Providing Utility Energy Efficiency Services in an Era of Tight Budgets: Maximizing Long-Term Energy Savings While Minimizing Utility Costs

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CONTENTS

INTRODUCTION

In the past two years, the dominant topic of discussion among utility companies, regulators, and other utility industry observers has been increased competition in the utility industry, including increased wholesale competition as well as the coming of retail competition. The general tenor of these discussions is that increased competition is coming (although there is a wide range of opinions as to what form[s] this increased competition will take and how long the transition will take) and that utilities should begin preparing for this increased competition now, primarily by reducing costs wherever possible.

In this report, we do not attempt to discuss the coming of increased competition to the utility industry, nor do we discuss the advisability of undertaking major cost-cutting efforts at this time (these topics are discussed in another ACEEE paper—Nadel, Geller, and Pye 1995). We also do not discuss the best structure(s) for delivering energy efficiency services in the post-competitive age (this is the topic of an upcoming ACEEE report). Instead, we begin with the understanding that many utilities are now trying to reduce costs, and one area where they are looking for cost savings is in budgets for energy efficiency programs. While most utilities understand that energy efficiency has many benefits for society, in an effort to cut costs, as part of broader cost-cutting efforts, many utilities are seeking to lower the amount of money they spend on energy efficiency programs. In some cases utilities are trying to reduce energy efficiency budgets in absolute terms, in other cases they are seeking to slow the growth in energy efficiency budgets. In an effort to assist with utility efforts to "get the most bang for the buck," in this report we attempt to summarize current thinking and research on how to maximize long-term, sustained energy savings while minimizing costs. Also, in some cases, energy efficiency programs will not be offered by utilities but instead will be offered by other independent entities, such as energy service companies or agencies affiliated with state government. These organizations will also be interested in maximizing savings within budget constraints. In discussing reduced costs, we focus on costs to the utility (or the non-utility implementing entity) instead of costs to society because utilities are primarily interested in lowering their costs, in an effort to keep electricity rates down.[1]

The focus of this report is on energy efficiency strategies utilities can use during the transition period from a heavily regulated market to a more competitive market. Until the forms of increased competition are decided, it is premature to recommend energy efficiency strategies for the competitive age. However, many of the strategies discussed below could serve as a cornerstone of energy efficiency efforts in a highly competitive market.

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[1] Some utilities are trying to limit programs to those that pass the Rate Impact Measure (RIM) test. This test essentially says that if a DSM program even slightly raises rates for program nonparticipants, then the program should be rejected. This is a very stringent test and eliminates most energy-saving programs from consideration. Many economists and utility commissions have rejected use of the RIM test (Chamberlin and Herman 1993). For these reasons, we do not focus on the RIM test in this report but instead emphasize programs that can reduce but not eliminate rate impacts.

ELEMENTS OF A LEAST-COST ENERGY EFFICIENCY STRATEGY

A least-cost energy efficiency strategy for the rest of the 1990s probably involves seven elements:

1. Foster market transformation where possible, so that efficient equipment and designs become the norm;

2. Address lost opportunity resources by targeting energy-related purchases that are already happening in the market for efficiency upgrades;

3. Build loyalty of potentially mobile customers by offering enhanced but moderately priced services including energy efficiency services;

4. Expand programs that lower rates, such as load-management programs and programs that can defer transmission and distribution investments;

5. Offer limited retrofit programs targeted at customer segments that are least likely to share in the benefits of increased competition, such as low-income households;

6. Experiment with new energy efficiency strategies, particularly strategies that can perhaps be operated at a profit or at least may have lower rate impacts than traditional energy efficiency programs; and

7. Utility support for non-utility regulatory and voluntary energy efficiency programs such as building energy codes, equipment efficiency standards, building retrofit ordinances, and voluntary market-driven programs.

Each of these elements is discussed in the sections below.

MARKET TRANSFORMATION

Market transformation is a process whereby energy efficiency innovations are introduced into the marketplace and over time penetrate a large portion of the eligible market. Market transformation can be visualized in terms of the classic S-shaped logistic diffusion curve (see Figure 1). Once a new product or other type of innovation is introduced, its penetration begins to rise through early adopters. Penetration then "takes off" as awareness of the technology and its advantages grows. The adoption process continues until market penetration levels off at "full market potential." Market transformation also implies lasting change such that the market does not regress to lower levels of efficiency at some later time.

Figure 1. Approaches to increasing the market penetration of energy efficiency measures.

Source: Geller and Nadel 1994.

In the past few years, many program planners and policymakers have begun discussing program and policy initiatives to encourage and accelerate the market transformation process. Instead of saving energy building by building, a market transformation approach seeks to change the entire market for particular products or services so that efficient products or services are the norm and do not need to be promoted with incentives. Relative to conventional program approaches, market transformation programs can potentially increase the amount of energy that is saved (because participation rates approach 100 percent) while lowering long-term program costs per unit of energy saved (because transformed markets do not require incentives).

There are many specific policy and program approaches that can contribute to market transformation. These different approaches work in different ways to influence the technology diffusion curve. Many of these approaches can complement each other, either by design or by chance, to form a complete market transformation strategy. Among the approaches that can contribute to a market transformation strategy are:

1. Research and development (R&D)
2. Demonstrations and field tests
3. Commercialization incentives (e.g., Golden Carrots™ such as the Super-Efficient Refrigerator Program)
4. Marketing and consumer education

5. Financial incentives
6. Voluntary commitments (e.g., Green Lights)
7. Bulk purchases
8. Building codes
9. Equipment efficiency standards

Explanations and examples of each of these approaches are discussed by Geller and Nadel (1994).

There are several recent examples of how utilities have influenced the transformation of an end-use market, including residential buildings in the Pacific Northwest, electronic ballasts and super-efficient refrigerators in the United States, and efficient electric motors in British Columbia.

Changing residential construction practices in the northwestern United States was an eight-year effort (1983-1991) spearheaded by the Bonneville Power Administration (BPA) and involving many other utilities and agencies. The initiative included four steps: (1) development of model conservation standards; (2) demonstration projects that showed builders how to build to the model standards and evaluated the costs and benefits of the model standards; (3) incentive programs to popularize the new standards and give them a significant share of the market; and (4) passage of new building codes based on the model standards by the Washington and Oregon legislatures (Watson and Eckman 1993). The entire effort cost Bonneville over $100 million, but an evaluation of the effort determined that the entire effort cost Bonneville less than $0.01 per kWh saved (Schwartz, Byers, and Mountjoy/Venning 1993).[2]

Efforts to transform the market for fluorescent ballasts also consisted of several steps. However, unlike the building practices example above, the different steps took place somewhat independently, without a conscious effort to plan a comprehensive market transformation strategy. Four principal steps were involved: (1) research, development, and demonstration (RD&D) and commercialization of electronic ballasts through the efforts of many companies but particularly a small electronics firm and U.S. Department of Energy's (DOE) Lawrence Berkeley National Laboratory (LBNL); (2) bulk-purchases by several institutional customers, funded in part by local utilities, which brought the cost of electronic ballasts down to competitive levels and allowed production and purchases to accelerate; (3) utility incentive and other promotion programs (e.g., U.S. Environmental Protection Agency's [EPA] Green Lights programs) that popularized the new ballast and gave it a significant market share (31 percent in 1995 according to the Bureau of the Census [1996]); and (4) the proposed establishment, by DOE, of ballast minimum efficiency standards based on electronic ballast performance (Geller and Nadel 1994). Based on data published by EPRI (Gough and Blevins 1992) we estimate that utilities and government agencies spent on the order of $700 million to promote electronic ballasts over the 1989-1995 period, resulting in the direct purchase of at least 70 million ballasts. If we assume that these efforts are accelerating the transformation of the market towards electronic ballasts by five years (e.g., without these efforts the federal government would not require electronic ballasts until the next

[2] All calculations of cost per kWh saved in this report are based on a 5 percent real discount rate.

standard revision cycle, five years after the current rulemaking) then the cost of the utility and government efforts is only $0.003 per kWh saved over the life of the ballasts.[3]

Residential refrigerators provide an example of a very recent effort that is likely to be successful in transforming the market. In 1990 a group of efficiency advocates, including representatives from utilities, government, and public interest organizations, became convinced by a variety of technical studies that it was possible to develop and produce new refrigerators at modest cost that used at least 25 percent less energy than the 1993 federal standard. They devised a two-step program to transform the refrigerator market. The steps were to: (1) offer a contest among refrigerator manufacturers for a multimillion dollar prize to develop and bring to market a super-efficient refrigerator that was cost-effective to most utilities, thereby promoting development, commercialization, and initial sales of the new refrigerator; and (2) advocate for a new federal efficiency standard based on the new super-efficient refrigerator. Part one of this strategy was implemented through the Super-Efficient Refrigerator Program (SERP) (Feist et al. 1994). Part two is now being implemented through a DOE rulemaking that is scheduled to be completed in October 1996. This rulemaking is being heavily influenced by an agreement between refrigerator manufacturers and efficiency advocates to jointly petition DOE to adopt a new standard that results in average percentage energy savings that are nearly identical to the savings of the winning bid in the SERP program (DOE 1995).

Under the SERP program, participating utilities are providing a total of $27 million in prize money; when monies required to develop and administer the program are accounted for, the total comes to $30 million. If we estimate that the program increased the energy savings of the new standard relative to the 1993 standard by 10 percent and this acceleration only holds for the five-year period prior to next standard (currently scheduled for 2005 or 2008), then the $30 million cost works out to $0.001 per kWh saved throughout the United States, or $0.005 per kWh saved in the service areas of the 24 utilities who sponsored the SERP program.[4]

An example of industrial market transformation is B.C. Hydro's effort since 1988 to transform the provincial motor market. The B.C. effort consists of four components: (1) educational efforts to provide customers and dealers with information on high-efficiency motors—their economics and availability; (2) customer incentives, to pay part of the incremental cost of high-efficiency motors; (3) vendor incentives, to encourage vendors to routinely stock and promote high-efficiency motors; and (4) support for efforts to enact national minimum efficiency standards. As a result of the first three components, high-efficiency motors had a 70 percent share of the new motor market in 1993, up from approximately 5 percent in 1987. In 1992 and again in 1993, the utility reduced the incentives by just

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[3] Other key assumptions in this calculation are savings of 48 kWh annually per ballast, annual ballast production of 69 million units covered by the federal standard, and a 12-year electronic ballast life.

[4] These calculations assume savings of 70 kWh per refrigerator, 8.1 million refrigerators sold annually of which 18 percent are in the service areas of SERP utilities, and 0.25 million units sold directly through the SERP program.

over 10 percent; still market penetration held as dealers now routinely stock and customers routinely request high-efficiency motors. In fact, in a reversal of the pre-program situation, in some areas standard efficiency motors are no longer stocked and must be special-ordered, resulting in delivery times of six to eight weeks. In 1993, the utility was finally successful with its lobbying efforts and national and provincial legislations were passed setting motor efficiency standards. The new standards took effect in 1995, thereby completing the transformation of the market. Costs of this program to the utility have averaged less than $0.01 per kWh saved from the beginning of the program through 1993. Once the impacts of the new standard are factored into the calculations, the cost of energy savings will be significantly lower (B.C. Ministry of Energy, Mines and Petroleum Resources 1994; Flanigan and Fleming 1993; Nadel and Jordan 1993).

These four examples illustrate how market transformation can produce large energy savings at a very low utility cost per unit of energy saved. All but the motor example involve customer classes that are likely to remain primarily on the local utility grid for many years to come. Taken together, these four efforts will save on the order of 60 TWh in 2010, which is approximately equal to the energy efficiency savings that U.S. utilities were claiming in 1994 (EIA 1995). All of these efforts have utility costs of less than $0.01 per kWh saved.

On the other hand, not all attempts by utilities to transform a market have been successful. Utilities, government agencies, and others have been promoting compact fluorescent lamps (CFLs) for as long as they have promoted electronic ballasts. Utility incentives for CFLs have been estimated at more than $100 million over the 1990-1994 period, approximately 55 percent of the estimated incentives for electronic ballasts over the same period (Gough and Blevins 1992). Due in large part to these efforts, in 1993 CFLs accounted for approximately 4-5 percent of the general service lamp market traditionally served by incandescent bulbs (Geller and Nadel 1994). However, it is unclear what will happen to CFL sales if incentives are eliminated since the incremental cost of CFLs is generally more than ten times the cost of an incandescent bulb. Mandating use of CFLs through equipment efficiency standards is problematic because not all applications are appropriate for CFLs. Thus, while substantial progress has been made to transform the general service lighting market, completing the task will be very difficult and as utility incentives are reduced, even some of the current market penetration may be lost.

Based on a review of these and other case studies, Geller and Nadel (1994) reached four conclusions regarding market transformation, including: (1) market transformation is feasible for many energy-saving technologies and practices; (2) the preferred market transformation strategy varies from product to product, depending on the characteristics of the technology and the market being served; (3) in developing market transformation strategies it is important to pay attention to quality control, so that new technologies stand the test of the marketplace and deliver the long-term energy savings that are needed; and (4) minimum efficiency standards and building codes often play a critical role in completing the market transformation process.

However, while market transformation has many advantages, such as high savings and low costs, there are several limitations to market transformation. Probably the biggest barrier is that in order to transform markets, long-term efforts are needed that require coordination among many parties.

Utilities, government agencies, and the private sector must work together and make long-term commitments, as exemplified by the experience with new housing in the Pacific Northwest. Thus, the number of market transformation initiatives that can successfully be put together may be limited. Utilities in particular are reluctant to make long-term commitments because of uncertainties about future regulatory policies and increasing competition in the utility industry. Regulatory commissions can address this barrier by supporting and encouraging local utilities to become involved in market transformation efforts, as has occurred in several states such as California and New York.

Another limitation to market transformation is that the ability to transform energy efficiency varies among technologies and end-use markets. Of the successful market transformation efforts discussed above, all relied on a government mandate (efficiency standards and building codes) to complete the transformation process. For technologies that do not lend themselves to mandates, such as CFLs and adjustable speed drives, achieving the full market potential may be difficult or impossible. Furthermore, a long-term comprehensive market transformation strategy may be inappropriate for some technologies or industrial processes that are evolving rapidly and/or are highly application-specific.

The potential benefits of market transformation can overcome many of these limitations and many utilities and government agencies are interested in developing market transformation strategies for new products as well as for existing but underutilized products. For example, BPA recently reorganized its energy efficiency programs to rely almost exclusively on the market transformation approach (BPA 1995). Similarly, the U.S. Climate Action Plan incorporates many initiatives to help transform markets including Golden Carrot™ and voluntary commitment programs and enhanced building codes and equipment efficiency standards (Clinton and Gore 1993). In addition, a group of electric and gas utilities, government agencies, and public interest organizations formed the Consortium for Energy Efficiency (CEE), a national non-profit organization dedicated to assisting in the development of markets for new super-efficient technologies. As of mid-1996, CEE has 31 utility members serving over 30 million households and has launched six market transformation initiatives covering residential clothes washers, central air conditioners, apartment-sized refrigerators, and CFLs; commercial packaged air conditioners; and commercial/industrial premium-efficiency motors (CEE 1996d). Regional market transformation organizations have also been formed, including the Energy Center of Wisconsin and Northeast Energy Efficiency Partnerships.

In response to the attractions of market transformation, in the past few years more than a dozen market transformation efforts have begun at the national, regional and local levels. In a recent report, Nadel and Geller (1996) review many of the national efforts. This review is summarized in Table 1. This table also includes estimates of the potential energy savings from each of these initiatives (assuming they are successful in their objectives of fully transforming markets) and the average cost per kWh saved to consumers for each technology. These savings and cost estimates come from a previous analysis on potential market transformation targets (Nadel and Geller 1994).

Table 1. Summary of National Market Transformation Initiatives Now Starting or Underway.

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As part of their least-cost energy efficiency strategy, utilities should become involved in some of these efforts. While not all utilities need to be involved in all initiatives, experience to date indicates that typically several dozen utilities need to be involved for an initiative to be successful.

LOST OPPORTUNITY RESOURCES

At the time a home, office building, or industrial facility is constructed or expanded, customers are spending substantial amounts of money to purchase energy-consuming equipment. At this time, many conservation measures can be installed for only the incremental cost beyond standard construction practices. To retrofit these measures later is usually much more expensive and sometimes impossible, which is why new construction conservation opportunities are often referred to as "lost opportunity" resources. If efficient designs and equipment are not installed in a new building, then the opportunity to improve the building's energy efficiency is lost until the building or equipment is replaced, which may be many decades away. Building renovations, remodeling, and situations when long-lived equipment (e.g., ballasts, motors, and cooling equipment) are being replaced are other examples of potential lost opportunities. In each of these situations there is a one-time opportunity to install efficient equipment, an opportunity that will not occur again for many years.

Lost opportunity situations permit substantial efficiency gains at modest cost. Also, these measures are likely to be long-lived because customers would not be investing their own money if they planned to move or cease operations soon. In addition, annual costs of lost opportunity programs are commonly less than retrofit programs because with lost opportunity programs only a portion of the customer base is eligible each year, unlike retrofit programs where virtually all customers are potential participants.

Still, many utilities pay little attention to these markets. To capture these opportunities requires developing specific programs or program components for new construction, renovation, and equipment replacement situations. Also, separate programs are generally needed for residential, commercial, and industrial customers because of the large differences between these sectors.

In many cases lost opportunity programs are also market transformation programs since a market transformation strategy is used to capture lost opportunity resources. For example new construction programs often seek to permanently change construction practices, such as by laying the groundwork so that building codes can be strengthened. Many equipment replacement programs, such as the SERP refrigerator program and the B.C. Hydro motors program, are designed on a market transformation foundation. Even with remodeling, as discussed below, market transformation can be an important focus.

An important element of lost opportunity programs is on-going market research and marketing to identify and solicit customers who are about to make construction or equipment replacement decisions. These decisions are generally made within a narrow window of time, so to capture efficiency gains, the utility has to be able to quickly offer a wide range of assistance and inducements to convince customers to develop the most efficient designs and install the most efficient equipment that is viable. Further details on the design of lost opportunity programs for particular market segments are discussed in the sections below.

New Construction

New construction programs are probably the most common type of lost opportunity program offered by utilities to date. Many utilities offer residential new construction programs and some utilities offer commercial new construction programs but only a few offer industrial new construction programs. Unless otherwise stated, the following descriptions of new construction programs are based on a recent review of particularly successful energy efficiency programs (Nadel, Pye, and Jordan 1994), where success was defined as a program with a combination of high participation and savings while remaining very cost- effective to the sponsoring utility.

Residential new construction programs generally specify minimum efficiency criteria for a home to be classified as energy efficient. These criteria call for levels of efficiency that reduce energy use by 10-50 percent relative to local building code requirements (savings targets typically vary as a function of local building code stringency—the stronger the local code, the more limited the target for additional savings). Since home building markets often are larger than utility service areas, it often makes sense for several utilities in a state to develop a statewide program in which common eligibility criteria and marketing are shared by several utilities. Examples of such programs include the NYE-STAR program in New York State and the Energy Crafted Home Program in southern New England (Sandahl, Shankle, and Wise 1994).

A key feature of the most successful programs is active marketing to promote the virtues of efficient houses to home builders and home buyers. Efficient homes are typically marketed under catchy titles such as "Good Cents," "Smart Saver," and "Climate Crafted" home. Marketing emphasizes increased comfort and quality and not just energy savings. Some utilities even include a comfort guarantee ("if you are uncomfortable, we will fix the problem at our cost") or guarantee that energy bills will not exceed a specified ceiling ("or we'll pay the difference"), in order to assure home buyers that an efficient home is a good investment. Another important feature of these programs is building a good working relationship with builders through one-on-one contacts with utility representatives, training programs on new construction techniques found in efficient homes, and often cooperative advertising jointly funded by individual builders and the utility. Financial incentives, in the form of rebates, financing, or rate discounts, are usually, but not always, included as well. For example the Pacific Gas & Electric (PG&E) Comfort Home program combines modest incentive payments of $225-400 per home with a special financing package in which area lenders have agreed to reduce closing costs by $500 and increase maximum mortgage amounts by 10 percent relative to conventional underwriting criteria for participating homes (Cassentini 1996). Recently, some electric utilities have added incentives to promote ground- source heat pumps to their residential new construction programs.

Perhaps the most successful residential new construction programs were the residential new construction market transformation programs offered by BPA during the 1983-1991 period and briefly discussed above. Key to this effort were two complementary promotion programs—the Super Good Cents builder incentive program, which was very similar to the description in the previous paragraph, and the Northwest Energy Code program, which encouraged municipalities to adopt local energy codes based on Super Good Cents standards. During the program period more than one-third of new homes in the region participated in these two programs. As a result of these programs combined with a concerted lobbying effort by utilities and other energy efficiency advocates, the states of Washington and Oregon adopted statewide energy codes based on Super Good Cents standards. A study by the Washington State Energy Office (Schwartz, Byers, and Mountjoy/Venning 1993) found that BPA's efforts to change building practices in the Pacific Northwest cost BPA less than $0.01 per kWh saved when the benefits of the new energy code are factored into the calculations.

In a similar vein, PG&E's Comfort Home program is now actively promoting efficiency improvements, such as proper duct sealing and air conditioner installation, that are not part of California's Title 24 building code. Approximately 25 percent of new homes in their service territory are participating in the program. PG&E plans to work with the California Energy Commission to include increased attention to duct sealing and other efficiency measures in the 1998 version of Title 24 (Cassentini 1996).

Commercial new construction programs also encourage new buildings whose efficiency significantly exceeds local building code requirements. Typically these programs have two tracks—a prescriptive track that provides rebates for common measures such as high-efficiency lighting and HVAC equipment, and a performance track that provides design assistance and custom rebates for comprehensive packages of efficiency measures that are optimized through the design process. Two programs that are worth noting are United Illuminating's (UI) Energy Blueprint program and PacifiCorp's Large Commercial Energy FinAnswer program.

United Illuminating (a utility in Connecticut) estimates that at least 75 percent of new buildings built in its service area participate in the Energy Blueprint program. The program includes both prescriptive and performance tracks although the former accounts for the vast majority of participants. Incentives typically cover 50-75 percent of incremental measure costs. The performance track can provide higher incentives but to participate in this track facilities must reduce energy use by 20 percent relative to prevailing local construction practices. The program also offers Design Grants to help cover the additional costs of designing efficient buildings, and Commissioning Grants to help ensure that building systems are set-up properly. The program is primarily marketed by word-of-mouth—utility representatives regularly contact developers, architects, engineers, and designers as well as owners of buildings in the construction process. Most owners hear about the program through their architects or engineers who have heard of the program from UI staff. Engineering calculations indicate that energy use in participating buildings is reduced by about 10 percent on average relative to prevailing local construction practices (Marone 1996). These savings are more modest than programs with more extensive incentives or services such as PacifiCorp's FinAnswer program, discussed below.

PacifiCorp serves large parts of Oregon and Utah. Its program emphasizes a comprehensive, whole-building approach to achieving energy savings. Large buildings are analyzed with a computer model to estimate energy savings from different packages of measures and to select the optimal package. Small buildings can take advantage of measure packages developed by PacifiCorp based on prototypical small buildings. In order to participate in the program, buildings must reduce energy use by at least 10 percent relative to local construction packages. Unlike most other commercial new construction programs, the PacifiCorp program requires commissioning of all projects to ensure that systems are set-up and running properly. The program also includes an audit one year after occupancy to verify savings. These extra services help ensure that savings are achieved, providing major benefits to participants and the utility. These comprehensive and quality services are a major reason for the program's participation rate of 63 percent of new commercial building floor area in the third year of program operations. Another unique aspect of the FinAnswer program is the financing approach—PacifiCorp provides a loan to customers at the prime interest rate to finance 100 percent of the incremental cost of efficiency measures. Customers then pay the loan back through their utility bill over a 10-20 year period. Program administrative costs are paid by the utility. Overall, loan payments cover 70-80 percent of program costs and the utility funds the remainder. Thus, the PacifiCorp program uses extensive services and moderate incentives to achieve its savings goals.

These and other similar commercial new construction programs typically cost the utility $0.015-0.035 per kWh saved, approximately $0.005-0.015 less than commercial retrofit programs that seek to promote comprehensive packages of efficiency improvements.

As with the BPA residential new construction program described above, commercial new construction programs can also support and facilitate building codes, thereby increasing energy savings. For example, in 1991 Ontario Hydro conducted research on the commercial new construction market in Ontario and decided that the best course of action was to encourage the provincial government to adopt a model building standard for new commercial buildings developed by the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE). In the April 1992 to March 1993 period Ontario Hydro offered training on the ASHRAE standard and paid incentives for buildings meeting this standard; 29 percent of new commercial floor area built in that year participated in the program. In 1993 the provincial government adopted the ASHRAE standard and Ontario Hydro agreed to continue to fund training programs for building officials and building designers on the new code. In addition, Ontario Hydro offered incentives to building designers for new buildings that exceeded the new code, thereby helping to lay the groundwork for future code updates (Lemoine 1994). By helping to leverage building code changes, utilities can have a large "multiplier effect" and thereby achieve energy savings at relatively low cost.

The late 1990s will provide a good opportunity to follow this path as the main model commercial energy code in use in the United States—ASHRAE Standard 90.1—is now undergoing revision. In March 1996 the first draft of this new standard was published for public comment. The draft new building code standard is estimated to reduce energy use of new buildings by an average of roughly 20 percent relative to the old standard (McBride 1995[5]). This new standard should be completed in approximately 1998 and can be adopted in state energy codes shortly thereafter. However, utilities now can begin to use elements of the draft standard to offer voluntary incentive programs, thereby laying the groundwork for mandatory adoption of the standard once it is finalized.

Only a few utilities have offered industrial new construction programs, and of these, only some have actively worked to customize the program to meet the needs of industrial customers (most industrial new construction programs also serve commercial customers). Industrial new construction programs can encourage use of efficient processes in new factories and new production lines. These programs can also be used to encourage new plants to locate in the sponsoring utility's territory or can be used to encourage existing customers to expand their local operations. Because each production process and factory are different, a key component for a successful new construction is to have consultants on retainer who are experts in particular process industries. These consultants can offer advice to customers on process line improvements they can make that save energy. These consultants can also advise the utility on which measures are prevailing practice in a particular industry (and hence the customer should pay for) and which measures go beyond standard practice and are appropriate for utility incentives.

Among the industrial new construction programs that have achieved some success to date are UI's Energy Blueprint, B.C. Hydro's New Plant Design, and BPA's Energy Savings Plan programs. Each of these programs deal with both industrial buildings and industrial processes and make extensive use of experienced process engineers to establish baselines and recommend efficiency improvements. All offer design grants to industries to cover their costs of analyzing alternative plant designs. Under the UI and BPA programs, incentives to industrial customers typically cover 50-80 percent of the incremental cost of a project and reduce energy use by 20-30 percent below baseline on average. The managers of these programs have several recommendations to make. UI has found that it is important to staff the program with people who are experienced and well versed in a particular industry. B.C. Hydro notes that several years can elapse from the time when a project is proposed and the new plant completed, and therefore patience is required on the part of the utility and also a willingness to honor incentive commitments made several years earlier. The industrial component of UI's program has cost the utility $0.02 per kWh saved (Nadel and Jordan 1993; Nadel, Pye, and Jordan 1994).

Equipment Replacement

Equipment replacement programs encourage customers to buy efficient equipment when old equipment needs replacement. Since new equipment is being purchased, energy savings can be purchased for the incremental cost of the more efficient equipment. In the residential sector, these programs commonly cover refrigerators and air conditioners, but clothes washers and water heaters also offer large energy-saving opportunities. In the commercial sector, these programs commonly cover ballasts,

[5] The analysis presented was broken down by fuel type and tier. The 20 percent figure provided is an approximate weighted average by fuel type for tier 1 (the basic tier intended for mandatory use).

HVAC systems, refrigeration systems and motors. In the industrial sector, motors are most commonly covered but efficient fans, pumps, and compressors are other potential targets. Market transformation programs for many of these equipment types are now getting underway, as summarized in Table 1.

Regardless of sector, most equipment replacement decisions are made hurriedly—when the existing equipment breaks, it must be replaced immediately. Thus a key to the success of equipment replacement programs is to work closely with equipment vendors and contractors, so that the vendors and contractors promote the program when customers come to them for replacement equipment. In addition, since equipment replacement decisions are often made on the basis of first-cost—there often is not time for a drawn-out decision-making process involving life-cycle costing, incentives are usually needed to cover a significant share of the incremental costs of the more efficient equipment. Incentives of 50-75 percent of incremental cost are typical for equipment that is well-proven; for new, unproven technologies without an established track record, incentives close to full incremental cost are often needed to obtain consumer interest.

Remodeling

Remodeling is the replacement of some major building components in response to tenant changes or the need to update the "look" of systems in a building. Remodeling of energy systems is probably most common in the commercial sector. For example, when tenants change, frequently internal walls are moved, the space is redecorated, and new lights are installed. Major renovations may include a new HVAC system as well. A 1994 survey conducted for BPA estimated that approximately 10 percent of commercial floor area is remodeled each year (Skumatz and Hickman 1994). A previous BPA survey found that more than 90 percent of the potential energy savings during remodeling are in lighting improvements, with most of the remaining available savings in HVAC and refrigeration (Katz, Baylon, and Gordon 1989). Thus, over an approximately ten-year period, there is an opportunity to affect the efficiency of most lighting systems in a service area while longer periods are needed to influence most existing HVAC and refrigeration systems. At the time new lighting, HVAC, and refrigeration systems are being installed, efficiency can be purchased for only the incremental cost of efficient systems and designs relative to conventional systems and designs.

Influencing remodeling decisions is not easy. From the time a decision to remodel is made, often only a month or two elapses before the job is completed. As a result, little time is available to find out about each remodeling job and affect the design. Thus, a key to successfully marketing a remodeling program is to work with the designers and contractors who work on remodeling jobs. However, these contractors and designers are not easy to locate as many of them work in small firms or even sole proprietorships.

Very few utilities have attempted to capture this lost opportunity resource. Green Mountain Power and Boston Edison offered limited remodeling programs for several years. The Boston Edison program started slowly, but by its third year incremental net annualized savings totaled 1,297 MWh, nearly all of which was from indoor lighting measures (RCG/Hagler Bailly 1994). The GMP program reported some success working with large chains with multiple facilities in their service area. Ultimately the remodeling program was combined with their equipment replacement program in order to simplify program administration (Results Center 1993). In addition to focusing on large chains, remodeling programs can also work with property management companies, rental agents, and mall owners to identify spaces that have just been rented and are about to be remodeled. The remodeling program can then work with designers and contractors hired by these trade allies to encourage them to specify and install efficient equipment.

A Commercial Lighting Remodeling program targeted at owners and managers of multiple properties (i.e., chain stores and real estate investment managers) is now being developed in Massachusetts by Northeast Energy Efficiency Partnerships, a new consortium of utilities, state agencies, and public interest groups. Key elements of the program include firm-specific demonstrations and training on high-quality, high-efficiency lighting remodeling projects; enhancements to the state building code such as tightening the Watts per square foot lighting power allowances in the state building code; and development of industry consensus lighting guidelines for remodeling (e.g., prototype specifications for specific commercial building types) (Gordon, Tumidaj, and Coakley 1995).

A specific remodeling opportunity that will occur extensively in the late 1990s involves chillers. Most large chillers use CFCs as refrigerants. Production of these refrigerants was phased out in 1995 under the provisions of the Montreal Treaty on Stratospheric Ozone Protection. As a result, many chillers that use CFCs are now being replaced or are being converted to use alternative refrigerants. For example, a 1996 survey by the Air-Conditioning and Refrigeration Institute (ARI) estimated that over the 1996-1998 period, 25 percent of the existing stock of CFC chillers will be replaced or converted, with replacements outnumbering conversions by 3:1. In subsequent years many additional chillers will be converted or replaced; ARI estimates that as of January 1999, 57 percent of pre-1992 CFC chillers will still need replacement or conversion (ACHRN 1996).

As part of this replacement and conversion process, there are extensive opportunities to save energy. First, more efficient chillers of the same type as the present chiller can be purchased—typically 10-20 percent savings are possible by purchasing high-efficiency instead of standard-efficiency machines. Second, a more efficient type of chiller can be used. Water-cooled equipment is generally more efficient than air-cooled equipment; centrifugal chillers are generally more efficient than screw chillers, which are generally more efficient than reciprocating equipment. Third, multiple-speed or variable-speed chillers, pumps, and cooling towers can be used to save energy during off-peak periods. Fourth, through careful system design—optimizing system approach temperatures, heat exchange surface area, and other design parameters to the needs of the application—substantial additional energy can be saved. Fifth, efficient auxiliary systems, such as efficient cooling towers and evaporative coolers, can save additional energy. Overall, through these steps, energy savings of as much as 45 percent can be achieved at the time of chiller replacement (Nugent 1993; PG&E 1994). The cost of saved energy for these measures averages approximately $0.02 per kWh saved (Nadel and Geller 1994).

However, promoting these energy savings requires skilled systems designers to provide technical assistance and also requires more complex incentive designs than simple rebates based on chiller efficiency at standard design conditions. CEE is now working to develop a model program design that utilities can adopt (CEE 1996d). In a precursor to the CEE program, PG&E's new construction program offers chiller incentives as a function of chiller efficiency at design conditions and chiller condensing temperature (lower condensing temperatures improve efficiency, provided other system components are sized to meet cooling needs with the lower condensing temperature). In addition, incentives are offered for oversized cooling towers and evaporative condensers (oversizing reduces the temperature of refrigerant entering the chiller, allowing lower chiller condensing temperatures) (PG&E 1994).

Furthermore, by implementing lighting and other efficiency improvements at the same time, it is possible to reduce cooling loads, thereby reducing conversion costs (since smaller chillers cost less than large chillers) and increasing post-conversion chiller efficiency (either because a new, more efficient chiller is installed or because with a remodeled, downsized chiller, heat exchange surfaces are oversized for the new, reduced cooling load, increasing system efficiency). Due to the large savings possible from this one-time CFC-phase-out opportunity, at least five utilities are offering chiller conversion and replacement programs (Robertson 1996; Robertson, Stein, and Wolpert 1994). Results of these programs are generally not yet available. However, preliminary results from one of these programs indicate average reductions in whole-building energy use of 14 percent, at an average cost of $4.50 per square foot of floor area, resulting in an average simple payback period of six years before any utility rebate contribution (Fryer and Leach 1995).

BUILD CUSTOMER LOYALTY

As utilities prepare for increased competition, retaining important customers is a key objective. There is a growing body of work that indicates that energy efficiency services can increase customer loyalty.

Many utilities are doing survey and statistical research on the factors that are likely to affect individual customer’s choice of an electricity supplier. In general this information is considered proprietary and is not published. However, discussions with several experts familiar with this body of research indicates that price is a primary determinant of customer loyalty, but several other factors are also important and when these other factors are combined, they can contribute as much to customer loyalty as price. For example, one national study on loyalty of industrial customers to their electric utility found that five major factors contribute to customer loyalty, including, in order from most to least important, satisfaction with price, complaint handling, energy conservation, account representatives, and reliability (confidential source). Similarly, a major electric utility has used information from its customer opinion surveys to statistically identify the major factors that affect the value of a utility to its customers. Among both residential and commercial customers this utility found that overall price satisfaction and overall quality of products/services contributed equally to customer value ratings. Five to six major factors contributed to quality of products/services ratings, including energy conservation services (confidential source).

Several utilities are now conducting more direct research on the likelihood that customers will switch electricity suppliers and the impact of energy efficiency programs on this decision. For example, in a confidential study by one large utility on its small- to medium-sized business customers, likelihood to switch suppliers was compared across a range of possible price discounts and as a function of customer ratings of their utility on a range of factors. In general, likelihood to switch was found to be approximately 20 percent higher among customers who rated their current utility's energy efficiency programs poor than among customers who rated such services excellent. Energy efficiency services were among only three non-price factors that had a statistically significant relationship to customers' expressed likelihood of switching suppliers.

A few utilities have begun to introduce customer retention more directly into their energy efficiency programs. For example, Northeast Utilities (NU) has a special program named PRIME which they target at "at-risk" customers. PRIME offers a process audit that examines manufacturing productivity improvements including energy cost savings, improvements in raw material utilization, labor productivity gains, improvements in product quality, increased production capacity, reduced costs for emissions/hazardous waste abandonment, and other potential direct customer benefits. Financing and energy efficiency incentives are offered to help customers implement productivity improvements identified in the PRIME audit.

In addition, NU's commerical and industrial (C&I) DSM programs, particularly the flagship Energy Action program, address customer retention. Under Energy Action, NU provides comprehensive energy assessments and financial and technical assistance to implement comprehensive energy efficiency packages. As part of the Energy Action contract, customers must commit to use NU as their sole electricity supplier for a three-year period or refund the incentive payments they received (Morante 1996).
An example of a PRIME and Energy Action success was a joint PRIME/Energy Action project implemented at a battery manufacturing company. As a result of this project the customer has successfully consolidated plant operations, reducing required square footage by more than 45 percent while increasing manufacturing capabilities by 25 percent. In addition to this substantial improvement in manufacturing productivity, overall energy use was reduced by 30 percent (Ogurick 1995).

Similarly, NEES offers the Energy Fit program, primarily to its largest customers, in particular customers who may be vulnerable to leaving the utility system. The general approach is to identify problems facing the customer and then to provide targeted services that address these problems. Overall, the attitude is do what is best for the customer because this approach builds and maintains trust and contributes to satisfied customers. Among the services available include: energy efficiency, power quality and reliability analyses, cogeneration analyses, and rate studies (Davis 1995).

Virginia Power (VEPCo) has also begun to use efficiency services as an inducement to retain existing customers and attract new business from outside their service territory. While efficiency services are not currently marketed alone, the company views them as important way to differentiate themselves from potential competitors. Recent power purchase agreements between VEPCo and several of their large industrial users have all included a significant efficiency component (Elliott, Pye, and Nadel 1996). Services, such as those available from the North Carolina Alternative Energy Corporation's Industrial Electrotechnology Laboratory (IEL), of which VEPCo is a sponsor, are made available to any at-risk industrial customer. VEPCo's new unregulated subsidiary, Evantage, also offers efficiency services as a "relationship building opportunity," including services provided by IEL, a growing group of contracted efficiency experts, and VEPCo's wholly owned energy consulting company, A&C Enercom. These services are often delivered at or below cost as an enticement for developing a future relationship (Web 1996).

Energy efficiency services can also play a role in longer-term power supply agreements. For example, Detroit Edison recently signed agreements with the "Big 3" auto makers in which the manufacturers agreed to purchase power from Detroit Edison for a ten-year period, securing electricity sales that totaled $332 million in 1994. In exchange, the utility has agreed to rate reductions to the three automakers worth a total of $30-50 million annually. In addition the utility is providing power quality upgrades, on-going power quality evaluation, on-site utility energy analysts to work in customer facilities, and creation of a customer-directed efficiency fund (Elliott, Pye, and Nadel 1996).

PROGRAMS THAT LOWER RATES

Load Management Programs

Load management programs shift electric loads from one period to another (typically from peak to off-peak periods) but generally do not reduce electricity use. While they are often not energy efficiency programs, they have often been operated jointly with energy efficiency programs under the heading demand-side management (DSM). But load management programs promote many of the same benefits as energy efficiency programs, such as deferring the need for new power plants, and hence we include them in this report. However, because they do not save energy, they do not cause revenue losses from reduced electric sales and, as a result, they are one of the few types of DSM programs that generally pass the rate impact measure (RIM) cost-effectiveness test. Over the past two decades, the most popular types of load management programs have probably been load control programs and interruptible and time-of-use (TOU) rates.

Load control programs primarily involve direct utility control over residential air conditioners and water heaters. In exchange for an incentive, customers permit the utility to use a timer or radio controlled switch to shut off customer equipment during peak periods. Nationwide, the average incentive payment per participant is approximately $25–30 per year. Davis, Van Liere, and Kirksey (1988) report on a number of air conditioner and water heater cycling programs that have achieved participation rates of 25 percent or more, including a few programs with participation rates of approximately 50 percent. Factors linked with high participation include high incentives, program duration (participation rates tend to steadily increase with time), and an intensive marketing effort including print and broadcast media and direct mail. For example, Houston Lighting and Power increased installations in its load control program by 50 percent by offering free movie rental coupons to customers who signed on (AESP 1995a). Savings per participant average nearly 1.0 kW for air conditioner programs (typically each air conditioner is cycled off for 20 minutes each hour) and 0.6-0.9 kW for water heater programs, with savings towards the upper end of this range in the winter (Blevins

1995). However, savings per customer vary with climate and cycling schedule. Savings increase as the length of the shutoff period increases, but the longer the shutoff period the more likely customers are to complain of discomfort or lack of hot water.

In an interruptible rate program, customers agree to reduce their demand during peak periods when requested by the utility. In exchange, customers receive a discount on their electric bills. The size of the discount depends on the demand reduction; one study found an average incentive of $44 per kW annually (Blevins 1995). These programs are primarily oriented towards large commercial and industrial (C&I) customers. The number of participants are generally low (even the most successful programs typically only include a few hundred customers) but load reductions per customer can be significant (up to several MW) and overall load savings substantial. For example, one study of 38 programs found an average reduction per customer of 1.4 MW and an average reduction per program of 88 MW (Blevins 1995).

Time-of-use rates vary the cost of energy by season or time of day. Rates are higher during periods of peak demand and lower during off-peak periods. Some utilities have made TOU rates mandatory for large C&I customers. In the residential sector, TOU rates are often limited to electrically heated homes—other homes do not use enough electricity to justify the cost of TOU electric meters for they cost several hundred dollars more than standard meters. One review found that peak load savings averaged 1 percent for C&I program participants and 6-20 percent for residential program participants. However, savings from TOU rates vary depending on the size of the peak/off-peak price differential and the length of the peak period—it is easier to shift loads out of a four-hour period than out of a twelve-hour period (Acton et al. 1983).

Another type of load management program that has received a lot of interest in the past few years is real-time pricing (RTP). Under RTP the price of electricity varies by day and for several different periods during the day. Prices are sent to customers a day or so in advance and customers seek to adjust their loads in response to these price signals. RTP differs from TOU programs in that with RTP rates typically vary each hour and each day and with TOU rates typically vary by season and daily time period (e.g., morning, afternoon, evening, and night). Many utilities are now engaged in experimental RTP programs for some of their large C&I customers. In most cases these experimental programs are limited to a specific number of participants (commonly 10-20) so that it is not possible the examine the participation rates.

However, preliminary results from a few programs provide some insight into the impact of these programs. For example, a 1993 review of RTP programs found four programs in which participating customers were surveyed. In general, participants were happy with the programs, with bill savings being a very strong factor motivating them to join and stay in the programs (Mak and Chapman 1993). More recently, a survey by Public Service Company of Oklahoma found that all of their customers are saving money under the RTP program (AESP 1995b). With high customer satisfaction and customer bill reductions, RTP programs can be a powerful tool in utility customer retention efforts. However, if all customers save under RTP, then utility revenues go down; who pays for these lost revenues (shareholders, utility cost-cutting, or ratepayers not on RTP) is an important and controversial issue.

Mak and Chapman (1993) found three utilities that have compiled data on load response to RTP. These utilities found that customer loads were reduced by 5-12 percent during the highest priced hours of the year (with maximum prices varying from $0.14-2.70 per kWh). However, since many of the RTP programs are experimental and not permanent, participating customers are reluctant to make capital investments (e.g., in computerized control systems driven by RTP price signals) that would allow them to better take advantage of the RTP rates. Thus, when RTP programs become permanent and contracts long term, peak savings may be higher.

During off-peak periods, with low electricity prices, electricity use can increase. Depending on the number of hours at low versus high prices, overall energy use can increase. Such was the case with Santee Cooper of South Carolina, which reports that participating customers are buying more power in response to lower average prices (AESP 1995b). Georgia Power and Alabama Power have also found that RTP customers increase their energy use (Krause 1995; Smith 1996). In general, such a response seems likely for many participating customers since RTP participants are self-selected to be customers who on average receive lower average rates on the RTP tariff than on standard tariffs. In fact, it appears that some utilities are using RTP programs as load building programs.

Programs for T&D Constrained Areas

Most utilities need to improve the transmission and distribution (T&D) systems in several portions of their service area each year. The cost of some of these improvements can be substantial. By offering intensive energy efficiency programs in a district a few years before the T&D improvements are needed, loads can be reduced and the need for these T&D improvements can be postponed for several years, thereby saving money and improving the cost-effectiveness of energy efficiency programs. In order to have a significant impact on loads in just a few years, retrofit programs are usually needed, as short-term savings from lost opportunity and market transformation programs are usually limited.

Several utilities have targeted retrofit programs to T&D constrained areas including Central Maine Power, Consolidated Edison, Idaho Power, Niagara Mohawk, PG&E, and Portland General Electric. For example, in 1990 Idaho Power determined that a T&D upgrade in one area would cost $3 million but that energy efficiency programs to defer the upgrade would cost less. The energy efficiency programs were run in 1991 and 1992 and achieved 78 percent of the planned reductions (participation rates were lower than planned) but this was still sufficient to postpone the upgrade. The final cost of the programs was less than the $3 million upgrade cost (Sparks et al. 1994).

Similarly, a 1993 pilot program run by Portland General Electric offered intensive energy efficiency services in four areas in an attempt to delay T&D upgrades. As a result, one of the upgrades has been delayed, another upgrade is proceeding (because T&D staff did not trust energy efficiency programs to deliver the energy efficiency savings, and implemented the upgrade anyway, even though subsequent program results showed that the upgrade could have been deferred), and decisions on the other two upgrades have yet to be made (Weijo and Ecker 1994).

UNDERSERVED CUSTOMER CLASSES

While much of this report argues that utility energy efficiency efforts should focus on market transformation, lost opportunity, and customer retention programs, a problem with such a strategy is that these program approaches may leave some customer classes subsidizing energy efficiency savings by other classes. Also, the transition to a more competitive electricity industry is likely to be of particular benefit to large customers with substantial market power and the least benefit to small customers, particularly small customers with limited political power. Both of these factors apply particularly to low-income households, and thus special energy- and bill-saving programs targeted at low-income families are needed. Small commercial and industrial customers may also meet these criteria.

Low-Income Weatherization and Energy-Saving Services

Low-income families rarely buy new homes or remodel existing homes, and often buy appliances from the used rather than the new appliance market. For these reasons, low-income families are less likely to be served by the lost opportunity and market transformation programs discussed above. This fact can produce the perverse result that low-income families are helping to subsidize energy efficiency savings for wealthier customer classes. To prevent this from occurring, many utilities have developed special programs or marketing efforts targeted specifically towards low-income families. An additional rationale for these programs is that reducing electric bills makes it easier for low-income families to pay their electric bill, thereby reducing the amount of uncollectible bills and disconnection costs that utilities must write-off (Colton 1993). In a recent report, Pye (1996) highlights some of these efforts and identifies many different strategies for targeting this customer class.

A 1984 study (Morgan and Katz) found that participation rates among low-income customers tend to increase when community-based marketing is employed using respected community organizations, services are free (or heavily subsidized), and measure installation is included among the services provided.

In an era of tight budgets, many utilities will be looking for a simple and relatively inexpensive approach for serving this sector. Perhaps the program approach that best meets this need is for the utility to work with the Weatherization Assistance Program (WAP), which is administered by Community Action Programs (CAPs) throughout the country, with funding from DOE. The WAP program helps weatherize homes of low-income residents; the program emphasizes space heating, with the result that frequently electricity-saving measures are not covered by the limited grant per home. To address this problem, some utilities contract with CAP agencies to install specific electricity-saving measures in homes served by the WAP program and/or provide complete weatherization services for additional electrically heated homes. By piggy-backing on an existing program, administrative costs are minimized, which allows utilities to pay the full cost of a measure and still keep the program cost-effective.

One example of such a collaborative is funded by the state of Iowa, its major investor-owned utilities (IOUs), and federal funds (WAP and Low-Income Home Energy Assistance Program—LIHEAP). Collaborating allows the group to minimize costs and enhance program quality by establishing common eligibility and reporting criteria, purchasing standardized conservation measures in bulk, sharing evaluation costs, creating uniformity, working with agencies that are knowledgeable about low-income households and weatherization, and providing the greatest amount of services with minimum intrusion to customers (Dalhoff 1996a; WECC 1995). Utilities provide approximately 13 percent of total program funding but their expenditures account for a disproportionately large fraction of energy and demand savings: 56 percent of electricity savings, 37 percent of electricity demand savings, 28 percent of annual therm savings, and 25 percent of peak day therm savings (Dalhoff 1996b). As a result of this concentration of energy savings from utility spending, from a utility perspective (IES Utilities, Inc., in particular), the program is cost-effective, with a benefit-cost ratio of 1.4 for electricity and 1.25 for gas (Reuter 1996).

Another potentially viable approach for utilities is performance contracting. In recent years several non-profit organizations have developed expertise in improving the efficiency of public housing and other low-income housing on a fee-for-savings basis. At least one for-profit organization has also entered this field. In these programs the service provider identifies, finances, and installs efficiency measures, and conducts tenant education. Electricity savings are determined by analyzing electric bills and the service provider is paid based on the kWh savings that are actually achieved. In this way the utility is assured that savings are actually achieved. Such programs have been operated by Niagara Mohawk, Northeast Utilities, Commonwealth Edison, Central Maine Power, and Portland General Electric. A study analyzing bids in these programs estimated an average benefit-cost ratio of 1.4, indicating that these programs are generally cost-effective to the sponsoring utility (Morgan 1994; Riordan 1994).

While most low-income programs have concentrated on space heating, in most service areas the majority of low-income households do not have electric heat and instead their electric bills primarily cover such end-uses as water heating, refrigerators, lights, and water bed heaters. To address these non-space heating loads, Duquesne Light Company created an end-use-reduction program, Smart Comfort, which offers more cost-effective, electric-reduction opportunities than approaches that primarily address space heating (Gregory 1994). Trained energy managers walk through qualified customers' homes, identifying efficiency opportunities for each individual home. They help the customer make better choices on energy use and install appropriate energy efficiency measures (e.g., CFLs, hot-water tank wraps, low-flow shower heads, and faucet aerators, as well as replacement of electrically heated water bed mattresses and older major appliances) at no cost to the customer (Duquesne 1995). The program has been very successful, reducing average electricity use by 35 percent per household in 1993 for a utility cost of around $0.03 per kWh saved, based on billing analysis (Results Center 1996b).

Small Commercial and Industrial Lighting Retrofits

Many utilities have found that small commercial and industrial (C&I) customers are less likely to participate in equipment rebate or new construction programs than large C&I customers (Nadel 1990). In order to address this imbalance and provide greater service to small C&I customers, several utilities have developed small C&I programs that have achieved participation rates of 50 percent or more of eligible customers. These programs, often called direct installation programs, provide complete services for the identification, installation, and financing of efficiency measures, primarily efficient lighting. Under this type of program, utility contractors conduct a lighting audit of a facility, prepare a work order for cost-effecting lighting measures (and sometimes other measures), obtain owner or tenant approval to install the recommended measures, finance the measures, and install the measures. Financing is most commonly in the form of a grant that covers all material and installation costs. Some utilities ask participating customers to help pay for measures, up to the point that the simple payback on the customer's investment is one or two years.

Examples of programs of this type are New England Electric's Small C&I program, PG&E's Model Communities program, and the Sacramento Municipal Utility District's Commercial Lamp Installation program. These programs are generally cost-effective to the sponsoring utility but utility costs are higher than most of the other energy efficiency programs discussed in this report. For example, a 1994 study of several of these programs found utility costs of $0.036-0.064 per kWh saved (Nadel, Pye, and Jordan 1994). Thus, the rationale for these programs are equity considerations, not inexpensive savings.

In an effort to reduce the cost of these programs, some utilities have begun asking customers to pay a greater share of program costs, either up-front or by taking out a utility-provided loan to cover equipment and installation costs. For example, in 1994 NEES reduced the utility share of measure and installation costs in its small C&I direct installation program from 100 percent to 80 percent. Following this change, the percentage of customers who installed measures recommended by the audit decreased from 91 percent to 71 percent, a still very substantial installation rate (MECo 1995). In Wisconsin, a pilot program jointly sponsored by Wisconsin Public Power and Wisconsin Gas in the town of New London combines 6 percent utility loans with a community-based marketing approach. After 1.5 years, approximately 0.3 percent of the 300 eligible commercial and industrial customers have participated, primarily to implement lighting efficiency measures (Holt, Gordon, and Tumidaj 1995). There is additional discussion on this program in the next section of this report.

EXPERIMENTAL PROGRAMS

As a result of concerns about industry restructuring and the possibility of retail competition, some utilities are looking for more radical changes to their energy efficiency efforts than the ideas discussed above. These utilities would ideally like to find ways to profit from energy efficiency or at least reduce energy efficiency expenditures to very low levels by making recipient customers pay most if not all of the cost of energy efficiency services. Several ideas along these lines have been suggested, including shared savings and loans, energy service rates, and enhanced information and technical assistance services. While these types of programs have been offered for many years, results were often disappointing. In the past few years, new creative ways to structure loan, shared savings, and information programs have been developed which hold significant promise. However, for the most part, these ideas are not fully proven. Thus, the next few years are a good time for continued experimentation with these approaches by offering pilot programs in order to see which approaches work well and which do not. While these experiments progress, the proven program approaches discussed above can also be implemented, thereby providing continued customer service and energy savings. If utilities were to rely entirely on these new program approaches before they have been proven successful, they risk being disappointed with the results, and risk disappointing their regulators as well. The sections below discuss three of the experimental approaches that are being tried. Other new ideas can be considered and experimented with as well.

Loans and Shared Savings

Utilities have experimented with shared savings and loan programs for more than a decade. Unfortunately, these programs have usually been less successful at achieving high participation rates and acquiring large, cost-effective energy savings than other program approaches. Still, new approaches for offering loans and shared savings continue to be suggested and these new approaches merit experimentation.

Utility-operated loan programs were popular in the early 1980s, particularly for residential customers. For example, perhaps the most successful of these loan programs was the Tennessee Valley Authority's (TVA) Home Weatherization program. This program provided zero interest loans to families for weatherization improvements. Over the ten-year period in which it operated (1978–1988), over 600,000 homes participated, which represented 23 percent of eligible households. Reasons for this high participation rate included the attractive interest rate, the availability of free energy audits, and extensive advertising during a period of high consumer interest in energy issues. The TVA program had a utility cost of approximately $0.01 per kWh saved and a total resource cost of approximately $0.03 per kWh (both figures are based on engineering estimates) (Nadel, Pye, and Jordan 1994).

In the mid- and late-1980s some utilities started offering rebates, including several programs that offered both loans and rebates. These utilities found that most customers prefer rebates. For example, both Wisconsin Electric and Puget Sound Power and Light offered C&I customers a choice between a zero interest loan or a rebate that was approximately equivalent to the interest subsidy on the loan. In both programs, over 90 percent of the participating customers chose rebates instead of loans, although loans were useful for the minority of customers who lacked capital to finance measures on their own. Also, these utilities found that the rebates were generally easier to administer than loans (Nadel 1990). Comparisons of residential loans versus grants have reached similar conclusions (Stern, Berry, and Hirst 1985). As a result of these findings, most utilities discontinued their loan programs in favor of rebates.

In a shared savings approach, a utility or energy service company helps identify and finance energy efficiency measures in customer facilities. As energy savings accrue, the customer then pays the utility or energy service company a portion of the money saved. In some programs, all program costs are recouped from participating customers; in other programs, only a portion of program costs are recouped—remaining costs are a utility-financed investment in end-use efficiency. While the shared savings concept appears very attractive on paper, and these programs can be effective for some market niches such as government buildings, for the most part they have not generally been very successful.

For example, in the late 1980s several utilities offered industrial shared savings programs including Central Maine Power (CMP), Northeast Utilities (NU), and Wisconsin Power & Light (WP&L). Most of these programs included some utility subsidies. Participation rates were disappointingly low: for example, 1 out of 45 targeted customers participated in CMP’s program while only 3 out of 179 participated in NU's program (Nadel 1990). These programs were generally marked by complex negotiations on how savings would be measured and the energy service provider paid. Many of these discussions never reached completion.

In the 1990s, in an attempt to lower the utility share of energy efficiency costs and to use non-utility capital to help finance efficiency improvements, some utilities started experimenting with loans and shared savings again and a few utilities also experimented with leases (which differ from loans in that the leasing agent rather than the customer owns the equipment during the lease period). Several of these programs have achieved good participation rates although program operators generally note that it is much more difficult to market a loan program than a rebate program. Among these model programs are Sacramento Municipal Utility District's (SMUD) Conservation Power Financing Program, Burlington Electric Department's Smartlight program, PacifiCorp's Energy FinAnswer Commercial New Construction Program, Connecticut Light & Power's Hospital Revolving Loan Fund, and Wisconsin Public Power's and Wisconsin Gas Company's New London Community Resources Project (Flanigan et al. 1995; Holt, Gordon, and Tumidaj 1995).

The SMUD program uses utility funds to finance energy-saving improvements in customer homes and businesses. Loans are provided at 8.5 percent interest, sufficient to cover SMUD's costs. Underwriting criteria and loan processing are very simple, which combined with the attractive interest rate led to 12,000 loans in 1994 and a similar rate in 1995. This is an annual participation rate of 2.6 percent of SMUD's customers. The Smartlight program has achieved a participation rate of more than 40 percent by leasing CFLs to residential customers, primarily by using a door-to-door marketing approach. The FinAnswer Commercial New Construction Program has achieved an estimated participation rate of more than 50 percent in Oregon when evaluated on a square foot of new construction basis. The program includes extensive technical assistance identifying, installing, and commissioning energy-saving measures and also finances measure installation at the prime interest rate. The program's success is probably attributable to the extensive and high-quality services provided (Flanigan et al. 1995). Also, significant credit goes to the Oregon 35 percent tax credit for energy conservation investments: in other states participation in the FinAnswer Commercial New Construction Program has been much lower. FinAnswer programs for residential and industrial retrofit have not been nearly as successful. In fact, PacifiCorp's recent offering of a cash incentive program for small commercial retrofit indicates that they do not believe that the FinAnswer Commercial New Construction Program is a viable solution for all markets (Holt, Gordon, and Tumidaj 1995). The Hospital Revolving Loan Fund is administered by the local Hospital Association and has served half of the 28 eligible hospitals

(Flanigan et al. 1995). The New London program combines 6 percent utility loans with a community-based marketing approach. After 1.5 years, approximately 0.3 percent of the 300 eligible commercial and industrial customers have participated, primarily to implement lighting efficiency measures (Holt, Gordon, and Tumidaj 1995).

In addition, a few other program that have received a lot of publicity and are worth mentioning are Southern California Edison's ENVEST program, PG&E's Home Energy Saving Loan program, and Northern State Power's Energy Smart Project. ENVEST is similar to many comprehensive direct installation programs except that financial incentives are limited and most of the program costs are financed through loan or lease arrangements with each participant. ENVEST is still midway through its pilot phase but initial results are that the program is effective at promoting comprehensive efficiency packages to institutional customers such as government agencies and hospitals. As of mid-1995, contracts were signed that call for investments of around $45 million. However, only two non-institutional customers have signed up for the program (Hassan 1995; Holt, Gordon, and Tumidaj 1995).

The PG&E program is targeted at cooling energy savings and provides loans to residential customers who buy efficient air conditioners, insulation, and low-E windows from approved contractors. Approved contractors are required to attend one-day classes on quality installation procedures and a large sample of projects receive quality-control inspections from PG&E. Loans are provided by a private utility services company who packages groups of loans together and sells the loans to Fannie Mae, a quasi-federal agency that repurchases mortgages and other types of loans from financial institutions. PG&E guarantees the loans against default. The combination of the repurchase arrangement and the PG&E default guarantee allows loans to be offered at slightly lower rates than most home improvement loans. After about one year, 4,000 loans totaling $20 million had been issued. Costs to the utility are much lower than a rebate program, consisting of program marketing and administrative costs as well as loan default costs (Altscher 1995; Byrne 1996).

The Energy Smart Project is a comprehensive, one-stop-shop program in which residential and commercial customers are offered a complete package of services including identification of efficiency measures, measure installation, financing, and quality control of measures installed. In order to keep costs to the utility down, a variety of fees are charged for services. For example, a "Complete Assessment" costs $35 and includes a walk-through assessment of potential efficiency upgrades, analysis of potential savings from installing insulation and programmable thermostats, a blower-door diagnostic test, installation of low-cost hot water saving devices, and a demonstration of CFLs in the customer’s home. CFLs, programmable thermostats, and additional showerheads and aerators are sold to customers at retail cost but bulk purchases of these products permits the utility to make a profit, which is used to subsidize some of the other services. Financing for measure installation is available at a 7 percent interest rate; in most cases financing packages are designed to have immediate positive cashflow, meaning monthly energy savings are greater than monthly loan payments (Berkowitz and Karl 1996). Results from the program are not yet available.

Most of these programs serve some type of niche market, either because they are offered for a single community (Burlington or New London), a single type of customer (hospitals or public buildings), or a particular market type (commercial new construction). Additional experimentation is needed to see whether loan and leasing programs can be effective in other customer segments.

All of these successful loan and leasing programs feature aggressive marketing (generally by organizations trusted in the community) and extensive technical assistance. However, despite the original objective of reducing utility costs, these programs may not save utilities a lot of money. Both the Smartlight and FinAnswer programs cost the utility approximately $0.03 per kWh saved (based on engineering estimates), which is approximately similar to successful rebate-oriented CFL and commercial new construction rebate programs offered by other utilities. These loan and leasing programs have significant utility costs because while the customer pays equipment costs, the utility pays substantial marketing and administrative costs (Flanigan et al. 1995; Nadel, Pye, and Jordan 1994). PacifiCorp is working on ways to reduce FinAnswer costs.

Energy Service Rates

A very old concept that is being suggested again is Thomas Edison's original idea that utilities should sell energy services, not kWh (see for example LeBlanc 1994). Under this concept, which is sometimes called end-use pricing, utilities would own or lease energy-using equipment such as lights and motors and would charge customers for the energy services delivered, such as lumen-hours of lighting or Btu’s of heating or cooling. With utilities responsible for the equipment and being paid for services not kWh, utilities have an incentive to invest in efficiency improvements that provide the same or more energy services for less kWh. However, many issues need to be addressed before this system can be successfully used, such as dealing with ownership issues (most customers presently own their own equipment), performance specification and monitoring, pricing and other contract terms, and equipment maintenance.

A recent experiment with the concept was Wisconsin Electric's End-Use Pricing program, which began in 1993. Under the program, the utility provided equipment specification, purchase, ownership, maintenance, repair, and warranty and the customer paid a monthly fee for end-use services. By the spring of 1994, the program had three participants and four more were close to being finalized. The participants included refrigeration services provided to two supermarkets and air conditioning provided to a school district. In marketing the program, the utility found that end-use services were attractive to some customers and not to others. However, the program was abruptly canceled by Wisconsin Electric after local contractors complained that the utility was taking away business from them. The utility canceled the program rather than risk a large fight with local contractors; avoiding a fight was important because Wisconsin Electric was seeking regulatory approval for a merger with neighboring Northern States Power. Program managers at Wisconsin Electric think the program design and concept are sound and that end-use services are an attractive market. However, greater attention needs to be paid to trade ally relations, including bringing local vested interests into the program rather than excluding them. Equipment prices may be a little higher working with local distributors and contractors but the alternative may be worse. Another option is to run such programs through unregulated subsidiaries or through private companies not affiliated with the utility. In these cases, contractor complaints to the utility commission are less of a concern (Results Center 1996a).

Improved Information and Technical Assistance Programs

There are many highly cost-effective energy saving measures that are not being implemented because consumers and businesses are either unfamiliar with or have significant questions about the measures. Also, some measures are not implemented because consumers and businesses do not know how best to proceed to implement the measure or lack the time for the measure implementation process. Information and technical assistance can help overcome these obstacles and lead to improved measure implementation rates.

As the utility industry moves towards increased competition, information programs have several additional attractions. First, information programs tend to be inexpensive because they do not pay incentives. Second, they have significant public relations value, an important consideration for utilities who want to lessen the fallout from energy efficiency cutbacks. On the other hand, information programs tend to be difficult to evaluate, in part because it is often unclear who is a participant and who is a nonparticipant. With tight energy efficiency budgets, programs will often have to compete for limited funds on the basis of proven return for the investment. This will generally be hard to show for information programs.

Historically, information programs began as broad public information campaigns, such as information mailed to customers along with their utility bills and media campaigns. Where these programs have been evaluated, the evaluations generally show very limited savings; for example, Collins et al. (1985) found energy savings of only 0-2 percent among recipients of pamphlets, videos, and other energy-saving information services.

Perhaps the most common type of information program is the energy audit. Most U.S. utilities (electric and gas) offered residential energy audits during the 1980s as part of the federally mandated Residential Conservation Service (RCS) program. According to an evaluation of the program six years after it began, approximately 7 percent of eligible customers nationwide had participated in the program (DOE 1987). Other evaluations of the program found audited households had average net savings of 3-5 percent (Hirst 1984) while some programs had higher participation rates and savings. Factors linked with high participation and savings included a high degree of state and utility commitment to the program, the provision of financing assistance, and assistance helping customers arrange for measure installation (DOE 1987).

Similar participation rates and savings are typical with commercial audit programs although a few programs that emphasize personal, one-on-one marketing and provide financial incentives have achieved participation rates up to 90 percent and net savings up to 8 percent. Commercial rebate programs typically cost the utility $0.01 per kWh saved (Nadel 1990).

Another common type of information program is labeling. These labeling programs come in several varieties. Federal government labels for appliances provide an estimate of the annual operating cost of each appliance. Evaluations of this program have generally found that consumers have difficultly understanding the information on the label and that savings from this type of program are limited (BPA 1988).

Utility labeling programs generally do not contain energy consumption information but instead just identify high-efficiency homes or products, helping consumers to differentiate between efficient and less efficient offerings. Utility labeling programs have been largely limited to two areas—new homes and new appliances. Several new home labeling programs have achieved considerable success, with net participation rates (gross participation minus free riders) of up to 40 percent, energy savings relative to conventional homes of up to 25 percent (based on engineering estimates), and costs to the utility on the order of $0.02 per kWh saved. These successful programs work closely with builders to elicit their participation and support and include extensive consumer education programs (including advertising) in order to create a demand for efficient products. Labeling programs for appliances have generally had lower participation rates and savings—for example, one impact evaluation of a refrigerator labeling program estimated net savings of 1.5 percent relative to new refrigerators that would have been purchased without the program (Nadel, Pye, and Jordan 1994).

In recent years the EPA has also begun the Energy Star labeling program for high-efficiency equipment including office equipment (personal computers, printers, copiers, and fax machines), HVAC equipment (central air conditioners, heat pumps, furnaces, boilers, and thermostats), and emergency exit signs for commercial and industrial buildings. Similarly, the DOE is planning an Energy Star program for home appliances including refrigerators, dishwashers, and room air conditioners. These programs involve agreements between EPA/DOE and manufacturers to label and promote high-efficiency equipment meeting agreed-upon specifications. Typically, Energy Star eligibility criteria are selected to include the approximately the top 15 percent most efficient equipment on the market. Frequently, EPA/DOE also work closely with retailers and utilities to jointly market Energy Star products. The joint endorsement of the U.S. government and the local utility can be more powerful than the endorsement of either party alone. Also, since these programs are national in scope it is easier for manufacturers to justify product design changes than for regional or utility-specific programs. Results of the initial Energy Star programs, for office equipment, have been very encouraging. For example, EPA estimates that in 1995 Energy Star personal computers, computer monitors, and printers had a national market share of approximately 70 percent, 80-85 percent, and more than 95 percent, respectively, up from very low levels prior to the start of these Energy Star programs in 1992-1993. However, these programs involved very modest cost improvements that were easy for manufacturers to make across most of their entire product lines. It is unclear how effective Energy Star will be in promoting high-efficiency HVAC equipment and appliances where the incremental cost of efficient equipment is significantly higher (Suozzo and Nadel 1996). EPA and DOE are planning to develop Energy Star labeling programs for additional equipment including residential lighting fixtures, clothes washers, and beverage vending machines and are considering programs for many additional products (Latham 1996).

Many evaluations have found that information programs can be a very useful complement to other program approaches, but information-only programs tend to result in very limited energy savings (Nadel 1990). For example, Niagara Mohawk mailed an informational brochure on energy-saving fluorescent lamps to a targeted group of lighting decision-makers at customer facilities. In a survey conducted at the end of the six-month experiment, 3 percent of these customers reported they had switched to high-efficiency fluorescent lamps in the last six months while 5.6 percent of customers who received the same brochure combined with a rebate offer reported the same switch. By way of comparison, among a control group of customers who received neither information nor incentives, 2.5 percent switched to high-efficiency lamps. Thus, relative to the control group, information alone increased use of efficient lamps by 20 percent while information plus rebates increased efficient lamp use by more than 100 percent (Clinton and Goett 1989).

The value of combining information with other program approaches is also shown by a set of programs in which extensive energy-saving education efforts are targeted at recipients of free low-income weatherization services. Typically these programs involve an initial visit by an energy educator to the home at the conclusion of weatherization measure installation; during this visit the educator and residents discuss the proper use of the new measures and other energy-use habits that can lower energy bills. Educational messages are highly targeted at the major energy uses and energy-saving opportunities in each individual home. Some of these programs include a "contract" which the customer signs, pledging to adopt discussed items. Such a commitment increases the likelihood that follow-up actions will result. Many of these programs also include follow-up contacts to reinforce the educational message, such as one or two follow-up visits or telephone calls by the energy educator or reminder postcards. Such follow-ups may include a review of households energy bills, showing households how much they have saved and providing motivation for continued or increased savings. Programs along these lines have been offered in Michigan, New York, Ohio, Oregon, Pennsylvania, and Wisconsin. Often, these programs have been thoroughly evaluated. A review of these evaluations (Quaid 1990) found that well-designed and well-delivered programs incorporating many of the elements discussed above can increase energy savings by 4-8 percent over programs without education. These evaluations indicate that the median incremental cost of a modest education program is approximately $70 and the simple payback on this investment approximately two years. Furthermore, at least one study has found that savings persist for at least three years following treatment, suggesting that education may assist in maximizing the persistence of weatherization measures (Harrington 1994).

Targeted education programs are starting to move into other sectors. Several utilities have operated or are starting targeted programs to encourage industrial customers to adopt practices to reduce the energy used by motor systems. While none of these programs have been thoroughly evaluated (many are still getting underway), they do provide useful ideas for other utilities wishing to experiment. For example, Carolina Power & Light has long operated a program to assist customers in identifying motors that are cost-effective to replace with high-efficiency motors when existing motors fail. CP&L encourages customers to paint these motors with a large yellow dot so that when these motors fail maintenance staff clearly know which type of motor to install (Jordan and Nadel 1993). In 1997 new federal efficiency standards take effect that effectively require that all new motors be "energy-efficient" motors. Even more efficient "premium efficiency" motors are now available that are cost-effective in many applications. The Consortium for Energy Efficiency has developed a model program for promoting these premium efficiency motors that will be used by utilities in the western, eastern, and central United States in 1997 (CEE 1996a).

CEE is also developing model education programs to improve motor repair practices (CEE 1996b) and optimization of critical, high-energy-use motor systems (CEE 1996c). The latter program is based on a pilot Performance Optimization Service (POS) program, originally developed by Ontario Hydro and now operated by the Energy Center of Wisconsin (a non-profit organization chartered by the Public Utilities Commission and funded by Wisconsin’s utilities). POS involves a careful evaluation of critical motor systems in order to identify ways to better optimize the system to improve production line operation and save energy. The POS program is an integrated program involving: (1) specialized trade ally training to enable them to perform the evaluations, (2) customer education on the benefits of performance optimization, (3) technical assistance to the customer's project implementation team from POS experts, and (4) financing through the electric utilities. For example, the G. Heileman Brewing Company’s POS analysis of its cooling system indicated that the main 150 HP cooling water pump was heavily throttled resulting in reduced chiller capacity and inefficient operation. Trimming the pump impeller (a low-cost measure) allowed production to be increased while reducing annual energy bills by more than $25,000 based on engineering estimates (Elliott, Pye, and Nadel 1996).

Utilities working on motor system programs can also take advantage of DOE's Motor Challenge program, which is encouraging large companies on a national basis to commit to carefully examining opportunities to improve motor system efficiency and to implement cost-effective measures. DOE is developing a growing list of informational and technical assistance tools to assist customers—and utilities working with their customers—in identifying, analyzing, and installing motor system efficiency improvement measures (DOE 1996).

Another area where targeted information and technical assistance programs are starting is on the proper commissioning and operations and maintenance (O&M) of control and other systems in large commercial buildings. When energy management systems, lighting and HVAC controls, and other building systems do not operate properly, substantial energy waste can result. For example, staff associated with the Texas LoanSTAR program have found that O&M measures can reduce energy use by an average of 23 percent, with savings in individual buildings ranging from 10-40 percent (Claridge et al. 1994). Commissioning a new system typically requires the services of an engineering consultant experienced in commissioning work. On-going operations and maintenance is then commonly the responsibility of facility staff.

In the area of commissioning, several utilities have run incentive-based commissioning programs, including PacifiCorp, NEES, Seattle City Light, and UI (Benner and Dasher 1996). PacifiCorp alone has commissioned more than 50 projects and considers commissioning a vital part of their commercial new construction program (Yoder and Kaplan 1994). Data on commissioning savings and paybacks are very limited but available data indicate operating cost savings of 7-15 percent and simple payback periods of 1.8-3.0 years (Bjornskov et al. 1994). With cutbacks in energy efficiency budgets, PacifiCorp is seeking to lower utility-funded commissioning costs by concentrating on the projects with the largest potential for commissioning energy savings and by promoting the value of commissioning to customers so that customers are more likely to undertake commissioning on their own (Yoder and Kaplan 1994). More recently, several utilities have begun programs to educate their customers about the value of commissioning, to provide technical assistance to customers wishing to contract for commissioning services, and/or to provide commissioning on a fee-for-service basis. For example, Florida Power & Light is holding workshops on commissioning for their customers and is preparing a guide for customers on obtaining commissioning services (Dasher 1996). Wisconsin Gas is running a pilot program that includes educational materials and training workshops for customers and trade allies. And Southern California Edison is incorporating commissioning into their ENVEST program and is also providing commissioning on a fee-for-service basis for its other customers (Benner and Dasher 1996). These education-based and fee-for-service programs are too young to be evaluated.

In the area of O&M, Shaw (1994) reviewed initial results from several commercial operations and maintenance training programs for facility operations staff and found that important elements in the design of effective O&M programs include: (1) securing the involvement and commitment of facility-operations decision-makers and not just working with low- and mid-level staff; (2) building a rapport with trainees in order to convince staff to change ingrained behaviors; and (3) customizing training to the particular needs of the audience. Shaw also noted several barriers to successful O&M training programs for facility maintenance staff and suggests that some building operators may be willing to contract with energy service companies or utilities for O&M services.

Overall, there are many different approaches for providing energy efficiency training and technical assistance. While it is difficult to generalize about these programs, the results discussed above indicate that programs tend to be most effective when they are highly targeted, emphasizing measures that offer large savings opportunities for specific facilities. Also, many information and technical assistance programs work best when they are a component in a broader effort (i.e., one of several components in a lost opportunity or market transformation program) rather than an isolated effort.

UTILITY SUPPORT FOR NON-UTILITY REGULATORY AND VOLUNTARY ENERGY EFFICIENCY PROGRAMS

As an alternative or supplement to utility energy efficiency programs, some have suggested increased regulation to promote cost-effective energy savings. In many cases efficient equipment is cost-effective to end-users but due to a variety of market barriers, consumers will often choose less efficient equipment (Levine et al. 1994). To address these problems, federal, state and provincial governments have adopted energy efficiency standards for approximately two dozen different types of equipment and many states and local jurisdictions have building codes that regulate the energy efficiency of new construction.

In many cases, regulation has proven to be an effective and cost-effective way to promote substantial energy savings. For example, a recent analysis of federal appliance and equipment efficiency standards estimated that these programs will reduce peak electric demand by 20,800 MW in 2000 and have an average benefit-cost ratio of more than 3:1 (Geller 1995). In other cases, such as building retrofit ordinances, regulation is still somewhat experimental.

There are substantial opportunities to expand these regulations, including adopting stronger efficiency standards on some products (Nadel 1994b), strengthening state and local building codes (Klevgard, Taylor, and Lucas 1994), and adopting efficiency standards on products not yet covered (Nadel 1994a). Increased utility support for adoption of new and strengthened codes and standards can be very helpful for getting these regulations adopted. For example, in Canada electrical utilities, working through the Canadian Electrical Association, have been in the forefront of efforts to conduct research and development of consensus standards that can be adopted by provincial governments and ultimately the Canadian federal government. Among the products involved are commercial refrigeration equipment, water coolers, ice makers, vending machines, and distribution transformers (Nadel 1996).

For existing buildings there is an additional option—building retrofit ordinances. Building retrofit ordinances require that when a home or building is sold or renovated, the energy efficiency must be improved to meet specific prescriptive standards (e.g., R-30 attic insulation) and/or performance standards (e.g., maximum of 2 Watts of lighting equipment per square foot of floor area). The rationale is that when buildings are sold, significant profits are often made due to real estate appreciation and it is reasonable to expect that a portion of these profits will be channeled into energy saving retrofits that are in the purchaser's and society's long-term interest. Building-retrofit ordinances have been adopted by several local and state governments including Berkeley and San Francisco. Often these ordinances cap expenditures required for compliance. For example, Berkeley limits expenditures on one- and two-family homes to 0.75 percent of the property's sale price or 1 percent of the renovation costs; in this way homeowners are protected against high costs. A number of states and municipalities, such as Minnesota and Ann Arbor, Michigan, also target rental properties, requiring landlords to perform specific efficiency upgrades to rental units (Suozzo, Wang, and Nadel 1996).

Significant energy savings can be achieved with these ordinances. San Francisco’s retrofit ordinance, for example, led to efficiency improvements in 160,000 residential units and $6 million in energy cost savings (Hubbard and Fong 1995). However, enforcement of ordinances has been a problem, as building inspectors place ordinance enforcement low down on their priority lists and financing for the improvements may not be readily available. To address the first problem, building inspectors’ roles can be limited to renovations; for property sales a system can be set up where the seller certifies compliance with the retrofit ordinance and is liable if the buyer subsequently learns the certification is false. To address the latter problem, utilities can provide loans to customers, with loan payments included on subsequent electric bills. Alternatively or in addition, arrangements can be made with local banks to include the cost of energy improvements in the building mortgage or renovation loan. However, another big barrier to retrofit ordinances is political opposition—real estate interests in particular tend to fight passage of these ordinances.

In addition to supporting adoption of codes, standards, and regulatory ordinances, utilities can assist in the proper implementation of these regulations. For example, as discussed above, BPA and Ontario

Hydro have played important roles in conducting training programs on new building codes. In California, utilities have operated joint training programs with the state on the requirements of the state building code and on utility programs to encourage builders to exceed code requirements. Going beyond basic training, in the state of Washington utilities have helped fund a "circuit rider" who provides technical assistance to local building officials and assists them in enforcing the energy sections of the state building code (Nadel 1992; Sandahl, Shankle, and Wise 1994). Efforts such as these improve code implementation, helping to ensure that energy savings are achieved in the field instead of just on paper.

All of these regulatory programs offer an opportunity to capture energy savings that could be captured, at least in part, by utility energy efficiency programs. However, these options should be seen as a complement rather than an alternative to utility energy efficiency efforts. Utility programs and other voluntary programs help build up builder, contractor, and building owner comfort with specific efficiency measures, thereby making it easier to adopt regulations in the long term. However, without first using the carrot (utility technical assistance and incentives), it will usually be very difficult to use the stick (regulations).

Furthermore, while large energy savings have been achieved by mandatory regulations, government agencies and independent associations often operate programs that use voluntary, market-based mechanisms to encourage businesses to adopt energy-saving practices. Notable examples include EPA's "Green Lights" and "Energy Star" programs and DOE's "Motor Challenge" program. Many of these programs were discussed earlier in this report. All of these programs encourage close coordination with local utilities. However, budgets for these programs are small, much smaller than recent-year utility energy efficiency expenditures, so these voluntary programs also represent a complement rather than a supplement to utility efforts.

ROLES FOR TRADITIONAL UTILITY PROGRAM APPROACHES

Traditional utility energy efficiency programs have emphasized retrofitting inefficient buildings. Much of these savings can be captured over the long term through programs that concentrate on new construction, remodeling, equipment replacement, and market transformation. However, with most utilities in the United States not needing new capacity until after 2000, when energy efficiency budgets are tight it makes sense to limit retrofit expenditures and concentrate on the long-term market transformation, lost opportunity, customer retention, and RIM-passing programs discussed above.

In an era of tight energy efficiency budgets, the role of many traditional energy efficiency program approaches will change. Rebates will be used more sparingly, will decline in magnitude, and will tend to focus on lost opportunity measures, measures being promoted as part of comprehensive market transformation strategies, retrofit measures for low-income households and other underserved customer classes, and retrofit measures that are inexpensive per unit of energy saved and serve critical customer satisfaction goals. Direct installation programs will probably be used very sparingly, primarily to serve customer classes such as low-income families and possibly small C&I customers who are underserved by other program approaches and may be the least likely to benefit from utility restructuring.

The role of other program approaches, such as bidding, are less clear. On the one hand, increased wholesale competition to supply power to utilities will probably lead to increased bidding programs for both supply- and demand-side resources. In addition, bidding programs rely primarily on outside contractors, which is attractive to utilities that anticipate they may need to make extensive budget cuts in the future. Also, some utility commissions may require use of bidding, based on concerns that utility-operated energy efficiency programs may give utility-affiliated generating companies an advantage when competing for power sale contracts with non-utility generating companies. On the other hand, limited experience to date with demand-side bidding tends to show that bidding programs are more expensive to the utility and society per kWh saved than traditional energy efficiency approaches (Goldman and Kito 1994; Nadel and Jordan 1993). In an era of tight budgets it is the more expensive programs that will generally be cut first. Also, as competition among power providers increase, utilities will increasingly emphasize customer service. However, third party contractors may be less likely to take the extra step to provide top quality service than utility employees whose long-term livelihood depends on the health of the company. Time will tell how utilities weigh these different factors and decide the role of bidding in future program mixes.

DISCUSSION AND CONCLUSIONS

Due to broad changes taking place in the utility industry, energy efficiency budgets are being cut. Most utilities in the United States and Canada do not need significant new capacity until after the turn-of-the-century. As a result, the rationale for energy efficiency programs is changing away from short-term resource acquisition towards other goals such as customer retention, cost-cutting, rate reduction, profit-making, and providing long-term public benefits such as energy savings and low-income energy services. Achieving these different goals will require several different program approaches including:

* Market transformation programs that offer great potential for maximizing long-term energy savings while minimizing utility costs.

* Lost opportunity programs that can also provide substantial long-term energy savings as well as customer-service benefits.

* Customer service programs, such as customized technical assistance and financing, to assist customers in reducing energy use and energy bills, thereby increasing customer satisfaction and aiding customer retention and customer attraction goals. Some of these services may even have the potential for generating profits.

* Programs that pass the RIM test and lower rates for all customers, such as many load-control programs and geographically targeted programs that can delay expensive transmission and distribution upgrades.

* Underserved customer programs, such as programs for low-income households and small commercial and industrial customers, who are likely to be underserved by other energy efficiency program approaches and are likely to be the last to benefit from increased competition in the utility industry.

* New and refined approaches for reducing utility costs and increasing the share of energy efficiency investments paid by customers, including loans, shared savings, leasing, energy-service rates, and targeted information/technical assistance programs.

* Increased utility support for mandatory codes and standards and non-utility voluntary market-driven programs that require or promote efficiency improvements to equipment, buildings, and facilities.

Many of these program approaches are well-proven, others still in the experimental stage. All of these approaches can be further refined and improved. Over the next few years, which represents a transition period from a heavily regulated to a more competitive market, utilities are advised to pursue a mix of energy efficiency program approaches, mixing the most effective programs from the past with new, more experimental programs now at the cutting edge. In this way utilities can make progress towards customer-service and energy-saving goals while gaining experience in a broad array of approaches that may be useful in the future.

With many utilities proposing substantial cutbacks in energy efficiency programs, utility regulators have a particularly important role to play. Most importantly, as the utility industry is restructured, they need to set up a system in which relatively inexpensive programs with large societal benefits, such as lost opportunity and market transformation programs, are attractive for utilities (and/or others) to pursue. Care also needs to be taken to see that the new regulatory system does not discourage or penalize investments in energy efficiency. For example, use of price cap regulation may encourage utilities and other power-industry players to promote energy sales and discourage investments in efficiency, while revenue cap regulation should avoid many of these problems (Woolf 1995). In addition, since the transition to a new regulatory system is likely to be gradual, regulators should encourage a gradual, rather than sudden, change in energy efficiency programs. Industry restructuring can encourage utilities and efficiency advocates to find ways to acquire energy efficiency more cost effectively, to everyone's advantage.

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