Energy Efficiency
Program Planning Workbook

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Contents

Executive Summary

This Workbook is designed to assist state policy makers and regulators who are considering or designing ratepayer-funded energy efficiency programs. The Workbook consists of this 25-page document, plus a set of links, electronically embedded in the document and usually displayed in color text, to source and other reference materials cited in the text.

Energy Efficiency Action at the State Level

Bush Administration and Federal Energy Regulatory Commission (FERC) policy has generally been focused on the wholesale supply-side aspects of the energy market, leaving the retail and demand-side aspects of the market up to the states. Policy makers and regulators at the state level have a variety of tools available to help shape the demand side of the market, including retail deregulation, ratepayer funding of energy efficiency, building codes and enhanced appliance efficiency standards.

Potential of Energy Efficiency

Numerous studies from states and regions across the country have shown that between a quarter and a third of our current energy use can be replaced with cost-effective (positive cash flow) energy efficiency using currently available technology. The level of these potential resources sometimes surprises policy makers, but the studies have been performed by a variety of experts, under the sponsorship of a variety of state, regional, and energy industry groups. Besides documenting the gross amount of available demand resources, the studies also identify the particular market segments and energy efficiency technologies which are the most promising in each area. The report describes, as an example, some of the technologies available today for implementation in new commercial and industrial buildings.

Resource Acquisition and Market Transformation

Publicly funded, or ratepayer funded programs that provide incentives for energy efficiency are generally classified as either Resource Acquisition or Market Transformation programs. It is useful for policy makers to understand the two program approaches in order to properly focus the programs in their states. Most programs in fact require a balance of the two approaches in order to capture all of the available energy efficiency opportunities, but emphasis and focus can make a big difference in the results a particular state or region will realize from its expenditures.

Publicly funded energy efficiency programs began with federal mandates in the Carter Administration. During the 1980s, Resource Acquisition programs were developed to offer ratepayers a cost-effective alternative to new power plant construction, which appeared to be very expensive. Programs paid incentives based on the calculated value of saved energy over the life of the installation and were designed to persuade consumers to replace still-functional energy equipment with more efficient equipment, and thus produce what one state called "energy efficiency power plants." Energy efficiency was envisioned as a resource that supplanted the need to procure more supply resources.

In the mid 1990s, many Resource Acquisition programs came to be viewed as too expensive, as the cost of new power plants declined, and as it became clear that because of deregulation most new generating plants would be merchant plants, rather than rate-based plants. Market transformation programs were invented to take advantage of the momentum of consumer decisions, rather than to try to motivate these decisions from scratch. The emphasis in a Market Transformation program shifts from trying to convince a factory owner to replace his lighting system to trying to convince a factory owner who is building a production building to install the most efficient lighting system, rather than the cheapest lighting system.

By 2001, however, the public policy pendulum swung back to Resource Acquisition programs, as two major states, California and New York, found themselves short of supply resources and uncertain that Market Transformation programs could deliver demand resources where and when they are needed.

Looking forward, it seems clear that most states and regions need a carefully designed, balanced portfolio of Resource Acquisition and Market Transformation programs in order to optimize the potential of energy efficiency. Policy makers and regulators should undertake comprehensive energy efficiency resource assessments to identify the target market segments, technologies and energy services industry resources available in each state or region for inclusion in the program portfolio.

Déjà vu All Over Again?

During the last year, the FERC has begun a determined effort, through its Standard Market Design (SMD) proceeding, to facilitate the creation of the missing demand side of the competitive energy market. It is clear from the first few years of deregulation that the vast majority of consumers are not interested in participating in the competitive electric market, so the market doesn't work as originally anticipated by deregulation proponents. FERC proposes to require that transmission grid operators and retail electricity suppliers (acting as surrogates for the uninterested customers) engage in planning regimens that assure that supply and demand resources can compete fairly with each other. These new FERC mandates seem to put states squarely back into the world of system planning, and particularly designing and implementing energy efficiency programs.

Introduction

Programs designed to promote the use of energy efficient technologies and mandate reductions in energy consumption first began to appear in the late 1970s. A subsequent generation of programs, variously known as DSM (Demand Side Management), SBC (System Benefit Charge) or PGC (Public Goods Charge), has been operating in some states since the mid-1980s. These programs, for better or worse, reflect the dynamics of a changing energy industry and have been redefined and significantly redesigned every few years.

State policy makers will find this Workbook useful in highlighting some of the current policy choices, which have evolved from previous program experience and shifting policy expectations and objectives.

Energy Efficiency Action at the State Level

A number of factors make energy efficiency policy and programs the responsibility of state governments.

Bush Administration Focused on Supply

During the last two years, President Bush has focused national energy policy on the supply side of the energy equation, reasoning that the role of the national government is to assure ample energy supply, and placing energy efficiency in a clearly secondary role at the national level.

FERC Focused on Wholesale Market

During the last few years, the Federal Energy Regulatory Commission has, through several proceedings and cases, endeavored to make the wholesale electric market competitive. Though a number of states are opposed to what they see as FERC's over-reaching its authority in trying to establish the competitive wholesale market, it is significant to note that FERC has never, even in its most expansive moments, asserted jurisdiction over retail energy efficiency policy and programs.

Retail Deregulation a State Matter

While FERC has worked to remake the wholesale electric market, the deregulation or re-regulation of the retail markets has been left exclusively to the states. About half of the states have chosen to deregulate their electric utilities, while the other half are either waiting to see if retail deregulation delivers the promised benefits, or have considered and rejected retail deregulation.

States Control DSM and SBC Funding

The level of ratepayer spending on energy efficiency programs is determined either by state law, in some of the states that have deregulated their electric utilities, or by utility regulators.

States Control Building Codes

Energy performance building codes can be, in and of themselves, very effective energy efficiency programs. While certain components of building codes are developed and promulgated by national professional associations, the ultimate responsibility for the enactment of the codes is up to the states. While building code enforcement is typically a local government responsibility, state government sets the tone for code enforcement, particularly enforcement of the energy performance components of the code.

States Supplementing National Appliance Standards

Finally, a number of states are acting to supplement national appliance energy efficiency standards for types of appliances that are important in those states. If even several of the major states enact stricter efficiency standards, their standards may become *de facto* national standards because of the size of the markets in the major states.

Programs Function in an Evolving Policy Environment

Energy efficiency programs are the product of energy policies that have been evolving since the oil embargoes of the 1970s. As the goals of energy policy have changed during the past 25 years, the programs that states have employed to meet policy goals have also changed. This report outlines those policy and program changes and addresses how these policy decisions affect the achievement of energy savings. Program design and implementation choices have proven to be critical in meeting energy consumption reduction objectives.

Basic Program Approaches – Resource Acquisition (RA) and Market Transformation (MT)

Energy efficiency programs can be usefully grouped into two major categories.

- **Resource acquisition** programs are designed to procure "negawatts," units of saved energy or reduced peak demand that are less expensive than additional units of consumed energy or additional electric generating capacity required to serve peak loads. Resource acquisition programs typically provide incentives rich enough to motive consumers to act now.
- **Market transformation** programs are designed to change the way consumers and businesses think about energy consumption, and to promote the manufacturing, distribution and retail sale of energy efficiency equipment. Market transformation programs are designed to motivate consumers who have already decided to make a purchase, for example of a new appliance, to buy the most energy efficient appliance available.

The history and ability of these two types of programs to stimulate energy savings will be outlined in this report.

Make Policies and Programs Solve Market Problems

After reviewing the major types of existing energy efficiency programs, this report will offer a method for state policy makers to use in designing effective energy efficiency programs. The outline stresses the importance of developing a comprehensive state or regional assessment of the potential of energy efficiency, identifying target market segments, selecting target technologies or a continuous improvement approach, and understanding the delivery potential of the local energy services industry. The report urges that state policy makers identify the specific problems, such as persistent transmission congestion that leads to high prices, in a state or region, and use energy efficiency programs to help solve those problems. The best programs are not designed in the abstract, but are developed to address specific policy, technology and behavioral objectives.

Potential of Energy Efficiency

Assessing Energy Efficiency Opportunities

Studies during the last decade have documented the extent of the potential of energy efficiency in a number of states and regions of the US. Other assessments have documented the potential on a national basis. A sampling of some of these studies indicates the magnitude of the potential.

- An Interlaboratory Working Group drawn from the major federal laboratories concluded in a 2000 study that with mainly voluntary programs, the US could reduce its projected energy use in 2020 by about 23 quadrillion Btu, which is equal to about 25% of the nation's current energy use. In perspective, 23 quadrillion Btu is about as much energy as is used each year in the three states that consume the most energy (Texas, California and Ohio) or the 30 states that consume the least energy. The savings could be increased by about 10% with policies that eliminate current barriers to distributed generation. (see USDOE, *Scenarios for a Clean Energy Future,* 2000)

- The Alliance to Save Energy projected in 2001 that applying available energy efficiency technologies, primarily air conditioning, appliances and lighting can reduce the US DOE's forecast need for 1,300 new US power plants by more than half. (see http://www.ase.org/media/factsheets/facts1300.htm)

- Studies in California indicate that the state has to date realized about 18% of the potential savings available in electricity use and about 5% of the potential savings in gas use. (see www.calmac.org)

- A 1997 study by the American Council for an Energy Efficient Economy (ACEEE) determined that cost-effective energy efficient technologies could reduce projected electricity use in 2010 by 33% in the Mid-Atlantic region, while producing a net increase of about 164,000 jobs in the region. (see http://www.aceee.org/store/prodList.cfm)

- The results of this ACEEE Mid-Atlantic region study were corroborated by a 1999 study of New Jersey, commissioned by the state's major investor-owned utilities, that documented cost effective electric and natural gas savings of about 32% in the residential sector, 27% in the commercial sector and 31% in the industrial sector. (see above)

- A 1998 ACEEE study determined that Illinois could reduce its projected 2015 electricity use by 44%, while producing a net increase of about 59,000 jobs in the state. (see above)

- A 2001 study by the Massachusetts Department of Energy Resources said that potential electricity savings in the state during a four-year period (2003-2007) from currently available technologies were 31% of the residential sector and 21% of the commercial sector. (see http://www.state.ma.us/doer/pub_info/e3o.pdf)

The savings projected in each of these studies are based on the application of particular commercially available and proven technologies and policies that accelerate implementation of these technologies. Energy efficiency programs, therefore, are designed primarily to overcome market implementation barriers not to develop new energy efficiency technologies.

A statewide program to promote or provide incentives for energy efficiency should be grounded in a rigorous analysis of the energy efficiency potential of a specific state or region. The program created should reflect explicit decisions about how program design can best achieve state or regional objectives, such as environmental remediation, job creation and energy consumption reduction.

Broadly speaking, in recent years, many state or utility-run energy efficiency programs have focused on specific technologies or specific behavioral patterns that are targeted to particular market segments. When thinking about energy efficiency technologies, it is important for policy makers to think about whether an energy efficiency program should promote the use of specific technologies, which technologies these should be (commercially available or experimental), or whether the approach should emphasize multiple technologies, e.g., a comprehensive approach.

Potential of Energy Efficiency Technologies

There are a range of available commercially proven technologies which ideally should be considered when project developers like ESCOs are designing comprehensive retrofit strategies. However, policy makers often yield to the temptation of favoring certain technologies when designing energy efficiency programs and creating technology specific incentives. This can have unintended effects because potential energy savings are left unmined as a result of the lack of emphasis on measure comprehensiveness. Moreover, the technologies favored by program designers are often new "sexy" technologies at the expense of what is perceived as old stodgy technologies like commercial lighting upgrades. While a blend of diverse energy conservation measures yields the maximum amount of energy savings, it is also important for policy makers to understand that even one of the most prosaic energy efficiency technologies, commercial lighting systems, is in fact a dynamic technology the benefits of which the marketplace has only begun to fully exploit. Consider that the studies cited above typically estimate the current saturation of T-8 fluorescent systems at about 30-50%; the remaining buildings still employ T-12 technology.

- The 2002 standard construction, an electronic ballast T-8 fluorescent lighting system, uses about half as much energy as the magnetic ballast T-12 fluorescent lighting system which was the standard in new construction ten years ago. The Canadian utility BC Hydro, in a study reported in *Energy User News*, documented the fact that redesigning the 2002 standard to fully utilize state-of-the-art lighting control systems reduces energy use 65-80% below the 2002 standard. Payback on the state-of-the-art system, vs. the 2002 standard, is about five months in the Northeast US. (see http://www.energyusernews.com/eun/cda/articleinformation/features/bnp__features__item/0,2584,76084,00.html
- Just beyond these new control systems are white LED lighting systems (red and green are already in widespread use in stoplights), which are expected to come to

market within five years, are projected to reduce lighting energy use to about 10-20% of the 2002 standard system.

Given the magnitude of the potential savings in lighting technology, which is reinforced with potential savings in other technologies, the task facing policy makers is to understand and design programs which overcome the market barriers to the implementation of the technology.

Potential of Comprehensive Building Approaches

The potential savings from a single technology like lighting can be compounded with a comprehensive approach to energy use in a building. For several years, the National Association of Energy Service Companies (NAESCO) and the Lawrence Berkeley National Laboratory (LBNL), with the sponsorship of the U.S. Department of Energy, have been building a database of energy efficiency retrofit projects implemented by energy service companies (ESCOs). In a report published in May 2002, LBNL and NAESCO reported on savings generated in about 1,500 ESCO projects. In these projects, the median savings for lighting-only projects was about 47% of the lighting costs, while the median savings for comprehensive projects (lighting plus other technologies) was about 23% of total electricity costs.

In addition to achieving large percentage reductions in customer electricity bills, comprehensive projects can also address system reliability issues in areas where electricity supply is constrained. The New York State Energy Research and Development Authority (NYSERDA) has been operating a Commercial and Industrial Performance Program (CIPP) for several years, providing incentives for the types of projects reported by NAESCO and LBNL. During its first four years of operation, CIPP has provided incentives for about 450 projects, which will produce about 486 million kWh in annual electricity savings and 110 MW of summer peak reductions – a significant contribution in a state which is short of power and where it is very hard to site new power plants or transmission lines (see: http://www.nyserda.org/energyinfo.html).

Even greater potential exists in new building construction. The discussion in Appendix A below is designed to introduce some of the energy efficiency elements that can be designed into a new commercial or institutional building, and to provide an introduction to the full breadth of the available technologies and approaches. A well-designed new commercial or institutional building will use less than half of the energy of a standard commercial building built in the early 1990s. The construction cost of the well-designed buildings is usually about the same as the construction cost of the standard buildings, because energy-efficient design usually uses less material and smaller mechanical and lighting systems. Occupant comfort and productivity in well-designed buildings is usually measurably higher than in standard buildings.

Do We Still Need Explicit Policies and Public Programs To Tap This Potential?

Many state policy makers and regulators are perplexed that they still need to be involved in energy efficiency policy and programs. Wasn't the market supposed to have taken hold by now, and replaced centralized planning with competition? The theory was that by now the majority of customers would have stopped buying energy from their regulated utility, and would have signed up with a competitive supplier. These suppliers, unregulated, private companies, would maximize their profits through sophisticated portfolio management, in which they optimize the supply and demand resources they acquire to serve their customers.

The problem is that customers do not appear much interested in the competitive energy market. The FERC has been successful in moving the wholesale electricity market toward competition in some parts of the country, especially the Northeast where the New England, New York and PJM (Pennsylvania, Jersey Maryland) ISOs are operating. But even in the Northeast, the retail market has not attracted many customers. Only a small number of large customers have moved to the competitive retail market, though these customers represent a substantial amount of the total load.

The large majority of customers, however, continue to buy energy from their distribution utilities, which were supposed to have already exited the retail energy business to concentrate on the "pipes and wires" business. This situation does not appear likely to change anytime soon. Competitive retail suppliers are struggling to field profitable offers that are more attractive than the standard offer or default service that distribution utilities are required, by law or regulation, to offer. States are studying ways to gently force customers into the competitive marketplace, but no acceptable political model has yet emerged.

In the meantime, the distribution utilities are in a caretaker mode – servicing the retail needs of their customers during an indefinite transition period, and trying to avoid expensive investments in energy efficiency systems and staff expertise that will be obsolete when the competitive market finally takes off. In most instances, these utilities will aggressively pursue the potential of energy efficiency only if they are ordered to do so by their regulators.

Furthermore, a study published last year by Martin Kushler and Patti Witte for the American Council for an Energy Efficiency Economy (ACEEE) entitled "An Examination of the Role of Private Market Actors in an Era of Electric Market Restructuring" (See www.aceee.org, Report U011), casts doubt on the notion that a competitive market will optimize the use of energy efficiency. Citing experience in nine states, Kushler and Witte conclude that "this study has found little evidence to support the premise that relying on private market actors to provide energy efficiency would be a superior approach and that government/regulatory policies and funding for energy efficiency can be phased out or eliminated."

So it appears that at least for the foreseeable future a well-designed and implemented public program is necessary to harvest the full potential of energy efficiency.

Program Approaches:
Resource Acquisition and Market Transformation

Publicly funded, or ratepayer funded programs that provide incentives for energy efficiency are generally classified as either Resource Acquisition or Market Transformation programs. It is useful for policy makers to understand the two program approaches in order to properly focus the programs in their states. Most programs in fact require a balance of the two approaches in order to capture all of the available energy efficiency opportunities, but emphasis and focus can make a big difference in the results a particular state or region will realize from its expenditures.

A Bit of History

Utility-sponsored energy efficiency programs began in the late 1970s, when the Carter Administration decided, in between the two oil price crises, to try to help consumers cope with high heating bills. Led by White House aide David Freeman, now the Chairman of the California Power Authority, the Administration passed a bill that mandated that almost all utilities offer energy audits and help arrange for the construction and financing of energy efficiency measures for their residential customers. According to what we now know, the whole movement started on the wrong foot, because residential programs are generally conceded to be the least cost-effective of programs serving any customer sector.

During the 1980s, these utility-operated residential programs gradually expanded to small, and then to large, commercial and industrial customers. Part of the expansion was driven by customer requests for information and assistance, but the expansion was really due to the advent of Integrated Resource Planning (IRP), a methodology that captivated the regulatory community nationwide. IRP posited that utilities, in planning to meet the growth of demand in their service territory, should look at both the supply and demand sides of the equation. Prior to IRP, an electric utility simply built more power plants; now, it had to present a plan that demonstrated the optimal integration of both new supply and reductions in customer demand. Regulators encouraged utilities to sponsor competitive bidding between supply and demand resources, and thus gave rise to Resource Acquisition energy efficiency programs.

Resource Acquisition Programs

Resource Acquisition programs really spawned the energy services industry that we know today. Specialized service vendors had grown up in the late 1970s to provide utility programs with manpower and systems. The IRP bidding programs offered opportunities to new types of companies that could develop, engineer, finance and implement projects – stand alone, full-service energy service companies (ESCOs). The incentives offered by utilities, particularly in the Northeast and in California, were relatively rich, since the chief competition was new power plants that were expensive to build and difficult to site. Entrepreneurs jumped into the business; the national controls companies also started ESCO business units. Since the idea was to acquire the most cost-effective resources, attention shifted away from residential to large commercial and industrial customers, where a single project could yield hundreds or thousands of kilowatts of savings. By the early 1990s, ESCOs had become a real industry subject to scrutiny and criticism from the regulators and environmental/conservation groups that had helped create the industry.

Resource Acquisition programs have several characteristics that are important to policy makers and program designers.

Primarily Retrofit Market

Most Resource Acquisition programs are designed to encourage the retrofit of existing buildings – residential, commercial or industrial. Incentives are provided either to replace specific energy systems (lighting, HVAC, controls, etc.) or to develop and implement a comprehensive project that retrofits all major systems.

Drive Customer Decisions

In Resource Acquisition Programs, incentive levels are typically at a level deemed "too good to refuse", that is sufficient to drive customers to replace functioning and useful equipment with more efficient equipment. It is not uncommon for Resource Acquisition programs to provide incentives equal to 50 or 75% of the full cost of the retrofit, because these incentives were less expensive for the ratepayers than the alternative, new generating facilities in the rate base.

Timing and Location Critical

In Resource Acquisition Programs, the timing and location of energy efficiency retrofits is critical, again because the retrofits are designed to substitute for energy supply.

Load Reductions on Peak

Incentives usually are designed to pay only for, or pay significantly more for, energy efficiency improvements that reduce system peak demand.

Load Reductions in Problem Areas

Incentives are also designed to emphasize retrofits in specific geographical areas which have known shortfalls of generation or transmission, or that require distribution systems upgrades to serve rapidly growing loads. Two examples of such areas are:

- **Southwestern Connecticut,** which is a severely transmission constrained "load pocket," and where the utilities, Connecticut Light & Power and United Illuminating, are offering special incentives to commercial building customers.
- **Chicago,** which has an aging distribution system, and where the utility, Exelon, has published studies and organized community programs that target dozens of specific distribution substation areas where the utility is encouraging energy efficiency and distributed generation installations.

Load Reductions During Market Startup

Finally, as will be discussed in more detail below, it is becoming apparent that energy efficiency measures that reduce system peak load may be much more valuable during the startup of competitive markets, because these reductions tend to dampen market volatility and reduce prices for all ratepayers.

Problems with Resource Acquisition

Resource Acquisition programs, were designed in a way that created implementation challenges. This was in part because when the programs started in the late 1980s, sustained, long-term demand reduction was not completely "real" to policy makers. As a consequence of this skepticism, costly requirements for monitoring or retention studies were built into programs to continuously prove the existence of savings. Policy makers began to look for program alternatives that addressed perceived problems such as the following.

High Cost of Savings

Like the investigators who discovered that the Pentagon was spending $500 for toilet seats, evaluators of DSM bidding programs discovered extreme examples of program costs. One utility appeared to be paying $95 for screw-in fluorescent bulbs, because its incentive was based on energy saved during the life of the installation, not the cost of the installation. Never mind that this flawed incentive structure, once identified, was quickly corrected, and that even ESCOs who signed contracts specifying the $95 incentive had a hard time collecting it, the image of the $95 light bulb was firmly planted in the minds of policy makers.

Another, more serious example of cost-based criticism of Resource Acquisition programs was the criticism leveled at the New Jersey Standard Offer program. That program, in which ESCOs delivered hundreds of projects that produced more than 300 MW of peak demand reductions, was criticized for a very high cost and a long-term payment obligation. Today, however, the cost of the program (about $.047/kWh) and the long-term payment obligations do not seem so problematic for projects that will continue to produce savings for another decade. The cost/kWh is competitive in today's market. The long-term payment obligations are puny in comparison to the billions of dollars of stranded costs for above-market utility investments. It seems clear that the Standard Offer program has in fact delivered hundreds of millions of dollars of net benefits to New Jersey ratepayers.

Cost of Monitoring and Verification (M&V)

One particularly sticky element of the perceived cost problem was the necessity to monitor the savings produced by Resource Acquisition programs. If the program is designed to substitute for new generating facilities in a particular location, utility planners and public policy makers have to be sure that the programs are delivering the paid-for savings, or else the lights will go out. Early Resource Acquisition programs required expensive and cumbersome monitoring systems (*e.g.*, full-time metering of lighting systems for the expected 10-year life of the system, with data automatically transmitted to central collection systems) because no one was sure if the energy efficiency technologies would really work. As experience with the technologies grew, and major manufacturers began to provide long-term product guarantees, expensive long-term monitoring was increasingly seen as unnecessary. It has also become apparent in recent years that widely used measures of cost-effectiveness, like the Total Resource Cost (TRC) test, may not have been that relevant in a market that was deregulating.

Customer Equity Issues

Resource Acquisition programs were also criticized because they seemed to be very inequitable. Funding for incentives was collected from all ratepayers but actual incentives were paid to a relatively few customers, often large customers who could deliver large energy savings more cost-effectively than small customers. To consumer advocates this seemed to be a straightforward case of the big guys taking advantage of the little guys. Elaborate calculations were devised to try to balance the gain to participating customers against the loss borne by non-participating customers. Much like the monitoring question described above, recent experience has dramatically changed our perception of this issue. In the emerging competitive markets, the participant vs. non-participant inequities seem to be dwarfed by the value of load reductions to all ratepayers (see discussion below).

The Concept of Market Transformation (MT)

Faced with the perceived problems of Resource Acquisition programs, policy makers and program designers in the early 1990s developed a new type of energy efficiency program, which came to be known as Market Transformation (MT). The central concept of this new generation of programs was that customers, whether business or residential, have a natural cycle for making choices about major energy-consuming equipment. Homeowners replace appliances or HVAC systems when the old one dies. Businesses replace lighting and HVAC systems when they move to new quarters or renovate their existing quarters. MT advocates argue that research can tell you the average life cycle of a refrigerator or the time between major renovations of Class A office space. Rather than trying to entice customers to make improvements now, by paying nearly the whole cost of the improvements, why not try to leverage the natural cycle? Catch the customer when he or she has already decided to replace equipment, and provide a modest incentive to persuade the customer to choose the most energy-efficient equipment available. Over a decade or so, one will see a significant improvement in energy efficiency at a fraction of the cost of Resource Acquisition programs.

Market Transformation programs also seem to harmonize with the de-regulation of the utility business. It was postulated that rather than providing large subsidies to a small set of customers, the utility incentives would be used to transform the existing appliance and HVAC equipment manufacturing and distribution industries and the construction industry into pro-active purveyors of energy efficiency. These huge industries would then compete with each other, and with the host of new competitive energy suppliers, to optimize the customer's use of energy.

Not As Easy As It Sounds

It is hard to argue with this vision of Market Transformation, but there are severe practical limitations.

To reach the customers at the precise moment they are making decisions about new energy equipment is no trivial task. Residential customers don't replace HVAC equipment until it is broken, and then they need it replaced immediately, so the window of opportunity for them is at most a few days. Commercial/industrial customers have longer decision cycles, perhaps as long as a few months. Since energy equipment purchasers are not required to register with a government agency several days in advance of their purchase, the only way to reach them is with effective awareness advertising.

Two problems here – dollars and talent. First, the total amount of energy efficiency marketing and advertising dollars available is probably one to two orders of magnitude less than is required to penetrate the background marketing/advertising din. Second, the relatively modest MT budgets tend to restrict marketing efforts, and as utilities are often reluctant to pool their marketing budgets (because they use the marketing for corporate identification) these limited budgets are often unable to overcome the market barriers and reach the customers.

Even if customers are reached with the message at the exactly right moment, most customers, even with the utility incentive, cannot afford to buy energy efficient equipment. Most households and most businesses are not, and will never be, in the optimal life cycle cost world, they live in the weekly or monthly budget world. Lowering the cost of a $15 compact fluorescent bulb to $8 does not make it competitive with a $.75 incandescent bulb for the majority of consumers who only have $1 in their pockets to spend on a light bulb. The commercial lighting market is not transformed, as many would argue, because 30-50% of commercial customers have purchased T-8 fluorescent technology. The capital barriers for most of the un-transformed customers are probably insurmountable. They are small businesses, living on hand-to-mouth cash flow, or large institutions with minimal budgets for maintenance, let alone capital for improvements.

Finally, the notion that utility programs can transform the equipment and construction industries into energy efficiency advocates is probably unrealistic. Private companies have spent hundreds of millions of dollars in failed efforts to acquire chains of construction contractors and transform them into pro-active marketing companies. Contractors are not marketers; they react to bid requests or respond to the service needs of their regular customers. Appliance retailers have sales forces that turn over several times a year, and their training reflects the fact that energy efficiency is way down the list of priorities for most retailers.

Market Transformation in Re-regulating States

The first states to re-regulate their electricity industries (California, New York and New England) established Public Goods or System Benefits Charge (SBC) programs to provide tens or hundreds of millions of dollars of incentives for energy efficiency and renewable energy technologies. The trend in these states was to abandon Resource Acquisition programs as remnants of the world of regulated, vertically integrated monopoly utility companies. Market Transformation programs were seen as vehicles for building energy efficiency and renewable energy industries in the new world of deregulation. Unfortunately, some of the states leading this trend have recently found that they misunderstood the development of the competitive electricity market, and are reversing course to try to cope with the actual market development patterns.

- In California, a 2000 report to the Governor, written by the Chairman of the Public Utilities Commission and the Chairman of the Electricity Oversight Board, cites the switch away from resource acquisition programs as one of the causes of the 2001 electricity crisis. To begin to remedy this situation, the Commission then shifted its programs to emphasize the immediate delivery of energy efficiency technologies that also deliver on-peak load reductions.
- In New York, the Public Service Commission established the Price and Reliability Task Force to seek ways for New York to avoid the problems that California is experiencing. One of the first recommendations of the Task Force was an overhaul of the state's SBC programs, shifting the Standard Performance Contract (SPC) program (which accounts for about a third of total SBC funding) away from the goal of building a competitive energy services industry to focus on immediate load reductions, particularly in New York City.
- In Texas, the Legislature established the ambitious goal that, starting in 2003, utilities will have to meet 10% of load growth with new renewable and energy efficiency resources. Bucking the national trend with this very aggressive Resource Acquisition program, it relegated Market Transformation to a minor role.
- In New Jersey, the Board of Public Utilities took about two years to decide how to most effectively spend about $1 billion of legislatively mandated SBC funds. Confronted with strong arguments by market transformation advocates, on the one hand, and the historical success of the state's resource acquisition programs, the Board delayed the start of the program for a year, and is now, after about a year of program operation, re-assessing the program rationale and administration. An audit report commissioned by the Board is highly critical of the market transformation approach in the state, saying it has not been well designed and is unlikely to meet its public policy goals.

New Economics of Energy Efficiency

The confusion in the states is understandable. Just when legislators and regulators had become comfortable with the theory that Market Transformation produces results more economically than resource acquisition, recent studies of the California and PJM ISOs indicate that Resource Acquisition programs are significantly more valuable than previously thought. It has become quite clear that because of the way that the ISO markets work in states where generation supply is tight or transmission is constrained (*e.g.,* California and New York), all ratepayers, not just participants, benefit from Resource Acquisition programs, because these programs produce immediate, verifiable peak load reductions which suppress the market price. The short-term value of Resource Acquisition programs to ratepayers is several times the price of power.

The studies were conducted by Dr. William B. Marcus of JBS Energy Inc. Dr. Marcus conducted two studies of the California market. In the first study, entitled "Financial Externalities and 'Peak Hogs': New Considerations for Energy Efficiency and Rate Design Policy," he studied prices in California for the period of April 1998 to August 1999, and concluded that, "the impact of demand reduction from a high peak level is well over twice the market price at all load levels and rises almost exponentially as load rises toward a system peak." In this study, Dr. Marcus calculated the value of demand reductions on peak at about $.70/kWh. In a second paper, entitled, "Analysis of PG&E's Electric Distribution Marginal Cost, Revenue Allocation and Rate Design, Appendix A: Cost Curve Analysis of the California Power Markets," he analyzed the California markets during the period of the electricity crisis in 2000, and documented that even in a price-capped market, the value of energy efficiency load reductions still rose to about $.40/kWh.

Confronted with this research, the California Energy Commission, which had been an advocate of Market Transformation programs, reversed its position and urged the California Public Service Commission to re-value peak load reducing energy efficiency programs. The Commission then significantly changed the cost-effectiveness standards for the 2001 SBC programs.

Dr. Marcus then applied the methodology he used in the two California studies to the PJM market and produced a paper entitled, "Mid-Atlantic States Cost Curve Analysis," and found that:

> "The value of load reduction was found to be about 24 cents/kWh on summer weekday afternoons in the year 2000 – compared to a market price of 5 cents/kWh.[1] In other summer heavy load hours (6 am-10 pm except peak hours), load reduction was worth almost 14 cents, with a market price of 4 cents/kWh. Off-peak and in the winter, the value of load reduction was less, but still ranged from 3.5 to 6 cents/kWh, with market prices in the range of 1.5 to 3 cents/kWh."

[1] Prices were considerably higher in 1999 due largely to higher loads.

Additional Value from Resource Acquisition

Further complicating the issue is that two significant additional values of energy efficiency programs are emerging. States are now allowed to include emission reductions resulting from these programs in their State Implementation Plan (SIP) Call programs designed to meet US EPA requirements. The four functioning ISOs (California, New York, New England and PJM) are all operating load reduction or demand response programs that pay customers to reduce their loads in times of high system demand. But both of these new value sources require immediate, verifiable load reductions, the type of load reductions produced by Resource Acquisition programs.

Does Resource Acquisition Transform Markets?

It has also become apparent that Resource Acquisition programs can have profound market transformation effects. For example, lighting projects are perhaps the prototype Resource Acquisition projects in which ESCOs or contractors are paid a generous rebate to install a more efficient lighting system. Perceived wisdom is that the projects are just expensive subsidies to a few customers, and do little to effect changes in the entire marketplace. The reality is quite different.

In 1990, when lighting rebate programs began to ramp up, an ESCO providing a lighting project got a substantial markup on direct costs for assembling a set of services that included specialized lighting design engineering, stocking newfangled products not readily available from electrical distributors, cajoling recalcitrant contractors to install the newfangled products, financing the project from its own capital, and accepting extended payment terms based on the metered energy savings delivered by the project.

Within a few years, the lighting incentive programs had produced marketplace changes and reduced costs in every one of these functional areas.

- High-efficiency lighting design is now widely practiced and combines specialized design skills with assembly-line-type survey systems operated by low-cost technicians.
- High efficiency lighting products are now in common distribution. Contractors can buy them from any electrical supply house.
- Contractors now routinely work under low-cost, labor-only, unit-priced installation contracts.
- Project financing is widely available at competitive rates from local banks and specialized divisions of international financing companies.
- Customers have been convinced by historical project successes that continuous, long-term project metering is not necessary.

The standardization and competition spawned by these prototypical Resource Acquisition programs totally transformed the lighting market, and have probably reduced the transaction costs of lighting projects by two-thirds.

Resource Acquisition or Market Transformation?

After becoming acquainted with the various types of energy efficiency programs, how do policy makers and regulators decide which menu of programs is appropriate for a particular state? This section of the report outlines a planning methodology that states may find useful.

Usually Need Both

The choice of programs is really not an "either-or" choice between resource acquisition and market transformation programs. In fact, most states will need a mix of the two types of programs.

Resource Acquisition is Targeted and Measurable

Resource acquisition programs will deliver measurable results in target market segments or target geographical areas that may be of concern to policy makers. Well-constructed resource acquisition programs can also significantly accelerate energy efficiency investments, particularly investments in new retrofit technologies in existing buildings, with incentives offers that are "too good to refuse" – that actually persuade building owners to replace functioning equipment with more efficient equipment.

Market Transformation is Diffuse and Relatively Difficult to Measure

Market transformation programs deliver cost-effective results in markets like appliance replacement and new construction, in which consumers do not need to be motivated to make an investment, but rather need to be educated and prodded to invest in the most energy efficient technology available. Market transformation programs are often less expensive that resource acquisition programs, but market transformation is harder to target and more difficult to measure than resource acquisition.

Assess the State or Regional Situation

Policy makers and regulators should begin a program design exercise by assessing the state or regional potential for energy efficiency. As noted above, a number of states and regions have recently undertaken such studies, which typically show that one-quarter to one-third of current energy use can be replaced with cost-effective energy efficiency. If no such study is available, it is a good investment by state or regional policy makers.

Potential of Energy Efficiency

Once a reliable estimate of the overall potential for energy efficiency has been developed, policy makers and regulators can begin to develop programs based on the specifics developed in the state or regional assessment. While it is often useful to study successful programs in other regions of the country, such programs, at the very least, have to be carefully adapted to the specific conditions of the local markets to assure their effectiveness. A number of factors should be considered, including the following.

Competitive or Regulated Energy Markets

Policy makers must be careful to design programs for the markets that actually exist, rather than the markets that they hope will soon exist. As noted above, it makes a big difference if the local retail energy market is still largely regulated, that is most of the customers have not chosen competitive energy suppliers and seem unlikely to do so in the near future. In this case, which is the dominant case throughout the country, distribution utilities, operating through regulated energy efficiency programs, are likely to be *the* program delivery vehicle.

Target Market Segments

The state or regional energy efficiency potential assessment will identify the target market segments that offer the most potential or are causing problems for the electricity system. These segments are not always obvious. For example, until very recently, in New England the residential sector was not considered to be a prime driver of the summer system peak. However, during the prosperity of the 1990s, central air conditioning, which used to be a rarity in New England, became a standard feature of most residential new construction and a very common retrofit for existing homes. As a consequence the residential peak demand significantly outstripped projections, and now warrants significant program design attention.

Target Technologies

Within the target market segments, the state or regional assessment will analyze which technologies are ripe for energy efficiency improvements. In the example given above (residential central air conditioning in New England) a program mix might well include a market transformation program that mandates maximum efficiency for new central air conditioning units plus a resource acquisition program that installs and operates a remote-control load-shedding system for existing units.

Available Resources

It is also important for policy makers to understand the capabilities currently available in the state or region to actually deliver a large volume of energy efficiency. Very efficient technologies can easily falter for lack of an appropriate energy services infrastructure or inadequate incentives.

Energy Services Infrastructure

Many new technologies require sophisticated energy services companies to develop and deliver projects. Policy makers must be very careful to make sure that they create programs that nurture the local energy services industry into a robust competitive marketplace. As with the market segments described above, the effects of program structure on the energy services market are not always crystal clear.

For example, during the mid1990s, New Jersey spent hundreds of millions of dollars in a program that was supposed to, as one of its goals, help create a robust energy services industry in the state. The program, however, had a major design flaw – the state's largest utility was allowed to enter, and in fact to dominate, the program. The number of participating energy service companies actually decreased as the program went along. After it established dominance, the utility changed corporate strategy, and exited the business, leaving a gaping hole in the market as the program was winding down. So at the end of the program, there wasn't much of an energy services industry left in the state.

New York learned from this program design flaw. In the late 1990s, it created its own program, and did not allow utilities to participate as they had in New Jersey. Spending a fraction of the money that New Jersey had spent, New York now has a program in which about 110 energy service companies have developed more than 450 projects, which will produce about 486 million kWh in annual electricity savings and 110 MW of summer peak reductions – all for incentives of about $75 million, paid when savings are delivered and verified.

Incentives

Another program feature that is very important is the level of incentives provided for various technologies or market segments. This is a complex area, which deserves a lot of attention from policy makers. There seems, for example, to be a threshold level required for incentives to be effective. Policy makers sometimes think that if an incentive of $x/kWh will draw one level of response, then an incentive of $.5x/kWh should draw half the response. In fact, an incentive of $.5x may draw no response at all.

A good example of this phenomenon is the successful New York Commercial Industrial Performance Program, cited above, which drew essentially no response during its first year, because the incentives offered were just below the threshold. An increase in the incentives of about 20 percent took the program from zero participation to over-subscribed in one year, and it continues to be oversubscribed three years later. Some program designers would say that this continual oversubscription is evidence that the incentives in New York should be lowered, as incentives in California were lowered under the same circumstances several years ago. But the California program went begging until the energy crisis hit there, while the New York program has continued to exceed its program targets, in terms of both energy efficiency and energy service company program participation.

Recently, California energy program designers and regulators have begun to talk at national meetings about the problems caused by their program design approach. Saying that they have rediscovered the old proverb that, "The perfect is the enemy of the good," they are urging other states to adopt a program portfolio management strategy. The idea is not to try to discover the precisely correct incentives for a particular technology, because that approach leads to endless program design tinkering which frustrates the market. Rather, program designers should be focused on results -- trying to develop a full portfolio of programs, which capture as much cost-effective energy efficiency as possible. This new approach has been introduced in the California Public Utilities Commission case that authorized the investor-owned utilities to get back into the power procurement business starting in January 2003. (see: http://www.cpuc.ca.gov/published/comment_decision/19842-05.htm#P217_42670)

Déjà vu All Over Again?

As noted above, Integrated Resource Planning programs were the electric utility industry norm during the 1980s and early 1990s, but fell out of favor as the electric utility industry was deregulated in the late 1990s. The thinking was that the IRP was a kind of central planning function that was necessary only in the absence of a viable competitive market. Deregulation would create a market that would make IRP, like the central economic planning in Eastern Europe, obsolete.

Most Customers Still in Regulated World

Unfortunately, as noted above, in most states that have tried it, deregulation has created only half of a retail market – the supply side. The demand side of the market is stunted because the vast majority of customers don't want anything to do with retail electricity choice, and are sticking with regulated, fixed-rate standard offer or default electric service. Electricity customers thus do not react, as customers in normal markets do, when prices and/or supplies fluctuate.

Dominant LSEs are Regulated Utilities

This means that the dominant Load Serving Entities (LSEs) are not competitive suppliers, but the regulated distribution utilities. Most of these companies, as noted above, do not see themselves in the retail energy business (as opposed to the "pipes and wires" business) beyond a short transition period, and so are operating energy efficiency programs on a kind of caretaker basis, not as part of a long-term business plan. These distribution utilities eagerly look forward to the day when they will be finally finished with energy efficiency programs.

What If Customers Don't Switch?

The problem with this scenario, of course, is that there is not much indication today that the majority of customers have any interest in switching to competitive suppliers at any time in the foreseeable future, and certainly not any time soon. State policy makers and regulators thus face a difficult choice about how to deal with this reality. California has decided to retrench, and has formally closed the competitive retail market. Other states consider ways to gently force consumers into the competitive marketplace, though really effective methods of coercion, like changing retail rates structures, seem politically taboo.

FERC SMD Pushes States

By and large, policy makers and regulators in deregulated states have not chosen to act boldly, as California did, but have taken a "wait and see" attitude, hoping that consumers will gradually warm to the competitive electric market without a need for further policy actions. The FERC, however, realizes that its wholesale market reforms cannot take hold unless there is a complete market, that is an active demand side of the market, and is pushing state policy makers and regulators to help create that market. FERC's vehicle is the SMD or Standard Market Design proceeding, which has several components that bear directly on state and regional energy efficiency programs.

Transmission Expansion Planning

Transmission system expansion planning must allow demand resources, such as distributed generation or load shedding programs, to compete with new transmission lines to ensure that adequate supplies of power are available at all points on the transmission grid.

Resource Adequacy

LSEs, today primarily distribution utilities, will be required to demonstrate that they have secured the long term resources they need to serve their projected loads over a medium term, probably three to five years. As with transmission planning, LSEs are expected to demonstrate that their plans allow supply and demand resources to compete on an equal footing.

Persistent Economic Congestion

Finally, FERC proposes to ease the economic burden of persistent economic congestion (discrete areas of the grid where costs are higher than the grid average because transmission constraints compel the operation of higher cost generators in the constrained area) by having the customers in those areas pay the costs of the congestion. Up until now, in most areas, these costs have been "socialized" across all of the customers on the grid. FERC's reasoning is that if a relatively small number of customers are forced to pay the costs of the congestion that they are causing (by, for example, preventing the construction of new transmission lines), they will figure out some creative solutions to the problem. Again, FERC is insisting that in formulating solutions, supply and demand resources compete fairly.

Integrated Resource Planning (IRP) by a Different Name?

If the majority of retail customers are choosing to remain under state regulation, rather than entering the competitive market, and the FERC is mandating planning processes to address major issues, processes that consider all available supply and demand resources, it is beginning to look like the FERC may be taking us back to the IRP world. The FERC has tried very hard to assure the energy industry that it is not talking about IRP, but has also made it very clear that it is talking about a rigorous mandatory planning process.

Supply and Demand Resources on an Equal Footing

As noted above, FERC's basic principle in the SMD is that developing the supply and demand equation and investment choices in the electricity market should be the subject of public processes at the state or regional level, in which supply and demand resources can compete on an equal footing.

Planning at State and/or Regional Level

While the development of supply resources is at least partially under the control of the FERC, since most of these resources function in the wholesale market, the development of demand resources, which function in the retail market, are under state control, or regional control in situations where states cede authority to regional organizations.

New Laws and Regulations Needed?

It seems to be an open question at this point whether new laws and regulations, designed to deal with the realities of the deregulating markets and the new mandates from FERC, are required at the state level. Instead, the policy focus may need to shift to a kind of pre-deregulation mind set. State regulators and policy makers may need to reflect once again on the role of energy efficiency in achieving a cost effective and environmentally benign electricity system. They need to remember that the implementation of widespread energy efficiency delivers results for customers, the environment and the electricity system infrastructure.

States may very well have to replace policies that were intended to guide distribution utilities through a relatively short transition out of the retail energy market with policies that recognize that these utilities are likely to be in the retail business for years. States have to be willing to order their utilities to make investments in retail portfolio management capabilities, or to subcontract this work to specialty companies like energy service companies that are willing to make this investment.

Appendix A: Energy Efficient New Building Design

In order to give policy makers a sense of the broad scope of energy consumption reduction technologies that can be effectively utilized, the following annotated list highlights some commercially available technologies that can be employed in new commercial and institutional buildings in conjunction with suggestions about best practices.

Energy Needs Assessment

In the early stages of design development consider the addition of a specific Energy Needs Assessment to be integrated with other planning processes. The development of an energy assessment to determine precise energy requirements will assist the design professional in evaluating energy efficiency strategies and their application. Focus on the environmental and process energy requirements of the different user categories applicable to the facility.

Building Shape and Shell Technologies

In designing the building shell, several technologies can be employed to minimize total building demand. These include:

Extended Floor Plan

Elongate the building footprint in an east-west direction to maximize daylighting and passive solar heating.

Perimeter Circulation Space

Use circulation and gathering areas as buffers between the exterior and interior conditioned spaces.

Direct-Gain Passive Solar Heating

Install south facing glazing to facilitate the collection of solar energy, which is partially stored in the walls, floors, and/or ceiling of the space, to be released when needed.

Non-Absorbing Roofing

Install reflective coatings or membranes to reduce cooling loads and enhance daylighting efforts.

Selective Glazing

Use the technical advances in glazing and sophisticated design analysis software to carefully select the amount of solar gain, visible light, and heat transmitted by glass, without affecting the "look" of the building.

Shading Devices

Use fixed or movable devices located inside or outside the glazing -- overhangs (on south façades), fins (on east and west façades), interior blinds and shades, louvers, and special glazing (such as fritted glass)-- to control direct or indirect solar gain.

High performance lighting design

Design illumination levels to work in tandem with daylighting and high-performance glazing systems. A wide variety of very efficient components and design software resources are available to create high quality, low load lighting systems, such as high-efficiency lamps (fluorescent and HID) electronic ballasts (multiple switching and dimmable) in combination with high output fixtures (specular reflectors, reflective coatings).

Task specific lighting design

Carefully match illumination levels and quality to task requirements.

Daylighting

Introduce natural light through the strategic placement of windows, skylights and facades in floor plan designs can reduce the dependence on artificial lighting systems, reducing energy costs while enhancing occupant health, comfort and productivity. Optimize daylighting by carefully selecting glazing, locating private offices at interior positions, strategically placing skylights and atriums, and utilizing light shelves.

Occupancy and light level controls

Use dimming, occupancy sensors and light level controls in building designs that optimize daylighting as well as in locations where intermittent reduced lighting levels is acceptable, such as warehousing and distribution facilities and private office spaces.

Load Efficient Heating, Ventilation, and Cooling Equipment

Size the HVAC systems, components, and equipment as determined by the Energy Needs Assessment; don't oversize. Use modular and variable-speed equipment when appropriate for greater flexibility in precisely meeting building needs under varying load conditions. Specify systems with the highest feasible operating efficiencies for HVAC; the range of equipment available today can readily address the specific needs and operating patterns of almost any new building.

Induced (Stack-Effect) Ventilation

Reduce mechanical cooling and fan use by ventilating lower spaces with operable windows and inducing hot air to rise through the building, exhausting it through roof openings.

Exhaust Air Heat Recovery

Use heat exchangers, including heat wheels, plate and fin air-to-air heat exchangers, and heat pipes to 70% recapture of heat from exhaust air.

Ground water source/earth tube cooling

Use ground-source heat pumps to make the earth the building's heat source during the winter and its heat sink during the summer, taking advantage of the thermodynamic properties of earth and and/or the groundwater (temperatures a few feet below the surface stay relatively constant throughout the year.

Chilled beams

Design HVAC systems with control strategies that anticipate the precooling (or heating) of the building during off-peak hours in order to take advantage of lower energy prices and minimize building peak demand.

Controls

Use computerized industrial Process Control Systems (PCS) and Building Automation Systems (BAS) and Energy Management Systems (EMS) to do more than turn production equipment on and off or change the building temperature. Employing the energy and environmental monitoring capabilities for these systems is a relatively inexpensive way to ensure that the performance of load-efficient building is optimized and sustained.

HVAC Controls

Take care to specify a system that matches building use patterns as well as building design. Evaluate the use of variable speed drives (VSD) on pumps and fans in conjunction with control strategies that match system efficiencies to building environmental requirements.

Demand limiters

Integrate the building infrastructure design, especially the electrical and HVAC distribution systems, with a building demand limiting strategy (i.e., HVAC cycling) to provide for peak demand control. Demand limiting systems can be as simple as a flashing light or as complex as a Building Automation System with the ability to anticipate demand trends, provide early warnings and take automated action.

Sources

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