Evaluation of the 2004-2005 Statewide Multifamily Rebate Program – Volume II (Appendices)

FINAL REPORT

Program 1118-04

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Tables

1. Appendix A - Methodology

1.1 Process and Market Assessment

1.1.1 Information Sources

Most of the findings for the market assessment and process evaluations came from five surveys of program and market participants. These included a survey of 106 2004 participating property managers/owners, 150 2005 participating property managers/owners, 40 non-participating property managers/owners, 28 participating contractors, and 17 nonparticipating contractors. Table 1-1 summarizes the key characteristics of these surveys. Copies of the survey instruments appear in Appendix B.

Table 1-1
Summary of Program/Market Participant Surveys
Used for Market Assessment and Process Evaluation

Survey Target Group	Time Period of Survey	Number of Completed Surveys	Survey Format
2004 participating property managers/ owners	August 2005	106	Computer-Assisted Telephone Interview (CATI)
Nonparticipating property managers/owners	July 2005	40	Computer-Assisted Telephone Interview (CATI)
2005 participating property managers/ owners	June 2006	150	Computer-Assisted Telephone Interview (CATI)
Participating contractors	May - July 2005	28	In-depth expert survey
Nonparticipating contractors	May - June 2006	17	In-depth expert survey

In addition to gathering information from these five surveys, the evaluation team also:

- Conducted a group interview with most of the Multifamily Rebate Program managers;
- Conducted additional interviews with the program managers and staff of each of the investor-owned utilities participating in the program;
- Reviewed the program documents provided by the utilities including program plans, application forms, tracking databases, and monthly reports;

- Reviewed the past two evaluations of the Multifamily Rebate Program (for program years 2002 and 2003), as well as the 2000 California Market Baseline Report[1]; and
- Leveraged multifamily market knowledge and insights gained from two other California multifamily programs – the Efficient Affordable Housing (EAH) program and the Partnership for Energy Affordability in Multi-Family Housing (Energy Action) – that KEMA is also evaluating.

1.1.2 Sampling Approach

The sampling plan for the survey of 2005 participating property managers/owners balanced two objectives. The first objective was to insure that there was adequate sample sizes for calculating program attribution factors for the program's three dominant energy-efficiency measures – compact fluorescent lamps (CFLs), programmable thermostats, and boiler controls. As noted, CFLs and programmable thermostats alone accounted for 88 percent of the kWh savings claimed by the program for 2004-2005. Boiler controls and programmable thermostats alone accounted for 87 percent of the 2004-2005 claimed therm savings. One limitation of the program attribution factors calculated from the survey of 2004 participating property managers was that the sample size for the boiler controls was very small (n = 10). The second sampling objective was to insure that the participating investor-owned utilities – PG&E, SCE, SCG, and SDG&E – were represented in the sample in a similar fashion as they were represented in the overall participant population.

To try to meet these two objectives we chose to stratify the sample by utility service territory and measure group[2], with each stratum having a target number of completed surveys. For all the utilities except for PG&E we were fairly successful at reaching our targets, as the table below shows. In the case of PG&E, where some of the strata had very small sample sizes, we did not reach our targets for boiler controls and programmable thermostats. In these cases, we instructed the surveyors to make up the missing sample points from other PG&E strata (CFLs, other measures).

[1] 2002 California Statewide Multifamily Program Evaluation, Prepared for San Diego Gas & Electric, Prepared By: Wirtshafter Associates, Inc., February 27, 2004; 2003 California Statewide Multifamily Program Evaluation, Prepared For: San Diego Gas & Electric, Prepared By: Wirtshafter Associates, Inc., March 18, 2005; Best Practices Benchmark for Energy Efficiency Programs, "Residential Multi-Family Comprehensive Report," Quantum Consulting, Inc. Final Report; Statewide Survey of Multi-family Common Area Building Owners Market, Volume I: Apartment Complexes, prepared by: ADM Associates, Inc. TecMRKT Works LLC. June 2000.

[2] The measure group label identifies the measure for which the participant was asked the program attribution sequence of questions. Some participants had multiple measures installed. In such cases, due to the length of the program attribution questions and concerns about respondent fatigue, they were only asked the program attribution questions for the measure that headlined their stratum. For example, participants in stratum 2 were only asked the program attribution questions about CFLs, even if they installed other measures.

Table 1-2
Summary of Sampling Strata Targets and Completes

Stratum	Utility	Group	Population		Targeted Surveys		Completed Surveys	
			Number	Percent	Number	Percent	Number	Percent
1	PGE	Boiler control	53	3%	9	6%	2	1%
2	PGE	CFL	253	15%	14	9%	22	15%
3	PGE	P-STAT	35	2%	14	9%	7	5%
4	PGE	OTHER	136	8%	8	5%	14	9%
5	SCE	CFL	350	21%	14	9%	15	10%
6	SCE	P-STAT	72	4%	14	9%	13	9%
7	SCE	OTHER	63	4%	8	5%	8	5%
8	SCG	Boiler control	54	3%	9	6%	9	6%
9	SCG	OTHER	197	12%	10	7%	10	7%
10	SCG	P-STAT	118	7%	14	9%	14	9%
11	SDGE	Boiler control	20	1%	9	6%	9	6%
12	SDGE	CFL	154	9%	10	7%	10	7%
13	SDGE	P-STAT	117	7%	11	7%	11	7%
14	SDGE	OTHER	21	1%	6	4%	6	4%
		Total	**1643**	**100%**	**150**	**100%**	**150**	**100%**

The following table shows how participants with the various utilities were represented in the sample and how this compared with their representation in the overall participant population. The survey responses from the 2005 participants that appear in this report were not weighted to account for these slight differences between representation in the sample and representation in the participant population.

Table 1-3
Distribution of Participating Property Managers/Owners by Utility
Population vs. Sample

Category	Population		Completed Surveys	
	Number	Percent	Number	Percent
PG&E	477	29%	45	30%
SCE	485	30%	36	24%
SCG	369	22%	33	22%
SDG&E	292	19%	27	24%

1.1.3 Program Attribution Methodology

This sections describes the methodology that KEMA used to calculate the program attribution factors (net-to-gross ratios) used in our impact analysis. We calculated per-measure program attribution using the following six steps:

1. Assessment of energy-efficient measure awareness

2. Initial assignment

3. Calculation of simple free ridership

4. Adjustment of free-ridership calculation

5. Delayed free-ridership calculation

6. Calculation of final program attribution

1.1.3.1 Step 1: Assessment of energy-efficient measure awareness

The first step in calculating program attribution was to determine whether the surveyed program participants were even aware of the rebated technology before having it installed through the program. If the participants had not been aware of the technology before participating in the program, they were skipped out of most the remaining program attribution questions, and the program was given full attribution for this/these implemented measure(s).

1.1.3.2 Step 2. Initial Assignment

All surveyed participants who said that they were previously aware of the -rebated technology were asked how likely they would have had the -rebated measure installed if the program had not provided rebates to them or their contractors or had not provided installation assistance. Based on their response to this question, they would be sent down two different paths:

1. If the participants said that it was "very unlikely" that that they would have installed the measures without the program, or if the likelihood question was not answered (don't know or refused), the program was given full attribution for this/these implemented measure(s) and the participants were skipped out of most of the remaining program attribution questions.

2. If the participants had responded to the likelihood question by saying that it was "very likely," "somewhat likely," or "not very likely," that they would have had the -rebated measure installed without the program, then they were asked additional questions in Step 3 to determine the simple free-ridership level

1.1.3.3 Step 3: Calculation of simple free ridership

KEMA asked an additional series of program attribution questions of participants who had previously been aware of the -rebated measure and indicated some likelihood of having this measure installed without the program's help. In this step, simple free ridership factor F was calculated as the fraction of savings that would have been implemented at some time without the Multifamily Rebate Program rebate. This fraction was calculated as the fraction of units that would have been implemented without the program rebate, times the fraction of the efficiency improvement (relative to a baseline) that would have been implemented without the program rebate. For some measures, incremental quantities or efficiency was not relevant. If only one of these fractions was meaningful, F equaled that fraction. If neither fraction

was meaningful or a question used to determine the relevant fractions was not answered (don't know or refused), simple free ridership was assigned based on the value of the likelihood question (see Table 1-6).

Thus, for cases where the survey provided information on the efficiency fraction and/or the quantity fraction,

$$F = \begin{cases} Q \times E, \text{ if both are meaningful} \\ Q, \text{ if Q is meaningful but E is not} \\ E, \text{ if E is meaningful but Q is not} \end{cases}$$

where

Q = the fraction of units (quantity) that would have been implemented without the program rebate

E = the fraction of efficiency improvement that would have been implemented without the program rebate

The program receives credit for the non-free-rider fraction. That is, the initial attribution from the simple free rider calculation is
$A_1 = 1- F$.

The efficiency fraction E was based on whether the efficiency would have been greater, the same, or less without the program rebate (Question z16). If the same or greater efficiency would have been implemented, the efficiency fraction was set at 100 percent. If lower efficiency would have been used, Question z17 probes what the efficiency would have been without the rebate. This qualitative response is then translated into a specific efficiency fraction as described in Table 1-4.

Table 1-4
Efficiency Fraction Assignments

Question/ Response	Efficiency Fraction E
Question z16. Without the rebates from the program, how different would the energy efficiency level of the <MEASURE TYPE> been? Would you say the efficiency would have been the… [same, lower, higher, don't know, refused]	
Greater or same	100%
Less	Value from z17
Question z17. How much lower ….? [READ LIST]	
Standard efficiency or according to code	10%
Slightly higher than standard efficiency	30%
About midway between standard and the high efficiency that was used	50%
Slightly lower than the high efficiency that was used	70%

The quantity fraction Q was based on a similar pair of questions (z18 and z19). If the same or a greater quantity would have been installed, the quantity fraction was 100%. If a smaller quantity would have been installed, the fraction was obtained from the follow-up question (z19). These assignments are summarized in Table 1-5.

Table 1-5
Quantity Fraction Assignments

Question/ Response	Quantity Fraction Q
Question z18. Without the rebates from the program, how different would the quantities of installations have been for the <MEASURE TYPE> you installed? Would you say the quantity would have been the…[READ LIST]	
Greater or same	100%
Less	Value from z19
Question z19. About what percentage of these <MEASURE TYPE> would your organization have installed without the rebates from the program?	
Value given	Value reported

Simple free ridership could not be calculated if neither E nor Q was meaningful, or if no answer (don't know or refused) was given for either the initial or follow-up question (z16 or z17; z18 or z19). For these cases, the simple free ridership was assigned based on the response to z13, on the likelihood that the measure would have been implemented without the program rebates. These assignments are indicated in Table 1-6.

Table 1-6
Simple Free Ridership Assignment
if Not Based on Efficiency and Quantity Fractions

Reason F can't be calculated from E and Q	Question z13. If <UTILITY NAME>'s multifamily rebate program had not paid the rebates to your company or your installation contractor in 2005, how likely would it have installed the <MEASURE TYPE>? Would you say that the likelihood would have been…				
	Very Likely	Somewhat Likely	Not Very Likely	Very Unlikely	Don't Know/ Refused
Both E (z16, z17) and Q (z18, z19) are inapplicable	90%	50%	10%	F not calculated, program attribution = 100%	
One or more of z16, z17, z18, z19 = don't know or refused	75%	50%	10%		

1.1.3.4 Step 4: Adjustment of free-ridership calculation

Participant assessments of their likelihood of implementing the -rebated measures without the program might be overstated or understated for various reasons. Some participants might overstate the true likelihood because they wish to appear more proactive about energy efficiency than they actually are.

Some participants might understate this true likelihood because they think that the evaluation surveyor is with the program and they want to please the surveyor by giving the program more attribution than it deserves. KEMA's methodology tried to adjust for these possible biases by incorporating information concerning the participant's pre-program experience with similar energy-efficiency measures and the program's assistance in overcoming key barriers.

1. *Previous experience installing the measure* - If the participants said that they had previously installed a similar energy-efficient measure in one of their properties, then their simple free-ridership factor (F), as calculated in Step 3, then 25 percent was added to this factor. If the participant said that they had not previously installed a similar energy-efficient measure in one of their properties, then 25 percent was subtracted from this factor.

2. *Program assistance in overcoming key barriers* – The evaluations of the program have found that two of the most significant barriers to energy efficiency implementation in the multifamily sector are the inability to identify energy efficiency opportunities and the lack of maintenance staff and installation expertise. If the participant said that the program had helped them identify energy efficiency opportunities then 10 percent was subtracted from the simple free-ridership factor (F). If the participant said that the program had helped them with the installation, then an additional 10 percent was subtracted from this factor.

These adjustments resulted in an adjusted free-ridership factor (AF). This factor AF was further adjusted so that it was not less than 0 percent or greater than 100 percent. The initial estimate of program attribution (A_1) was calculated as 1 – AF.

1.1.3.5 Step 5: Delayed free-ridership calculation

In addition to affecting the quantity and efficiency of the installed measures, the program can affect the timing of these measures. For example, the program rebates or the availability of an installation contractor may cause a planned energy efficiency project to occur more quickly than it otherwise would have. Therefore the program was given credit for a portion of the adjusted free ridership savings based on the amount of time that the program accelerated implementation. The credit given to the program for the accelerated savings was calculated as

$A_2 = (m^*/48) * AF$

where

$m^* = \min(m, 48)$

m = number of months by which the program rebate accelerated the implementation.

A pair of questions determined whether the project timing have been earlier, the same, or later (z14) without the program; and if later, how many months later (z15). If the measure would have been installed at the same time or earlier, then number of months (m) was set at 0. If a respondent did not answer (don't know or refusal) either of the timing questions, the number of months by which the program rebate accelerated the implementation was set at 48.

1.1.3.6 Step 6: Calculation of final program attribution

The final program attribution factor for the measure was calculated as the sum of the initial estimate of program attribution (A_1) plus the credit for accelerated savings (A_2). Thus, the total fraction of savings attributed to the program rebate was calculated as:

$A = A_1 + A_2$

= (1-AF) + (m*/48) AF.

1.2 Impact Evaluation

Below, we describe methods used to evaluate the gross impacts of all measures except boiler controls, which are discussed in Appendix D.

1.2.1 Sample Design

This section describes the onsite survey sample design. The onsite survey collected both verification and measurement data to inform the impact evaluation.

1.2.1.1 Sample Frame

The site visits were conducted in two phases. Phase 1, implemented during the summer of 2005, addressed measures implemented during the 2004 program year. The source of the sample frame for Phase 1 was the utility tracking databases provided by PG&E, SCE, and the Sempra utilities for the 2004 program year and for Phase 2 was the equivalent databases for the 2005 program year. The sample unit is a participating multi-family property site.

1.2.1.1.1 Phase 1

According to utility tracking data obtained during sampling[3], a total of 1,422 sites were visited in 2004 and 2 million therms and 36 million kWh were saved. Table 1-7 shows the energy savings contribution to the 2004 program savings by measure based on utility tracking data, including kWh savings, therm savings, and percentage of kWh and therm savings. The final column shows the percentage of total energy savings that each measure contributed. (This percentage of "energy value" was calculated by combining converting kWh and therms to Btu) The majority of the energy savings is attributed to compact fluorescent lamps (CFLs), programmable thermostats (p-stats), and boiler control measures. All other measures combined account for less than 7 percent of the program's energy savings.

[3] Which typically does not match up exactly with the "frozen" data upon which ex ante estimates are based.

Table 1-7
2004 Program Savings Claims by Measure

Measure	# Sites with Measure	Total kWh	% of kWh	Total therms	% of therms	% of total energy savings
Boiler	82	-	0%	105,599	5%	3%
Boiler Controller	183	-	0%	693,815	32%	20%
Central AC/HP	6	40,276	0%	-	0%	0%
CFLs	511	21,419,314	59%	-	0%	21%
Clothes Washer	80	5,506	0%	5,246	0%	0%
Dishwasher	75	11,400	0%	5,264	0%	0%
Faucet aerator	11	16,816	0%	4,845	0%	0%
Furnace	4	-	0%	7,591	0%	0%
Insulation/Ductwork	42	463,274	1%	17,949	1%	1%
Pool pump	4	5,045	0%	-	0%	0%
P-stat	347	11,908,215	33%	1,250,744	58%	49%
Room AC/HP	23	19,541	0%	-	0%	0%
Shower Head	17	29,678	0%	9,555	0%	0%
T8s/Exit signs/ Delamping	76	1,948,734	5%	-	0%	2%
Water Heater	148	-	0%	39,477	2%	1%
Windows	55	323,731	1%	34,238	2%	1%
Total	**1,422**	**36,191,530**	**100%**	**2,174,324**	**100%**	**100%**

Table 1-8 shows the breakdown of sites by utility and Table 1-9 the breakdown of energy savings by utility. The utilities treated between 250 and 500 sites each in 2004 and contributed about equally to statewide kWh savings, while SCG and PG&E contributed nearly 40 percent each to statewide therm savings. The final column of Table 1-9 shows the percentage of total energy savings each utility contributed.

Table 1-8
2004 Sites by Utility

Utility	Total Sites	% of Sites
PG&E	304	21%
SCE	282	20%
SCG	496	35%
SDG&E	340	24%
Total	**1,422**	**100%**

Table 1-9
2004 Net Energy Savings by Utility

Utility	Total KWh Savings	% KWh Savings	Total Therm Savings	% Therm Savings	% Total Energy Savings
PG&E	8,095,270	22%	822,622	38%	31%
SCE	10,548,505	29%	-	0%	13%
SCG	7,484,177	21%	916,954	42%	32%
SDG&E	10,063,578	28%	434,748	20%	24%
Total	**36,191,530**	**100%**	**2,174,324**	**100%**	**100%**

1.2.1.1.2 Phase 2

The Phase 2 sample frame was the 2004 and 2005 program tracking data. According to utility tracking data obtained during sampling, a total of 2 million therms and 68 million kWh were saved in 2005. Table 1-10 shows the energy savings contribution to the 2005 program savings by based on utility tracking data, including kWh savings, therm savings, and percentage of kWh and therm savings. The final column shows the percentage of total energy savings that each measure contributed.

Table 1-10
2005 Net Energy Savings by Utility

Utility	Total KWh Savings	% KWh Savings	Total Therm Savings	% Therm Savings	% Total Energy Savings
PG&E	13,392,840	20%	763,961	37%	28%
SCE	34,708,351	51%	-	-	27%
SCG	7,823,041	11%	961,285	47%	28%
SDG&E	12,231,625	18%	335,637	16%	17%
Total	**68,155,857**	**100%**	**2,060,883**	**100%**	**100%**

1.2.1.2 Sample Design

A total of 216 on-site visits were conducted during the course of two phases. During Phase 1, 96 sites were visited with 2004 program participants. During Phase 2, 15 and 105 sites were visited with 2004 and 2005 program participants, respectively.

1.2.1.2.1 Phase 1

The Phase 1 on-site survey sample was stratified by utility, measure category, and the level of energy savings achieved per site. The main reason for stratifying the sample was to maximize the precision of the analysis results at minimum cost. A secondary reason was to ensure a minimum sample size for important strata.

Utility. Since each utility has varying inspection levels and covers different climate zones, we wanted to ensure that impact results could be reported at the utility level.

Measure Category. The sample was stratified by measure category for efficiency, since the variation in energy savings is smaller across sites with the same measure installed versus sites with different measures installed.

Since some sites received two or more different measures (e.g., CFLs and programmable thermostats), we had to assign each site a measure category based on the mix of measures installed. P-stat sites were given first priority because they were responsible for almost half of the program's energy savings. Secondary consideration was given to CFLs, then to boiler controls. The rest of the measures were combined into one "other" category because they resulted in such a small fraction of the program's energy savings.

Size. The level of energy savings per site was factored into the sample design. Sites with a higher level of energy savings contribution have a higher likelihood of being selected into the sample because (1) the variance of energy savings is higher for large sites and (2) more measures and energy savings may be verified and measured at one large site versus several small sites. The size variable was assigned to each utility-measure category combination using Delanius Hodges stratification design.

1.2.1.2.2 Phase 2

Lessons learned from the Phase 1 onsite results were applied to the Phase 2 sample design. We addressed the following critical questions with regard to sampling:

- What aspects of the sample contributed most to variation in phase one results?
- What is the appropriate sample unit (e.g., tenant unit or multi-family complex)?
- What level of sampling precision was achieved with the 2004 sample?
- Did results differ significantly by IOU service territory? If so, what level of precision was achieved for each IOU?

These questions were asked of each measure category: CFLs, p-stats, and "other". CFLs were found to produce the most variation across sites and not across tenant units, making the key sample unit for CFLs the entire multifamily site. There were no statistically significant differences in savings by IOU service territory. The 90 percent confidence interval around the Phase 1 results of 39 kWh was +/- 3.8 kWh using data from 36 sites. To achieve at least this level of precision and balance between program years, 36 sites (all from 2005 program year) were chosen as the CFL sample size for the Phase 2 onsite evaluation.

P-stats, on the other hand, showed the most variation between tenant units and not across sites; therefore, the relevant sample unit for p-stats is the tenant unit. The realization rate for the 2004 sample (using data from 350 units) was estimated at 40 percent, with 90 percent confidence intervals of +/- 4 percent. The difference in this result across IOUs was statistically significant. Therefore, to increase precision levels associated with IOU-specific savings estimates, the sample plan for Phase 2 was set at 200 tenant units per utility, or 800 units statewide. The total sample (1150 units statewide) was allocated across program years to achieve a balance, resulting in additional 2004 program sites included in the Phase 2 site visits.

Data for the "other" measure category consisted only of installation verification and program qualification. Phase 1 results showed a 100% installation rate, therefore there was no variation.

Therefore, to achieve a balance of sites across program years, the Phase 2 sample design for "other" measures was set at 25 sites. Table 1-11 summarizes the overall program sample plan at the beginning of Phase 2.

Table 1-11
Overall Sample Design Developed at the Beginning of Phase 2

Phase	Phase 1 - Completed		Phase 2 - Planned		Total - Expected	
Program Year	2004		2004	2005		
Measure Category	Sample Size	Precision	Sample Size		Sample Size	Precision
CFLs	36 sites	+/- 3.8 kWh	0	36 sites	72 sites	+/- 2.7 kWh
P-stats	349 units (34 sites)	+/- 4%	112 units (15 sites)	339 units (44 sites)	800 units (93 sites)	+/- 3%
Other	25 sites	+/- 0%	0	25 sites	50 sites	+/- 0%
Total	**96 sites**		**15 sites**	**105 sites**	**216 sites**	

The Phase 2 sample was stratified by utility and measure category only. There was no oversampling for larger sites. Due to recruitment problems in Phase 1, discussed in greater detail in later sections, the Phase 2 sample was grouped by geographical region. However, there was no additional stratification associated with the geographical groupings.

1.2.1.3 Sample Allocation

1.2.1.3.1 Phase 1

Table 1-12 shows the sample allocation for 2004 participants. The sample was allocated using three different methods and then taking the average of the results. Each allocation used the Neyman allocation method, which optimally allocates the sample by using each stratum's variance and the total number of sites to maximize precision while minimizing the sample points. First, we allocated 200 sites across the strata. Second, we allocated sample to strata by utility with 50 sites given to each utility. Third, we allocated sample to sites across measure categories based on their proportional contribution to total energy savings. All three methods resulted in a very similar allocation because the total number of sites and the variance in energy savings are similar across the utilities and are proportional to each measure category's contribution to total energy savings.

Table 1-12
2004 On-Site Survey Sample Design

Utility	Measure Category	Size	# Sites-Total	# Sites-Sample	Total Energy Value	Mean Energy Value Per Site	Std Dev Energy Value
PG&E	Boiler control	HIGH	12	5	3,042,788	253,566	108,463
		LOW	39	4	1,541,523	39,526	24,671
	CFLs	HIGH	28	4	2,768,372	98,870	37,875
		LOW	79	5	1,599,784	20,250	14,048
	Other	HIGH	2	2	869,225	434,612	327,663
		LOW	58	6	923,180	15,917	22,192
	P-stat	HIGH	22	12	7,750,551	352,298	147,466
		LOW	64	14	6,052,280	94,567	55,873
SCE	CFLs	HIGH	5	5	2,294,655	458,931	267,848
		LOW	220	30	6,552,607	29,785	38,281
	Other	HIGH	2	2	42,924	21,462	15,754
		LOW	20	2	20,698	1,035	636
	P-stat	HIGH	5	2	924,018	184,804	96,910
		LOW	30	3	713,602	23,787	21,280
SCG	Boiler control	HIGH	4	2	731,580	182,895	123,197
		LOW	75	6	2,520,444	33,606	21,020
	Other	HIGH	23	2	902,528	39,240	17,991
		LOW	238	5	1,351,483	5,679	4,579
	P-stat	HIGH	36	17	10,974,611	304,850	124,611
		LOW	120	23	9,342,619	77,855	50,442
SDG&E	Boiler control	HIGH	7	7	2,981,927	425,990	251,556
		LOW	42	9	2,903,257	69,125	53,886
	CFLs	HIGH	34	9	4,990,824	146,789	60,954
		LOW	95	10	2,839,892	29,894	21,921
	Other	HIGH	3	2	120,898	40,299	12,978
		LOW	89	2	120,954	1,359	1,608
	P-stat	HIGH	26	7	3,394,857	130,571	61,511
		LOW	44	3	1,405,919	31,953	16,817
Total			**1,422**	**200**	**79,678,001**	**3,549,515**	

Table 1-13 shows the total sites, the number of sample sites allocated, and the percentage of total sites that the sample represents by utility. Overall, the sample of 200 sites represents 14 percent of the 1,422 sites that were treated by the program in 2004.

Table 1-13
Total and Percentage of Sites Included in the Sample by Utility

Utility	Total Sites Treated in 2004	Sites Included in Sample	% Total Sites in Sample
PG&E	304	52	17%
SCE	282	44	16%
SCG	496	55	11%
SDG&E	340	49	14%
Total	**1,422**	**200**	**14%**

Table 1-14 shows the total kWh savings claimed in 2004, the claimed kWh savings for the sites included in the sample, and the percentage of total kWh savings that the sample will be measuring and verifying by measure category. Overall, the sample represents 29 percent of the program's kWh savings in 2004.

Table 1-14
Total and Percentage of KWh Included in the Sample by Measure Category

Measure Category	Total KWh Claimed in 2004	KWh Included in Sample	% Total KWh in Sample
P-stats	11,908,215	4,033,644	34%
Lighting	23,368,047	6,022,689	26%
Boiler controls	-	-	-
Other	915,268	342,673	37%
Total	**36,191,530**	**10,399,007**	**29%**

Table 1-15 shows the total therm savings claimed in 2004, the claimed therm savings for the sites included in the sample, and the percentage of total therm savings that the sample will be measuring and verifying by measure category. Overall, the sample represents 37 percent of the program's therm savings in 2004.

Table 1-15
Total and Percentage of Therms Included in the Sample by Measure Category

Measure Category	Total Therms Claimed in 2004	Therms Included in Sample	% Total Therms in Sample
P-stats	1,250,744	458,877	37%
Lighting	-	-	-
Boiler controls	693,815	300,410	43%
Other	229,765	46,893	20%
Total	**2,174,324**	**806,179**	**37%**

Table 1-16 shows the percentage of total sites, measures installed, kWh and therms that are included in the sample by measure. For example, the sample included 18 percent of sites treated with boiler controls in the 2004 program year, representing 43 percent of all boiler controls installed by the program and 43 percent of the therm savings associated with all boiler controls installed by the program.

Table 1-16
Percentage of Sites, Measures, KWh and Therms Included in the Sample by Measure

Measure	Sites	Measures	Total therms	Total kwh
Boiler	6%	14%	19%	-
Boiler Controller	18%	43%	43%	-
Central AC/HP	-	-	-	-
CFLs	15%	-	-	27%
Clothes Washer	4%	4%	4%	6%
Dishwasher	3%	1%	1%	0%
Faucet aerator	9%	3%	3%	3%
Furnace	-	-	0%	-
Insulation/Ductwork	17%	3%	6%	27%
Pool pump	-	-	-	-
P-stat	23%	33%	37%	34%
Room AC/HP	9%	10%	-	46%
Shower Head	18%	1%	1%	1%
T8s/Exit signs/ Delamping	13%	10%	-	8%
Water Heater	3%	2%	5%	-
Windows	11%	64%	68%	64%
Total	**14%**		**29%**	**37%**

1.2.1.3.2 Phase 2

As mentioned above, the Phase 2 sample was grouped geographically, though it was only stratified by measure category and, in the case of p-stats, by utility and program year. A proportional analysis was used to assign the sites within geographical group, or cluster. Table 1-17 shows the targeted number of completes for each strata and cluster.

Table 1-17

Allocation of Completes Across Strata and Geographical Cluster

Measure Category	Cluster Name	Target Completes
CFL	East Bay	5
	Fresno	5
	Los Angeles	16
	San Diego	10
	Strata Total	**36**
Other	South Bay	3
	East Bay	4
	San Francisco	3
	Fresno	2
	Los Angeles	9
	San Diego	4
	Strata Total	**25**
PG&E 2005 P-stat	Sacramento	4
	Stockton	2
	Fresno	2
	South Bay	1
	Strata Total	**9**
SCE 2005 P-stat	San Bernardino	3
	Los Angeles	5
	Palm Springs	1
	North Los Angeles	1
	Inland Los Angeles	3
	Strata Total	**13**
SCE 2004 P-stat	San Bernardino	5
	Palm Springs	2
	Orange County	1
	Strata Total	**8**
SDG&E 2005 P-stat	South San Diego	9
	North San Diego	4
	Strata Total	13
SDG&E 2004 P-stat	South San Diego	4
	North San Diego	3
	Strata Total	**7**
SCG 2005 P-stat	Palm Springs	1
	Inland Los Angeles	3
	North Los Angeles	2
	Los Angeles	3
	Strata Total	**9**
Phase 2 Total		**120**

A sample was not actually pulled for each cluster. Instead, all of the sites within the cluster were available for completion. As a result, the 3 of sites in the sample is equal to the # of sites in the strata. The same is true for the kWh, kW, and therms savings. Therefore, the 'sample' represents 100% of the program-reported savings in each strata. Of course, the final completes will represent only a portion of the program savings, but the actual portion was not known until the site surveys were complete. More on the cluster sample and its effect on the site surveys will be discussed later. Table 1-18 shows the distribution of savings across the 8 strata.

Table 1-18
Total and Percentage of Program-Reported Savings Included in Onsite Sample by Broad Measure Category

Measure Category	# Sites in Sample	Program-Reported Savings*			% of Total Savings
		Energy (kWh)	Demand (kW)	Gas (therms)	
All programmable thermostats	10	232,695	45.16	41,520	48%
Boilers but no thermostats	14	36,492	4.41	17,695	18%
Lighting only	23	1,018,959	209.5	0	34%
Total	**47**	**1,288,146**	**259.07**	**59,215**	**100%**

* Note that the sample design was based on preliminary program results that differ from the final ex ante values reported in this document.

1.2.2 Site Visit Protocol

We completed 96 site visits during the Phase 1 portion of the evaluation and 120 site visits during the phase two portion of the evaluation. Again, lessons learned from Phase 1 were applied to the Phase 2 site visit protocol.

1.2.2.1 Phase 1

Although sites were stratified based on measure installed, once on site the auditor verified all measures that the site received and not only those for which the site was selected. For example, if a site was chosen for the p-stat strata, but also installed washers and CFLs, then data was collected for all three measures and not only the p-stats. Verification procedures differed slightly in tenant spaces versus common areas.

1.2.2.1.1 Tenant spaces

For measures installed in tenant space, we verified installation in according to the plan showed in Table 1-19.

Table 1-19
Installation Verification Protocol

Building Size	Protocol
< 5 units	Attempt surveys in all units
5 to 20 units	Attempt surveys in 25% of units
More than 20 units	Approach 25%, no more than 20 units. Attempt from every other floor.
Multiple buildings	Approach 25%, no more than 20 units. Attempt from every other building, every other floor.

Once arriving onsite, auditors worked with the property manager to determine the best way to access the tenant space. In most cases, this was a random door-to-door solicitation. Auditors adhered to the following measure-specific protocols for CFLs and programmable thermostats.

CFLs. Onsite data collection focused on verification that the CFLs were installed, determining the delta watts per fixture, and the space type in which the CFLs were installed. When sub-sampling was required, the sample represented the same variation of spaces as indicated for the site on the application.[4]

Programmable thermostats. P-stat information was obtained using a tiered approach. The main objective was to determine the behavioral change of the tenant since the installation of the p-stat. Based on a literature review of previous studies[5] on p-stat impacts we believed that a significant portion of tenants would not be utilizing the automatic setback and set forward features of the thermostat. The on-site data collection focus was to answer the following questions in order:

- Is the thermostat being used in a different fashion than the previous manual thermostat?
- If the programmable features are being utilized, what are the current settings?
- Are the settings modified seasonally?
- What was the thermostat behavior prior to the installation of the p-stat?

We determined by visual inspection the current thermostat settings and interviewed the tenant as to whether or not the thermostat was being used to set back or forward temperatures based on time of day periods. If the programming features of the thermostat were not being utilized, the tenant was interviewed to determine if the usage patterns had changed since the installation of the new thermostat. For those whose operation had not changed the baseline and current operation was recorded as no change.

[4] Each applicant is required to complete the *Apartment Products Locations Form.* This form indicates the space location of the installed product, i.e. Kitchen, Bath, Bedroom, etc.
[5] Paul Reeves, Jeff Hirsch. *Programmable Thermostats Installed into Residential Buildings: Predicting Energy Savings Using Occupant Behavior & Simulation. Draft* . October 26, 2004. Southern California Edison.

Southern California Edison Company, *California Statewide Residential Contractor Program Energy and Market Impact Assessment Study*, Study ID #SW058, October 2002.

California Energy Commission. California Statewide Residential Appliance Saturation Study. June 2004.

If the tenant utilized the programming features of the thermostat, the current settings were recorded. The tenant was then interviewed to determine if the settings were modified seasonally. We interviewed the tenant to determine what their thermostat behavior was prior to the installation of the programmable thermostat.

While on-site we also collected data to characterize the space and equipment. Data included:

- Type, size, and age of the air conditioning unit
- Wall, floor, and roof U-value and area
- Window and door area and u-values
- Infiltration level
- Vintage of the building
- Climate zone

1.2.2.1.2 Common areas

In common areas, auditors attempted to verify every fixture or unit that was installed at each property. Auditors adhered to the measure-specific protocols for common spaces below.

CFLs. We leveraged information available from the California CFL Metering Study[6]. This study included almost 400 sites and nearly 1,000 CFLs with monitoring of each CFL covering 6 months and up to 1 year. While multi-family homes make up less than one-quarter of the sample, the study concluded that differences in usage of compact fluorescent lamps (CFLs) in single-family and multi-family homes are not statistically significant. The study found that the variation in hours of use was most significantly related to the space type.

We assumed that participating multi-family properties are no different from the population of multi-family properties with regard to lighting usage. As such, the CFL Metering Study results may be assumed to be representative of residential lighting usage in general, and may be applied to this evaluation. Therefore, onsite data collection focused on verification that the CFLs were installed, determining the delta watts per fixture, and the space type in which the CFLs were installed.

Programmable thermostats. For thermostats, the auditor used the same method as with tenant spaces, but surveyed the site contact instead of a tenant.

1.2.2.1.3 Onsite Difficulties

Several issues were encountered in attempting onsite visits during Phase 1, ranging from recruitment to scheduling the site visits, to completing the surveys.

The first step in our approach of site recruitment was to send letters to the appropriate contact names provided on the rebate applications and follow up with a phone call. Major hurdles to initial contact included a high percentage of ownership changes of property, contacts not residing on site, and invalid

[6] KEMA, Inc., 2005. "CFL Metering Study: Final Report." Prepared for Pacific Gas & Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company. February 2005.

contact information. Many letters were returned and many phone numbers were no longer in service. Further investigation was often required to obtain current, accurate contact information. Many sites required an initial visit in order to contact the new owner or property manager, explain the rebate program and follow-up study, and attempt to schedule a site visit.

Once on site, surveyors experienced another set of issues in the attempt to obtain useful data. Apartment tenants, being the least aware of the program, were understandably hesitant to allow access inside the units. High turnover rates made gathering respondent-reported previous usage information difficult, as did the occasional language barrier. At some sites we encountered a language barrier at nearly all the attempted units.

To further complicate the collection of quality data, a lack of installation information regarding room type by unit made it difficult for surveyors to know exactly where to look for CFLs installed under the program and record a reliable verification ratio. It was also difficult to determine exactly which lamps were installed under the program and, of those, which had been replaced.

Adjustments were made to the Phase 2 onsite protocol in response to these difficulties.

1.2.2.2 Phase 2

Again, once on site the auditor verified all measures that the site received and not only those for which the site was selected. Verification procedures again differed slightly in tenant spaces versus common areas but were changed from Phase 1. The Phase 1 results showed that CFLs produced the most variation across sites and not across tenant units, making the key sample unit for CFLs the entire multifamily site. Therefore, the number of tenant units sampled for CFLs was reduced for each participating site.

1.2.2.2.1 Tenant spaces

For programmable thermostats installed in tenant space, we verified installation in accordance to the plan shown in Table 1-12 of the Phase 1 onsite protocol. For CFLs, we attempted 5 units at every site, regardless of the number of units at the site.

Once arriving onsite, auditors worked with the property manager to determine the best way to access the tenant space. In most cases, this was a random door-to-door solicitation. During the Phase 2 onsite portion, auditors collected analysis information for all lighting measures, not just CFLs. Additional information was collected regarding control types and settings. Auditors adhered to the following measure-specific protocols for CFLs; T5 and T8 lighting; and programmable thermostats.

CFLs. For CFLs, the auditor verified the installation of each bulb and visually determined the installed wattage. If the auditor could not easily visually determine the wattage, the site contact was asked to provide this information. The auditor also visually determined the room type in which each CFL was installed (e.g., living room, kitchen). The previous (incandescent) lamp wattage was determined by asking the tenant or site contact to indicate the previous wattage. If s/he could not provide reliable data, we used standard CFL/incandescent replacement wattage tables to determine the most likely incandescent

wattage.[7] The auditor also recorded the control mechanism for the lamp. The same process was repeated for every compact fluorescent lamp or fixture installed in the tenant space.

T8 and T5 lighting. For T8s and T5s, auditors verified the installation of each fixture and visually determined the length of bulb and number of bulbs installed in the fixture. The auditor asked the site contact what kind of ballast (electronic or magnetic) was installed in the new fixtures. S/he also asked about the lamp length, number of bulbs per fixture, ballast type, and number of fixtures that were replaced. The room location and control mechanism were recorded for each fixture.

Programmable thermostats. For thermostats, the auditor completed a survey with each tenant. The survey differed from Phase 1. The survey asked:

- Is the thermostat currently installed?
- Is it programmed?
- Did the tenant have a thermostat before the new one was installed?
- Does the tenant override the program more than once per week?

Based on the answers to these questions, the survey was either terminated or the tenants were asked to complete a battery of questions meant to determine the change in their HVAC control behavior that resulted from the installation of the thermostat (see the survey in Appendix B for details). Current thermostat settings were recorded for every apartment that received a survey.

1.2.2.2.2 Common areas

In common areas, auditors attempted to verify every fixture or unit that was installed at each property. We also asked the site contact or property manager (by phone) to identify who initiated the project (contractor, property manager, maintenance staff, or tenant); whether the building was individually- or master-metered; the fuel used for water heaters, space heating, and cooling; and which of those systems were central. Auditors adhered to the measure-specific protocols for common spaces below.

CFLs. For CFLs, the auditor verified the installation of each bulb and visually determined or asked the site contact about the installed wattage. The previous (incandescent) lamp wattage was determined by asking the site contact. If s/he could not provide reliable data, we used standard CFL/incandescent replacement wattage tables to determine the most likely incandescent wattage.[8] Auditors also recorded the control mechanism for the lamp and asked the site contact to identify daily operating hours.

T8 and T5 lighting. For T8s and T5s, auditors verified fixture installation and visually determined the length of bulb and number of bulbs installed in each fixture. The auditor asked the site contact what kind of ballast (electronic or magnetic) was installed in the new fixtures. S/he also asked about the lamp length, number of bulbs per fixture, ballast type, and number of fixtures that were replaced. Auditors also recorded the control mechanism for the fixture and asked the site contact to identify daily operating hours.

[7] Alternative Energy Systems Consulting, Inc. , 2000. "California's 2000 Small Business Standard Performance Contract Procedures Manual, Revision 2.1." Prepared for Pacific Gas & Electric Company, San Diego Gas & Electric, and Southern California Edison. September 22, 2000.
[8] Alternative Energy Systems Consulting, Inc. , 2000. Ibid.

Programmable thermostats. For thermostats, the auditor used the same method as with tenant spaces, but surveyed the site contact instead of a tenant.

Exit signs. For exit signs, auditors verified fixture installation and asked the site contact to verify the new lamp type and fixture wattage. S/he also asked about the previous number of lamps per sign, the lamp type, and the previous lamp wattage.

Other measures. For other measures, auditors verified installation and measure qualification.

1.2.2.2.3 Adjustments to Phase 1 Approach

The Phase 2 onsite implementation was adjusted in an attempt to alleviate the problems encountered during Phase 1. The sample design was altered from a more traditional format (pull a sample, randomize the order, call to recruit) to a geographically clustered format. As discussed above, the targeted number of completes for the individual strata were proportionally allocated to geographical clusters. The entire population of sites qualifying for that strata made the 'sample'. Auditors canvassed sites in the population until the targeted number of completes was met for that strata and cluster. This alleviated many of the difficulties discovered during Phase 1, including the high percentage of ownership changes of property, contacts not residing on site, and invalid contact information.

We employed one Spanish-speaking auditor and provided the rest of the auditors with a letter in Spanish explaining the auditor's purpose and requesting access to tenant space to verify equipment installation. At non-Spanish or -English speaking properties, we asked the onsite property manager to write a similar letter to tenants explaining our purpose and validating our request to enter the space. This did not alleviate the language barriers, especially when trying to ask about previous conditions, but it did improve communication.

Finally, we requested unit-level information from all 4 IOU's and provided that information to the auditor. With that information, the auditor could identify exactly how many CFLs were installed in each unit and in which rooms they were installed. This made the identification and verification process much easier.

We expected the Phase 2 canvassing approach to improve our completion rate (# sites completed per # of sites attempted) but were successful above our expectations. We were able to accomplish a completion rate of 85%, making the Phase 2 approach much more efficient and cost-effective.

1.2.3 Analysis Methods

1.2.3.1 CFLs

The energy savings per installed lamp were calculated as the sum of the product of the delta watts and the average hours per year applicable to the space type or determined from the onsite contact. The average hours by space type determined by the CFL Metering Study[9] are shown in Table 1-20 below.

[9] KEMA, Inc., 2005. "CFL Metering Study: Final Report." Prepared for Pacific Gas & Electric Company, San Diego Gas & Electric Company, and Southern California Edison Company. February 2005.

Table 1-20
CFL Hours of Use Per Day by Room Type

Location	Average # Hours/Day
Bedroom	1.6
Bathroom	1.5
Family room	2.5
Garage	2.5
Halls/entry	1.6
Kitchen	3.5
Living room	3.3
Laundry room	1.2
Other room	1.9
Outdoor	3.1
Overall Average	**2.3**

The effective useful life (EUL), as published in the Commission's Energy Efficiency Policy Manual[10], was used for calculating the program's lifecycle savings. This approach adheres to Option A of the International Program Monitoring and Verification Protocol (IPMVP).[11]

We divided the CFL data into two categories: tenant space and common space.

- **Tenant space.** The data recorded at the site for the tenant space was compared to the unit-level information provided by each utility. The number of lamps or fixtures verified was compared to the number of lamps or fixtures claimed and used to determine an installation rate for the unit. Data from all of the units at a particular site was combined to provide an installation rate for that site. Given the CFL watts recorded or verified on site, the previous watts verified on site, and the operating hours for the location of the lamps (by recorded room location), we were able to calculate the unit kWh and compare that to the utility-provided unit information for the tenant space to determine a realization rate.
- **Common areas.** Site-level data for common areas was generally population data – we verified all of the bulbs installed in common areas (installed wattage) and asked site contacts to identify previous bulb wattage and operating hours. Given that data, we were able to calculate the kWh for common areas for each measure.

[10] California Public Utilities Commission, 2003. "Energy Efficiency Policy Manual, Version 2." August 2003.
[11] International Program Monitoring and Verification Protocol Committee, 2005. "International Program Monitoring and Verification Protocol: Concepts and Options for Determining Energy and Water Savings, Volume 1." March 2002. DOE/GO-102002-1554.

1.2.3.2 T8s

The energy savings per installed T8 fixture were calculated as the sum of the product of the delta watts and the average hours per year applicable to the space type. The hours of use by space type are found in Table 1-14 above.

The effective useful life (EUL), as published in the CPUC Energy Efficiency Policy Manual[12], was used for calculating the program's lifecycle savings. This approach adheres to Option A of the IPMVP.[13]

We again divided the data into tenant space and common space and adhered to the following protocols:

- **Tenant space.** The data recorded at the site for the tenant space was compared to the unit-level information provided by each utility. The number of lamps or fixtures verified was compared to the number of lamps or fixtures claimed and used to determine an installation rate for the unit. Data from all of the units at a particular site was combined to provide an installation rate for that site. The delta watts for each measure were determined using fixture wattages for a standard T8 and standard T12 fixture from the SPC program wattage tables.[14] Given the delta watts and the operating hours for the location of the lamps (by recorded room location), we were able to calculate the unit kWh and compare that to the utility-provided unit information for the tenant space to determine a realization rate.
- **Common areas.** The data recorded at the site for the common area was generally population data – we verified all of the fixtures installed in the common area and asked site contacts to identify fixture operating hours. Given the delta watts for each fixture (determined using the SPC program wattage tables) and the reported operating hours, we calculated kWh savings for the common areas for each measure.

1.2.3.3 Exit signs

The energy savings per installed exit sign were calculated as the sum of the product of the delta watts and the total number of hours in the year (8,760 hr/yr). Exit signs were only found in common areas and thus the entire population of signs at a given site was verified. Given the delta watts for each fixture determined from information gathered from the site contact, we calculated kWh savings for each site.

1.2.3.4 Programmable thermostats

The analysis method for programmable thermostats differed between Phase 1 and Phase 2. During Phase 1, each sample point was categorized as "changed behavior", "no change", or "not installed" based on the data collected on site. For the units where there is no change in behavior or the p-stats we not installed we assumed that there are no impacts. Savings for the interim report were determined by multiplying the percent of p-stats used by the ex ante savings by utility.

[12] California Public Utilities Commission, 2003. Ibid.
[13] International Program Monitoring and Verification Protocol Committee, 2005. Ibid.
[14] Alternative Energy Systems Consulting, Inc. , 2000. Ibid.

For Phase 2, KEMA developed savings proportions based on the thermostat installation, use, and answers to a behavioral survey related to programmable thermostats (see Appendix B). The average savings proportion was calculated for each unit and multiplied by the prescriptive value for programmable thermostats (as reported in the program's final monthly reporting workbook) to produce kWh and therm savings per unit. We compared the result to the utility-provided unit information for the tenant space to determine a realization rate. Realization rates were only calculated for p-stat that were verified to be installed.

1.2.3.5 Other measures

The other measure category includes:

- High Efficiency Windows
- Central AC and heat pumps
- Room AC
- Clothes washers
- Low flow showerheads
- Dishwashers
- Furnaces
- Pool pumps
- Room AC and heat pumps
- Insulation, ductwork
- Faucet aerators
- Water heaters, and
- Boilers

None of these measures contributed significantly to overall program savings, individually or combined. Therefore, only verifications of these measures were accomplished during the onsite visits.

HVAC Measures. For new or replacement HVAC equipment, we verified information contained in the program tracking database pertaining to equipment manufacturer, model number, efficiency rating, and other nameplate information.

Water Heating Measures. For new or replacement water heating equipment, the surveyor followed the same procedures as new or replacement HVAC equipment. For aerators and showerheads, the surveyor verified installations using the sub-sampling procedures and noted the quantity verified on the data collection form.

Building Shell Measures. For building shell measures, such as energy-efficient windows and insulation, the surveyor verified the quantity and location of measures installed through interviews with property managers and visual inspections of treated buildings.

Appliances. For clothes washers and dishwashers, the verification procedure was the same as for new or replacement HVAC and water heating equipment.

1.2.3.6 Demand Savings

Demand savings were calculated for lighting measures by determining the difference in lighting wattage and applying a peak energy diversity factor. The diversity factor was based on residential lighting load shapes developed for the CFL Metering Study.[15]

Demand savings were calculated for programmable thermostats by multiplying the electric savings (kWh) by the system on-peak capacity h-factor for each utility. We calculated the h-factor from the utility workbooks.

1.2.4 Extrapolation to Population

The measure-specific analyses described above yielded a dataset with one record per unique site/unit/measure combination. Columns included the number of installed units reported by the program, as well as reported (ex ante) kW, kWh, and therm savings. We added the KEMA verified quantity and our (ex post) kW, kWh, and therm savings.

Common area and tenant area savings were determined separately. For both calculations, savings by measure were aggregated into 5 measure analysis categories: CFLs, T8s, exit signs, programmable thermostats, and other measures. Realization rates for each measure analysis category were determined by dividing the total KEMA savings (ex post) by the total program savings (ex ante). Realization rates were then applied to the program's total ex ante savings to determine the ex post savings.

[15] KEMA, Inc., 2005. Ibid.

2. Appendix B - Survey Instruments

2.1 Process and Market Assessment

Survey Instrument for Participating Property Managers – California State Multifamily Rebate Program

Finding the Decision Maker

I1. Hello, may I please speak with [USE CONTACT NAME, IF AVAILABLE]?
Contact available ..... [SKIP TO l2] 1
Contact currently unavailable ..... [ARRANGE CALL BACK] 2
No contact 3

l1b. I'd like to speak with the person responsible for managing property improvements [RECORD NAME]
Person responsible available 1
Person responsible currently unavailable ..... [ARRANGE CALL BACK] 2
No person responsible for property management or maintenance ..... [SKIP TO l7] 3
Don't know ..... [SKIP TO l7] -97
Refused ..... [SKIP TO l7] -98

l2. Hello I am _____ from Research America. I am calling on behalf of <UTILITY NAME> and the California Public Utilities Commission. According to our records, sometime in 2005 your organization had some energy efficiency improvements made at your property at <INSTALLATION ADDRESS>. These improvements were partially paid for by rebates from the 2005 <UTILITY NAME> multifamily rebate program. <UTILITY NAME> is trying to improve this program and I was hoping you could help us out by answering a few questions.

[PROVIDE UTILITY CONTACT NAMES IF NEEDED TO VERIFY STUDY]
SDG&E – Mary Wold, 858-636-6838
SCE – Shahana Samiullah, 626-302-8293
PG&E – Helen Fisicaro, (415) 973-1022

l4. According to our records, sometime in 2005 you had some energy efficiency improvements made at your property at <INSTALLATION ADDRESS> including <MEASURE TYPES > Are you familiar with these energy efficiency improvements?
Yes (all or some) 1
No 2
Don't know ..... –97
Refused ..... –98

l4a. Were you involved in the decision to install these energy efficiency improvements?
Yes (all or some) [RECORD NAME BELOW THEN SKIP TO NEXT SECTION] 1
RESPONDENT NAME //i4r//:_____
No 2
Don't know ..... –97
Refused ..... –98

l6. Do you know who is likely to be familiar with your company's decision to make these energy efficiency improvements?

Yes [RECORD NAME BELOW THEN START OVER AGAIN WITH l1] 1

_____
_____
_____

No 2
Don't know ..... -97
Refused ..... -98

l6b. [CHECK TO MAKE SURE ALL CONTACTS HAVE BEEN TRIED.]
Not all contacts have been tried ..... [START OVER AGAIN WITH l1] 1
All contacts have been tried 2

l7. Thank you very much for your time today. Those are all the questions I have.
[END INTERVIEW. RECORD "NO DECISIONMAKER CONTACT AVAILABLE"]

Information About Respondent and Property

First I would like to get some background information about you and the multifamily property at <INSTALLATION ADDRESS>.

r1. What is your position or job title at <INSTALLATION ADDRESS> or with the company that manages this property?
Owner 1
Property/leasing manager/associate 2
Senior property manager 3
Maintenance supervisor 4
Senior/regional maintenance supervisor 5
Purchasing manager 6
Other (PLEASE SPECIFY) _____ ..... -96
Don't Know ..... -97
Refused ..... -98

r3. How many years have you been in the business of owning, managing, or maintaining multifamily properties?
_____(RECORD # YEARS)
Don't Know ..... -97
Refused ..... -98

r5. About how many apartment units are located in the building or buildings at <INSTALLATION ADDRESS>? [RECORD # UNITS]

_____

Don't know ..... -97
Refused ..... -98

r5a. Do you have a system in the building at <INSTALLATION ADDRESS> that provides heating to all tenant units?

Yes.....1
No.....2
Don't know.....-97
Refused.....-98

r5b. Do you have a system in this building that provides cooling to all units?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

r5c. Do you have a system in this building that provides hot water to all units?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

r5d. Are the tenants at <INSTALLATION ADDRESS> responsible for paying their own utility bills, or are utilities included in the rent?
Tenants pay their own bills.....1
Utilities included in the rent.....2
Tenants pay some utilities while others are included in rent.....3
Other [SPECIFY].....-96
Don't know.....-97
Refused.....-98

r5e. Is the electricity for the tenant units in this building individually metered or master-metered?
Individually metered.....1
Master metered.....2
Other [SPECIFY].....-96
Don't know.....-97
Refused.....-98

r5f. Is the natural gas for the tenant units in this building individually metered or master-metered?
Individually metered.....1
Master metered.....2
Other [SPECIFY].....-96
Don't know.....-97
Refused.....-98

r6. Do you or your firm, own the property at <INSTALLATION ADDRESS>, do you manage it, or do you both own and manage it? [ACCEPT ONLY ONE ANSWER]
Own it only.....1
Manage it only.....2
Both own and manage it.....3
Don't know.....-97
Refused.....-98

Participation Information and Drivers

p1. Are you aware that <UTILITY NAME> offers rebates for making energy efficiency improvements to apartment complexes such as yours?

Yes.....1
No.....2
Don't know.....-97
Refused.....–98

p2. If you wanted to get information about <UTILITY NAME>'s energy efficiency rebate programs for apartment complexes, what would be your preferred means of getting this information? [DO NOT READ LIST. ACCEPT MULTIPLE RESPONSES]

Utility website.....1
Bill inserts/ stuffers.....2
Other direct mail from the utility.....3
Newspaper ads.....4
Radio ads.....5
Television ads.....6
Email or fax.....7
Installation contractors or other vendors.....8
Apartment/trade associations.....9
Utility training centers.....10
Not interested in information.....11
Other [PLEASE SPECIFY] _____.....-96
Don't Know.....-97
Refused.....-98

p3. Have you participated in any California programs that help customers improve their energy efficiency, either through rebates, energy audits, or education?

Yes.....1
No.....2
Don't know.....-97
Refused.....–98

p4a. [IF P3 = 1 ELSE SKIP TO P5] Do you recall the names of any of the programs that you participated in?

Yes.....1
No.....2
Don't know.....-97
Refused.....–98

p4b. [IF P4A=1 ELSE SKIP TO P5] What were the names of these programs? [ALLOW MULTIPLE RESPONSES]

Multifamily Energy-Efficiency Rebate Program.....1
Single Family Rebate Program.....2
Low Income Energy Efficiency Program.....3
Express Efficiency Program.....4
Standard Performance Contract Program.....5

Designed for Comfort – Efficient Affordable Housing Program 6
ICF's Energy Action Program 7
Other [SPECIFY] _____ ..... -96
Don't know ..... -97
Refused ..... -98

p5. [IF P1 ≠ 1 THEN SKIP TO P9] Are you aware that in 2005 <UTILITY NAME>'s multifamily rebate program paid rebates to either your company or the installation contractor to help reduce the cost of the installation of <MEASURE TYPES> at <INSTALLATION ADDRESS>?
Yes 1
No ..... [SKIP TO P9] 2
Don't know ..... [SKIP TO P9] -97
Refused ..... [SKIP TO P9] -98

p6. From where did you first learn about the 2005 <UTILITY NAME> multifamily rebate program? [DO NOT READ LIST.ACCEPT MULTIPLE RESPONSES]
Installation contractor offering services 1
Previous participation in program 2
Utility website 3
Apartment/trade association presentation 4
Apartment/trade association journal/newsletter 5
Utility bill insert 6
Other utility direct mail piece 7
Other [PLEASE SPECIFY] _____ ..... -96
Don't Know ..... -97
Refused ..... -98

p7. What was your primary reason for joining the program? [ONLY SELECT ONE OPTION]
To make property improvements in the tenant units 1
To make property improvements in the common areas 2
To save energy 3
To take advantage of the rebate/ The rebate made the project cost effective 4
To replace broken equipment 5
Other [PLEASE SPECIFY] _____ ..... -96
Don't Know ..... -97
Refused ..... -98

p9. When purchasing or replacing energy-using equipment in your common areas or tenant units, what sources of information do you use to help you make a decision? [DO NOT READ. ACCEPT MULTIPLE RESPONSES]
Internal maintenance staff 1
Our regular installation contractor 2
An outside installation contractor we may hire or consult with occasionally 3
Equipment distributors/ wholesalers 4
Equipment manufacturers 5
Equipment dealers/ retailers 6
Apartment/trade associations (presentations and newsletters) 7
Our electric or gas utility representative 8

Our electric or gas utility website.....9
Our own research on the Internet.....10
Other [PLEASE SPECIFY] _____.....-96
Don't Know.....-97
Refused.....-98

p10. Who came up with the idea for the energy efficiency improvements at <INSTALLATION ADDRESS>? Was it mainly your idea, mainly the contractor's idea, or a combination of both?
Mainly my idea.....1
Mainly the contractor's idea.....2
Mainly someone else's idea [SPECIFY PERSON]_____.....3
The idea came from multiple sources.....4
Don't know.....-97
Refused.....-98

p11. [IF P4 =1 AND P10 = 1 ELSE SKIP TO P9] Earlier you mentioned that you have participated in California energy efficiency programs in the past. Using a scale of 1 to 5, with 1 meaning "not important at all" and 5 meaning "extremely important," how important were these past programs in helping you to identify the energy efficiency improvements that you made in 2005 at <INSTALLATION ADDRESS>?
1 Not at all important.....1
2.....2
3.....3
4.....4
5 Extremely important.....5
Don't know.....-97
Refused.....-98

Determining Program Impact On Decision To Install (Net-To-Gross)

Now, I have a few questions about how the rebates and other services from the 2005 <UTILITY NAME> multifamily rebate program affected your decision to go ahead with the energy efficiency improvements at <INSTALLATION ADDRESS>.

Measure-Specific Net-to-Gross Questions

My next questions are about your organization's decision to go forward with the energy efficiency improvements at <INSTALLATION ADDRESS> through the <UTILITY NAME> rebate program.

z4. Were you aware of the <Z SEQUENCE MEASURE > technology before you had it installed at <INSTALLATION ADDRESS>?
Yes.....1
No.....[SKIP TO b0] 2
Don't know.....[SKIP TO b0] -97
Refused.....[SKIP TO b0] -98

z5. Before you installed the < Z SEQUENCE MEASURE > at <INSTALLATION ADDRESS> last year, had you installed the < Z SEQUENCE MEASURE > technology at this location or any of the other properties that your company manages or owns?

Yes....1
No....2
Don't know....-97
Refused....-98

z5a. [IF Z5 = 1 ELSE SKIP TO Z6] Did your previous installations of the < Z SEQUENCE MEASURE> technology use rebates provided by <UTILITY NAME>?
Yes....1
No....2
Don't know....-97
Refused....–98

z6. [IF Z5 = 1 THEN SKIP TO Z6aa] How come your company had not installed the < Z SEQUENCE MEASURES> on its own before becoming involved with the 2005 <UTILITY NAME> multifamily rebate program? [ALLOW MULTIPLE RESPONSES]
Already did all cost-effective energy efficient improvements....1
Unaware of/unable to identify measures....2
Tenants pay their own utility bills....3
Lack maintenance staff to install measures....4
Lack of time/not a priority....5
Financial limitations....6
Lack of information on energy savings or costs....7
Question reliability of energy efficient equipment....8
Energy savings estimates for equipment are unreliable....9
Fuel prices were low....10
New to building....11
Timing....12
Technology unavailable....13
Replacing on an as-needed basis....14
It was unnecessary....15
Other [SPECIFY]....-96
Don't know....-97
Refused....–98

z6aa. [IF r5d ≠ 1 THEN SKIP TO z6a]
Earlier you said that your tenants pay their own utility bills. Using a scale of 1 to 5, with 1 meaning "not important at all" and 5 meaning "extremely important," how important was this as a reason why you did not make these energy efficiency improvements earlier?
1 Not at all important....1
2....2
3....3
4....4
5 Extremely important....5
Don't know....-97
Refused....-98

z6a. Did the 2005 <UTILITY NAME> multifamily rebate program and its installation contactors help you to identify the opportunities for installing < Z SEQUENCE MEASURES> at <INSTALLATION ADDRESS>?

Yes.....1
No.....2
Don't know.....-97
Refused.....-98

z6b. [IF z6 = 3 ASK z6b ELSE SKIP TO z6c] You said that one reason why you had not installed < Z SEQUENCE MEASURES> before becoming involved with the 2005 <UTILITY NAME> multifamily rebate program was that your tenants pay their own energy bills. What did the program do to get you to install these <Z SEQUENCE MEASURES > despite this barrier? [ACCEPT MULTIPLE RESPONSES]

Program's rebates made it worthwhile.....1
Program's contractors helped identify energy savings opportunities.....2
Program's contractors helped install the energy efficient measures.....3
Other reason [SPECIFY].....-96
Don't know.....-97
Refused.....-98

z6c. Did the 2005 <UTILITY NAME> multifamily rebate program and its installation contactors help you to install the <Z SEQUENCE MEASURE > at <INSTALLATION ADDRESS>?

Yes.....1
No.....2
Don't know.....-97
Refused.....-98

z6d. [IF z6 = 6 ASK z6d ELSE SKIP TO z13] Did the rebates offered by the 2005 <UTILITY NAME> program help you overcome the financial limitations that kept you from installing the <Z SEQUENCE MEASURE > at <INSTALLATION ADDRESS> at an earlier date?

Yes.....1
No.....2
Don't know.....-97
Refused.....-98

z13. If <UTILITY NAME>'s multifamily rebate program had not provided rebates to you or your installation contractor in 2005 or provided installation assistance, how likely would it have installed the < Z SEQUENCE MEASURE>? Would you say that the likelihood would have been…[READ LIST]

Very likely.....1
Somewhat likely.....2
Not very likely.....3
Or very unlikely.....[SKIP TO b0] 4
Don't know.....[SKIP TO b0] -97
Refused.....[SKIP TO b0] -98

z14. Without rebates or installation assistance from the program, how different would the timing have been for the installation of the < Z SEQUENCE MEASURE >? Would you say the timing would have been…[READ LIST]

About the same.....[SKIP TO z16] 1

Sooner ..... [SKIP TO z16] 2
Or later.....3
Don't know..... [SKIP TO z16] -97
Refused..... [SKIP TO z16] -98

z15. How many months later? [TRY TO GET A NUMBER]
[RECORD NUMBER OF MONTHS] ___
Don't know.....-97
Refused.....-98

z16. Without rebates or installation assistance from the program, how different would the energy efficiency level of the < Z SEQUENCE MEASURE > been? Would you say the efficiency would have been the… [READ LIST]
Same ..... [SKIP TO z18] 1
Lower 2
Or higher ..... [SKIP TO z18] 3
Don't know..... [SKIP TO z18] -97
Refused..... [SKIP TO z18] -98

z17c. How much lower? [READ LIST—DON'T ACCEPT A RESPONSE UNTIL FINISHED READING LIST]
Standard efficiency or according to code 1
Slightly higher than standard efficiency.....2
About midway between standard and the high efficiency that was used 3
Or slightly lower than the high efficiency that was used 4
Don't know.....-97
Refused.....-98

z18. Without the rebates or installation assistance from the program, how different would the quantities of installations have been for the < Z SEQUENCE MEASURES > you installed? Would you say the quantity would have been the…[READ LIST]
Same ..... [SKIP TO b0] 1
Smaller 2
Larger ..... [SKIP TO b0] 3
Or it doesn't make sense to talk about quantity ..... [SKIP TO b0] 4
Don't know..... [SKIP TO b0] -97
Refused..... [SKIP TO b0] -98

z19. About what percentage of these < Z SEQUENCE MEASURES> would your organization have installed without the rebates from the program?
[RECORD PERCENTAGE 0-99].....] [SKIP TO b0]
..... [SKIP TO b1] Don't know -97
Refused..... [SKIP TO b0] -98

Plans and Barriers To Future Energy Efficiency Implementation

b0. Is your organization considering making similar energy efficiency improvements over the next three years at the same or another multifamily complex?

Yes.....1
No.....[SKIP TO b2] 2
Don't know.....[SKIP TO s1a] -97
Refused.....[SKIP TO s1a] –98

b1. What types of energy-efficient equipment are you now considering? [DO NOT READ. ALLOW MULTIPLE RESPONSES]
Compact Fluorescent Lamps.....1
Other energy efficient lighting.....2
High efficiency windows.....3
High efficiency clothes washers.....4
High efficiency dishwashers.....5
High efficiency refrigerators.....6
Programmable thermostats.....7
High efficiency furnaces.....8
High efficiency central boilers.....9
High efficiency water heaters.....10
Other [SPECIFY] _____ ..... -96
Don't know.....-97
Refused.....–98

b0b. Would your organization consider making these improvements in the future without rebates or assistance in installation from the <UTILITY NAME> multifamily rebate program?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

b2. [IF b0 = 1 THEN SKIP TO s1A] Why don't you have plans making similar energy efficiency improvements over the next three years? [ALLOW MULTIPLE RESPONSES]
Already did all cost-effective energy efficient improvements.....1
Unaware of/unable to identify measures.....2
Tenants pay their own utility bills.....3
Lack maintenance staff to install measures.....4
Lack of time/not a priority.....5
Financial limitations.....6
Lack of information on energy savings or costs.....7
Question reliability of energy efficient equipment.....8
Energy savings estimates for equipment are unreliable.....9
Fuel prices were low.....10
New to building.....11
Timing.....12
Technology unavailable.....13
Replacing on an as-needed basis.....14
It was unnecessary.....15
Other [SPECIFY].....-96
Don't know.....-97
Refused.....–98

Other [SPECIFY] ..... -96
Don't know ..... -97
Refused ..... –98

Participant Satisfaction

s1a. Were the energy efficient improvements made at <INSTALLATION ADDRESS> installed in the common areas only, in the tenant units only, or in both?
Only the common areas 1
Only the tenant units 2
In both the common areas and the tenant units 3
Don't know ..... -97
Refused ..... -98

s1b. Who installed the energy efficiency improvements? Was it the contractor, your own internal staff, or a combination of both?
Only the installation contractor 1
Only the internal staff 2
A combination of both 3
Don't know ..... -97
Refused ..... -98

Common area improvements

IF s1a = 2 SKIP TO s5

s1. Now I am going to ask you about your satisfaction with the work done in the common areas. On a scale of 1 to 5, with 1 meaning "not at all satisfied" and 5 meaning "extremely satisfied," how satisfied are you with the overall quality of the work performed by the contractor for the energy efficiency improvements in the common areas at <INSTALLATION ADDRESS>? [EMPHASIZE WORDS IN ITALICS SINCE QUESTIONS S1, S3, S5, AND S7 ARE ALL VERY SIMILAR]
1 Not at all satisfied 1
2 2
3 3
4 ..... [SKIP TO s3] 4
5 Extremely satisfied ..... [SKIP TO s3] 5
Don't know ..... [SKIP TO s3] -97
Refused ..... [SKIP TO s3] -98

s2. Why were you less than satisfied with the quality of the contractor's work in the common areas? [ALLOW MULTIPLE RESPONSES]
The equipment broke down/ malfunctioned 1
The quality of the equipment was not up to our standards 2
The quality of the installation was not up to our standards 3
We did not like the way the product looked 4
The installers did not meet our standards 5
The job took too long 6

The installers were too disruptive, or messy 7
Other [SPECIFY] _____ .....-96
Don't know.....-97
Refused.....-98

s3. On a scale of 1 to 5, with 1 meaning "not at all satisfied" and 5 being "extremely satisfied," how satisfied are you with the performance of the equipment installed by the contractor in the common areas at <INSTALLATION ADDRESS>? [EMPHASIZE WORDS IN ITALICS SINCE QUESTIONS S1, S3, S5, AND S7 ARE ALL VERY SIMILAR]
1 Not at all satisfied.....1
2.....2
3.....3
4..... [IF s1a = 1 SKIP TO s8c ELSE SKIP TO s5] 4
5 Extremely satisfied.....[IF s1a = 1 SKIP TO s8c ELSE SKIP TO s5] 5
Don't know.....[IF s1a = 1 SKIP TO s8c ELSE SKIP TO s5] -97
Refused.....[IF s1a = 1 SKIP TO s8c ELSE SKIP TO s5] -98

s4. Why were you less than satisfied with the performance of the equipment in the common areas? [ACCEPT MULTIPLE RESPONSES]
The equipment broke down/ malfunctioned.....1
The quality of the equipment was not up to our standards 2
The quality of the installation was not up to our standards 3
We did not like the way the product looked 4
The installers did not meet our standards.....5
The job took too long 6
The installers were too disruptive, or messy 7
Other [SPECIFY] _____ .....-96
Don't know.....-97
Refused.....-98

Tenant area improvements

s5. [IF s1a = 1 SKIP TO s8c] Now I am going to ask you about your satisfaction with the work done in the tenant units. On a scale of 1 to 5, with 1 meaning "not at all satisfied" and 5 meaning "extremely satisfied," how satisfied are you with the overall quality of the work performed by the contractor for the energy efficiency improvements in the tenant units at <INSTALLATION ADDRESS>? [EMPHASIZE WORDS IN ITALICS SINCE QUESTIONS S1, S3, S5, AND S7 ARE ALL VERY SIMILAR]
1 Not at all satisfied.....1
2.....2
3.....3
4.....[SKIP TO s7] 4
5 Extremely satisfied.....[SKIP TO s7] 5
Don't know..... [SKIP TO s7] -97
Refused..... [SKIP TO s7] -98

s6. Why were you less than satisfied with the quality of the contractor's work in the tenant areas? [ALLOW MULTIPLE RESPONSES]
The equipment broke down/ malfunctioned.....1

The quality of the equipment was not up to our standards 2
The quality of the installation was not up to our standards 3
We did not like the way the product looked 4
The installers did not meet our standards.....5
The job took too long 6
The installers were too disruptive, or messy 7
Other [SPECIFY] _____ .....-96
Don't know.....-97
Refused.....-98

s7. On a scale of 1 to 5, with 1 meaning "not at all satisfied" and 5 being "extremely satisfied," how satisfied are you with the performance of the equipment installed by the contractor in the tenant units at <INSTALLATION ADDRESS>? [EMPHASIZE WORDS IN ITALICS SINCE QUESTIONS S1, S3, S5, AND S7 ARE ALL VERY SIMILAR]
1 Not at all satisfied.....1
2.....2
3.....3
4.....[SKIP TO s8c] 4
5 Extremely satisfied.....[SKIP TO s8c] 5
Don't know.....[SKIP TO s8c] -97
Refused.....[SKIP TO s8c] -98

s8. Why were you less than satisfied with the performance of the equipment in the tenant units? [ALLOW MULTIPLE RESPONSES]
The equipment broke down/ malfunctioned.....1
The quality of the equipment was not up to our standards 2
The quality of the installation was not up to our standards 3
We did not like the way the product looked 4
The installers did not meet our standards.....5
The job took too long 6
The installers were too disruptive, or messy 7
Other [SPECIFY] _____ .....-96
Don't know.....-97
Refused.....-98

s8c. Did the contractors who installed or managed the energy efficiency improvements provide any performance guarantees for the installed equipment?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

s8d. Did these contractors provide any information on manufacturer warranties for the installed equipment?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

s8e. Were these contractors responsive to any questions or complaints that you had?
Yes.....1
No.....2
I didn't have any questions or complaints.....3
Don't know.....-97
Refused.....-98

Satisfaction with Rebates and Rebate Forms

s8f. Did you receive a rebate check from the 2005 <UTILITY NAME> multifamily rebate program for the energy efficiency measures installed at <INSTALLATION ADDRESS>
Yes.....1
No.....[SKIP TO s11] 2
Don't know..... [SKIP TO s11] -97
Refused..... [SKIP TO s11] -98

s8g. Did the amount of the rebate check meet your expectations?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

s9. Did you fill out any rebate application forms for the 2005 <UTILITY NAME> multifamily rebate program?
Yes.....1
No.....[SKIP TO s11] 2
Don't know..... [SKIP TO s11] -97
Refused..... [SKIP TO s11] -98

s10. Did you find the rebate application forms to be reasonable in terms of length and level of detail?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

s10a. After the rebate application was submitted, did the rebate check arrive in a reasonable amount of time?
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

s10b. About how many weeks after you submitted the rebate application did the rebate check arrive?
_____ [RECORD # of WEEKS]
Don't know.....-97
Refused.....-98

s11. Did you interact with the <UTILITY NAME> multifamily rebate program staff during the energy efficiency improvements at <INSTALLATION ADDRESS>?

Yes.....1
No.....[SKIP TO s13] 2
Don't know.....[SKIP TO s13] -97
Refused.....[SKIP TO s13] –98

s12. Using a scale of 1 to 5 where 1 = "not at all satisfied" and 5 = "extremely satisfied," how satisfied have you been with the way that the utility staff has responded to any questions you had about the energy efficiency improvements at <INSTALLATION ADDRESS>?

1 Not at all satisfied.....1
2.....2
3.....3
4.....[SKIP TO s13] 4
5 Extremely satisfied.....[SKIP TO s13] 5
Don't know.....[SKIP TO s13] –97
Refused.....[SKIP TO s13] –98

s12a. Why were you less than satisfied with the utility staff? [RECORD RESPONSE]

_____

-96
Don't know.....–97
Refused.....–98

s13. Using a scale of 1 to 5 where 1 = "not at all satisfied" and 5 = "extremely satisfied," how satisfied have you been with the 2005 <UTILITY NAME> multifamily rebate program as a whole?

1 Not at all satisfied.....1
2.....2
3.....3
4.....[SKIP TO s14] 4
5 Extremely satisfied.....[SKIP TO s14] 5
Don't know.....[SKIP TO s14] –97
Refused.....[SKIP TO s14] –98

s13a. Why were you less than satisfied with this program? [RECORD RESPONSE]

_____

-96
Don't know –97
Refused –98

s14. Would you recommend this program to the property manager at another facility?

Yes.....[SKIP TO s16] 1
No.....2
Don't know.....[SKIP TO s16] -97
Refused.....[SKIP TO s16] –98

s15. Why not?

[RECORD RESPONSE]
_____ .....
Don't know.....–97
Refused.....–98

s16. Do you have any suggestions as to how the <UTILITY NAME> multifamily rebate program could be improved? [RECORD RESPONSE]

_____

_____ -96

Don't know.....-97
Refused.....-98

Size of Company

We're almost done, just a few more questions....

C1. About how many multifamily residential properties in California do you or your company:
a. Own and manage?
_____ (RECORD #)
-96
Don't know.....-97
Refused.....-98
b. Own but do not manage?
_____ (RECORD #)
-96
Don't know.....-97
Refused.....-98
c. Manage but do not own?
_____ (RECORD #)
-96
Don't know.....-97
Refused.....-98

C2. Would you like to have <UTILITY NAME> send you information about energy efficiency programs currently available to Multifamily Property Managers? [IF YES, VERIFY NAME AND ADDRESS FOR MAILING.]
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

Thank you very much for participating in this survey.

Survey of Plumbers, Boiler, HVAC Contractors Not Participating in the California Multifamily Energy Efficiency Rebate Program

Lead In: Finding the Decision Maker and Screener

S1. Does your company have experience installing large central boilers or water heaters or water recirculation controls that would be used in a multifamily building like an apartment building?
Yes.....[CONTINUE] 1
No.....[THANK AND TERMINATE] 2
Don't know..... [THANK AND TERMINATE] -97
Refused..... [THANK AND TERMINATE] -98

Hello, may I please speak with [USE CONTACT NAME FROM D & B]?
Contact available.....[SKIP TO L2] 1
Contact currently unavailable..... [ARRANGE CALL BACK] 2
No contact 3

L1b. I'd like to speak with the person responsible for your residential sales and service [RECORD NAME]
Person responsible available 1
Person responsible currently unavailable.....
..... [ARRANGE CALL BACK] 2
No person responsible for residential sales and service .....[THANK AND TERMINATE] 3
Don't know..... [THANK AND TERMINATE] -97
Refused.....[THANK AND TERMINATE]] -98

L2. Hello I am _____ from KEMA Consulting. I am calling on behalf of [Utility] and the California Public Utilities Commission. We are talking to plumbers and HVAC contractors to find out more about their current practices and to get feedback on how current energy efficiency programs could be improved.

[PROVIDE UTILITY CONTACT NAMES IF NEEDED TO VERIFY STUDY:
SDG&E – Mary Wold, 858-636-6838
SCE – Shahana Samiullah, 626-302-8293
PG&E – Helen Fisicaro, (415) 973-1022

L3. Does your company currently do any work in multifamily housing such as apartment buildings and condominiums?
Yes.....1 [SKIP TO L5]
No.....2
Don't know.....-97
Refused.....-98

L4. Does your company have any interest in doing work in multifamily housing such as apartment buildings and condominiums?
Yes.....1
No.....2
Don't know.....-97

Refused.....-98

L5. Have you heard of California's Multifamily Energy Efficiency Rebate Program? This is a statewide program that offers rebates for the installation of EE equipment in multifamily housing.
Yes.....1
No.....2
Don't know.....-97
Refused.....-98

[IF L3 ≠ 1 AND L4 ≠ 1 THEN THANK AND TERMINATE]

Reasons for Non Participation

N1. According to our records, your company is currently not promoting rebates for the California Multifamily Energy Efficiency Rebate Program, is this correct?
Yes.....1
No.....[THANK AND TERMINATE] 2
Don't know.....-97
Refused.....-98

N2. What is the main reason why you are not participating in the program? Are there other reasons? [DO NOT PROMPT]

	Main [circle one]	Other [circle all that apply]
a. No trouble getting work without rebates	1	2
b. Customers aren't interested in EE	1	2
c. No time to get informed about techniques	1	2
d. Market is too cost-competitive, couldn't recover extra costs	1	2
e. No time to get informed about program	1	2
f. Don't like the program (Prompt 'why?')	1	2
g. Program measures not applicable for many jobs they do	1	2
h. Other (Specify)	1	2

N3. Are there any California energy efficiency programs that you participate in? [IF NO CODE "NONE" AND SKIP TO N4, ELSE ASK:] Which ones? [DO NOT PROMPT. CHECK ALL THAT APPLY]
Single Family Rebate Program 1
Low Income Energy Efficiency Program.....2
Express Efficiency Program.....3
Standard Performance Contract Program.....4
Designed for Comfort – Efficient Affordable Housing Program.....5
ICF's Energy Action Program.....6
Other [SPECIFY] _____ 7
None.....8
Don't know.....-97

Refused.....-98

N4. If the California Multifamily Energy Efficiency Rebate Program wanted to send you information about their program, what would be the best way to reach you?

N5. If the program wanted to recruit more distributors or installation contractors like your own company, what would be the best way to do this?

Contractor Firmographics and Market Characterization

Now I would like to get some background information about you and your company.

C1. What is your job title? _____

C2. Approximately how many employees, including yourself, work for your company? _____
Don't know.....-97
Refused.....-98

C3. What electric utility serves most of your customers? _____
Don't know.....-97
Refused.....-98

C4. What natural gas utility serves most of your customers? _____
Don't know.....-97
Refused.....-98

C5. Is your company headquartered in California or outside the state?
In California 1
Outside the state 2
Don't know.....-97
Refused.....-98

C5a. What is the normal service territory for your company?

_____

C5b. Approximately what percentage of your business involves installation and service of boilers, water heaters, and related equipment such as boiler controls??
___%
Don't know.....-97
Refused.....-98

C5c. Approximately what percentage of your business involves sales and distribution of boilers, water heaters, and related equipment (e.g., controls)?
___%
Don't know.....-97
Refused.....-98

C6a. Please provide a rough estimate of what % of your EE installation business is in the following sectors. [READ OPTIONS]

Sector	a. % of Total Installations	DK	Refused
Residential single-family	_____%	-97	-98
Residential multifamily	_____%	-97	-98
Non-residential	_____%	-97	-98

C6b. About what % of your energy efficient installations are retrofit/replacements
____%
Don't know.....-97
Refused.....-98

C7. [IF L3 ≠ 1 SKIP TO NEXT SECTION] About how many EE installation projects does your company do in multifamily buildings in a typical year? ___
Don't know.....-97
Refused.....-98

C8. About what % of your EE installation projects in the residential multifamily sector fall into the following categories:
Installations in tenant units only ___%
Don't know.....-97
Refused.....-98

b. Installation in common areas only___%
Don't know.....-97
Refused.....-98

Installations in both tenant units and common areas___%
Don't know.....-97
Refused.....-98

C9. About what % of your EE installation projects in the residential multifamily sector fall into the following categories:
a. Projects in buildings with 20 units or less ___%
Don't know.....-97
Refused.....-98

b. Projects in buildings with greater than 20 units and fewer than 100 units ___%
Don't know.....-97
Refused.....-98

c. Projects in buildings with greater than 100 units and fewer than 250 units___%
Don't know.....-97
Refused.....-98

d. Projects in buildings with greater than 250 units ___%
Don't know.....-97
Refused.....-98

C10. About what % of your projects in the residential multifamily sector is with public housing or other government-subsidized housing? ___%
Don't know.....-97
Refused.....-98

Experience with EE Equipment

EE1. Which of the following types of energy measures do you install?

Measure	Yes	No	DK	Refused
a. Central System Natural Gas Boiler with at least 82% AFUE with input rating < 300 Mbtuh	1	2	-97	-98
b. Central System Natural Gas Boiler with at least 82% thermal efficiency with input rating ≥ 300 Mbtuh	1	2	-97	-98
c. Gas Wtr Htr and/or Boiler Controllers (either digital or non-digital)	1	2	-97	-98
d. Central System Natural Gas Water Heaters with at least 82% thermal efficiency	1	2	-97	-98
e. Gas Storage Water Heater (energy factor .6 or >)	1	2	-97	-98
f. Energy Star Programmable Thermostats	1	2	-97	-98
g. Energy Star High Eff. Clothes Washer (Tier 1 or Tier 2) (in dwelling unit)	1	2	-97	-98
h. Energy Star Dishwashers	1	2	-97	-98

EE2B. [ASK ONLY OF THOSE WHO INSTALL BOILER CONTROLLERS] When you install boiler controllers, on average, how many tenant units are you typically controlling?

EE3. Do you actively promote any of this high efficiency equipment? Which types? How so?

EE4. On a scale of 1 to 5 where 5 means "Very Important" and 1 means "Not at all Important", How important do you believe it is to your business success to market and deliver EE equipment?

Not at all Important 1
Somewhat Unimportant 2
Neither Important nor Unimportant 3
Somewhat Important 4
Very Important 5
Don't know ..... -97
Refused ..... -98

EE5. Are the EE measures I just named pretty easy to get a hold of if you wanted to install them? For which types is availability a problem?

EE6. Do you agree with the following statement: "Most building owners/managers only replace central boilers or water heaters when they have broken down or not performing satisfactorily."

Yes 1
No 2
Don't know ..... -97
Refused ..... -98

EE6A. [IF EE6 =1 THEN SKIP TO EE7] What are some situations where a building owner/manager might replace a central boiler or water heater when the equipment was performing adequately and still had some useful life?

EE7. When replacing a central boiler or water heater, what energy efficiency level (AFUE, thermal efficiency) would you consider standard practice in such situations?

EE8a. When replacing a central boiler or water heater, are there any factors that would discourage you from recommending a higher efficiency model?

[Prompt for
Customer-specific barriers
IOU rebate specifications/availability
Equipment-related barriers
Site applicability barriers]

EE8b. When replacing a central boiler or water heater, are there factors that would encourage you to recommend a higher efficiency model?
[Prompt for
The impact of the IOU rebates
Customer preferences]

EE9. I'm going to tell you the current rebates levels offered by California's Statewide Multifamily Energy Efficiency for some of the high efficiency equipment that you say you sell or install. For each piece of equipment please tell me whether you think the rebate is too high, too low, or just about right in order to encourage the installation of this higher EE equipment.

Measure	Too low	Just About Right	Too high	Don't Install Measure	DK	Refused
ab. Central System Natural Gas Boiler -- $1,500 - $2,000	1	2	3	4	-97	-98
c. Gas Wtr Htr and/or Boiler Controllers -- $750 <20 units, $1,500 for >= 20 units	1	2	3	4	-97	-98
d. Central System Natural Gas Water Heaters with 82% thermal efficiency - $550	1	2	3	4	-97	-98
e. Gas Storage Water Heater (energy factor .6 or >) -- $40	1	2	3	4	-97	-98
f. ES Programmable Thermostats -- $50	1	2	3	4	-97	-98
g. ES High Eff. Clothes Washer (Tier 1 or Tier 2) (in dwelling unit) -- $75-$125	1	2	3	4	-97	-98
h. ES Dishwashers -- $50	1	2	3	4	-97	-98

Interaction with Multifamily Property Owners & Managers

[IF L3 ≠ 1 THANK AND TERMINATE] Now I would like to ask you some questions about how you typically interact with owners and managers of multifamily properties.

POA. Tell me a little about your clients who own or manage multifamily buildings – such as apartment buildings. Can you generalize as to how they typically become your clients? Is it through word-of-mouth, yellow pages, etc.?

POB. Do you do any proactive outreach or marketing to try to gain new multifamily property managers and owners as clients?

Yes.....1
No.....[SKIP TO P3A] 2
Don't know.....[SKIP TO P3A] -97
Refused.....[SKIP TO P3A] -98

P1. How do you find out which multifamily properties to target for energy-efficiency improvements? [NOTE: POSSIBLE OPTIONS MIGHT INCLUDE: GET/BUY LISTS FROM APARTMENT ASSOCIATIONS OR MULTIFAMILY TRADE ASSOCIATIONS, GET/BUY LISTS FROM OTHER SOURCES, STREET CANVASSING, KNOCKING ON DOORS, WOM, ETC.]

P2. Are there any types of multifamily properties that you avoid, whether this decision is based on type of housing or the geographic area where the housing is located?

P3a. Do you find it more difficult to get installation business from large property management firms than with small or medium-sized firms? If so, why is this?

P3b. Do you think that whether an apartment building is master metered or individually metered makes any difference as to the willingness of the property manager or owner to invest in energy efficient technologies?

P4. Are you involved in selling EE products directly to owners or managers of multifamily properties?

Yes.....1
No.....[SKIP TO P5] 2
Don't know.....[SKIP TO P5] -97
Refused.....[SKIP TO P5] -98

P4a. Once you have identified a multifamily property that you wish to sell or install energy-efficient products for, what is your typical sales pitch?

P4b. To what degree does this sales pitch change depending on the EE product you are promoting?

P4c. Who are you typically making this pitch to? Is it a maintenance supervisor, a property manager? An owner?

P4d. Does your sales pitch change depending on whom you are dealing with or the type of property? If so, under what situations?

P5. Do you have any sales strategies that are targeted at multifamily properties in particular? If so, what are these strategies?

P6. What do you think are the main reasons why multifamily property owners and managers do not implement EE measures on their own? [NOTE: POSSIBLE OPTIONS MIGHT INCLUDE: UNAWARENESS OF EE OPTIONS, UNAWARENESS OF NEED TO SAVE ENERGY, SPLIT INCENTIVE, HASSLE COSTS, HIGHER FIRST COSTS, UNAWARENESS OF PROGRAMS/REBATES]

Thank you very much for participating in this survey.

2.2 Impact Evaluation

CFL Survey Form

Utility: _____

Site Name: _____ **% Occupied:** _____ **Sheet:** _____ **of** _____

Site Address: _____ **# Common Areas Sampled:** _____ **Date:** _____

Site City: _____ **# Units Sampled:** _____ **Staff Initials:** _____

Site ID: _____

Room Type Codes:	
H = Hall/Entrance	BT = Bathroom
BD = Bedroom	L = Living Room
K = Kitchen	O = Other Tenant
D = Dining Room	C = Common Area
OD = Outdoor	

Control Type Codes:
S = Standard Switch
D = Dimmer Switch
T = Timer
MP = Motion/Photocell
O = Other (Describe)

Reason Not Installed Codes:	
B = Burned Out	G = Given Away
R = Removed	N = Not Installed Yet
O = Other (Describe)	

On-Site Survey Data

					Previous			New					
ID #	Unit / Area #	Room Type (if "C" enter op hrs)	# of Lamps Per Fixture	Fixture Quantity per Room	Lamp Wattage	Control Type	Timer Settings	Lamp Wattage	Lamp or Fixture	Control Type	Timer Settings	Reason Not Installed	**Notes:** Source of previous lamp wattage, previous control types, etc. Source for any equipment not actually viewed. Other descriptions.
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													
15													

High Efficiency Exit Sign Survey Form

Site Name: _____ **% Occupied:** _____ **Sheet:** _____ **of** _____

Site Address: _____ **# Common Areas Sampled:** _____ **Date:** _____

Site City: _____ **# Units Sampled:** _____ **Staff Initials:** _____

Site ID: _____ **Utility:** _____

Lamp Type Codes:
I = Incandescent
F = Fluorescent
LED = LED
EL = Electroluminescent

Reason Not Installed Codes:	
B = Burned Out	G = Given Away
R = Removed	N = Not Installed Yet
O = Other (Describe)	

On-Site Survey Data

		Previous				New					
ID #	**Unit / Area #**	**# of Lamps Per Fixture**	**Fixture Quantity per Area**	**Lamp Type**	**Lamp Wattage**	**# of Lamps Per Fixture**	**Fixture Quantity per Area**	**Lamp Type**	**Lamp Wattage**	**Reason Not Installed**	**Notes:** source of previous lamp info, etc.
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											

Lighting Controls Survey Form

Site Name: _____ **% Occupied:** _____ **Sheet:** _____ **of** _____

Site Address: _____ **# Common Areas Sampled:** _____ **Date:** _____

Site City: _____ **# Units Sampled:** _____ **Staff Initials:** _____

Site ID: _____ **Utility:** _____

Room Type Codes:	
H = Hall/Entrance	BT = Bathroom
BD = Bedroom	L = Living Room
K = Kitchen	O = Other Tenant
D = Dining Room	C = Common Area

Control Type Codes:
S = Standard Switch
D = Dimmer Switch
T = Timer
MP = Motion/Photocell
O = Other (Describe)

Lamp Type Codes:
T12 = T12 fluorescent
T8 = T8 fluorescent
T5 = T5 fluorescent
CFL = CFL
I = incandescent

Ballst Type Codes:
M = Magnetic
E = Electronic

On-Site Survey Data

ID #	Unit / Area #	Room Type	Lamp Type	Ballast Type	# of Lamps Per Fixture	Lamp Length	Fixture Quantity per Room	Lamp Wattage (CFL or Inc only, not T12/T8/T5)	Previous Control Type	Previous Control Settings	Previous Operating Hours	New Operating Hours	**Notes:** Timer settings, source of previous operating hours, logger installed, etc.
1													
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													
14													

T5/T8 Survey Form

Utility: _____

Site Name: _____ **% Occupied:** _____ **Sheet:** _____ **of** _____

Site Address: _____ **# Common Areas Sampled:** _____ **Date:** _____

Site City: _____ **# Units Sampled:** _____ **Staff Initials:** _____

Site ID: _____

Room Type Codes:	
H = Hall/Entrance	BT = Bathroom
BD = Bedroom	L = Living Room
K = Kitchen	O = Other Tenant
D = Dining Room	C = Common Area
OD = Outdoor	

Ballst Type Codes:
M = Magnetic
E = Electronic

Control Type Codes:
S = Standard Switch
D = Dimmer Switch
T = Timer
MP = Motion/Photocell
O = Other (Describe)

Reason Not Installed Codes:	
B = Burned Out	G = Given Away
R = Removed	N = Not Installed Yet
O = Other (Describe)	

On-Site Survey Data

			Previous							New									
ID #	Unit / Area #	Room Type	# of Lamps Per Fixture	Lamp Length	Fixture Quantity per Room	Lamp Type	Ballast Type	Control Type	Timer Settings	# of Lamps Per Fixture	Lamp Length	Fixture Quantity per Room	Lamp Type	Ballast Type	Control Type	Timer Settings	Operating Hours	Reason Not Installed	**Notes:** Source of previous lamp wattage, previous control types, etc. Source for any equipment not actually viewed. Other descriptions.
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			

Generic Building Shell Survey Form

Utility: _____

Site Name: _____ **% Occupied:** _____ **Sheet:** _____ **of** _____

Site Address: _____ **# Common Areas Sampled:** _____ **Date:** _____

Site City: _____ **# Units Sampled:** _____ **Staff Initials:** _____

Site ID: _____

On-Site Survey Data

windows, insulation

ID #	Measure	Total Area in Square Feet	Operational? Y or N	Notes: Reason equipment is not operational, other site notes.
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				

Generic Equipment Survey Form

Utility: _____

Site Name: _____ % Occupied: _____ Sheet: _____ of _____

ite Address: _____ # Common Areas Sampled: _____ Date: _____

Site City: _____ # Units Sampled: _____ Staff Initials: _____

Site ID: _____

On-Site Survey Data

boiler, central air conditioner, clothes washer, water heater, dishwasher, faucet aerator, furnace, pool pump, room air conditioner, low flow showerhead

ID #	Equipment Type	Brand	Model Number	Quantity	Operational? Y or N	Notes: Reason equipment is not operational, other site notes.
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						

Statewide Multifamily Rebate Program Evaluation
Programmable Thermostat Survey

Site Name: _____ Date: _____
Site Address: _____ Staff Initials: _____
Site City: _____ # Units Sampled: _____
Site ID: _____

Survey Instructions: Use the same survey form, one for each site, and record the answers on a corresponding Answer Sheet for later data entry.

For buildings with:
<5 units: Attempt all
5-20 units: obtain 25%
High-rise building: Approach 25%; no more than 20 units
Attempt from every other floor
Multiple buildings: Approach 25%; no more than 20 units
Attempt from every other building,
every other floor

1. Does the tenant have a programmable thermostat now?
   a. Yes
   b. No (reason:_____)
   c. Don't know (reason:_____)

If #1 = No, Don't know – terminate survey

Record the settings on the thermostat:
See P-stat Settings Form

Minimum Acceptable Energy Star Setpoint Times and Temperature Settings

Setting	Time	Setpoint Temp, Heat	Setpoint Temp, Cool
Wake	6 am	70 F	78 F
Day	8 am	62 F	85 F
Evening	6 pm	70 F	78 F
Sleep	10 pm	62 F	82 F

2. Is the programmable thermostat currently programmed? (view tenant's thermostat)
    a. Yes
    b. No

If #2 = No – terminate survey

3. Is the thermostat programmed with the Energy Star program?
    a. Yes
    b. No
    c. Don't know
    d. Refused

4. Did the tenant have a programmable thermostat before?
    a. Yes
    b. No
    c. Don't know
    d. Refused

If #4 = Yes – terminate survey

5. Does the tenant override the thermostat program more than once per week?
    a. Yes
    b. No
    c. Don't know
    d. Refused

If #5 = Yes – terminate survey

If #3 = Yes – complete Energy Star Behavioral Survey
If #3 = No, Don't know, Refused – complete Non-Energy Star Behavioral Survey

Energy Star Behavioral Survey

H. Heating – D. Daytime settings

HD1. Before you got the programmable thermostat, did you use a fairly constant temperature setting during the daytime when you were at home in the winter?

a. Yes
b. No
c. Don't Know
d. Refused

IF HD1 = a. THEN GO TO HD2, ELSE GO TO HD4

HD2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF HD2 = a. THEN GO TO HN1, ELSE GO TO HD3

HD3. Was it set higher or lower than 68 degrees (current setting)?

a. A lot higher
b. A bit higher
c. About the same as it is now
d. A bit lower
e. A lot lower
f. Don't know
g. Refused

IF HD3 = a. or b., CONFIRM: "So your house was warmer than it is now during the winter and the heat ran more often?"

IF HD3 = c., CONFIRM: "So your house was about the same temperature then as it is now?"

IF HD3 = d. or e., CONFIRM: "So your house was colder than it is now during the winter and the heat ran less often?"

IF HD3 = a, b, c, d, or e, GO TO HN1, ELSE GO TO HD4

HD4. Was your house typically heated the same, less, or more often than it is now?

a. Much less heat CONFIRM: "So it was a lot colder?"
b. A bit less heat CONFIRM: "So it was a little colder?"
c. The same CONFIRM: "So it was no warmer or colder?"
d. A bit more heat CONFIRM: "So it was a little warmer?"
e. A lot more heat CONFIRM: "So it was a lot warmer?"
f. Don't know
g. Refused

H. Heating – N. Nighttime settings

HN1. Before you got the programmable thermostat, did you use a fairly constant temperature setting (or turn it off) during the night when you went to bed in the winter?

a. Yes
b. No
c. Don't Know
d. Refused

IF HN1 = a. THEN GO TO HN2, ELSE GO TO HN4

HN2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF HN2 = a. THEN GO TO HU1, ELSE GO TO HN3

HN3. Was it set higher than 55 degrees, so the heat was on during the night?

a. A lot higher
b. A bit higher
c. About the same as 55
d. Don't know
e. Refused

IF HN3 = a, b, or c, GO TO HU1, ELSE GO TO HN4

HN4. Did you run the heat during the nighttime always, most of the time, sometimes, or hardly ever?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Don't know
f. Refused

HN5. Do you remember what the setting was when you used the heat during the nighttime?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF HN5 = a. THEN GO TO HU1, ELSE GO TO HN6

HN6. Was it set higher than 55 degrees, so the heat was on during the night?

a. A lot higher
b. A bit higher
c. About the same as 55
d. Don't know
e. Refused

H. Heating – U. Unoccupied settings

HU1. Before you got the programmable thermostat, did you keep your heater on while you were away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

HU2. Now that you have your programmable thermostat, do you keep your heater on while you are away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

C. Cooling – D. Daytime settings

CD1. Before you got the programmable thermostat, did you use a fairly constant temperature setting during the daytime when you were at home in the summer?

a. Yes
b. No
c. Don't Know
d. Refused

IF CD1 = a. THEN GO TO CD2, ELSE GO TO CD4

CD2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CD2 = a. THEN GO TO CN1, ELSE GO TO CD3

CD3. Was it set higher or lower than 78 degrees (current setting)?

a. A lot higher
b. A bit higher
c. About the same as it is now
d. A bit lower
e. A lot lower
f. Don't know
g. Refused

IF CD3 = a. or b., CONFIRM: "So your house was warmer than it is now during the summer and the air conditioner ran less often?"

IF CD3 = c., CONFIRM: "So your house was about the same temperature then as it is now?"

IF CD3 = d. or e., CONFIRM: "So your house was colder than it is now during the summer and the air conditioner ran more often?"

IF CD3 = a, b, c, d, or e, GO TO CN1, ELSE GO TO CD4

CD4. Was your house typically cooled the same, less, or more often than it is now?

a. Much less cooling CONFIRM: "So it was a lot warmer?"
b. A bit less cooling CONFIRM: "So it was a little warmer?"
c. The same CONFIRM: "So it was no warmer or cooler?"
d. A bit more cooling CONFIRM: "So it was a little cooler?"
e. A lot more cooling CONFIRM: "So it was a lot colder?"
f. Don't know
g. Refused

C. Cooling – N. Nighttime settings

CN1. Before you got the programmable thermostat, did you use a fairly constant temperature setting (or turn it off) during the night when you went to bed in the summer?

a. Yes
b. No
c. Don't Know
d. Refused

IF CN1 = a. THEN GO TO CN2, ELSE GO TO CN4

CN2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CN2 = a. THEN GO TO CU1, ELSE GO TO CN3

CN3. Was it set lower than 82 degrees, so the air conditioner was on during the night?

a. A lot lower
b. A bit lower
c. About the same as 90
d. Don't know
e. Refused

IF CN3 = a, b, or c, GO TO CU1, ELSE GO TO CN4

CN4. Did you run the air conditioner during the nighttime always, most of the time, sometimes, or hardly ever?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Don't know
f. Refused

CN5. Do you remember what the setting was when you used the air conditioner during the nighttime?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CN5 = a. THEN GO TO CU1, ELSE GO TO CN6

CN6. Was it set lower than 90 degrees, so the air conditioner was on during the night?

a. A lot lower
b. A bit lower
c. About the same as 90
d. Don't know
e. Refused

C. Cooling – U. Unoccupied settings

CU1. Before you got the programmable thermostat, did you keep your air conditioner on while you were away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

CU2. Now that you have your programmable thermostat, do you keep your air conditioner on while you are away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

6. Who programmed the settings for your thermostat?
   a. Tenant
   b. Contractor
   c. Property manager
   d. Other: _____
   e. Don't know
   f. Refused

H. Heating – D. Daytime settings

HD1. Before you got the programmable thermostat, did you use a fairly constant temperature setting during the daytime when you were at home in the winter?
Yes
No
Don't Know
Refused

IF HD1 = a. THEN GO TO HD2, ELSE GO TO HD4

HD2. Do you remember the setting?
Yes – Record Setting: _____
No
Don't Know
Refused

IF HD2 = a. THEN GO TO HN1, ELSE GO TO HD3

HD3. Was it set higher or lower than the current setting?
   a. A lot higher
   b. A bit higher
   c. About the same as it is now
   d. A bit lower
   e. A lot lower
   f. Don't know
   g. Refused

IF HD3 = a. or b., CONFIRM: "So your house was warmer than it is now during the winter and the heat ran more often?"

IF HD3 = c., CONFIRM: "So your house was about the same temperature then as it is now?"

IF HD3 = d. or e., CONFIRM: "So your house was colder than it is now during the winter and the heat ran less often?"

IF HD3 = a, b, c, d, or e, GO TO HN1, ELSE GO TO HD4

HD4. Was your house typically heated the same, less, or more often than it is now?
   a. Much less heat CONFIRM: "So it was a lot colder?"
   b. A bit less heat CONFIRM: "So it was a little colder?"
   c. The same CONFIRM: "So it was no warmer or colder?"
   d. A bit more heat CONFIRM: "So it was a little warmer?"
   e. A lot more heat CONFIRM: "So it was a lot warmer?"
   f. Don't know
   g. Refused

H. Heating – N. Nighttime settings

HN1. Before you got the programmable thermostat, did you use a fairly constant temperature setting (or turn it off) during the night when you went to bed in the winter?

a. Yes
b. No
c. Don't Know
d. Refused

IF HN1 = a. THEN GO TO HN2, ELSE GO TO HN4

HN2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF HN2 = a. THEN GO TO HU1, ELSE GO TO HN3

HN3. Was it set higher or lower than the current setting?

a. A lot higher
b. A bit higher
c. About the same as it is now
d. A bit lower
e. A lot lower
f. Don't know
g. Refused

IF HN3 = a. or b., CONFIRM: "So your house was warmer at night than it is now during the winter and the heat ran more often?"

IF HN3 = c., CONFIRM: "So your house was about the same temperature at night then as it is now?"

IF HN3 = d. or e., CONFIRM: "So your house was colder at night than it is now during the winter and the heat ran less often?"

IF HN3 = a, b, c, d, or e, GO TO HU1, ELSE GO TO HN4

HN4. Did you run the heat during the nighttime always, most of the time, sometimes, or hardly ever?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Don't know
f. Refused

HN5. Do you remember what the setting was when you used the heat during the nighttime?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF HN5 = a. THEN GO TO HU1, ELSE GO TO HN6

HN6. Was it set higher than 55 degrees, so the heat was on during the night?

a. A lot higher
b. A bit higher
c. About the same as 55
d. Don't know
e. Refused

H. Heating – U. Unoccupied settings

HU1. Before you got the programmable thermostat, did you keep your heater on while you were away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

HU2. Now that you have your programmable thermostat, do you keep your heater on while you are away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

C. Cooling – D. Daytime settings

CD1. Before you got the programmable thermostat, did you use a fairly constant temperature setting during the daytime when you were at home in the summer?

a. Yes
b. No
c. Don't Know
d. Refused

IF CD1 = a. THEN GO TO CD2, ELSE GO TO CD4

CD2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CD2 = a. THEN GO TO CN1, ELSE GO TO CD3

CD3. Was it set higher or lower than the current setting?

a. A lot higher
b. A bit higher
c. About the same as it is now
d. A bit lower
e. A lot lower
f. Don't know
g. Refused

IF CD3 = a. or b., CONFIRM: "So your house was warmer than it is now during the summer and the air conditioner ran less often?"

IF CD3 = c., CONFIRM: "So your house was about the same temperature then as it is now?"

IF CD3 = d. or e., CONFIRM: "So your house was colder than it is now during the summer and the air conditioner ran more often?"

IF CD3 = a, b, c, d, or e, GO TO CN1, ELSE GO TO CD4

CD4. Was your house typically cooled the same, less, or more often than it is now?

a. Much less cooling CONFIRM: "So it was a lot warmer?"
b. A bit less cooling CONFIRM: "So it was a little warmer?"
c. The same CONFIRM: "So it was no warmer or cooler?"
d. A bit more cooling CONFIRM: "So it was a little cooler?"
e. A lot more cooling CONFIRM: "So it was a lot colder?"
f. Don't know
g. Refused

C. Cooling – N. Nighttime settings

CN1. Before you got the programmable thermostat, did you use a fairly constant temperature setting (or turn it off) during the night when you went to bed in the summer?

a. Yes
b. No
c. Don't Know
d. Refused

IF CN1 = a. THEN GO TO CN2, ELSE GO TO CN4

CN2. Do you remember the setting?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CN2 = a. THEN GO TO CU1, ELSE GO TO CN3

CN3. Was it set lower than the current setting?

a.	A lot lower	CONFIRM: "So it was a lot colder?"
b.	A bit lower	CONFIRM: "So it was a little cooler?"
c.	About the same as now	CONFIRM: "So it was no warmer or cooler?"
d.	A bit higher	CONFIRM: "So it was a little warmer?"
e.	A lot higher	CONFIRM: "So it was a lot warmer?"
f.	Don't know	
g.	Refused	

IF CN3 WAS ANSWERED, GO TO CU1

CN4. Did you run the air conditioner during the nighttime always, most of the time, sometimes, or hardly ever?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Don't know
f. Refused

CN5. Do you remember what the setting was when you used the air conditioner during the nighttime?

a. Yes – Record Setting: _____
b. No
c. Don't Know
d. Refused

IF CN5 = a. THEN GO TO CU1, ELSE GO TO CN6

CN6. Was it set lower than 90 degrees, so the air conditioner was on during the night?

a. A lot lower
b. A bit lower
c. About the same as 90
d. Don't know
e. Refused

C. Cooling – U. Unoccupied settings

CU1. Before you got the programmable thermostat, did you keep your air conditioner on while you were away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

CU2. Now that you have your programmable thermostat, do you keep your air conditioner on while you are away?

a. Always
b. Most of the time
c. Sometimes
d. Hardly ever
e. Never
f. Don't know
g. Refused

Programmable Thermostat Settings Form

Auditor Initials:_____ Site Name: _____

Unit Number:

Sunday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Monday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Tuesday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Wednesday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Thursday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Friday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature
Saturday			
Period Start Time	Period End Time	Heating Temperature	Cooling Temperature

3. Appendix C - Interim Evaluation Report Executive Summary

This document is the executive summary of the interim report for the 2004–2005 California Statewide Multifamily Rebate Program Evaluation, Measurement, and Verification (EM&V) Study. The California Public Utilities Commission's Energy Division (CPUC or Commission) is the primary guidance organization for this evaluation effort, with the state's investor-owned utilities (IOUs) [San Diego Gas & Electric (SDG&E), Pacific Gas & Electric (PG&E), Southern California Edison (SCE) and Southern California Gas (SCG)] providing valuable feedback. The purpose of the interim report is to provide preliminary findings based on an interim round of process and impact research that was conducted in late spring and summer of 2005. A final report will be delivered in early 2006 that will document the complete study results, including a second round of process and impact research that will be conducted in late 2005 and early 2006.

3.1 Background and Program Description

The 2004-2005 California Statewide Multifamily Rebate Program was launched in 2002 to address the unique needs of the multifamily sector. This market was served prior to 2002 by the Residential Contractor Program, which typically focused on single-family homes. Thus, the 2002 program was innovative in having its design tailored to the unique barriers faced by the multifamily sector, primarily the split-incentive barrier. The program theory, as described in the program plans, is that financial incentives, along with program marketing and education, will be used to help multifamily property owners and managers overcome the split-incentive barrier. Although these owners and managers are responsible for facility improvements, they usually do not pay energy bills for the tenant spaces and therefore have little incentive to install more expensive energy-efficient measures in these spaces. The rebates help reduce—and in some cases totally eliminate—these higher first costs for energy-efficient equipment. The program also helps to encourage the participation of multifamily property owners and managers by offering rebates for energy-efficient measures installed in common areas. The program hopes that "program momentum and market penetration will likely increase at a faster rate" as multifamily property owners become more familiar and comfortable with energy-efficient measures and learn the long-term benefits of energy efficiency.

The 2004–2005 program is offered statewide in the service territories of PG&E, SCE, SDG&E and SCG. The program promotes energy savings in apartment dwelling units and in the common areas of apartment and condominium complexes and mobile home parks. Property owners (and property managers, as authorized agents for property owners) of existing residential multifamily complexes with five or more dwelling units may qualify for rebates for installing a variety of energy efficiency measures. These include:

- Apartment improvement measures (e.g., interior and exterior hardwired fixtures, ceiling fans, compact fluorescent lights (CFLs), clothes washers, and dishwashers)
- Common-area improvement measures (e.g., exit signs, occupancy sensors, photocells, high-performance dual-paned windows)
- Mechanical improvement measures
- High-efficiency heating and cooling equipment.

The electric measures, such as lamps, fixtures and appliances, have made up most of the savings attributed to the program. Gas measures have been much more challenging to sell to both contractors and property managers.

For 2004, modifications to the program included the addition and/or deletion of certain measures, modified rebate levels, and general program process improvements. The primary reason for these changes is to increase overall customer participation by removing barriers to energy efficiency product installations.

3.2 Overview of EM&V Objectives and Approach

This study will assess the performance of the 2004–2005 California Statewide Multifamily Rebate Program in terms of accomplished program goals and effectiveness of program processes. Key EM&V objectives include:

- Measurement and verification of energy and peak demand savings through development of ex-post savings and verification of measure installations
- Process evaluation to assess overall levels of performance and success of the program processes
- Market assessment of response to program interventions.

The following summarizes key elements of our interim EM&V approach.

3.2.1 Impact Evaluation

The objectives of the impact evaluation are to verify the energy savings claimed by the program. The interim impact evaluation:

- Assessed which savings parameters for each measure are most crucial for developing reliable energy and demand savings estimates
- Implemented data collection and analysis to update these parameters (as necessary)
- Implemented data collection and analysis to verify 2004 measure installations
- Calculated gross savings attributable to the program.

We conducted a total of 96 site visits, which is a subset of the 200 site visits that will be conducted for 2004 properties. An additional 200 site visits will be conducted for 2005 properties, and the final report will include results from all 400 sites. Additionally, the final report will report on net savings attributable to the program and will include a cost-effectiveness assessment. (The interim process evaluation includes an assessment of attribution factors, which may be applied to the impact evaluation estimates of gross savings to provide an estimate of interim net savings.)

3.2.2 Process Evaluation

The objectives of the process evaluation are to address the effectiveness of changes in program implementation from prior years and to identify areas for continued improvement. For example, increased emphasis on gas measures and quality control issues are being addressed in the 2004–2005 program based on feedback from prior years. The process evaluation will determine how effective implementation changes have been in bringing about improvements in these areas. The process evaluation will test the program theory by asking multifamily property owners about their barriers to previous implementation of energy-efficient measures and to what degree the program has mitigated these barriers. As noted, the interim process evaluation also includes an assessment of attribution factors, which measure the level of program free ridership. Finally in Phase 2 of the property/manager interviews, the process evaluation will do some measurement of participant spillover.

3.2.3 Market Assessment

The objectives of this task are to provide additional insight on the effectiveness of changes to the program over time and the impacts these changes have had on participant satisfaction. As such, we will explore satisfaction as part of the process evaluation activities described above. In addition, as part of the on-site verification activities planned for the impact evaluation, we will conduct brief interviews with tenants to assess satisfaction with the program and the measures installed. In addition, the market assessment involves an examination of the characteristics of participating properties as well as the geographic and other characteristics of the remaining potential. To further inform this market assessment as well as the process evaluation, we will review past studies of the California multifamily market such as the 2000 Statewide Survey of the Multifamily Market by ADM Associates and TecMRKT Works. Since we are also currently evaluating two other California multifamily programs—the Efficient Affordable Housing (EAH) program and the Partnership for Energy Affordability in Multifamily Housing (Energy Action)—we will also leverage knowledge from these evaluations.

3.3 CPUC Policy Manual Requirements

The evaluation addresses the California Public Utilities Commission (CPUC) Policy Manual evaluation requirement, as demonstrated in Table 3-1.

Table 3-1
CPUC Policy Manual Evaluation Requirements and Study Components and Approach to Meeting Requirements

CPUC Policy Manual Evaluation Requirement	Study Component	Study Approach
1. Measuring level of energy and peak demand savings achieved	Impact evaluation	• The impact evaluation includes both a verification study and a measurement study, which together will yield estimates of the program's energy and peak demand savings.
2. Measuring cost-effectiveness	Cost-effectiveness assessment	• KEMA will update the program's cost-effectiveness calculations using the measurement and verification results from the impact evaluation. We will recalculate the program's cost-effectiveness using the updated formulas and include the results in the study's draft and final reports.
3. Providing up-front market assessments and baseline analysis	Market Assessment	• The market assessment includes a review of existing multifamily market baseline studies, the results of which will be used to inform our process and market assessment and will be incorporated into our market assessment results.
4. Providing ongoing feedback and guidance	Impact, Process and Market Assessments	• The evaluation consists of two phases of research, with interim process, impact and market assessment results being provided mid-year 2005.
5. Measuring indicators of effectiveness, including testing of the assumptions that underlie the program theory and approach	Process and Market Assessment	• Interviews with property managers/owners and contractors will be used to test the assumptions underlying the program theory.
6. Assessing the overall levels of performance and success of programs	Impact, Process and Market Assessments	• The verification study will assess the overall levels of program performance. The process and market assessments will determine the effectiveness of the program in meeting its goals.
7. Informing decisions regarding compensation and final payments	Impact evaluation	• A verification study will be performed, which will generate verification ratios for each measure installed under the program. These ratios will be applied to the program's claimed accomplishments to provide counts of program-level verified measure installations.
8. Helping to assess whether there is a continuing need for the program	Process, Cost-effectiveness and Market Assessments	The final evaluation report will include a statement concerning the continuing need for program. This statement will be based on consideration of the following pieces of evidence: ▪ The degree to which the program is addressing the barriers to implementation identified by program participants; ▪ To what degree the program may be mitigating these barriers in any sustainable way; and ▪ Quantitative assessments of the relative cost-effectiveness of the program.

3.4 Interim Conclusions and Recommendations

This section provides our interim conclusions and recommendations. Note that this section is based on one phase of research activities. We plan to revisit our findings after completing the final round of research in early 2006 and will present final conclusions and recommendations in our final report.

3.4.1 Process Evaluation and Market Assessment

3.4.1.1 Program Targeting of the Multifamily Market Sector and Subsectors

3.4.1.1.1 Summary and Conclusions

KEMA's characterization of the multifamily market (Section 3) found that some subsectors of the multifamily market were underrepresented in the 2004 participant population. These included:

- Property managers/owners of small multifamily buildings (< 100 units),
- Property managers/owners of large multifamily buildings (> 250 units), and
- Large multifamily property management firms (50+ properties).

In their plans for the 2006-2008 Multifamily Rebate Program, the participating utilities appear to be trying to reach these underrepresented sectors.

The utility plans for the 2006-2008 Multifamily Rebate Program also aim to increase the number of self-initiators. Self-initiators are property managers/owners who join the program on their own accord without being driven to do so by an installation contractor. Program managers prize self-initiators because of assumed benefits of greater diversity in the types of energy efficiency measures installed (and thereby greater per-site energy savings) compared to "contractor-driven" participants. They also hope that these self-reliant participants will initiate more energy-efficiency projects than their contractor-driven counterparts.

KEMA's examination of the data from the 2004 program participants raised questions as to whether self-initiators are really a more desirable type of participant. It found no significant difference between the contractor-driven participants and the self-initiators in terms of their measure diversity or their plans for future energy efficiency projects. However, the types of marketing strategies that the utilities have been using to recruit more self-initiators – such as making presentations before apartment associations or paying for advertisements in multifamily trade publications – would likely benefit a broader range of property managers/owners than just the self-initiators.

3.4.1.1.2 Recommendations

Proceed with planned efforts to recruit large property management firms. The contractors' most-cited reason for not reaching these firms is that layers of bureaucracy make it difficult to locate the key decision maker. The Multifamily Rebate Program, using the prestige and perceived objectivity of its utility members, should have better luck finding these key decision makers and making them aware of the program than small installation contractors. Program managers have also speculated that large property management firms may be shutting out participating contractors because they do not know them or trust them. The program may also be help in this regard by using the prestige of the utilities to reassure the

large property management firms that the program has site inspections and other quality assurance practices to discourage poor-quality installations

Monitor whether new efforts to increase participation among managers/owners of small multifamily properties are having their desired effect. Opening up the program to properties with fewer than five units – as will happen in 2006 – should help participation in this subsector. However, making very small properties eligible will only increase participation in this subsegment if small property owners become aware of the program – either through contractors seeking them out or through other methods of program outreach. Smaller properties are naturally unattractive to contractors because they often do not have enough apartment units to offset contractor costs for marketing, administration, and travel. Program managers have stated that doing outreach with apartment associations will help reach the smaller property owners. Yet it is unclear whether these outreach efforts can offset the problems of contractor avoidance. Therefore, it is important for program managers to monitor carefully the size of the multifamily properties participating in their program. If the new eligibility rules and outreach to apartment associations fail to have their desired effect, then program managers may have to explore other approaches – such as direct mail campaigns targeted at smaller property owners.

Share data with contractors to help make their prospecting more efficient. Only the utilities have the "big picture" view of which properties and which geographic areas have been already served by the program. Contractors only know which properties they have served and not where their competitors have already done installations. Although utilities understandably cannot share specific customer data with contractors, they could share higher-level data of interest – e.g., ZIP codes with high levels of multifamily properties not served by the program. This could make contractor prospecting more efficient while also allowing the program to reach underserved areas.

Improve descriptions of program theories for program planning and targeting purposes. The Multifamily Rebate Program is currently disadvantaged by the lack of an explicit program theory. Some of the program plans for the 2006-2008 period do improve on past program plans in trying to articulate the program theory. However, much improvement is needed. An explicit program theory would help explain the purpose of key program activities, help identify appropriate strategies for mitigating market barriers, and help measure program progress and success through metrics that are based on desired program outcomes.

3.4.1.2 Program Targets for Energy Efficiency Measures

3.4.1.2.1 Summary and Conclusions

In 2004 the Multifamily Rebate Program did not achieve diversity in the types of energy efficiency measures that were installed. Three measure types – compact fluorescent lamps, programmable thermostats, and boiler controllers – accounted for 90 percent of the program's claimed savings and there is very little overlap at properties among these measures. In addition, over half of the participating contractors either install only lighting measures and programmable thermostats or only install lighting. For those installing lighting measures, compact fluorescent lamps accounted for the majority of lighting measures. With the phase-out of programmable thermostat rebates, many of these contractors may become solely lighting contractors. It is not clear whether this lack of contractor diversity is a cause or an effect of the lack of measure diversity.

However, the 2004 evaluation found evidence that the multifamily market may be shifting towards other types of energy efficient technologies and more diversity in energy-efficient lighting:

- Seventy-seven percent of participating property managers said that they were planning energy efficiency improvements over the next 3 years and the measures they were most likely to install included energy-efficient lighting other than CFLs, high-efficiency refrigerators, and high-efficiency water heaters.
- Nearly two-thirds of the nonparticipating property managers were interested in energy-efficient water heaters and controllers. At least 40 percent of the respondents were also interested in energy-efficient fluorescent fixtures, screw-in CFLs, energy-efficient air conditioners and heat pumps, and ENERGY STAR clothes washers.
- Participating contractors believed that the greatest market potential was for T5/T8 lamps and the least market potential was for CFLs installed in common areas. Using a scale where 10 indicated "unlimited" market opportunities and 1 indicated "no opportunities," contractors gave a 7.9 rating to T5s/T8s, a 6.8 rating to CFLs in tenant units, a 6.1 rating to programmable thermostats, and 5.5 rating to CFLs in common areas.

One additional reason for encouraging measure diversity is evidence from the evaluation that free ridership rates for the program's most popular measure types may be higher than prior assumptions. KEMA calculated program attributions factors of 65 percent for compact fluorescent lamps, 77 percent for programmable thermostats, and 39 percent for boiler controls. These factors represent the percentage of verified gross savings that can be attributed to the program rebates after adjusting for free-ridership effects including partial free ridership and delayed free ridership. The program attribution analysis did find that the program helped increase the energy efficiency of a large majority of projects. Only 7 – 20 percent of the participants in each measure category were total free riders. However, conversely, only a little more than half of the programmable thermostat participants, less than half of the CFL participants, and only a fifth of the boiler controller participants were non-free riders.

3.4.1.2.2 Recommendations

Increase incentives for measure diversity. Multifamily Rebate Program managers say that they do verbally encourage contractors to implement projects with greater measure diversity. The program also promotes measure diversity indirectly through caps on lighting rebates and CFL rebates in particular. However, the 2004-2005 program does not have any formal requirements or explicit incentives to encourage projects with multiple measures. In addition, the KEMA evaluation finds no evidence that self-initiators are more likely to have projects with more diverse measure types. In its plan for the 2006-2008 program SDG&E does offer a bonus incentive for installations of three or more measure types. Other utilities participating in the program should consider incorporating similar requirements.

Continue and enhance marketing efforts to recruit underrepresented contractor types. In 2004 some of the utilities initiated marketing efforts to try to recruit contractor types that are currently underrepresented in the program's contractor mix such as plumbers and insulation contractors. Such efforts should be continued. However, utilities should also try other approaches besides direct mail to recruit these

contractors. For example, interviews with nonparticipating plumbing contractors and distributors from past evaluations revealed that the best way to promote the Multifamily Rebate Program was through joint workshops with manufacturers, supply houses, and plumbers.

Consider increasing rebates for exterior hardwired lighting fixtures and T5s/T8s. Contractors generally thought that current rebate levels offered by the Multifamily Rebate Program were adequate. The two measure types that the largest number of contractors thought needed higher rebates were exterior lighting fixtures and T5s/T8s. They pointed to higher equipment costs along with higher installation costs. The 2006-2008 program plans do not increase rebate levels for these measures. The utilities participating in the Multifamily Rebate Program should examine whether contractor claims of higher equipment costs are justified and also compare program rebate levels for these measures with those offered by other energy efficiency programs. Then the utilities should consider increasing these rebate levels if the information it gathers appears to justify such an increase.

Reconsider offering rebates for boiler controllers. Although it was based on a small sample (N = 10), KEMA's evaluation found high free-ridership levels for this measure among 2004 participants. Almost all of the participants who installed boiler controllers said that they likely would have installed the same measure without the rebate. The biggest effect of the rebates was to accelerate the purchase of the equipment by 6 months to a year. If requested, KEMA could examine free ridership among 2005 boiler controller participants using a larger sample size.

Use data-mining to identify untapped energy efficiency opportunities among past participants. In its April 2005 Gap Analysis Memorandum, KEMA noted that the Multifamily Rebate Program did not appear to be leveraging existing tracking databases to identify untapped energy efficiency opportunities from past participants. This "data-mining" activity has been identified as a "best practice" for multifamily energy efficiency program in the National Best Practices Study. Some program managers have said that program's recent success in meeting its energy savings goals has made such research unnecessary. However, the 2006 phase-out of programmable thermostat rebates, which have been a large contributor to program savings in the past, will make alternative ways of finding new energy projects – such as data-mining – all the more necessary.

3.4.1.3 Program Quality Assurance Efforts

3.4.1.3.1 Summary and Conclusions

Utilities participating in the Multifamily Rebate Program have taken a number of actions to improve the quality of equipment and installations rebated by the program. These include more frequent inspections of rebated projects, conducting post-installation customer satisfaction surveys, providing property managers/owners with manuals that help guide them in selecting contractors, requiring contractors to provide contact and warranty information for addressing post-installation problems, quickly responding to customer complaints and making contractors remedy the situation, and even gaining the authority to exclude noncompliant contractors from the program.

However, no one utility does all these things to assure quality. Some participating utilities provide property managers/owners with manuals for choosing contractors while others do not. Some utilities require contractors to provide warranty information while others only encourage contractors to do so. Some utilities conduct post-installation customer satisfaction surveys while other do not. More importantly, despite these efforts, quality control remains a concern for the Multifamily Rebate Program:

- Only two-thirds of the 2004 participants were satisfied with the installation of their equipment, whether this was done in the common areas or in the tenant units.
- Only a small majority of participants are satisfied with the quality of the CFL and programmable thermostats.
- The most-cited reasons for dissatisfaction were equipment breakdowns and poor-quality installations.
- Only 43 percent of the property managers/owners said that their contractors had provided any information on manufacturer warranties for the installed equipment.
- Participating contractors said that, on average, over 70 percent of their lighting products come directly from manufacturers. Since quality-control testing of CFLs by organizations such as PEARL is currently limited to retail products, this raises concerns that the CFLs installed by participating contractors may be of lower quality than those that are subject to quality testing.

The findings concerning program quality control were not all bad. Over three-quarters of the property managers/owners did say that their contractors were responsive to their questions and complaints. Seventy-one percent of contractors said that they leave warranty information behind and 81 percent of the lighting installers said that they leave extra lamps behind to replace early as a standard practice. Seventy-one percent of contractors said that when customers are unhappy with the equipment they install or the installation itself, their standard procedure is to send someone out to fix the problem. It should also be noted that participant dissatisfaction with the quality of installations and equipment has not tremendously affected their satisfaction with the Multifamily Rebate Program as a whole.

3.4.1.3.2 Recommendations

Advocate for the PEARL program to test CFLs directly from manufacturers. As noted, over 70 percent of lighting products installed by participating contractors come directly from manufacturers. Since quality-control testing of compact fluorescent lamps by organizations such as PEARL is currently limited to retail products, this raises concerns that the CFLs installed by participating contractors may be of lower quality than those that are subject to quality testing. Therefore program managers should advocate for an expansion of this program to include testing of CFLs that come directly from the manufacturers.

Use program inspections more intelligently. Some utilities are inspecting 100 percent of participant sites and one utility is calling back almost all of their participants. Yet it is not clear why such a high level of inspections or callbacks is necessary for the purposes of verification, deterrence, or information collection. Random samples of a much smaller percentage of sites or participants—along with targeted inspections of new contractors, problem contractors, and very expensive measures—should be an effective deterrent and would appear to be a more cost-effective approach.

3.4.1.4 Program Processes and Program Satisfaction

3.4.1.4.1 Summary and Conclusions

With a few exceptions, participating property managers/owners and participating contractors were generally satisfied with program processes. Some of the positive findings concerned program processes included:

- Ninety-percent of participants were satisfied with the rebate application form.
- Over three-quarters of participating property managers/owners were satisfied with the program staff.
- Over three-quarters of participating contractors were satisfied with the rebate levels and the rebate process.
- Over two-thirds of participating contractors were satisfied with the program staff and website.
- Only one contractor said that it was difficult to find out which energy-efficient measures qualify for the Multifamily Rebate Program rebates.

Rebate payment was the program process that both participating property managers/owners and participating contractors were least satisfied with. Only 48 percent of participating property managers/owners thought that the rebate check was sent in a timely manner. Fewer than 40 percent of the participating contractors said that rebate payment was timely. The most-cited contractor recommendation for a program improvement was increasing rebate/program funding.

Participating property manager/owner satisfaction with the program as a whole was very high. Over three-quarters of participants were satisfied with the program as a whole and 91 percent said that they would recommend the program to another property manager/owner. Only 7 percent of participants were dissatisfied with the program. In addition, 85 percent of participating contractors were satisfied with the program as a whole.

3.4.1.4.2 Recommendations

Improve processing of rebate applications and issuing checks. Most participating property managers/owners and most participating contractors did not think that incentives were paid in a timely manner. The utilities should examine how they process rebate application forms and issue payment—including an analysis of the time taken for each step of the process. Other utilities have been able to make significant reductions in processing and payment times through such efficiency analyses.

3.4.2 Impact Evaluation

The interim findings indicate that the program impacts are much lower than the ex ante impacts. The impacts are primarily due to installation of CFLs (excluding SCG) and programmable thermostats (p-stats). The evaluation has found that both of these measures are not achieving the impacts assumed in the deemed savings values used by the utilities in 2004 and 2005. Given that recent studies also concluded lower savings for p-stats and CFLs our findings were expected. The primary drivers of the low realization rates are:

1. P-stats and CFLs account for over 73 percent of the Statewide program impacts.
2. P-stats impacts were known to be over-estimated prior to the evaluation.
3. Evaluation findings indicated that 46 percent of p-stats installed were operated in the same fashion as the pre-retrofit manual thermostat. In addition, 15 percent of the units surveyed were either not installed or have been replaced with a manual thermostat. Therefore, only 40% of the units have any potential to provide savings.
4. Based on the comprehensive 2004 California CFL Metering study (KEMA) the average hours of operation for residential space lighting is 2.3 hours per day. It appears that the deemed savings were based on 3.5 hours per day. The evaluation results to date indicate that the average usage for CFLs surveyed is 2.1 hours per day. This indicates a 40 percent reduction in savings comparing the ex ante and evaluation impacts. In addition, the average delta watts of lamps surveyed is only about 73% of the assumed values used to produce the deemed savings.

4. Appendix D – Boiler Control Analysis Results

Impact Evaluation of the 2004-2005 Statewide Multifamily Boiler Control Measure

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March 12, 2007

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Executive Summary

1.1 Introduction

This report describes the data, methodology, and analysis results of the boiler control measure installed through the 2004-2005 Statewide Multifamily Rebate Program operated by San Diego Gas & Electric Company (SDG&E), Southern California Gas Company (SoCalGas), and Pacific Gas & Electric Company (PG&E), the three California IOUs that provide natural gas services to their customers. The impact analysis uses a Statistically Adjusted Engineering (SAE) regression technique to estimate first year therm savings associated with boiler controller measures. Four sections comprise this report.

- This **Executive Summary** provides a brief overview of the billing analysis method and the high-level IOU-specific results for boiler control measures.
- The **Analysis Methodology** section details the data requirements of an SAE analysis, the data made available to the Itron team for the analysis of the Statewide Multifamily boiler control measure, and the SAE modeling technique used in this analysis.
- The **Impact Evaluation Results** section includes a presentation of estimated gross and net therm savings and realization rates, with a discussion of the lessons learned as the team conducted the analysis.
- The **Recommendations for Future Analysis** section describes the steps that could be taken by the California IOUs and the Itron team to improve any future impact analysis of the multifamily boiler control measure.
- **Appendix A** describes the additional steps that were taken to ensure that the realization rate from the impact evaluation was consistent with alternative methods of evaluation.

1.2 Overview of Billing Analysis

Therm savings from the installation of boiler control measures installed in multifamily complexes was estimated using billing analysis and regression techniques. Statistically Adjusted Engineering (SAE) analysis was used to econometrically estimate a ratio of realized impacts to an a priori engineering estimate of savings. These realized impacts represent the

fraction of engineering estimates actually "observed" or "detected" in the statistical analysis of the billing data. Utility-specific SAE coefficients are estimated, and can then be used to calculate therm savings from the installation of boiler controls at multifamily complexes in each utility's service territory.

In the SAE framework, initial estimates of the program participation effects are represented by engineering estimates of savings for each facility. One benefit to using the SAE approach is that the engineering estimate implicitly accounts for the difference in savings associated with different measure types. The coefficient of the engineering estimate of savings is referred to as a realization rate, or the fraction of the engineering estimate realized in the form of actual reductions in natural gas consumption.

1.3 Statewide Level Results

This section presents the estimated 2004-2005 statewide gross and net therm savings achieved by PG&E, SDG&E, and SCG from the installation of boiler controls. The estimate of gross savings is derived by multiplying an a priori engineering estimate of therm savings from boiler controls by an estimated realization rate of savings. The realization rate used to calculate statewide savings from this measure is PG&E's estimated rate. As described in Section 3 of this report, the realization rates estimated for SDG&E and SoCalGas were not statistically significant. We attribute this principally to a lack of contributing data, due in part to: an evaluation plan that did not include the collection of participant phone survey/on-site/metering data, inaccuracies in the tracking data, and a lack of sufficient billing data provided by the utilities. Sufficient data may have been difficult for the utilities to provide had they not anticipated an SAE analysis of multifamily boiler controls would be conducted.

Another possible explanation for the low realization rate estimates could arise from the installation of boiler controllers onto boilers that have been previously controlled. During an interview with one of the boiler control vendors, he estimated that approximately 30% of boiler controllers are installed in facilities already equipped with boiler controllers. It is expected that a controller upgrade, such as that described by this vendor, would result in reduced savings for those particular installations, as the ex-ante estimates are based on a baseline condition without equivalent boiler controls.

Since PG&E's program tracking and billing data are sufficiently complete, we use the estimated realization rate from this analysis to calculate the 2004-2005 statewide multifamily boiler therm savings. Though the PG&E realization rate presented is our best available estimate for the boiler controller measure, we still feel this realization rate should be viewed with caution. Table 1-1 presents estimates of gross and net annual therm savings per boiler controller derived from the billing analysis. Included in this table is the gross engineering

estimate of annual savings per boiler controller overall, gross engineering estimates for small and large controllers, the gross estimates of realized savings based on the realization rate estimated for PG&E, and the net estimates of realized savings based on a net-to-gross ratio of 0.83.[1]

The residential multifamily rebate program PY2004/2005 Work Papers state that the estimated gas savings from a water heater and/or boiler controller is approximately 15% of water heating usage, or approximately 231 therms per apartment unit for a typical 40 unit multifamily complex. For boiler controllers installed in multifamily complexes with fewer than 20 units, the engineering estimate is 554.4 therms per boiler controller. The engineering estimate of gross savings for controllers installed in complexes with more than 20 units is 1,388. When these engineering estimates of therm savings per boiler controller are multiplied by the estimated realization rate of 12% for PG&E, the results are relatively small ex-post gross therm savings estimates. Multiplying by the net-to-gross ratio further reduces the estimates of realized savings per boiler controller.

Table 1-1: Statewide 2004-2005 Multifamily Boilers Program Engineering and Realized Therm Savings (Therms/Year/Controller)

Measure	Gross Engineering Estimate of Savings* (A)	Gross Estimate of Realized Savings (12%*A) = G	Net Estimate of Realized Savings (G*83%)
Boiler Controller for Facilities with less than 20 Apartment Units	554.4	66.53	55.22
Boiler Controller for Facilities with more than 20 Apartment Units	1,388	166.56	138.24

* The engineering estimates of savings per boiler controllers were taken from PG&E Multifamily Rebate Program PY2004/PY2005 Work Papers.

1.4 Program Goals and Accomplishments

The gross and net projected goals and recorded accomplishments for each of the utilities operating the multifamily boilers program during 2004-2005 are presented in Table 1-2, which shows that overall, the utilities' recorded accomplishments represent approximately 85% of their goals.

[1] This net-to-gross ratio was recently revised downward from 0.89% to 0.83% based on comments received by the California IOUs involved in the multifamily boilers program.

Table 1-2: Gross and Net Program Goals and Recorded Accomplishments for 2004-2005 Statewide Multifamily Boiler Program

Utility	Projected Number of Boilers	Recorded Number of Boilers	Gross		Net Realized	
			Projected Annual Goals (therms)	Recorded Annual Savings (therms)	Projected Annual Goals (therms)	Recorded Annual Savings (therms)
PG&E	1,070	764	951,656	790,346	96,783	80,378
SCG	520	425	426,480	356,204	43,373	36,226
SDG&E	416	361	535,575	473,340	54,468	48,139
TOTAL	**2,006**	**1,550**	**1,913,711**	**1,619,890**	**194,624**	**164,743**

* Results are taken from the following workbooks: 03_ResMultifamilyEERebates_Nov05.xls for SoCalGas, 19 - SDGE SW Residential Multifamily Rebates – Dec 05.xls and 27 – SDGE SW Residential Multifamily Rebates (Proc) – Dec 05.xls for SDG&E, and the AEAP filing, MF rebate tab in a Res data.xls spreadsheet received from PGE. Confirmed as correct source by Frank Lee at PG&E.

2

Analysis Methodology

2.1 Overview

The approach used to estimate realized savings for the boiler control measure is a traditional SAE billing analysis framework. This is a typical specification for studying panel data where a priori engineering estimates of savings are available. Panel data containing many cross-sectional units (i.e., premises) with multiple observations over time for each unit (i.e., monthly data) are used to estimate therm savings over the entire population of participants with usable billing and program tracking data. The resulting estimate is a realization rate that when subsequently applied to the engineering estimate of savings, yields an SAE adjusted ex-post estimate of program savings.

The use of an SAE framework to analyze the installation of boiler controllers in a multifamily setting requires a significant amount of data on multiple units and facilities over time. The needed data include gas consumption for facilities associated with the boiler control installations, engineering estimates of per-unit savings from the installation of boiler controllers, tracking information surrounding the date of installation and quantity of controllers installed at each site, and weather data. Much of this information could have been collected through phone surveys or on-site visits, but budget constraints and difficulties in communicating with managers of multifamily facilities made these data collection activities prohibitive.

2.2 Data Sources

The econometric analysis used three types of data to compute program impacts:

- Monthly billing data for participants covering 2002 – 2006 were requested from the utilities. Below we present the data ultimately received from each utility:
  - PG&E provided billing data covering January 2002 – May 2006
  - SDG&E provided billing data covering June 2003 – May 2006
  - SoCalGas provided billing data covering September 2003 – August 2006[1]

[1] Given the lack of data during the early portion of 2003, it was not possible to estimate a realization rate for controllers installed prior to June 2004 for SDG&E and September 2004 for SoCalGas.

- Monthly weather data matching the period covered by the billing data, and
- Program tracking data for the participants in the 2004 and 2005 multifamily program where boiler controllers were installed.

For the multifamily model, the basic unit of observation is the facility. Aggregating gas use accounts to the facility level allows common area impacts to be captured as part of the modeling process. Aggregating to the facility level requires the participant tracking data to include all relevant account numbers associated with the boiler control installations. The tracking data account numbers are then carefully matched to all relevant facility-level monthly gas bills. The next few sections describe the process by which these data were reviewed, aggregated, and transformed for their use as model inputs.

Program Tracking Data

The following fields from the program tracking data were included in the creation of the analysis database:

- Utility serving the site,
- The type and number of boiler controllers installed,
- The contractor installing the boiler controllers,
- The engineering estimate of savings,
- The account numbers associated with each boiler control installation,[2]
- The number of units in the facility, and
- The project completion date for each boiler control installation.

To ensure the quality of the tracking data, each utility was asked to verify that the tracking information provided to the project team included all account numbers associated with the boiler control installations. A full account number listing is necessary to ensure that all associated consumption data are included in the SAE model.[3]

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[2] A complete list of all impacted account numbers is necessary to ensure that the model includes all consumption associated with the boiler controllers. For example, if 10 equally sized accounts are associated with a facility receiving 10 boiler controllers and the tracking data only includes one account number, the team will only have access to the change in consumption associated with one boiler. The model will compare the consumption from one account with the savings associated with 10 boilers which were associated with 10 accounts. The model will find an inaccurate and low realization rate in this situation.

[3] Analysis of the tracking and billing data suggests that not all of the account numbers associated with SDG&E and SoCalGas installations were provided. Several facilities in the SDG&E and SoCalGas databases had engineering estimates of savings that exceeded the gas usage level of the site. The high ratio of savings-to-usage suggests that the listing of account numbers (Acct_NBR or BAID) in the program tracking database is incomplete. PG&E's 2004 tracking data included multiple account numbers (or SAID numbers) for a given application. Multiple SAID numbers represent multiple meters at a facility. The 2005

Consumption Data

A gas billing data request was submitted to PG&E, SDG&E and SoCalGas for each meter at each facility that installed boiler controls. These data consist of all monthly billed consumption data by location and facility ID and the read date associated with the billed consumption.[4] The billing data were aggregated to the facility level. Some facilities were master metered with only one meter serving a large number of dwelling units. Other sites were master metered with several meters serving a large number of dwellings. Furthermore, some sites had separate meters for common area equipment while others did not.

The next step was to review monthly gas consumption on a site-by-site basis. This review identified anomalous billing data at the facility level. This review took several forms. First, data were printed for each location by month and year. This report permitted a detailed examination of the data where problems such as rebilling, missing reads, and estimated reads could be identified. The review of the data led to averaging of reads that covered several months, setting some reads to missing if the data appeared inconsistent with previous and past reads, and elimination of sites with consistent billing data anomalies. After the data were thoroughly reviewed, the database was finalized and merged with other components of the model.

Weather Data

Actual daily heating and cooling degree days were obtained at the start of the analysis for the following stations: Oakland, Red Bluff, Sacramento, San Francisco, San Jose, Santa Rosa, Burbank, Long Beach, Los Angeles, Riverside, San Diego, and SD-Miramar. The weather data were associated with the consumption data based on zip codes and monthly read dates found on the billing data. Once the appropriate degree days were calculated for each billing month of consumption, they were summed and normalized to a monthly value for the use in the model.

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tracking data, however, initially included only one SAID number per application. A 2005 tracking data set with a full listing of facility SAID numbers was subsequently provided to the project team.

[4] As stated in footnote 1, it is clear that we did not receive all of SDG&E or SoCalGas account numbers. Eleven SCG sites and 24 SDG&E sites were eliminated from the Sempra data due to a savings to consumption ratio exceeding 0.5. Eight sites from the 2004 program tracking data and 14 sites from the 2005 program tracking data were eliminated from the PG&E database due to the inability to match bills to all SAID numbers at the site.

2.3 Model Specification

The SAE model specification to determine the impact of boiler controllers on multifamily gas usage was designed to yield utility-specific results. Each utility's model can be represented by the following equation:

$$\frac{Therm_{it}}{Units_i} = \beta_0 + \beta_1 \frac{Therm_{it-12}}{Units_i} + \beta_2 \frac{BCSAV_{it}}{Units_i} + \beta_3 \Delta CDD_{it} + \beta_4 \Delta HDD_{it} + \beta_5 W\text{int}er04$$

$$+ \beta_6 W\text{int}er05 + \beta_7 W\text{int}er06 + \beta_8 \frac{Therm_{it-12}}{Units_i}\left(\frac{HDD_{it} - HDDNA_i}{HDDN_i}\right) + \varepsilon_{it}$$

where:

$\frac{Therm_{it}}{Units_i} =$	the gas usage per dwelling unit at site *i* in billing period *t*
$\frac{Therm_{it-12}}{Units_i} =$	the gas usage per dwelling unit at site *i* in billing period t-12
$\frac{BCSAV_{it}}{Units_i} =$	the monthly engineering estimates of savings for all installed boiler controllers per dwelling unit at site i
$\Delta CDD_{it} =$	the change in normalized cooling degree days from the previous year's month for site i and month *t* in site *i*'s climate zone (i.e., CDD_{it}-CDD_{it-12})
$\Delta HDD_{it} =$	the change in normalized heating degree days from the previous year's month for site *i* and month *t* in site *i*'s climate zone (i.e., HDD_{it}-HDD_{it-12})
Winter04 =	a binary indicator for December 2003, January 2004, and February 2004
Winter05 =	a binary indicator for December 2004, January 2005, and February 2005
Winter06 =	a binary indicator for December 2005, January 2006, and February 2006
$\varepsilon_{it} =$	a random error term.
$\left(\frac{HDD_{it} - HDDNA_i}{HDDN_i}\right) =$	difference between normalized monthly heating degree days and the average normal monthly heating degree days, divided by annual normal heating degree days

Each coefficient in the model shows the impact on the dependent variable given a one-unit change in the explanatory variable it describes. The following briefly describes each coefficient in the model and how they are interpreted.

$\beta_0 =$	Intercept
$\beta_1 =$	the change in therm/unit given a per-unit change in the 12-month lag of therm/unit
$\beta_2 =$	the change in therm/unit given a per-unit change in the total engineering estimate of savings per unit
$\beta_3 =$	the change in therm/unit given a per-unit change in the 12-month change in cooling degree days
$\beta_4 =$	the change in therm/unit given a per-unit change in the 12-month change in heating degree days
$\beta_5, \beta_6, \beta_7 =$	the adjustment to therm/unit given the winter month and year which the observation's consumption was obtained.
$\beta_8 =$	the change in therm/unit given a per-unit change in the engineering estimate of boiler control savings multiplied by the ratio of the difference of normal monthly heating degree days from average normal monthly heating degree days, divided by annual normal heating degree days

2.3.1 Model Description

Participant per-unit gas usage in billing period *t* was modeled as a function of per-unit usage in the same billing period 12 months prior, as well as weather changes, the engineering estimate of per-unit savings, and other available relevant independent variables.[5] For the first year of the months where the new boiler is in place, the per-unit engineering estimate of savings is non-zero. In all other months, the per-unit engineering estimate of savings is zero. The coefficient on this variable represents the portion of the predicted impacts of the boiler controller actually detected in the bills. Usage from January 2002 through the most recent available month in 2006 was requested from the utilities. Data from all of 2003 are

[5] SDG&E and SoCalGas do not track the number of units in a facility on either their program tracking or billing databases. Therefore, participant gas usage for SDG&E and SoCalGas was modeled as a function of usage in the same billing period 12 months prior, as well as the engineering estimate of total savings. This method is likely to be inferior to the per-unit method. Modeling consumption associated with both very small complexes and relatively large facilities is likely to reduce the precision of the resulting estimates. Normalizing consumption and savings to the per-unit level reduces problems of heteroskedasticity and places the consumption and savings of all facilities into the same order of magnitude.

necessary to allow the model to use the facility's per-installation usage to control for facility specific consumption patterns. These data are also necessary to calculate the 12-month lag in gas consumption for installations in 2004. The 12-month lag in gas usage controls for various factors affecting gas consumption at the site during the calendar month in question.

The model quantifies the relationship of usage to heating and cooling degree days. Increases in heating degree days, relative to the previous year's value, are expected to increase gas consumption. Increases in cooling degree days are expected to decrease gas consumption. The model exhibited significant autocorrelation. Generalized least squares was used to correct the problem.[6] The model is cast in terms of usage per dwelling unit in order to minimize heteroskedasticity.[7]

The approach uses only participant data. Given that the SAE model was estimated without nonparticipant data, results are interpreted as an estimate of gross savings. The estimation of a monthly SAE model, as the team has carried out in this analysis, includes extensive billing data for both pre- and post-installation periods of boiler controllers. These data help control for changes in the environment, such as economic fluctuations, energy crises, etc., that may influence consumption. The extensive pre- and post-information on participants is similar to including nonparticipant data in an SAE model designed to model gross realization rates.

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6 In regression analysis it is assumed that the estimated error for each observation has no correlation to the estimated errors in the other observations. When the element of time is introduced, however, this assumption may not hold. Autocorrelation occurs when the error terms from period to period show a distinct pattern indicating that there is some correlation in the errors over time. See Greene, William. *Econometric Analysis*, 2nd edition, New York: Macmillan Publishing Co., 1993 for further information.

7 When heteroskedasticity is observed, it is generally true that as one of the variables (e.g., number of units) increases the variance of the errors also increases violating the assumption that the variance of the errors is minimized and constant for all observations.

3

Impact Evaluation Results

3.1 Overview

This section presents the results from the model estimation for each utility to determine the therm savings achieved from the installation of boiler control measures at multifamily facilities. The analysis methodology described in Section 2 was employed to calculate utility-specific gross realization rates of therm savings for PG&E, SDG&E, and SoCalGas. The PG&E model was estimated using installations from the 2004 and 2005 program years. Since SoCalGas and SDG&E did not provide billing data that extended for the period requested (2002 through the last available date in 2006), not all installations over both program years could be included. A minimum of one year of billing data prior to the installation of a boiler controller is required for the SAE model. Specifically, the billing data received by Itron from SoCalGas begins in September 2003, and for SDG&E it begins in June 2003. This means that SoCalGas' installations before September 2004 and SDG&E installations before June 2004 could not be fully included in the SAE analysis, accounting for the exclusion of 73 out of 123 (60%) and 18 of 56 (32%) of 2004 program year sites from the analysis, respectively.

The SAE models were estimated using generalized least squares (GLS) for program years 2004 and 2005. The use of GLS allows for the recognition of the non-spherical nature of the disturbance terms, thereby enabling the model to produce linear unbiased estimators with a variance-covariance matrix (i.e., a relatively efficient estimator) that is "smaller" than traditional ordinary least squares (OLS).[1] All models presented in this section have been corrected for autocorrelation in the model's residuals.

Data Issues

The Itron team encountered difficulty as it conducted the impact analyses for the utilities. This was mostly due to a lack of sufficient data, as discussed throughout the presentation of results.

[1] For further details on Generalized Least Squares estimation, see Greene, William. *Econometric Analysis*, 2nd edition, New York: Macmillan Publishing Co., 1993.

PG&E provided the team with the tracking data requested; however, all site specific tracking data for PY2005 were received relatively late on November 29, 2006. The lateness of the PY2005 tracking data was due to the receipt of prior PY2005 tracking datasets with incomplete information on the SAID numbers associated with participating facilities. A complete set of SAID numbers associated with boiler controller installations is needed to request/identify/use appropriate billing data and to enable site aggregation up to the facility level. Given the late receipt of the PY2005 tracking data, the project team proceeded without an update on the billing data request. The inability to update the billing request led to 22 sites being eliminated from the 104 (21%) sites listed in the PY2004-2005 tracking database due to incomplete billing records.

The tracking data provided by SDG&E and SoCalGas also appear to be incomplete. The team requested the utilities check to ensure that the team had received all account and BAID numbers associated with the boiler controllers. After checking, the utilities indicated that the numbers listed included all available identification numbers associated with the boiler control installations. The team felt, however, that it did not have all the billing data associated with the boiler controllers due to the high value of claimed savings relative to usage for several sites. Ex ante savings assume that boiler controllers reduce boiler consumption by 15%. The team decided to eliminate sites where the claimed savings exceeded 50% of natural gas consumption. These criteria led to the elimination of 11 out of 190 (6%) SoCalGas sites and 24 out of 81 (31%) SDG&E sites.

Additionally, neither Sempra Energy utility was able to provide the number of units in each multifamily complex since this is tracked neither in their billing systems nor in their tracking system.[2] The SAE model is designed to analyze average per-unit consumption, determining the realization rate of per-unit claimed savings. Using per-unit consumption and savings in the model guarantees that all dependent variables are in the same order of magnitude. Analyzing the model at the facility level allows larger sites to have substantially larger consumption while smaller facilities have relatively little consumption. Dividing by number of units allows for an analysis of similar-sized consumption.

Additional variables that would have improved the quality of the results include information on occupancy rates, whether the premises were master metered or master metered with sub-metering, the average square footage per unit, boiler type present at facilities (space heating,

[2] PG&E tracked the number of units in both the tracking and the billing systems. Information on the number of units in a complex is useful information that could be used by the utilities as a cross check to ensure that the correct size boiler controller was requested by the applicant and installed by the contractor. For example, a site with 200 units and 20 boiler controllers would not be eligible for a large boiler controller (more than 20 units per controller). The team recommends that Sempra track these data in the future.

water, or both), and information on the existence of a previous boiler controller.[3] This information could be collected by a phone or on-site survey, or ideally during measure installation by the vendor.

3.2 PG&E Model Estimates

Table 3-1 presents the estimates for the PG&E SAE model estimated for the multifamily complexes in PG&E's territory that had boiler control measures installed during program years 2004 or 2005. The gross realization rate of therm savings from this program is the coefficient on the engineering estimate of savings, (BCSavings), which is equal to 12%.

Table 3-1: PG&E Monthly SAE Model for Boiler Controllers, Program Years 2004-2005

Variable	Parameter Estimate	T-statistics
Intercept	0.71177	6.65
$Therm_{T-12}$	0.89043	80.76
BCSavings	-0.12253	-3.08
ΔHDD	0.00672	11.10
ΔCDD	-0.00432	-4.72
HDD_{T-1}	0.00076348	1.63
CDD_{T-1}	-0.00067887	-0.91
$\left(\frac{HDD_{iT} - HDDNA_i}{HDDN_i}\right) \times Therm_{T-12}$	0.11541	2.24
Winter04	0.30523	1.21
Winter05	-0.11669	-0.64
Winter06	-0.35420	-2.13
Oakland	1.75	4.46
San Francisco	1.01554	2.05
Red Bluff	-0.03902	-0.21
Sacramento	-0.02737	-0.13
Santa Rosa	0.52021	0.99
Adjusted R-Squared = 0.9128		

The impact of the locational variables is relative to San Jose.

[3] During an interview with one of the boiler control vendors, they estimated that approximately 30% of boiler controllers are installed in facilities already equipped with boiler controllers. It is expected that a controller upgrade, such as that described by this vendor, would result in reduced savings for those particular installations, as the ex-ante estimates are based on a baseline condition without equivalent boiler controls.

As the results show, dummy variables were included to create a fixed effects model in order to control for season/time as well as locational differences. Results for these variables were statistically insignificant with the exception of the Winter06 season/time variable and the Oakland and San Francisco location variables.

The estimated realization rate for boiler controllers installed in PG&E's service territory was much lower than expected, even after an attempt was made to clean the data for anomalous bills. The low estimated realization rate may be due to a low actual value, the poor quality of data received from the utility, and/or limited time and effort afforded to the evaluation team to clean the provided data. The late arrival date of data did not allow the team to update the billing request or to adequately clean the data for errors or estimates in gas meter readings or for possible mistakes in the date of controller installation.[4]

The realization rate may be much lower than anticipated if a large number of boilers was previously controlled or if the assumptions used to determine the a priori estimates differ substantially from the actual boiler characteristics. To determine the source of the a prior estimate, the team turned to the 2004/2005 Program Year Multifamily Work Papers. These papers referenced the 2001 SoCalGas Work Papers as the source of the boiler controller estimate. The team was not able to locate the 2001 SoCalGas Work Papers. The 2006 Program Year SoCalGas Work Papers, however, lists a priori savings estimates of 34 therms per apartment unit, consistent with the 2004/2005 program year estimate of a 15% savings on boiler consumption of 231 therms per unit (0.15×231 therms = 34.65 therm savings per unit). The 2005 boiler controller savings are derived using a DOE-2 simulation on an apartment building constructed post 1970.

The team compared the 2001 Work Paper's boiler therm usage of 231 therms per apartment unit to the 2004 Residential Appliance Saturation Survey (RASS) estimate of whole house gas consumption for an apartment in a 5+ unit apartment complex.[5] The RASS estimate of whole house gas consumption was 232 therms per unit per year.[6] The Work Paper assumption that boilers consume 231 therms per unit per year appears slightly high unless the Work Papers assume that all boilers are space heating boilers. Itron was not provided with information on whether the boilers were space heating, water heating, or both. This

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4 There is no a priori data to indicate that the sites eliminated due to insufficient billing data for PG&E sites biased the results in any maner.

5 The 5+ unit per-unit consumption was chosen as the reference consumption to simulate those units most likely to be included in a multifamily unit with a boiler.

6 The RASS estimate of whole house gas consumption was limited to non-master metered homes. It is likely that most boiler controllers are installed in master metered units. Consumption for an individual metered house is likely to be less than for a master metered home.

information is crucial to the calculation of a prior yearly savings and to the distribution of yearly savings into monthly savings estimates.

The per unit boiler therm usage of 231 therms was also compared to the per unit gas consumption for PG&E sites with boiler controller installations in 2005. The average 2004 usage for sites in Oakland was 156.7 therms, 192.5 for Sacramento, 369.3 for San Francisco, 187.5 for San Jose, and 159.5 therms for Santa Rosa. Given the very low gas consumption for all locations other than San Francisco, it is highly likely that either the ex ante engineering estimates are high, the tracking data on number of apartment buildings is high, or most of the boilers in locations other than San Francisco are limited to water heating boilers.

Vendor-Specific Realization Rates

In addition to the above SAE model, the Itron team estimated the model separately for the two vendors who conducted the installations at the multifamily sites in PG&E's territory. This analysis was completed to determine whether there is a difference in the realization rate across vendors. Table 3-2 presents a comparison of the estimated rates.

Table 3-2: Estimated Realization Rates by Vendor in PG&E Territory

Vendor	Estimated Realization Rate	T-Statistic
Vendor A	3%	-0.55
Vendor B	16%	-6.86

The estimated realization rate for Vendor B was 16%, substantially higher than the 3% realization rate for Vendor A. Analysis of the data indicates that the ratio of claimed savings to consumption for large boiler controllers was higher for Vendor A (0.28) than for Vendor B (0.10). The Residential Multifamily Rebate Program PY2004/PY2005 Work Papers estimate that controllers save 15% of usage. The higher claimed savings for Vendor A will lead to an estimated lower realization rate if savings are truly less than or equal to 15%.

3.3 SDG&E Model Estimates

Table 3-3 presents the estimates for the SDG&E SAE model for multifamily complexes in SDG&E's territory that had boiler control measures installed from June 2004 through the end of 2005. The gross realization rate of therm savings from this program is the coefficient on the engineering estimate of savings, (BCSavings), which is equal to 28%, however this coefficient estimate is statistically insignificant with a t-value of -1.39.

Table 3-3: SDG&E Monthly SAE Model for Boiler Controllers for Program Years 2004 and 2005

Variable	Parameter Estimate	T-statistics
Intercept	89.85416	4.10
$Therm_{T-12}$	0.89991	42.97
BCSavings	-0.28521	-1.39
ΔHDD	0.47038	2.01
ΔCDD	-0.45201	-1.77
HDD_{T-1}	-0.12712	-0.55
CDD_{T-1}	0.14592	0.57
$\left(\frac{HDD_{iT} - HDDNA_i}{HDDN_i}\right) \times Therm_{T-12}$	0.49997	3.74
Winter05	-24.82384	-0.50
Winter06	-76.07758	-1.66
Inland	-108.97938	-1.61
Adjusted R-Squared = 0.7805		

Inland is a binary variable representing inland San Diego County. Given that SDG&E provided billing data starting in June 2003, the 2004 program installations prior to June of 2004 are not included in the analysis.

Due to the significant data tracking problems associated with the SDG&E's Multifamily Boilers Program, PG&E's realization rate of 12% is considered a statewide realization rate and was used to calculate the net realized therm savings for SDG&E, presented in Section 1.

3.4 SoCalGas Model Estimates

Table 3-4 presents the estimates for the SoCalGas SAE model estimated for multifamily complexes in SoCalGas's territory that had boiler control measures installed during program years 2004 or 2005. The gross realization rate of therm savings from this program is the coefficient on the engineering estimate of savings, (BCSavings), which is equal to -16%. The t-statistic for this estimate is -1.44 and is therefore statistically insignificant.

Similar to SDG&E, there were significant data tracking problems associated with the SoCalGas Multifamily Boilers Program. For this reason, PG&E's realization rate of 12% is considered a statewide realization rate and was used to calculate the net realized therm savings for SoCalGas, presented in Section 1.

Table 3-4: SoCalGas Monthly SAE Model for Boiler Controllers for Program Years 2004 and 2005

Variable	Parameter Estimate	T-statistics
Intercept	120.90946	4.50
$Therm_{T-12}$	0.88082	104.66
BCSavings	0.16221	1.44
ΔHDD	1.56945	8.34
ΔCDD	-0.23742	-1.71
HDD_{T-1}	0.03526	0.25
CDD_{T-1}	0.07356	0.67
$\left(\frac{HDD_{iT} - HDDNA_i}{HDDN_i}\right) \times Therm_{T-12}$	0.32525	6.58
Winter05	29.17318	0.72
Winter06	-70.5601	-1.83
Los Angeles	-45.13776	-0.82
Burbank	-101.84645	-2.75
Riverside	185.18433	1.89
Adjusted R-Squared = 0.9335		

The locational binary variables are relative to Long Beach, the missing category. Given that SoCalGas provided billing data starting in September 2003, the 2004 program installations prior to September 2004 are not included in the analysis.

4

Recommendations for Future Analysis

4.1 Overview

This section presents some of the lessons learned by the Itron team as it analyzed the impacts of boiler control installations at multifamily premises. From this endeavor, the team developed recommendations, which are presented here to ensure that future multifamily SAE models have better data available for analysis. As the team conducted this evaluation, it became clear that the results presented in this report should be interpreted with a high degree of caution. A number of difficulties were encountered, the most salient being the difficulty of obtaining all account numbers affected by the installation of the boiler controllers. This point was a problem for all three utilities, though PG&E was eventually able to satisfy this data requirement. The other major obstacle to conducting a thorough analysis was the delayed receipt of data (PG&E) and the lack of sufficient billing data that SDG&E and SoCalGas were able to provide.

4.2 Data Requirements for Analysis

Desired data for an SAE analysis includes gas consumption per unit, engineering estimates of per-unit savings from the installation of boiler controllers, monthly occupancy rates for the facilities, characteristics of the average multifamily unit in the facility, information about remodels, amenities of common areas, and weather data. If the facilities are individually metered, gas consumption per unit can be derived from the customers' bills. Alternatively, if the facilities are master metered, average monthly individual consumption can be calculated by summing all of a given facility's master meters and dividing by the number of units in the facility. Discussions with one of the vendors also indicated that some of the boilers receiving boiler controllers may have had comparable existing controllers. The replacement of an existing controller could dramatically reduce the observed bill savings relative to an uncontrolled boiler.

The following sections summarize some of the problems encountered in this analysis and data recommendations for the future.

Utility Billing and Tracking Data

Monthly billing data for the 2002-2006 period were requested from the utilities. PG&E provided data covering January 2002 to May 2006; SDG&E and SoCalGas provided billing data starting in 2003. Data from SDG&E covered June 2003 to May 2006 while SoCalGas provided billing data for September 2003 to August 2006. Given the lack of data during the early portion of 2003 for the Sempra Energy utilities, it was not possible to estimate a realization rate for controllers installed prior to June 2004 for SDG&E and September 2004 for SoCalGas. This reduced the number of multifamily facilities that could be included in these analyses (Section 3 provides details on the specific number of installations that could not be included).

Analysis of the Sempra billing data revealed that the Itron team did not receive all of the account numbers associated with SDG&E and SoCalGas installations. Several facilities in the SDG&E and SoCalGas databases had engineering estimates of therm savings that exceeded natural gas consumption of the site, as measured by the aggregation of the available consumption data. This unrealistically high level of savings was likely due to an incomplete listing of account numbers (Acct_NBR or BAID) associated with the boiler control installations. SAE models that do not include data for all impacted consumption records will lead to an underestimate of the realization rate.

Future tracking databases must include all account numbers associated with the installation of energy efficiency devices or measures if the claimed savings may be subject to billing analysis. A process that simply records an account number associated with the application is insufficient.

Multifamily Site Characteristics Data

Ideally, an SAE analysis includes several site and measure specific characteristics. Information about the design of the boiler is particularly important. To accurately calculate the ex ante engineering savings for a boiler controller, one must know the type of boiler (space heating, water heating or both), the size of the boiler, the number of units it serves, and whether it has been previously controlled. In lieu of these data, the multifamily program assumes a set level of savings for controllers installed in boilers serving a small number of apartment units (less than 20) and a large number of apartment units (more than 20). These estimates of savings are likely imprecise and could be improved by collecting data during the installation of the controller. Desired and obtainable data include the number of apartment units served by a boiler, the average square footage of units in the complex, and the previous control and the type of boiler.

Knowledge about the type of boiler is also important to estimate the ex post savings. Space heating boilers will have a very different shape for the assumed monthly distribution of

savings than a water heating boiler. Without accurate information about the type of boiler, an SAE analysis cannot accurately distribute the savings across months. This problem is likely to lead to an underestimate of the realized savings.

Additional information about the occupancy, possible remodel, and change in ownership may impact the SAE results. Each of these characteristics is likely to lead to changes in consumption unrelated to the variables used to explain consumption, such as previous consumption, weather, and the engineering estimates of savings. The project team attempted to reduce the problems associated with anomalous bills by carefully analyzing the consumption records, averaging bills for missing reads, and setting other unexplainable shifts in the consumption record to missing. Ideally, these types of data would be provided through an on-site survey.

SDG&E and SoCalGas do not track the number of apartment units in a facility on either their program tracking database or their billing database. Therefore, the team modeled SDG&E and SoCalGas participant gas usage as a function of usage in the same billing period 12 months prior, as well as the engineering estimate of total savings. This method is likely to be inferior to the per-unit method. Modeling consumption associated with both very small complexes and relatively large facilities is likely to lead to imprecise estimates. Normalizing consumption and savings to the per-unit level reduces problems of heteroskedasticity and places the consumption and savings of all facilities into the same order of magnitude. Given the lack of adequate billing data and the fact that heteroskedasticity influences the efficiency but not the consistency of the estimates, the team felt that the available data did not warrant additional analysis for heteroskedasticity.

4.3 Recommendations for Future Analyses

The realization rate calculated during this analysis should be viewed with caution. The results from this study were negatively impacted by the quality and quantity of tracking and billing data received by the project team. Initial evidence, however, supports the conclusion that the ex ante engineering estimates overstates the true savings.

If the utilities want to undertake billing analysis of their multifamily programs, more effort must be undertaken to ensure that the tracking databases include all of the necessary account numbers. Inadequate tracking of account numbers is one of the most significant problems encountered during this analysis. The failure to correctly aggregate the site-level consumption data was a substantial contributor to the small estimated realization rate.

An accurate SAE realization rate for boiler controllers also requires additional data on the site, boiler, and the controller. Ideally, the controller information would include data on the

existence of a previous controller and the type of boiler; this information could be easily collected at the time of installation. Without these data, it is difficult to correctly control for site-specific shifts in consumption or to accurately allocate the yearly engineering estimate of saving to their monthly distribution. An incorrect distribution will lead to a lower estimated realization rate.

Future SAE analysis of the multifamily program will require more tracking and billing data, more complete tracking data, and more on-site information. Assuming the above recommendations are carried out, the team recommends that SAE analysis be used to evaluate the savings from boiler controllers. The team believes that boiler controllers are a good measure for this type of analysis when appropriate tracking, billing, and on-site data are provided to the analysis team.

Appendix A

Additional Analyses of the Multifamily Boiler Control Measure

The results of therm savings from the installation of multifamily boiler control measures presented in the impact evaluation report were smaller than had been expected. In an effort to scrutinize these impacts, three additional analyses were undertaken.

- The team examined the difference between 2003 pre-boiler control consumption of gas and 2005 post-boiler control consumption of gas for locations at which boiler control measures were installed during 2004 in PG&E territory. The team compared assumed consumption levels to actual consumption levels and the California Statewide Residential Appliance Saturation Study[1] (RASS) whole house consumption (this analysis was restricted to PG&E due to lack of pre-consumption data for SDG&E and SCG).
- Additionally, we created individualized unit estimates of therm savings equal to 15% of the 2003 pre-installation consumption level for PG&E installations (again, analysis was restricted to PG&E due to lack of pre-consumption data for the SDG&E and SCG). An SAE analysis, similar to the one presented in the report, was conducted using these individualized unit estimates of savings instead of the engineering estimate of savings, to derive an alternative realization rate.
- Last, we ran a fixed effects SAE model that regressed current facility-level therm consumption on the previous month's consumption, a dummy variable for the time of installation for PG&E, SDG&E, and SCG, and dummy variables for each facility.

The following subsections of this appendix describe the results from these additional analyses. These results reconfirm that lower than expected therm savings were observed in participant bills following the adoption of boiler control measures at multifamily sites.

[1] KEMA, Inc. and Itron, Inc. *California Statewide Residential Saturation Study Final Report*. Prepared for the California Energy Commission. June 2004

A.1 Gas Consumption Pre- and Post-Boiler Control Installations

To determine whether a detectable difference exists between the average consumption of natural gas before and after boiler control measures were installed, the monthly mean therm consumption was calculated at the facility level and the apartment unit level for PG&E multifamily locations. Only those sites that had boiler control measures installed during the 2004 year and had a full 12 months of consumption data for 2003 and 2005 were included in this analysis. Seven multifamily facilities were excluded from the analysis due to insufficient data, leaving 33 multifamily facilities that contain 6,913 apartment units. Table A-1 presents the monthly average consumption of gas at the facility and apartment unit level for 2003 and 2005, the pre-and post-boiler control installation periods selected for analysis.

Table A-1: Monthly Average Facility and Unit Therm Consumption Before and After 2004 Installation of Boiler Control Measures

	Facility (n=33)		Apartment Unit	
Year	Monthly Mean Consumption (therms)	Standard Deviation (therms)	Monthly Mean Consumption (therms)	Standard Deviation (therms)
2003	4,124.1	3,493.1	21.4	11.0
2005	4,011.2	3,391.5	20.9	11.1
Difference	112.9	-	0.5	-
% Reduction	2.7%		2.3%	

The results show a decrease in monthly therm consumption of approximately 113 at the facility level and 0.5 at the apartment unit level after boiler control measures were installed. These differences are multiplied by 12 to arrive at the annual average decrease in therm consumption before and after the installation of boiler controls. The annual average reduction in consumption of natural gas is 1,356 therms at the facility level (112.9 therms*12 months) and is 6 therms at the unit level (0.5 therms*12 months).

Savings rates are estimated by dividing the difference in gas consumption before and after the installation of boiler controllers by the 2003 pre-boiler control installation consumption level and we find these to equal just under 3% at the facility level and 2.3% at the unit level. Both of these results are substantially lower than the assumed 15% savings level.

The annual therm savings listed in Table A-1 are similar to the reported results in the impact evaluation report and they continue to reflect lower than anticipated therm savings achieved from the installation of boiler control measures at multifamily complexes. In order to gain additional perspective, the Itron team made a comparison of these annual

average therm consumption values for the pre- and post-boiler control installation periods with the therm consumption values found in the RASS for multifamily complexes and the assumed savings levels in the PY2004/2005 work papers. According to the RASS table entitled, *Gas UECs and Saturations, by Residence Type, for all Households and for Homes with Gas Account Data*, whole house gas consumption is equal to 232 therms for apartment units in multifamily complexes with at least five apartment units. The estimated therm usage by conventional gas water heaters in these same types of apartment units is equal to 186 therms. The estimate of therm usage for gas water heaters represents 80% of the RASS estimate of total whole house gas consumption. The mean value of apartment-level gas consumption found in the 2003 PG&E sites reported in Table A-1 is 257 (21.4*12) therms. Assuming that the gas boiler consumes 80% of the apartment-level gas, the approximate boiler consumption is 205 therms. In light of the RASS and PG&E data, the assumed boiler gas consumption in the program work papers of 231 appears rather high.

A.2 Apartment-Unit-Level Estimated Therm Savings for PG&E

In addition to calculating the monthly and annual average consumption of gas before and after the installation of boiler control measures at multifamily complexes, an alternative estimate of therm savings at the apartment-unit-level was calculated. The alternative was calculated by multiplying the 2003 facility pre-installation gas consumption for PG&E locations by 15%. The PY2004/2005 Work Paper assumed therm savings rate of 15%.

Once the individualized monthly unit-level therm savings was calculated for each unit, this variable, called *NewBCSavings*, was used in place of the engineering estimate of therm savings in an SAE regression analysis. A number of regressions were run, similar in structure to those described in the report. Table A-2 presents the coefficients estimated for one of the regressions, using the new therm savings estimate in an SAE model for multifamily complexes in PG&E's territory that had boiler control measures installed during 2004 and 2005. The coefficient on *NewBCSavings* is -0.15, which means that the actual realization rate of savings is 15% of the estimated 15% of therm savings calculated from the 2003 pre-boiler control installation consumption of the apartment units. In other words, the therm savings rate is equal to 2.25%, which is consistent with the results presented in this appendix in subsection A.1. The results from this analysis add further support to the initial SAE model findings, a relatively low realization rate for multi family boiler controllers.

Table A-2: PG&E Monthly SAE Model for Boiler Controllers Using Alternative Estimate of Boiler Savings, Program Years 2004 and 2005

Variable	Parameter Estimate	T-statistics
Intercept	1.26	2.36
$Therms_{t-12}$	0.96	50.1
NewBCSavings	-0.15	-1.53
ΔHDD	0.017	6.86
ΔCDD	-0.008	-1.63
HDD_{T-1}	0.0003	0.18
CDD_{T-1}	-0.003	-1.75
Winter04	-0.08	-0.14
Adjusted R-Squared = 0.81		
N = 898		

A.3 Facility-Level Statistically Adjusted Engineering Analysis

The third supplemental analysis focused on estimating facility-level therm savings. Participant multifamily complexes in PG&E, SDG&E, and SCG territories (n=245) were included in a fixed effects SAE model which regressed current facility-level therm consumption on the previous month's consumption, a dummy variable for the time of installation for PG&E, SDG&E, and SCG, and dummy variables for all but one facility.[2] From this analysis, a monthly facility-level savings realization rate of -46.72 therms was estimated. The annual therm savings from all of the facilities in the analysis is estimated to equal 137,357 therms, which is calculated by multiplying the monthly realization rate of savings by 12 to make it annual, and then multiplying by 245, the number of facilities included in the analysis.

The claimed savings for the 245 sites used in this analysis was 800,007 therms. The ratio of the estimated savings (137,357 therms) to the claimed savings was 17%. This finding is consistent with the realized savings listed in the report and the two analyses listed in above.

[2] Sites were deleted from this data set if the ratio of claimed savings to bills was over 50%. Eleven SDG&E sites were eliminated and 24 SCG sites were eliminated for failing this check.