The Link Between Program Participation and Financial Incentives in the Small Commercial Retrofit Market

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ABSTRACT

The stakes involved in accurately predicting customer response to different energy efficiency strategies are high. Many utilities and energy service companies have tried to minimize the costs of program delivery, while still capturing maximum savings, with varying success. In many cases, program participation and savings levels have dropped dramatically, resulting in substantial lost net benefits and savings opportunities. On the other hand, increasing program costs in ways that do not substantially impact savings levels may result in unnecessarily high utility and ratepayer costs.

The prediction of customer participation and energy efficiency measure adoption in program planning is particularly difficult because there is no single variable that clearly dominates all others in energy-user decision-making. Nonetheless, studies have generally found a positive correlation between the level of financial incentive provided to customers and the level of participation. Unfortunately, many of these studies have not controlled for numerous other variables that impact participation, such as different markets, marketing approaches, delivery mechanisms and implementation procedures.

This paper analyzes the relationship between program participation and the level of financial incentives offered in the small commercial retrofit market. Unlike other studies, it relies on a rich database of program activity for a single program in which virtually all other program design and implementation procedures were held constant. It confirms many previous research results, yet provides some indication that other non-cash rebate strategies may be more effective in this market than previously thought.

Introduction

A fundamental question in designing energy efficiency programs is the prediction of customer participation and measure adoption, given different program design strategies. A number of studies have analyzed how participation is related to financial and other program strategies. However, it is often difficult to apply these research findings to other programs or markets. Many studies analyze a cross section of data from diverse programs operating by different utilities, in different markets, and sometimes with different data definitions (e.g., Berry 1990; MECO 1993; Nadel 1996; Nadel, Pye & Jordan 1994; Pratt 1993). Others analyze time series data for a single program that may undergo a multitude of changes over the analysis period (e.g., Holt 1992). These research results must be applied with caution because customer participation is impacted significantly by many non-financial factors as well, including marketing, technical assistance, ease of participation and utility-customer relations (Berry 1990).

To inform future program design, Citizens Utilities Company (CUC) analyzed the relationship between customer participation and the level of incentives observed in its Small Commercial and Industrial Retrofit Program (SCIP), delivered from 1993 to 1995. Unlike other studies, this investigation relied on data from a single program, over a period when the program design and delivery were virtually constant. Because the program incentive structure offered each customer a customized financial package, the analysis compares the responses to different financial offers, holding most other important factors constant.

As expected, customer participation and measure adoption rates generally declined with falling financial contributions by the utility (as a percent of total project cost). However, we also found participation did not decline as quickly or substantially as expected.

Analytical Approach

Program Description and Data

Two hundred and thirty-six small commercial and industrial (C&I) customers participated in the SCIP. The program provided direct audit and energy efficient equipment installation services, and financial strategies to encourage customer participation. The program primarily addressed lighting, although motors, refrigeration, water heating, and space and water heating fuel switching measures were also recommended.

The financial incentives for all measures except fuel switching included a mix of cash rebates and zero interest financing, tailored to each customer. The financing was designed to provide an immediate positive cash flow to the customer and be paid back on the electric bill. No incentives were provided for fuel switching measures. As a result, the portion of project cost covered by CUC varied from 0% to 100%, depending on the type of measures, the magnitude of the project, and the estimated customer bill savings. Overall, 74% of customers receiving audits installed at least some measures. Approximately 50% of the identified and recommended measures were implemented. When excluding fuel switching, the overall adoption rate of recommended measures was about 65%.

The SCIP offered customers the following financial incentive structure for non-fuel switching measures:

- CUC pays 100% of the first $750 of project cost.
- CUC provides 0% interest financing on the balance of the project cost.
- Customer pays back the financed portion with payments set to a maximum of 50% of estimated bill savings (percentage increases as project cost increases).
- Customer makes payments for a term of either 5 years, or until 100% of the financing balance is paid back, whichever occurs first.

The above incentive structure results in customers with very low cost projects (i.e., less than $750) paying nothing. In general, the higher the project costs or payback periods, the lower the incentive level. Because of the relationship between project cost, bill savings, and incentive level, these other factors were examined as well to try to isolate the financial incentive effect.

The participant database contained information for each customer that received an audit, including the recommended and actual installed project cost and estimated savings, and the types of measures recommended and installed.

Because of the clear distinction between fuel switching and non-fuel switching measures (in terms of incentives, technologies and market barriers), fuel switching and non-fuel switching projects were analyzed separately. Of the 236 customers, 12 were omitted from the analysis because of poor data.

Analysis

Participation Parameters. The analysis investigated the relationship of three different participation parameters to overall incentive levels:

1. the mean customer measure adoption rate (customer installation \$/customer recommended \$);
2. the overall measure adoption rate (total installation \$/total recommended \$); and
3. the proportion of audit customers installing any measures.

The first parameter provides an indication of the estimated portion of recommended savings that a customer is likely to install given a particular incentive offer. The second parameter places greater weight on bigger projects, and provides an indication of the overall portion of savings from a customer population likely to be acquired with a given incentive offer. Finally, the third parameter provides an estimation of the proportion of customers that would be willing to install any measures at all. While all three parameters are highly correlated, analysis of the differences between them provides some insight into other issues, including variations in comprehensiveness and project size.

Incentives. Incentive level is defined in terms of the portion of total recommended project installation cost that CUC offered to pay.

Each customer was presented with a written financial offer that showed the customer's estimated positive cash flow, and the allocation of overall project costs between the customer and CUC, ignoring the time value of money. As a result, it is not clear whether customers based their decisions solely on this "undiscounted" incentive level shown, or whether they also inherently considered the additional value of the financing interest buy-down provided by CUC. Warner (1994) found that most small commercial customers tend to *over value* the savings from 0% interest financing when choosing between alternate financing packages. However, the Warner customer sample may not have been provided with information similar to that given the CUC customers. Consequently, we examined the relationship of participation to both undiscounted and discounted incentive levels.[1] For purposes of utility planning, the discounted incentive level figures may be more useful because they more closely reflect the true costs to the utility. We also analyzed the participation response to fuel switching recommendations (0% incentive) to provide an indication of likely response from information-only efforts.[2]

Partial Versus Complete Measure Adoption. A review of the data, and interviews with the program implementation contractor, indicated that most, but not all, customers tended to accept or decline the recommended package *in toto,* rather than adopting only a portion of measure recommendations. As a result, the distribution of the ratio of installed to recommended costs for those accepting measures tended to be clumped around 100%. However, because *a priori* cost estimates are imperfect, and change orders may occur during installation, the ratio was often slightly more or less than 100%.

Because our focus is on customer response to the initial offer (as opposed to the accuracy of installation cost estimation), and the theoretical implausibility of capturing greater than 100%

[1] While the present value cost to the utility of incentive levels would be discounted based on its weighted cost of capital, we calculated the value of the interest buy-down based on a more typical interest rate (12%) available to small commercial customers to more closely reflect the customer decision-making process.

[2] Comparisons between the fuel switching and non-fuel switching responses must be made with caution given the lack of positive cash flow financing, and the somewhat different barriers faced with these decisions.

participation, all individual customer proportions of installed to recommended project cost greater than 75% were set to 100%.[3] Because most of the projects set to 100% had actual ratios above 100%, this adjustment has the effect of slightly reducing overall estimated participation proportions.

Stratification. The individual participation data was grouped into strata reflecting incentive level ranges. Table 1 shows definitions, sample sizes, and average overall parameter proportions for each strata. Figure 1 shows graphically how the parameters vary by incentive level strata. We investigated the likelihood that the sample parameter proportions for each stratum are statistically different. T-statistics and confidence levels that the strata mean proportions are different are reported in Table 2.

Table 1. Participation and Installation Rates, by Discounted Incentive Level Strata

Strata	Strata range (recommended incentive)	Sample Size (n)	Mean Customer Installation Rate (installed$/ recommended$)	Overall installation rate by strata (total installed$/total recommended$)	Percent of participants who installed anything
1	90-100%	56	84%	91%	84%
2	70-89%	60	74%	66%	75%
3	50-69%	64	61%	54%	63%
4	20-49%	44	77%	65%	80%
5	0%	53	6%	4%	8%
1&2	70-100%	116	79%	72%	79%
3&4	20-69%	108	68%	59%	69%

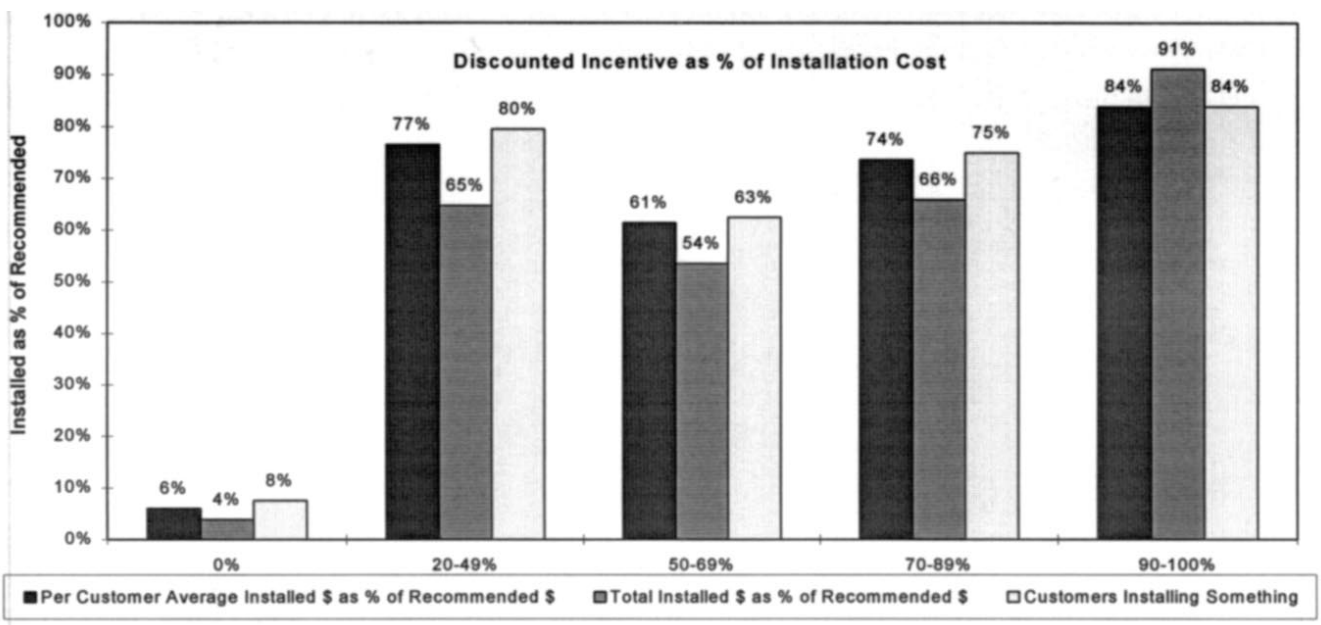

Figure 1. Customer Response to % of Installation Cost Offered

[3] The 75% cut-off was selected from a review of the data, and judgment about which specific projects seemed to be complete, rather than partial based on the kWh saved.

Table 2. Confidence Levels that Strata Mean Proportions are Different

Strata Comparisons	Mean Customer Installation Rate (installed$/ recommended$) t-Statistic	Mean Customer Installation Rate Confidence Level	Overall installation rate by strata (total installed$ /total recommended$) t-Statistic	Overall installation rate Confidence Level	Percent of participants who installed anything t-Statistic	Percent of participants who installed anything Confidence Level
1 to 2	1.37	82.6%	3.50	99.9%	1.20	76.7%
2 to 3	1.46	85.4%	1.41	84.0%	1.52	86.8%
3 to 4	1.71	91.0%	1.17	75.6%	1.99	95.0%
4 to 5	9.83	100.0%	7.92	100.0%	10.17	100.0%
1 to 3	2.87	99.5%	5.14	100.0%	2.75	99.3%
1 to 4	0.91	63.8 %	3.24	99.8%	0.56	42.4%
1+2 to 3+4	1.86	93.6 %	2.05	95.8%	1.70	90.9%

Logit Analysis. While the analysis by strata shows clear differences between likely participation over distinct incentive level ranges, it is difficult to interpolate results, or estimate an overall predictive relationship. Some studies (Camera, Stormont & Sabo 1989) have performed regression analyses on participation data to estimate the typical relationship over the range of possible incentive values. However, because participation is bounded (on the low end at 0%, and on the high end at 100%), a simple regression will tend to oversimplify the relationship, and fail to capture the variations in slope over the full range of incentive levels. Clearly, as participation approaches 100%, a given percent increase in incentive must result in a smaller and smaller % increase in participation.

We performed a logit probability analysis on the bounded data (Figure 2), using the following functional form:

$$\log[P/(1-P)] = \alpha + \beta X + \epsilon$$

where: P = the proportion of per-customer overall recommended measure $ actually installed
X = the incentive level as a percent of total project cost

Ideally, the logit analysis would be done by simply regressing $\log[P/(1-P)]$ on X. However, because many observations of P are either 0 or 1.0, the regression fails. To solve this problem, we performed the logit analysis on the five discounted incentive level strata. Ideally, maximum likelihood estimation (MLE) should be performed to avoid the introduction of possible bias, and is an area for future research.

Results

Differences in Proportions

Figure 1 shows a steady decline in all participation parameters as incentive levels decrease from 100% to 50% (strata 1, 2 & 3). Participation parameters then *increase* for stratum 4 (20-49% incentive), before dropping off precipitously in the last stratum (0%, fuel switching). The differences between any two adjoining strata participation rates are significant at the 75% confidence level or higher.

Looking at the overall installation rate parameter, the drop from 91% to 66% between strata 1 & 2 is highly significant at 99% confidence. The next drop from 66% to 54% (strata 2 to 3) is less significant at 84% confidence level. The unexpected increase in participation in stratum 4 is only significant at the 76% confidence level, indicating that this increase may be an anomaly. All comparisons to the 0% incentive (fuel switching) stratum are highly significant, at 99.99% confidence.

When combining strata 1&2 (70 – 100%) and strata 3&4 (20 – 69%), the difference in all parameters is significant at 90% confidence or higher, with the overall installation rate significant with 96% confidence.

These results seem to suggest a significant and large reduction in participation can be expected when dropping from relatively high incentives (90 to 100%) to incentives covering somewhere around half to two thirds of the installation cost. Continued reductions in incentives in the mid-level range seem much lower, or possibly even insensitive to incentive level. This is supported by other research on the subject. For example, Holt (1992, p. 13) notes "high incentives appear to promote greater participation than moderate incentives, but the impact of low and moderate incentives may be indistinguishable." This general trend was also identified by Warner (1994).

The variation between different participation parameters seems to indicate that the overall level of savings and measure comprehensiveness may drop off more dramatically with reductions in incentives than the decision to participate at all does. It is possible that, given the SCIP incentive structure, low incentive levels may still encourage customers to do some measures, while foregoing other cost-effective measures. While the significance of these shifts in parameters was not tested, similar results have been found in cross-sectional comparisons of other C&I programs (Holt 1992; Nadel, Pye & Jordan, 1994). Further research might determine whether this observation holds for larger or more diverse samples, or under different incentive designs.

When considering undiscounted incentive levels, the results follow a similar pattern. Surprisingly, participation levels remained in the 60% range even with very low incentives. This is consistent with theories that simply having an incentive may be more important than the magnitude of it (Vine & Harris 1988), and that financing services are most valued by customers when the utility incentive is lowest (Warner 1994).

Because of the incentive structure, a high proportion of large projects, and those where the bill savings were highest, tend to be at the low incentive levels. We therefore examined the effect of increased project cost on participation, and whether increased net bill savings caused a higher likelihood of participation. Our hypothesis was that the surprisingly high levels of participation at relatively low incentive levels might be a result of larger customers, and those with the greatest potential bill reductions, being more likely to participate. However, in both these cases, participation went *down* as either project cost or net bill savings increased. This trend is counter to many energy efficiency programs, where larger customers tend to have a greater likelihood to participate than smaller ones (Warner 1994).[4]

Logit Analysis

The logistic curve in Figure 2 shows the estimated relationship of the overall measure installation rate to discounted incentive levels. This curve predicts participation of approximately 91% at 100%

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[4] While project cost and customer size are not linked, they tend to be highly correlated, particularly for direct install programs, such as this one, with a high concentration of lighting measures.

incentive, dropping down to about 80% at an 80% incentive level. These results are almost identical to those achieved by Massachusetts Electric Company's similar Small Commercial Retrofit Program (Nadel & Geller 1995, pp. 17-18), perhaps indicating that in the small commercial market, results of similar programs are relatively transferable from one utility to another, at least within the same general geographic region.

At the low end of the curve, the y-intercept of 6.5% predicts the participation rate for a program offering information-only.

Because no positive-cash-flow financing was offered for fuel switching we also estimated a logistic curve omitting the fuel switching data. Under this scenario, participation with no incentive (other than positive-cash-flow financing) is significantly higher (25.7%), but then increases less rapidly over the range of incentive levels. This curve may better predict future program participation when positive-cash-flow, on-the-bill financing is offered without rebates or an interest buydown.

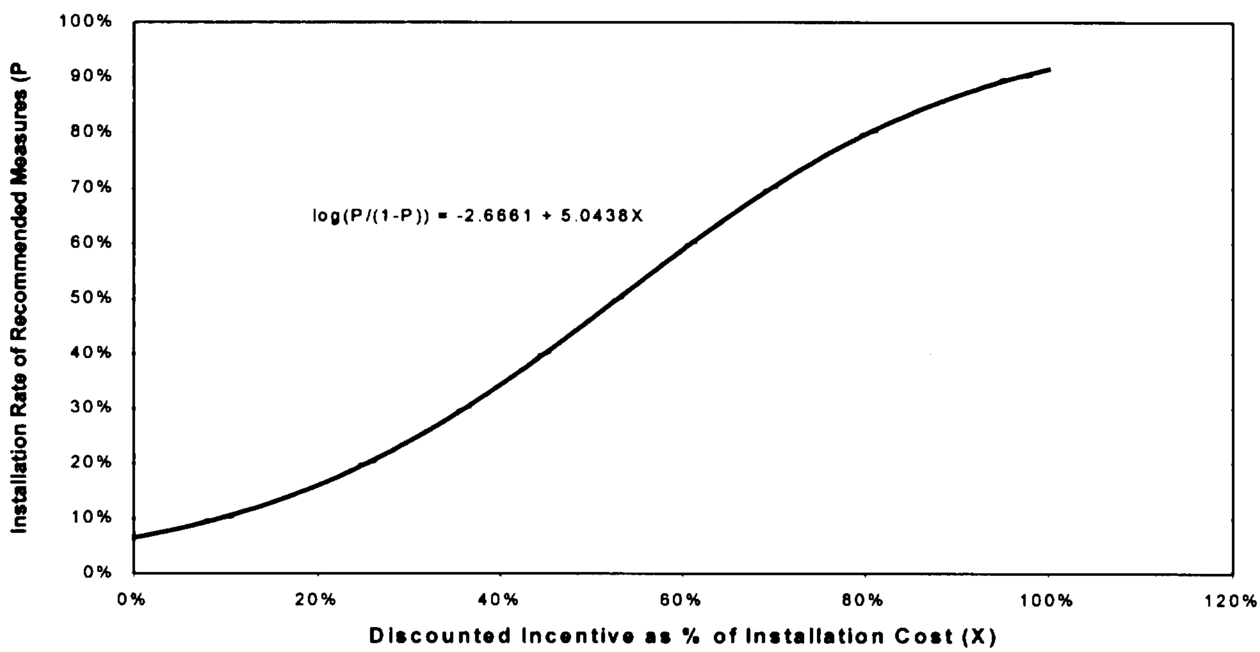

Figure 2. Logistic Curve

Inferences and Implications for Program Design

The general trend of dropping participation levels with dropping incentives both confirms expectations and is consistent with most other findings (e.g., Berry 1990; Holt 1992; Nadel 1996; Nadel and Geller 1995; Nadel, Pye and Jordan 1994; Warner 1994). However, most estimates predict much higher drop-offs in participation at mid to low incentive levels than were achieved by CUC. For example, Warner (1994) estimates 30% participation at 50% incentive levels for small commercial retrofit programs — less than half of CUC's achieved rate. The CUC data shows participation decreasing significantly as incentives drop from very high to medium, but then leveling off and becoming relatively insensitive to incentive level as incentives drop below approximately 50%.

It is possible that CUC's ability to provide customers immediate positive cash flow may be as significant to many customers as the overall incentive levels. This theory might explain the clear and precipitous drop when positive-cash-flow financing was no longer offered (for the fuel switching measures), and the maintenance of relatively high participation levels even at quite low incentive levels when the financing was available. For example, at discounted incentive levels of only 20% to 49%, the overall participation rate is estimated at 65%, but then drops to only 4% when customers are offered a 0% incentive. If these results are replicable at low incentive levels, they would represent a divergence from other analyses that have found little success in small commercial markets with significant customer cost contributions (MECO 1993). Because of the clear distinctions between the fuel switching and non-fuel switching measures and incentive structures, this hypothesis is difficult to test. An area for further research may be testing the relative influences of positive-cash-flow financing on small commercial customer decision-making.

The data may indicate that financing has the potential to substantially increase participation rates for those programs offering low incentives, at much lower cost to utilities. A few financing programs have had some success (e.g., Pacificorp's Energy FinAnswer Program).[5] However, most recent research indicates that in most cases, financing or shared savings approaches have failed to effectively substitute for cash rebates in achieving substantial participation, particularly in the small commercial market (Prindle 1995; MECO 1993; Nadel 1996). It is possible that CUC succeeded in capturing high levels of participation through careful design of its financing services. Key design parameters include:

- **Provision of immediate and significant positive cash flow.** All customers not only received immediate positive cash flow, they also retained at least 50% of their estimated bill savings, in some cases significantly more.
- **Simple qualifying mechanisms.** It is critical to simplify the credit application process. Customers who have kept current with their electric bill payments will presumably be able to make the loan payments because their total costs will go down. In addition, by combining payments on the bill, utilities may be able to increase their leverage over non-payers. Utilities should eliminate traditional credit approvals and streamline the process. This is particularly important for tenants.
- **Simple repayment mechanisms.** All repayments were included in the regular monthly electric bills. Not only does this minimize transaction costs and the inconvenience of another loan, it reinforces the impact of the immediate positive cash.

Figure 3 shows the predicted present value net benefits of a small C&I retrofit program, under different assumptions about incentive levels, based on the estimated logistic curve. The net benefit analysis is based on actual administrative, audit, and installation program costs for CUC, and current Vermont statewide electric avoided cost estimates (VT DPS, 1997). Its applicability to much larger utilities that could potentially lower per-customer administrative costs is somewhat limited.

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[5] While Pacificorp's program achieved a 76% participation in its Oregon territory (Prindle 1995, p. 68), a 35% cash incentive (in the form of tax credits) from the state was available at the time to supplement the utility financing. Pacificorp's participation level in other areas was substantially lower (Nadel 1996, p. 30).

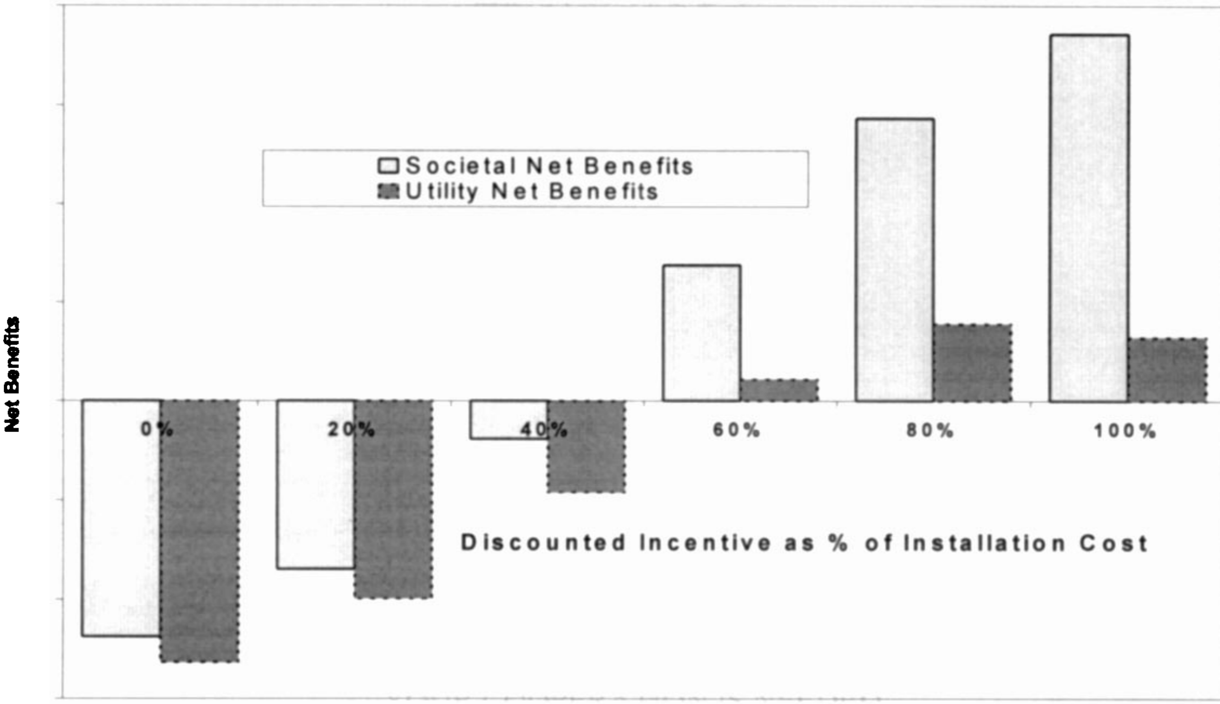

Figure 3. Program Cost-Effectiveness vs. Incentive Level Offered

Obviously, societal net benefits are maximized under a 100% incentive approach.[6] When comparing *utility* net benefits (total utility program costs less avoided electric cost benefits), it appears that the optimal strategy is not that different than under a *societal* analysis. The point of maximum utility net benefit is when the utility pays approximately 80% of the installation cost.

This confirms predictions by some others that requiring substantial customer cost contributions may actually *increase* net utility costs, as well as lower overall savings (e.g., Berry 1990; Gettings & MacDonald 1989; MECO 1993; Nadel, Pye & Jordan 1994; NEPSCO 1992; Pratt 1993). Our analysis indicates that, for a small utility, the lower incentive payments would be more than offset by the increased marketing, audit and administrative costs required to capture the same level of gross avoided cost benefits.

Conclusions

Our overall analysis confirms much of the prior research. It shows statistically significant reductions in participation parameters and measure adoption rates as financial incentives go down. In addition, it seems to confirm other hypotheses that participation levels are more sensitive to incentive changes at high levels of incentives (80-100% of project cost), than across the mid-range of incentives (30-70% of project cost).

The analysis diverges somewhat from prior findings that at low levels of incentives (10-40% of project cost) participation will drop off significantly. It is possible that the relatively high levels maintained by CUC are, at least in part, a result of the offer of immediate positive-cash-flow, on-the-bill, easy-to-use financing. It may be that properly designed financing services are a more important incentive to customers when the total utility contribution is lowest, and are least significant at very high levels of utility contribution. The CUC program results seem to diverge significantly from most of

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[6] Customer incentives are transfer payments from non-participating ratepayers to participants, and therefore have no impact on societal costs.

the recent research that has found very few examples of successful financing services in utility programs (in terms of achieving significant levels of participation and savings).

While CUC was able to maintain relatively high participation levels at the relatively low incentive levels, the data seems to indicate a loss of comprehensiveness and overall savings that is greater than the loss in participation rate. This confirms other cross-sectional research of C&I programs.

The logit analysis seems to indicate that the overall net benefits to utility ratepayers are maximized with incentives in the high range of 80% to 100% of project cost. Again, this is consistent with some prior research.

Finally, our analysis identifies areas for further research. The CUC analysis benefited from a rich database, and the control of many non-financial variables. However, it raises questions about the impact of positive-cash-flow financing, both combined with and without cash rebates. Future tests that isolate different financial strategies may shed light on these effects. Other fruitful areas of research include testing the significance of changes between levels of measure comprehensiveness and overall participation levels, and improving on the logit model by employing MLE techniques.

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