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THE EXPERIENCE OF ENERGY CONSERVATION PROGRAMS WITH NEW COMMERCIAL BUILDINGS

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ABSTRACT

As part of Lawrence Berkeley Laboratory's Least-Cost Utility Planning Project, we have recently completed a review and assessment of the experience of 30 energy conservation programs with new commercial buildings in the U.S. and other countries. The focus was on non-mandatory strategies, which complement, reinforce, or in some cases may substitute for energy-efficiency requirements in building codes. The programs are primarily conducted by state and federal agencies and utility companies. The types of programs investigated include: large-scale demonstrations, financial incentives, energy rating and labeling, energy awards, design tools, design assistance, and standards-related training, compliance and quality control programs.

We focus our discussion on design assistance programs and examine available data on market penetration, energy and cost savings, program costs, and cost-effectiveness. Despite the scarcity of quantitative evaluation data on most programs, we present our major findings and make recommendations for program managers interested in designing and implementing energy conservation programs for new commercial buildings.

THE EXPERIENCE OF ENERGY CONSERVATION PROGRAMS

WITH NEW COMMERCIAL BUILDINGS

For over ten years, energy conservation programs for new commercial buildings have been implemented by local, state, and federal government agencies, utility companies, and private organizations. Most of these programs have been designed and implemented in isolation from one another and have emphasized different technical and marketing designs. Because of the renewed interest in these programs (in part related to least-cost utility planning efforts), it is important to understand how effective they have been in penetrating the new construction market, in saving energy, and in influencing the design and construction of energy-efficient buildings.

This paper contains material from a larger report that examines a broad range of energy conservation programs for both new residential and new commercial buildings (Vine and Harris, forthcoming). The report represents one of a series of program experience reports that seek to synthesize current information from both published and unpublished sources to help utilities, state regulatory commissions, and others to identify, design, and manage demand-side programs to meet their needs.

In this paper, we examine the experience with programs to promote energy efficiency in new construction. We investigated this topic for several reasons. First, many areas of the country are experiencing increasing demand for electricity, in large part to all-electric new construction. Accordingly, constructing energy-efficient buildings (including those with lower demand during utility system peak periods) will reduce the need for new power generating plants. Second, even in areas where there is now a surplus of electric generation capacity, new construction should be considered a "durable good" that will last for 3 to 5 decades or more; any delay in constructing energy-efficient buildings represents a "lost opportunity" to save energy. Third, it is often easier and less expensive to construct an energy-efficient building from the beginning than to retrofit an existing building later. Fourth, in those areas where building codes have been in place for a number of years, there is a general reluctance to further tighten the energy-efficiency requirements until other, nonregulatory approaches have been explored. Finally, the experience of several programs demonstrates that utilities can become active participants in promoting energy-efficient construction without being linked by their customers with the imposition of mandatory building standards.

The programs examined in this paper illustrate the range of approaches taken in promoting energy-efficient construction. We were interested in both successful and less successful programs, since both can help guide future program design. In this paper, we report initial findings from an ongoing study. We have not described the entire universe of programs, but after summarizing the general approaches that have been tried, we focus on design assistance programs as a particularly promising strategy for encouraging energy-efficient construction in new commercial buildings.

CONCEPTUAL FRAMEWORK

Our investigation was guided by a perspective on how programs address the barriers to widespread adoption of energy-efficient design and better end-use technologies in new construction. Different frameworks have been used in the investigation of barriers in residential and commercial buildings, and our categorization reflects these earlier perspectives (e.g., Blumstein *et al.*, 1980; Nieves and Fang, 1985). We considered four types of barriers: information, initial cost, technological, and perceived risk. These barriers are not mutually exclusive and often interact:

- Designers, architects and engineers, builders and developers, and the lending community need information on energy-efficient design and product availability, as well as data on their costs and energy performance. In addition, there is a widespread need for better energy design tools and improved methods for evaluating new technologies as they relate to a specific building. The lack of this information and the perception of problems regarding new technologies may prevent even highly motivated individuals from investing in cost-effective, energy-efficient buildings, or inhibit design professionals from recommending such measures.
- Most of the actors involved in the design, construction, and ownership of energy-efficient buildings are very sensitive to initial costs and less concerned with long-term operating costs. Similarly, any time delays in designing and constructing a building represent increased costs that someone must bear. This is of special concern to small developer-builder firms, to owners or developers of "speculative" commercial space, to many governmental agencies, and to prospective home buyers with limited budgets. Frequently, an increase in initial costs is passed through to the buyer (possibly affecting his ability to qualify for a loan) and to tenants in apartments and leased commercial buildings. Accordingly, market demand for more efficient buildings may be lessened if the initial costs are perceived as too high, and the corresponding savings in energy operating costs viewed as too small.
- The availability of some new energy-efficient technologies may be limited (e.g., electronic ballasts and point-of-use water heaters), especially in those areas where there is no established market. Also, new products are currently being introduced into the marketplace at a fast rate by a large number of manufacturers. As a result, problems arise related to the

quality, performance, reliability, and possible adverse impacts of these products on occupant health and comfort. The lack of a support infrastructure that is willing and ready to service these products may compound these problems. Furthermore, these technologies may not be adopted without the availability of measured, long-term performance data from a credible source, or some sort of quality assurance from an established institution.

- For some individuals, the perceived risks associated with constructing (or owning) an energy-efficient building may be considered too high, compared to a "current practice" building. In the absence of adequate financial incentives, individuals may prefer to wait until new energy-efficiency standards are required, or until the advantages of these new technologies have been demonstrated beyond any doubt (e.g., energy-efficient design may be a good marketing device, or may lead to increased status), or until they are more familiar with the performance of the new designs and products.

Each of these suggests, in turn, possible strategies to overcome barriers to energy-efficient construction in new commercial buildings. In organizing the information on the wide range of programs examined, we developed a typology that reflects different approaches to overcome the barriers to energy-efficient construction mentioned above (Table I).

Table I. Types of nonmandatory programs.

Programs	Barriers Addressed			
	Information	Cost	Technological	Risk
Technology Demonstration and Monitoring	Yes	[Yes]*	Yes	Yes
Financial Incentives	No	Yes	No	[Yes]
Consumer Information and Marketing				
Energy Rating and Labeling	Yes	[Yes]	[Yes]	Yes
Energy Awards	Yes	No	No	[Yes]
Technical Information				
Professional Guidelines	Yes	No	[Yes]	Yes
Design Tools	Yes	No	[Yes]	Yes
Design Assistance	Yes	[Yes]	[Yes]	Yes
Standards-related Training, Compliance, and Quality Control	Yes	[Yes]	[Yes]	Yes

* A [Yes] response indicates that the barrier addressed is not the primary focus of the program.

Several of the programs we examined have multiple objectives and may overlap the program categories described in Table I. Moreover, at different stages in the implementation of a given program, the objectives and emphasis may change, thereby changing the nature of the program. For example, demonstration efforts tend to evolve toward technical information programs. Similarly, financial incentives may be phased out once they achieve a certain amount of visibility and market acceptance, to be replaced by information, marketing, and design assistance activities.

We focused our investigation on nonregulatory programs that are designed to complement--or in some cases substitute for--mandatory energy efficiency requirements in local and state building codes. We did not examine implementation issues or impacts of the codes themselves.[1] Building codes and standards, however, do serve an important purpose that is missing in nonmandatory programs. Codes and standards provide a mechanism to establish minimum acceptable efficiency for all new construction ("sacrificing depth for breadth"). Thus, the role of mandatory regulations is to eliminate (in principle) the "worst" practices in terms of energy efficiency. Because such standards are necessarily the products of compromise, they do relatively less in the best energy-efficient designs, products, and materials. In contrast, nonmandatory programs help push efficiency beyond the minimum acceptability for program participants ("sacrificing breadth for depth"). Nonmandatory programs can complement building standards by providing: (1) options for innovative approaches not covered by standards, (2) incentives for early adoption of standards, and (3) training workshops and material for educating the building community and thus enhancing compliance with standards (reducing the cost of compliance to builders, and the cost to government of code enforcement). In sum, these programs may not only provide a receptive environment for proposed standards and ease the process of introducing new standards or upgrading existing ones, but also, in some cases, help promote building practices that exceed state or local standards.

METHODOLOGY

In selecting programs for new commercial buildings[2], we conducted extensive literature searches and contacted key organizations and knowledgeable individuals in the field. We also sought program descriptions from state energy offices through an announcement in *Conservation Update*, a monthly newsletter published by the U.S. Department of Energy. Our interests

[1] For information on current building codes and standards in the United States, see NCSBCS, 1985. Examples of recent studies that have evaluated the implementation of energy-efficient building standards for commercial buildings: C-Engineering, 1986; Coates and Sumi, 1987; O'Neill and Company, Inc., 1988; Portland Energy Conservation, Inc., 1988.

[2] Including institutional and industrial buildings, as well as manufactured buildings for nonresidential uses.

included programs that were completed (or otherwise terminated), are presently being conducted, and, in some cases, those about to be initiated. Some of the programs were considered successful by their sponsors, while others were not. The common strand linking these programs was that valuable lessons could be learned from their experience.

We focused on programs that promote the design and construction of energy-efficient buildings, with a particular emphasis on the building shell or envelope. Those programs that simply promote the purchase of energy-efficient appliances, without addressing the building envelope, were not included in this study (e.g., rebates for installing efficient lighting equipment, heat pumps, and other space conditioning equipment).[3] However, we did include programs that address both shell and equipment efficiencies. Similarly, conservation-oriented rate design, such as time-of-use rates and demand charges, were not included in this report. Although these rate design strategies are often targeted primarily to existing construction, designers of new buildings may take them into account when designing energy-efficient buildings.

Using these criteria, we examined a total of 30 programs affecting new commercial buildings. Detailed descriptions of these programs are contained in a separate volume of the larger report (Vine and Harris, forthcoming). Each description is based on a telephone interview with at least one individual knowledgable about the program (usually a representative of the program sponsor) and, when available, on written material. The interviews lasted from 10 to 30 minutes and were based on a structured questionnaire. The principal topics addressed during the interview were: program objectives, key participants, date(s) of implementation and current status, marketing methods, type of monitoring and evaluation, key results (in terms of market penetration, savings, costs, and cost-effectiveness), the interviewee's overall assessment of the program, and related programs.

PROGRAMS FOR NEW COMMERCIAL BUILDINGS

Design Assistance

Aside from programs providing direct rebates for appliances and equipment, one of the most common types of energy-efficiency programs offered by utilities and governmental agencies to new commercial customers has been the provision of technical assistance in designing energy-efficient commercial buildings. Table II summarizes key features of these 16 programs; the programs have been separated into two groups reflecting the emphasis given to design assistance. These programs have been implemented both by utilities and by governmental agencies at the

[3] Information on appliance and equipment efficiency programs has recently been published in a report on utility rebate programs promoting energy-efficient appliances, space conditioning systems, lighting products, and motors (CECARF, 1987).

Table II. Design assistance programs for new commercial buildings.

Name of Program	Sponsor	Location	Other Features						
			TD	DP	FI	RL	EA	DT	TC
Primary Design Assistance Programs									
New Construction Energy Design Assistance	TVA	SE U.S.					•	•	•
Design Assistance for New Commercial	Wash. State	Washington		•	•			•	•
Energy Smart Design Assistance Program	BPA	Pacific NW	•	•	•	•	•	•	•
Energy Edge	BPA	Pacific NW	•	•	•	•		•	•
Technical Assistance	SMUD	Sacramento			•			•	
Solar Design Strategies	PSIC	National				•		•	
Energy Conscious Construction	NE Utilities	Connecticut						•	
Daylighting and Thermal Analysis	SCE	So. Calif.			•			•	
Secondary Design Assistance Programs									
Good Cents Commercial	So. Electric	National				•		•	•
Good Cents New Commercial	PSC of Okla.	Oklahoma			•	•		•	•
Tacoma's Early Adopter Program	Tacoma	Tacoma	•	•	•	•			•
Customized Pgm. for New Commercial	PG&E	No. Calif.			•			•	
California's Conservation Standards	CEC	California						•	•
Passive Solar Nonresidential Buildings	DOE	National	•	•	•			•	
Passive Solar Manufactured Buildings	DOE/SERI	National	•	•	•				
Solar in Federal Buildings Demonstration	DOE	National	•						

Key to Sponsors:
- TVA = Tennessee Valley Authority
- BPA = Bonneville Power Administration
- SMUD = Sacramento Municipal Utility District
- PSIC = Passive Solar Industries Council
- SCE = Southern California Edison
- PSC = Public Service Company
- PG&E = Pacific Gas and Electric Company
- CEC = California Energy Commission
- DOE = U.S. Department of Energy
- SERI = Solar Energy Research Institute

Key to Features:
- TD = Technology Demonstration Site(s)
- DP = Demonstration Program
- FI = Financial Incentives
- RL = Rating and Labelling
- EA = Energy Awards
- DT = Design Tools
- TC = Training, Compliance, and Quality Control

national, regional, state, and municipal levels. As part of the design process, these design assistance programs often include consulting services and site-specific design review between energy experts and the architect and engineering team and their client. These programs tend to be most successful when they introduce energy-efficient options as early as possible in the design stage, where key actors are often most open to new ideas and suggestions. Other key actors (such as lenders and real estate agents) may be included in these early discussions in order to educate them about the potential energy and financial savings resulting from energy-efficient improvements. Because money and time are at a premium at the design stage, both the design team and the client (and lender) must be convinced the benefits of the increased design effort and expense are worthwhile, in terms of energy efficiency and marketability of the property.

In addition to review of architectural and engineering drawings, computer modeling is often provided to simulate the effect on energy performance and cost-effectiveness of different building configurations, orientations, design features, and energy technologies. Computer programs are most often used to estimate the energy needed for heating and cooling a building and the operating costs for heating and cooling. Sometimes, energy used for lights, water heating, and other appliances is also estimated, as well as peak electricity demand or energy usage by time-of-use (as defined in the rate design). Both peak demand and energy by time-of-use are of increasing concern as factors affecting energy operating costs. Some programs establish recommended energy targets for each type of building in a particular climate zone. Comparisons are made between energy used in the target building and energy used in the proposed design for the new building, and the design is modified in order to meet (or exceed) the target.

As an example, architects and engineers in Tennessee Valley Authority's (TVA) New Construction Energy Design Assistance Program work with private architects and engineers on specific projects on a one-to-one basis (Edwards, 1986). Assistance is given at the schematic design level as well as during design development. Assistance includes identifying energy saving options most appropriate for the specific project, providing energy and cost analyses, and making recommendations on the basis of cost-effectiveness and energy performance of each option in relation to the whole building. A written report is provided to the consumer recommending specific strategies to be implemented.

If in-house expertise is not available, architectural and engineering firms might be able to provide the necessary resources for providing design assistance. For example, the Washington State Energy Office used a competitive selection process for selecting four firms to work with developers and builders in their Design Assistance program. Washington State chose this approach because (1) they didn't have design engineers in their office, (2) there were experienced consulting firms in the state, (3) they hoped to create a larger market for energy design firms in the state, and (4) they wanted better oversight of the program (e.g., through the use of standardized forms). A third option--allowing utilities to choose their own experts (in-house or outside the utility)--is planned for the Bonneville Power Administration's (BPA) Energy Smart Design Assistance Program.

The marketing of these programs is diverse. For example, TVA uses direct mail to market their program: customers are identified who can use a particular technology and are sent a letter, program literature, and postage-paid return card for requesting additional information. Follow-up telephone calls are made to determine if there are additional questions or information needs. Also, advertisements are placed in professional journals. Public Service Company of Oklahoma's Good Cents New Commercial Program uses a comprehensive marketing strategy including audio/visual presentations and a very intensive training schedule for the utility's commercial customer representatives (Termini, 1986).

Aside from a few cases, there has been very little evaluation of design assistance programs. As a result, there are few quantitative data on program effectiveness. Although we do have such data for a few programs, it is hard to tell how representative these may be:

- Market penetration was quite low: most programs targeted professionals at the "leading edge" so that others would be encouraged to copy these innovators. In addition, lengthy, personal discussions between the design professional and the sponsoring organization limited the number of program participants. TVA, for example, only reached about 3% of the design community in their region. From 1980 to 1986, design assistance was provided by TVA to architects and engineers on 430 projects, and during Fiscal Year 1987, construction was completed on 79 projects previously receiving energy design assistance.
- The national design assistance programs were expensive and usually one-time events, in contrast to the ongoing design assistance programs of utility companies. For example, DOE's Solar in Federal Buildings Demonstration Program cost $30 million to administer (most of this money went into the monitoring of the buildings and for data analysis; an additional $29 million was spent for incentives), and DOE's Passive Solar Nonresidential Buildings cost $5.5 million to administer.
- Energy savings were *measured* in only one program: DOE's Passive Solar Nonresidential Buildings were found to be saving an average 45%, compared to estimates for comparable "base case" buildings. Moreover, operating costs were found to be 51% less than the base case.

- Energy savings were *estimated* for a number of programs, as shown in Table III:

Table III. Estimated energy savings for new commercial buildings.

Name of Program	Sponsor	Estimated Savings
Energy Edge	BPA	30% annual electric use
Energy Smart Design Assistance Program	BPA	10-30% annual electric use
Title 24 Standards for Office Bldgs.	Calif. Energy Comm.	40-50% annual electric use
New Construction Energy Design Assistance	TVA	142,261 kWh per year 50kW peak savings
Energy Conscious Construction Program	Northeast Utilities	144,000 kWh per year 20 kW peak savings

The more recent design assistance programs have shown that the initial reluctance of some designers to have their plans "reviewed" can be overcome when both the design firm and the client are clearly shown the benefits of designing energy-efficient commercial buildings: long-term energy cost savings, the potential for first-cost savings in some cases, improved professional reputation and status, and an increased competitive edge. The experience of these programs has shown that, in many cases, substantial gains could be made in energy efficiency without any significant deviations from conventional practice. Some participants reported that the added amount of time spent in design and energy modeling in the early stages of a project led not only to energy savings but also reduced initial construction costs, generally as a result of down-sizing HVAC equipment to meet reduced loads, or by installing fewer but more efficient lighting fixtures. (Benner *et al.*, 1987).

These programs have also had important indirect effects, by helping to create a network among designers, builders, and utility and government program sponsors, all of whom are more receptive to innovative methods, materials, and technologies. For example, one developer participating in a design assistance program in the Pacific Northwest has decided to use his prototype for future buildings in the region (*ibid*).

Design assistance programs seldom occur alone; they are often combined with marketing and financial incentive programs to promote energy-efficient construction. For example, Public Service Company of Oklahoma's Good Cents New Commercial Program includes the following services: technical design study, marketing strategy, program development study, energy analysis software, audio/visual presentations, program support manuals, and training workshops (Termini, 1986). The last seven columns of Table II show the range of other services that are offered in conjunction with each of the design assistance programs. The next sections briefly describe some of these other program features (some of which are separate program categories discussed in our larger study).

Technology and Program Demonstrations

Some of the design assistance programs are part of technology and program demonstrations. These demonstrations are designed to field-test new technologies or to prove the "buildability," performance, economics, and marketability of energy-efficiency features. Demonstration programs often select a small number of sites to test the performance of new technologies in occupied buildings and to prove that the *technology* works. Such technology demonstration sites differ from a second type of demonstration program that is aimed at testing a new *program* approach on a small-scale, pilot basis; if successful, the program is then expanded to a larger-scale. Many of the demonstration programs included in this category have included both objectives: to test new technologies and new program strategies.

For example, the Energy Edge program was run as a design competition (Benner *et al.*, 1987). Applicants were given extensive design assistance and financial incentives for the design and construction of the buildings. The buildings were selected based on the merits of their design and the costs and predicted savings of the energy conservation measures. Each building was designed to use at least 30% less energy than a corresponding "base case" building. Initially, the buildings were designed to demonstrate innovative, state-of-the-art technologies without sacrificing construction schedules or tenant comfort. Also, building designs were to be replicable to future new commercial buildings. However, these two criteria--innovation design and replicable technologies--conflicted somewhat, so that final projects often leaned toward relatively conventional but energy-efficient solutions (*ibid*).

Financial Incentives

A number of design assistance programs offer incentives for installing energy-efficient measures as well as for subsidizing actual design costs. For measures, incentives can either be "prescriptive" (based on specified payments for a list of measures) or "customer-defined" (based on dollars per square foot or dollars per kWh saved). Examples of the former are incentives for high-efficiency heat pumps offered by the Public Service Company of Oklahoma, and Southern California Edison's daylighting controls. An example of the latter is Pacific Gas and Electric's (PG&E) commercial incentive program in which customers can decide what options they want to pursue, and qualify for an incentive after obtaining PG&E's approval. The City of Palo Alto (a municipal utility) allows customers to choose either a prescriptive or performance approach to reduce their cooling loads; rebates are provided as long as demand is reduced during the City's summer peak demand period.

Some programs offer incentives to designers to reimburse (subsidize) their costs of participating in the program and of redesigning their buildings for incorporating energy-efficient measures. In Washington State's Design Assistance program, for example, incentives to designers ranged from $0.046 to $0.44 per square foot.

Energy Rating and Labeling

Energy ratings and labels are sometimes given to all buildings that meet a certain level of energy efficiency. For example, in BPA's planned Energy Smart Design Assistance Program, two level of awards will be presented: Energy Smart Awards for electrically heated buildings designed to be at least 10% more energy efficient than a base case building; and Energy Edge Awards for electrically heated buildings at least 30% more energy efficient than base case buildings.[4] For Energy Smart buildings, certificates will be provided to building designers and owners. Award benefits for Energy Edge buildings will include site designs, publicity (directed to prospective tenants, builders, developers, and designers), building plaques and certificates for the building designers, and formal recognition at regional and national conferences.

Energy Awards

Energy awards are sometimes presented in recognition of those design professionals whose work demonstrates energy efficiency in commercial buildings (i.e., "the best" energy-efficient buildings). For example, in Pennsylvania Power and Light's Architect and Engineer Energy Awards Program, members of the project team for qualifying buildings receive awards and significant promotional benefits. Free publicity is offered to promote those responsible for the design, as well as the building itself. The publicity includes advertisements and case studies in professional and trade journals, and news releases to mass media. Information on the program is also distributed to members of the architectural and engineering professions, building owners, developers, financiers, real estate professionals, businesses, industries, and other utilities.

Design Tools

As part of most design assistance programs, special design tools for evaluating energy-efficiency features have been developed and made available to the design community. The available design tools are varied, including workbooks, guidebooks, energy nomographs, calculator programs, daylighting models, and microcomputer or mainframe computer software. In some

[4] This program is based on two existing demonstration programs: Washington State Energy Office's Design Assistance and BPA's Energy Edge programs.

cases, the same tools have been used for both complying with local or state energy codes and for improved design that goes beyond the standards.

As an example, TVA has published its Energy Design Guideline Series containing individual manuals, one for each building type, that describe ways to utilize energy more efficiently. The topics include: identifying design problems and baseline energy use characteristics, selecting and testing energy design strategies, incorporating energy strategies into the design process, and evaluating building performance. TVA's manuals are currently available for schools, offices, hospitals, and hotels/motels. Additional manuals are being developed for retail trade and restaurants. The energy-related design criteria in the guidelines are intended to be incorporated into the normal design process. In addition, TVA is currently developing a manual containing a detailed energy and cost-based evaluation procedure to accompany the design guidelines. This manual will provide architects and engineers in the region with a complete package of evaluation tools and support information.

Standards-related Training, Compliance, and Quality Control

Technical workshops and seminars are sometimes conducted, as part of design assistance programs, to provide technical information and training to architects, engineers, building owners and managers, builders, developers, building code officials, appraisers, commercial real estate professionals, and staff of financial institutions. These training activities are especially important to encourage conformance with mandatory standards or voluntary guidelines. For example, one of the most important findings in the evaluation of Washington State's commercial energy code was that most officials responsible for the commercial energy code did not feel adequately trained or educated to enforce it (O'Neill and Company, 1988). As a result, mechanical and lighting code requirements, in particular, were largely being ignored by the building officials in most jurisdictions. In response to and in expectation of these kinds of problems, the California Energy Commission (CEC) has conducted numerous training workshops around the state for promoting compliance with its new mandatory energy conservation requirements for new commercial buildings (Pennington, 1986). In addition, several design manuals have been prepared for the CEC by local architectural firms.

Quality control inspections are sometimes made during the construction process and/or after the building has been completed. Public Service Company of Oklahoma's Good Cents New Commercial Program includes final inspections to make sure the constructed building is a Good Sense building.

It is expected that the emphasis on quality control will increase as more attention is paid to what happens to a building after the design stage. Potential problems with the performance of building systems will need to be addressed at the pre-design, design, and construction stages, rather than await their arrival during post-construction. Accordingly, building owners, designers, contractors, and manufacturers will need to cooperate and coordinate their activities and responsibilities as part of a quality assurance or building commissioning team.

Other Programs

Sometimes, the programs described above have been implemented in the absence of design assistance; and we have listed 14 of these programs in Table IV. The programs are categorized using the organization in Table II. In addition, we have added two programs concerned with developing planned communities. Where appropriate, we have included other components of the programs which are featured in their implementation.

DISCUSSION AND CONCLUSIONS

In our review of energy conservation programs for new commercial buildings, one of the most important (as well as most frustrating) findings was the lack of program evaluation. Consequently, we were able in only a few cases to assess the effectiveness of programs in terms of market penetration, energy and cost savings, program costs, and cost-effectiveness. Both process and/or impact evaluation were conducted in only a few cases. On the brighter side, a number of programs currently underway will be including both process and impact evaluation as an institutionalized component of the program (e.g., the Energy Edge program). Hopefully, these future results will continue to shed more light on the question of program effectiveness.

From our perspective, a successful program is one in which, at a minimum, energy conservation features have been incorporated into the design of commercial buildings and, at a maximum, energy savings have been significant and cost-effective, and/or market penetration has been extensive. Other indicators (e.g., occupant satisfaction and indoor air quality) are also sometimes included in defining a successful program. Despite the scarcity of quantitative evaluation data on most programs, we did come up with a number of findings, some of which are related to program success:

- There were successful programs of many different types - no strategy was clearly dominant.
- Successful programs were often characterized by intervention early in the design and planning process.
- Many programs were considered successful for both energy and nonenergy reasons (e.g., developing better relations with a targeted audience).
- Details of program design and operation were often crucial (e.g., delays in construction may negate the positive features of rebates).

Table IV. Other energy conservation programs for new commercial buildings.

Name of Program	Sponsor	Location	Other Features				
			TD	FI	RL	DT	TC
Demonstration Program							
Code Adoption Demonstration, Early Adopter, & Model Conservation Standards Implementation Assistance Programs	BPA	Pacific NW	•	•			•
Financial Incentive Program							
New Construction Incentive	Palo Alto	Palo Alto					
Energy Award Programs							
Architect and Engineer Energy Award	PP&L	Pennsylvania					
Energy Conservation Design Award	Florida Power	Florida					
Energy Award	ASHRAE	National					
Energy Award	Edison Electric	National					
Low-Energy Building Design Award	EM&R	Canada					
Energy Conservation Awards	Owens-Corning	National					
Professional Guidelines							
Whole Building Performance Standards	DOE	National				•	
Design Tool Programs							
Whole-Building Energy Design Targets	DOE/PNL	National					
General Design Criteria Manual	DOE	National					
Training, Compliance, and Quality Control							
Florida Energy Code and Marketing Program	Florida EO	Florida			•	•	
Community Planning							
Milton Keynes Energy Park Demonstration	Milton Keynes	England	•		•		•
Saint Paul Energy Park	Saint Paul	Minnesota					

Key to Sponsors:
BPA = Bonneville Power Administration
PP&L = Pennsylvania Power and Light
ASHRAE = American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.
EM&R = Energy, Mines and Resources
DOE = U.S. Department of Energy
PNL = Pacific Northwest Laboratories
EO = Energy Office

Key to Features:
TD = Technology Demonstration Site(s)
FI = Financial Incentives
RL = Rating and Labeling
DT = Design Tools
TC = Training, Compliance & Quality Control

- Most of these programs can be easily implemented in other areas around the country.
- Market penetration of these programs has been low so far, reflecting the emphasis of these programs on "innovators" rather than on all potential participants.
- There were few examples of large-scale programs, targeted at a major proportion of new buildings.

We also make the following recommendations for designing and implementing energy conservation programs for new commercial buildings:

- Programs should be comprehensive and, at a minimum, should include a well-integrated package containing the following components: design assistance, financial incentives, quality control, training and education of design professionals and the building community, simple and easy-to-use design tools, rating and labeling of buildings, energy awards for buildings and for design and building professionals, process and impact evaluation, monitoring, and feedback activities.
- Programs should be tailored to their natural and sociopolitical environment for successful implementation. One must be cautious in simply copying a reportedly successful program. Program managers need to find out about the details of other programs before adopting them, including any mid-course corrections made during the implementation of the program.
- Market-based incentives, such as the rating and labeling of buildings, should be used as much as possible for promoting energy conservation. Support activites (e.g., aggressive publicity) are also needed to promote the program so that market pressures can work effectively. Nonmandatory programs, combined with market-based incentives, can complement and facilitate the adoption of energy conservation building standards.

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