Tales from the DSM Trenches: The Moral of the Story

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Innovative utility DSM programs have been operating for several years now. During this time, many lessons have been learned about the proper development of program components, incentive structures and delivery mechanisms. Some of these lessons have been learned through splendid success and others through enlightening failures. Each lesson has enabled us to build on successful program design.

This paper shares some of the authors' personal experiences, gained from the DSM trenches in commercial new construction programs. It walks step-by-step through the design of a commercial new construction program. The authors have implemented two of these programs for their own organization and helped design programs for nineteen utilities throughout the United States and Canada.

This paper includes tales of real buildings and what happened as they were built to become models of energy efficiency. Each tale has a "moral" that elucidates a guiding principle of DSM program development or implementation. This paper will help other DSM program developers and implementors to avoid similar program mistakes and to use the ideas and techniques that we found to be effective. The authors include examples addressing such program components as marketing, designing financial incentives, delivering design assistance and building commissioning.

Introduction

Only six years ago, the phrase "demand-side management" belonged in the vocabulary of a handful of professionals who believed in energy conservation. Since then, through planning, programs have developed that provide value to a broader audience.

The authors have been designing DSM programs since their inception, and we have learned some valuable lessons about the elements of program design. We were one of several companies involved in the first design assistance pilot program for commercial new construction in the Northwest. Since that time, much experience has been gained about the best way to design and implement commercial new construction programs. We are convinced that the best programs are comprehensive, customized, and well-guided from concept through evaluation. Successful implementation hinges on identifying each step in the program that will enhance the function, as well as the potential savings, for each building.

Essential Program Components

We have found the following eight program components critical to developing successful commercial new construction programs that utilities can provide to their customers. In chronological order:

(1) Personalized, targeted marketing (direct sales to key decision participants)

(2) Design support/technical assistance

(3) Design incentives

(4) Construction incentives

(5) Commissioning

(6) Operations and maintenance

(7) Training

(8) Evaluation

The stories that follow will illustrate the importance of these eight steps. Although we have developed a few programs that have omitted one or more of these steps, and also some programs that include other components, program design always begins with an examination of the requirements in each of these categories.

Tales from the Trenches

Personalized, Targeted Marketing

The purpose of marketing a DSM program is to achieve maximum market penetration, thereby capturing maximum savings. After resource acquisition goals are defined and program design is completed, no time should be lost in identifying projects that will benefit immediately from energy efficiency measures.

Targeting the market for DSM is only the beginning of the process of acquiring participants, and can be accomplished in several ways. Utility documentation usually contains enough information to pinpoint customers who are constructing new buildings. The utility representatives know their service territories well, and are usually informed about prospective commercial construction projects. Dodge Reports, public permitting records where available, newspaper articles and local industry journals are also resources to locate potential new commercial construction program participants.

Who is targeted? Normally, the architects, engineers, developers, building owners and contractors participate in decision making for new construction projects. The most active architects, engineers and developers in the service territory, who are often, but not necessarily, the largest or best known, were chosen for the targeted marketing effort. In an ideal world, the entire design team of a project and a representative from each profession would meet to discuss energy efficiency options before any building plans would be drawn. What we have found, instead, is that the architects, engineers and contractors usually work independently, each handing off a segment of the plan to the next designer, and also to the developer or owner. For this reason it is imperative to contact everyone who participates in planning and building of the project individually, and not count on reaching all decision-makers through a single meeting.

Getting decision-makers' attention is another matter. The most common method, direct mail, has been tried and, in our estimation, has failed. In one case, handsome program brochures were sent out to about two thousand targeted architects, engineers, developers and owners in a Pacific Northwest service territory. Only a few responses came back. Why? Because these people receive glossy direct mail every day. From the customer's point of view there is no urgency to respond and no enticement to care, if the mailer is opened at all. Also, mass media simply does not reach them because each building they own, design or build is unique.

A utility on the east coast once hired an advertising agency to develop a marketing strategy for about 300 targeted customers. The agency suggested sending, on the first day, a mysterious announcement that "something will be arriving on your doorstep tomorrow", and, on the second day, a small tree. Another marketing tool, a brochure with a pop-up skyline, was suggested. Both strategies were discarded based on focus group interviews because, from the designer's point of view, the message was not direct and both methods could be perceived as a waste of ratepayers' money.

Personalized, targeted marketing, or direct personal contact, is the best method for urging participation in DSM programs. General managers of chain operations can be contacted directly. Fast-food franchises, grocery stores, and department stores often have a design team under contract who are familiar with the particular construction requirements of the franchisor.

If targeted "mass" mailings are used to initiate contact, they should always be followed up by telephone calls to everyone who did not respond. In most cases, in-person presentations, brown bag lunches, or short meetings can be arranged. Public presentations to architects, engineers and developers generally result in question and answer sessions that raise the level of knowledge - hence, interest - in DSM programs. As an example of the difference personal contact makes, one of the utilities involved in a program sponsored by the Bonneville Power Administration sent out a mass mailing and got two responses. For the same program, another group received 38 responses immediately following personal visits with prospective customers who were planning commercial buildings.

After candidates for program design have been selected and contacted, certain guidelines may be useful. Developers (1) approach projects differently than architects, engineers and building owners; (2) want to know the bottom line immediately, and what they can do within the program to maximize profit, and (3) are likely to reject any program that could slow construction unless they are convinced of its value to the owner. Architects, on the other hand (1) approach projects from a design perspective and appreciate visuals like slide presentations; (2) want to examine the various program designs we've implemented in the past; (3) require assurance based on the DSM program personnel's experience; and (4) want to know how a program can benefit their developer or owner; and finally, (5) want to understand how they can enhance their services by participating in the DSM program.

Integration of developers' and designers' concerns requires sensitivity on the part of the DSM program representative. Of the two, it is normally useful to approach a project's architects first. Often developers who rely on their architects will refuse to accept the idea if the architect is not supportive. If the architects are familiar with the program and can reassure the developer that DSM implementation will work, then the developer is much more likely to approve.

Initial presentations should address as many anticipated objections as possible before they are voiced. Some of the likely ones that can be minimized in the initial visit are:

- We're too busy to think about this
- Our clients want marble floors before they want energy efficiency
- Our clients can't afford it
- The building occupants will end up cold, dark, or living in a "sick" building
- Energy-efficient technology is unproven or short-lived
- The project will not be completed on time.

A personalized marketing presentation should be timed conveniently and should approach prospective DSM participants on "home ground" - in their offices or a site they choose. As much as possible should be known about the participant's previous projects and current concerns.

These marketing steps are only the beginning of a fluid and possibly protracted relationship, especially if the participants have limited experience with design and implementation of energy-efficient systems. The success of the program will depend greatly on the confidence the DSM representative is able to establish among the parties, and their ability to convince architects and developers of the advantages to themselves and to the ultimate occupants of their building.

Design Support/Technical Assistance

After reaching agreement on the value of the DSM program for a customer's project, we move quickly into the design support stage. It is important at this juncture to maintain the high level of interest in energy-efficiency measures so that the project can proceed without lags. During this period a technical assistance provider, or "TAP", helps the designers and contractors to integrate DSM into their building plan.

A good TAP understands and respects the expertise of the architects and engineers. The TAP's job is to support and provide service to the owner's design team by asking questions about the building's operation, looking for energy-efficiency opportunities and suggesting strategies. The TAP should first determine what the designers want, then point out possible drawbacks and suggest alternatives that incorporate energy-efficiency measures. The power of decision-making should always be left to those who are ultimately responsible for the construction of the building. A good TAP is non-threatening, elicits curiosity from architects and engineers, voices unspoken but perceived concerns, provides case studies and examples. The TAP should concentrate first on developing a foundation for credibility.

The best-designed buildings begin with a TAP who facilitates a collaboration of all the team members, and who acts on everyone's behalf. The TAP can encourage all the team players to meet at the beginning of the design process to discuss criteria for energy efficiency. For example, the TAP may explain how an understanding of the effect of window glazing upon the heating and cooling load, or how daylighting will interface with lighting fixtures, will result in greater efficiency. If the contractor can be present (even if construction is scheduled a year hence), ballpark costs can be determined and issues related to energy-efficient equipment can be ironed out.

A TAP who cannot facilitate a group process, no matter how expert in energy-efficient design, will quickly negate the progress made during the initial presentations. In one case, a building project in the Energy Edge program had developed to the design support stage. An excellent designer was brought into our meeting with the owners, architects and other representatives. This TAP, though highly skilled technically, was confrontational and did not seem to believe the project would be completed with this group. He was condescending and was not a team player. He was removed from the project immediately. We were lucky that the owner and architect continued to desire the energy-efficiency measures and, after bringing in the right TAP, went on with the project. As it happens, the design team and the new TAP worked so well together that the owner's next building included even more measures.

Essentially, DSM design support is work that architects, engineers, developers, owners and contractors cannot perform or do not have time to do, such as evaluating whole building interactive energy systems. The TAPs help define the conditions for the building. They provide a list of measures that would enhance energy efficiency, and help the owners and designers to define the measures that would work best for their building, involving as many of the owner's team members as possible in these discussions.

There may be a continuing perception that a DSM program does not work, or is too expensive, or holds up construction. Most of all, budgets often are unable to handle the burden of first cost, and developers or owners may be willing to let future tenants worry about energy consumption costs instead. The TAP should be aware of these concerns and should respond to them as he guides participants through the design process.

Design support also takes into consideration the owner's preferences and ultimate business goals. As an example, dark window glazing may prevent excessive heat gain in a highrise coastal hotel but, from the owner's perspective, will also obscure the beautiful view the hotel's customers pay for. In this case the savings captured by the measure would also defeat a revenue goal of the building. The final result must be a building that is tailored, customized for the efficiencies that can be gained without losing sight of the nature and use of the building itself.

Even the best TAP may be unable to change certain aspects of his customer's orientation. A developer may have a friend who had problems with an electronic ballast five years ago. Though the reliability of the technology has improved, the developer will not be moved on this particular line item. Until someone else has a good experience, this developer will consider electronic ballasts too risky. A rule of thumb in such a case is to concentrate on other measures.

Certain concerns about the design support process are bound to arise and should be handled by carefully providing an understanding of the distinction between the existing design team and DSM design support. TAPs can be perceived as a potential threat to the building designers who feel they already have good engineers, and it should be pointed out that their purpose is to add value, to enhance design rather than to change it.

Engineers may say they know about energy efficiency - and they often do - but they generally do not have the implementation background that a TAP can provide. The best TAPs often come from small, innovative firms that are non-threatening to large firms, or are specialists in energy assessment rather than design.

We have found that after designing several energy-efficient buildings, the architects and engineers know what is most likely to work for them, they understand that energy efficiency is real, and they begin to approach contracts with energy efficiency in mind. A letter received from one lighting contractor said, "you brought me into this process kicking and screaming, but now I won't design a building that doesn't use energy-efficient lighting."

Design Incentives

Design incentives are funds provided by the utility to encourage architects, engineers and other design professionals to review and design energy-efficiency measures into their building project. When we conducted focus groups with architects and engineers, one of the apparent barriers to program implementation was the additional work involved which would not be compensated by owners. The strong opinion was that the owners would not understand why the architects were not already designing energy-efficient buildings. The architects could not ask for additional money to consider energy efficiency because they would be charged with not having provided a full service in the first place.

Current practice indicates that architects do not design for energy efficiency because the price of designing an energy-efficient building is not competitive with the general market, which does not build for maximum energy efficiency because there is little market demand. On the other hand, the architects often are enthusiastically interested in providing energy-efficient design and would do so - if the additional cost were paid.

A telephone survey (PECI 1991) revealed that design incentives are based on a variety of calculations. Some are based on the incremental cost of designing and analyzing energy conservation measures actually included in building design. Some are offered only for buildings with minimum square footage. Others are based on estimated annual kilowatt hour savings. Another is based on a percentage of the equipment (construction) incentive. Still another incentive is a flat fee. Some programs feature a dollar or percentage cap. Each program has developed a design incentive that reflects the needs of the utility and its market, although a formal evaluation of the relative effectiveness of incentive strategies remains to be quantified. The approaches are perceived, however, by both planners and utility customers who eventually do build, to be appropriate for their service territories.

Each program has a design incentive that reflects the desired outcome for the utility. While incentives based on building square feet are simpler, and therefore easier to market, an incentive based on the energy savings achieved by the building design encourages the efficient performance of the design team to work toward higher levels of

Table 1. Selected Design Incentive Programs for New Commercial Construction

Northeast Utilities Energy Conscious Construction	Estimated incremental cost for each measure up to $0.02/annual kWh saved based on modeling for that measure.
United Illuminating Energy Blueprint	Incentive for analysis and/or modeling is calculated using a sliding scale for building size times incentive/square foot. This amount is affected by the design path selected and the number of times the architect or engineer has previously participated in the program.
Bonneville Power Administration Energy Smart Design	Brainstorming honorarium up to $1,500. Incremental cost incentive.
L.A. Department of Water & Power Commercial New Construction	Design/analysis incentive up to 5% of incremental equipment and materials cost of the conservation measure.
Boston Electric Company Energy Efficiency Partnership	For commercial buildings over 80,000 square feet, incentive is $0.01 per annual kWh saved. For commercial buildings under 80,000 square feet, incentive is $0.005 per annual kWh saved. Both use either state code or customer's base case as baseline.
New England Electric Systems Design 2000	Six percent of equipment incentive not to exceed $10,000. A portion of the design incentive is paid within 45 days of signing the agreement, with the balance paid when first payment is made for equipment incentive.

energy efficiency. Each method has its advantages and disadvantages. However, no empirical studies have been conducted to evaluate the effectiveness in the market of one incentive design over another. It is known that the market does not normally provide for a payment procedure for design teams to spend additional design time for energy efficiency. The design incentive, when offered by utility energy conservation programs, addresses that inadequacy by requiring energy-efficient measures to be designed into building plans.

Who receives the design incentive? Although the architect normally receives the incentive payment to offset additional design time required, we have found it advisable to ask the owner of the building, or the developer, to sign a document designating the recipient of the design assistance funds to avoid any possibility of disagreement over entitlement. Also, smaller new commercial buildings sometimes are built without the advice of an architect and it becomes the owner or developer's responsibility to disburse funds appropriately.

Design incentives will be a necessary component of program development until there is a market demand for energy efficiency. Eventually the market may change: developers may be willing to pay for energy-efficient design, and architects and engineers may consider energy-efficient design the norm. At the present time, it is important to create this bridge between design and implementation to promote demand-side management.

Construction Incentives

We had the experience of implementing a program without construction incentives, and later running that very same program to include incentives. When no construction incentives were offered, only a limited market was interested - the owner-occupied builders. Without the incentives the only value provided was energy-efficiency studies to help assess the design decisions. That group was very interested in going through the program, but when construction costs appeared to be going over budget, energy-efficiency measures were cut.

Churches were a perfect example of the scenario without construction incentives. They were multi-purpose buildings with special heating, cooling and lighting needs that were on irregular schedules but frequently used. Eventually, some of the people installed some of the measures some of the time.

Another example of a program without construction incentives was a project for a utility in the state of Washington. Two veterinary clinics were involved, using the same architect and engineer. They were similar-sized buildings. Veterinary clinics have special needs such as air handling - the waiting room must smell fresh and healthy; the surgery rooms require positive air pressure to prevent infiltration of infection; the isolation and extended stay rooms for animals required extensive extraction and conditioning 24 hours a day. The systems were elaborate for the size of the buildings.

Both vets intended to install energy-saving measures, and both projects were over budget. Financial incentives were not offered by the program when the first clinic was ready for measure installation. To save money, the owner installed a less efficient, less expensive air handling system. Then the utility instituted construction incentives. The second vet was able to install the recommended measures because the first-cost barrier was removed by the financial incentive.

Full incremental cost is the total difference between the cost of equipment for a "standard practice" measure and the cost for an energy-efficient measure. In developer interviews conducted throughout the country, the top priority is usually to bring a project in at the minimum completion cost. Because of this, developers universally identify the additional up-front cost as one of the largest barriers to selecting energy-efficient equipment. A survey of building professionals in the service area of a large Atlantic coast utility supports this finding. "First cost was the most often cited factor" inhibiting use of energy conservation options cited by the respondents. According to the study, "First cost was a factor more than three times as often as simple payback." This suggests that regardless of energy savings potential for any Energy Conservation Option, at least among the building professionals in the survey, initial capital costs are critical.[2]

When a utility program includes full incremental cost as an incentive for new commercial construction, lost opportunities for energy conservation are minimized. Lost opportunity resources are not only the most flexible demand-side resources available to the utility, but are also the most easily acquired if the market barrier (first-cost) is removed. The benefits to the customer are lower energy costs over the life of measures as well as other benefits that more expensive equipment is often designed to provide - longer useful life, reduced operating costs, etc. - at no additional cost.

A fast-growing Pacific Northwest utility continues in its third year of offering an incentive program for new commercial buildings. Initially, program incentives were set at 50-80 percent of incremental measure costs. Puget decided, after the first year of the program, to change its policy and now offers incentives equal to full incremental cost, up to a maximum of avoided costs for this program. According to management, "...without full incentives, in the long run, we would have lost as much as 80 percent of penetration into buildings. It is easier to attract owner-occupied buildings, where the owner has a stake in the savings, and full-incremental cost incentives would encourage the owner to become more aggressive on energy conservation. In the speculative buildings market, we felt that we could lose as much as 100 percent of the market without full incremental cost incentives."[3]

Although a certain level of controversy exists on this subject, we recommend that 100 percent of incremental cost of equipment should be paid to maximize both market penetration and level of participation. Partial incentives will not achieve maximum participation, but will incur the same administrative costs to utilities as full incremental cost incentives. Without any incentive, the opportunity for comprehensive savings (which could be captured at the time of construction) is likely to be lost altogether.

The short history of full incremental cost payment for new commercial construction programs leads us to believe that removing the barrier of additional up-front equipment cost allows a full-scale program to move ahead quickly and cost-effectively because project designers can concentrate on the work for which they contract, and can also enthusiastically investigate alternative equipment capabilities and embrace new design concepts.

Commissioning

The role of commissioning in the construction process is often limited to performance testing which happens just before final acceptance. However, ideal program design includes commissioning throughout the entire construction process, from planning in the predesign phase through occupancy. Broadening the role of commissioning to this extent ensures that design intent documentation exists, the building systems function as designed, the owner's operational criteria are met, tenant comfort and other needs are satisfied, operation and maintenance documentation is complete, and the O&M staff is properly trained and educated to operate and maintain the systems.

A commissioning agent selected during the conceptual design stage provides the owner with a team leader who coordinates and facilitates the commissioning process. The commissioning agent acts as a liaison among the designers, contractors, vendors, owners, operation and maintenance staff and the sponsoring utility. The

Table 2. Commercial Incentives of Collaboratively-Designed Energy Efficiency Programs

Utility	Incremental Cost Paid	Design Incentive Paid
Boston Edison Company	100%	Y
Commonwealth Electric	100%	Y
Central Vermont Public Service	100%	Y
Eastern Utilities Association	100%	Y
Green Mountain Power	100%	Y
New England Electric System	100%	Y
New York State Electric and Gas	100%	Y
United Illuminating	57-93%	Y
Western Massachusetts Electric	100%	Y

commissioning agent develops the overall commissioning plan, the detailed functional performance test plans, and the final report along with all the necessary documentation. The commissioning agent provides review and comment on technical considerations during all phases of the construction process with a view toward the efficient operation and effective maintenance of the building systems.

PECI was asked to commission a particular building in Portland, Oregon. Since the building had been fully renovated and occupied before the commissioning process began, the work is more correctly termed recommissioning. Had commissioning taken place from the beginning of the renovation process, most (if not all) of the following problems, uncovered during the recommissioning process, would have been alleviated.

In this building, the lack of any control schematics, diagram, or strategies, left the control engineering in the hands of the installers. Though the goal was to have an energy management and control system (EMCS) that coordinated the HVAC plant and systems, the result is a plant and systems that are controlled by various methods and panels, with only a few unitary heat pumps and lights scheduled on and off by the EMCS.

Testing the points (in the EMCS) performing time-of-day control for the heat pumps revealed that the program had never been fully tested and needed to be reworked, and some of the points had never been physically connected to the field hardware. Also, the EMCS field panels contained blown fuses and, in one instance, the normally open contacts on a relay controlling a set of points was welded shut.

The primary heat source for the hydronic loop, an air-to-water 30-ton heat pump, had such a low charge that the compressor was not doing any effective work. A water treatment system for the hydronic loop had never been installed. Operation and maintenance manuals had never been compiled and no as-built drawings existed. The two-speed fan controls for the unitary heat pumps were installed but were not performing according to intent. The daylighting controls for several floors were installed but never wired into the lighting circuit. Because of incorrect application, it is doubtful that these controls would have worked even if they were connected.

In another new building, months after construction was completed, occupants complained that they were very dissatisfied with the energy-efficiency measures. Their energy bills were three times higher than what they were led to expect. Also, the higher they turned the thermostat, the colder they felt. A building audit revealed that the duct work had never been connected to the HVAC equipment and to make matters worse, the utility had inadvertently used the wrong multiplier on their electricity bill. The problems were remedied, but if commissioning had been part of the original process, the problems would never have occurred.

Commissioning provides the owner with a building that functions according to design intent from the day of acceptance forward, and ensures persistence of savings and effective operation throughout the life of the building. Although post-occupancy work falls under operations and maintenance, preparation for comprehensive O&M is an important function of commissioning. Until recently, most conservation programs have not been set up with a commissioning component. By offering commissioning as a part of the energy-efficiency program, utilities fulfill their responsibility of seeing that maximum savings are achieved.

Operation & Maintenance

O&M directly impacts the attainable savings from energy-efficiency measures. Proper operation and maintenance practices with a solid maintenance management program leads to the efficient operation of the building and extends the life of the equipment. Including O&M as a component of commissioning ensures that the O&M manuals contain all the information necessary to properly service the installed equipment, and provides relevant training and education to the facility manager and O&M staff, allowing them to operate the building in accordance with its design goals.

Often equipment is needlessly installed in ways that make it inaccessible. Simple but important tasks such as changing filters or troubleshooting a safety control on an HVAC unit can become extremely difficult and time consuming if the unit is oriented in such a way that the door to the controls or filter compartment cannot be easily opened. It may be so frustrating for the building operators to work on a unit that the unit is rarely - or never - serviced. When commissioning focuses on O&M issues early in the construction process, improper location or orientation of equipment is controlled. This ultimately saves the owner money by decreasing the time it takes to repair or service easily accessible equipment.

To encourage effective operation and maintenance, assistance from utilities has been recommended as part of program design in the following ways:

- Building-specific technical assistance such as energy accounting, as simple as bill monitoring or as complex as hourly end-use metering of loads and building conditions
- Follow-up visits by utility-trained personnel to identify and solve O&M problems
- Developing upper management commitment to O&M savings
- Requiring O&M service contracts, equipment-specific training, manuals and maintenance schedules before incentives are paid
- Subsidizing O&M service contracts, as well as low-cost measures, if the customer uses energy accounting
- Providing an O&M incentive payable over a number of years, based on measured savings
- Providing or sponsoring hands-on training to building operators

Insufficient data exists to verify the effectiveness of these suggested strategies at this time, but all are viable methods of practicing successful programs. A number of utilities and other organizations have taken steps to promote O&M, often as part of their new construction programs, such as Western Montana Pilot Project, Washington State Pilot Project, Northeast Utilities Energy Action Program, Northeast Utilities Energy Conscious Construction Program, Southern California Edison Thermal Energy Storage Program, Southern California Edison New Commercial Buildings Program, Puget Sound Power and Light Commercial Retrofit Program, and Central Maine Power Partners Program. Comparative results should be available as the programs progress.

Evaluation

Two types of evaluation normally are conducted to measure the success of program implementation: impact and process evaluation. The purpose of impact evaluation is to measure the gross and net savings from the measures, and verify the amount of resource acquired from installation of the energy-efficiency measures. The impact evaluation should also help determine the potential for further savings both in the aggregate and measure-by-measure. Impact evaluation performance includes development of a "rolling" baseline, estimating the numbers of free riders and free drivers, and the extent of penetration by DSM technology.

The purpose of process evaluation is to determine what has happened and to what extent the building's performance followed the designed plan. Some of the criteria for process evaluation cannot be quantified, but rather deal with perceptions of building owners, occupants and operators. The process evaluation not only examines performance, but also, aggregately, the effects of the program on the market. It can quickly identify the extent to which developers comply with specific incentive levels, or which design teams are most active in the program. It also indicates the relative success of marketing efforts and delivery options.

For these reasons, it is important to begin the evaluation process at an early stage of project development. Evaluation is perceived as an end product, a review of program effectiveness following planning and implementation. Typically, evaluations are conducted after two or more years of data collection. The standard evaluation plan calls for the two-tiered approach of impact evaluation and process evaluation. After these two processes are completed, most programs are never again evaluated.

During the two-year time period between building start-up and evaluation, operation and maintenance problems may surface that affect either the anticipated level of savings derived from equipment, or the level of satisfaction in human terms. It is important, therefore, not to wait two years. If evaluation is an integral part of the design process, operational results reflecting each particular building, as well as the aggregate data, can be used immediately to modify or enhance the program.

We performed an impact evaluation for a utility on its program for large commercial and industrial customers. Unfortunately, the evaluation was inadequate because sufficient data was not available, emphasizing the importance of considering evaluation during program design. The appropriate data to collect for evaluation should be determined at the beginning of the program design, then reviewed during the development process. It is also important to generate a feedback loop from evaluation to program design, because mid-course corrections and fine tuning will enhance the program's marketability and achieve its goals more directly.

Training

Training can support the program by increasing the building and design community's ability to design, install and service the energy-efficient equipment. Many training needs are associated with a commercial new construction program, including those of utility staff, architects, engineers, contractors, and suppliers. The purpose of training and education is to obtain a level of understanding of the program, and to build the capabilities of utility staff, customers and service providers. In this connotation, training supports the other program components by increasing the utility's capability to deliver - and the customer's ability to participate - in a valuable way.

Implementation of these programs has demonstrated three basic areas of training need: utility staff and contractors, customers, and the building community at large. Apart from the utility's ability to provide useful assistance, the industry itself must be capable of designing, installing and servicing the energy-efficient equipment. Training is integrated into the program by assisting the customer through the design, construction and operation of an energy-efficient building. In addition, utilities can offer additional educational opportunities for the building community through seminars, courses and educational material to ensure the success of, and continuing commitment to, their energy conservation programs. Further training to ensure building performance and equipment life cycle savings should also be offered as encouragement for proper operation and maintenance.

We have found that an essential training component for program implementation staff is hands-on training in the field to develop an operational understanding of energy-efficient measures and how they are integrated into building design. After the staff understands the program's intent and operating procedures, they are sent into the field with more experienced staff. This method has been used in-house at PECI as well as with utilities. We find that the opportunity for peer training created by this method is appreciated, and significantly increases program reliability.

Conclusion

To achieve the energy- and cost-saving goals of a DSM program plan, a variety of issues must be addressed. We have learned that good program design is not static, but is derived from a collection of guiding principals that must work together with the uniqueness of each market. Changes in technology, pricing, and attitudes are among the many factors that affect the fluidity of program planning from one year to the next. In spite of the difficulties of wrapping a plan around such changing conditions, some fundamental principles can guide the process successfully:

- Develop personal, trusting relationships with building owners, designers and developers

- Provide as much guidance as customers require throughout the process, from design support or technical assistance through commissioning and evaluation

- Remove onerous market barriers by providing incentives for both design and construction

- Assist in streamlining implementation by providing a commissioning agent to review, plan and oversee equipment, operation and maintenance strategies

- Evaluate the project from the start to provide necessary feedback both to the utility and to the building owners and occupants.

- Provide education to all levels of participants, and hands-on training to everyone who will be involved in operation.

These programs represent a long-term relationship between the utility and the customer. Both parties elect to invest in project design, construction and operation. Both parties stand to gain from comprehensive programs that serve their needs. If there is a single guiding principle we can share from implementation experience, it is this: like any new idea, energy efficiencies and cost savings derived from DSM programs are only as possible as the market which accepts them. Potential customers should be educated as thoroughly as necessary to understand and believe in energy efficiency as a concept. They should be guided through the process of accomplishing maximum efficiency and savings. Finally, they should be assisted to customize their building design and construction to accommodate energy-efficiency measures which enhance their unique design, quality and function.

Endnotes

1. Telephone survey conducted with program managers of utilities listed in Table 1 by PECI, 1991.

2. American Consulting Engineers Council (ACEC/RMF), survey of designers and owners of recently constructed large Washington area buildings, "Energy-Related Design of Large Commercial Buildings in the Washington Metropolitan Area," ACEC Research and Management Foundation, Washington, DC, April 1990, p.16.

3. Personal communication between Mac Jourabchi, PECI, and Syd France, PSP&L, 3/8/91.