How To Cost-Effectively Serve Small Nonresidential Hard-to-Reach Customers

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ABSTRACT

Quantum Consulting (QC) and Pacific Gas and Electric Company have recently completed a statewide study on behalf of the California Public Utilities Commission (CPUC), assessing the cost to deliver energy efficiency programs targeted to small nonresidential customers. The CPUC defines small customers, which comprise over 90% of all nonresidential electric accounts, as those with peak demand less than 100 kW. The a priori hypothesis was that small customers are more costly and difficult to reach, but existing literature offers little cost data to support this assertion. To meet the study's objective, four distinct tasks were conducted: (1) conduct a detailed literature review to identify existing studies and data sources that could provide both insight and empirical data to assist in meeting the study's objective; (2) collect and analyze existing study results and empirical data on measure costs, or the costs vendors charge customers to purchase and install energy efficient equipment; (3) collect and analyze empirical data on program costs (i.e., the costs involved with administering, marketing and implementing energy efficiency programs); and (4) integrate the measure and program costs, and develop a set of prototypical energy efficiency programs that could provide an estimate of the incremental costs involved with serving small nonresidential customers. The study found that, based on empirical data, measure costs were generally 17% higher for small customers compared to large customers; and program costs were higher by a similar margin. Combined, the total costs to serve small nonresidential customers could be as much as 40-50% higher, depending on the program design. This paper presents the detailed methodology and findings from this study.

INTRODUCTION

Quantum Consulting (QC) and Pacific Gas and Electric Company have recently completed a study on behalf of the California Public Utilities Commission (CPUC), assessing the cost to deliver energy efficiency programs targeted to small nonresidential customers. The CPUC defines small customers, which comprise approximately 80% of all nonresidential electric accounts, as those with peak demand less than 20 kW. There is a general consensus that small customers are more costly and difficult to reach, but existing literature offers little cost data to support this assertion. The objective of this study was to determine the incremental cost of serving small customers primarily by mining existing data sources and interviewing program implementers that are delivering programs targeted to this hard-to-reach segment. An additional objective of this study was to compare and contrast the costs associated with serving small nonresidential customers under alternative program design scenarios in an attempt to provide insight into how to most cost-effectively serve this segment.

The study consisted of four primary phases. The first phase involved a detailed literature review that identified existing studies and data sources that provided both insight and empirical data on the cost to serve small customers. The second phase focused on collecting and analyzing existing study results and empirical data on measure costs, or the costs that vendors charge customers to purchase and install energy efficient equipment. The third phase focused on collecting and analyzing empirical data on program costs, or the costs involved with administering, marketing and implementing energy efficiency programs. The fourth phase integrated the measure and program costs, and developed a set of prototypical energy efficiency programs that could provide an estimate of the incremental costs involved with serving small nonresidential customers. The detailed methodology and findings from each of these phases is discussed below.

METHODOLOGY AND RESULTS

As discussed above, the study consisted of four distinct phases: (1) literature review, (2) measure cost analysis, (3) program cost analysis, and (4) incremental cost analysis. Below we discuss the methodology and results associated with each phase.

Literature Review

The literature review encompassed a broad range of sources, including major conference proceedings, trade publications, and industry organizations. Furthermore, energy efficiency program filings submitted to the California Public Utilities Commission (CPUC) by the California IOUs and independent third party administrators were also reviewed. The key sources reviewed are summarized in Figure 1. This thorough literature review turned up many relevant findings on the barriers to participation as well as vendor perceptions of this market. The chief findings, mainly drawn from studies based on customer and vendor interviews, are clear: (1) small customers are more costly and difficult to reach and (2) energy service providers avoid the small business market due to higher transaction cost and lower profit margins. However, little data exist on the actual costs to serve this class of customers. There does exist relevant cost information in California's Database for Energy Efficient Resources (DEER), the IOU's tracking systems, and there is potential useful information in many of the recent CPUC filings. But no analysis to determine the cost to deliver energy efficiency programs to the small nonresidential population has previously been conducted.

Key Literature Review Sources		Years
Conferences	International Energy Program Evaluation Conference	1993-2001
	Amercian Council for an Energy-Efficient Economy (ACEEE) Summer Study	1994-2000
	Association of Energy Service Professionals	1997-2001
	ACEEE, Third Annual Market Transformation Workshop	1999
Trade Publications and Data Sources	E-Source	
	The Energy Journal	
	California Database for Energy Efficient Resources	2001
	California IOU Energy Efficiency Program Tracking Systems	1994-2001
	CPUC 2002 Third Party Initiative Energy Efficiency Program Proposals	2002
Industry Organizations	Consortium for Energy Efficiency	
	Energy Ideas Clearinghouse	
	Iowa Energy Center	
	National Association of Regulatory Commissioners	
	Northwest Energy Efficiency Alliance	
	Northeast Energy Efficiency Partnership	
	New York State Energy Research and Development Authority	
	California Energy Commission	
	California Measurement Advisory Council	

Figure 1. Key Literature Review Sources

Measure Cost Analysis

We define measure cost as the equipment costs and labor costs charged by vendors to install energy efficient equipment. In the literature review, two reliable data sources were identified that provided detailed information on measure cost: the 2001 California DEER database, and PG&E's 1997 Management Decision Support System (MDSS, energy efficiency program tracking database).

The DEER database provides measure costs for hundreds of energy efficiency products, and is based on vendor data collected during surveys. The MDSS is a detailed program tracking system for all of PG&E's energy efficiency programs. In 1997[1], PG&E entered measure cost data collected from actual vendor invoices, which were required as part of the program application. The MDSS documents project costs for approximately 10,000 measure installations.

Job size (or volume) was used as a proxy to assess the incremental costs associated with serving small customers, as it was our working assumption that job size and customer size would be highly correlated. It is expected that smaller customers will have smaller job sizes, and will cost more on a per measure basis due to the fixed costs associated with serving a customer (of any size). The DEER database presents measure costs for high and low volume for lighting measures. In general, the DEER reports that the whole-to-retail markup values for lighting products is 17% higher for low volume than high volume (page 2-8).

The MDSS, on the other hand, provides the actual vendor costs for each measure for each project that was rebated through the program. To determine the average measure costs associated with low versus high volume, we binned projects by size for each measure type, and developed cut points where the average measure cost jumped. For most measures, the low volume bin generally comprised half to two-thirds of the projects (overall 60% of the 9,803 projects analyzed were considered to be low

1 PG&E collected this data in other years, but not recently. 1997 was the most robust and recent year.

volume). Consistent with the DEER, the MDSS program tracking data indicated that the increased cost associated with serving small customers (or low volume projects) was 18% higher for key lighting measures.

Below we present the high and low volume measure costs found in the DEER and MDSS databases for three key lighting measures:

- Screw-in compact fluorescent lamp (CFL) systems, modular 14-26 Watts No Reflector
- Hard-wired CFL systems, modular 14-26 Watts
- T-8 fluorescent, 4-Foot 32 Watt lamp, electronic ballast systems

Because multiple types of specific equipment can fall within each of these measures (e.g., 2 lamp T-8 systems vs. 3 lamp systems), the costs have been normalized to the dollars per kW of energy savings. Figure 2 presents the dollars per kW for high and low volume projects, based on the DEER and MDSS databases, for each of these three measures.

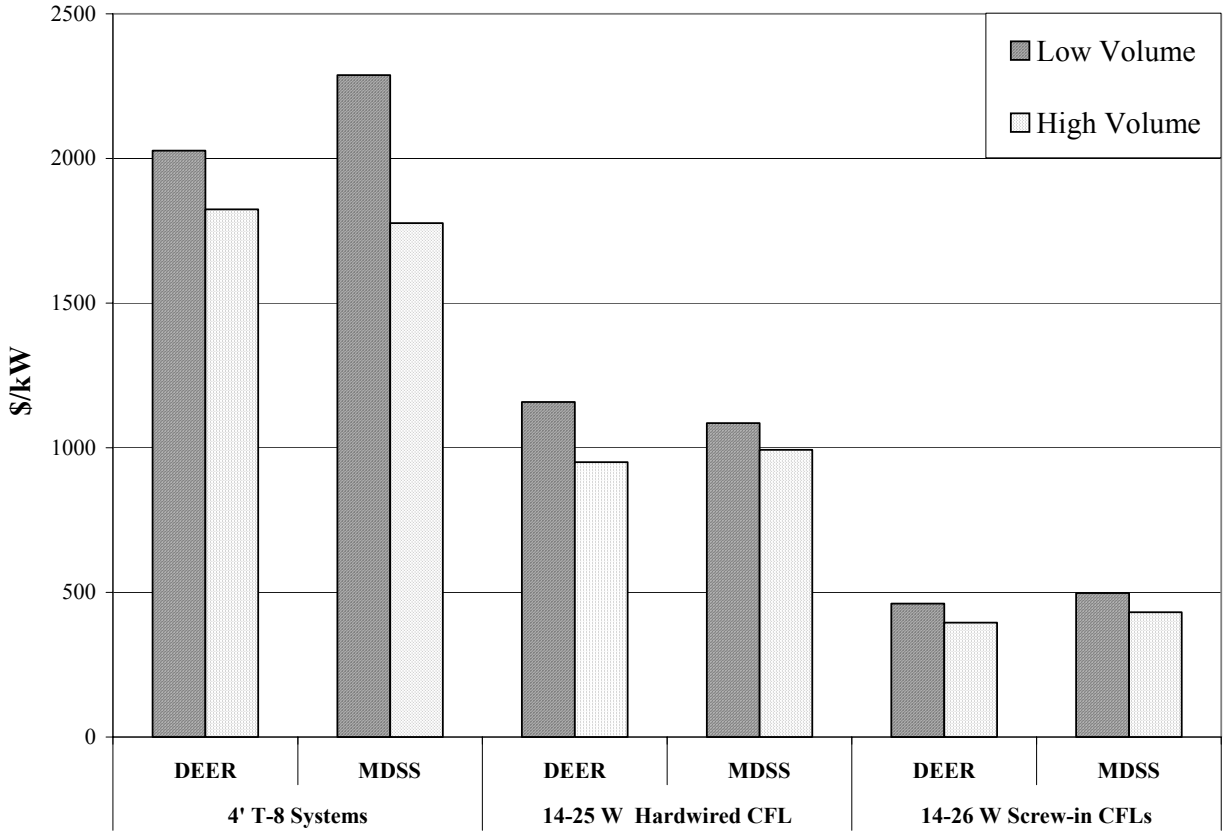

Figure 2. Measure Costs for Key Lighting Measures, High versus Low Volume Projects Based on DEER and MDSS Databases Dollars per kW Saved

Figure 3 presents the percentage increase in measure cost for low volume projects versus high volume projects, based on the DEER and MDSS databases, for each of these three measures.

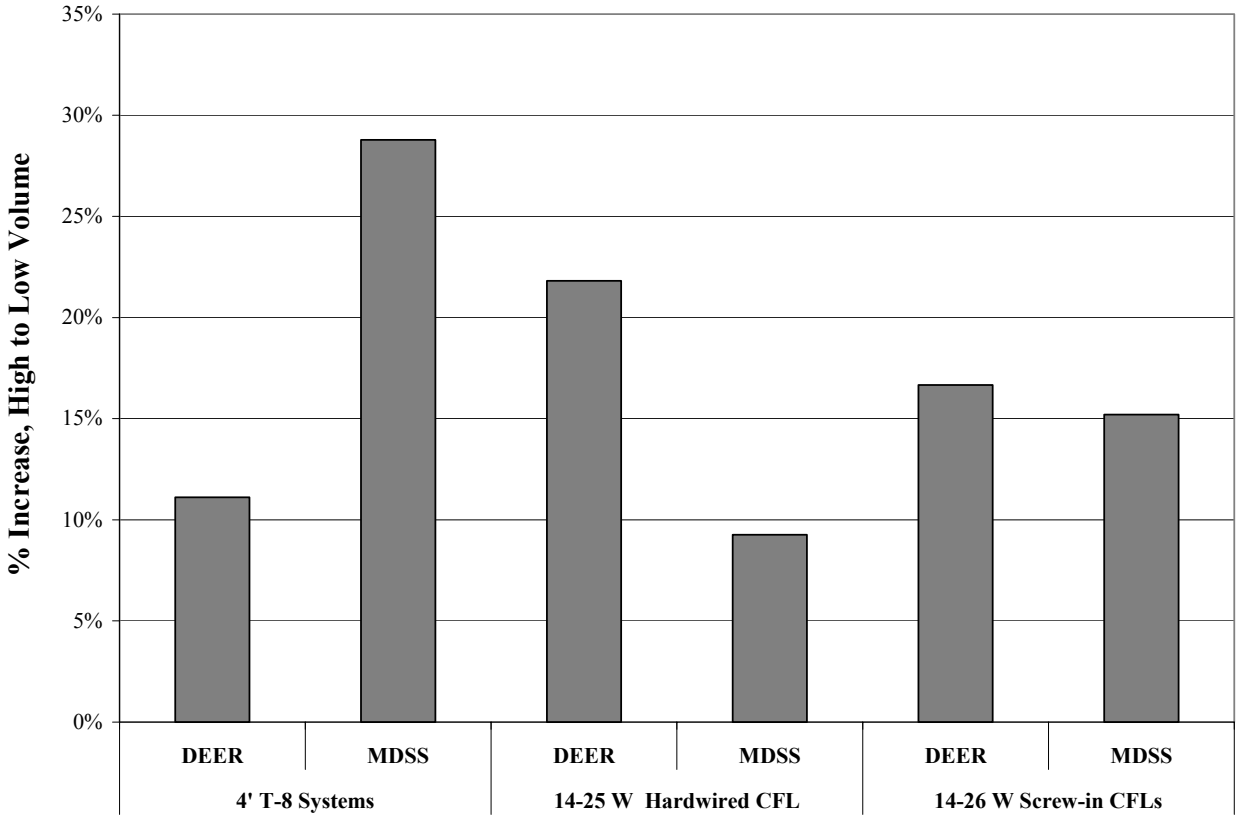

Figure 3. Increase in Measure Costs for Low Volume vs. High Volume Projects Based on DEER and MDSS Databases

The three measures presented in Figures 2 and 3 have proved to be the most popular measures installed in California rebate programs over the past few years. The largest energy efficiency program serving nonresidential customers is the Statewide Express Efficiency program. In 2002, these measures contributed over three-quarters of the total energy savings associated with this program. On average, across these three measures and two data sources, low volume projects exceeded high volume projects by 17%.

Program Cost Analysis

Budgets and program filings for nine different energy efficiency programs were analyzed to assess the differences in programmatic costs associated with serving small nonresidential customers. These nine programs were all offered in 2002 and were implemented by both the California Investor Owned Utilities (IOUs) as well as independent third party administrators. Five of these programs were offered only to small nonresidential customers (generally with peak demand less than 100 kW) and only in targeted geographic areas. These programs were typically direct install type programs that offered incentives that averaged anywhere from 33% to 100% of the measure cost. These were primarily lighting programs, with lighting measures generally consisting of 80 to 100% of the programs' goals.

Two other programs were offered to both small and medium sized customers (peak demand less than 500 kW) and in much larger geographic areas (entire IOU service territories). These programs were typical rebate programs that offered incentives that averaged approximately 25% and 33% of the

measure cost. These were also primarily lighting programs, with lighting measures consisting of around 80% of the programs' goals.

The final two programs were offered primarily to large customers (peak demand greater than 500 kW) and in much larger geographic areas (entire IOU service territories). These programs were typical standard performance contract programs that offered incentives that averaged approximately 50% and 70% of the measure cost. These programs targeted more customized types of measures, but included standard lighting measures.

For the remainder of this paper, these nine programs will be referred to as follows:

1. Small Direct Install Program, 33% Incentives
2. Small Direct Install Program, 50% Incentives
3. Small Direct Install Program, 50% Incentives (second to offer 50%)
4. Small Direct Install Program, 75% Incentives
5. Small Direct Install Program, 100% Incentives
6. Small/Medium Rebate Program, 25% Incentives
7. Small/Medium Rebate Program, 33% Incentives
8. Large Customized SPC Program, 50% Incentives
9. Large Customized SPC Program, 70% Incentives

The budgets and program filings for each of these programs were analyzed and the following cost and program data were estimated for each program:

- Administration Costs
- Marketing and Outreach Costs
- Audit Costs for Identifying Potential Measures
- Application Processing and Inspection Costs
- Incentives Paid
- Expected Participant Co-payment (measure costs minus incentives)
- Demand (kW) savings for the program

When assessing the costs to serve small customers across each of these nine programs, we normalized the costs by putting them in terms of dollars per kW. Because program administrators were not always consistent in the way they categorized costs (e.g., administration versus marketing versus auditing), we focused on two aggregate cost values: the program cost and the societal cost. The program cost includes all costs paid for by the program (administration, marketing, auditing, application processing, inspections and incentives). The societal cost includes all costs needed to deliver the program and pay for the measure, which is the program cost plus the participant's co-payment. Because the programs pay widely varying levels of incentives, the truest comparison lies with the societal cost per kW.

Figure 4 presents the societal cost per kW associated with each of these nine programs, with the total cost broken down into the individual components. To look at the program cost per kW, simply remove the top bar associated with the customer co-payment (which is zero for the small direct install program paying 100% incentives).

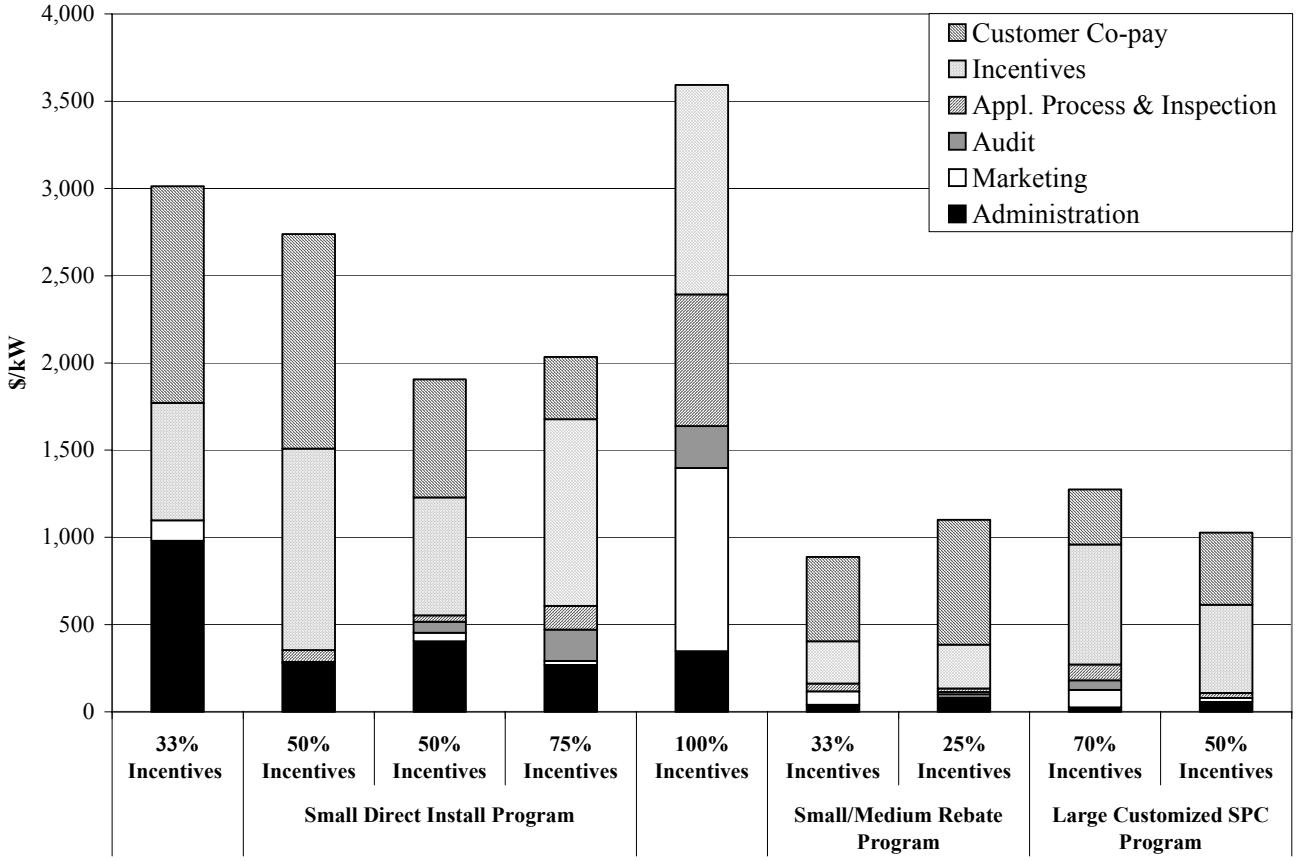

Figure 4. Total Societal Cost per kW Saved for Nine Studied Programs Including Breakout of Costs by Component

There are many factors to consider when comparing these costs. It is important to note that many of the differences across programs are due to different program assumptions and the underlying portfolio of measures emphasized in the program. For example, in Figure 2 above, a program that emphasizes screw-in CFLs will have a much lower dollar per kW than a program that emphasizes T-8s. Furthermore, we found that assumptions of measure savings and measure costs also varied significantly from program to program. A program that assumes larger kW savings or lower measure costs will result in lower societal costs per kW saved.

A good example of how dramatically program design assumptions and program mix can differ is through a comparison of the two small direct install programs offering 50% incentives. One program has a societal cost that is 44% higher and a program cost that is 23% higher. However, the "more expensive" program actually has administration, marketing, auditing, application processing and inspection costs that are one third *lower*. The reason the first program is so much more expensive is due to differences in the measure mix emphasized and assumptions about measure savings and measure costs (e.g., higher measure costs, lower demand savings, and a less cost-effective measure mix). Figure 5 below presents the average measure cost per kW saved for each program to illustrate how much the underlying measure mix and assumptions about cost and savings varied across programs.

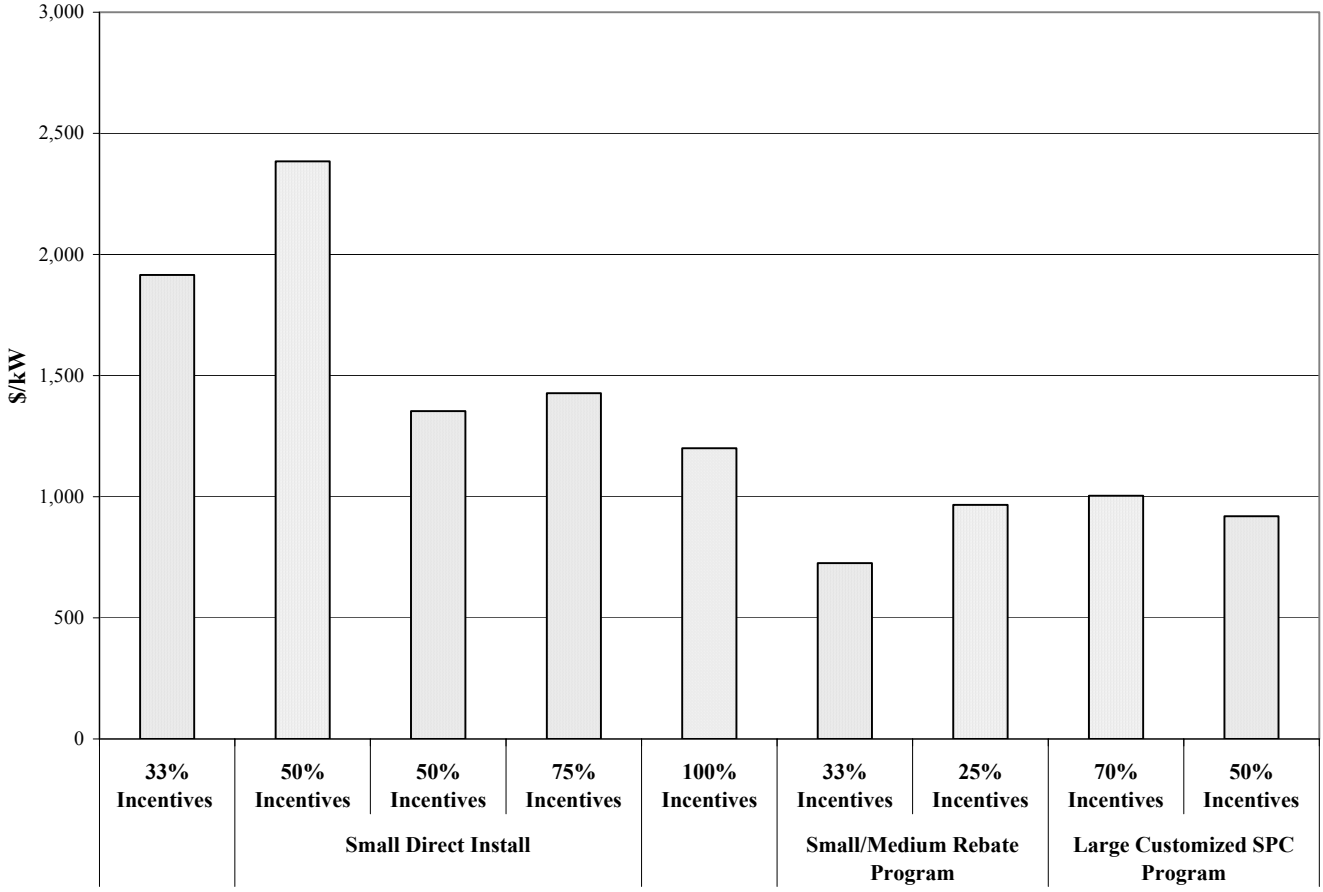

Figure 5. Measure Cost per kW Saved for Nine Studied Programs

Analysis of DEER and MDSS databases revealed that measure costs are significantly higher for programs targeted at small customers. Even considering the differences in measure mix and assumptions about costs and savings, expected costs are higher for programs targeted at small customers.

For a more robust comparison of costs, we attempted to normalize the underlying measure mix and assumptions about measure costs and savings. We assumed that each program had an underlying measure mix that had an average measure cost of $1200 per kW saved (in other words, after this normalization, the bars in Figure 5 would all equal $1200). Figure 6 presents the societal cost per kW associated with each of these nine programs, normalized to have a measure mix that costs $1200 per kW (note that the customer co-pay and incentives bars sum to 1200 for each program).

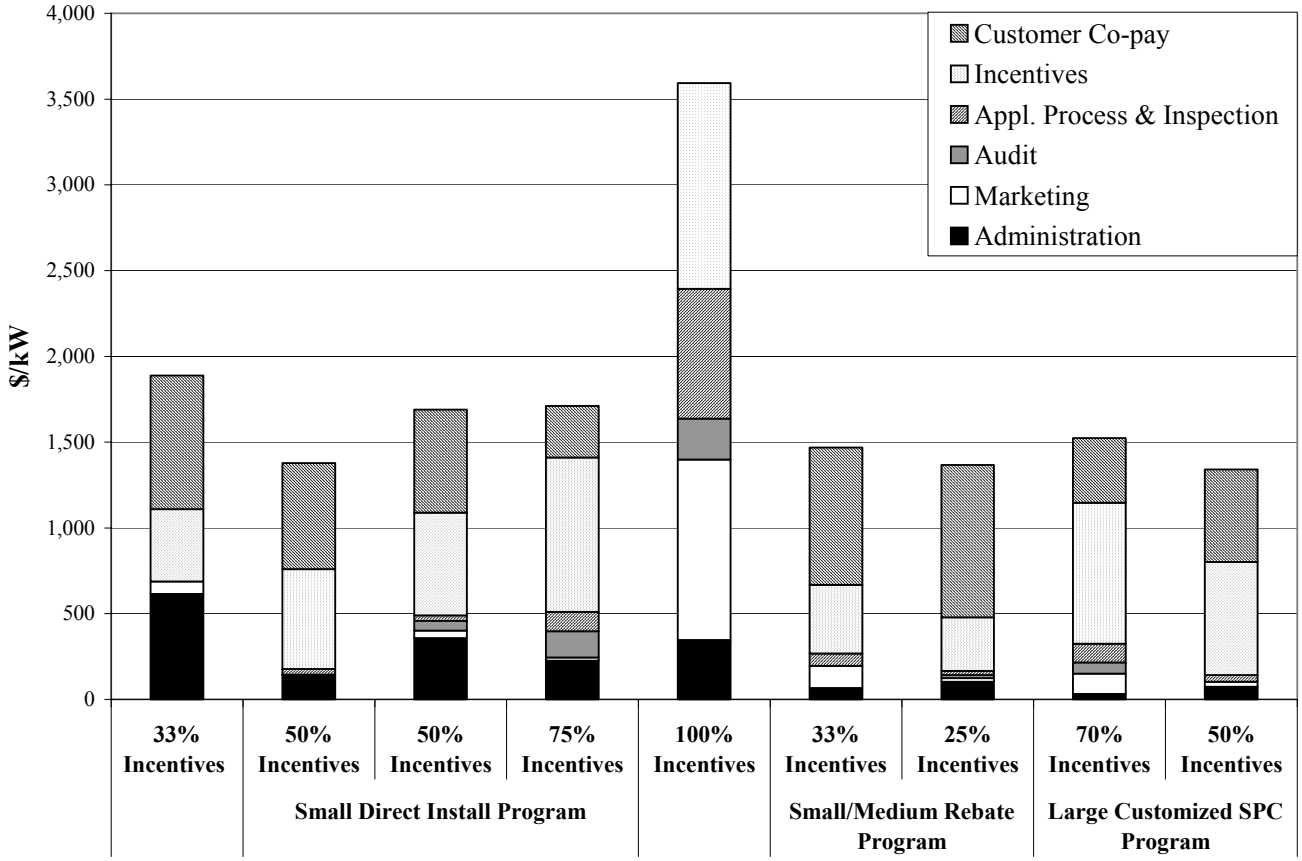

Figure 6. Total Societal Cost per kW Saved for Nine Studied Programs Normalized to $1200/kW Average Measure Cost

The normalized societal costs show that the programs targeted to small customers still cost more. The program offering 100% incentives appears to be a bit of an outlier, having excessively high marketing, application processing and inspection costs. The first small direct install program offering 50% incentives is the only program that has a lower societal cost per kW than any of the four programs targeting larger customers. This was also the program that had excessively high measure cost per kW assumptions. Overall, the five small direct install programs have a societal cost per kW that is 44% higher than the other four programs targeted to larger customers. Even after removing the one outlier with a societal cost of $3,593/kW, the four direct install programs are still 17% higher.

Program Cost Analysis

Based on the empirical program data, we developed four prototypical programs:

- Small Direct Install Program, offering 75% incentives – The costs for this program were developed by averaging the costs associated with the second small direct install 50% incentive program and the 75% incentive program. Incentives paid for the 50% incentive program were scaled up to reflect the 75% incentive.
- Small Customer Rebate Program, offering 33% incentives – The costs for this program were developed by averaging the costs associated with the two small/medium rebate programs, and doubling the administration, marketing, application processing and inspection costs. It

was assumed that twice as many applications would need to be processed to achieve the same level of savings for a program targeted only to small customers, which would also require more administrative and marketing effort to double participation. Incentives paid for the 25% incentive program were scaled up to reflect the 33% incentive.

- Medium Customer Rebate Program, offering 33% incentives – The costs for this program were developed by averaging the costs associated with the two small/medium rebate programs, and dividing the application processing and inspection costs in half. It was assumed that half as many applications would need to be processed to achieve the same level of savings for a program targeted only to small customers. However, an equivalent level of administration and marketing was assumed. Incentives paid for the 25% incentive program were scaled up to reflect the 33% incentive.
- Large Customer Customized SPC Program, offering 50% incentives – The costs for this program were developed by averaging the costs associated with the two large customized SPC programs.

The measure mix and assumptions about measure cost and savings were normalized to a $1200 measure cost per kW saved. Figure 7 presents the societal cost per kW associated with each of these four hypothetical programs, normalized to have a measure mix that costs $1200 per kW.

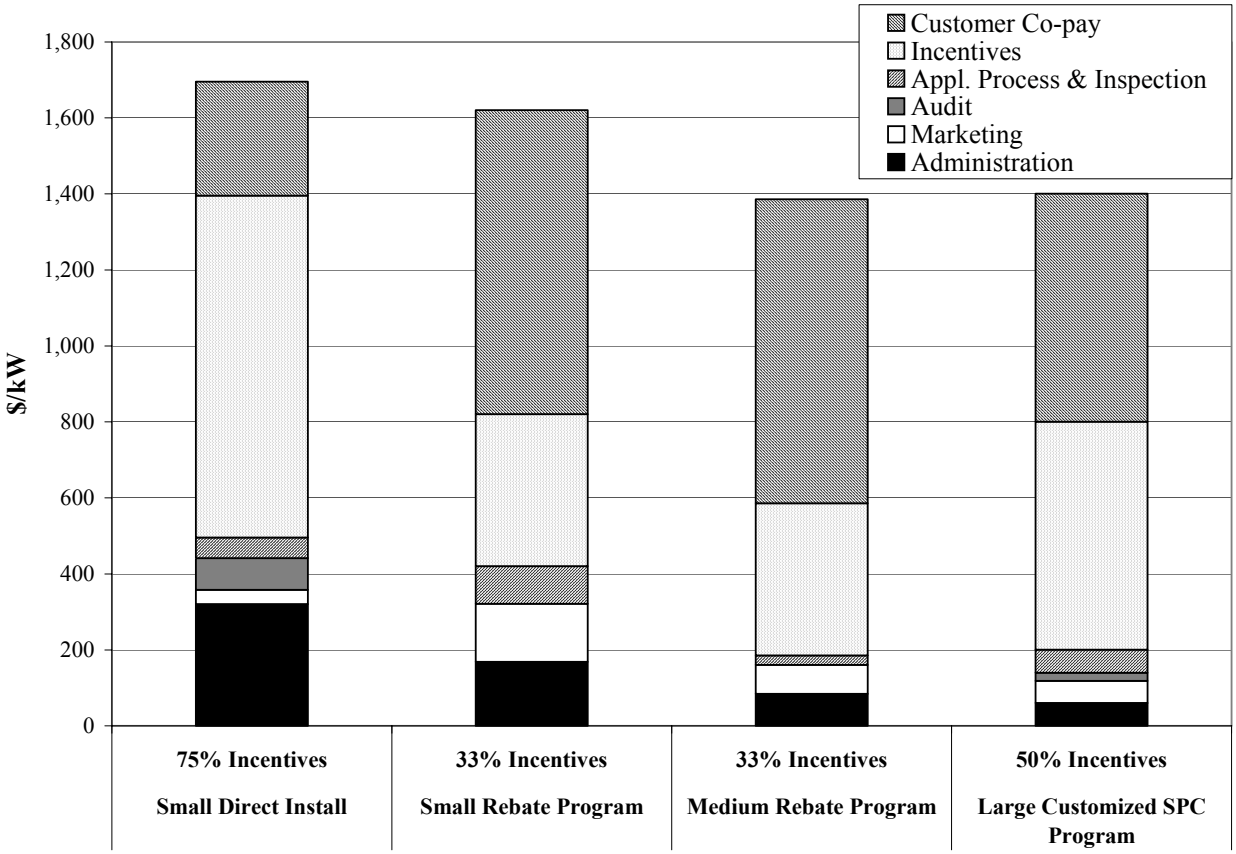

Figure 7. Total Societal Cost per kW Saved for Four Hypothetical Programs Normalized to $1200/kW Average Measure Cost

In both cases, the societal costs associated with the programs targeted to small customers are higher. Interestingly, the programs targeted at medium and large customers have nearly identical costs. Some believe that because a large customer program generates significantly more impact per participant, that it is more cost effective than a program targeted to medium sized customers, because it reduces average administration costs and requires less mass marketing. However, these advantages are offset by the additional costs associated with the large customer program, including expensive auditing and detailed application processing.

Because the measure cost per kW is normalized to $1200, the differences in societal costs are all attributable to program related costs (not incentives though). From the measure cost analysis, we found that vendors also charge small customers more, about 17% on average. We can assume that the small direct install, small rebate and medium rebate programs may have a similar measure mix (although it is likely that the medium sized customers may tend to have more expensive measures, such as T-8s relative to CFLs). However, the large customers are likely to have a significantly more expensive measure mix, as is indicative of the findings presented in Figure 5. If we average the measure costs per kW for the two small/medium rebate programs and the two large SPC programs, we find that the average measure cost is $826/kW and $945/kW, respectively. If we assume these costs for our hypothetical medium and large programs, and increase the cost by 17% (over the medium program) for the two hypothetical small programs (to $972/kW), we can develop societal costs per kW that incorporate the effects of increased measure and program costs.

Figure 8 presents the societal cost per kW associated with each of these four hypothetical programs, with varying measure costs.

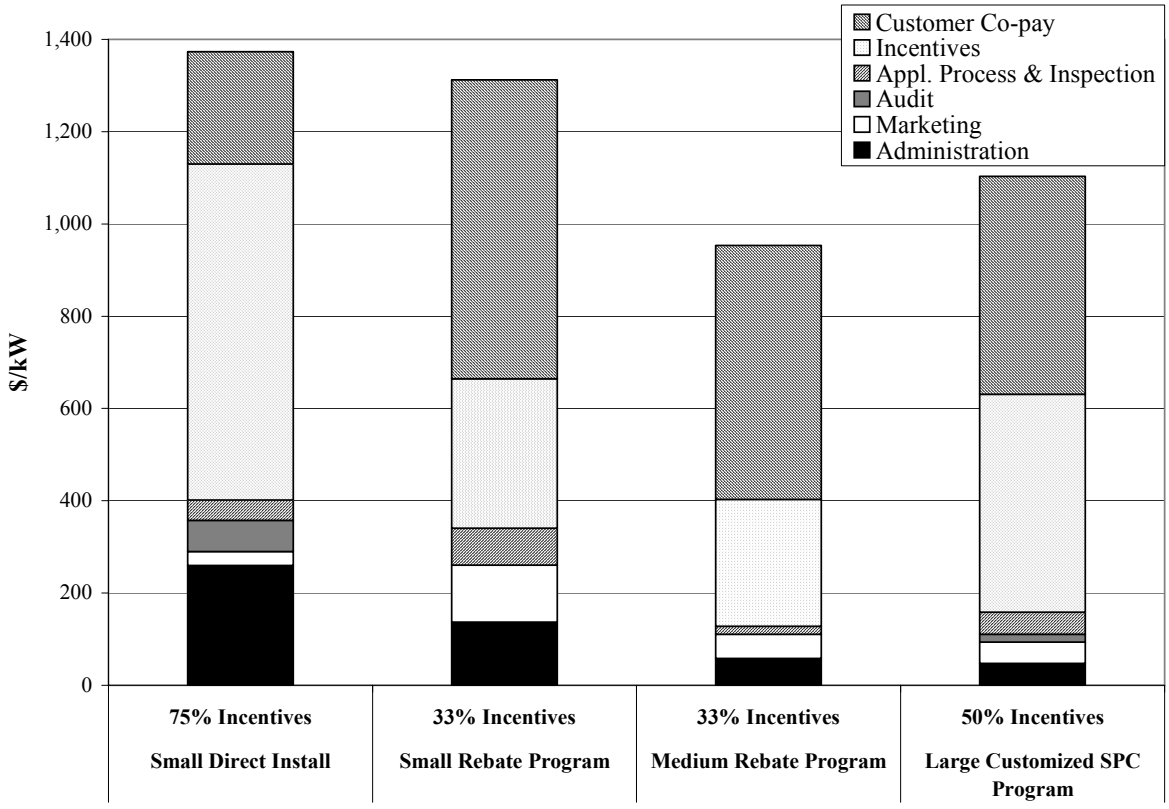

Figure 8. Total Societal Cost per kW Saved for Four Hypothetical Programs With Varying Measure Cost

As discussed, the measure costs were fixed at 17% higher for the two small programs, compared to the medium program, based on the measure costs analysis presented above. The large program was found to have a measure cost per kW that is 14% higher than the medium program, due solely to the fact that more expensive measures are installed under a customized program targeted at large customers. Relative to the medium program, program costs per kW were found to be 22% higher for the small direct install program, 17% higher for the small rebate program and just 1% higher for the large program. The compounded effects of measure and program costs lead to societal costs per kW that are higher relative to the medium rebate program by 44% for the small direct install program, 38% for the small rebate program, and 16% for the large customized program.

CONCLUSIONS

Program data analyzed in this study consistently revealed substantially higher costs associated with delivering energy efficiency programs to small nonresidential customers. Although much of the data were based on expected budgets for energy efficiency programs that contained varied assumptions of measure mix, measure savings and measure cost; the budgets consistently showed that it was more expensive to administer, market and implement a program targeted at smaller nonresidential customers. Furthermore, vendor survey data (the basis for DEER) and actual customer invoices (contained in PG&E's MDSS) clearly showed an increase in measure cost (for equipment and labor) to install energy efficiency measures among smaller nonresidential customers.

This has significant implications for the California IOUs, and potentially other areas throughout the nation that publicly fund energy efficiency programs. In California, there is significant focus on equity considerations among hard-to-reach customer segments. In particular, one question being raised is whether small nonresidential customers are underserved relative to the contributions that these customers make as part of the public funding mechanism. When analyzing this issue, it is imperative to consider that it is more costly to serve small customers. Energy savings and rebates received should not be used as the sole basis to determine if these customers are receiving a proportional level of program benefit, as relatively more public funds are expended per kW saved, or per dollar of rebates paid. Program or societal costs should also be considered as the basis of this determination, that reflect the higher costs to serve these customers.

As discussed above, an additional objective of this study was to compare and contrast the costs associated with serving small nonresidential customers under alternative program design scenarios in an attempt to provide insight into how to most cost-effectively serve this segment. Unfortunately, the empirical data available on programs targeted to small customers were limited to direct install programs, that were offered in relatively small geographic areas. However, the prototyped programs presented in Figure 8 indicate that there are not significant differences in cost-effectiveness between a locally offered direct install program paying 75% incentives, and a mass marketed rebate program paying 33% incentives. However, we might expect that the rebate program would be less cost-effective if offered to a smaller geographic region, as there are many fixed costs associated with marketing such a program. Conversely, marketing costs associated with a direct install program are more variable, often utilizing a door-to-door sales approach, which may not have the economies of scale that a mass market rebate program has (in fact, direct install approaches may become less effective over larger service territories that contain less populated, rural areas).

One other factor to consider is program penetration. Generally, mass market programs achieve significantly lower rates of penetration, generally due to lower incentives and a less customized marketing approach. Finally, there is the consideration of incentive levels. For a direct install program, per customer marketing costs are relatively high. Therefore, for such a program to be cost-effective, it

must also have a high rate of participation among those to which the program is marketed. This is typically achieved by increasing incentives. Furthermore, for many of the smaller customers, especially those in more economically distressed areas, cost is the biggest barrier to participation. Therefore, for a program that is targeted to highly underserved segments within the small nonresidential market, higher incentives become increasingly more important.

Finally, it is important to note that when considering the costs presented in this paper, that we are not advocating that the programs with the lowest cost per kW are necessarily the best. All of these programs may be a good investment from a societal standpoint. However, there are different costs associated with serving different markets, that may be a result of the program implementation strategy, the measure cost, or the portfolio of measures typically adopted for a given customer segment. Therefore, these costs should be considered in the context of a public purpose program that is trying to maintain an equitable allocation of program funds across various market segments.