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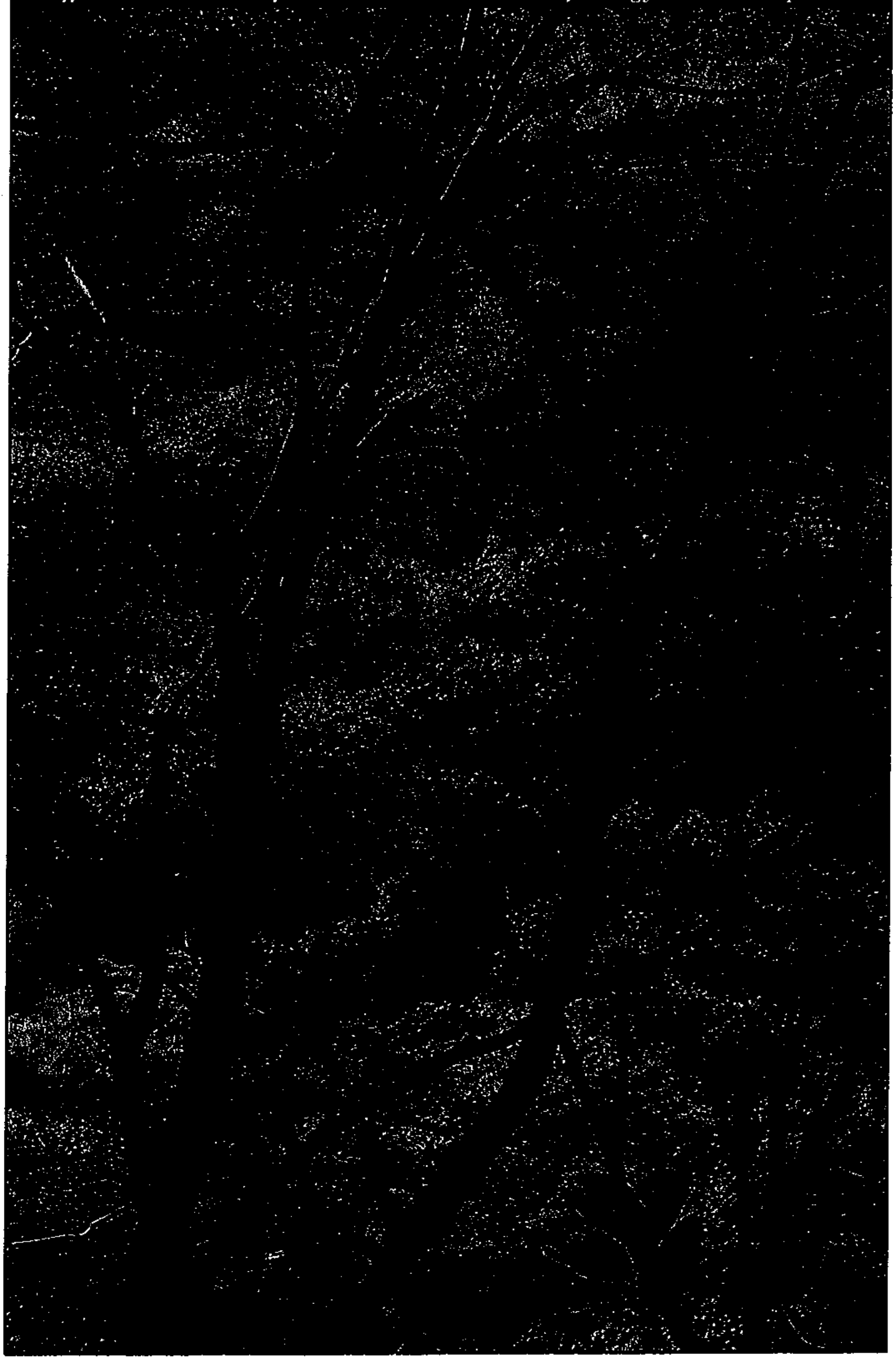

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The Cost and Performance of Utility Commercial Lighting Programs

In recent years, more and more utilities have begun offering demand-side management (DSM) programs, and more and more money has been spent on DSM. The Energy Information Agency (EIA) estimates that U.S. utilities spent more than $2.2 billion on DSM in 1992, up from $1.2 billion in 1991 (EIA 1993). Concerns regarding the economic value of DSM have been raised by work relating to the total cost and performance of utility activities to promote energy efficiency (Joskow and Marron 1992).[1]

Our study, the first in a series from the Database on Energy Efficiency Programs (DEEP), reports on the total cost and measured performance of 20 utility-sponsored lighting efficiency programs in the commercial sector (Vine 1992).[2] We focus on the resource value that commercial lighting programs contribute to utilities' DSM portfolios.[3] We are able to report on information previously missing from past analyses of utility DSM programs, such as customer cost contributions and on program savings based on post-program evaluations rather that on unverified pre-program estimates.

Estimates of lighting as a large, untapped, and cost effective resource opportunity for energy efficiency have led U.S. utilities to promote customer adoption of energy-efficient lighting improvements as a core resource element of utility demand-side management activities.[4] Lighting is a major component of commercial electricity use (approximately 40 percent) and a significant component of industrial electricity use (approximately 10 percent) (EIA 1991). Investigations of the technical potential for efficiency improvements routinely conclude that 40 to 7 percent of current electricity consumption for lighting could be saved cost-effectively (see, for example, Atkinson et al. 1992, and EIA 1992).

Twenty commercial lighting program

With substantial effort, we developed a data set on the cost and performance of a significant fraction of utility spending on DSM. In aggregate, the 20 programs represent utility spending of approximately $190 million.

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Although not strictly comparable (because the spending for the programs we studied was spread over different years), $190 million represents about 15 percent of the $1.2 billion in nationwide utility spending on all DSM activities in 1991.[5]

The commercial lighting programs we examine represent a broad cross-section of utility experience in promoting energy-efficient lighting in the commercial sector. They vary substantially in their life-cycle stages, delivery mechanisms, and technologies offered. These variations in design and implementation of DSM programs result from the evolution of energy-efficient lighting technologies in the commercial sector over time. Design variations are also the result of important differences in utilities': needs for new resources; avoided costs used to design programs; experiences with DSM programs and with local energy efficiency markets; as well as, in many cases, regulatory requirements.

Sixteen of our programs are full-scale, although eleven have been in full-scale operation for less that two-and-a-half years. These programs accounted for an average of 25 percent of the utilities' budgets for energy efficiency programs. The four remaining programs are pilot programs.

Sixteen of our 20 commercial lighting programs offered rebates to customers, and four programs offered both the lighting equipment and installation at no cost to the customer. We refer to these latter programs, which require no out-of-pocket investment on the part of the customer, as "direct install" programs.[6] We expressed all rebates as fractions of the total measure cost, which the utility "bought down."

The mix of technologies offered by DSM programs is changing over time as new efficient technologies emerge and older efficient technologies become standard practice. The major categories of lighting equipment offered by the programs include compact fluorescent lamps, electronic ballasts, high-efficiency magnetic ballasts, reflector systems, T-8 efficient fluorescent lamps, T-12 efficient fluorescent lamps, lighting controls or occupancy sensors, and high intensity discharge (HID) lamps.

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Our experience in developing a consistent data set for this report demonstrates that differences in the terms to describe DSM activity and the lack of consistent reporting formats are substantial, yet avoidable, liabilities for future DSM programs. Industry adoption of a standard DSM terminology and a consistent format for reporting the results of DSM programs is important because accurate comparison of program experience facilitates identification of best practices.

The total resource cost of commercial lighting programs

The total resource cost for each of the 20 commercial lighting programs is presented in . The total resource cost of a program is the total cost of the efficiency measures delivered through the program levelized over the lifetime energy savings achieved by the program, using a 5 percent real discount rate. Our findings directly address shortcomings that have been identified for previous estimates of total resource costs by (1) relying on post-program evaluations of energy savings rather than unverified pre-program estimates; and (2) accounting for the direct costs borne by both

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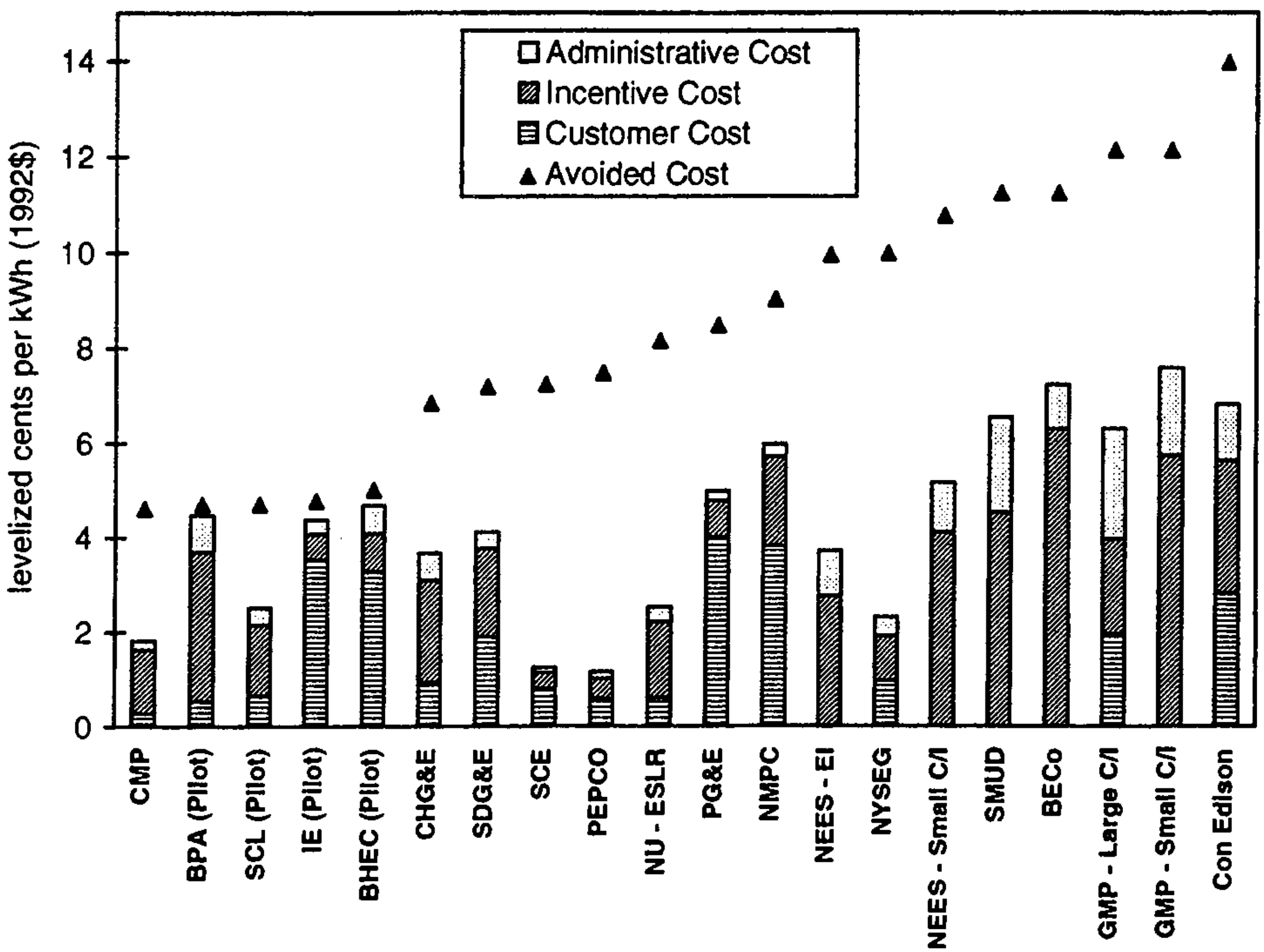
the utility and the participating customers, rather than only those costs borne by the utility.

We find that the average cost of the 20 lighting programs is 4.4¢/kWh (in 1992 dollars), ranging from a low of 1.2¢/kWh to a high of 7.6¢/kWh. Weighted by energy savings, the average cost of the programs is 3.9¢/kWh. We find that utility administrative costs, weighted by energy savings, represent about 0.5¢/kWh or approximately 13 percent of the mean total resource costs of the programs. The ratio of the utility's avoided cost to the total resource cost for each of the 20 programs we examine is greater than 1.0, indicating that each is cost effective.[7]

Many of the factors that result from program design choices can be systematically related to observed variations in program costs. For example, we find that the largest programs, as measured by total annual energy savings, have been substantially less expensive on a cost per kWh basis than the smallest programs. In addition, Figure EX-1 suggests that many aspects of program design and implementation are influenced by the avoided costs of the utilities; several of the more costly programs were developed by utilities facing very high avoided costs.

Other measures of program performance

We also found that program participation rates were not defined consistently across utilities



and, in any case, may not provide an appropriate basis for comparing programs. We found three general definitions of a program participant ("account number," "customer," and "rebates paid") as well as differences in definitions of eligible populations. Inconsistency in defining these terms can have a large effect on the calculation of participation rates (the ratio of participants to eligible population). Even when these problems of definition can be resolved, cross-utility comparisons are complicated by differences in program life-cycle stage and differences in the sizes of program budgets.

Pilot programs or programs in their initial years of operation are often explicably designed for limited participation; comparing these programs with mature programs is not appropriate. Even mature programs are sometimes limited in their performance by program budgets: we examined two programs that exhausted their budgets early in the program year and consequently had to turn participants away. Because of the factors that complicate annual participation rates, cumulative participation rates are probably more reliable indicators of performance. At the same time, the notion of a market saturation point for participation may be too limiting if the measures offered by the program are changing rapidly, which is likely because the energy efficient technologies offered by commercial lighting programs are rapidly improving and becoming less expensive.

The difficulty involved in measuring program participation consistently among DSM programs also complicates the examination of savings per participant as a measure of program performance. Moreover, for this measure to be a meaningful indicator of the "depth" of energy savings per participant, additional information is required on the cost-effective savings potential for each participant.

With regard to the utility costs of DSM, important differences in utility reporting of cost components limited our analyses to incentive costs versus all other costs (which we grouped under "administrative costs"). Because minimizing utility costs will reduce rate impacts, we examined the characteristics of programs with low utility costs (per kWh of savings). We found that utility costs were not systematically related to higher or lower total resource costs. This should come as no surprise because - except in the case of direct install programs - utility incentives cover only a portion of the total resource cost of energy efficiency. We then examined the impact of free riders on rate impacts because free riders cause the utility to incur costs that produce no net savings. We found that the rate impacts of free riders for our programs are significant - utility costs are 31 percent higher that they would have been without free riders. Clearly, minimizing free riders (and taking credit for free drivers) is an important program design strategy for minimizing rate impacts.

The evolving science of measuring energy savings

Current practice in DSM program evaluation is evolving quickly. Five years ago we would have been pressed to find even a handful of programs with evaluations incorporating multiple measurement methods. We found it useful to distinguish between savings estimates that relied on tracking databases, which had been updated with substantial post-program information (such as hours of use, measures installed, etc.), and savings estimates based on analyses of measured consumption data (such as bills or end-use metering). Utilizing stringent selection criteria, we found almost a dozen programs with both tracking database and measured consumption savings estimates.

Surprisingly, we found little difference in the estimates of total resource cost based on the tracking databases and those based on measured consumption data. In part, this seems to be a result of different utility assumptions regarding the economic lifetimes of installed measures. Because measure lifetimes

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are a crucial component of energy savings and total resource cost estimates, we expect that current practice will begin to embrace medium- and long-term persistence studies in the near future. The short-term persistence studies in our sample of programs suggest that persistence in the first few years of measure operation is relatively high.

In our sample, ratios of measured consumption savings estimates to tracking database estimates ranged from 0.53 to 1.26, with a mean (weighted by energy savings) of 0.75. However, the diversity of methods used to calculated both types of savings estimates makes it difficult to draw conclusions about a reasonable range for this ratio. The particular methods one uses to calculate these savings estimates, and not just program design and implementation characteristics, profoundly affect the resulting ratio estimate.

Our review of free rider evaluation methods suggests that there is little consensus among utilities about the definition of a free rider. Although the absence of consensus is a secondary concern for the total resource cost of energy efficiency programs, as noted previously, free riders have important consequences for the impacts of programs on utility rates and thus ratepayers. We also note, with some irony, that comparatively little attention has been devoted to measuring free-drivers and spillover effects, which both reduce total resource cost of energy efficiency and mitigate the rate impacts of these programs.

Concluding thoughts

Our examination of the measured performance of 20 utility-sponsored commercial lighting programs has confirmed the cost-effectiveness of a significant portion of utility industry spending on DSM. Utility-sponsored energy efficiency programs, however, are not too cheap to meter. If future programs are to achieve their expected economic benefits, utilities must take active measures to minimize program costs and rate impacts. Our review suggests that ample room remains for program innovations to achieve these ends. We feel strongly that these improvements will be facilitated by industry adoption of standard definition and reporting formats so that the best program designs can be readily identified and adapted.

[1] Joskow and Marron examined 10 utility-sponsored DSM programs. They documented differences between utility accounting practices and expressed concern regarding utility reliance on pre-program savings estimates. They concluded that the evidence they collected "suggest that computations based on utility expectations could be underestimating the actual societal cost [of DSM programs] by a factor of two or more on average.

[2] The DEEP Project was initiated in 1992 by the U.S. DOE through the Integrated Resource Planning Program. The DEEP Project is co-sponored by the Bonneville Power Administration, Electric Power Research Institute, the New York State Energy Research and Development Authority and the Rockefeller Family and Associates.

[3] There are, of course, other legitimate reasons for utility involvement in demand-side markets, such as equity and customer service. From a resource planning perspective, however, energy efficiency programs are desirable only if they cost less than the alternatives available for meeting customer energy service needs. Accordingly, the primary measure of performance for commercial lighting programs is the total resource cost of the energy savings.

[4] EPRI reports that, in 1992, 175 utilities offered some type of lighting efficiency program. The majority of these programs targeted commercial and industrial customers (EPRI 1993).

[5] Recall that utility spending on DSM includes spending on activities in addition to energy efficiency (such as load management and retention). This, although $190 million represents 15% of total DSM spending, represents a much larger portion of utility spending on DSM activities that focus on energy efficiency.

[6] One rebate program provided a 100% rebate of installed costs; program participants, however, did have to make the initial cash outlay.

[7] In standard DSM terminology, this ratio is referred to as the Total Resource Cost (TRC) Test.