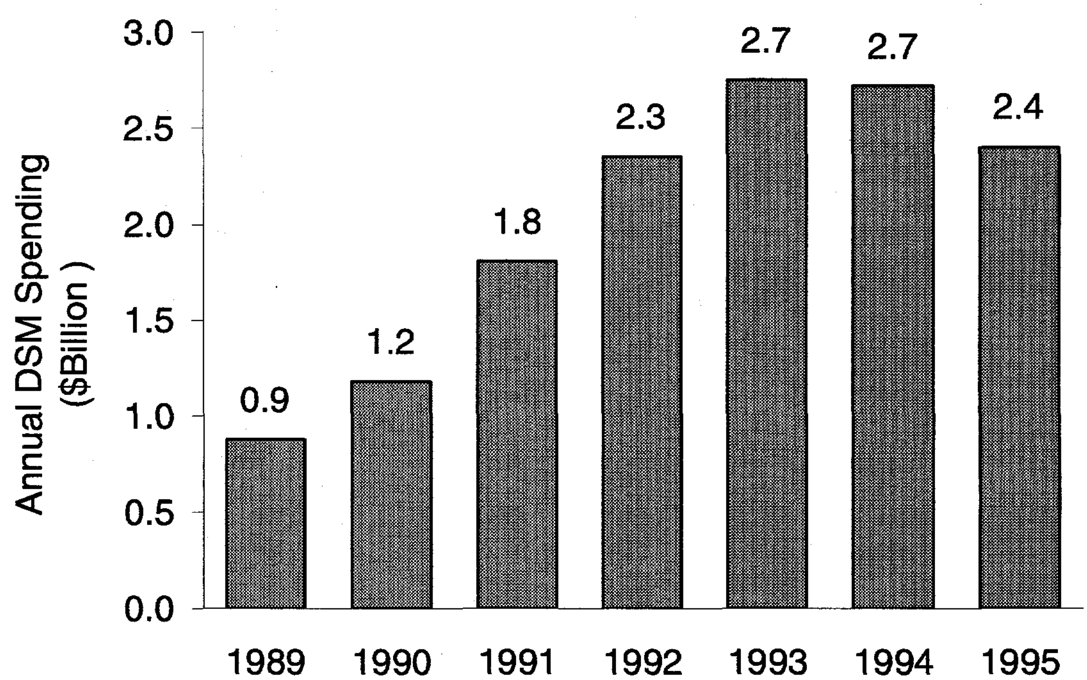
By the mid 1980s, a growing number of states began to recognize the value of proactive utility regulation. In 1984, the National Association of Regulatory Utility Commissioners (NARUC) formalized its endorsement of least-cost planning by creating a Committee on Energy Conservation. With support from the Department of Energy's newly-created Least-Cost Planning Program, the committee commissioned handbooks on least-cost planning principles and techniques (Krause and Eto 1988), and conducted the first national conference

2 We now understand many of these market barriers as examples of what economists formally define as market failures, such as mispricing and imperfect information (Golove and Eto 1995).

on the subject. By the late 1980s, a growing number of states had adopted least-cost planning regulations.

Utility DSM budgets grew rapidly in the late 1980s. In 1990, the U.S. Energy Information Administration began formally tracking these expenditures in their annual survey of utility operations. These surveys revealed that DSM spending by U.S. electric utilities had increased dramatically from $0.9 billion in 1989 to $2.7 billion in 1993[3] (see Figure 1).

Figure 1. U.S. Utility DSM Spending



Source: U.S. Energy Information Administration (1996)

4. Two Critical DSM Policy Issues

Two critical public policy issues were raised by the development of least-cost planning and the resulting growth in utility DSM programs: (1) What regulatory changes were required in

3 1989 was the U.S. Energy Information Administration's first year of comprehensive data collection on utility DSM spending. Anecdotally, many believe spending in 1989 doubled from a relatively static level of spending throughout most of the 1980s.

order to stimulate utilities to deliver energy-efficiency programs? and (2) How well were U.S. utilities performing in operating these programs?

4.1 Aligning Public and Private Interests

During the late 1980s, utilities became more and more concerned as regulatory requirements began mandating DSM programs, changing them from public service obligations to resource alternatives, and increasing their scale. Utility relations with state PUCs had already been severely strained by nuclear power plant cost disallowances; DSM produced additional financial concerns for utilities (Moskovitz 1989, Wiel 1989).

All regulation is incentive regulation in that it rewards certain forms of behavior and discourages others. Traditional rate-of-return regulation discouraged utilities from pursuing energy-efficiency DSM programs because: (1) utilities might not recover DSM program expenses when these expenses were not anticipated in the rate-setting process; (2) utilities lost revenue from sales not made because of the success of energy-efficiency DSM programs; and (3) utilities forego other earnings opportunities because resources are devoted to DSM programs instead.

In many instances, DSM programs had been ordered by state PUCs outside of rate cases. PUC orders typically specified an amount of money to be spent on DSM. As the funding increased, it became apparent that DSM programs needed to be incorporated into the rate-setting process. Most states reset rates infrequently (once every 3 to 7 years), except for fuel costs, which are adjusted annually in most states. Thus, it became common practice to allow utilities to recover costs for DSM programs by treating them like fuel costs through annual adjustments to rates (Reid 1988).

Utilities have an incentive to sell more electricity and a disincentive to sell less whenever the marginal revenue from a sale exceeds the marginal cost of production. In the short run (i.e., between rate cases when prices are fixed) utilities have a powerful incentive to sell more electricity than the amount assumed in the rate-setting process. That is, because only a fraction of costs are affected by increases in load (40 to 80% of total costs are fixed), marginal production costs rarely exceed average rates (Eto, Stoft, and Belden 1994).

Two regulatory strategies have been developed to overcome this incentive to sell electricity between rate cases. The first compensates utilities for the margin foregone from sales "lost" as a result of cost-effective DSM programs (Baxter 1995). The second "decouples" revenue from sales. Decoupling requires establishing a revenue target that is independent of sales and creating a balancing account for the difference between revenues actually collected and the revenue target (Eto, Stoft, and Belden 1994). The balance is cleared annually through either an increase or decrease in the subsequent year's revenue target. As a result, the utility has no incentive to increase loads and no disincentive to reduce loads because total revenues are independent of actual sales volumes in the short run.

Because rate-of-return regulation encourages utilities to increase their base of capital assets (e.g., through new power plant construction) whenever the rate of return exceeds the cost of capital, the rate case is a periodic check to ensure that rate base additions are prudent. However, the purpose of the rate case is not to question the wisdom of the traditional rules which govern it: basing utility rates on formulas that link authorized earnings to a fixed percentage of undepreciated utility capital assets. If building rate base to meet increased loads leads to increases in authorized revenues and profits, then the very formulation of rate-of-return regulation creates a distinct incentive for incremental sales as well as a disincentive for DSM energy-efficiency programs.

Some states responded to this "anti-energy-efficiency" feature of rate-of-return regulation by creating separate financial incentives for the delivery of superior DSM programs. Three types of incentives have been used (Stoft, Eto, and Kito 1995). In the first, the utility earns a percentage adder on the money spent on DSM, which is very similar in spirit to the rate of return a utility currently earns on undepreciated capital assets. In the second approach, the utility earns a bonus paid in $/kWh or $/kW based on the energy or capacity saved by a DSM program. In the third approach, the utility earns a percentage of the net resource value of a DSM program. Net resource value is measured as the difference between the electricity system production costs that the utility avoids because of the program(s) and the costs required to run the program(s). The third approach is by far the most popular because of its superior incentive properties. Under the first two approaches, the utility has an incentive to pursue DSM programs without regard to their cost effectiveness. The third approach directly aligns the utility's interest with society's interest in promoting energy efficiency only when it is cost effective.

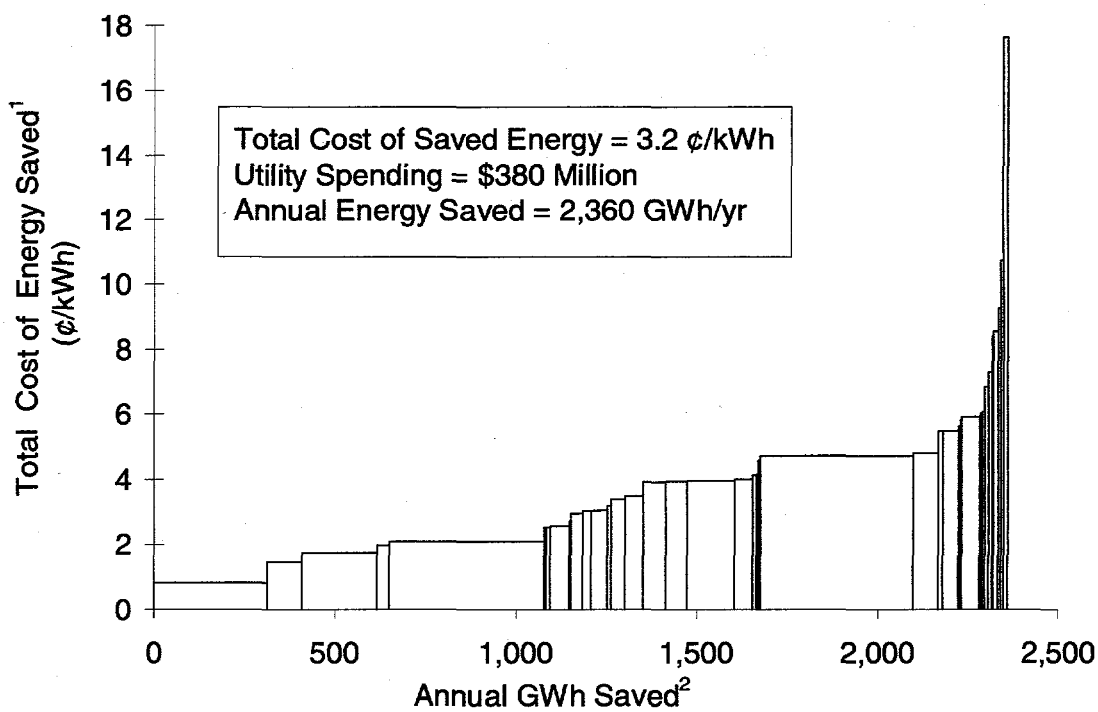
These new ratemaking procedures were instrumental in stimulating aggressive utility pursuit of DSM energy-efficiency programs. The success of these new regulatory approaches has often been cited as a key factor in changing utilities' perception of their role, from providing an energy commodity to one of providing energy services. A handful of utilities, primarily in the northeast and in the west, several of which were already acknowledged as industry leaders in DSM program design and implementation, doubled and tripled their DSM budgets in direct response to new ratemaking procedures. The spending increases by these utilities account for much of the dramatic growth in DSM spending nationwide.

4.2 Measuring DSM Program Performance

As utility spending on DSM increased in the early 1990s, critics began to express their concerns that DSM programs were not cost effective so utility spending on DSM was contrary to the interests of ratepayers (Joskow and Marron 1992). Critics argued that the full costs of DSM were not being accounted for because many utilities did not include the portion of costs paid by program participants who received energy-saving technologies and because utilities did not include many administrative costs in calculating the total cost of DSM programs. DSM program savings were said to be inflated because they were based on engineering assumptions that were not borne out in the field.

More recently however, a systematic review of utility DSM program records has cast doubt on the critics' conclusions (Eto, Kito, Shown, and Sonnenblick 1995). Although utility reporting practices vary in accordance with different state PUC regulations, and savings evaluation methods are an evolving science, program performance can be assessed reliably. Our recent study examined 40 of the largest U.S. utility commercial-sector DSM programs, representing about $400 million or nearly one-third of total utility spending on DSM energy-efficiency programs. The study accounted for all customer costs and all overhead and administrative expenses, including financial incentives paid to utilities as well as the cost of measuring savings. The study also examined the savings evaluation methods used by utilities

Figure 2. The Cost of the Largest Utility DSM Programs for the Commercial Sector 1992



Source: Eto et al. 1995

[1] The total cost of energy saved includes installation of energy-efficiency measures (including net customer-paid costs) and all utility administration costs (including marketing, overhead, measurement, and shareholder incentives). Costs are levelized using a 5% real discount rate and divided by annual energy savings.

[2] Programs are arranged in ascending order of cost. The "width" of each program represents program size as represented by annual energy savings.

and found that the choice of method did not introduce a statistically significant bias in the results.

We found that, on average, DSM programs had saved energy at a cost of 3.2 ¢/kWh and that, on average, they were highly cost effective when compared to the original avoided costs used by utilities in designing the programs (See Figure 2). Nevertheless, our study also found that utility performance was not uniform. Some utilities, notably those with large DSM programs, had saved energy at cost of less than 2 ¢/kWh, while others had saved energy at a cost in excess of 10 ¢/kWh. In other words, not all utilities were equally effective in running energy-efficiency DSM programs. As we will discuss in Section 7, this conclusion has important implications for future public policies to promote energy efficiency through utility DSM programs.

5. Utility DSM Programs in Transition

The U.S. electric utility industry is currently undergoing rapid change; the introduction of competitive forces in both generation and distribution is expected to create significant public benefits: lower prices and more customer choices.[4] Most observers see the introduction of these forces, which signal the end of the vertically integrated monopoly franchise, as inevitable.

In the U.S., the future of the vertically-integrated monopoly franchise will be decided on a state-by-state basis. A wide variety of interests will influence the final outcome. On the demand side, large customers (mainly, in the industrial sector) are pressing for lower cost sources of supply; on the supply side, independent power producers are pressing for access to new markets. Retail rates for large customers vary by a factor of two or more across the U.S.; therefore, pressure for change varies regionally. Political opposition to competition is strongest from high-cost utilities (mainly those with expensive nuclear generating plants), who would lose many of their current captive customers if these customers were allowed to shop for less expensive rates from competing suppliers. Without rate adjustments to offset the revenues that would be lost if these customers leave the system, many utilities would go bankrupt because their assets, which are uneconomic at current market prices, exceed the common equity of the utility's private investors.[5] Utilities' preferences for the future conflict in some cases with the interests of small customers and environmental organizations. Many

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4 Customer choice, retail competition, retail access, and retail wheeling are terms we use interchangeably to describe situations in which consumers of electricity contract directly for sources of electricity supply for which the local distribution company acts solely as a common carrier. Currently, local distribution companies acquire electricity for all customers under a monopoly franchise for a given service territory.

5 Restructuring the U.S. electricity industry poses unique public policy problems that result directly from the unique U.S. system of private utility ownership. Other countries, which are restructuring formerly publicly-owned systems, do not face these problems.

are concerned that small customers (for whom access to the new sources of supply might not be permitted or practical) will be required to pay disproportionately for the rate adjustments necessary to protect utility shareholder equity if large customers are allowed to leave the system. Environmental groups are concerned that environmental costs of electricity generation will not be reflected in the prices paid in a more competitive electricity industry, which will lead to dirtier power plants. Environmentalists are also concerned that public purpose programs historically funded by utilities (such as DSM programs) will be dropped as utilities attempt to cut costs.

Today, DSM programs are beginning to evolve in two directions (Eto and Hirst 1996). In the first, DSM transforms from a mandated activity pursued because of regulation, into an integral customer service that is part of the unregulated utility's future business strategy. In the second, DSM continues as an activity pursued in the broad public interest, which is complicated by utility interest in pursuing DSM as part of a business strategy. To understand how these two futures are developing and might interact, it is useful to review recent changes brought on by utility restructuring around three themes: (1) the utility's obligation to serve and the related obligation for resource planning and acquisition on behalf of retail customers; (2) the electricity industry's future structure and the forms of regulation that will be employed for its remaining monopoly functions; and (3) the implications of current changes in DSM program emphasis from resource value to customer value for energy efficiency.

5.1 The End of the Retail Monopoly Franchise

Current utility involvement in promoting energy efficiency as a least-cost resource alternative is based on the long-standing compact between a regulated utility and its state PUC. The utility's obligation to serve means that the utility manages its resources on behalf of its customers. This obligation is the primary reason for requiring a utility to rely on energy efficiency whenever it costs less than supply. The previously described changes in rate-making practices were to remove financial disincentives associated with DSM programs and were instituted specifically to realign utility financial interests with this obligation.

When retail wheeling relieves a utility from its obligation to serve certain customers, it also relieves the utility from its obligation to use the least-cost planning principle to acquire resources on behalf of these customers. Thus, a critical question for the future of utility energy-efficiency programs is whether the retail monopoly franchise will be eliminated. For the reasons discussed above, this process in the U.S. will likely take five to ten years and proceed at different rates in different states.

In the transition to full retail competition for all customers, some customers may choose to remain with their local utility and rely on it for the traditional resource-management functions. This distinction is already well-established in the U.S. for natural gas local distribution companies. In most states, many natural gas customers currently have the option to choose their natural gas supplier. In fact, where customers are allowed to choose their supplier, residential and small commercial sector energy users have tended to remain customers of the established local utility; and these customers account for 50 to 60% of total gas use.

Where the obligation to serve customers remains, pursuit of DSM as part of a least-cost planning process will continue to be appropriate. However, the size of the energy-efficiency resource available to the utility will probably decrease because only part of the utility's former load will remain with residential and small commercial sector customers.

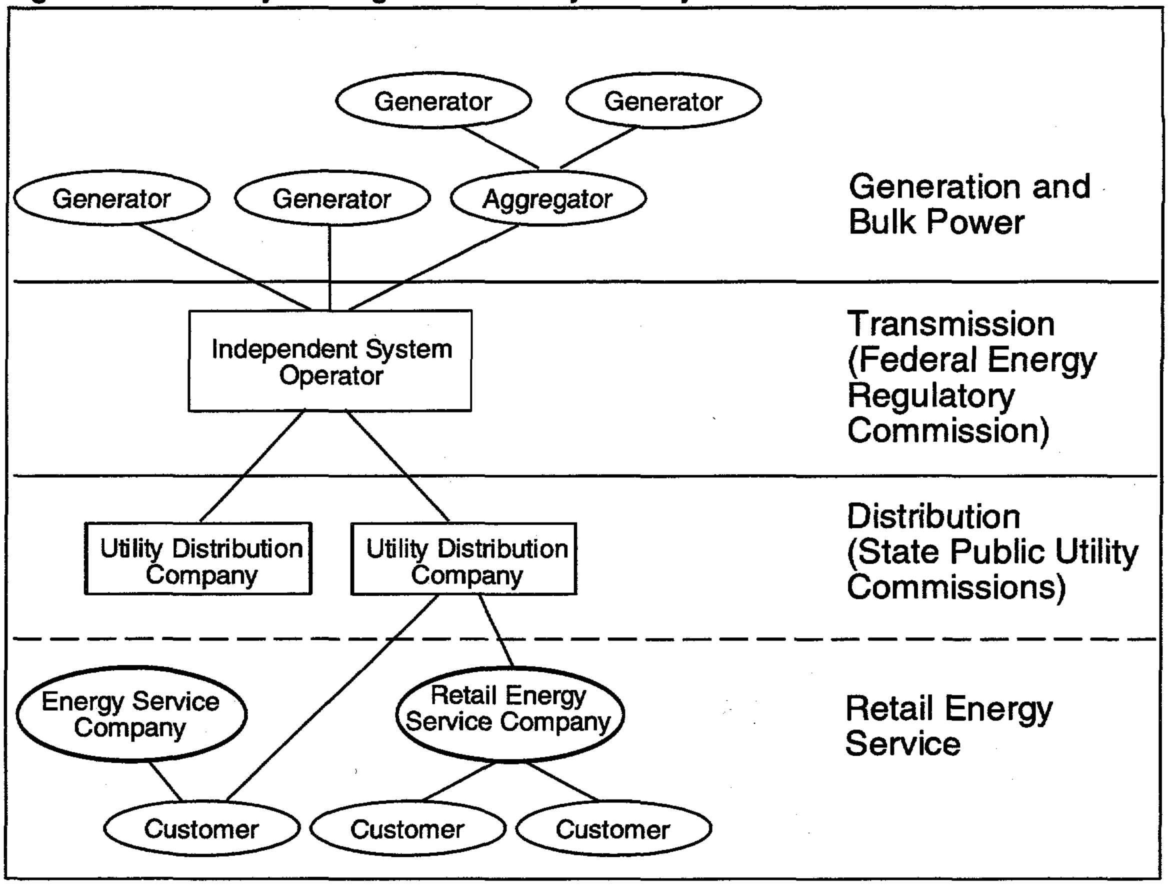
5.2 Regulation of Remaining Monopoly Functions

The introduction of retail competition will change the definition of utilities; they will, in part, become regulated distribution companies with only an obligation to connect all customers to the electric grid. Regulation will still exist in a world of retail competition (see Figure 3). Although regulated utilities that only have an obligation to connect customers to the grid will no longer have resource planning responsibilities, state regulatory policies will continue to influence utilities' decisions about expanding local distribution systems. For utilities' remaining regulated activities, we expect to see states rely increasingly on performance-based ratemaking approaches, such as price caps, which attempt to mimic the pricing and cost-minimizing discipline of unregulated markets.

Some are concerned that recent regulatory interest in price-cap regulation will be in conflict with utility pursuit of many DSM energy-efficiency programs (Comnes, Stoft, Greene, and Hill 1995). Under price-cap regulation, a utility is provided with two strong disincentives to pursue energy-efficiency programs. First, price caps create an incentive to reduce all costs not associated with producing electricity for the lowest per unit cost; these costs include the cost of DSM programs. Second, price caps create an incentive to increase sales whenever the cost of production is less than the price cap.

If, however, the form of rate regulation adopted for distribution utilities does not discriminate against energy efficiency when it is the least-cost option, these utilities are likely to provide energy-efficiency services that defer the addition of more expensive distribution facilities. In these situations, DSM will likely be targeted to specific geographic areas within a utility's distribution system, and the DSM objectives will be to reduce local-area, coincident-peak demands. Thus, DSM programs in support of distribution system resource planning objectives will likely be narrower in geographic scope and will focus more on local-area peak demand reductions and less on energy savings than today's programs do.

Figure 3. A Vertically De-Integrated Electricity Industry



5.3 The Changing Business Objectives of Utility DSM Programs and the Pace of Vertical Dis-Integration

Thus far, we have concentrated on two possible models for the electricity industry: one in which the regulated utility has an obligation to serve and thus an obligation to pursue least-cost planning principles, and one in which only its distribution function remains a regulated activity, as the utility retains only an obligation to connect customers to the grid. During the next five to ten years, we believe the U.S. electricity industry will be in transition from the first model to the second. During this period, we foresee a growing divergence between a utility's interest in pursuing DSM as a business strategy in a restructured industry and the public's interest in DSM as an alternative to new sources of supply. Addressing the conflicts that will inevitably arise as a result of this divergence will be difficult because vertical dis-integration will probably be rapid.

In a world of retail competition, utilities are likely to cut costs wherever possible because the profitability of their product (defined for the moment as kWh) will be determined by market conditions, not by their embedded costs. Some utilities will also attempt combine production efficiency with strategies to market distinct products and services (Newcomb 1994). Some forms of energy efficiency, such as those offered as part of a strategy designed to retain large customers, will likely play an important part in many utilities' future product offerings.

Thus, utility DSM programs are unlikely to disappear. However, they are likely to change in nature from emphasizing resource savings to emphasizing energy services that customers value and are willing to pay for in a deregulated retail electricity market. These changes are beginning to raise challenges from other energy service providers concerned that ratepayer funding for DSM programs is being used to unfairly subsidize the development of business opportunities that utilities will pursue exclusively as unregulated profit-making activities once the transition to full retail competition is complete. Strategic alliances between utilities on one hand, and unregulated energy and non-energy service providers on the other, are already proceeding at a rapid pace. Many utilities are initiating pilot "DSM" programs, supported by ratepayer funds, to test new product concepts that integrate information and telecommunication technologies with traditional energy-efficiency and load control technologies (Goldman, et. al. 1996). Few states have ruled on whether these efforts' near-term benefits for ratepayers are sufficient to outweigh the potential inappropriateness of ratepayer funding for what are sure to be less regulated or unregulated business activities (i.e., benefiting shareholders) in the future. A particular concern of regulators is that strategic alliances between regulated utilities and unregulated energy service providers today may create unfair business advantages that work against nonaffiliated, competing energy service companies in the future, thus stifling competition in retail energy service markets.

Other conflicts between public and private interests in DSM are exacerbated by the vertically integrated structure of privately owned utilities. Utilities faced with large, uneconomic assets and uncertainty over what fraction of these assets they will be able to recover as the market moves to retail competition have strong incentives to maximize recovery of these assets prior to the transition. As with price caps, these utilities have strong incentives to cut all costs, including DSM programs, and to maximize sales. Recent declines in utility DSM spending can be traced to precisely this strategy.

6. The Relevance Today of the Original Rationales for Utility DSM Programs and the Future of Ratepayer-Funded Energy-Efficiency Activities

If no entity retains an obligation to serve all energy customers on a nondiscriminatory basis, the restructured U.S. electricity industry will, by default, be relying on an untested combination of market and regulated institutions to perform formerly integrated planning functions for generation, transmission, distribution, and demand-side resources (see Figure 3). A variety of unregulated retail businesses will provide energy and energy-efficiency services, and regulated distribution utilities will provide distribution-system-oriented DSM services in accordance with incentives created by state PUCs. The critical public policy issue in the U.S. is whether there is a continuing need for energy-efficiency programs in the broad public interest. Addressing this issue requires re-examining the relevance today of the original rationales for utility energy-efficiency DSM programs (Eto, Goldman, Kito 1996). We consider these rationales as responses to three sequential public-policy questions: Should there be public policies for energy efficiency? Should utility ratepayers fund them? Should utilities be involved in administering DSM programs?

6.1 Should There Be Public Policies for Energy-Efficiency?

U.S. electric industry restructuring offers the promise of increased customer choice, resulting in market-based prices for electricity. Market-based pricing, if it is not unduly influenced by abuses of market power, would lead to prices closer to the marginal cost of production. Thus, market-based pricing would begin to address an early rationale for utility DSM programs, which was that regulated prices did not accurately reflect the true marginal cost of production, leading to inefficient production and consumption decisions.

However, it seems unlikely that electricity industry restructuring will, by itself, address the myriad of additional market failures that plague today's energy service markets. These failures include imperfect information, which manifests in the high transaction costs consumers face when making energy use decisions, as well as externalities (notably, those associated with the environmental consequences of electricity generation) that are unlikely to be reflected in market-based prices for electricity. Hence, we believe that, despite the improved allocative efficiencies promised by electricity restructuring, the continuing presence of other, important market failures remains a compelling justification for continued government intervention.

6.2 Should Utility Ratepayers Fund Energy-Efficiency Policies?

Traditional rationales for ratepayer funding of energy-efficiency DSM programs have included: (1) ratepayer funding is fair because the "problems" addressed by the programs are unique to electricity use; (2) it is more practical than alternative public-policy responses; and finally (3) it is more consistent with other social objectives. We now briefly expand on these rationales, which we maintain are also unaffected by electricity restructuring.

It's fair. The environmental consequences of electricity generation are significant and electricity consumers have a unique responsibility for the consequences of their purchase decisions. Ratepayer funding for energy-efficiency programs, which are a partial solution to these environmental problems, is consistent with this responsibility. Whether such programs or ratepayer funding of them are the most appropriate ways to fulfill this responsibility is separate from accepting the basic principle that the polluter should pay.

It's practical. Because the existence of environmental externalities in many activities is widely accepted, there is substantial debate about the appropriateness of policies that specifically target the utility sector. For example, economic theory has been used to argue that a tax levied uniformly on all forms of greenhouse gas emissions according to their relative contributions offers a more efficient approach to address one significant environmental consequence of activities that include electricity production. However, such a tax or even agreement that this type of approach is appropriate is unlikely in the U.S. in the short term. Hence, because electricity generation is a major contributor to the problem, electricity energy-efficiency policies represent a practical alternative.

It's consistent with other social objectives. A final justification for ratepayer-funded energy-efficiency programs is pragmatic: these programs promote public support and acceptance for policies that rely on *voluntary* participation. From the consumer's point of view, DSM programs, unlike government product standards and building codes, represent a non-coercive approach to promoting energy efficiency. Moreover, these programs can be designed to provide a stimulus to the private sector that, in the long run, may decrease the need for them.

Looking to the future, we expect that a new rate design, such as a surcharge on electricity purchases, will be used to fund energy-efficiency DSM programs in the public interest. The rationale for this surcharge is that all electricity users would pay it. Currently, many utilities are concerned that regulators will require them to include DSM program costs in their rates, which they feel would put them at a competitive disadvantage to competitors who are not required to include these costs. A separate surcharge to recover DSM program costs, levied on all electricity users regardless of their suppliers, eliminates this concern.

6.3 Should Utilities Be Involved in the Administration of DSM Programs?

Continued ratepayer funding for energy-efficiency DSM programs raises the question of who should administer DSM programs after electricity industry restructuring changes utilities' traditional roles. In the past, utilities had unique capabilities to promote public interest in energy efficiency: (1) access to low-cost capital; (2) name recognition among customers and acknowledged technical expertise on energy use; (3) lack of direct financial interest in promoting particular energy-efficiency products or services; (4) access to detailed information on customer energy-use patterns; and (5) a system for billing customers for services.

In the future, there are many questions as to whether utilities will retain these advantages, and, if they do, whether they will have sufficient incentive to deploy them for the public good, rather than only for private gain. Meanwhile, years of ratepayer funding for utility DSM programs has helped to develop a private energy-efficiency services industry. As described earlier, many utilities plan to offer unregulated energy-efficiency services, which will compete with these private firms. As a result, utility management may face a conflict of interest between delivering ratepayer-funded DSM programs in the broad public interest and maximizing shareholder returns through customer load retention DSM programs and efforts to increase the utility's share in local energy-efficiency service markets. Finally, as described in Section 4, we now recognize that DSM program performance varies among utilities. Some utilities have demonstrated that they are capable of saving energy at low cost through DSM programs while others have been less successful.

We expect to see multi-layered policy approaches for promoting energy efficiency with ratepayer funds. In some parts of the U.S., state-directed public policies to promote energy efficiency will probably not focus on the utility sector. In these states, utilities never actively promoted energy-efficiency DSM programs; after restructuring, they will be unlikely to start. Efforts to promote energy efficiency in these states will depend solely upon other public policy instruments, such as state or federal building codes and appliance standards, which in the past have worked effectively in partnership with utility DSM programs.

In other parts of the U.S., broad public support for DSM in the public interest will lead to some form of surcharge or explicit provision for continued ratepayer funding for energy-efficiency programs. This support is strongest in areas that were formerly leaders in least-cost utility planning, including New England, California, Wisconsin, and the Pacific Northwest.

These regions are currently working to define the role of utilities in administering DSM programs after restructuring (Eto, Goldman, and Kito 1996). Work in these areas has clarified the need to consider separately three components of DSM programs: the collection of funds to support DSM programs, the planning for programs, and the marketing and delivery of energy-efficient technologies. Utility involvement in each of these activities is neither inevitable nor necessarily desirable.

Some states will rely on utilities with good past records in DSM to continue to administer DSM programs. The decision will rest on the assurance the utility can mitigate conflicts of interest. Other states will seek alternatives to administer ratepayer funds for DSM because local utilities have had poor past performance with DSM, cannot offer assurance that the factors underlying past success will persist, or cannot mitigate conflicts of interest. Two alternatives have been suggested: (1) administration by an existing or newly created government agency, and (2) administration by an independent, possibly nonprofit entity. Both alternatives raise questions of governance and accountability for the administration of funds.

Whatever administrative structured is used, we believe that a guiding principle for the design of future ratepayer-funded energy-efficiency DSM programs is that they should, to the extent feasible, foster the development of a more competitive energy service market. Pursuing this objective will lead a strong emphasis on creating institutions and supporting private-sector entities to permanently overcome the many failures in these markets. For many energy-efficient products, coordinated programs might work directly with manufacturers. For energy-efficiency services, this may involve increased reliance on "standard offer" DSM solicitations, in which a posted price for energy savings with a fixed quantity limit is offered to all potential suppliers, including utility and nonutility energy service companies as well as customer-sponsored projects. In addition to providing a level playing field for competition among energy service providers, the price posted in a standard offer can be lowered over time as the market matures.

7.0 Summary

U.S. utility DSM programs have been highly successful in overcoming shortcomings in the markets for energy services. The experience in the U.S. shows that utilities, when provided with appropriate incentives, can provide a powerful stimulus to energy efficiency in the private sector. The foundation for the unique U.S. partnership between government and utility interests can be traced first to the private-ownership structure of this formerly vertically integrated industry and second to the monopoly franchise granted by state regulators.

Electricity industry restructuring calls into question both of these basic conditions, and thus the future of utility DSM programs for the public interest. Restructuring does not, however, call into question the basic rationales for public policies to promote energy efficiency; the environmental consequences of electricity generation in particular, remain a strong argument for continuing energy-efficiency programs. In many parts of the U.S., broad public support for energy-efficiency programs will lead to continued ratepayer funding for them. At the same time, many utilities will use DSM programs to further their unregulated business interests in a restructured electricity industry. Thus, future policies guiding ratepayer-funded energy-efficiency DSM programs will need to pay close attention to the specific market objectives of the programs and to the balance between public and private interests.

In the U.S., four regulatory policy issues will be central to this process: (1) Will regulated utilities (which may become only distribution entities) have planning and operating incentives embedded in rate-setting formulas or processes that are consistent with the public interest in energy efficiency? (2) What criteria will PUCs use to review utility-proposed uses of ratepayer funds for DSM programs if the primary purpose of these programs is customer value rather than resource value? Which programs are likely to be conducted by utilities because they are in the utilities' unregulated business interests? Which programs should be funded by utility ratepayers rather than by shareholders? (3) How can regulatory efforts to check market-power abuses by utilities or their subsidiaries operating in energy-service markets help these markets mature and become fully competitive? (4) To the extent that markets, rather than vertically integrated utilities, make end-use and supply/resource choices, how, if at all, will state PUCs or the federal government assess the consistency of these choices with the public interest? How will inconsistencies in these choices be addressed?

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