Where Did the Money Go? The Cost and Measured Performance of the Largest 1992 Commercial Sector DSM Programs

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We present consistently derived estimates of the cost and cost effectiveness of energy savings from 40 of the largest 1992 commercial sector DSM programs. The costs include all utility costs, including incentives received by customers, program administrative and overhead costs, measurement and evaluation costs, and shareholder incentives paid to the utility, as well as the participating customer's net cost contribution to energy saving measures. The energy savings are all based on some form of post-program savings evaluation. We find that, on a savings-weighted basis, the programs have saved energy at a cost of 3.2¢/kWh. When compared to the avoided costs faced by the utilities when the programs were developed, the programs have been highly cost effective with a total resource cost benefit-cost test ratio greater than 3. We find that differences in program costs can be partially explained by differences in program size and type.

INTRODUCTION

Utility demand-side management (DSM) activities are at a crossroads. After five years of unprecedented growth, during which aggregate DSM spending increased nearly fourfold from about $700 million in 1990 to almost $3 billion in 1994, utilities and public utility commissions are reexamining their roles and responsibilities in improving customer energy efficiency. Many issues need to be considered, including the magnitude and value of available energy-efficiency opportunities, the future scope and definition of utilities' obligations to serve, and the maturity of the private-sector energy-efficiency services industry. We believe that evidence on the actual performance of utility DSM programs should be an integral part of the discussion. Ideally, this evidence will help us answer the questions: What have utility-sponsored energy-efficiency DSM programs cost? Have they been cost effective? What explains differences in program costs? This paper describes key findings from a major research project to address these questions (Eto et al. 1995).

Developing consistent and comprehensive information on the total cost and measured performance of utility DSM programs in order to answer these questions is difficult. As Joskow and Marron (1992) document, utilities' reporting and savings evaluation practices differ considerably. Cost reporting by utilities is not uniform. Customer costs are not tracked with the same rigor as utility costs, overhead cost allocation practices vary, and measurement and evaluation costs are generally incurred in years subsequent to the program year being studied. Savings evaluation practices, too, also vary. They range from simple extractions from program tracking databases to sophisticated econometric analyses of billing information.

However, we do not agree with Joskow and Marron who conclude that ''better utility cost accounting procedures and the application of more sophisticated methods to estimate actual energy savings achieved are clearly necessary before large sums of money can be expended wisely on programs.'' We believe that systematic treatment of differences in current reporting and evaluation methods along with careful examination of utility evaluations and annual filings corroborated by extensive discussions with utility staff to verify interpretations can produce meaningful assessments of DSM program performance and that assessments such as these do provide adequate grounding for future DSM program expenditures.[1]

We demonstrate our conviction by using this approach to develop a consistent set of information on the cost and cost effectiveness of 40 of the largest commercial sector DSM programs operating in program year 1992. We begin by describing the programs examined. We then describe elements of our evaluation process to ensure consistency in the results. Next, we present our results on the cost and cost effectiveness of the programs. Finally, we describe our efforts to explain variations in program cost using statistical correlations between program costs and selected features of the programs.

THE LARGEST COMMERCIAL SECTOR DSM PROGRAMS

The programs we examined were selected in order to capture a significant fraction of utility expenditures on DSM. For this reason, we targeted large commercial sector DSM programs. Technical potential studies routinely identify commercial building retrofits as a large and untapped source of cost-effective energy savings. As a result, utility DSM program

Table 1. Summary of DSM Expenditures ($ millions)

	Utility Expenditures on Programs Evaluated	Total Utility Energy-Efficiency Expenditures	Total Utility DSM Expenditures	Utility Electric Revenue
Utilities we are studying	377.1	720.0	1,081.5	46,028.1
All utilities reporting to EIA		1,204.7	2,243.3	158,753.6
Utilities we are studying as % of all utilities reporting to EIA		60%	48%	29%

Source: EIA (1994)

expenditures to acquire savings from existing commercial buildings are significant. Our final data set consisted of 40 commercial sector DSM programs that were offered by 23 utilities.[2]

Utility expenditures on programs we examined totaled $380 million, which represents nearly a third of total 1992 industry expenditures on energy-efficiency DSM programs ($1.2 billion); see Table 1. The programs we examined accounted for more than half of the sponsoring utilities' energy-efficiency DSM program expenditures ($720 million).

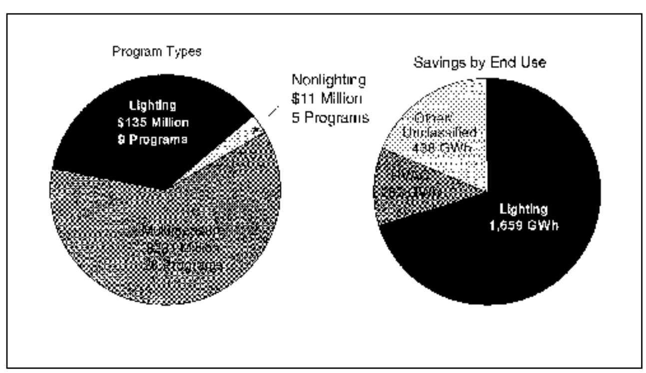
The sponsoring utilities are among the largest energy-efficiency DSM providers in the nation. Total energy-efficiency program expenditures by the utilities accounts for a significant portion of total industry expenditures on energy-efficiency DSM programs ($720 million out of $1.2 billion or 60%). Total DSM program expenditures by these utilities ranged from less than 0.5% of electric revenues to more than 6%. Weighted by expenditures, total DSM expenditures by the utilities averaged 2.4% of revenues, which is significantly higher than the industry average of 1.4%.

Each program individually accounted for more than $1 million of utility spending. Several were among the largest DSM programs in 1992. The programs were all full-scale programs (as opposed to pilots), but varied in maturity. Five only began full-scale operation in 1992, while three began full-scale operation prior to 1986. The majority of programs (29) were rebate programs,[3] while the remaining programs were direct installation programs (11). We did not include new construction only programs, although some of the programs we examined also offered rebates for equipment upgrades in buildings under construction. We categorized the majority of programs as multi-measure programs; the next largest number were lighting-only programs (see Figure 1). While multi-measure programs promoted measures for all major commercial sector end uses, including lighting, heating, ventilating and air conditioning (HVAC), motors, shell, refrigeration, water heating, process, and other, lighting measures from these and the lighting-only programs accounted for the majority of the savings from all of the programs. The lighting technologies promoted by the programs were quite similar. For 30 of the 35 lighting and multi-measure programs for which we had information, 26 promoted compact fluorescent lamps, electronic ballasts, and either T-8 or T-12 fluorescent lamps; 24 promoted reflector systems; and 22 promoted lighting controls and high intensity discharge lamps.

ASSEMBLING CONSISTENT PROGRAM COST AND SAVINGS INFORMATION

Our examination focussed on estimating two measures of cost: the utility cost of energy savings or UC, and the total

Figure 1. DSM Program Types vs. Savings by End Use



resource cost of energy savings or TRC.[4] The UC is more limited; it includes only utility costs. Utility costs include incentives paid to participating customers, program administrative and overhead costs, measurement and evaluation costs, and shareholder incentives paid to the utility. The TRC is more comprehensive; it includes both utility costs and the participating customers' net cost contributions to energy saving measures. The TRC and UC are both calculated by dividing the levelized cost of a program by annual energy savings.[5] The definition of energy savings differs between the TRC and UC (see Table 2). The units of the TRC and UC are expressed as a cost per kilowatt-hour of savings (¢/kWh).

Measuring the cost of the energy savings delivered by utility DSM programs is difficult because accounting practices and savings evaluation methods differ among utilities. We now briefly describe our methods for addressing five issues that we encountered in assembling a consistent set of information on the programs: (1) net participant cost contributions; (2) utility administrative overhead, and measurement and evaluation costs; (3) shareholder incentives; (4) savings evaluation methods; and (5) the economic lifetime of savings.

As we will describe in the next section, we found that including net participant costs was important because they accounted for nearly a third of the TRC. Not including

Table 2. *Cost and Savings Components of the TRC and UC of Energy Savings*

	Included in Total Resource Cost of Energy Savings	Included in Utility Cost of Energy Savings
Cost Elements		
Participant-paid measure costs	Yes	No
Utility-paid measure costs	Yes	Yes
Participant- or utility-paid measure costs associated with free riders	Yes[1]	Yes
Utility administrative costs (including overhead and measurement and evaluation)	Yes	Yes
Utility shareholder incentives	Yes	Yes[2]
Changes in customer operating costs (+/−)	No	No
Savings Elements		
Savings from free riders	Yes[3]	No
Savings from non-free riders	Yes	Yes
Savings recaptured through takeback[4]	When reported	When reported
Savings due to participant and nonparticipant spillover	No	No

1 Our treatment of free riders in the TRC differs from standard practice; see Eto et al. (1995).
2 Our inclusion of shareholder incentives in the UC differs from standard practice, which does not include them. Our definition is, thus, a more comprehensive measure of the direct ratepayer cost of energy savings.
3 As noted previously, our treatment of free riders in the TRC differs from standard practice.
4 Takeback refers to savings that are ''recaptured'' by program participants, typically through increased energy services. A common example in the commercial sector is the installation of efficient security lighting in areas that were formerly unlit.
5 Spillover refers to savings from measures installed as a result of the program, but not through the program. It can include additional measures installed by program participants outside of the program or measures installed by nonparticipants as a result of the program.

them in the TRC, consequently, would lead to significant underestimation of the true cost of energy savings. However, collecting this information is difficult because it is not normally a part of a utility's accounting system. As a result, we have less confidence in the accuracy of the information reported to us by the utilities. In several cases, we made independent estimates of net participant cost contributions based on independent studies of measure costs and actual counts of measures installed, and based on reviews of measure invoices.

In developing this information, we made a concerted effort to document the assumptions underlying the participant cost information reported to us. The most important distinction depended on whether the program targeted equipment upgrades at the time of normal replacement or at some earlier time (early replacement). For normal replacements, the cost attributable to the energy savings should reflect only the incremental or additional cost beyond that which would be otherwise incurred to replace the affected equipment. For early replacements, the entire cost of the new equipment must be counted against the energy savings. For the subset of programs where we had detailed information on normal versus early replacements, we found that these differences led to statistically significant differences in the mean of the TRC for the two replacement decisions. In those cases where we had to make an independent estimate, we used the full cost of the measures; i.e., we assumed conservatively that all measures installed were early replacements.

We also took great pains to ensure that administrative overhead, and measurement and evaluation costs were included. We found that these costs were small in comparison to participant costs. For the subsets of programs in which we could reliably identify these costs (9 and 37 programs, respectively), they averaged 4% and 3%, respectively.[6] For the remaining programs, these costs were included in the totals reported to us and could not be separately identified.

We included shareholder incentives in the calculation of both TRC and UC. For the 27 programs that received them, excluding the incentives reduced the average TRC by 7%. We note that inclusion of these costs in the TRC could be an overestimate of the true societal cost of shareholder incentives; that is, some part of the costs could simply be a transfer payment. Determining the balance between the transfer payment and true societal cost element, however, requires an assessment of what economists label ''hidden costs,'' which are difficult to measure.[7] Therefore, our inclusion of the entire cost of shareholder incentives in the TRC is conservative.

We found that the science of measuring annual energy savings has progressed to the point that the differences among methods are less discernible than they used to be. In particular, savings based on tracking databases now routinely incorporate substantial after-the-fact performance information such as end-use metered hours of operation. At the same time, new questions have been raised challenging the reliability of more sophisticated methods.[8] In contrast to our previous efforts to develop consistent savings from programs using adjustment factors (see Eto et al. 1994), we decided not to adjust savings based on this improved understanding of the strengths and limitations of current approaches.

This is not to say that savings evaluation methods are free from bias and imprecision; they most certainly are not. However, categorical statements regarding bias and imprecision are not supportable without detailed examination of assumptions, methods, and underlying data. To test our decision, we compared the TRCs of programs evaluated using different savings evaluation methods. As described later in this paper, we found that differences in the methods were not statistically correlated with changes in the TRC.

We remain concerned about the accuracy of the estimated economic lifetime of measures because it is still inherently a forecasted quantity. The related issue of the measurement of free riders, too, is another area in which differences in estimates appear to reflect the choice and application of evaluation method as well as differences in free ridership. For both issues, we again separately compared means of the TRC for use of standardized measure lives (separately for lighting, non-lighting measures) and use of common free ridership assumptions. In both cases, we found that the differences were not statistically significant.

In summary, we developed procedures for representing a variety of differences in utility practices for accounting for and evaluating DSM program costs and savings. Our preliminary examinations led us to conclude that we had acknowledged or accounted for the most important sources uncertainty.

WHAT HAVE THE ENERGY SAVINGS FROM DSM PROGRAMS COST?

The savings-weighted mean TRC and UC for our 40 programs is 3.2 ¢/kWh and 2.7¢/kWh, respectively (see Table 3). Utility non-measure costs, which include utility administration, overhead, measurement and evaluation, and shareholder incentives, account for 25% (0.8¢/kWh) of the TRC. Measure costs, split between utility and participants, account for 44% (1.4¢/kWh) and 31% (1.0¢/kWh), respectively, of the remaining savings-weighted TRC of energy savings.

Figure 2 arranges the DSM programs from the least expensive to the most expensive and plots them sequentially

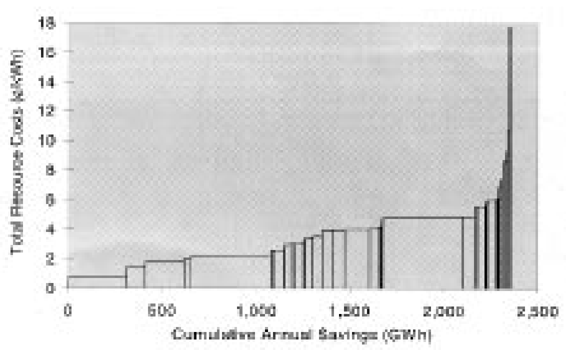
Table 3. The Total Resource Cost and Utility Cost of Energy Savings (¢/kWh)

Program ID	Nonmeasure Costs (Admin. and M&E)	Shareholder Incentives	Utility-Paid Measure Costs	Participant-Paid Measure Costs	Utility Costs	Total Resource Costs	Avoided Costs	TRC Ratio	RIM Ratio
1	0.4	0.7	1.9	1.7	3.5	4.7	6.6	1.4	0.4
2	3.2	0.6	1.8	0.0	7.1	5.6	11.2	2.0	0.6
3	0.3	0.2	1.9	0.6	2.7	3.0	8.2	2.7	0.7
4	0.3	0.8	3.5	0.0	4.7	4.6	4.0	0.9	0.2
5	0.4	0.5	1.0	4.1	2.0	5.9	5.3	0.9	0.3
6	0.4	0.6	1.7	6.7	2.6	9.3	5.5	0.6	0.3
7	0.1	1.6	1.6	1.5	3.8	4.8	6.6	1.4	0.5
8	0.9	0.3	7.5	2.0	10.7	10.7	6.6	0.6	0.3
9	21.8	(10.4)	33.8	2.9	45.2	48.1	6.6	0.1	0.1
10	0.5	0.1	1.1	1.3	2.3	3.0	3.1	1.0	0.3
11	1.6	0.1	1.0	0.0	2.7	2.7	3.7	1.4	0.3
12	0.1	0.4	1.1	0.2	2.0	1.7	5.1	2.9	0.4
13	0.6	0.1	1.0	3.8	2.2	5.5	5.2	1.0	0.4
14	0.2	0.0	1.3	1.7	1.6	3.2	3.0	1.0	0.5
15	0.2	0.0	1.9	1.3	2.1	3.4	4.0	1.2	0.5
16	0.4	0.0	1.7	3.4	2.2	5.5	8.9	1.6	0.8
17	1.2	0.1	5.5	0.0	7.4	6.8	10.7	1.6	0.7
18	3.9	0.1	12.5	1.2	23.7	17.6	9.8	0.6	0.3
19	0.3	0.1	2.6	0.0	3.5	3.0	7.9	2.7	0.6
20	0.4	0.0	1.8	0.4	3.3	2.5	4.5	1.8	0.4
21	0.3	0.0	1.5	0.7	1.8	2.5	4.5	1.8	0.4
22	1.5	0.0	4.3	0.0	5.8	5.8	12.1	2.1	0.9
23	2.4	0.0	2.0	1.6	5.0	5.9	12.1	2.0	1.0
24	0.5	0.4	2.4	0.6	3.7	4.0	6.7	1.7	0.5
25	0.9	0.6	7.1	0.0	8.7	8.5	10.1	1.2	0.6
26	0.6	0.2	2.6	0.7	3.6	4.1	7.1	1.7	0.5
27	1.1	0.3	7.0	0.0	8.5	8.4	10.0	1.2	0.6
28	0.5	0.0	5.6	0.0	6.6	6.1	5.9	1.0	0.4
29	0.5	0.0	1.2	2.3	1.8	3.9	5.2	1.3	0.6
30	0.9	0.6	4.5	0.0	6.0	6.0	4.8	0.8	0.3
31	0.4	0.6	2.2	0.9	3.2	4.1	5.4	1.3	0.4
32	0.1	0.0	0.3	0.4	0.9	0.8	7.7	9.6	0.6
33	0.3	0.7	0.7	0.4	2.3	2.1	7.0	3.3	0.5
34	0.3	0.8	1.4	0.0	3.3	2.6	10.4	4.1	0.9
35	0.3	0.6	0.3	0.8	1.2	2.0	17.6	9.0	1.7
36	0.1	0.0	0.3	1.0	0.5	1.5	3.1	2.1	0.5
37	1.9	0.0	0.8	0.8	3.4	3.5	4.4	1.3	0.4
38	0.8	0.8	5.7	0.0	7.7	7.3	5.6	0.8	0.4
39	0.6	0.3	1.5	1.5	2.6	4.0	5.6	1.4	0.6
40	1.1	0.4	2.1	0.2	3.7	3.9	5.6	1.4	0.6
Weighted Average	0.4	0.4	1.4	1.0	2.7	3.2	6.6	3.2	0.5
Mean	1.3	0.1	3.5	1.1	5.4	6.0	6.9	1.9	0.5
Standard Deviation	3.4	1.7	5.5	1.4	7.6	7.5	3.1	1.9	0.3

against annual energy savings; the ''width'' of each program along the x-axis represents the savings accounted for by each program.[9] This form of presentation shows that the savings-weighted average is dominated by several very large and inexpensive programs, and that the most expensive programs are comparatively small in size. For example, 28% of the savings have cost less than 2¢/kWh and 50% have cost less than 3¢/kWh. At the same time, only 1% have cost more than 9¢/kWh.

The savings-weighted TRC of energy savings (3.2¢/kWh) is almost 20% lower than previously reported DEEP project

Figure 2. The Total Resource Cost of Commercial Lighting Programs



findings for 20 commercial lighting programs, which presented a savings-weighted TRC of 3.9¢/kWh (Eto et al. 1994). We believe the difference can be traced to two sources. First, as indicated in Figure 2, the results for our sample are strongly affected by the presence of large, inexpensive programs. As described earlier, the inclusion of large programs was a conscious element of the program selection criteria for this study, which was not pursued in the earlier report. Second, for the programs that were included in both the earlier report and this report, we are generally relying on information from a more recent program year (that is, 1992 program information versus 1991 or earlier program information); several of these programs acquired energy savings at lower cost in 1992 than they did in earlier program years. In the second section following, we describe our efforts to use both factors (program size and program maturity) among others to help explain differences in the TRC of the programs.

HAVE THE PROGRAMS BEEN COST-EFFECTIVE?

The societal value and hence the cost effectiveness of DSM programs is measured by the resource costs they allow the utility to avoid. We worked from each utility's benefit-cost ratios for its DSM programs in order to develop a ''top-down'' estimate of program-specific avoided costs.[10] As a result, the avoided costs we report (see Table 3) differ from those that might be published by the utility, for example, in a tariff sheet of payments to qualifying facilities because we express avoided costs using a single, aggregated value. For example, even though we present avoided costs in units of¢/kWh, they include avoided capacity costs implicitly. The avoided cost for two programs from the same utility may differ because the load shape impacts and lifetimes differ. Finally, without commenting on their appropriateness, we chose to eliminate environmental externality adders in an effort to ensure greater comparability across utilities.

The savings-weighted TRC benefit-cost test ratio of avoided costs to program costs is 3.2, indicating that, taken as whole, the programs are highly cost effective. The un-weighted mean of the TRC benefit-cost test ratios is 1.9 with a standard deviation of 1.9. Since the savings-weighted TRC benefit-cost test ratio is higher, we can conclude that some of the largest programs have also been the most cost effective. The high standard deviation also indicates that some programs were not cost effective; 11 of the programs had TRC benefit-cost test ratio of less than 1.0. This should not be too surprising because there are several very expensive programs. The 11 programs that were not cost effective accounted for 12% of the total resource costs of all of the programs.

The most critical issue for our estimates of program-specific avoided costs is that they are based on a forecast of the future and hence are inherently uncertain. For many utilities, avoided costs have dropped significantly since the time when they were first developed. In particular, the program planning estimates of avoided cost for our 1992 programs were for the most part developed in 1991.

In view of this situation, it is useful to consider how lower avoided costs would affect our findings.[11] If we assume that avoided costs are 50% lower than those originally reported, TRC benefit-cost test ratios drop below unity for an additional 19 programs. However, the savings-weighted TRC benefit-cost test ratio would be 1.6. In other words, the large programs accounting for the majority of the savings remain highly cost effective.

WHAT EXPLAINS DIFFERENCES IN PROGRAM COSTS?

Our final examination consisted of correlating program TRCs to selected program features to determine whether there were statistically significant relationships between the two. In Table 4, we present the results from two regressions of the various explanatory variables on TRC.[12] The first model, labeled ''best fit,'' was selected by including only those variables that had the greatest explanatory power.[13] The second model, labeled ''all variables,'' was estimated using all available explanatory variables. Comparing coefficients in the second model for variables included in the first model provides some evidence for the stability of the correlations found in the ''best fit'' model.

While suggestive, our regression results are by no means definitive. Taken together, the explanatory variables from the ''best fit'' model accounted for only slightly more than 30% of the observed variance in the results.

Table 4. Regression Equations for Total Resource Cost (¢/kWh)

	Best Fit	All Variables
Intercept	6.35 (3.10)	38.2 (0.12)
Program Type (Direct Installation = 1 versus Rebate = 0)	2.34 (2.28)	2.22 (2.05)
Program Size (Annual kWh Saved)	−8.63 E-9 (−2.02)	−9.26 E-9 (−1.95)
Shareholder Incentive (Yes = 1 versus No = 0)	1.64 (1.67)	1.67 (1.64)
Economic Lifetime of Savings (Years)	−2.58 E-1 (−1.85)	−2.71 E-1 (−1.73)
Savings/Participant (kWh/participant)	−5.06 E-6 (−1.50)	−5.30 E-6 (−1.48)
Avoided Cost (¢/kWh)	1.45 E-1 (1.04)	1.45 E-1 (0.99)
Program Start Date		−1.61 E-2 (−0.10)
Savings Evaluation Method (Billing-Metering = 1 versus Tracking = 0)		4.94 E-1 (0.51)
Adjusted R-square	0.312	0.273

Note: T-statistic in parentheses.

Two variables (program type and program size) from the ''best fit'' model were statistically significant (T-statistic greater than 2). Moreover, the coefficients were stable between the two regressions. These correlations indicate that direct installation programs cost about 2¢/kWh more than rebate programs and that programs costs went down about 1¢/kWh for every 100 GWh in annual energy savings.

We found evidence of a weak, but not statistically significant, relationship between the TRC and the presence of shareholder incentives, the economic lifetime of savings, savings per participant, and avoided costs. The presence of shareholder incentives and higher avoided costs were weakly correlated with higher program costs. Longer economic lifetimes and higher savings per participant were weakly correlated with lower program costs. We also found that there was not a statistically significant correlation between the TRC and program start date or, as mentioned earlier, program savings evaluation method.

CONCLUSION

We examined the total resource cost and utility cost of energy savings for 40 of the largest 1992 commercial sector DSM programs using consistent methods to ensure comparability of program results. The TRC included the participating customers' cost contributions to energy saving measures. The TRC and UC included program overhead, and measurement and evaluation costs, as well as shareholder incentives. All savings were based on post-program savings evaluations.

We found that, on a savings-weighted basis, the programs had saved energy at a cost of 3.2¢/kWh. Taken as a whole, the savings from the programs were highly cost effective when compared to the avoided costs used in first developing the programs. The results were dominated by several large and inexpensive programs; some programs, albeit small in absolute size, were found not to be cost effective. The majority of the savings remained cost effective even when compared dramatically lower avoided costs, which are more representative of the avoided costs currently faced by utilities, although a substantial number of individual programs were not cost effective under these hypothesized lower avoided costs.

We conducted exploratory analyses to determine what factors helped to explain variations in program cost. We found program type and program size were statistically significant factors; our overall regression equations explained about 30% of the variance in the TRC of energy savings.

No one knows the future of utility DSM programs. However, we feel strongly that discussions about this future should be based on unbiased and critical assessments of the performance of past programs. The goal of the DEEP project is to contribute information to this end by providing comprehensive information on program costs and cost effectiveness.

ACKNOWLEDGMENTS

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ENDNOTES

1. The Database on Energy Efficiency Programs has prepared three reports on the total cost and measured performance of utility DSM programs: Eto et al. (1996), Vine. (1995), and Eto et al. (1995).

2. The program identification and data collection processes are described in Eto et al. (1995).

3. Several rebate programs also featured loan or financing options although rebates constituted the bulk of the programs' activities. Also, many of the rebate programs were linked to utility-sponsored audit activities.

4. The reader is cautioned that our choice of terms, TRC and UC, refer to costs, as measured in ¢/kWh. When we use these terms in the context of DSM benefit-cost tests (from which they were derived, but from which they differ slightly as described in Table 2), we will explicitly label them as TRC or UC *benefit-cost test ratios*, which are dimensionless.

5. Levelization is an engineering/economic technique that spreads costs in equal nominal amounts over the lifetime of a program so that the present value of nominal amounts is left unchanged. See, for example, EPRI (1991). Levelization is more appropriate than simply dividing total costs by lifetime savings because levelization accounts for the time-value of money. The importance of accounting for the time-value of money increases as savings extend farther into the future or when discount rates are high. All levelizations were performed using a common real (i.e., net of inflation) discount rate of 5%.

6. For the remaining programs, we determined that these costs were already included in total non-measure, administrative costs, and could not be separately identified.

7. See Stoft et al. (1995) for a discussion of the significance of hidden costs in DSM shareholder incentives.

8. See, for example, Sonnenblick and Eto (1995) for a demonstration that the popular statistically-adjusted engineering model used in savings evaluation is subject to potentially significant bias to ''errors in variables.''

9. Figure 2 does not include one very high costs program (#9 on Table 3), which extends significantly above the highest value on the graph. However, the cost of this program was included in all subsequent results, except where noted. Its influences on savings-weighted means was low because it accounted for less than 1% of savings from all the programs.

10. For example, from a TRC benefit-cost test ratio of two and a levelized estimate of the denominator (i.e., total utility and incremental participant costs) of 4¢/kWh, we can conclude that the effective avoided cost or numerator is 8¢/kWh (i.e., 2 × 4¢/kWh). By estimating avoided costs in this fashion, we bypassed the need to know the specific avoided costs faced by a particular utility, as reported in time-of-day-, seasonal-, and annual-differentiated avoided costs for energy and capacity. In order to increase comparability among program-specific avoided costs, we also normalized them using both the weighted average cost of capital reported by the utilities and the same real discount rate used to estimate the TRC and UC: 5%.

11. It is somewhat unfair to evaluate the cost effectiveness of programs retrospectively using assumed reductions in avoided costs. We submit that it is unlikely that the utilities would have designed the same programs they ran in 1992 had they known that avoided costs were going be lower in the future. In all likelihood, they would have designed lower cost programs.

12. We did not include the high cost program noted in endnote 9 in this analysis.

13. Specifically, we used the automatic variable selection procedure in SAS called *Forward*.

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