

# **Nonresidential Audit Impacts: Digging Deeper Toward Causality**

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## **ABSTRACT**

This paper will share key findings from a comprehensive attempt to quantify California Nonresidential Audit (NRA) program net energy impacts. The paper provides a detailed characterization of program impacts, including the results of an attribution analysis allocating net impacts across the NRA and rebate programs, when both are in play. NRA net-to-gross ratios and net impacts are compared by rebate status, and the timing of the savings relative to the audit is explored by customer size and end use.

The underlying Study from which this paper is drawn leverages of an enormous wealth of data and the application of a full complement of quantitative techniques to estimate program gross and net energy impacts. In addition, unique to this study is an attempt to allocate net impacts across audit and rebate programs, when both are in play. Not only does the study apply a full arsenal of impact estimation and attribution techniques, but goes a step further by incorporating a time dimension to the study of audit impacts. Through analysis of previous and current evaluation surveys (including a subset of panel surveys) we document the unfolding of audit impacts over time, and highlight important differences in these patterns by customer size and technology end use.

The Study utilizes a total of over 6,000 customer surveys conducted in 2007, and nearly 1,000 surveys conducted for previous NRA evaluations. It leverages five years of participant tracking data, including NR audit program tracking and recommendation databases, as well as statewide incentive program tracking systems.

Many utilities are considering audit programs as part of their resource acquisition portfolio. This paper summarizes available data characterizing the efficacy of California's nonresidential audit programs as a channel to increase savings in other utility programs, and also brings to light the unique evaluation requirements involved in estimating impacts for Audits when they are provided simultaneously with other programs.

## **Overview of the Nonresidential Audit Program**

The Statewide Nonresidential Audit program is a key component in an integrated energy efficiency infrastructure in California providing essential analysis of customer end-use systems, conservation and energy efficiency opportunities, and economic information for customers to make investment decisions. The program provides direct support for and coordination with the IOUs' incentive programs.

Customer-specific building information including equipment and its operation is first gathered using online, CD-ROM, telephone, mail or on-site surveys. This data is in turn used to make energy conservation recommendations for each customer, culminating in the preparation of a tailored report (or list of recommendations) for each participant. The ensuing reports outline or refer to potential energy and dollar savings, and provide information about utility incentive programs.

In some instances, recommended equipment are later installed using further assistance from a rebate program, such as the Express Efficiency (a prescriptive program) or Standard Performance Contract (SPC) programs. For this reason, the Audit program is considered a "feeder" program, providing an important marketing service for other incentive programs.

## Impact Evaluation Approach

The Impact Assessment approach includes an engineering analysis, an SAE<sup>1</sup> billing analysis, follow-up evaluations conducted by a professional engineer, and self-report based impact attribution analysis. Impact analysis techniques vary by customer size, using somewhat different strategies for Small /Very Small customers than for Medium/Large customers. We discuss these approaches for each customer size category next.

**Very Small and Small Customer Gross Impact Approach Estimation (less than 100 kW/ 50,000 therms per year.)** The gross impact analysis for this group measures the energy impacts accrued through the adoption of efficient measures. The approach entails the following.

- Document equipment adoptions that participants take and, where possible, assess whether or not those are efficient actions. Conduct follow-up interviews/data collection where warranted to support an engineering-based estimate of program impacts and savings.
- Complete an engineering analysis of measure adoption data, leveraging available deemed savings values and Express Efficiency and/or, if relevant, SPC tracking/application data. This step results in unadjusted gross kW/kWh and therm impacts for each self-reported participant adoption. In addition to program impacts, unadjusted engineering-based savings estimates are also generated, yielding the expected savings in a customers' utility bill, reflecting the removal of in-situ equipment, rather than a traditional code- or market-based baseline.
- Unadjusted electric energy impact estimates based on an engineering/deemed savings approach are then refined using a statistically adjusted engineering (SAE) billing model approach.

**Medium/Large Customers (Greater than 100 kW/50,000 therms per year.)** For Medium/Large companies the final step in the Gross Impact approach is not an SAE, but is a rigorous follow-up effort by a professional engineer. Medium/large customers reporting measure adoptions in the participant survey underwent a more detailed gross impact assessment. This follow up investigation was concentrated on relatively complex measure adoptions falling under the process and 'other' end-use categories, where a deemed savings approach was thought to be less effective. Furthermore, follow-up efforts were concentrated among customers reporting measure adoptions with a preponderance of evidence supporting program net benefits (based on self-reported net-to-gross questions).

## Net Impact Estimation and Cross Program Attribution

This section details the survey response-based method applied in the calculation of free ridership rates for the NRA program and Cross Program Attribution. The former is focused on measures installed outside the rebate programs, and indicates which activities would have occurred even in the absence of the NRA Program. The latter is focused on adoptions made through the Express Efficiency or SPC programs, and is focused on measuring how much each program contributes to measure adoption activity.

Self-report net-to-gross analyses were conducted for participants in the NRA Program using participant impact survey data. Responses to selected survey questions were used to develop a free ridership score for each measure adoption. These scores were then weighted by energy savings to determine a weighted free-ridership score by measure and for the NRA program overall. The scoring method was

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<sup>1</sup> Statistically Adjusted Engineering

developed to be as similar as possible to that used for the Express Efficiency self-report analysis while taking into account the slight differences in survey questions used for the NRA program.

Two separate approaches are used to calculate free ridership. For each customer, the results of these two approaches are averaged to yield the final self-reported free ridership result. This dual approach is adopted to improve the consistency of the free ridership measurement methodology.

**Cross Program Attribution.** For customers in the “Cross Program” sample, a self-report based method is applied to “attribute” participant measure adoption behavior between free ridership, the Audit program and the rebate programs. Customers that participated in both the Audit program and the Express Efficiency or SPC programs were subjected to a second round of free ridership questioning. In general, they were asked the same three questions used to determine NRA Program free ridership, except the questions were focused on how the customer would have behaved in the absence of Express Efficiency or SPC program participation. Thus, the Cross Program participants were assigned two free ridership scores, one for the NRA program and one for the respective incentive program.

**Total Free Ridership Score.** The total free ridership score—inclusive of the combined effect of both programs—is taken as the minimum of the two separate program-specific free ridership scores. The assessment of how much a single program contributed to a customers’ measure adoption behavior must, be a minimum estimate of how much both programs together contributed to customers’ adoption decisions. The method used to allocate the total remaining net-impacts across the two programs is described next.

**Allocation of Net-Impacts Across Audit and Incentive Programs.** The allocation of net-impacts across the Audit and incentive programs is done using a survey question designed to elicit the relative importance of each program in customers’ adoption decisions. Customer responses to this question are used to allocate the measure net impacts across the two programs. The percent allocation to each program based on the various responses is shown in Table 1 below.

**Table 1: Attribution of Final Net-Impacts Across Audit and Incentive Programs**

Thinking about the different ways in which the Audit and <incentive program> may have influenced your equipment purchase decisions, which program would you say had more influence on your selection of high efficiency <end-use> equipment, - the Audit Program or the <incentive program> rebate program? [DO NOT READ]		
Responses	Percent Allocation of Net Impact to Audit Program	Percent Allocation of Net Impact to Express Efficiency/SPC
Audit Program	100%	0%
Incentive Program	0%	100%
Both Program had the equal influence	50%	50%
Neither Program had any influence	N/A	N/A
Don't Know / Refused	50%	50%

## Key Impact Findings

Table 2 below shows cross-program total and per-unit annual net impact associated with NRA Program participation, broken into rebated and non-rebated measures. The NRA Program works to raise awareness of both measures and available rebates to help pay for those measures, such as those offered through the California Express Efficiency or Standard Performance Contract Programs. However, to avoid

double counting, only non-rebated impacts can be claimed for the program accomplishments. Thus, the distinction between rebated and non-rebated net income is of critical importance to the IOUs and the program managers.

The NRA program has a fairly uniform delivery, with remote audits targeted to small and very small companies. Note that due to limited available recommendation data, the gross impacts are defined as all efficient equipment purchases occurring post-audit. For Medium and large companies, these adoptions took place over a period of 4 to 6 years. For small and very small companies, the adoptions took place over a period of 2 to 3 years.

The table shows that less than 20 percent of the NRA cross-program total net impact arise from non-rebated measures.

**Table 2: Summary of Cross-Program Total NRA Program Annual Impact, Rebated and Non-Rebated Sources**

Description	On-Site Audits		Remote Audits
	Very Small/Small	Medium/Large	
<b>NON-REBATED NET IMPACTS</b>			
<b>Statewide Non-Rebated Net Impacts, Total</b>			
kWh	8,517,184	6,625,979	7,566,447
kW	4,107	1,849	4,382
Therms	775,911	2,385,762	1,434,255
<b>Statewide Non-Rebated Net Impacts, Per-Unit</b>			
kWh	404	1,444	213
kW	0.2	0.4	0.1
Therms	37	520	40
<b>Statewide Non-Rebated Net-to-Gross Ratios</b>			
kWh	40%	34%	24%
Therms	20%	30%	13%
<b>REBATED NET IMPACTS</b>			
<b>Statewide Rebated Net Impacts, Total</b>			
kWh	7,852,929	76,941,209	6,101,803
Therms	345,781	865,449	864,509
<b>Statewide Rebated Net Impacts, Per-Unit</b>			
kWh	373	16,769	171
Therms	16	189	24
<b>CROSS-PROGRAM TOTAL (REBATED AND NON-REBAED) NET IMPACTS</b>			
<b>Statewide Rebated and Non-Rebated Net Impacts, Total</b>			
kWh	16,370,113	83,567,188	13,668,250
Therms	1,121,692	3,251,211	2,298,764
<b>Statewide Rebated and Non-Rebated Net Impacts, Per-Unit</b>			
Total Per-Unit kWh	777	18,213	384
Total Per-Unit Therms	53	709	65

The most important finding of this evaluation is that the cross-program total net impacts of the audit are largely attained through rebated adoptions. Though for small/very small company audits (including all remote audits and small/very small company on-site audits) rebated adoptions are a few percent under half of all impacts; net impacts for the medium/large segment are heavily weighted in rebated measures.

Please note the term “cross-program total net impact” refers to the combined program effect through both rebated and non-rebated program channels. Impacts associated with rebated measures are excluded from official Audit impact reporting because of the potential for double-counting.

Many audit participants go on to install efficient equipment through the rebate programs, and much of the cross-program total impact associated with these installations is attributable to Audit participation. One of the primary functions of the Audit program is to introduce customers to measures and the rebates that are available for those measures. It follows that when the audit is effective and functioning as designed, customers often adopt measures through rebate programs.

Figure 1 shows the relative magnitude of ‘cross-program total net impacts’ originating from rebated and non-rebated sources for the very small and small company segment. Note that in addition to rebated measures that were identified using a tracking system merge between NRA and the Express Efficiency program, some measures were self-reported by the participant to have been rebated, though not identified more directly through a tracking system merge. The figure shows that nearly half of the cross-program total net impacts achieved by the Audit program in the small and very small company segment are associated with rebated measures.

**Figure 1: Very Small and Small Company Cross-Program Total Net Impact by Rebate Status**

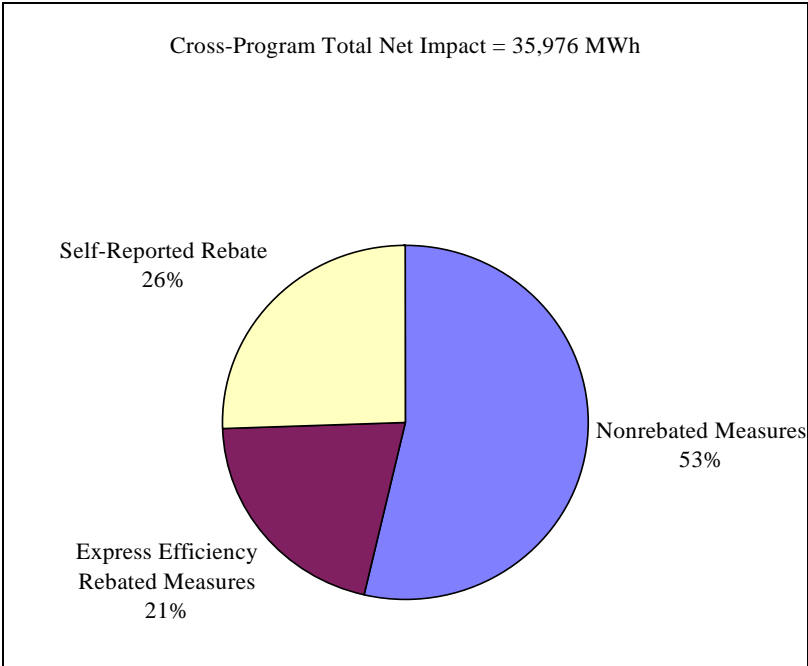
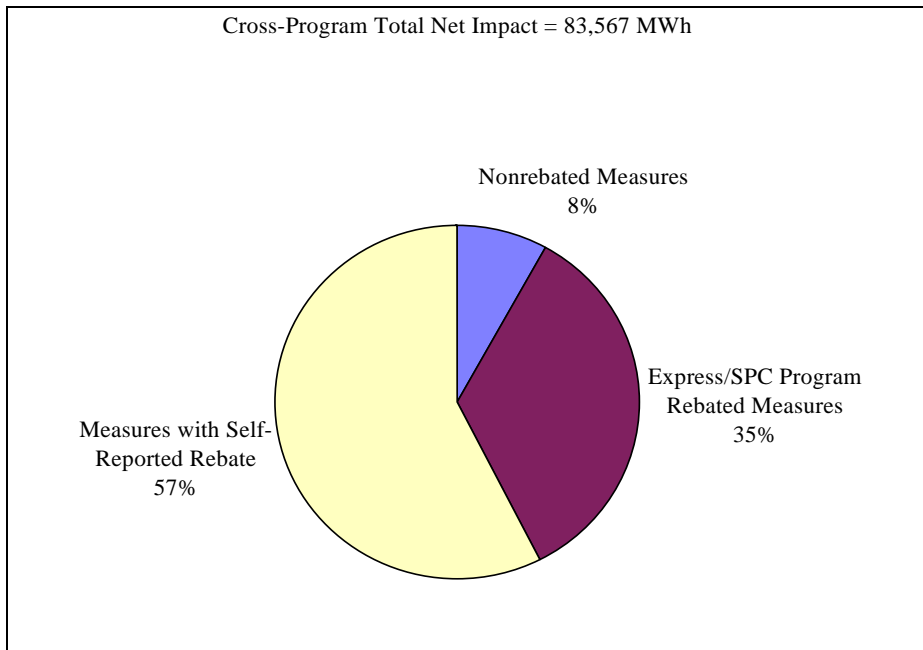


Figure 2 below displays the breakdown of Audit cross-program total net impacts by rebate status for the medium and large company segment. In this segment, only 8 percent of the identified cross-program total net impacts are associated with non-rebated measures.

**Figure 2: Medium and Large Company Cross-Program Total Net Impact by Rebate Status**

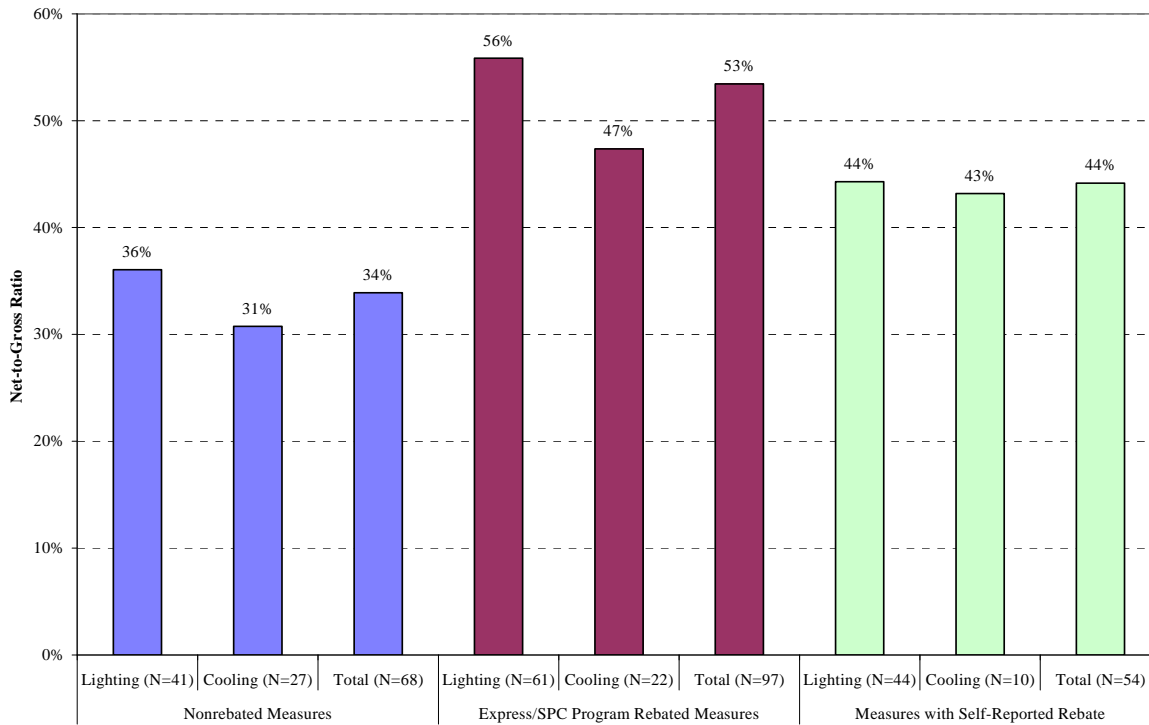


*Rebate Status and the Net-to-Gross Ratios.* In addition to rebated actions contributing the majority of Audit cross-program total net impacts (and therefore cannot be claimed by the Audit program) an examination of net-to-gross results reveal that the Audit is a greater motivating force and more “necessary” in motivating customers to adopt rebated equipment than non-rebated equipment. This is demonstrated in the relative magnitude of net-to-gross ratios in the rebated and non-rebated segments.

For the Audit program, the net-to-gross ratio is higher for rebated measures than non-rebated measures. Among small and very small customers the ratio is 30 percent for non-rebated items and 63 percent for items adopted through Express Efficiency. Among medium and large customers the net-to-gross ratio is 34 percent among non-rebated items and 53 percent for items adopted through the Express Efficiency or SPC programs.

Figure 3 below shows the self-report based net-to-gross ratios for medium and large customers by end-use and rebate status. The net-to-gross ratios for cross-program measures are about 1.5 times higher than for non-rebated measures. It is also evident that medium and large companies find the audit to be of greater importance in their cross-program adoptions than do the small and medium companies.

**Figure 3: Medium and Large Customer Comparison of Net-to-Gross Ratios by Measure Rebate Status, kWh Impact Weighted<sup>2</sup>**



The Audit program seeks to inform customers not only of retrofit opportunities, but also of incentive programs available to lower first costs to the customer. The Audit program success in this regard is apparent in the figures above, and also by the generally lower free ridership ratios calculated for rebated measures. In summary, this section brings home the importance of cross-program evaluation in understanding the achievements of the Audit program and the true value of the program to the California portfolio of nonresidential programs.

### **The Role of Timing, Customer Size, and End-Use**

This section presents key findings from various sections of the Study that highlight the ways that audit effects unfold over time, and how these effects vary by customer size and measure end-use.

*Cross Program Participation Patterns over Time by Customer Size and End-Use.* Table 3 below shows patterns of cross-over from the NRA program to the Express Efficiency rebate program by customer size and end-use. The Table shows a very significant concentration of cross over to the lighting end use among very small and small customers. There is more diversity in end-use adoptions among the medium and large customers, though there remains concentration in the lighting end-use. The Table also shows that among medium and large customers, adoptions in the cooling end-use are flat for the first four years following the audit. This is consistent with a more drawn out program effect for this end-use. Data for refrigeration indicates a minimal or negligible cross over effect for this end-use.

<sup>2</sup> Net-to-gross estimates do not include “Process” and “Other” end-use items for self-reported rebate measures and non-rebated measures. While net impact estimates are available for these items, gross adjusted impact estimates are not.

**Table 3: Cross Program Participation Summary, Audit Participants Going on to Express Efficiency, By End Use and Customer Size**

Audit Program	Customer Size	End Use	Match to Express 2002-2005	Participation rate, Years After the Audit			
				First Year	Second Year	Third Year	Fourth Year
NRA Program	Very Small and Small	Lighting	7%	5%	2%	1%	1%
		Cooling	2%	1%	1%	1%	1%
		Refrigeration	0%	0%	0%	0%	0%
		All	8%	6%	3%	2%	2%
		N	57,102	57,102	37,397	19,105	5,867
	Medium and Large	Lighting	11%	7%	5%	4%	3%
		Cooling	5%	3%	2%	2%	2%
		Refrigeration	1%	1%	1%	0%	0%
		All	20%	11%	8%	9%	8%
		N	8,557	8,557	6,155	3,752	1,722

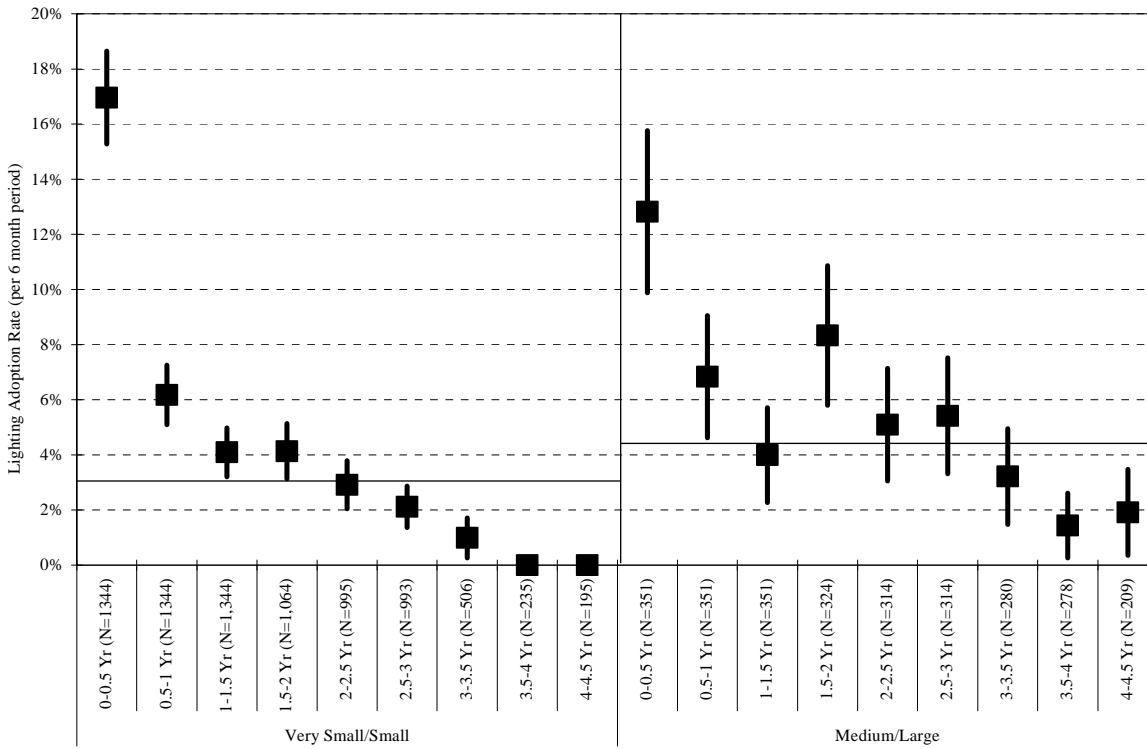
*Lighting Adoptions Over Time Relative to the Audit.* The percentage of adoptions for each six month period following the audit is shown for lighting measures in Figure 4 with the vertical bars representing the 90 percent confidence intervals around the mean values shown. As hypothesized, smaller firms had a high rate of lighting adoptions in the first six months after the audit, after which adoption rates fell sharply. After two years, the rate of lighting adoptions by very small and small customers had fallen to the baseline rate of 2.8 percent; after more than 2.5 years it was significantly lower, with no adoptions reported after 3.5 years.

The baseline rate is derived from nonparticipant adoptions identified through a telephone survey of 2,000 nonparticipating customers. The survey asked respondents to report adoptions over a period similar to that over which the participants were reporting. Further, the design of the nonparticipant sample was constructed to mimic the participant population characteristics of IOU service territory, business type and size. The baseline rate is shown in Figure 4 below as the grey horizontal lines.

For medium and large customers, the initial surge in lighting adoptions was not as high, but neither was the subsequent decline. Lighting adoptions for medium/large customers were above the baseline rate of 4.1 percent for most of the first 3 years, and only fell significantly below the baseline after 3.5 years. The extent to which the adoption rate for medium/large customers remained above the baseline from 1.5 to 3 years after the audit tends to support the hypothesis that larger customers take longer to implement measures.



**Figure 4: Lighting Adoptions Over Time Relative to the Audit**



### Audit Follow Up Initiatives

Another key finding of the Study relates to the importance of Audit program follow up. This section explores the effects of follow-up calls made to customers after the audit had been completed. These calls asked customers about their progress towards implementing energy efficiency measures recommended through the audit in an attempt to increase the impacts of the program.

The effect of follow up contact on the likelihood of participating in the Express Efficiency or Standard Performance Contracting program is investigated in Table 4 below. The table compares incentive program penetration rates among the Audit program population in general, and among the sub-population of customers who received follow-up contact. The table reveals that the follow-up effort had a strong positive impact on Audit participants' likelihood of participating in Express Efficiency, with the overall probability of participating in Express following the audit increasing more than two-fold (from 11 to 24 percent) among those that received a follow-up call. SPC program penetration does not appear to be influenced by follow-up contact.

**Table 4: Follow Up and Cross Program Participation**

Utility	Size	Express Penetration		SPC Penetration		N	
		Follow-Up Database	Audit Database	Follow-Up Database	Audit Database	Follow Up Database	Audit Database
PG&E	Large	39%	36%	7%	7%	409	697
	Medium	36%	33%	2%	2%	590	1,024
	Small	23%	20%	1%	0%	1,069	2,338
	Very Small	18%	13%	0%	0%	1,993	9,924
	Total	25%	17%	1%	1%	4,845	13,985
SCE	Large	0%	18%	0%	31%	0	937
	Medium	25%	22%	0%	4%	32	1,158
	Small	30%	20%	0%	0%	208	3,482
	Very Small	21%	11%	0%	0%	312	6,006
	Total	25%	16%	0%	3%	559	11,584
SDG&E	Large	8%	15%	15%	19%	26	59
	Medium	20%	19%	3%	3%	61	232
	Small	17%	14%	0%	0%	127	551
	Very Small	6%	3%	0%	0%	227	3,000
	Total	12%	6%	1%	0%	474	3,842
SCG	Large		14%		0%		170
	Medium		18%		0%		375
	Small		10%		0%		2,009
	Very Small		1%		0%		10,262
	Total		3%		0%		12,890
Total	Large	37%	24%	7%	19%	435	1,863
	Medium	34%	25%	2%	3%	683	2,789
	Small	24%	17%	0%	0%	1,404	8,380
	Very Small	17%	7%	0%	0%	2,532	29,192
	Total	24%	11%	1%	1%	5,878	42,301

## Concluding Remarks

The NRA program has substantial net impact, though it is focused in incented adoptions. The net impact of incented adoptions are excluded from NRA impact reporting to avoid double counting incented measures.

Medium and large companies generally found the audit to be more influential on their efficient equipment purchases (including both rebated and nonrebated measures).

Nonrebated measure adoptions with positive NRA net impact were scarcer among the medium and large companies than small/very small. This is likely a reflection of higher awareness rates among medium/large customers of available rebates, but also the need within this market segment for audit information to motivate efficient purchases.

The audit report has the greatest adoption response over the first year, both among small/very small and medium/large companies. However, the small/very small companies are quite likely to adopt within the first year, after which the effects wear off quickly. Larger companies adoption rates do not spike quite as high the first year, but remain more consistent over a period of about 3 years.

Follow up programs, usually consisting of a phone call from the IOU, have been successful in raising measure follow-through as indicated by rebate program participation. The effect is seen most strongly among the small and very small customer segments, though medium and large companies also exhibit a

positive response. Overall, participation in incentive programs is more than twice as high among those customers that received a follow up call versus those that simply had an Audit.

To correctly attribute utility programs net impacts, it behooves Evaluators to include measurement of both audit and rebate effects in measurements of net impact, or net to gross ratios. That is, as part of the assessment of *incentive* program net-impacts and net-to-gross ratios, provisions should be made for Audit program participants. For customers that had an Audit prior to incentive program participation, the net-to-gross ratio estimation should take into account effects of both programs.