Evaluation, Measurement, and Verification Report for the Emerging Communities Energy Efficiency Program #1396-04

Study ID: FCI0001.01

FINAL REPORT

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San Francisco, California
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1. Executive Summary

This report provides the Evaluation, Measurement, and Verification (EM&V) findings for the FCI Management Consulting (FCI) Emerging Communities Energy Efficiency Program (ECEEP) #1396-04. This study was conducted by Robert Mowris & Associates (RMA) with public goods charge (PGC) funds under the auspices of the California Public Utilities Commission and is available for download at www.calmac.org. The program focused on improving energy efficiency for hard-to-reach small businesses by performing audits and implementing direct-install energy efficiency measures. The ex ante program implementation plan (PIP) goals were to directly install 23,071 energy efficiency measures at 1,100 hard-to-reach small business customer sites in the Southern California Edison (SCE) service area (**Table 1.1**). The program exceeded these goals and installed 21,621 measures at 1,339 sites. This was verified by checking the tracking database with on-site inspections and telephone surveys.

The energy efficiency objectives of the ECEEP are as follows.

- Perform 1,500 comprehensive energy audits for small commercial businesses and services and information through organizations that are trusted and understood by the target group.
- Directly install energy efficient T-8 fluorescent lighting and electronic ballasts, compact fluorescent lamps (CFLs), LED exit signs, HVAC diagnostic tune-ups, and programmable thermostats at 1,100 small commercial businesses.
- Assist 28 fast food restaurant customers who request support in finding financing for energy efficient cooking equipment and/or other energy efficiency program benefits.
- Assist small commercial customers in implementing other energy efficiency improvements with financial support for businesses in an area where their continued service to the community is critical, but continually threatened by economic pressure.

The PIP goals, ex ante program estimates, and ex post accomplishments are shown in **Table 1.1**.

Table 1.1 Ex Ante Goals and Ex Post Accomplishments for the EAH Program

Description	Program Implementation Plan Goal	Ex Ante Program Estimate	Ex Post Accomplishment
Nonresidential Direct-Install Measure Incentives	23,071	23,071	21,621
Nonresidential Comprehensive Audits	1,500	1,500	1,339
Net Annual Electricity Savings (kWh/yr)	5,301,845	4,952,884	4,081,809
Net Demand Savings (kW)	1,339	1,275	1,197
Net Annual Therm Savings (therms/yr)	0		39,346
Net Lifecycle Electricity Savings (kWh)	66,536,310	64,504,089	48,289,007
Net Lifecycle Gas Savings (therms)	0	0	432,801
Total Resource Cost (TRC) Test	2.38	2.52	1.89
TRC Test Costs	$1,309,165	$1,196,600	$1,196,600
TRC Test Benefits	$3,115106	$3,010,960	$2,258,685
TRC Test Net Benefits	$1,805,940	$1,814,360	$1,062,085
Participant Test	17.18	2.53	2.55
Participant Test Costs	$593,460	$445,963	$445,963
Participant Test Benefits	$10,197,932	$1,129,181	$1,138,033
Participant Test Net Benefits	$9,604,472	$683,218	$692,070

The largest differences between PIP goals/ex ante estimates and ex post accomplishments are with the lifecycle savings and TRC. These differences are mostly due to the 8-year EUL assumed for CFL measures. The weighted average ex post EUL for CFL measures is 2.437 years based on annual hours of operation from logger data and 10,000 hour lifetime from manufacturer data. If the 8-year EUL for CFL measures is used instead, then the ex post TRC would be 2.2 and the lifecycle savings would be 53,260,738 kWh instead of 48,289,007 kWh. The second most important difference between PIP goals/ex ante estimates and ex post accomplishments is the annual electricity savings. The ex post annual savings are 4,081,809 kWh/yr, and this is 17.5% less than the ex ante estimate and 23% less than the PIP estimate.[1] This difference is largely due to lower operating hours for lighting measures. The weighted average ex post operating hours are 3,523 ± 247 hours/yr, and this is 24.8% less than the 4,685 hours/yr assumed in the PIP goals and ex ante estimates.

The program succeeded in providing energy efficiency incentives at 1,339 hard-to-reach businesses and directly installed 21,621 measures. Ex post accomplishments were verified by randomly inspecting 2,501 measures at 79 sites. Light loggers were installed at 69 sites to measure operating hours on 2,366 lighting fixtures, AC tune-ups inspections were conducted for 85 units, three-years of pre-post billing data were analyzed for 71 sites, and in-person and telephone follow-up surveys were conducted for 74 customers.

The ex ante annual savings per measure are summarized in **Table 1.2** and the ex post annual savings are summarized in **Table 1.3**. The net-to-gross ratio (NTGR) is 0.96 based on the Express Efficiency Program and reflects what customers would have done in the absence of the program (i.e., 4 percent free riders).[2] The net ex ante program savings are 4,952,884 kWh per year and 1,276 kW. First-year net ex post program savings are 4,081,809 ± 230,212 kWh per year, 1,196.5 ± 110 kW, and 39,346 ± 13,006 therms per year at the 90 percent confidence level. The program net realization rate for kWh savings is 0.82 ± 0.05 and the net realization rate for kW savings is 0.94 ± 0.09.

Table 1.2 Ex Ante Annual Electricity Savings for the ECEE Program

Measure	Units	Gross Ex-Ante Unit Savings (kWh/y)	Gross Ex-Ante Unit Savings (kW)	Gross Ex-Ante Unit Savings (therm/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (therm/y)
Reflect. Window Film	0	16.01	0.0030	0	0.96	0	0	0
Prog. Thermostat	22	327.00	0.0000	0	0.96	6,906	0	0
Prog. Thermostat	792	327.00	0.0000	0	0.96	248,625	0	0
HVAC Tune-up	28	807.00	0.4580	0	0.96	21,692	12	0
HVAC Tune-up	510	807.00	0.4580	0	0.96	395,107	224	0
HVAC Tune-up	265	807.00	0.4580	0	0.96	205,301	117	0
HVAC Tune-up	195	807.00	0.4580	0	0.96	151,070	86	0
Motion Sensors	0	416.00	0.0000	0	0.96	0	0	0
60/75w to CFL-13	1,792	234.25	0.0500	0	0.96	402,985	86	0
100w to CFL -23	2,074	346.69	0.0740	0	0.96	690,274	147	0
150w to CFL -28	19	543.46	0.1160	0	0.96	9,913	2	0

[1] The ex ante savings assume actual unit accomplishments, ex ante savings, and ex ante EUL values. The PIP savings assume ex ante unit goals, ex ante savings, and ex ante EUL values.

[2] *Energy Efficiency Policy Manual*, Chapter 4, Table 4.2, page 23, prepared by the California Public Utilities Commission, 2001.

Table 1.2 Ex Ante Annual Electricity Savings for the ECEE Program

Measure	Units	Gross Ex-Ante Unit Savings (kWh/y)	Gross Ex-Ante Unit Savings (kW)	Gross Ex-Ante Unit Savings (therm/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (therm/y)
2' 1L T12 to 2'1L T8	77	37.48	0.0080	0	0.96	2,771	1	0
3' 1L T12 to 3' 1L T8	99	84.33	0.0180	0	0.96	8,015	2	0
4' 1L T12 to 4' 1L T8	686	74.96	0.0160	0	0.96	49,366	11	0
4' 2 L T12 to 4' 2L T8	2,653	84.33	0.0210	0	0.96	214,778	53	0
4' 3 L T12 to 4' 3L T8	292	182.72	0.0390	0	0.96	51,220	11	0
4' 4 L T12 to 4' 4 L T8	3,331	206.14	0.0440	0	0.96	659,186	141	0
4' 4L T12 to 4' 3L T8	434	318.58	0.0680	0	0.96	132,733	28	0
4' 4L T12 to 4' 2L T8	2,456	346.69	0.0740	0	0.96	817,412	174	0
4' 3L T12 to 4' 2L T8	239	210.83	0.0450	0	0.96	48,373	10	0
8' 1 L T12 to 4' 2L T8	130	98.39	0.0210	0	0.96	12,279	3	0
8' 2L T12 to 4' 4L T8	805	107.76	0.0230	0	0.96	83,277	18	0
8' 1L T12 to 8' 1L T8	189	79.65	0.0170	0	0.96	14,452	3	0
8' T12 to 8' 2L T8SLO	570	89.02	0.0190	0	0.96	48,712	10	0
F40U 2L to U 2L T8	291	60.91	0.0130	0	0.96	17,016	4	0
8' 2L T8 RLO	4,267	140.56	0.0300	0	0.96	575,779	123	0
2 watt LED Exit sign	268	332.88	0.0380	0	0.96	85,643	10	0
EE Cooking Equip.	5	0.00	0.0000	0	0.96	0	0	0
Strip Curtains	0	465.00	0.0530	0	0.96	0	0	0
Total	22,489					4,952,884	1,276	0

Table 1.3 Ex Post Annual Savings for the ECEE Program

Measure	Units	Gross Ex-Post Unit Savings (kWh/y)	Gross Ex-Post Unit Savings (kW)	Gross Ex-Post Unit Savings (therm)	Net-to-Gross Ratio	Net Verification Rate	Net Ex-Post Program Savings (kWh/y)	Net Ex-Post Program Savings (kW)	Net Ex-Post Program Savings (therm/y)	Net Realization Rate kWh	Net Realization Rate kW
Reflect. Window Film	0	n/a	n/a	0	0.96	0	0	0.0	0	n/a	n/a
Prog. Thermostat	22	680	0	53	0.96	0.95	13,644	0.0	1,063	n/a	n/a
Prog. Thermostat	792	680	0	53	0.96	0.95	491,167	0.0	38,282	1.98	n/a
HVAC Tune-up	28	640	0.5904	0	0.96	0.64	11,010	10.2	0	0.51	0.83
HVAC Tune-up	510	640	0.5904	0	0.96	0.64	200,540	185.0	0	0.51	0.83
HVAC Tune-up	265	640	0.5904	0	0.96	0.64	104,202	96.1	0	0.51	0.83
HVAC Tune-up	195	640	0.5904	0	0.96	0.64	76,677	70.7	0	0.51	0.83
Motion Sensors	0	n/a	0	0	0.96	0	0	0.0	0	0.00	n/a
60/75w to CFL-13	1,792	159.6	0.047	0	0.96	0.91	249,823	73.6	0	0.62	0.86
100w to CFL -23	2,074	330.5	0.074	0	0.96	0.97	638,374	142.9	0	0.92	0.97
150w to CFL -28	19	479.5	0.116	0	0.96	0.8	6,996	1.7	0	0.71	0.80
2' 1L T12 to 2'1L T8	77	14.0	0.008	0	0.96	1	1,034	0.6	0	0.37	1.00
3' 1L T12 to 3' 1L T8	99	56.1	0.018	0	0.96	1	5,335	1.7	0	0.67	1.00
4' 1L T12 to 4' 1L T8	686	38.9	0.012	0	0.96	0.95	24,367	7.5	0	0.49	0.71
4' 2 L T12 to 4' 2L T8	2,653	54.1	0.014	0	0.96	0.99	136,505	35.3	0	0.64	0.66
4' 3 L T12 to 4' 3L T8	292	59.7	0.026	0	0.96	1	16,727	7.3	0	0.33	0.67
4' 4 L T12 to 4' 4 L T8	3,331	159.4	0.046	0	0.96	1.03	525,127	151.5	0	0.80	1.08
4' 4L T12 to 4' 3L T8	434	264.4	0.064	0	0.96	0.49	53,974	13.1	0	0.41	0.46
4' 4L T12 to 4' 2L T8	2,456	336.0	0.09	0	0.96	1.09	863,599	231.3	0	1.06	1.33
4' 3L T12 to 4' 2L T8	239	183.2	0.052	0	0.96	n/a	0	0.0	0	0.00	0.00
8' 1 L T12 to 4' 2L T8	130	43.9	0.014	0	0.96	1	5,479	1.7	0	0.45	0.67
8' 2L T12 to 4' 4L T8	805	51.3	0.02	0	0.96	0.78	30,912	12.1	0	0.37	0.68
8' 1L T12 to 8' 1L T8	189	56.6	0.017	0	0.96	0.85	8,724	2.6	0	0.60	0.85
8' T12 to 8' 2L T8SLO	570	82.3	0.019	0	0.96	1	45,017	10.4	0	0.92	1.00
F40U 2L to U 2L T8	291	49.0	0.013	0	0.96	1	13,701	3.6	0	0.81	1.00
8' 2L T8 RLO	4,267	121.7	0.03	0	0.96	1.04	518,284	127.8	0	0.90	1.04
2 watt LED Exit sign	268	157.8	0.038	0	0.96	1	40,591	9.8	0	0.47	1.00
EE Cooking Equip.	5	n/a	n/a	0	0.96	n/a	0	0.0	0	0.00	n/a
Strip Curtains	0	n/a	n/a	0	0.96	n/a	0	0.0	0	0.00	n/a
Total	22,489						4,081,809	1196.5	39,346	0.82	0.94

Lifecycle kWh savings are summarized in **Table 1.4** and lifecycle therms savings are summarized in **Table 1.5**. The required energy impact reporting for 2004-05 programs is provided in **Table 1.6**. The net ex-ante lifecycle savings are 64,504,089 kWh. The net ex-post lifecycle savings are 48,289,007 ± 2,774,456 kWh and 432,801 ± 13,006 therms. The lifecycle ex-post net lifecycle kWh realization rate is 0.75 ± 0.04 and the net lifecycle therm realization rate is undefined.

Table 1.4 Lifecycle Electricity Savings for the ECEE Program

Measure	Net Ex-Ante Program Savings (kWh)	Ex Ante Effective Useful Life (EUL)	Net Ex-Ante Lifecycle Program Savings (kWh)	Net Ex-Post Program Savings (kWh)	Ex Post Effective Useful Life (EUL)	Net Ex-Post Lifecycle Program Savings (kWh)	Net Lifecycle Realization Rate
Reflect. Window Film	0	10	0	0	10	0	
Prog. Thermostat	6,906	11	75,969	13,644	11	150,079	1.98
Prog. Thermostat	248,625	11	2,734,871	491,167	11	5,402,834	1.98
HVAC Tune-up	21,692	10	216,922	11,010	10	110,100	0.51
HVAC Tune-up	395,107	10	3,951,072	200,540	10	2,005,402	0.51
HVAC Tune-up	205,301	10	2,053,008	104,202	10	1,042,022	0.51
HVAC Tune-up	151,070	10	1,510,704	76,677	10	766,771	0.51
Motion Sensors	0	16	0	0	16	0	
60/75w to CFL-13	402,985	8	3,223,880	249,823	2.94	734,479	0.23
100w to CFL -23	690,274	8	5,522,189	638,374	2.24	1,429,958	0.26
150w to CFL -28	9,913	8	79,302	6,996	2.48	17,350	0.22
2' 1L T12 to 2'1L T8	2,771	16	44,328	1,034	16	16,552	0.37
3' 1L T12 to 3' 1L T8	8,015	16	128,236	5,335	16	85,361	0.67
4' 1L T12 to 4' 1L T8	49,366	16	789,851	24,367	16	389,870	0.49
4' 2 L T12 to 4' 2L T8	214,778	16	3,436,454	136,505	16	2,184,083	0.64
4' 3 L T12 to 4' 3L T8	51,220	16	819,521	16,727	16	267,627	0.33
4' 4 L T12 to 4' 4 L T8	659,186	16	10,546,980	525,127	16	8,402,034	0.80
4' 4L T12 to 4' 3L T8	132,733	16	2,123,731	53,974	16	863,586	0.41
4' 4L T12 to 4' 2L T8	817,412	16	13,078,589	863,599	16	13,817,581	1.06
4' 3L T12 to 4' 2L T8	48,373	16	773,965	0	16	0	0.00
8' 1 L T12 to 4' 2L T8	12,279	16	196,465	5,479	16	87,668	0.45
8' 2L T12 to 4' 4L T8	83,277	16	1,332,431	30,912	16	494,588	0.37
8' 1L T12 to 8' 1L T8	14,452	16	231,227	8,724	16	139,587	0.60
8' T12 to 8' 2L T8SLO	48,712	16	779,388	45,017	16	720,276	0.92
F40U 2L to U 2L T8	17,016	16	272,253	13,701	16	219,208	0.81
8' 2L T8 RLO	575,779	16	9,212,460	518,284	16	8,292,542	0.90
2 watt LED Exit sign	85,643	16	1,370,294	40,591	16	649,449	0.47
EE Cooking Equip.	0	12	0	0	12	0	
Strip Curtains	0	4	0	0	4	0	
Total	4,952,884		64,504,089	4,081,809		48,289,007	0.75

Table 1.5 Lifecycle Gas Savings for the ECEE Program

Measure	Net Ex-Ante Program Savings (therm)	Ex Ante Effective Useful Life (EUL)	Net Ex-Ante Lifecycle Program Savings (therm)	Net Ex-Post Program Savings (therm)	Ex Post Effective Useful Life (EUL)	Net Ex-Post Lifecycle Program Savings (therm)	Net Lifecycle Realization Rate
Reflect. Window Film	0	10	0	0	10	0	0
Prog. Thermostat	0	11	0	1,063	11	11,697	0
Prog. Thermostat	0	11	0	38,282	11	421,103	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
Motion Sensors	0	16	0	0	16	0	0
60/75w to CFL-13	0	8	0	0	2.94	0	0
100w to CFL -23	0	8	0	0	2.24	0	0

Table 1.5 Lifecycle Gas Savings for the ECEE Program

Measure	Net Ex-Ante Program Savings (therm)	Ex Ante Effective Useful Life (EUL)	Net Ex-Ante Lifecycle Program Savings (therm)	Net Ex-Post Program Savings (therm)	Ex Post Effective Useful Life (EUL)	Net Ex-Post Lifecycle Program Savings (therm)	Net Lifecycle Realization Rate
150w to CFL -28	0	8	0	0	2.48	0	0
2' 1L T12 to 2'1L T8	0	16	0	0	16	0	0
3' 1L T12 to 3' 1L T8	0	16	0	0	16	0	0
4' 1L T12 to 4' 1L T8	0	16	0	0	16	0	0
4' 2 L T12 to 4' 2L T8	0	16	0	0	16	0	0
4' 3 L T12 to 4' 3L T8	0	16	0	0	16	0	0
4' 4 L T12 to 4' 4 L T8	0	16	0	0	16	0	0
4' 4L T12 to 4' 3L T8	0	16	0	0	16	0	0
4' 4L T12 to 4' 2L T8	0	16	0	0	16	0	0
4' 3L T12 to 4' 2L T8	0	16	0	0	16	0	0
8' 1 L T12 to 4' 2L T8	0	16	0	0	16	0	0
8' 2L T12 to 4' 4L T8	0	16	0	0	16	0	0
8' 1L T12 to 8' 1L T8	0	16	0	0	16	0	0
8' T12 to 8' 2L T8SLO	0	16	0	0	16	0	0
F40U 2L to U 2L T8	0	16	0	0	16	0	0
8' 2L T8 RLO	0	16	0	0	16	0	0
2 watt LED Exit sign	0	16	0	0	16	0	0
EE Cooking Equip.	0	12	0	0	12	0	0
Strip Curtains	0	4	0	0	4	0	0
Total	0		0	39,346		432,801	Undefined

Table 1.6 Required Energy Impact Reporting for 2004-2005 Programs

Program ID:		1396-04					
Program Name:		Emerging Communities Energy Efficiency Program (ECEEP)					
Year	Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	5,523	4,082	1.395	1.197	0	39,346
2	2005	5,523	4,082	1.395	1.197	0	39,346
3	2006	5,523	3,578	1.395	1.197	0	39,346
4	2007	5,523	3,187	1.395	0.978	0	39,346
5	2008	5,097	3,187	1.347	0.978	0	39,346
6	2009	5,097	3,187	1.347	0.978	0	39,346
7	2010	5,097	3,187	1.347	0.978	0	39,346
8	2011	5,097	3,187	1.347	0.978	0	39,346
9	2012	4,238	3,187	1.163	0.978	0	39,346
10	2013	4,238	3,187	1.163	0.978	0	39,346
11	2014	3,236	2,794	0.598	0.616	0	39,346
12	2015	3,023	2,289	0.598	0.616	0	
13	2016	3,023	2,289	0.598	0.616	0	
14	2017	3,023	2,289	0.598	0.616	0	
15	2018	3,023	2,289	0.598	0.616	0	
16	2019	3,023	2,289	0.598	0.616	0	
17	2020	0	0	0	0	0	
18	2021	0	0	0	0	0	
19	2022	0	0	0	0	0	
20	2023	0	0	0	0	0	
TOTAL		69,309	48,289			0	432,801

** Peak MW savings are defined in this evaluation as the weekday peak period Monday through Friday from 2PM to 6PM during the months of May through September.

1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

Participant and non-participant process surveys were used to obtain general feedback and suggestions. Surveyed participants were very satisfied with measures and services offered by the program. On a scale of 0 to 10 overall satisfaction was 8.26 +/- 0.09 based on survey responses from 71 participants to 1,069 questions. Approximately 37 participants (i.e., 51%) shared information with business associates and 86 businesses installed similar measures (the study didn't have budget to evaluate load impacts from spillover). Non-participant survey results indicate 31% percent would have participated if they had known about the program, but were unable to participate due to a number of reasons, most notably the program running out of funding. The primary reason for non-participation was the hassle cost (i.e., "too busy or no time"), followed by misplaced or split incentives, lack of trust (performance uncertainty), information cost, organizational practices, and bounded rationality. The most frequent suggestion to improve the program (43%) was to provide better advertising or marketing information about the program to increase participation. Non-participants felt that better follow through would increase participation (19%) or offering better or more energy efficiency services (9.5%). Better follow through suggestions came from the 23% who wanted to participate but were unable to due to the program running out of funding. Approximately 5% of non-participants suggested continuing the program so more small business customers could participate.

Process survey results, on-site inspections, and field measurements were used to guide the overall process evaluation in terms of investigating operational characteristics of the program and developing specific recommendations to help make the program more cost effective, efficient, and operationally effective. The most important process recommendations are as follows.

- Directly install night-time security lighting measures for customers to reduce the tendency to have all lights on at the businesses during night hours.
- Provide comprehensive HVAC diagnostic tune-ups for free to hard-to-reach small commercial customers since most customers are tenants and air conditioner maintenance is the responsibility of the landlord who doesn't have a financial interest in maintenance (i.e., split incentive).
- Ensure HVAC subcontractors are properly trained to diagnose and correct refrigerant charge and airflow, clean/comb condenser coils, and suction line insulation.
- Improve program tracking database and quality control procedures.[3] Obtain customer billing data to ensure the program is delivering measurable savings. Sites with billing data indicating low or negative savings can be checked for proper installation of measures. This will also facilitate better EM&V analysis of program savings.
- Provide user-friendly programmable thermostat instructions in various languages to ensure persistence of savings.
- Provide customers with extra air filters to increase HVAC diagnostic tune-up measure effective useful life (EUL).
- Label installed measures with a permanent sticker or mark to assist with verification.

The study includes "bottom-up" engineering analysis based on audits and calibrated DOE-2 simulations, and "top-down" analysis based on historical billing data and the PRInceton

[3] FCI responded to this recommendation and implemented quality control procedures after the first set of inspections and these improvements were clearly evident during later inspections.

Scorekeeping Method (PRISM). Insufficient billing data was available to perform PRISM analysis of the gas savings.

Section 2 describes how the EM&V study addresses the required CPUC Energy Efficiency Policy Manual objectives, including baseline information, energy efficiency measure information, measurement and verification approach, and the evaluation approach. **Section 2** also includes equations used to develop energy and peak demand savings, sample design, methods used to verify proper installation of measures, and methods used to perform field measurements. **Section 3** provides EM&V study findings including load impact results and process evaluation results regarding what works, what doesn't work, and recommendations to improve the program's services and procedures. **Section 3** also includes measure recommendations to increase savings, achieve greater persistence, and improve customer satisfaction. **Appendix A** provides the participant and non-participant survey instruments.

2. Required CPUC Objectives and Components

This section discusses how the EM&V study meets the required CPUC objectives and components including baseline information, energy efficiency measure information, measurement and verification approach, and the evaluation approach.

2.1 Baseline Information

Existing studies were used to evaluate baseline and measure-specific multifamily energy savings data (**Table 2.1**). Existing baseline data was obtained from prior EM&V studies, the CALIFORNIA MEASUREMENT ADVISORY COMMITTEE (CALMAC, www.calmac.org), SCE, and the California Energy Commission (CEC, www.energy.ca.gov).

Table 2.1 Existing Baseline Studies for Small Commercial Customers

1	*Southern California Edison Small Express Hard to Reach Program Workbook,* 2004 2005 Energy Efficiency Program Selection R.01-08-028, prepared by SCE, 1-17-04.
2	*2004-2005 Database for Energy Efficiency Resources (DEER) Update Study,* page 7-40, prepared for Southern California Edison, prepared by Itron, Inc., Vancouver, Washington 2005.
3	*California Energy Demand: 1995-2015,* P300-95-008, California Energy Commission, 1516 Ninth Street, Sacramento, CA 95814, 1995
4	*Southern California Edison Energy Efficiency Potential Study,* prepared for Southern California Edison Company, prepared by XENERGY, 1992.
5	*California Commercial End-Use Survey ,* prepared for: California Energy Commission, prepared By: Itron, Inc., CALMAC Study ID: CEC0023.02. 2006.

Ex ante baseline cooling and total Energy Use Intensity (EUI) data for small commercial customers are provided in **Table 2.2**. These values are from the studies listed in **Table 2.1**.

Table 2.2 Existing Baseline Cooling EUI Data for Small Commercial Customers

Building	CEC Climate Zone	CEUS Study 5 Cooling EUI (kWh/ft2)†	SCE Study 4 Cooling EUI (kWh/ft2)	CEUS Study 5 Heating EUI (kBtu/ft2)
Retail	All	3.03	5.65	3.02
Small Office	All	2.90	3.95	8.62
Restaurant	All	8.22	6.92	7.70
Average		4.71	5.51	6.45

The baseline cooling and heating EUI values for the study are shown in **Table 2.3**. These values are based on participant utility billing data for 57 sites, eQuest (i.e., DOE-2.2) simulations, detailed site audits, and pre-retrofit thermostat schedules.

Table 2.3 Baseline EUI Values for Small Commercial Customers for the Study

Building	CEC Forecast Zone	Study Cooling EUI (kWh/ft2)	Study Heating EUI (kBtu/ft2)
Program Average	8	2.27	3.95

2.2 Energy Efficiency Measure Information

This section provides energy efficiency measure information including assumptions about important variables and unknowns, especially those affecting energy savings. Deemed energy savings for each measure are provided in **Table 2.4**. Deemed energy savings are based on FCI ex ante estimates and the Express Efficiency Hard to Reach Program (see SCE Study 1, **Table 2.1**).

Table 2.4 Deemed Savings for Measures

#	Description	Units	kW Savings per unit	kWh Savings per unit	Therm Savings per unit	EUL	NTG Ratio[4]	Qty.
1	Reflective Window Film	ft^2	0.0030	16.01		10	0.96	600
2	Programmable Thermostat	Unit		327		11	0.96	660
3	1 HVAC diagnostic and tune-up	Unit	0.4580	807		10	0.96	770
4	2 HVAC diagnostic and tune-up	Unit	0.9160	1,617		10	0.96	330
5	3 HVAC diagnostic and tune-up	Unit	1.3740	2,421		10	0.96	100
6	Motion Sensors	Unit		416		16	0.96	97
7	60/75w Incan to CFL -13	Unit	0.0500	234.25		8	0.96	2,000
8	100w Incan to CFL -23	Unit	0.7400	346.69		8	0.96	1,000
9	150w Incan to CFL -28	Unit	0.1160	543.46		8	0.96	80
10	2' 1 L 20w T12 to 2'1L 17w T8	Unit	0.0080	37.48		16	0.96	100
11	3' 1 lamp 30w T12 to 3' 1L 25w T8	Unit	0.0180	84.33		16	0.96	50
12	4' 1 L 34/40w T12 to 4' 1 Lamp T8	Unit	0.0160	74.96		16	0.96	200
13	4' 2 L 34/40w to 4' 2 Lamp T8	Unit	0.0210	84.33		16	0.96	2,300
14	4' 3 L 34/40 w T12 to 4' 3L T8	Unit	0.0390	182.72		16	0.96	1,900
15	4' 4 L 34/40w T 12 to 4' 4 L T8	Unit	0.0440	206.14		16	0.96	5,100
16	4' 4 L 34/40 w T12 to 4' 3L T8	Unit	0.0680	318.58		16	0.96	500
17	4' 4L 34/40w T12 to 4' 2L T8	Unit	0.0740	346.69		16	0.96	1,000
18	4' 3L 343/40w T12 to 4' 2L T8	Unit	0.0450	210.83		16	0.96	200
19	8' F96 1 L T12 to 4' 2L T8	Unit	0.0210	98.39		16	0.96	200
20	8' F96 2 L 60/75w T12 to 4' 4L T8	Unit	0.0230	107.76		16	0.96	600
21	8'1 L F96 60/75w T12 to 8' 1L T8	Unit	0.0170	79.65		16	0.96	220
22	8' F96 60/75w T12 to 8' 2L T8 w SLO	Unit	0.0190	89.02		16	0.96	2,200
23	F40 U tube 2 L to F31/32 U6 Tube 2L T8	Unit	0.0130	60.91		16	0.96	300
24	8' 2L T8 RLO	Unit	0.0300	140.56		16	0.96	500
25	2 watt LED Exit sign	Unit	0.0380	332.88		16	0.96	1,375
26	Energy Efficient Cooking Equipment	Unit				12	1.00	28
27	Strip Curtains	ft^2	0.0530	465		4	0.96	915

[4] NTGR of 0.96 is for Express Efficiency (see CPUC EEPM Table 4.2, page 23).

2.2.1 Measure Assumptions and Intended Results

The intended ex ante assumptions were provided by FCI in their PIP. Assumptions for ECEEP measures are from the Statewide Nonresidential Express Efficiency Program. The EM&V study assessed the ex ante measure assumptions and developed ex post measure assumptions from field measurements, engineering analyses, billing data, and calibrated DOE-2/eQUEST simulations. The intended ex ante energy results and the EM&V ex post results for the program are shown in **Table 2.4**. The ex ante program cost effectiveness was 2.52 for the total resource cost (TRC) and 2.53 for the participant test (PT). The ex post TRC is 1.89 and the PT is 2.55.

Table 2.4 Ex Ante and Ex Post Load Impacts

Program	Utility	Net kWh/yr	Net kW	Net therm/yr	Net Lifecycle kWh	Net Lifecycle therm
FCI ECEEP #1396-04 Ex Ante	SCE	5,301,845	1,339		66,536,310	
FCI ECEEP #1396-04 EM&V Ex Post	SCE	4,081,809	1,196	39,346	48,289,007	432,801

2.2.2 Description of Energy Efficiency Measures

This section provides a full description of each energy efficiency measure including assumptions about important variables and unknowns, especially those affecting energy savings. The study evaluated the ex ante measure savings and assumptions and developed ex post savings for each of the measures.

1. Reflective Window Film

Reflective window film reduces solar energy gains, thus reducing mechanical cooling energy consumption. Addition of film is often cost effective on all clear glass except North-facing exposures. Typical film thickness is 0.001 to 0.004 inches. Films are made with a variety of adhesives and are applied on-site to the interior surface (i.e., facing the room) of single- or double-pane windows. Historical problems of fading, installation difficulties, and poor adhesive performance have been solved through advancements in film and adhesive technologies and better application processes. “Second generation” window films often have low-emissivity coatings that provide good visible transmittance (VT), solar heat gain coefficients (SHGC), and shading coefficients (SC). Besides reducing cooling loads, adding reflective films improves shatter resistance and blocks up to 99% of ultraviolet radiation. Summer comfort near windows is improved as well. However, winter space heating energy use will typically increase from 10 to 25% due to the loss of winter-time solar gains. **Shading Coefficient** (SC) is the historical performance metric for rating solar gain. SC is the ratio of total solar transmission to the transmission through 1/8-inch clear glass. **Solar Heat Gain Coefficient** (SHGC) is similar to shading coefficient and is becoming the standard for window solar performance. SHGC is the fraction of incident solar energy transmitted through the window. SHGC ranges from zero to just under one. SHGC is expressed as a number between 0 and 1, and a lower SHGC means less heat gain. SHGC is particularly important in southern climates. Shading coefficient times 0.87 equals SHGC. **Visible Transmittance** (VT) is the percentage of visible light that makes it through a window. VT is expressed as a number between 0 and 1. Heavily tinted products with low shading coefficients typically have low VT. **Luminous Efficacy (Ke)** is the ratio of daylight transmittance to shading coefficient (VT/SC). This dimensionless ratio is also called the lighting-and-cooling selectivity index (LCS). Film must have a minimum five-year manufacturer’s

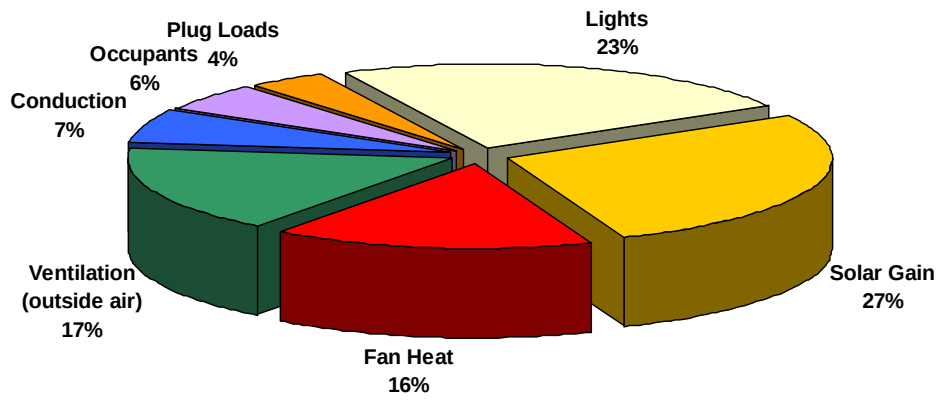
warranty. Statewide rebates are not available for windows with northern exposure. Additionally, film must have either a solar heat gain coefficient (SHGC) ≤ 0.39 and be applied to single-pane glass, or film can have an SHGC ≤ 0.47, and Luminous Efficacy, i.e., visible transmittance to shading coefficient ratio (VT/SHGC) ratio > 1.3. The Statewide Express Energy program savings for reflective window film are as follows: 13 kWh/yr-ft^2 for coastal areas; 16 kWh/yr-ft^2 for inland areas; and 24 kWh/yr-ft^2 for desert areas. Deemed kW savings are 0.003 kW/ft^2.

High performance window film will reduce solar heat transmission by 48% and save roughly 13% on cooling (see **Table 2.5**). Average commercial air conditioning loads for small commercial buildings are shown on **Figure 2.1**. Solar heat gains represent one of the largest cooling loads at 27%.

Table 2.5 Reflective Window Film Performance

Glass Type	Visible Light Transmission (%)	Solar Heat Transmission (%)	Solar Heat Gain Coefficient
Clear ¼ inch	89	83	0.84
Clear ¼ inch with Solis™ Film	70	45	0.44

Figure 2.1 Air Conditioning Loads in Commercial Buildings



2. Programmable Thermostat

Programmable thermostats are used to turnoff or setback HVAC equipment during periods when the building is unoccupied. Setback thermostats are typically used for areas where it is undesirable to shut off equipment due to such concerns as freeze protection or the need to provide some conditioning for equipment. Assumed ex ante savings are 327 kWh/year based on the Statewide Express Efficiency Program.

3-5. HVAC Diagnostic Tune-up

AC diagnostic tune-up involves checking and correcting the refrigerant charge and airflow (RCA), cleaning condensing coils, and cleaning air filters on packaged and split-system central

air conditioning and heat pump units. Detection of leaky Schrader valves is performed with leak detection equipment and leaky Schrader valves are replaced with new valves and core repair tools. Studies show an average efficiency loss of 10-20% for overcharging and 20% for undercharging.[5] Assuming an equal distribution of over- and undercharging the average efficiency loss is approximately 13%. The same studies showed an average efficiency loss of 7% for improper airflow across the air conditioning coil. Cleaning outdoor condenser coils improves cooling efficiency by 8% by increasing condenser heat transfer which increases cooling capacity. The overall average improvement is approximately 10 to 25%. Assumed ex ante savings are 8 percent or 807 kWh/yr and 0.458 kW and the ex ante EUL is 10 years.

6. Motion Sensors

Motion sensors are used to automatically turn on and off lights when people enter or leave rooms. They can be wall mounted or ceiling mounted, passive infrared (PIR) or ultrasonic. Occupancy sensors are reliable, market tested products, but require proper installation and calibration. Understanding the difference in operation between PIR and ultrasonic products is the key to proper installation. Occupancy sensors are applicable in most market sectors except retail and should only be connected to lighting loads that have instant start characteristics (incandescent or fluorescent).

Passive Infrared (PIR) Sensors react only to energy sources (such as the human body) from within their control areas. They sense occupancy by "noticing" the difference in the heat emitted between the human body and the background. The Fresnel lens of the sensor divides coverage into zones. When a change in infrared energy is detected in one of the zones, it assumes the area is occupied. PIR sensors use a dual-element pyroelectric-sensing device to detect occupancy. When one of the dual elements detects infrared energy before the other, it generates a positive pulse – a few milliseconds later, the other element produces a negative pulse, creating an 'ON' state within the sensor. Unlike Ultrasonic sensors, which can sometimes sense occupancy around solid barriers, passive infrared sensors must be able to "see" the area they need to control. Partitions and bookshelves will prevent detection in the blocked area. PIR sensors will also better sense motion when the movement is across the sensor's field of coverage rather than directly towards or away from it.

Ultrasonic Sensors are volumetric motion detectors, which use the Doppler Principle to detect occupancy. They broadcast sounds high above the range of human hearing to sense movement. Usually ultrasonic sensors consist of several components: a transmitter, receivers, and processing electronics. They work by bouncing ultrasonic sound waves off objects in the room and measuring the amount of time it takes for the waves to return. Movement in the controlled area causes the sound waves to return to the receiver at a faster or slower rate, resulting in a Doppler shift and occupancy detection. Because ultrasonic sensors broadcast in three dimensions, the ultrasound will leave the sensor and bounce off the walls, floor, and ceiling, giving them the ability to sense smaller amounts of motion. In enclosed spaces, proper sensor placement is essential, as sensors can "see" out open doorways, resulting in false triggering. Also, heavy airflow (from HVAC ducts or fans) can seriously impair ultrasonic sensor performance and

[5] Studies include: *National Energy Savings Potential from Addressing HVAC Installation Problems*, Chris Neme, Vermont Energy Investment Corporation, J. Proctor, Proctor Engineering, S. Nadel, ACEEE, prepared for US Environmental Protection Agency, March 1998.

result in false triggering. Room surfaces like heavy carpeting, sound-absorbing partitions, and ceiling tiles will absorb ultrasonic sound, reducing ultrasonic sensor coverage. More sensors or sensors with better coverage may be necessary. Areas like bathrooms which contain "hard" surfaces such as tile and metal partitions, normally result in increased sensitivity. The Statewide Express Energy program savings are 416 kWh/yr and 0.089 kW for wall-mounted motion sensors.

7-9. Compact Fluorescent Lamps (13, 23, and 28W CFLs)

Compact fluorescent lamps replace standard incandescent lamps. They are approximately four times more efficacious than incandescent light sources. Screw-in modular lamps have reusable ballasts that typically last for four lamp lives. Commercial applications for compact fluorescent lamps include general lighting, accent and specialty lighting, decorative and portable lighting, utility lighting, and exterior illumination. As with all fluorescent lamps, CFLs emit light when low-pressure mercury vapor is energized inside the lamp, which produces ultraviolet (UV) radiation. The UV radiation is absorbed by a phosphor coating on the inner surface of the lamp, which converts the radiation into light. Ballasts provide initial voltage for starting lamps and regulate lamp current during operation. CFL ballasts are electronic. Incandescent lamps typically use 60 to 150W and can be replaced with CFLs using 13 to 28W. Deemed savings for CFL measures shown in **Table 2.4** are based on the Statewide Express Efficiency program**.**

10-24. T-8 Fluorescent Lamps with Electronic Ballasts and Delamping

This measure involves replacing 1½-inch diameter T-12 fluorescent and standard magnetic ballasts with 1-inch diameter T-8 tri-phosphor lamps and electronic ballasts. The program includes fifteen measure types within this category for different lamp quantities and lengths including 4 feet and 8 feet (see measures 10 through 24 in **Table 2.4**). The deemed savings are based on the Statewide Express Efficiency program.

25. LED Exit Signs from Incandescent – Direct Install Measure

LED exit signs are used to replace incandescent or fluorescent exit signs. LED exit signs last up to 16 years, making the technology suitable to all situations, particularly where maintenance is a concern or where relamping is performed. LED exit signs require no maintenance until they burn out and then the exit sign is replaced. LED exit signs contain light emitting diodes (LED). The LED produces light when low-voltage direct current crosses a suitable semiconductor junction. The color of the light that is produced is determined by the composition of the semiconductor junction. Exit signs typically contain red or green LED lamps. Some exit signs use a diffuser to spread the light emitted by the LED. Typically, LED exit signs consume one to four Watts compared to incandescent exit signs which typically consume 40 Watts. The LED exit sign involves replacing 40W incandescent or 14W fluorescent exit signs with 2W LED exit signs. The program implementation plan savings for LED exit signs are based on the Statewide Express Efficiency program (see **Table 2.4**).

26. Energy Efficient Cooking Equipment

This measure involves efficient electric and gas cooking equipment based on the Statewide Express Efficiency program with measures and savings to be determined.

27. Strip Curtains

Strip curtains can be installed on doorways to walk-in boxes, refrigerated warehouses, or on display cases. They save energy by decreasing infiltration of warmer air into the refrigerated space. Although refrigerated spaces have doors, which if kept closed would make strip curtains obsolete, they are often left open. Strip curtains are a simple application and have been supported in the technical field for years. Though the consumer market has been receptive to their use, there is still potential for additional market penetration. Savings are based on the Statewide Express Energy program.

2.3 Measurement and Verification Approach

The measurement and verification approach for the study is based on the *International Performance Measurement & Verification Protocols* (IPMVP) defined **Table 2.6**.[6]

Table 2.6 IPMVP M&V Options

M&V Option	How Savings Are Calculated	Typical Applications
Option A. Partial Measured Retrofit Isolation Savings are determined by short-term or continuous field measurements of energy use of ECM, separate from facility energy use. Partial measurement means that some parameters may be stipulated. Careful review of ECM design and installation ensures that stipulated values fairly represent probable actual value.	Engineering calculations using short term or continuous post-retrofit measurements and stipulations.	Lighting retrofit where power draw is measured periodically. Operating hours of the lights are measured with light loggers, based on interviews with personnel, or assumed to be one half hour per day longer than store open hours.
Option B. Retrofit Isolation Savings are determined by short-term or continuous measurements of energy use of ECM, separate from the energy use of the rest of the facility.	Engineering calculations using short term or continuous measurements	Variable speed controls used on a constant speed fan. Electricity use is measured with a kW and kWh meter on fan motor with and without the controls.
Option C. Whole Facility Savings are determined by measuring energy use at the whole facility level. Short-term or continuous measurements are taken throughout the post-retrofit period.	Analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.	Whole building performance or energy management system. Energy use is measured with utility meters for pre- and post-retrofit periods.
Option D. Calibrated Simulation Savings are determined through simulation of components or whole facility. Simulation routines model actual energy performance measured in the facility.	Energy use simulation, calibrated with hourly or monthly utility billing data and/or end-use metering.	Measures affecting many systems in a building. Savings are determined by simulations calibrated with pre- or post-retrofit utility data.

2.3.1 M&V Approach for Load Impact Evaluation

The M&V approach for the load impact evaluation involved performing on-site measurement and verification activities for a statistically significant random sample of participating customers. Ex post energy savings for each measure were determined using the following IPMVP Options.

1. "Top-down" IPMVP Option C (i.e., billing analysis of whole facility utility meter data using regression analysis); and
2. "Bottom-up" IPMVP Option A (i.e., partial measurements and stipulated values) and IPMVP Option D (i.e., calibrated simulations).

[6] See *International Performance Measurement & Verification Protocols*, DOE/GO-102000-1132, October 2000.

The simulations were based on detailed on-site audits and self-reported thermostat schedules calibrated to monthly billing data. The results from each approach were compared and simulation inputs were calibrated within +/-2.2% of average annual normalized cooling consumption consistent with IPMVP Option D.

Gross ex post savings for each measure was calculated based on information or measurements collected in the statistical random sample of on-site inspections, telephone surveys, engineering analyses, and simulations or stipulated values. **Sample mean savings estimates** were calculated using **Equation 1**.

Eq. 1 $\bar{y}_i$ = Mean Savings $= \frac{1}{n_i}\sum_{j=1}^{n_i} y_j$

Where,

$\bar{y}_i$ = Mean savings for measure "i" in the sample (i.e., therm/yr).

n_i = Number of measures "i" in the sample.

Savings were adjusted based on the proportion of measures, $\hat{p}_i$ **,** found properly installed during verification inspections.

Eq. 2 Adjusted savings = $\hat{p}_i \bar{y}_i$

Where,

$\hat{p}_i$ = Proportion $= \frac{n_{verified}}{n_i}$

$n_{verified}$ = Number of verified measures in the sample.

The standard error, se_i**, of the measure sample mean** was calculated using **Equation 3**, **Equation 4** or both depending on the measure.[7]

Eq. 3 se_{i_p} = Standard Error of the Proportion $= \sqrt{\frac{\hat{p}_i(1-\hat{p}_i)}{n_i}}$

The standard error of mean savings was calculated using **Equation 4**.

[7] The standard error for all measures was calculated based on the proportion of measures found properly installed from the on-site surveys. In addition, the standard error of the mean savings was also calculated. These two standard errors were then combined to characterize the statistical precision of the sample mean as an estimator of the population mean. The population total was estimated by multiplying both the sample mean and the corresponding combined error bound by the number of units in the population as per sampling procedures from *The California Evaluation Framework*, prepared for the CPUC and Project Advisory Committee, prepared by TecMarktWorks Framework Team, Chapter 13: Sampling, February 2004.

Eq. 4 se_{i_s} = Standard Error of Mean Savings $= \sqrt{\frac{\sum_{j=1}^{n}\left(y_j - \bar{y}\right)^2}{n(n-1)}}$

The measure error bound at the 90 percent confidence level was calculated using **Equation 5** combining the applicable standard errors from **Equations 3** and **4**.

Eq. 5 Measure Error Bound $= \hat{p}_i \bar{y}_i (1 \pm (t)\sqrt{se_{i_p}^2 + se_{i_s}^2})$

Where,

t = The value of the normal deviate corresponding to the desired confidence probability of 1.645 at the 90 percent confidence level per CADMAC Protocols.

Savings for all measures "m" in the program was calculated using **Equation 6**.

Eq. 6 $\hat{Y}$ = Program Savings $= \sum_{i=1}^{m}\left(N_{p_i} \times \hat{p}_i \bar{y}_i\right)$

Where,

N_{p_i} = Number of "i" measures in the entire program population.

The program error bound for all measures was calculated using **Equation 7**.

Eq. 7 Program Error Bound $= \sum_{i=1}^{m} N_{p_i}\left\{\hat{p}_i \bar{y}_i \left(1 \pm (t)\sqrt{se_{i_p}^2 + se_{i_s}^2}\right)\right\}$

Net savings were calculated as gross savings times the CPUC-accepted 0.96 net-to-gross ratio.[8]

[8] Insufficient budget was available to evaluate the net-to-gross ratio.

2.3.2 Sampling Plan

The sampling plan was used to verify measure installation as well as for estimate ex post energy savings. The statistical sample design involved selecting a random sample of customers from the program participant population. Samples were selected to obtain a reasonable level of precision and accuracy at the 90 percent confidence level (budget permitting) per CPUC Energy Efficiency Policy Manual (EEPM). The sample design was based on statistical survey sampling methods to select a sample of participants to meet the CADMAC Protocols.[9] Sampling methods were used to analyze the data and extrapolate mean savings estimates from the sample measurements to the population of all program participants and to evaluate the statistical precision of the results.[10]

The sample size necessary to obtain the desired 10% relative precision for program mean savings estimates was calculated using **Equation 8**.

Eq. 8 $$\text{Sample Size} = n_i = \frac{t^2 C_{vi}^{\ 2}}{r^2}$$

Where,

n_i = Required sample size for measure "i",

t = The value of the normal deviate corresponding to the desired confidence probability of 1.645 at the 90 percent confidence level per CADMAC Protocols,

r = Desired relative precision, 10% per CADMAC Protocols,

C_{vi} = Coefficient of variation, $\frac{s_i}{\bar{y}_i}$, for measure "i."

For small populations, the sample size was corrected using the finite population correction (FPC) equation as follows.[11]

Eq. 9 $$\text{FPC Sample Size} = n_{FPCi} = \frac{n_i}{1+(n_i-1)/N}$$

Where,

n_{FPCi} = Sample size for measure "i" with finite population correction.

The preliminary and actual statistical sample sizes for the EM&V study are shown in **Table 2.7**.

[9] See Table 5c, Protocols for the General Approach to Load Impact Measurement, page 14, Evaluation design decisions related to sample design will be determined by the following protocols: if the number of program participants is greater than 200 for residential programs, a sample must be randomly drawn and be sufficiently large to achieve a minimum precision of plus/minus 10% at the 90% confidence level, based on total annual energy use. A minimum of 200 for residential programs must be included in the analysis dataset for each applicable end-use. *Protocols and Procedures for Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs*, as adopted by the California Public Utilities Commission Decision 93-05-063, Revised March 1998.

[10] Cochran, William G. *Sampling Techniques*. New York: John Wiley & Sons, 1977, Kish, Leslie. *Survey Sampling*. New York: John Wiley & Sons, 1965. Thompson, Steven K. *Sampling*. New York: John Wiley & Sons, 1992.

[11] Ibid.

Table 2.7 Statistical Sample Size for the EM&V Study

Measure Description	Units	Proposed Sample	Preliminary Cv	Actual Sample	Actual Cv	Relative Precision
Reflective Window Film	n/a	n/a	n/a	n/a	n/a	n/a
Programmable Thermostat	814	68	0.50	73	0.61	0.33
AC Diagnostic Tune-up	998	68	0.50	54	0.78	0.34
Motion Sensors	n/a	n/a	n/a	n/a	n/a	n/a
Lighting Retrofits (CFL)	3,885	68	0.50	434	0.26	0.15
Lighting Retrofits (T8)	15,095	68	0.50	1,915	0.19	0.04
LED Exit Signs	1,375	68	0.50	268	0.56	0.26
Rebate Measures	3	1	n/a	0	n/a	undefined
Light Logger Installations	68	68	0.50	69	0.42	0.09

2.3.3 Cost Effectiveness

The evaluation included an assessment of the cost effectiveness inputs used by FCI in preparation of the program. The following inputs were reviewed for accuracy:

- Electricity kWh Savings;
- Peak demand kW Savings (although not tied to the TRC);
- Therm savings;
- Gross Incremental Measure Cost (Gross IMC);
- Effective Useful Life (EUL); and
- Net to Gross Ratio (NTGR).

FCI used several sources and methods to develop the workbook inputs for each measure. For measures using deemed savings we verified the accuracy of deemed parameters. For inputs taken directly from the CPUC Energy Efficiency Policy Manual pertaining to EUL and Net to Gross Ratio, we reviewed the inputs for accuracy and applicability to the respective tables in the CPUC Energy Efficiency Policy Manual (i.e., Tables 4.1 and 4.2). For FCI measures where deemed savings were unavailable and previous studies were used to develop savings, we reviewed ex ante savings assumptions and methods and perform additional analyses (if necessary).

2.3.4 M&V Approach for Process Evaluation

The M&V approach for the process evaluation involved designing and implementing participant and non-participant surveys to evaluate participant satisfaction, and to obtain suggestions to improve the program's services and procedures. Interview questions assessed how the program influenced awareness of linkages between efficiency improvements, bill savings, and increased comfort for customers. A sample of 71 small commercial participants and 68 non-participants were asked process questions. The participant and non-participant surveys are provided in the **Appendices**. Participants were asked why and how they decided to participate in the program. Non-participants were asked why they chose not to participate in order to identify reasons why program marketing efforts were not successful with some customers as well as to identify additional hard-to-reach market barriers. Analysis of process evaluation survey data includes a summary of what works, what doesn't work, and the level of need for the program.

2.4 Evaluation Approach

The evaluation approach included:

- A list of questions to be answered by the study;
- A list of evaluation tasks to be undertaken by the study; and
- A description of how the study will be used to meet all of the Commission objectives described in the CPUC EEPM (page 31).

2.4.1 List of Questions Answered by the Study

The following list of questions were answered by the study.

1. **Are the ex ante measure assumptions appropriate and relevant with respect to actual measures being installed in the program?**
   The study answered this question by evaluating the baseline energy use index (EUI) values and ex ante energy savings estimates using on-site measurements and inspections, engineering analysis, building energy simulations, and billing data (i.e., IPMVP Options A, C, and D). Existing baseline UEC values were evaluated and refined, and ex post savings estimates are provided for each measure based on research performed for this study. The study performed an analysis of the quantity and type of measures that were installed or adopted by program participants by conducting on-site inspections and audits at 71 participant sites to determine if the ex ante measure assumptions are appropriate and relevant. The study evaluated light logger data collected from 2,138 fixtures at 68 sites.

2. **Is the ex ante net-to-gross ratio (NTGR) of 0.96 appropriate and relevant to this program?**
   The ex ante 0.96 NTGR was used for the study since program measures are similar to the Statewide Express Efficiency Program (for small commercial customers). This is based on Table 4.2 Net-to-Gross Ratios, page 19, CPUC *Energy Efficiency Policy Manual*, August, 2003.

3. **Are the total program savings estimates accurate?**
   The study will answer this question by developing ex post energy savings for the program at the 90 percent confidence level.

4. **Are customers satisfied with the program implementation and are customers satisfied with the measures that were offered and installed in the program?**
   The study answered this question by summarizing customer satisfaction responses to process survey questions. Participant satisfaction was found to be generally very high (see **Section 3.2.1**, Participant Survey Results).

5. **Have some small commercial customers decided not to participate in the program?**
   The study answered this question by conducting in-person and telephone interviews with 68 non-participants. The following questions were included.
   1. What reasons are there for not participating and how might conditions be revised to motivate participation?
   2. Why have non-participants decided not to install similar measures (i.e., HVAC diagnostic tune-up, programmable thermostats, T-8 fluorescent lighting fixtures, and compact fluorescent lamps)?

3. What barriers tend to reduce or restrict participation?
4. What percent of the small commercial market are affected by each of these barriers?
5. How can marketing, design, implementation, delivery, and follow-up efforts be changed to address these barriers?

6. Is there a continuing need for the program?

The study answered this question by evaluating ex post savings and responses from the in-person and telephone process surveys of participants and non-participants. The FCI ECEEP Program provided energy efficiency services to 1,339 small commercial businesses and overall participant satisfaction with the program was 82.6 ± 9 percent. Ex post measure savings and implementation costs were used to develop ex post Total Resource Cost (TRC) test values for the program using the CPUC cost effectiveness worksheets. Approximately 31% of non-participants would have participated if they knew the program installed no-cost/low-cost energy efficiency improvements in businesses like theirs, indicating a continuing need for the program.

7. Are there measurable program multiplier effects?

Program multiplier effects questions are used to measure program participants sharing information learned from the program with non-participants, and if sharing of information is acted upon in a way that results in the installation of similar measures within a non-participant population. For example, the program installs measures such as CFLs, LED exit signs, efficient lighting, and performs audits to educate small commercial customers on the value of these measures. Customers might share this information with their peers, following which, the peer says, "I think I will try these measures" and then buys CFLs or LED exit signs. In this case the program helped expand the impacts beyond the participant group. Based on process survey responses, 51 percent of interviewed customers shared program information with 31 times as many peers (37 participants shared information with 1,146 businesses). Roughly 7.5 percent of these businesses decided to install similar measures or participate in the FCI ECEE Program (86 out of 1,146). The multiplier effect for the program is estimated at 3.4 percent.[12] Programs that link technologies with educational measures can have multiplier effects as high as 25-30% including the sharing of program information to a population that is several times larger than the participant population. The following questions were included in the participant process surveys

1. Have you shared program information with any of your business associates about HVAC diagnostic tune-ups, programmable thermostats, CFLs, T8 lamps/electronic ballasts, LED exit signs, or other measures offered in the program?
2. With about how many other businesses have you shared this information in the last 12 months?
3. Of these people, about how many have used this information to install any of these measures?

8. Are measures being installed properly?

The study answered this question by performing 2,592 inspections at a random sample of 69 participant sites. In addition, billing analysis for 74 sites provided additional verification that

[12] Spillover of 3.4 percent is calculated based on 86 businesses adopting at least one spillover measure based on information shared by a group of 69 participants who adopted 2,501 verified measures (i.e., 86 ÷ 2,501 = 0.034).

measures were installed properly. These efforts provided useful information in developing best practices recommendations to ensure measures are installed properly (see **Section 3.2.3**).

2.4.2 List of Tasks Undertaken by the Study

Eight tasks will be undertaken by the study. The seven tasks are briefly summarized as follows.

Task 1. Prepare EM&V Plan

The EM&V Plan contained a detailed description of all activities required to complete the study. The EM&V Plan contained the components delineated in the CPUC Energy Efficiency Policy Manual (EEPM) and included a detailed description of all activities required to complete the project.

Task 2. Tracking Database

The EM&V tracking database provided a listing of all jobs that were completed including on-site pre- and post measurements of installed measurements. FCI provided the tracking database for evaluation purposes.

Task 3. Sample Design

The statistical sample design was selected to obtain a reasonable level of precision and accuracy at the 90 percent confidence level per CPUC EEPM. The proposed sample design was based on statistical survey sampling methods to select a sample of participants to meet or exceed the CPUC Protocols (see **Section 2.3.2**).

Task 4. Process Survey

Participant and non-participant process survey instruments were developed to collect information necessary to evaluate the program. The process surveys were designed to measure customer satisfaction and obtain suggestions for improvement in the program's services and procedures.

Task 5. On-Site EM&V Inspections

On-site EM&V inspections and measurements were performed for a statistically significant random sample of sites to verify measures were properly installed and provided feedback regarding any improvements to the installation efforts or procedures. On-site inspections were used to evaluate deemed kW, kWh, and therm savings estimates.

Task 6. Statistical Analyses

Statistical analyses included billing analyses to evaluate baseline electrical usage and savings. This step included an assessment of the relative precision of program-level savings, mean savings estimates, standard deviations, and confidence intervals. This analysis included an assessment of all assumptions used to calculate deemed savings. Gross savings estimates were adjusted based on proportion of measures found properly installed and the default CPUC-approved net-to-gross ratios. Analyses of process evaluation interview survey data included a summary of what works, what doesn't work, and the level of need for the program as well as recommendations to improve the program. Analyses of responses to interview questions included an assessment of market barriers to energy efficiency, participant satisfaction, and suggestions to improve the program. An analysis of why non-participants decided not to participate was made.

Task 7. Progress, Draft and Final Reports
Progress, draft, and final EM&V reports included a description of the study methodology and all deliverables as per the CPUC EEPM. The reports provided results of the impact evaluation including gross and net energy savings for each measure and the program as well as results.

Task 8. Project Management
Project management included consistent and timely communication, issue resolution, and periodic reporting.

2.4.3 How Study met CPUC EEPM Objectives

The study met the following Commission objectives described in the CPUC EEPM (pg. 31).

- **Measure the level of energy savings achieved.**
  The study met this objective by performing detailed on-site visits for a statistically significant sample of 69 participants to gather pre- and post-installation measurements for energy efficiency measures are installed under the program. Sites in the statistical sample included verification of proper installation of program measures and operation of equipment the measures were installed on (i.e., HVAC equipment). EM&V efforts included gathering enough information and measurements to develop savings estimates for each measure and number of small commercial businesses served by the program. Statistical analyses were used to extrapolate energy savings at the sample level to the program level. This step included an assessment of the relative precision of program-level savings, mean savings estimates, standard deviations, and confidence intervals. This analysis included an assessment of all major assumptions used to calculate program ex ante savings.

- **Measure the cost-effectiveness.**
  The study met this objective by developing ex post average energy savings for all measures. Ex post measure savings and implementation costs were used to develop ex post Total Resource Cost (TRC) test values for the program using the CPUC cost effectiveness worksheets. The ex post TRC was 1.89 and the ex post participant test was 2.55.

- **Provide up-front market assessments and baseline analysis.**
  The study met this objective by performing a simple market assessment and baseline analyses including an evaluation of the baseline unit energy consumption values for space cooling, space heating, and lighting. Process survey interviews included questions about market barriers to energy efficiency and the success of the program in meeting the needs of hard-to-reach customers.[13]

- **Provide ongoing feedback and corrective or constructive guidance regarding the implementation of programs.**
  The study met this objective by performing on-site inspections to verify that measures were installed properly. Results of on-site inspections were used to provide ongoing feedback and

[13] The CPUC definition of small commercial hard-to-reach customers are those who do not have easy access to program information or generally do not participate in energy efficiency programs due to language (i.e., primary language non-English), business size (less than ten employees); geographic (i.e., outside Los Angeles Basin), or lease (i.e., split incentives barrier).

corrective or constructive guidance regarding installation best practices and implementation of the program. This included recommended improvements to the installation efforts and procedures. Inspections also documented that all activities were completed as per the contract requirements.

- **Measure indicators of the effectiveness of the programs, including testing of the assumptions that underlie the program theory and approach.**
  The study met this objective by performing a process evaluation of the program including surveys of participants and non-participants.

- **Assess the overall levels of performance and success of the program.**
  The study provided ex post energy savings at the 90 percent confidence level as per the CADMAC Protocols. The study determined participant satisfaction and ways to improve the program. Non-participating customers were interviewed to evaluate why they chose not to participate.

- **Help to assess whether there is a continuing need for the program.**
  The study met this objective by assessing overall cost effectiveness, the number of small commercial businesses treated by the program, and survey responses from participants and non-participants. Ex post measure savings and implementation costs were used to develop ex post Total Resource Cost (TRC) test values for the program using the CPUC cost effectiveness worksheets. The overall ex post TRC was 1.89 and this was 20.6 percent lower than the ex ante 2.38 TRC. The program treated 1,386 small commercial customers with 998 Energy Star programmable thermostats, 803 HVAC diagnostic tune-ups, 3,885 compact fluorescent lamps (CFLs), 16,519 T8 fluorescent fixtures with electronic ballasts, and 268 LED exit signs. In-person interviews were conducted with 70 participants. Telephone surveys were conducted with 68 non-participants. Interviews assessed how the program influenced awareness of linkages between efficiency improvements, bill savings, and increased comfort for customers. The study also identified what works, what doesn't work, and the level of need for the program. Approximately 31% of non-participants surveyed indicated interest in the program, but were unable to participate due to a number of reasons, most notably the program running out of funding (these were referred to FCI).

3. EM&V Findings

This section provides load impact results for the program and for each measure. This section also provides the process evaluation results based on participant and non-participant surveys and recommendations regarding what works, what doesn't work, and the continuing need of the program. Also provided are recommendations for each measure to increase savings, achieve greater persistence of savings, and improve customer satisfaction.

3.1 Load Impact Results

The program succeeded in providing energy efficiency incentives at 1,339 hard-to-reach businesses and directly installed 21,621 measures. Ex post accomplishments were verified by randomly inspecting 2,501 measures at 79 sites. Light loggers were installed at 69 sites to

measure operating hours on 2,366 lighting fixtures, AC tune-ups inspections were conducted for 85 units, three-years of pre-post billing data were analyzed for 74 sites, and in-person and telephone follow-up surveys were conducted for 74 customers. Pre and post utility bill data and savings are provided in **Table 3.1**. The gross ex post realization rate based on average billing savings versus average ex ante savings is 46%. The realization rate is low due to many sites having relatively low pre-post utility bill savings, and 26 percent of sites had negative pre-post bill savings (i.e., 18 out of 70 with pre/post data). Additional research was conducted to understand why some customers had negative savings. Ten customers with negative savings indicated that their "air conditioners run more now" (i.e., after the retrofit). Nine customers with negative savings and customers with low savings indicated that post-retrofit hours of operation increased due to expanded business schedules or security lighting. Further analysis was performed to evaluate ex post savings using pre/post fixture wattage measurements, light logger data, and calibrated building energy simulations (see **Sections 3.1.2** through **3.1.22**).

Table 3.1 Pre/Post Utility Bill Data and Savings versus Ex Ante Savings

#	Pre-Retrofit Bill kWh	Post-Retrofit Bill kWh	Pre-Post Bill Savings kWh	Ex Ante Savings kWh	Notes
1	10,167	8,903	1,264	7,168	AC runs more now (hours 9:30 to 6:00 PM, M-F)
2	7,186	6,222	964	10,645	Longer hours of operation
3	67,902	52,650	15,252	25,497	
4	11,118	14,404	-3,286	4,807	TV Doesn't work due to ballasts and energy is going up.
5	4,066	3,662	404	1,593	
6	6,163	6,145	18	1,012	
7	122,862	123,486	-624	4,545	AC runs more now
8	5,838	7,211	-1,373	1,827	50% of previous lights didn't work before
9	3,126	2,712	414	768	
10	0	10,673	N/A	5,350	
11	31,687	31,059	628	6,466	
12	19,500	15,354	4,146	4,723	
13	17,176	15,947	1,229	1,781	
14	115,920	100,410	15,510	27,197	
15	20,680	19,194	1,486	13,568	New lighting used for security 24 x 7
16	82,121	78,926	3,195	7,871	
17	1,674	1,613	61	1,031	
18	6,530	10,246	-3,716	1,134	AC runs more now 10 to 7PM M-F
19	19,503	15,174	4,329	6,466	
20	11,664	10,908	756	6,466	AC runs more now
21	8,586	5,346	3,240	3,701	
22	29,133	25,551	3,582	5,510	
23	6,904	4,657	3,582	3,181	
24	27,144	24,300	3,501	15,119	
25	14,157	12,843	1,314	3,767	
26	34,596	38,772	-4,176	6,823	Lights & AC run more (9AM – 9PM x 7 days/week)
27	167,364	162,000	5,364	11,229	
28	45,962	35,175	10,787	17,166	
29	33,672	31,884	1,788	6,380	
30	4,752	10,908	-6,156	3,982	AC runs more now and projector screen was left on at night
31	6,486	7,710	-1,224	8,096	
32	29,196	27,306	1,890	12,228	
33	16,596	16,155	441	4,368	AC runs more now interested in tune-up
34	25,560	22,150	3,410	5,402	
35	9,945	12,960	-3,015	8,894	AC runs more now interested in tune-up
36	6,174	8,712	-2,538	15,391	AC runs more
37	20,322	19,251	1,071	4,282	
38	6,237	7,191	-954	3,241	AC runs more now
39	15,930	16,389	-459	3,330	AC runs more now
40	39,068	29,093	9,975	5,395	
41	33,480	35,622	-2,142	13,452	AC runs more now

Table 3.1 Pre/Post Utility Bill Data and Savings versus Ex Ante Savings

#	Pre-Retrofit Bill kWh	Post-Retrofit Bill kWh	Pre-Post Bill Savings kWh	Ex Ante Savings kWh	Notes
42	19,440	15,939	3,501	13,500	No change
43	116,940	110,880	6,060	807	
44	141,420	113,952	27,468	2,421	
45	38,880	23,904	14,976	2,421	
46	8,654	6,216	2,438	1,232	
47	4,136	3,575	561	1,434	
48	3,600	1,008	2,592	4,235	
49	102,480	106,400	-3,920	9,332	
50	20,388	15,300	5,088	10,410	
51	28,574	25,598	2,976	10,437	
52	46,428	41,772	4,656	5,791	
53	14,376	15,108	-732	6,470	Some lights replaced weren't working before
54	16,343	15,166	1,177	9,811	New Business
55	14,103	9,495	4,608	25,140	AC runs more now (9AM-5PM)
56	41,440	43,000	-1,560	8,460	AC runs more now
57	9,709	9,680	29	3,280	AC runs more now
58	25,297	20,934	4,363	5,931	
59	0	0	N/A	N/A	
60	7,626	6,435	1,191	4,769	Some lights didn't work and need to be replaced
61	9,459	8,469	990	3,973	Schedule change open more hours
62	43,059	44,208	-1,149	2,380	
63	7,352	5,832	1,520	4,451	
64	34,469	33,021	1,448	1,996	
65	102,619	105,930	-3,311	6,629	Installed new equipment with longer hours of operation
66	0	0	N/A	4,797	
67	4,770	4,824	234	3,701	Schedule change open more hours
68	74,892	65,405	3,252	4,484	
69	0	0	N/A	N/A	
70	89,418	99,595	-10,177	1,818	Two more hours per night (12 hrs/week = 624 hours/y)
71	17,640	14,994	2,646	13,528	AC runs more now
72	10,287	9,945	342	4,382	AC runs more now
73	42,182	37,839	4,342	23,778	AC runs more now
74	402,240	303,120	99,120	39,989	
Ave.	35,735	32,519	3,495	7,537	46% realization rate based on billing versus ex ante savings

The ex ante annual savings per measure are summarized in **Table 3.2** and the ex post annual savings are summarized in **Table 3.3**. The net-to-gross ratio (NTGR) is 0.96 based on the Express Efficiency Program and reflects what customers would have done in the absence of the program (i.e., 4 percent free riders).[14] The net ex ante program savings are 4,952,884 kWh per year and 1,276 kW. First-year net ex post program savings are 4,081,809 ± 230,212 kWh per year, 1,196.5 ± 110 kW, and 39,346 ± 13,006 therms per year at the 90 percent confidence level. The program net realization rate for kWh savings is 0.82 ± 0.05 and the net realization rate for kW savings is 0.94 ± 0.09.

Table 3.2 Ex Ante Annual Electricity Savings for the ECEE Program

Measure	Units	Gross Ex-Ante Unit Savings (kWh/y)	Gross Ex-Ante Unit Savings (kW)	Gross Ex-Ante Unit Savings (therm/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (therm/y)
Reflect. Window Film	0	16.01	0.0030	0	0.96	0	0	0
Prog. Thermostat	22	327.00	0.0000	0	0.96	6,906	0	0
Prog. Thermostat	792	327.00	0.0000	0	0.96	248,625	0	0

[14] *Energy Efficiency Policy Manual*, Chapter 4, Table 4.2, page 23, prepared by the California Public Utilities Commission, 2001.

Table 3.2 Ex Ante Annual Electricity Savings for the ECEE Program

Measure	Units	Gross Ex-Ante Unit Savings (kWh/y)	Gross Ex-Ante Unit Savings (kW)	Gross Ex-Ante Unit Savings (therm/y)	Net-to-Gross Ratio	Net Ex Ante Program Savings (kWh/y)	Net Ex Ante Program Savings (kW)	Net Ex Ante Program Savings (therm/y)
HVAC Tune-up	28	807.00	0.4580	0	0.96	21,692	12	0
HVAC Tune-up	510	807.00	0.4580	0	0.96	395,107	224	0
HVAC Tune-up	265	807.00	0.4580	0	0.96	205,301	117	0
HVAC Tune-up	195	807.00	0.4580	0	0.96	151,070	86	0
Motion Sensors	0	416.00	0.0000	0	0.96	0	0	0
60/75w to CFL-13	1,792	234.25	0.0500	0	0.96	402,985	86	0
100w to CFL -23	2,074	346.69	0.0740	0	0.96	690,274	147	0
150w to CFL -28	19	543.46	0.1160	0	0.96	9,913	2	0
2' 1L T12 to 2'1L T8	77	37.48	0.0080	0	0.96	2,771	1	0
3' 1L T12 to 3' 1L T8	99	84.33	0.0180	0	0.96	8,015	2	0
4' 1L T12 to 4' 1L T8	686	74.96	0.0160	0	0.96	49,366	11	0
4' 2 L T12 to 4' 2L T8	2,653	84.33	0.0210	0	0.96	214,778	53	0
4' 3 L T12 to 4' 3L T8	292	182.72	0.0390	0	0.96	51,220	11	0
4' 4 L T12 to 4' 4 L T8	3,331	206.14	0.0440	0	0.96	659,186	141	0
4' 4L T12 to 4' 3L T8	434	318.58	0.0680	0	0.96	132,733	28	0
4' 4L T12 to 4' 2L T8	2,456	346.69	0.0740	0	0.96	817,412	174	0
4' 3L T12 to 4' 2L T8	239	210.83	0.0450	0	0.96	48,373	10	0
8' 1 L T12 to 4' 2L T8	130	98.39	0.0210	0	0.96	12,279	3	0
8' 2L T12 to 4' 4L T8	805	107.76	0.0230	0	0.96	83,277	18	0
8' 1L T12 to 8' 1L T8	189	79.65	0.0170	0	0.96	14,452	3	0
8' T12 to 8' 2L T8SLO	570	89.02	0.0190	0	0.96	48,712	10	0
F40U 2L to U 2L T8	291	60.91	0.0130	0	0.96	17,016	4	0
8' 2L T8 RLO	4,267	140.56	0.0300	0	0.96	575,779	123	0
2 watt LED Exit sign	268	332.88	0.0380	0	0.96	85,643	10	0
EE Cooking Equip.	5	0.00	0.0000	0	0.96	0	0	0
Strip Curtains	0	465.00	0.0530	0	0.96	0	0	0
Total	22,489					4,952,884	1,276	0

Table 3.3 Ex Post Annual Savings for the ECEE Program

Measure	Units	Gross Ex-Post Unit Savings (kWh/y)	Gross Ex-Post Unit Savings (kW)	Gross Ex-Post Unit Savings (therm)	Net-to-Gross Ratio	Net Verification Rate	Net Ex-Post Program Savings (kWh/y)	Net Ex-Post Program Savings (kW)	Net Ex-Post Program Savings (therm/y)	Net Realization Rate kWh	Net Realization Rate kW
Reflect. Window Film	0	n/a	n/a	0	0.96	0	0	0.0	0	n/a	n/a
Prog. Thermostat	22	680	0	53	0.96	0.95	13,644	0.0	1,063	n/a	n/a
Prog. Thermostat	792	680	0	53	0.96	0.95	491,167	0.0	38,282	1.98	n/a
HVAC Tune-up	28	640	0.5904	0	0.96	0.64	11,010	10.2	0	0.51	0.83
HVAC Tune-up	510	640	0.5904	0	0.96	0.64	200,540	185.0	0	0.51	0.83
HVAC Tune-up	265	640	0.5904	0	0.96	0.64	104,202	96.1	0	0.51	0.83
HVAC Tune-up	195	640	0.5904	0	0.96	0.64	76,677	70.7	0	0.51	0.83
Motion Sensors	0	n/a	0	0	0.96	0	0	0.0	0	0.00	n/a
60/75w to CFL-13	1,792	159.6	0.047	0	0.96	0.91	249,823	73.6	0	0.62	0.86
100w to CFL -23	2,074	330.5	0.074	0	0.96	0.97	638,374	142.9	0	0.92	0.97
150w to CFL -28	19	479.5	0.116	0	0.96	0.8	6,996	1.7	0	0.71	0.80
2' 1L T12 to 2'1L T8	77	14.0	0.008	0	0.96	1	1,034	0.6	0	0.37	1.00
3' 1L T12 to 3' 1L T8	99	56.1	0.018	0	0.96	1	5,335	1.7	0	0.67	1.00
4' 1L T12 to 4' 1L T8	686	38.9	0.012	0	0.96	0.95	24,367	7.5	0	0.49	0.71
4' 2 L T12 to 4' 2L T8	2,653	54.1	0.014	0	0.96	0.99	136,505	35.3	0	0.64	0.66
4' 3 L T12 to 4' 3L T8	292	59.7	0.026	0	0.96	1	16,727	7.3	0	0.33	0.67
4' 4 L T12 to 4' 4 L T8	3,331	159.4	0.046	0	0.96	1.03	525,127	151.5	0	0.80	1.08
4' 4L T12 to 4' 3L T8	434	264.4	0.064	0	0.96	0.49	53,974	13.1	0	0.41	0.46
4' 4L T12 to 4' 2L T8	2,456	336.0	0.09	0	0.96	1.09	863,599	231.3	0	1.06	1.33
4' 3L T12 to 4' 2L T8	239	183.2	0.052	0	0.96	n/a	0	0.0	0	0.00	0.00
8' 1 L T12 to 4' 2L T8	130	43.9	0.014	0	0.96	1	5,479	1.7	0	0.45	0.67
8' 2L T12 to 4' 4L T8	805	51.3	0.02	0	0.96	0.78	30,912	12.1	0	0.37	0.68
8' 1L T12 to 8' 1L T8	189	56.6	0.017	0	0.96	0.85	8,724	2.6	0	0.60	0.85
8' T12 to 8' 2L T8SLO	570	82.3	0.019	0	0.96	1	45,017	10.4	0	0.92	1.00

Table 3.3 Ex Post Annual Savings for the ECEE Program

Measure	Units	Gross Ex-Post Unit Savings (kWh/y)	Gross Ex-Post Unit Savings (kW)	Gross Ex-Post Unit Savings (therm)	Net-to-Gross Ratio	Net Verification Rate	Net Ex-Post Program Savings (kWh/y)	Net Ex-Post Program Savings (kW)	Net Ex-Post Program Savings (therm/y)	Net Realization Rate kWh	Net Realization Rate kW
F40U 2L to U 2L T8	291	49.0	0.013	0	0.96	1	13,701	3.6	0	0.81	1.00
8' 2L T8 RLO	4,267	121.7	0.03	0	0.96	1.04	518,284	127.8	0	0.90	1.04
2 watt LED Exit sign	268	157.8	0.038	0	0.96	1	40,591	9.8	0	0.47	1.00
EE Cooking Equip.	5	n/a	n/a	0	0.96	n/a	0	0.0	0	0.00	n/a
Strip Curtains	0	n/a	n/a	0	0.96	n/a	0	0.0	0	0.00	n/a
Total	22,489						4,081,809	1196.5	39,346	0.82	0.94

Lifecycle kWh savings are summarized in **Table 3.4** and lifecycle therms savings are summarized in **Table 3.5**. The required energy impact reporting for 2004-05 programs is provided in **Table 3.6**. The net ex-ante lifecycle savings are 64,504,089 kWh. The net ex-post lifecycle savings are 48,289,007 ± 2,774,456 kWh and 432,801 ± 13,006 therms. The lifecycle ex-post net lifecycle kWh realization rate is 0.75 ± 0.04 and the net lifecycle therm realization rate is undefined.

Table 3.4 Lifecycle Electricity Savings for the ECEE Program

Measure	Net Ex-Ante Program Savings (kWh)	Ex Ante Effective Useful Life (EUL)	Net Ex-Ante Lifecycle Program Savings (kWh)	Net Ex-Post Program Savings (kWh)	Ex Post Effective Useful Life (EUL)	Net Ex-Post Lifecycle Program Savings (kWh)	Net Lifecycle Realization Rate
Reflect. Window Film	0	10	0	0	10	0	
Prog. Thermostat	6,906	11	75,969	13,644	11	150,079	1.98
Prog. Thermostat	248,625	11	2,734,871	491,167	11	5,402,834	1.98
HVAC Tune-up	21,692	10	216,922	11,010	10	110,100	0.51
HVAC Tune-up	395,107	10	3,951,072	200,540	10	2,005,402	0.51
HVAC Tune-up	205,301	10	2,053,008	104,202	10	1,042,022	0.51
HVAC Tune-up	151,070	10	1,510,704	76,677	10	766,771	0.51
Motion Sensors	0	16	0	0	16	0	
60/75w to CFL-13	402,985	8	3,223,880	249,823	2.94	734,479	0.23
100w to CFL -23	690,274	8	5,522,189	638,374	2.24	1,429,958	0.26
150w to CFL -28	9,913	8	79,302	6,996	2.48	17,350	0.22
2' 1L T12 to 2'1L T8	2,771	16	44,328	1,034	16	16,552	0.37
3' 1L T12 to 3' 1L T8	8,015	16	128,236	5,335	16	85,361	0.67
4' 1L T12 to 4' 1L T8	49,366	16	789,851	24,367	16	389,870	0.49
4' 2 L T12 to 4' 2L T8	214,778	16	3,436,454	136,505	16	2,184,083	0.64
4' 3 L T12 to 4' 3L T8	51,220	16	819,521	16,727	16	267,627	0.33
4' 4 L T12 to 4' 4 L T8	659,186	16	10,546,980	525,127	16	8,402,034	0.80
4' 4L T12 to 4' 3L T8	132,733	16	2,123,731	53,974	16	863,586	0.41
4' 4L T12 to 4' 2L T8	817,412	16	13,078,589	863,599	16	13,817,581	1.06
4' 3L T12 to 4' 2L T8	48,373	16	773,965	0	16	0	0.00
8' 1 L T12 to 4' 2L T8	12,279	16	196,465	5,479	16	87,668	0.45
8' 2L T12 to 4' 4L T8	83,277	16	1,332,431	30,912	16	494,588	0.37
8' 1L T12 to 8' 1L T8	14,452	16	231,227	8,724	16	139,587	0.60
8' T12 to 8' 2L T8SLO	48,712	16	779,388	45,017	16	720,276	0.92
F40U 2L to U 2L T8	17,016	16	272,253	13,701	16	219,208	0.81
8' 2L T8 RLO	575,779	16	9,212,460	518,284	16	8,292,542	0.90
2 watt LED Exit sign	85,643	16	1,370,294	40,591	16	649,449	0.47
EE Cooking Equip.	0	12	0	0	12	0	
Strip Curtains	0	4	0	0	4	0	
Total	4,952,884		64,504,089	4,081,809		48,289,007	0.75

Table 3.5 Lifecycle Gas Savings for the ECEE Program

Measure	Net Ex-Ante Program Savings (therm)	Ex Ante Effective Useful Life (EUL)	Net Ex-Ante Lifecycle Program Savings (therm)	Net Ex-Post Program Savings (therm)	Ex Post Effective Useful Life (EUL)	Net Ex-Post Lifecycle Program Savings (therm)	Net Lifecycle Realization Rate
Reflect. Window Film	0	10	0	0	10	0	0
Prog. Thermostat	0	11	0	1,063	11	11,697	0
Prog. Thermostat	0	11	0	38,282	11	421,103	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
HVAC Tune-up	0	10	0	0	10	0	0
Motion Sensors	0	16	0	0	16	0	0
60/75w to CFL-13	0	8	0	0	2.94	0	0
100w to CFL -23	0	8	0	0	2.24	0	0
150w to CFL -28	0	8	0	0	2.48	0	0
2' 1L T12 to 2'1L T8	0	16	0	0	16	0	0
3' 1L T12 to 3' 1L T8	0	16	0	0	16	0	0
4' 1L T12 to 4' 1L T8	0	16	0	0	16	0	0
4' 2 L T12 to 4' 2L T8	0	16	0	0	16	0	0
4' 3 L T12 to 4' 3L T8	0	16	0	0	16	0	0
4' 4 L T12 to 4' 4 L T8	0	16	0	0	16	0	0
4' 4L T12 to 4' 3L T8	0	16	0	0	16	0	0
4' 4L T12 to 4' 2L T8	0	16	0	0	16	0	0
4' 3L T12 to 4' 2L T8	0	16	0	0	16	0	0
8' 1 L T12 to 4' 2L T8	0	16	0	0	16	0	0
8' 2L T12 to 4' 4L T8	0	16	0	0	16	0	0
8' 1L T12 to 8' 1L T8	0	16	0	0	16	0	0
8' T12 to 8' 2L T8SLO	0	16	0	0	16	0	0
F40U 2L to U 2L T8	0	16	0	0	16	0	0
8' 2L T8 RLO	0	16	0	0	16	0	0
2 watt LED Exit sign	0	16	0	0	16	0	0
EE Cooking Equip.	0	12	0	0	12	0	0
Strip Curtains	0	4	0	0	4	0	0
Total	0		0	39,346		432,801	Undefined

Table 3.6 Required Energy Impact Reporting for 2004-2005 Programs

Program ID:		1396-04					
Program Name:		Emerging Communities Energy Efficiency Program (ECEEP)					
Year	Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
1	2004	5,523	4,082	1.395	1.197	0	39,346
2	2005	5,523	4,082	1.395	1.197	0	39,346
3	2006	5,523	3,578	1.395	1.197	0	39,346
4	2007	5,523	3,187	1.395	0.978	0	39,346
5	2008	5,097	3,187	1.347	0.978	0	39,346
6	2009	5,097	3,187	1.347	0.978	0	39,346
7	2010	5,097	3,187	1.347	0.978	0	39,346
8	2011	5,097	3,187	1.347	0.978	0	39,346
9	2012	4,238	3,187	1.163	0.978	0	39,346
10	2013	4,238	3,187	1.163	0.978	0	39,346
11	2014	3,236	2,794	0.598	0.616	0	39,346
12	2015	3,023	2,289	0.598	0.616	0	
13	2016	3,023	2,289	0.598	0.616	0	
14	2017	3,023	2,289	0.598	0.616	0	
15	2018	3,023	2,289	0.598	0.616	0	
16	2019	3,023	2,289	0.598	0.616	0	
17	2020	0	0	0	0	0	

Table 3.6 Required Energy Impact Reporting for 2004-2005 Programs

Program ID:		1396-04					
Program Name:		Emerging Communities Energy Efficiency Program (ECEEP)					
Year	Year	Ex-ante Gross Program-Projected Program MWh Savings (1)	Ex-Post Net Evaluation Confirmed Program MWh Savings (2)	Ex-Ante Gross Program-Projected Peak Program MW Savings (1**)	Ex-Post Evaluation Projected Peak MW Savings (2**)	Ex-Ante Gross Program-Projected Program Therm Savings (1)	Ex-Post Net Evaluation Confirmed Program Therm Savings (2)
18	2021	0	0	0	0	0	
19	2022	0	0	0	0	0	
20	2023	0	0	0	0	0	
TOTAL		69,309	48,289			0	432,801

** Peak MW savings are defined in this evaluation as the weekday peak period Monday through Friday from 2PM to 6PM during the months of May through September.

1. Gross Program-Projected savings are those savings projected by the program before NTG adjustments.
2. Net Evaluation Confirmed savings are those documented via the evaluation and include the evaluation contractor's NTG adjustments.

The EM&V ex-post cost effectiveness is 1.89 for the total resource cost (TRC) test and 2.52 for the participant test. The program ex ante cost effectiveness was 2.52 for the TRC test and 2.53 for the participant test. The largest differences between ex ante estimates and ex post accomplishments are with the lifecycle savings and TRC. These differences are mostly due to the 8-year EUL assumed for CFL measures. The weighted average ex post EUL for CFL measures is 2.437 years based on annual hours of operation from logger data and 10,000 hour lifetime from manufacturer data. If the 8-year EUL for CFL measures is used instead, then the ex post TRC would be 2.2 and the lifecycle savings would be 53,260,738 kWh instead of 48,289,007 kWh. The second most important difference between PIP goals/ex ante estimates and ex post accomplishments is the annual electricity savings. The ex post annual savings are 4,081,006 kWh/yr, and this is 17.5% less than the ex ante estimate and 23% less than the PIP estimate. This difference is largely due to lower operating hours for lighting measures. The weighted average ex post operating hours are $3,523 \pm 247$ hours/yr, and this is 24.8% less than the 4,685 hours/yr assumed in the PIP goals and ex ante estimates. The verification inspection findings and detailed load impact results are provided in the following sections.

3.1.1 Verification Inspection Findings

Seven sets of verification inspections were conducted for the study. The first set of inspections was completed in April 2005. The seventh set of inspections was completed in January 2006. Three ride-along inspections were completed on April 1st 2005. FCI personnel were present during the ride-along inspections with RMA personnel. Seven additional on-site inspections without FCI personnel present were completed on April 2nd 2005. The second set of verification inspections were completed without FCI present on April 9th 2005; the third set of verification inspections were completed without FCI present on June 6th through June 10th 2005; the fourth set of inspections were completed without FCI present on the 9th to the 14th of September; the fifth set of inspections were completed on the 7th to the 12th of November (FCI personnel were present during the inspection of three sites on November 7th); the sixth set of inspections were completed without FCI present on the 14th and 15th of December; and the seventh set of inspections were completed without FCI present on the 2nd to the 5th of January 2006. Verification inspections were completed at 71 sites as indicated in **Table 3.7**. The verification rate for each measure is provided in **Table 3.8**. Some measures have a verification rate greater

than 1.0 indicating more measures were installed than what were reported in the tracking database. The overall verification rate is 0.96.[15]

Table 3.7 Proposed and Actual Statistical Sample Plan for FCI ECEEP Measures

Measure Description	Ex Ante Units	Unit	Proposed EM&V Sample	Actual EM&V Site Sample	Actual EM&V Unit Sample	Notes
Reflective Window Film	600	ft^2	n/a	n/a	n/a	None in program
AC Diagnostic Tune-up	1,230	Site	68	96	96	
Programmable Thermostat	650	Site	68	68	68	
Reprogram Thermostat	n/a	Site	n/a	6	30	
Motion Sensors	97	Site	10	10	10	None in program
Lighting Retrofits (CFL)	3,081	Site	68	68	365	
Lighting Retrofits (T8)	15,095	Site	68	68	1773	
LED Exit Signs	1,375	Site	68	68	48	
Rebate Measures	3	Site	n/a	n/a	n/a	None in program
Energy Audits	1,500	Site	68	71	71	
Light Logger Installations		Site	68	69	69	

Table 3.8 Proposed and Actual Statistical Sample Plan for FCI ECEEP Measures

#	Description	Units	FCI Database Reported	EM&V Inspections Pass	Verification Rate	Installed Quantity
1	Reflective Window Film	ft^2				N/A
2-3	Programmable Thermostat	Unit	77	73	0.95	998
4-7	HVAC diagnostic and tune-up	Unit	85	54	0.64	803
8	Motion Sensors	Unit	0	8	N/A	N/A
9	60/75w Incan to CFL -13	Unit	253	229	0.91	1792
10	100w Incan to CFL -23	Unit	167	162	0.97	2074
11	150w Incan to CFL -28	Unit	15	12	0.80	19
12	2' 1 L 20w T12 to 2'1L 17w T8	Unit	3	3	1.00	77
13	3' 1 lamp 30w T12 to 3' 1L 25w T8	Unit	5	5	1.00	99
14	4' 1 L 34/40w T12 to 4' 1 Lamp T8	Unit	268	254	0.95	686
15	4' 2 L 34/40w T12 to 4' 2 Lamp T8	Unit	371	367	0.99	2653
16	4' 3 L 34/40 w T12 to 4' 3L T8	Unit	10	10	1.00	292
17	4' 4 L 34/40w T 12 to 4' 4 L T8	Unit	410	422	1.03	3331
18	4' 4 L 34/40 w T12 to 4' 3L T8	Unit	96	47	0.49	434
19	4' 4L 34/40w T12 to 4' 2L T8	Unit	320	349	1.09	2456
20	4' 3L 34/40w T12 to 4' 2L T8	Unit	0	0	N/A	239
21	8' F96 1 L T12 to 4' 2L T8	Unit	1	1	1.00	130
22	8' F96 2 L 60/75w T12 to 4' 4L T8	Unit	74	58	0.78	805
23	8' F96 1L 60/75w T12 to 8' 1L T8	Unit	13	11	0.85	189
24	8' F96 60/75w T12 to 8' 2L T8 w SLO	Unit	47	47	1.00	570
25	F40 U tube 2 L to F31/32 U6 Tube 2L T8	Unit	8	8	1.00	291
26	8' 2L T8 RLO	Unit	321	333	1.04	4267
27	2 watt LED Exit sign	Unit	48	48	1.00	268
28	Energy Efficient Cooking Equipment	Unit	0	0	N/A	5
29	Strip Curtains	per linear foot				N/A
Total			**2592**	**2501**	**0.96**	

[15] The verification rate of 0.96 is not indicative of any fault of the program implementer.

3.1.1.1 Verification Findings for HVAC Diagnostic Tune Measures

The HVAC diagnostic tune measure involved condenser coil cleaning, clean filters, and refrigerant charge adjustments. Not all sites received all three measures. EM&V inspections of HVAC tune-ups were attempted on ninety-six (96) packaged rooftop air conditioners. Eighty-five (85) measures were accessible and fifty four (54) measures passed inspections. Some units were inaccessible in terms of verifying proper refrigerant charge and airflow (RCA) or condenser coil cleaning due to not having permission to access the roof. Two sites where an air conditioner tune-up was reported, no air conditioners were found to have been installed (both of these sites were in the same building). Inspections of some units were conducted where the units failed the inspection, but this was due to the AC contractor not completing work as reported in the database. FCI was informed of these discrepancies and the database was corrected.

The overall verification rate for the HVAC inspections was 64% based on 54 measures being verified as being installed properly during the on-site inspections out of 85 measures reported as installed in the database.

3.1.1.2 Verification Findings for Programmable Thermostats

Verification inspections were performed at 68 sites and 100% of programmable thermostats were installed and operational. Process survey responses were used to evaluate thermostat settings before and after FCI installed programmable thermostats. Responses were used to evaluate ex ante assumptions and determine appropriate input assumptions for the DOE-2/eQUEST models used to evaluate ex post savings estimates for programmable thermostats.

3.1.1.3 Lighting Logger Findings

Lighting loggers were installed at 69 sites, and data from 64 loggers were downloaded to measure hours of operation. Seven light loggers were tampered with by customers where the loggers or the data were lost. The study encountered some challenges with the lighting data loggers (i.e., metering/monitoring equipment). One customer tampered with a data logger and erased the data, one was lost at the site, and one customer has not been available to allow us to pick up a logger to download the data. Five customers moved the data logger and we lost the data. These challenges were overcome by performing additional on-site visits at participant sites. The light logger data for 64 sites indicates 36.9 +/- 3.5 percent on time or 3,230 +/- 307 hours per year. For all lighting measures except LED Exit Signs, the preliminary EM&V operation (hours per year) are lower by 31.1 percent.

3.1.1.4 Verification Findings for Lighting Measures

Verification inspections were performed for lighting measures to ensure they were installed and operating properly. Virtually 100% of the lighting measures were installed and operational.

3.1.2 PRISM Load Impact Results

Load impacts were evaluated using historical billing data and the PRInceton Scorekeeping Method (PRISM). Three years of historical electric billing data was obtained for a sample of 74 participant sites located near Anaheim, California. This data was then analyzed using the PRISM statistical regression model to develop overall electricity savings for the sample, normalized annual consumption (NAC) and cooling unit energy consumption (UEC) values. The

Normalized Annual Consumption (NAC) values with error bars for 41 sites in the sample are plotted in **Figure 3.1**. The Normal Annual Savings (NAS) values for HVAC measures with error bars are shown in **Figure 3.2**. Average HVAC savings for the sample are 129 ± 295 kWh per year (1.9 ± 4.3 percent of the NAC) for six sites passing the reliability criteria of R-squared greater than or equal to 0.70 and CV(NAC) less than or equal to 7 percent. The billing data set was impacted by business start-ups, turn-over, and failures. Therefore, the PRISM results were only used to develop baseline cooling EUI values for calibrating simulation models, and not to directly calculate energy savings.

The average pre-NAC for 41 sites from PRISM is 31,352 ± 7,164 kWh per year and the average cooling UEC based on PRISM is 5,752 ± 1,937 kWh per year (see **Table 3.9**). The average floor area is 2,530 ± 1,150 ft^2 at the 90% confidence level, and the average cooling EUI is 2.27 kWh/yr-ft^2. This cooling EUI is 22 percent less than the average small office building EUI of 2.9 kWh/yr-ft^2 from CEUS Study 5 (**Table 2.1**), and 43 percent less than the average office building cooling EUI of 3.95 kWh/yr-ft^2 from SCE Study 4 (**Table 2.1**). The average EUI values based on participant billing data were used to calibrate the eQuest and DOE-2.2 building energy simulation models for audit sites to develop savings for HVAC measures.

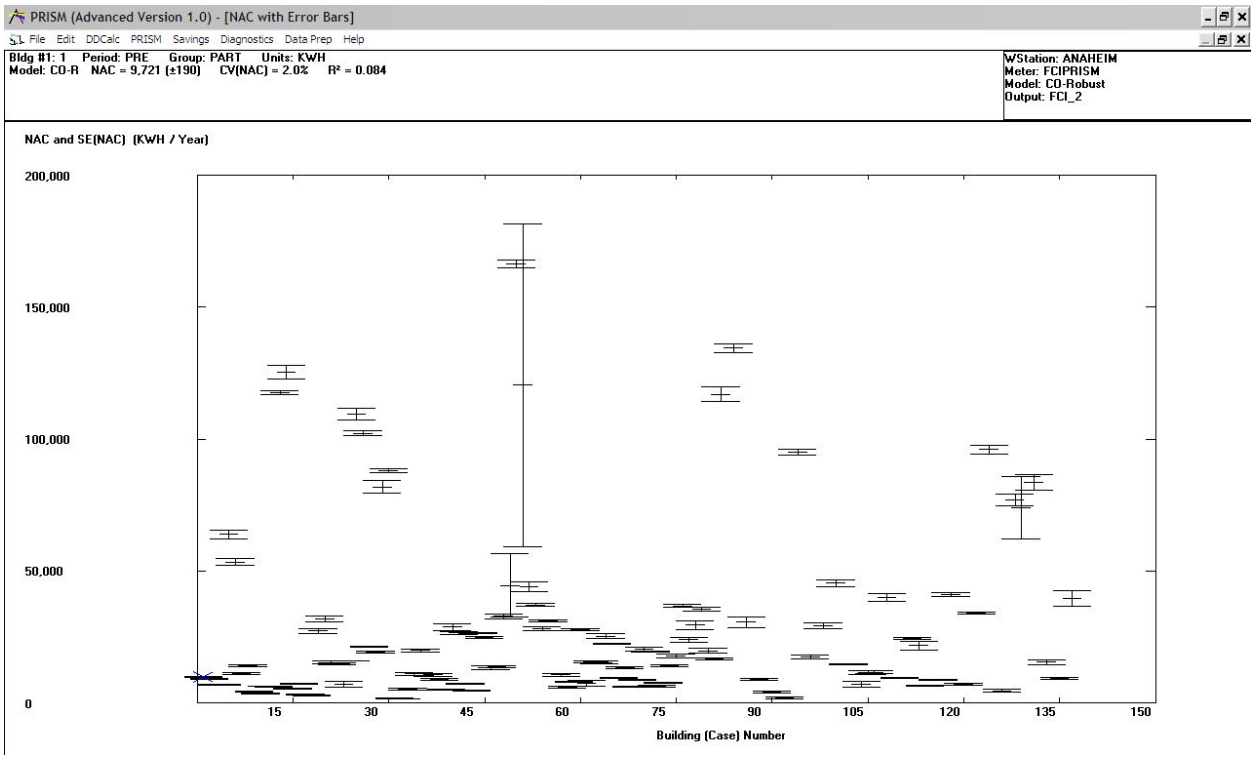


Figure 3.1 PRISM Normalized Annual Consumption for Sites in the Sample

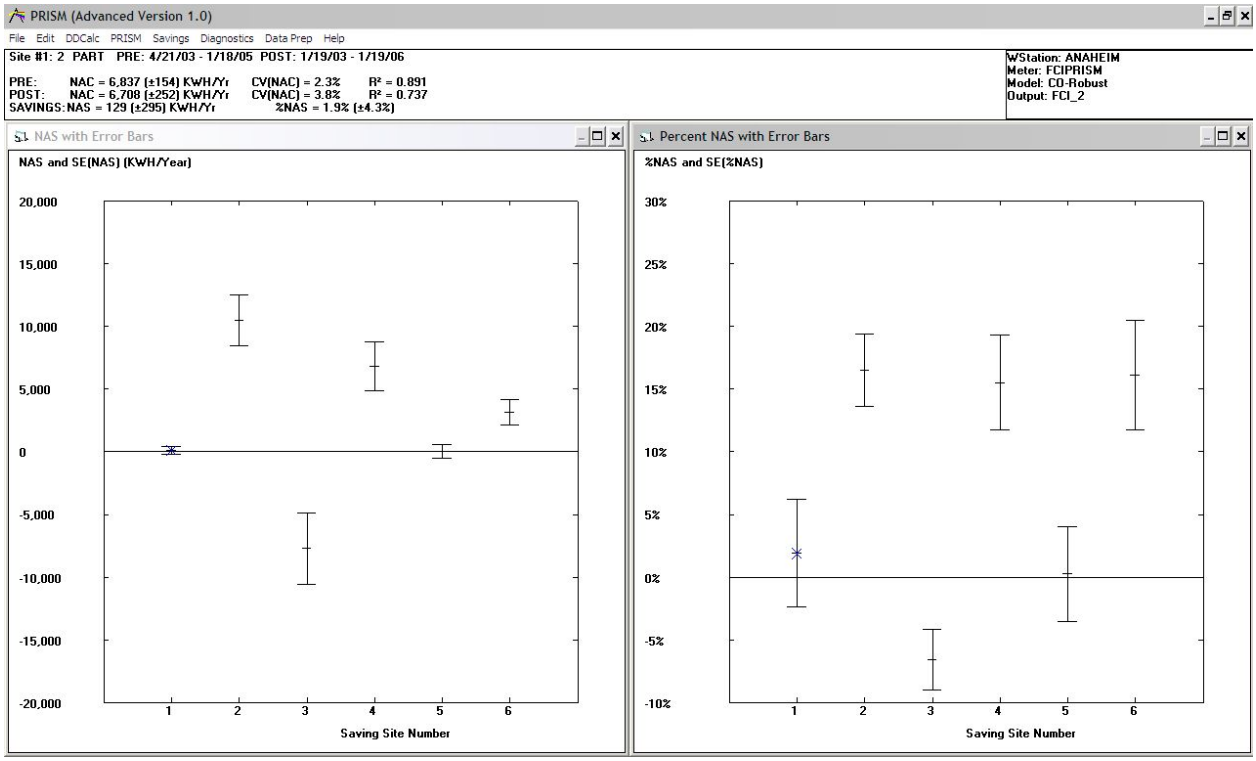


Figure 3.2 PRISM Normalized Annual Savings for Sites Passing the Reliability Criteria

Table 3.9 Pre- and Post-Retrofit Normalized Annual Consumption and Cooling UEC

Site	Pre NAC	Pre Cooling UEC	Post NAC	Post Cooling UEC
1	9,721	60	9,076	244
2	6,837	4,948	6,708	3,231
3	63,765	14,667	53,241	16,278
4	11,138		14,151	
5	4,124		3,576	
6	6,163	41	6,124	13
7	117,573	28,342	125,287	22,293
8	5,420	1,473	7,008	292
9	3,068		2,779	
11	27,195	2,180	31,785	5,434
12	15,298	3,353	14,835	459
13	7,024	1,315	15,925	1,640
14	109,285	9,883	102,181	18,069
15	21,189		19,276	154
16	81,828	16,971	87,856	733
17	1,650		1,584	44
18	5,036	1,054	10,958	3,764
19	19,848	108		
21	8,739		4,915	179
22	28,680	148	26,425	3,273
23	7,119		4,571	156
24	26,396	4,885	24,853	11,428
25	13,236		13,573	
26	32,737	6,536	44,418	
27	166,372	38,939	120,399	
28	43,894		37,081	10,803
29	28,039		31,043	808
30			10,592	769
31	5,883		7,799	62
32	27,800		7,367	7,102
33	15,385	10,842	15,347	6,627
34	25,132	148	22,370	407
35	9,402	814	13,289	244
36	6,153		8,631	

Table 3.9 Pre- and Post-Retrofit Normalized Annual Consumption and Cooling UEC

Site	Pre NAC	Pre Cooling UEC	Post NAC	Post Cooling UEC
37	20,422	203	19,415	3,377
38	6,294		7,539	
39	14,134	542	17,752	8,376
40	36,738	13,082	23,913	1,361
41	29,462	1,225	35,582	5,050
42	19,666	2,760	16,496	2,640
43	117,001	5,441		
44	134,453	17,800		
45	30,530	14,966		
46	8,768			
47	3,963	8		
48	1,804	1,684		
49	95,064	10,979		
50	17,269	242		
51	29,257	5,261		
52	45,337	284		
53	14,427			
54	6,967	640	11,466	
55	11,531	1,712		
56	39,941			
57	9,362	153		
58	24,309	3,915	21,679	10,227
60	6,389	2,075		
61	8,706			
62	41,055	4,407		
63	7,080	743		
64	34,075	902		
65	96,039	20,651		
67	4,561	16		
68	76,957	1,278	73,965	9,050
70	83,656	16,460		
71	15,317			
72	9,358	779		
73	39,595	1,200		
Average	**31,352**	**5,752**	**26,590**	**4,684**
90% CI	**7,164**	**1,937**	**7,577**	**1,641**

3.1.3 eQuest Simulation Model

Load impacts for space cooling and heating measures are based on field inspections, on-site audits, and calibrated eQuest building energy simulations consistent with IPMVP Option D. The baseline was calibrated to within +/-2.2% of average annual normalized cooling consumption.[16] The eQuest model for a prototypical small commercial building is shown in **Figure 3.3**. This model is based on detailed audits performed at 74 sites. The model was calibrated using average baseline space cooling UEC values from 36 months of customer billing data and Typical Meteorological Year (TMY) weather data for CEC climate zone 8.[17] The eQuest building characteristics and baseline UEC values are provided in **Table 3.10**. The pre- and post-retrofit thermostat schedules are shown in **Table 3.11**.

[16] IPMVP calibration targets are +/-15% root mean square (RMS) error and +/-5% mean bias error.

[17] *California Thermal Climate Zones*, California Energy Commission, 1516 Ninth St., Sacramento, CA 95814, 1992.

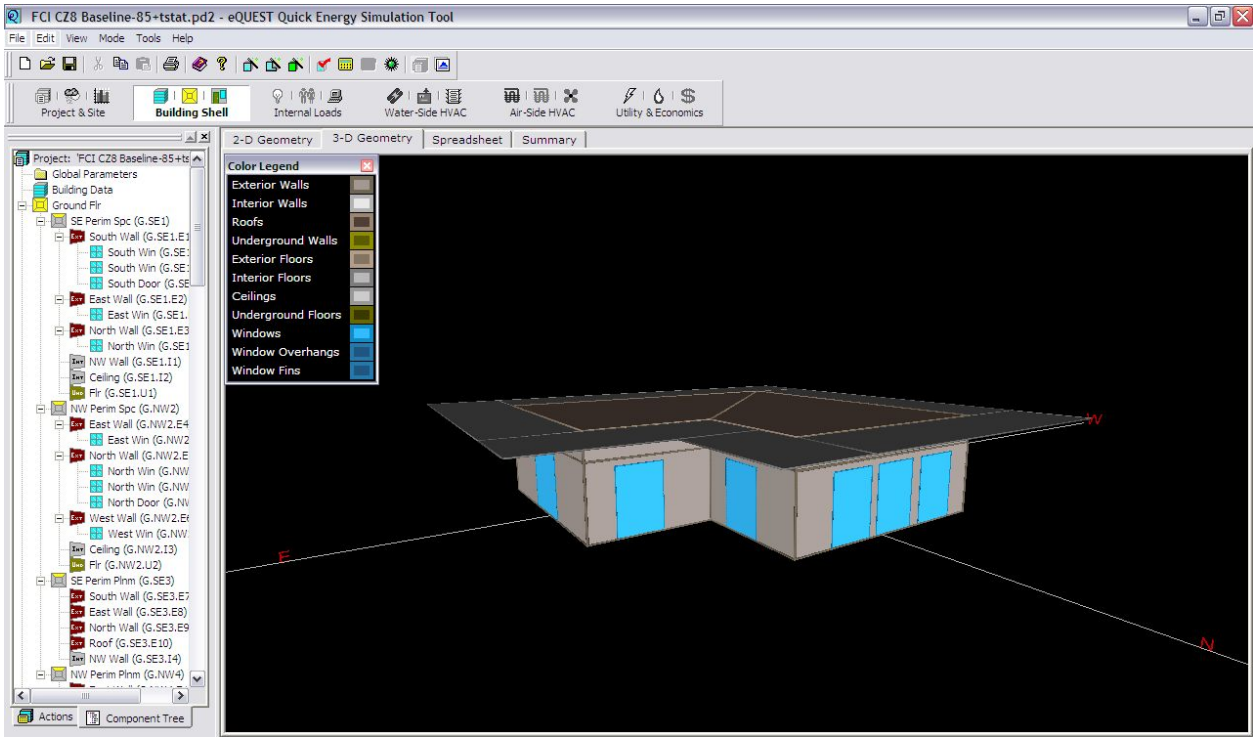


Figure 3.3 eQuest Small Commercial Building Model for Load Impact of HVAC Measures

Table 3.10 Small Commercial Building Characteristics

Characteristic	Existing [1978 vintage]
Total Floor Area (sf)	2,530
Total Units	1
Floors	1
Unit Floor Area (sf)	2,530
Average Floor Height	10
Wall R-value [cavity only]	2.6 [1]
Wall Type	Concrete Block
Ceiling R-value [cavity]	17.2 [11]
Ceiling Area, total exterior (sf)	2,530
Hallway Area per Floor (sf)	n/a
Floor R-value [cavity]	Concrete
Door Area (sf)	71.5
Door R-Value	2
Window-to-Floor Area Ratio	0.177
Air Changes per Hour	0.65
Window u-value	1.09
Number of Panes	1
Occupancy (people)	6
Lighting Intensity (W/sqft)	1.70
Electric Internal Loads (kW/sqft)	0.75
Internal Loads (Btu/hr-sqft)	n/a
Cooling Setpoint/Setforward (F)	74/84
Heating Setpoint/Setback (F)	70/53
HVAC Zoning	Single zone
Heating System Type	Gas furnace
Heating Capacity (kBtu/hr-unit)	65.5
Supplemental Heat Cap. (kBtu/hr)	n/a
Heating System Efficiency	0.77
Cooling System Type	Split/Packaged
Cooling Capacity (kBtu/hr-unit)	60
Cooling System EER	8.0

Table 3.10 Small Commercial Building Characteristics

Characteristic	Existing [1978 vintage]
Design Air (cfm/sqft)	1.04
Baseline Cooling (kWh/yr)	5,880
Baseline Cooling and Fan (kW)	6.82
Baseline Gas Heat (therm/yr)	100

Table 3.11 Average Pre- and Post-Retrofit Thermostat Schedules from On-Site Audits

Weekday Schedule	Midnight to 8AM	8AM to 10PM	10PM to Midnight
Pre-Retrofit Cooling Schedule °F	**84**	**74**	**84**
Post-Retrofit Cooling Schedule °F	**86**	**75**	**86**
Pre-Retrofit Heating Schedule °F	**54**	**70**	**54**
Post-Retrofit Heating Schedule °F	**53**	**68**	**53**
Weekend and Holiday Schedule	Midnight to 9AM	9AM to 8PM	8PM to Midnight
Pre-Retrofit Cooling Schedule °F	**84**	**74**	**84**
Post-Retrofit Cooling Schedule °F	**86**	**75**	**86**
Pre-Retrofit Heating Schedule °F	**54**	**70**	**54**
Post-Retrofit Heating Schedule °F	**53**	**68**	**53**

3.1.4 Load Impacts for HVAC Diagnostic Tune-up

Load impacts for HVAC diagnostic tune-up measures are based on field inspections and audits at 74 participant sites and calibrated eQuest building energy simulations consistent with IPMVP Option D. The measure involved refrigerant charge adjustments and chemical condenser coil cleaning depending on the site. The pre-retrofit unit was modeled with eQuest prototypes calibrated to billing data with 15 percent degradation in the electric input ratio based on field measurements of the energy efficiency ratio improvements from condenser coil cleaning on commercial units, and this yielded 8.4 percent savings. This is the same assumption used in the 2004-2005 DEER Update Study.[18] FCI assumed 8 percent savings and 807 kWh/yr and 0.458 kW based on refrigerant charge adjustments or condenser coil cleaning. The unadjusted gross ex post savings per measure are 640 ± 215 kWh/yr and 0.82 ± 0.28 kW at the 90 percent confidence level. Savings are slightly lower for FCI due to the lower baseline energy use intensity (EUI) based on billing data. The FCI database reported installing HVAC diagnostic tune-up measures at 998 sites, and the total unadjusted gross ex post savings are 638,720 ± 214,570 kWh/year and 818 ± 279 kW at the 90 percent confidence level. FCI assumed a 10-year ex ante effective useful lifetime (EUL), and this is used for the ex post EUL.

The inspections verified proper installation for 64 percent of measures. Therefore, the proportional savings adjustment is 64 percent. The total adjusted gross ex post savings are 409,180 ± 133,732 kWh/year and 524 ± 179 kW at the 90 percent confidence level.

3.1.5 Load Impacts for Programmable Thermostats

Load impacts for programmable thermostats are based on field inspections and detailed audits at 56 participant sites and calibrated eQuest building energy simulations consistent with IPMVP Option D. The thermostat was modeled using eQuest and average pre- and post-retrofit schedules based on data obtained from 73 participants for cooling and heating (see **Table 3.15**).

[18] *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study*, page 7-40, prepared for Southern California Edison, prepared by Itron, Inc., Vancouver, Washington 2005.

FCI assumed cooling savings of 327 kWh/year and no savings for kW or therms. The unadjusted EM&V ex post gross savings per measure are 680 ± 229 kWh/yr and 53 ± 18 therm/year at the 90 percent confidence level. The 2004-05 DEER Update Study provides programmable thermostat savings of 588 kWh/yr and 30.77 therms/yr per thousand square feet for small retail buildings.[19] The average participant floor area is 2,530 ft2 so the DEER savings would be 1,487.6 kWh/yr and 77.8 therm/yr. The 2004-05 DEER Update Study kWh savings are 2.2 times greater than the average unadjusted EM&V savings and the therm savings are 1.46 times greater than the average unadjusted EM&V savings. The FCI database reported installing programmable thermostats at 814 sites, and the total unadjusted gross ex post savings are 553,520 ± 186,406 kWh/year and 43,142 ± 14,652 therm/year at the 90 percent confidence level. FCI assumed an 11-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 95 percent of measures. Therefore, the proportional savings adjustment is 95 percent. The total adjusted gross ex post savings are 525,844 ± 177,452 kWh/year and 40,700 ± 13,838 therm/year at the 90 percent confidence level.

3.1.6 Load Impacts for Motion Sensors

No motion sensors were reported as being installed by the program.

3.1.7 Load Impacts for 60/75W Incandescent to 13W CFLs

Load impacts for going from 60/75W Incandescent to 13W compact fluorescent lamps (CFLs) are based on field inspections, electric power measurements, lighting logger measurements, and audits at 46 participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.12**. FCI assumed ex ante savings are 234.25 kWh/yr and 0.050 kW per lamp. The gross ex post savings per measure are 159.6 ± 14.9 kWh/yr and 0.047 ± 0.004 kW at the 90 percent confidence level. The difference between ex ante and ex post savings is primarily due to EM&V findings of lower ex post annual hours of operation. The FCI database reported installing 1,792 CFL-13W lamps, and the total gross ex post savings are 285,969 ± 26,747 kWh/year and 84.2 ± 8.4 kW at the 90 percent confidence level. The ex ante EUL was assumed to be 8 years, but the mean life before failure for CFLs is 10,000 hours. Therefore, the EUL is 2.94 years based on average annual hours of operation of 3,395 ± 238 hours per year and 10,000 hour lifetime based on manufacturer data.

The inspections verified proper installation for 91 percent of measures. Therefore, the proportional savings adjustment is 91 percent. The total adjusted gross ex post savings are 260,232 ± 24,339 kWh/year and 76.6 ± 7.7 kW at the 90 percent confidence level.

Table 3.12 Load Impacts for 60/75W Incandescent to CFL-13W

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
1	60/75w Incan	4	2,304	60	0.24	553	CFL-13	4	2,304	13	0.052	120	0.188	433
2	60/75w Incan	3	1,866	60	0.18	336	CFL-13	3	1,866	13	0.039	73	0.141	263
5	60/75w Incan	2	2,243	60	0.12	269	CFL-13	2	2,243	13	0.026	58	0.094	211
7	60/75w Incan	2	4,476	60	0.12	537	CFL-13	2	4,476	13	0.026	116	0.094	421
7	60/75w Incan	5	4,590	60	0.3	1,377	CFL-13	5	4,590	13	0.065	298	0.235	1,079

[19] *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study*, prepared for Southern California Edison, prepared by Itron, Inc., Vancouver, Washington 2005.

Table 3.12 Load Impacts for 60/75W Incandescent to CFL-13W

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
8	60/75w Incan	3	4,827	60	0.18	869	CFL-13	3	4,827	13	0.039	188	0.141	681
11	60/75w Incan	3	3,512	60	0.18	632	CFL-13	3	3,512	13	0.039	137	0.141	495
14	60/75w Incan	71	3,854	60	4.26	16,418	CFL-13	71	3,854	13	0.923	3,557	3.337	12,861
15	60/75w Incan	2	4,660	60	0.12	559	CFL-13	2	4,660	13	0.026	121	0.094	438
16	60/75w Incan	16	3,057	60	0.96	2,935	CFL-13	16	3,057	13	0.208	636	0.752	2,299
17	60/75w Incan	2	1,664	60	0.12	200	CFL-13	2	1,664	13	0.026	43	0.094	156
18	60/75w Incan	2	3,241	60	0.12	389	CFL-13	2	3,241	13	0.026	84	0.094	305
20	60/75w Incan	2	1,323	60	0.12	159	CFL-13	2	1,323	13	0.026	34	0.094	124
21	60/75w Incan	1	3,171	60	0.06	190	CFL-13	1	3,171	13	0.013	41	0.047	149
24	60/75w Incan	12	4,327	60	0.72	3,115	CFL-13	12	4,327	13	0.156	675	0.564	2,440
26	60/75w Incan	2	3,206	60	0.12	385	CFL-13	2	3,206	13	0.026	83	0.094	301
28	60/75w Incan	3	1,358	60	0.18	244	CFL-13	3	1,358	13	0.039	53	0.141	191
33	60/75w Incan	2	2,882	60	0.12	346	CFL-13	2	2,882	13	0.026	75	0.094	271
34	60/75w Incan	2	2,076	60	0.12	249	CFL-13	2	2,076	13	0.026	54	0.094	195
36	60/75w Incan	1	4,827	60	0.06	290	CFL-13	1	4,827	13	0.013	63	0.047	227
37	60/75w Incan	2	2,803	60	0.12	336	CFL-13	2	2,803	13	0.026	73	0.094	263
38	60/75w Incan	1	3,031	60	0.06	182	CFL-13	1	3,031	13	0.013	39	0.047	142
39	60/75w Incan	2	1,752	60	0.12	210	CFL-13	2	1,752	13	0.026	46	0.094	165
40	60/75w Incan	1	3,609	60	0.06	217	CFL-13	1	3,609	13	0.013	47	0.047	170
40	60/75w Incan	1	3,609	60	0.06	217	CFL-13	1	3,609	13	0.013	47	0.047	170
46	60/75w Incan	3	3,512	60	0.18	632	CFL-13	3	3,512	13	0.039	137	0.141	495
47	60/75w Incan	1	2,654	60	0.06	159	CFL-13	1	2,654	13	0.013	35	0.047	125
48	60/75w Incan	3	2,532	60	0.18	456	CFL-13	3	2,532	13	0.039	99	0.141	357
49	60/75w Incan	4	3,512	60	0.24	843	CFL-13	4	3,512	13	0.052	183	0.188	660
50	60/75w Incan	22	1,358	60	1.32	1,793	CFL-13	22	1,358	13	0.286	388	1.034	1,404
51	60/75w Incan	9	2,733	60	0.54	1,476	CFL-13	9	2,733	13	0.117	320	0.423	1,156
53	60/75w Incan	6	3,136	60	0.36	1,129	CFL-13	6	3,136	13	0.078	245	0.282	884
55	60/75w Incan	8	6,859	60	0.48	3,292	CFL-13	8	6,859	13	0.104	713	0.376	2,579
56	60/75w Incan	14	2,356	60	0.84	1,979	CFL-13	14	2,356	13	0.182	429	0.658	1,550
57	60/75w Incan	10	1,708	60	0.6	1,025	CFL-13	10	1,708	13	0.13	222	0.47	803
58	60/75w Incan	1	5,168	60	0.06	310	CFL-13	1	5,168	13	0.013	67	0.047	243
60	60/75w Incan	1	3,495	60	0.06	210	CFL-13	1	3,495	13	0.013	45	0.047	164
62	60/75w Incan	1	4,625	60	0.06	278	CFL-13	1	4,625	13	0.013	60	0.047	217
62	60/75w Incan	1	3,793	60	0.06	228	CFL-13	1	3,793	13	0.013	49	0.047	178
65	60/75w Incan	5	6,141	60	0.3	1,842	CFL-13	5	6,141	13	0.065	399	0.235	1,443
66	60/75w Incan	2	3,423	60	0.12	411	CFL-13	2	3,423	13	0.026	89	0.094	322
67	60/75w Incan	1	3,512	60	0.06	211	CFL-13	1	3,512	13	0.013	46	0.047	165
74	60/75w Incan	14	4,827	60	0.84	4,055	CFL-13	14	4,827	13	0.182	879	0.658	3,176
Total		253						253					11.891	40,373
Ave													0.047	159.6

3.1.4 Load Impacts for 100W Incandescent to 23W CFLs

Load impacts for 100 W incandescent lamps to 23W compact fluorescent lamps (CFL) are based on field inspections, electric power measurements, lighting logger measurements, and audits at 24 participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.13**. FCI assumed ex ante savings are 346.69 kWh/yr and 0.074 kW. The gross ex post savings per measure are 330.54 ± 38.5 kWh/yr and 0.074 ± 0.007 kW at the 90 percent confidence level. The difference between ex ante and ex post savings is primarily due to EM&V findings of lower ex post annual hours of operation. The FCI database reported installing 2,074 CFL-23W lamps, and the total gross ex post savings are 685,539 ±79,928 kWh/year and 153.4 ± 15.3 kW at the 90 percent confidence level. The ex ante EUL was assumed to be 8 years, but the mean life before failure for CFLs is 10,000 hours. Therefore, the EUL is 2.24 years based on average annual hours of operation of 4,466 ± 313 hours per year and 10,000 hour lifetime based on manufacturer data.

The inspections verified proper installation for 97 percent of measures. Therefore, the proportional savings adjustment is 97 percent. The total adjusted gross ex post savings are 664,974 ± 77,454 kWh/year and 148.9 ± 14.08 kW at the 90 percent confidence level.

Table 3.13 Load Impacts for 100W Incandescent to CFL-23W

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
2	100w Incan	1	1,866	100	0.1	187	CFL-23	1	1,866	26	0.026	49	0.074	138
4	100w Incan	9	3,495	100	0.9	3,146	CFL-23	9	3,495	26	0.234	818	0.666	2,328
13	100w Incan	2	2,330	100	0.2	466	CFL-23	2	2,330	26	0.052	121	0.148	345
14	100w Incan	6	3,854	100	0.6	2,312	CFL-23	6	3,854	26	0.156	601	0.444	1,711
15	100w Incan	13	4,660	100	1.3	6,058	CFL-23	13	4,660	26	0.338	1,575	0.962	4,483
16	100w Incan	4	3,057	100	0.4	1,223	CFL-23	4	3,057	26	0.104	318	0.296	905
24	100w Incan	8	4,327	100	0.8	3,462	CFL-23	8	4,327	26	0.208	900	0.592	2,562
26	100w Incan	4	3,206	100	0.4	1,282	CFL-23	4	3,206	26	0.104	333	0.296	949
27	100w Incan	4	5,037	100	0.4	2,015	CFL-23	4	5,037	26	0.104	524	0.296	1,491
28	100w Incan	2	1,358	100	0.2	272	CFL-23	2	1,358	26	0.052	71	0.148	201
30	100w Incan	2	2,295	100	0.2	459	CFL-23	2	2,295	26	0.052	119	0.148	340
31	100w Incan	12	2,672	100	1.2	3,206	CFL-23	12	2,672	26	0.312	834	0.888	2,373
35	100w Incan	1	2,146	100	0.1	215	CFL-23	1	2,146	26	0.026	56	0.074	159
47	100w Incan	2	2,654	100	0.2	531	CFL-23	2	2,654	26	0.052	138	0.148	393
49	100w Incan	11	3,512	100	1.1	3,863	CFL-23	11	3,512	26	0.286	1,004	0.814	2,859
50	100w Incan	2	1,358	100	0.2	272	CFL-23	2	1,358	26	0.052	71	0.148	201
55	100w Incan	47	6,859	100	4.7	32,237	CFL-23	47	6,859	26	1.222	8,382	3.478	23,856
61	100w Incan	2	3,512	100	0.2	702	CFL-23	2	3,512	26	0.052	183	0.148	520
63	100w Incan	6	3,303	100	0.6	1,982	CFL-23	6	3,303	26	0.156	515	0.444	1,467
64	100w Incan	1	6,824	100	0.1	682	CFL-23	1	6,824	26	0.026	177	0.074	505
65	100w Incan	1	6,141	100	0.1	614	CFL-23	1	6,141	26	0.026	160	0.074	454
71	100w Incan	11	4,827	100	1.1	5,310	CFL-23	11	4,827	26	0.286	1,381	0.814	3,929
72	100w Incan	3	2,085	100	0.3	626	CFL-23	3	2,085	26	0.078	163	0.222	463
73	100w Incan	12	2,523	100	1.2	3,028	CFL-23	12	2,523	26	0.312	787	0.888	2,240
Total		166						166					12.284	54,870
Ave													0.074	330.54

3.1.5 Load Impacts for 150W Incandescent to 28W CFLs

Load impacts for 150 W incandescent lamps to 28W CFL are based on field inspections, electric power measurements, lighting logger measurements, and audits at 2 of 3 participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.14**. FCI assumed ex ante savings are 543.46 kWh/yr and 0.116 kW. The gross ex post savings per measure are 479.5 ± 55.9 kWh/yr and 0.116 ± 0.012 kW at the 90 percent confidence level. The FCI database reported installing 19 CFL-28W lamps, and the total gross ex post savings 9,110 ± 1,062 kWh/year and 2.2 ± 0.22 kW at the 90 percent confidence level. The ex ante EUL was assumed to be 8 years, but the mean life before failure for CFLs is 10,000 hours. Therefore, the EUL is 2.48 years based on average annual hours of operation of 4,026 ± 281 hours/year assuming 10,000 hour lifetime based on manufacturer data.

The inspections verified proper installation for 80 percent of measures. Therefore, the proportional savings adjustment is 80 percent. The total adjusted gross ex post savings are 7,288 ± 850 kWh/year and 1.76 ± 0.18 kW at the 90 percent confidence level.

Table 3.14 Load Impacts for 100W Incandescent to CFL-23W

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
28	150w Incan	3	1,358	150	0.45	611	CFL-28	3	1,358	34	0.102	139	0.348	473
74	150w Incan	12	4,827	150	1.8	8,689	CFL-28	12	4,827	34	0.408	1,969	1.392	6,719
Total		15						15					1.74	7,192
Ave													0.116	479

3.1.6 Load Impacts for 2' 1L 20W T12 to 2'1L 17W T8

Load impacts for 2' 1L 20W T12 to 2'1L 17W T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at 2 of 3 participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.15**. FCI assumed ex ante savings are 37.48 kWh/yr and 0.008 kW. The gross ex post savings per measure are 14.0 ± 1.6 kWh/yr and 0.008 ± 0.001 kW at the 90 percent confidence level. The FCI database reported installing seventy 77 2' 1 L 17W T8 fixtures, and the total gross ex post savings 1,078 ± 126 kWh/year and 0.62 ± 0.062 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. The inspections verified proper installation for 100 percent of measures. Therefore, the adjusted gross ex post savings are equal to the gross ex post savings.

Table 3.15 Load Impacts for 2' 1L 20W T12 to 2'1L 17W T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
48	2 ft 1L (20w T12)	1	2,532	28	0.028	71	2 ft 1L (17w T8)	1	2,532	20	0.02	51	0.008	20
50	2 ft 1L (20w T12)	2	1,358	28	0.056	76	2 ft 1L (17w T8)	2	1,358	20	0.04	54	0.016	22
Total		3						3					0.024	42
Ave													0.008	14.0

3.1.7 Load Impacts for 3' 1L 30W T12 to 3' 1L 25W T8

Load impacts for 3' 1L 30w T12 to 3'1L 25W T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at 2 participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.16**. FCI assumed ex ante savings are 84.33 kWh/yr and 0.018 kW. The gross ex post savings per measure are 56.1 ± 6.54 kWh/yr and 0.018 ± 0.002 kW at the 90 percent confidence level. The FCI database reported installing 99 3' 1 L 25W T8 fixtures, and the total gross ex post savings 5,557 ± 648 kWh/year and 1.782 ± 0.178 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. The inspections verified proper installation for 100 percent of measures. Therefore, the adjusted gross ex post savings are equal to gross ex post savings.

Table 3.16 Load Impacts for 3' 1L 30W T12 to 3' 1L 25W T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
3	3 ft 1L (30w T12)	3	3,627	44	0.132	479	3 ft 1L (25w T8)	3	3,627	26	0.078	283	0.054	196
56	3 ft 1L (30w T12)	2	2,356	44	0.088	207	3 ft 1L (25w T8)	2	2,356	26	0.052	123	0.036	85
Total		5						5					0.090	281
Ave													0.018	56.1

3.1.8 Load Impacts for 4' 1L 34/40W T12 to 4' 1L T8

Load impacts for 4' 1L 34/40w T12 to 4'1L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.17**. FCI assumed ex ante savings are 74.96 kWh/yr and 0.016 kW. The gross ex post savings per measure are 38.95 ± 4.54 kWh/yr and 0.012 ± 0.001 kW at the 90 percent confidence level. The FCI database reported installing 686 4' 1 L T8 fixtures, and the total gross ex post savings 26,718 ± 3,115 kWh/year and 8.232 ± 0.823 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 95 percent of measures. Therefore, the proportional savings adjustment is 95 percent. The total adjusted gross ex post savings are 25,382 ± 2,959 kWh/yr and 7.82 ± 0.78 kW at the 90 percent confidence level.

Table 3.17 Load Impacts for 4' 1L 34/40w T12 to 4' 1L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
3	4 ft 1L (34/40w T12)	148	3,627	43	6.364	23,082	4 ft 1 lamp T-8 w/ elec ball	148	3,627	31	4.588	16,641	1.776	6,442
41	4 ft 1L (34/40w T12)	108	2,794	43	4.644	12,975	4 ft 1 lamp T-8 w/ elec ball	108	2,794	31	3.348	9,354	1.296	3,621
53	4 ft 1L (34/40w T12)	1	3,136	43	0.043	135	4 ft 1 lamp T-8 w/ elec ball	1	3,136	31	0.031	97	0.012	38
57	4 ft 1L (34/40w T12)	8	1,708	43	0.344	588	4 ft 1 lamp T-8 w/ elec ball	8	1,708	31	0.248	424	0.096	164
74	4 ft 1L (34/40w T12)	3	4,827	43	0.129	623	4 ft 1 lamp T-8 w/ elec ball	3	4,827	31	0.093	449	0.036	174
Total		268						268					3.216	10,438
Ave													0.012	38.95

3.1.9 Load Impacts for 4' 2L 34/40W T12 to 4' 2L T8

Load impacts for 4' 2L 34/40w T12 to 4'2L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.18**. FCI assumed ex ante savings are 84.33 kWh/yr and 0.021 kW. The gross ex post savings per measure are 54.14 ± 5.74 kWh/yr and 0.014 ± 0.001 kW at the 90 percent confidence level. The FCI database reported installing 2,653 4' 2 L T8 fixtures, and the total gross ex post savings 143,629 ± 15,251 kWh/year and 37.14 ± 3.71 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 99 percent of measures. Therefore, the proportional savings adjustment is 99 percent. The total adjusted gross ex post savings are 142,193 ± 15,099 kWh/yr and 36.77 ± 3.68 kW at the 90 percent confidence level.

Table 3.18 Load Impacts for 4' 2L 34/40w T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
1	4 ft 2L (34/40w T12)	3	2,304	78	0.234	539	4 ft 2 lamp T-8 w/ elec ball	3	2,304	64	0.192	442	0.042	97
3	4 ft 2L (34/40w T12)	152	3,627	78	11.856	43,002	4 ft 2 lamp T-8 w/ elec ball	152	3,627	64	9.728	35,283	2.128	7,718
6	4 ft 2L	7	2,908	78	0.546	1,588	4 ft 2 lamp T-	7	2,908	64	0.448	1,303	0.098	285

Table 3.18 Load Impacts for 4' 2L 34/40w T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
	(34/40w T12)						8 w/ elec ball							
54	4 ft 2L (34/40w T12)	1	4,590	78	0.078	358	4 ft 2 lamp T-8 w/ elec ball	1	4,590	64	0.064	294	0.014	64
12	4 ft 2L (34/40w T12)	1	3,811	78	0.078	297	4 ft 2 lamp T-8 w/ elec ball	1	3,811	64	0.064	244	0.014	53
13	4 ft 2L (34/40w T12)	1	2,330	78	0.078	182	4 ft 2 lamp T-8 w/ elec ball	1	2,330	64	0.064	149	0.014	33
14	4 ft 2L (34/40w T12)	6	3,854	78	0.468	1,804	4 ft 2 lamp T-8 w/ elec ball	6	3,854	64	0.384	1,480	0.084	324
16	4 ft 2L (34/40w T12)	19	3,057	78	1.482	4,530	4 ft 2 lamp T-8 w/ elec ball	19	3,057	64	1.216	3,717	0.266	813
19	4 ft 2L (34/40w T12)	1	4,012	78	0.078	313	4 ft 2 lamp T-8 w/ elec ball	1	4,012	64	0.064	257	0.014	56
22	4 ft 2L (34/40w T12)	3	2,707	78	0.234	633	4 ft 2 lamp T-8 w/ elec ball	3	2,707	64	0.192	520	0.042	114
23	4 ft 2L (34/40w T12)	2	3,539	78	0.156	552	4 ft 2 lamp T-8 w/ elec ball	2	3,539	64	0.128	453	0.028	99
24	4 ft 2L (34/40w T12)	1	4,327	78	0.078	338	4 ft 2 lamp T-8 w/ elec ball	1	4,327	64	0.064	277	0.014	61
10	4 ft 2L (34/40w T12)	1	4,327	78	0.078	338	4 ft 2 lamp T-8 w/ elec ball	1	4,327	64	0.064	277	0.014	61
25	4 ft 2L (34/40w T12)	1	4,398	78	0.078	343	4 ft 2 lamp T-8 w/ elec ball	1	4,398	64	0.064	281	0.014	62
29	4 ft 2L (34/40w T12)	1	3,627	78	0.078	283	4 ft 2 lamp T-8 w/ elec ball	1	3,627	64	0.064	232	0.014	51
34	4 ft 2L (34/40w T12)	1	2,076	78	0.078	162	4 ft 2 lamp T-8 w/ elec ball	1	2,076	64	0.064	133	0.014	29
42	4 ft 2L (34/40w T12)	2	3,653	78	0.156	570	4 ft 2 lamp T-8 w/ elec ball	2	3,653	64	0.128	468	0.028	102
46	4 ft 2L (34/40w T12)	1	3,512	78	0.078	274	4 ft 2 lamp T-8 w/ elec ball	1	3,512	64	0.064	225	0.014	49
47	4 ft 2L (34/40w T12)	1	2,654	78	0.078	207	4 ft 2 lamp T-8 w/ elec ball	1	2,654	64	0.064	170	0.014	37
50	4 ft 2L (34/40w T12)	2	1,358	78	0.156	212	4 ft 2 lamp T-8 w/ elec ball	2	1,358	64	0.128	174	0.028	38
51	4 ft 2L (34/40w T12)	14	2,733	78	1.092	2,984	4 ft 2 lamp T-8 w/ elec ball	14	2,733	64	0.896	2,449	0.196	536
52	4 ft 2L (34/40w T12)	7	8,760	78	0.546	4,783	4 ft 2 lamp T-8 w/ elec ball	7	8,760	64	0.448	3,924	0.098	858
53	4 ft 2L (34/40w T12)	3	3,136	78	0.234	734	4 ft 2 lamp T-8 w/ elec ball	3	3,136	64	0.192	602	0.042	132
55	4 ft 2L (34/40w T12)	2	6,859	78	0.156	1,070	4 ft 2 lamp T-8 w/ elec ball	2	6,859	64	0.128	878	0.028	192
56	4 ft 2L (34/40w T12)	18	2,356	78	1.404	3,308	4 ft 2 lamp T-8 w/ elec ball	18	2,356	64	1.152	2,714	0.252	594
57	4 ft 2L (34/40w T12)	4	1,708	78	0.312	533	4 ft 2 lamp T-8 w/ elec ball	4	1,708	64	0.256	437	0.056	96
62	4 ft 2L (34/40w T12)	1	4,625	78	0.078	361	4 ft 2 lamp T-8 w/ elec ball	1	4,625	64	0.064	296	0.014	65
32	4 ft 2L (34/40w T12)	1	4,625	78	0.078	361	4 ft 2 lamp T-8 w/ elec ball	1	4,625	64	0.064	296	0.014	65
65	4 ft 2L (34/40w T12)	1	6,141	78	0.078	479	4 ft 2 lamp T-8 w/ elec ball	1	6,141	64	0.064	393	0.014	86
68	4 ft 2L (34/40w T12)	11	3,294	78	0.858	2,826	4 ft 2 lamp T-8 w/ elec ball	11	3,294	64	0.704	2,319	0.154	507
70	4 ft 2L (34/40w T12)	1	3,512	78	0.078	274	4 ft 2 lamp T-8 w/ elec ball	1	3,512	64	0.064	225	0.014	49
71	4 ft 2L (34/40w T12)	1	4,827	78	0.078	377	4 ft 2 lamp T-8 w/ elec ball	1	4,827	64	0.064	309	0.014	68
73	4 ft 2L (34/40w T12)	2	2,523	78	0.156	394	4 ft 2 lamp T-8 w/ elec ball	2	2,523	64	0.128	323	0.028	71
74	4 ft 2L (34/40w T12)	98	4,827	78	7.644	36,898	4 ft 2 lamp T-8 w/ elec ball	98	4,827	64	6.272	30,275	1.372	6,623

Table 3.18 Load Impacts for 4' 2L 34/40w T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
Total		371						371					5.194	20,085
Ave													0.014	54.14

3.1.10 Load Impacts for 4’ 3L 34/40W T12 to 4' 3L T8

Load impacts for 4' 3L 34/40w T12 to 4’3L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.19**. FCI assumed ex ante savings are 182.72 kWh/yr and 0.039 kW. The gross ex post savings per measure are 59.67 ± 6.34 kWh/yr and 0.026 ± 0.003 kW at the 90 percent confidence level. The FCI database reported installing 292 4’ 3 L T8 fixtures, and the total gross ex post savings 17,424 ± 1,850 kWh/year and 7.592 ± 0.759 kW at the 90 percent confidence level. The inspections verified proper installation for 100 percent of measures. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

Table 3.19 Load Impacts for 4' 3L 34/40w T12 to 4' 3L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
30	4 ft 3L (34/40w T12)	10	2,295	116	1.16	2,662	4 ft 3 lamp T-8 w/ elec ball	10	2,295	90	0.9	2,066	0.26	597
Total		10						10					0.26	597
Ave													0.026	59.67

3.1.11 Load Impacts for 4’ 4L 34/40W T12 to 4' 4L T8

Load impacts for 4' 4L 34/40w T12 to 4’4L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.20**. FCI assumed ex ante savings are 206.14 kWh/yr and 0.044 kW. The gross ex post savings per measure are 159.43 ± 21.7 kWh/yr and 0.046 ± 0.005 kW at the 90 percent confidence level. The FCI database reported installing 3,331 4’ 4L T8 fixtures, and the total gross ex post savings 531,075 ± 72,162 kWh/year and 153.23 ± 15.33 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 1.03 percent of measures (i.e., more measures than reported). Therefore, the proportional savings adjustment is 1.03 percent. The total adjusted gross ex post savings are 547,007 ± 74,327 kWh/yr and 157.82 ± 15.78 kW at the 90 percent confidence level.

Table 3.20 Load Impacts for 4' 4L 34/40w T12 to 4' 4L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
1	4 ft 4L (34/40w T12)	15	2,304	154	2.31	5,322	4 ft 4 lamp T-8 w/ elec ball	15	2,304	108	1.62	3,732	0.69	1,590
2	4 ft 4L (34/40w T12)	33	1,866	154	5.082	9,483	4 ft 4 lamp T-8 w/ elec ball	33	1,866	108	3.564	6,650	1.518	2,833
54	4 ft 4L (34/40w T12)	2	4,590	154	0.308	1,414	4 ft 4 lamp T-8 w/ elec ball	2	4,590	108	0.216	991	0.092	422
11	4 ft 4L (34/40w T12)	15	3,512	154	2.31	8,113	4 ft 4 lamp T-8 w/ elec ball	15	3,512	108	1.62	5,689	0.69	2,423
12	4 ft 4L	17	3,811	154	2.618	9,977	4 ft 4 lamp T-	17	3,811	108	1.836	6,997	0.782	2,980

Table 3.20 Load Impacts for 4' 4L 34/40w T12 to 4' 4L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
	(34/40w T12)						8 w/ elec ball							
15	4 ft 4L (34/40w T12)	28	4,660	154	4.312	20,094	4 ft 4 lamp T-8 w/ elec ball	28	4,660	108	3.024	14,092	1.288	6,002
19	4 ft 4L (34/40w T12)	12	4,012	154	1.848	7,414	4 ft 4 lamp T-8 w/ elec ball	12	4,012	108	1.296	5,200	0.552	2,215
20	4 ft 4L (34/40w T12)	16	1,323	154	2.464	3,260	4 ft 4 lamp T-8 w/ elec ball	16	1,323	108	1.728	2,286	0.736	974
22	4 ft 4L (34/40w T12)	20	2,707	154	3.08	8,338	4 ft 4 lamp T-8 w/ elec ball	20	2,707	108	2.16	5,847	0.92	2,490
23	4 ft 4L (34/40w T12)	13	3,539	154	2.002	7,085	4 ft 4 lamp T-8 w/ elec ball	13	3,539	108	1.404	4,969	0.598	2,116
10	4 ft 4L (34/40w T12)	1	4,327	154	0.154	666	4 ft 4 lamp T-8 w/ elec ball	1	4,327	108	0.108	467	0.046	199
28	4 ft 4L (34/40w T12)	43	1,358	154	6.622	8,993	4 ft 4 lamp T-8 w/ elec ball	43	1,358	108	4.644	6,307	1.978	2,686
29	4 ft 4L (34/40w T12)	18	3,627	154	2.772	10,054	4 ft 4 lamp T-8 w/ elec ball	18	3,627	108	1.944	7,051	0.828	3,003
33	4 ft 4L (34/40w T12)	15	2,882	154	2.31	6,657	4 ft 4 lamp T-8 w/ elec ball	15	2,882	108	1.62	4,669	0.69	1,989
48	4 ft 4L (34/40w T12)	9	2,532	154	1.386	3,509	4 ft 4 lamp T-8 w/ elec ball	9	2,532	108	0.972	2,461	0.414	1,048
51	4 ft 4L (34/40w T12)	26	2,733	154	4.004	10,943	4 ft 4 lamp T-8 w/ elec ball	26	2,733	108	2.808	7,674	1.196	3,269
55	4 ft 4L (34/40w T12)	33	6,859	154	5.082	34,857	4 ft 4 lamp T-8 w/ elec ball	33	6,859	108	3.564	24,445	1.518	10,412
60	4 ft 4L (34/40w T12)	22	3,495	154	3.388	11,841	4 ft 4 lamp T-8 w/ elec ball	22	3,495	108	2.376	8,304	1.012	3,537
62	4 ft 4L (34/40w T12)	10	4,625	154	1.54	7,123	4 ft 4 lamp T-8 w/ elec ball	10	4,625	108	1.08	4,995	0.46	2,128
63	4 ft 4L (34/40w T12)	6	3,303	154	0.924	3,052	4 ft 4 lamp T-8 w/ elec ball	6	3,303	108	0.648	2,140	0.276	912
64	4 ft 4L (34/40w T12)	8	6,824	154	1.232	8,407	4 ft 4 lamp T-8 w/ elec ball	8	6,824	108	0.864	5,896	0.368	2,511
65	4 ft 4L (34/40w T12)	17	6,141	154	2.618	16,077	4 ft 4 lamp T-8 w/ elec ball	17	6,141	108	1.836	11,275	0.782	4,802
66	4 ft 4L (34/40w T12)	21	3,423	154	3.234	11,070	4 ft 4 lamp T-8 w/ elec ball	21	3,423	108	2.268	7,763	0.966	3,307
71	4 ft 4L (34/40w T12)	6	4,827	154	0.924	4,460	4 ft 4 lamp T-8 w/ elec ball	6	4,827	108	0.648	3,128	0.276	1,332
72	4 ft 4L (34/40w T12)	12	2,085	154	1.848	3,853	4 ft 4 lamp T-8 w/ elec ball	12	2,085	108	1.296	2,702	0.552	1,151
74	4 ft 4L (34/40w T12)	5	4,827	154	0.77	3,717	4 ft 4 lamp T-8 w/ elec ball	5	4,827	108	0.54	2,607	0.23	1,110
Total		423						423					19.458	67,441
Ave													0.046	159.43

3.1.12 Load Impacts for 4’ 4L 34/40W T12 to 4' 3L T8

Load impacts for 4' 4L 34/40w T12 to 4’3L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.21**. FCI assumed ex ante savings are 318.58 kWh/yr and 0.068 kW. The gross ex post savings per measure are 264.38 ± 35.92 kWh/yr and 0.064 ± 0.006 kW at the 90 percent confidence level. The FCI database reported installing 434 4’ 3L T8 fixtures, and the total gross ex post savings 114,741 ± 15,591 kWh/year and 27.78 ± 2.78 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 49 percent of measures. Therefore, the proportional savings adjustment is 49 percent. The total adjusted gross ex post savings are 56,223 ± 7,640 kWh/yr and 13.61 ± 1.36 kW at the 90 percent confidence level.

Table 3.21 Load Impacts for 4' 4L 34/40w T12 to 4' 3L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
54	4 ft 4L (34/40w T12)	22	4,590	154	3.388	15,551	4 ft 3 lamp T-8 w/ elec ball	22	4,590	90	1.98	9,088	1.408	6,463
50	4 ft 4L (34/40w T12)	10	1,358	154	1.54	2,091	4 ft 3 lamp T-8 w/ elec ball	10	1,358	90	0.9	1,222	0.64	869
58	4 ft 4L (34/40w T12)	17	5,168	154	2.618	13,530	4 ft 3 lamp T-8 w/ elec ball	17	5,168	90	1.53	7,907	1.088	5,623
Total		49						49					3.136	12,955
Ave													0.064	264.38

3.1.13 Load Impacts for 4’ 4L 34/40W T12 to 4' 2L T8

Load impacts for 4' 4L 34/40w T12 to 4’2L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.22**. FCI assumed ex ante savings are 346.69 kWh/yr and 0.074 kW. The gross ex post savings per measure are 336.04 ± 25 kWh/yr and 0.09 ± 0.009 kW at the 90 percent confidence level. The FCI database reported installing 2,456 4’ 2L T8 fixtures, and the total gross ex post savings 825,305 ± 61,366 kWh/year and 221.04 ± 22.1 kW at the 90 percent confidence level. FCI assumed a 16 year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 109 percent of measures (i.e., more measures than reported). Therefore, the proportional savings adjustment is 109 percent. The total adjusted gross ex post savings are 899,582 ± 66,889 kWh/yr and 240.93 ± 24.09 kW at the 90 percent confidence level.

Table 3.22 Load Impacts for 4' 4L 34/40w T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
11	4 ft 4L (34/40w T12)	2	3,512	154	0.308	1,082	4 ft 2 lamp T-8 w/ elec ball	2	3,512	64	0.128	450	0.18	632
14	4 ft 4L (34/40w T12)	14	3,854	154	2.156	8,309	4 ft 2 lamp T-8 w/ elec ball	14	3,854	64	0.896	3,453	1.26	4,856
18	4 ft 4L (34/40w T12)	9	3,241	154	1.386	4,492	4 ft 2 lamp T-8 w/ elec ball	9	3,241	64	0.576	1,867	0.81	2,625
19	4 ft 4L (34/40w T12)	8	4,012	154	1.232	4,943	4 ft 2 lamp T-8 w/ elec ball	8	4,012	64	0.512	2,054	0.72	2,889
21	4 ft 4L (34/40w T12)	10	3,171	154	1.54	4,883	4 ft 2 lamp T-8 w/ elec ball	10	3,171	64	0.64	2,029	0.9	2,854
24	4 ft 4L (34/40w T12)	34	4,327	154	5.236	22,656	4 ft 2 lamp T-8 w/ elec ball	34	4,327	64	2.176	9,416	3.06	13,241
25	4 ft 4L (34/40w T12)	10	4,398	154	1.54	6,773	4 ft 2 lamp T-8 w/ elec ball	10	4,398	64	0.64	2,815	0.9	3,958
26	4 ft 4L (34/40w T12)	12	3,206	154	1.848	5,925	4 ft 2 lamp T-8 w/ elec ball	12	3,206	64	0.768	2,462	1.08	3,462
27	4 ft 4L (34/40w T12)	19	5,037	154	2.926	14,738	4 ft 2 lamp T-8 w/ elec ball	19	5,037	64	1.216	6,125	1.71	8,613
35	4 ft 4L (34/40w T12)	20	2,146	154	3.08	6,610	4 ft 2 lamp T-8 w/ elec ball	20	2,146	64	1.28	2,747	1.8	3,863
36	4 ft 4L (34/40w T12)	27	4,827	154	4.158	20,071	4 ft 2 lamp T-8 w/ elec ball	27	4,827	64	1.728	8,341	2.43	11,730

Table 3.22 Load Impacts for 4' 4L 34/40w T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
37	4 ft 4L (34/40w T12)	11	2,803	154	1.694	4,748	4 ft 2 lamp T-8 w/ elec ball	11	2,803	64	0.704	1,973	0.99	2,775
40	4 ft 4L (34/40w T12)	13	3,609	154	2.002	7,225	4 ft 2 lamp T-8 w/ elec ball	13	3,609	64	0.832	3,003	1.17	4,223
42	4 ft 4L (34/40w T12)	28	3,653	154	4.312	15,752	4 ft 2 lamp T-8 w/ elec ball	28	3,653	64	1.792	6,546	2.52	9,206
49	4 ft 4L (34/40w T12)	9	3,512	154	1.386	4,868	4 ft 2 lamp T-8 w/ elec ball	9	3,512	64	0.576	2,023	0.81	2,845
56	4 ft 4L (34/40w T12)	3	2,356	154	0.462	1,088	4 ft 2 lamp T-8 w/ elec ball	3	2,356	64	0.192	452	0.27	636
61	4 ft 4L (34/40w T12)	9	3,512	154	1.386	4,868	4 ft 4 lamp T-8 w/ elec ball	9	3,512	64	0.576	2,023	0.81	2,845
32	4 ft 4L (34/40w T12)	30	4,625	154	4.62	21,368	4 ft 2 lamp T-8 w/ elec ball	30	4,625	64	1.92	8,880	2.7	12,488
67	4 ft 4L (34/40w T12)	10	3,512	154	1.54	5,408	4 ft 2 lamp T-8 w/ elec ball	10	3,512	64	0.64	2,248	0.9	3,161
70	4 ft 4L (34/40w T12)	5	3,512	154	0.77	2,704	4 ft 2 lamp T-8 w/ elec ball	5	3,512	64	0.32	1,124	0.45	1,580
71	4 ft 4L (34/40w T12)	17	4,827	154	2.618	12,637	4 ft 2 lamp T-8 w/ elec ball	17	4,827	64	1.088	5,252	1.53	7,385
73	4 ft 4L (34/40w T12)	50	2,523	154	7.7	19,427	4 ft 2 lamp T-8 w/ elec ball	50	2,523	64	3.2	8,074	4.5	11,354
74	4 ft 4L (34/40w T12)	4	4,827	154	0.616	2,973	4 ft 2 lamp T-8 w/ elec ball	4	4,827	64	0.256	1,236	0.36	1,738
Total		354						354					31.86	118,957
Ave													0.09	336.04

3.1.14 Load Impacts for 4’ 3L 34/40W T12 to 4' 2L T8

Load impacts for 4' 3L 34/40w T12 to 4’2L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.23**. FCI assumed ex ante savings are 210.83 kWh/yr and 0.045 kW. The gross ex post savings per measure are 183 ± 35.92 kWh/yr and 0.052 ± 0.006 kW at the 90 percent confidence level. The FCI database reported installing 239 4’ 2L T8 fixtures, and the total gross ex post savings 43,791 ± 3,256 kWh/year and 12.43 ± 1.24 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. No sites were inspected with this measure combination.

Table 3.23 Load Impacts for 4' 4L 34/40w T12 to 4' 3L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
N/A	4 ft 3L (34/40w T12)	1	3,524	116	0.116	409	4 ft 2 lamp T-8 w/ elec ball	1	3,524	64	0.064	226	0.052	183
Total		1						1					0.052	183
Ave													0.052	183

3.1.16 Load Impacts for 8’ F96 1L T12 to 4' 2L T8

Load impacts for 8' F96 1L T12 to 4’2L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.24**. FCI assumed ex ante savings are 98.39 kWh/yr and 0.021 kW. The gross ex post savings per measure are 43.9 ± 3.26 kWh/yr and 0.014 ± 0.001 kW at the 90 percent confidence level. The FCI database reported installing 130 4’ 2L T8 fixtures, and the total gross

ex post savings 5,708 ± 424 kWh/year and 1.82 ± 0.182 kW at the 90 percent confidence level. FCI assumed the ex ante EUL was assumed, and this is used for the ex post EUL. The inspections verified proper installation for 100 percent of measures.

Table 3.24 Load Impacts for 8' F96 1L T12 to 4' 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
53	8 ft F96 1 L (60/75w T12)	1	3,136	75	0.075	235	4 ft 2 lamp T-8 w/ elec ball	1	3,136	61	0.061	191	0.014	44
Total		1						1					0.014	44
Ave													0.014	44

3.1.17 Load Impacts for 8’ F96 2L T12 to 4' 4L T8

Load impacts for 8' F96 1L T12 to 4’4L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.25**. FCI assumed ex ante savings are 107.76 kWh/yr and 0.023 kW. The gross ex post savings per measure are 51.28 ± 3.81 kWh/yr and 0.02 ± 0.002 kW at the 90 percent confidence level. The FCI database reported installing 805 4’ 4L T8 fixtures, and the total gross ex post savings 41,282 ± 3,070 kWh/year and 16.1 ± 1.61 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 78 percent of measures. Therefore, the proportional savings adjustment is 78 percent. The total adjusted gross ex post savings are 32,200 ± 2,394 kWh/yr and 12.56 ± 1.26 kW at the 90 percent confidence level.

Table 3.25 Load Impacts for 8' F96 2L T12 to 4' 4L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
25	8 ft F96 2 L (60/75w T12)	2	4,398	128	0.256	1,126	4 ft 4 lamp T-8 w/ elec ball	2	4,398	108	0.216	950	0.04	176
34	8 ft F96 2 L (60/75w T12)	45	2,076	128	5.76	11,958	4 ft 4 lamp T-8 w/ elec ball	45	2,076	108	4.86	10,089	0.9	1,868
39	8 ft F96 2 L (60/75w T12)	13	1,752	128	1.664	2,915	4 ft 4 lamp T-8 w/ elec ball	13	1,752	108	1.404	2,460	0.26	456
32	8 ft F96 2 L (60/75w T12)	14	4,625	128	1.792	8,288	4 ft 4 lamp T-8 w/ elec ball	14	4,625	108	1.512	6,993	0.28	1,295
Total		74						74					1.48	3,795
Ave													0.02	51.28

3.1.18 Load Impacts for 8’ F96 1L T12 to 8' 1L T8

Load impacts for 8' F96 1L T12 to 8’1L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.26**. FCI assumed ex ante savings are 79.65 kWh/yr and 0.017 kW. The gross ex post savings per measure are 56.57 ± 4.21 kWh/yr and 0.017 ± 0.002 kW at the 90 percent confidence level. The FCI database reported installing 189 8’ 1L T8 fixtures, and the total gross ex post savings 10,691 ± 795 kWh/year and 3.21 ± 0.32 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL.

The inspections verified proper installation for 85 percent of measures. Therefore, the proportional savings adjustment is 85 percent. The total adjusted gross ex post savings are 9,088 ± 676 kWh/yr and 2.73 ± 0.27 kW at the 90 percent confidence level.

Table 3.26 Load Impacts for 8' F96 1L T12 to 8' 1L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	KWh Savings
61	8 ft F96 1L (60/75w T12)	2	3,512	75	0.15	527	8 ft 1 lamp T-8 w/ elec ball	2	3,512	58	0.116	407	0.034	119
68	8 ft F96 1L (60/75w T12)	11	3,294	75	0.825	2,718	8 ft 1 lamp T-8 w/ elec ball	11	3,294	58	0.638	2,102	0.187	616
Total		13						13					0.221	735
Ave													0.017	56.57

3.1.19 Load Impacts for 8’ F96 2L T12 to 8' 2L T8

Load impacts for 8' F96 2L T12 to 8’1L T8 SLO (standard light output) are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.27**. FCI assumed ex ante savings are 89.02 kWh/yr and 0.019 kW. The gross ex post savings per measure are 82.27 ± 6.12 kWh/yr and 0.019 ± 0.002 kW at the 90 percent confidence level. The FCI database reported installing 570 8’ 2L T8 SLO fixtures, and the total gross ex post savings 46,893 ± 3,487 kWh/year and 10.83 ± 1.08 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. The inspections verified proper installation for all measures.

Table 3.27 Load Impacts for 8' F96 2L T12 to 8' 2L T8 SLO

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	KWh Savings
36	8 ft F96 2 L (60/75w T12)	34	4,827	128	4.352	21,007	8 ft 2 L T-8 w SLO	34	4,827	109	3.706	17,889	0.646	3,118
9	8 ft F96 2 L (60/75w T12)	6	2,794	128	0.768	2,146	8 ft 2 L T-8 w SL)	6	2,794	109	0.654	1,827	0.114	319
46	8 ft F96 2 L (60/75w T12)	5	3,512	128	0.64	2,248	8 ft 2 L T-8 w SLO	5	3,512	109	0.545	1,914	0.095	334
48	8 ft F96 2 L (60/75w T12)	2	2,532	128	0.256	648	8 ft 2 L T-8 w SLO	2	2,532	109	0.218	552	0.038	96
Total		47						47					0.893	3,867
Ave													0.019	82.27

3.1.20 Load Impacts for F40 U Tube 2L to F31/32 U6 Tube 2L T8

Load impacts for F40 U Tube 2L to F31/32 U6 Tube 2L T8 are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.28**. FCI assumed ex ante savings are 60.91 kWh/yr and 0.013 kW. The gross ex post savings per measure are 49.04 ± 3.65 kWh/yr and 0.013 ± 0.001 kW at the 90 percent confidence level. The FCI database reported installing 291 F31/32 U6 Tube 2L T8 fixtures, and the total gross ex post savings 14,271 ± 1,061 kWh/year and 3.78 ± 0.378 kW at the 90 percent confidence level. FCI assumed the ex ante EUL was 16 years, and this is used for the ex post EUL. The inspections verified proper installation for 100 percent of measures.

Table 3.28 Load Impacts for F40 U Tube 2L to F31/32 U6 Tube 2L T8

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	KWh Savings
20	F40 U6-Tube 2L	2	1,323	72	0.144	191	F31/32 U6-Tube 2L T8	2	1,323	59	0.118	156	0.026	34
65	F40 U6-Tube 2L	1	6,141	72	0.072	442	F31/32 U6-Tube 2L T8	1	6,141	59	0.059	362	0.013	80
71	F40 U6-Tube 2L	4	4,827	72	0.288	1,390	F31/32 U6-Tube 2L T8	4	4,827	59	0.236	1,139	0.052	251
72	F40 U6-Tube 2L	1	2,085	72	0.072	150	F31/32 U6-Tube 2L T8	1	2,085	59	0.059	123	0.013	27
Total		8						8					0.104	392
Ave													0.013	49.04

3.1.21 Load Impacts for 8' F96 2L RT12 to 2L T8 RLO

Load impacts for 8' F96 2L T12 to 2L T8 RLO (reduced light output) are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.29**. FCI assumed ex ante savings are 140.56 kWh/yr and 0.03 kW. The gross ex post savings per measure are 121.66 ± 13.82 kWh/yr and 0.03 ± 0.003 kW at the 90 percent confidence level. The FCI database reported installing 4,267 8' 2L T8 RLO fixtures, and the total gross ex post savings 519,114 ± 58,977 kWh/year and 128.01 ± 12.8 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. The inspections verified proper installation for all measures.

Table 3.29 Load Impacts for 8' F96 2L T12 to 8' 2L T8 RLO

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
1	8 ft F96 2L T12	10	2,304	128	1.28	2,949	8 ft 2L T-8 w RLO	10	2,304	98	0.98	2,258	0.3	691
4	8 ft F96 2L T12	12	3,495	128	1.536	5,368	8 ft 2L T-8 w RLO	12	3,495	98	1.176	4,110	0.36	1,258
5	8 ft F96 2L T12	8	2,243	128	1.024	2,297	8 ft 2L T-8 w RLO	8	2,243	98	0.784	1,759	0.24	538
6	8 ft F96 2L T12	3	2,908	128	0.384	1,117	8 ft 2L T-8 w RLO	3	2,908	98	0.294	855	0.09	262
7	8 ft F96 2L T12	29	4,476	128	3.712	16,615	8 ft 2L T-8 w RLO	29	4,476	98	2.842	12,721	0.87	3,894
8	8 ft F96 2L T12	8	4,827	128	1.024	4,943	8 ft 2L T-8 w RLO	8	4,827	98	0.784	3,784	0.24	1,158
11	8 ft F96 2L T12	6	3,512	128	0.768	2,697	8 ft 2L T-8 w RLO	6	3,512	98	0.588	2,065	0.18	632
13	8 ft F96 2L T12	4	2,330	128	0.512	1,193	8 ft 2L T-8 w RLO	4	2,330	98	0.392	913	0.12	280
15	8 ft F96 2L T12	12	4,660	128	1.536	7,158	8 ft 2L T-8 w RLO	12	4,660	98	1.176	5,480	0.36	1,678
17	8 ft F96 2L T12	4	1,664	128	0.512	852	8 ft 2L T-8 w RLO	4	1,664	98	0.392	652	0.12	200
24	8 ft F96 2L T12	1	4,327	128	0.128	554	8 ft 2L T-8 w RLO	1	4,327	98	0.098	424	0.03	130
10	8 ft F96 2L T12	16	4,327	128	2.048	8,862	8 ft 2L T-8 w RLO	16	4,327	98	1.568	6,785	0.48	2,077
28	8 ft F96 2L T12	11	1,358	128	1.408	1,912	8 ft 2L T-8 w RLO	11	1,358	98	1.078	1,464	0.33	448
29	8 ft F96 2L T12	8	3,627	128	1.024	3,714	8 ft 2L T-8 w RLO	8	3,627	98	0.784	2,844	0.24	870
31	8 ft F96 2L T12	28	2,672	128	3.584	9,576	8 ft 2L T-8 w RLO	28	2,672	98	2.744	7,332	0.84	2,244
38	8 ft F96 2L T12	11	3,031	128	1.408	4,268	8 ft 2L T-8 w RLO	11	3,031	98	1.078	3,267	0.33	1,000

Table 3.29 Load Impacts for 8' F96 2L T12 to 8' 2L T8 RLO

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
41	8 ft F96 2L T12	30	2,794	128	3.84	10,729	8 ft 2L T-8 w RLO	30	2,794	98	2.94	8,214	0.9	2,515
42	8 ft F96 2L T12	6	3,653	128	0.768	2,806	8 ft 2L T-8 w RLO	6	3,653	98	0.588	2,148	0.18	658
47	8 ft F96 2L T12	3	2,654	128	0.384	1,019	8 ft 2L T-8 w RLO	3	2,654	98	0.294	780	0.09	239
52	8 ft F96 2L T12	37	8,760	128	4.736	41,487	8 ft 2L T-8 w RLO	37	8,760	98	3.626	31,764	1.11	9,724
53	8 ft F96 2L T12	33	3,136	128	4.224	13,246	8 ft 2L T-8 w RLO	33	3,136	98	3.234	10,142	0.99	3,105
58	8 ft F96 2L T12	2	5,168	128	0.256	1,323	8 ft 2L T-8 w RLO	2	5,168	98	0.196	1,013	0.06	310
68	8 ft F96 2L T12	11	3,294	128	1.408	4,638	8 ft 2L T-8 w RLO	11	3,294	98	1.078	3,551	0.33	1,087
71	8 ft F96 2L T12	1	4,827	128	0.128	618	8 ft 2L T-8 w RLO	1	4,827	98	0.098	473	0.03	145
74	8 ft F96 2L T12	27	4,827	128	3.456	16,682	8 ft 2L T-8 w RLO	27	4,827	98	2.646	12,772	0.81	3,910
Total		321						321					9.63	39,052
Ave													0.03	121.66

3.1.22 Load Impacts for Incandescent Exit to LED Exit

Load impacts for Incandescent Exit to LED Exit are based on field inspections, electric power measurements, lighting logger measurements, and audits at participant sites consistent with IPMVP Option B. Pre- and post-retrofit fixture quantities, hours of operation and savings are shown in **Table 3.30**. FCI assumed ex ante savings are 332.88 kWh/yr and 0.038 kW. The gross ex post savings per measure are 157.77 ± 41.49 kWh/yr and 0.038 ± 0.004 kW at the 90 percent confidence level. The FCI database reported installing 268 LED Exit fixtures, and the total gross ex post savings 42,282 ± 11,282 kWh/year and 10.18 ± 1.02 kW at the 90 percent confidence level. FCI assumed a 16-year ex ante EUL, and this is used for the ex post EUL. The inspections verified proper installation for 100 percent of measures.

Table 3.30 Load Impacts for Incandescent Exit to LED Exit

Site	Pre-retrofit	Pre-Qty	Pre-Hours	Pre W/Fix.	Pre kW	Pre kWh/y	Post-Retrofit	Post-Qty	Post-Hours	Post W/Fix.	Post kW	Post kWh/y	KW Savings	kWh Savings
2	Incan Exit	4	1,866	40	0.16	299	LED Exit	4	1,866	2	0.008	15	0.152	284
3	Incan Exit	4	3,627	40	0.16	580	LED Exit	4	3,627	2	0.008	29	0.152	551
14	Incan Exit	5	3,854	40	0.2	771	LED Exit	5	3,854	2	0.01	39	0.19	732
23	Incan Exit	1	3,539	40	0.04	142	LED Exit	1	3,539	2	0.002	7	0.038	134
24	Incan Exit	1	4,327	40	0.04	173	LED Exit	1	4,327	2	0.002	9	0.038	164
27	Incan Exit	1	5,037	40	0.04	201	LED Exit	1	5,037	2	0.002	10	0.038	191
41	Incan Exit	1	2,794	40	0.04	112	LED Exit	1	2,794	2	0.002	6	0.038	106
42	Incan Exit	2	3,653	40	0.08	292	LED Exit	2	3,653	2	0.004	15	0.076	278
56	Incan Exit	2	2,356	40	0.08	188	LED Exit	2	2,356	2	0.004	9	0.076	179
74	Incan Exit	27	4,827	40	1.08	5,213	LED Exit	27	4,827	2	0.054	261	1.026	4,953
Total		48						48					1.84	7,573
Ave													0.038	157.77

3.1.23 Load Impacts for Energy Efficient Cooking Equipment

The program reported installing 5 energy efficient cooking equipment measures. However, no data was provided regarding where the equipment was installed, type of equipment, model numbers, or efficiency. Therefore, these measures could not be evaluated.

3.1.24 Load Impacts for Strip Curtains

No strip curtains were reported as being installed by the program.

3.2 Process Evaluation Results

Process evaluation recommendations are based on process surveys conducted in-person with 68 participants and 69 non-participants. The process surveys were used to evaluate participant satisfaction and obtain suggestions to improve the program's services and procedures. Interview questions assessed how the program influenced awareness of linkages between efficiency improvements, bill savings, and increased comfort for customers. Participants were asked why and how they decided to participate in the program. Non-participants were asked why they chose not to participate. The surveys identified reasons why program marketing efforts were not successful with non-participants as well as to identify additional hard-to-reach market barriers. The process survey instruments are provided in **Appendix A**.

3.2.1 Participant Survey Results

Participant process survey results are summarized to answer the following questions from the CPUC-approved EM&V plan.

1. **Are participants satisfied with services or information provided by the program?**
   Participant satisfaction is very high as indicated by the following survey responses.
   - Overall Satisfaction with Program – 82.5% satisfaction rating (i.e., average score of 8.25 ± 0.09 out of 10 points).
   - Courteous and Professional Crew – 86% satisfaction rating (i.e., 8.61 ± 0.029 out of 10 points).
   - Timeliness (i.e., work scheduled and completed on time) – 100% satisfaction rating.
     Emerging Communities representatives – 1.03 ± 0.07 hours average time.
     Lighting subcontractor – 1.72 ± 0.18 hours average time.
     HVAC subcontractor – 1.50 ± 0.17 hours average time.
   - Increased understanding of the link between energy efficiency, bill savings, and comfort – 71.4 ± 4.8 percent indicating energy education efforts could be improved.
   - Responsiveness of the program to questions and concerns – 83.6 ± 3.2 percent.
   - Program marketing information – 83.5 ± 3.0 percent.

2. **Are customers satisfied with measures offered or installed by the program?**
   Customers were moderately satisfied with measures as indicated by the following ratings.
   - 90.28 ± 5.78 percent of customers are still using the measures installed by the program.
   - 84 ± 3 percent of customers are satisfied with measures installed by the program.
   - 85.2 ± 3.2 percent of participants are satisfied with screw-in CFLs.
   - 85.7 ± 3 percent of participants are satisfied with T8 fixtures with electronic ballasts.
   - 85.4 ± 4.7 percent of participants are satisfied with delamping.
   - 92.2 ± 5.3 percent of customers are satisfied with LED exit signs.
   - 78.5 ± 6.5 percent of participants are satisfied with programmable thermostats.
   - 76.7 ± 18.8 percent of participants were satisfied with reprogramming thermostats.
   - 85.3 ± 4.4 percent of participants were satisfied with HVAC diagnostic tune-ups.
   - 84.9 ± 4.5 percent of participants were satisfied with clean AC condenser coils.

3. Are customers satisfied with services or information provided by the program?
Customer satisfaction with the services or information provided by the program is indicated by the following customer ratings.

- 80.9 ± 3.3 percent were satisfied with the *Emerging Communities Audit Report.*
- 79.9 ± 3.6 percent felt the *Emerging Communities Audit Report* was useful.
- 70.9 ± 3.7 percent liked the *Emerging Communities Audit Report* presentation.
- 81.7% ± 3.1% percent felt the *Emerging Communities Audit Report* was accurate.
- 85.1% ± 2.9% percent felt rating of program increasing understanding of the linkage between energy efficiency, bill savings, and comfort.
- 75% of participants (43 out of 68) indicated that neighboring businesses would benefit from the program.
- 85. ± 2.9 percent of participants of participants were satisfied with the overall service received from the program.

4. What are the participant hard-to-reach demographics?
Participant demographics have been verified as "hard-to-reach" as indicated by the following results.[20] Demographic survey response data for participants indicate that 84 percent were tenants and most spoke English (49.3%), Spanish (30.4%), or Asian (10.1%), Arabic (8.7%), and Chinese (1.4%) languages as shown in **Table 3.31**. The average floor area was 2,530 ± 1,150 square feet, and the average number of employees was 6.63 ± 1.13.

Table 3.31 Participant Demographics

Language	Percent
English	49.3%
Spanish	30.4%
Asian	10.1%
Arabic	8.7%
Chinese	1.4%
Vietnamese	0.0%
Total	100.0%

5. Do participants have any suggestions to improve the program?
69% of participants provided comments or suggestions to improve the program.

- 30.6% said the Emerging Communities Energy Efficiency Program was a "great program!"
- 63% said their "utility bills decreased," 11% said their "utility bills stayed the same," and 26% said their "utility bills increased."
- 10.2% said "programmable thermostats were confusing, difficult to use, or not installed properly."
- 26.5% said they "liked the new fluorescent lighting."
- 34.7% said they "wanted a comprehensive air conditioner tune-up to save energy or a new smaller efficient air conditioner to replace their big and old inefficient unit."
- 4% said they "wanted information about other programs."

[20] The CPUC definition of small commercial hard-to-reach customers are those who do not have easy access to program information or generally do not participate in energy efficiency programs due to language (i.e., primary language non-English), business size (less than ten employees); geographic (i.e., outside San Francisco Bay Area, Sacramento, Los Angeles Basin or San Diego), or lease (i.e., split incentives barrier). ADM further defines hard-to-reach as less than 50kW and 5,000 ft^2.

- 6% said they "liked the installers/subcontractors who did a great job."

6. Did participants share information with business associates about the benefits of measures offered by the program (i.e., multiplier effects)?
Thirty-seven participants (53% of the 70 interviewed participants) shared program information with 1,146 business associates about the benefits of measures offered by the program. Approximately 86 out of 1,146 customers (i.e., 7.5 percent) decided to install similar measures or participated in the program. The 86 other customers were not identified so follow-up multiplier questions and analysis could not be performed.

3.2.2 Non-Participant Survey Results

Non-participant process survey results are summarized to in order to answer the following questions from the CPUC-approved EM&V plan.

1. Is there a continuing need for the program?
The following responses indicate a continuing need for the program.

- 31% of non-participants would have participated if they knew the program installed no-cost energy efficiency improvements at small commercial businesses like theirs.

2. Why have customers chosen not to participate (i.e., market barriers)?
Non-participant or refuser process survey results are provided in **Table 3.32**. The primary reason for non-participation was the hassle cost (i.e., "too busy or no time"), followed by misplaced or split incentives, lack of trust (performance uncertainty), information cost, organizational practices, and bounded rationality. Approximately 22.8% of non-participants surveyed indicated interest in the program, but were unable to participate due to a number of reasons, most notably the program running out of funding (these were referred to FCI). Most non-participants didn't participate due to simply not knowing about the program, too busy, or no time to participate. While better advertising would have helped, the FCI ECEE Program was fully subscribed in 2004-05. The most often cited barriers to participation include information costs, misplaced or split incentives, hassle costs, and performance uncertainty. Although difficult to quantify, it appears that a large segment of the market is affected by each of these barriers. Most customers indicated that better marketing, delivery, or follow-up efforts would overcome barriers to participation.

Table 3.32 Non-Participant or Refuser Process Survey Results

Reasons Given for Non-Participation (i.e., Market Barriers)	Percent
Didn't know about program (Information)	30.9%
Too busy, no time to participate (Hassle Cost)	36.8%
Tenant (Misplaced or Split Incentives)	21.1%
Doesn't Trust Free Programs (Performance Uncertainty)	12.3%
Refused to participate (Information Cost, Organizational Practices, Bounded Rationality)	7.0%
Signed up for program, but couldn't participate (Wanted to Participate)	22.8%

Note: Total exceeds 100 percent.

3. Do non-participants have any suggestions to improve participation?
Suggestions to improve the program are provided in **Table 3.33**. The most frequent suggestion (42.9%) was to provide better advertising or marketing information about the program to increase participation. Non-participants felt that better follow through would

increase participation (19%) or offering better or more energy efficiency services (9.5%). Better follow through suggestions came from the 22.8% who wanted to participate but were unable to due to the program running out of funding. Approximately 4.8% of non-participants suggested continuing the program so more customers could participate.

Table 3.33 Non-Participant Suggestions to Improve the FCI ECEEP Program

Suggestion	Percent
Better Advertising or Marketing	42.9%
Better Follow-through to Increase Participation	19.0%
Offer Better or More Energy Efficiency Services	9.5%
Continue Program	4.8%
Wishes to Participate	23.8%

4. What are the non-participant hard-to-reach demographics?

Demographic data for non-participants indicated that 84 percent were tenants and most spoke English (38.2%), Spanish (30.9%) or Asian (17.9%) languages as shown in **Table 3.34**. The average floor area was 1,416 ± 146 square feet, and the average number of employees was 4.1 ± 0.37.

Table 3.34 Non-Participant Demographics

Language	Percent
English	38.2%
Spanish	30.9%
Asian	17.6%
Chinese	2.9%
Hindi	4.4%
Other non-English	1.5%
Refused	4.4%
Total	100.0%

The following section provides process evaluation recommendations to improve the program.

3.2.3 Process Evaluation Recommendations

The following process evaluation recommendations are provided as per the CPUC-approved EM&V plan regarding what works, what doesn't work, and suggestions to improve the program's services and procedures.

3.2.3.1 General Program Recommendations

The following general program recommendations are provided to improve the program's services, procedures, and cost effectiveness.

1. Directly install night-time security lighting measures for customers to reduce the tendency to have all lights on at the businesses during night hours.
2. Provide comprehensive HVAC diagnostic tune-ups for free to hard-to-reach small commercial customers since most customers are tenants and air conditioner maintenance is the responsibility of the landlord who doesn't have a financial interest in maintenance (i.e., split incentive).
3. Ensure HVAC subcontractors are properly trained to diagnose and correct refrigerant charge and airflow, clean/comb condenser coils, and suction line insulation.

4. Improve the program tracking database and implement quality control procedures to ensure more accurate reporting of measure information. Conduct follow-up calls and site-visits to verify proper installation and operation of measures (especially programmable thermostats). Implement quality control (QC) inspections and spot checking to ensure accuracy and reliability of the program tracking database. Obtain customer billing data to ensure the program is delivering measurable savings. Sites with billing data indicating low or negative savings can be checked for proper installation of measures. This will also facilitate better EM&V analysis of program savings.
5. Provide user-friendly programmable thermostat instructions in various languages to ensure persistence of savings. Make sure technicians take time to properly explain programmable thermostats to participants and provide user-friendly instructions in various languages and include a toll-free number on thermostats for participants to call if they have questions. Many participants expressed frustration over not knowing how to program the thermostats. Programmable thermostats should include instructions for the technicians to follow for both cooling and heating and all old and new settings should be documented in the tracking database.
6. Provide customers with extra air filters to increase HVAC diagnostic tune-up measure EUL.
7. Label installed measures with a permanent sticker or mark to assist with verification.
8. Participants suggested offering more comprehensive air conditioner tune-ups to save energy or a smaller efficient air conditioner to replace their big and old inefficient units.
9. Non-participants suggested better advertising to explain how small commercial businesses could take advantage of no-cost energy efficiency improvements offered by the program. Non-participants suggested advertising through landlord, telephone, email, mail, newspapers, or television to increase participation.

3.2.3.2 Recommendations for Training

Train technicians on proper installation procedures and materials for all measures. Provide each technician with installation specifications and quality control guidelines to ensure proper installation of all measures. Make sure technicians take time to properly explain programmable thermostats to participants and consider providing simple instructions in various languages and placing a toll-free number on the thermostats for participants to call if they have any questions. Consider using a third-party verification service provider (VSP) to train and equip technicians with air conditioning diagnostic equipment for measuring refrigerant pressure and temperature to check and correct refrigerant charge and airflow. This would ensure more air conditioners are working properly, provide greater savings, reduce lost opportunities, and yield greater customer satisfaction. Technicians would need the following equipment for performing AC diagnostic tune-ups.

- Bacharach sling psychrometer for calibrating digital temperature measurements.
- Fluke Model 52 II two-temperature probe digital thermometer (or equivalent).
- Fluke Model 80PK-8 Clamp-on Type K digital thermometer (or equivalent).
- Carrier Model 020-434 Superheat Calculator or VSP software to verify refrigerant charge and proper airflow, economizer operation, clean condenser coil, and suction line insulation.
- Compound refrigerant pressure gauge.
- Digital scale for weighing refrigerant.
- Refrigerant leak detection equipment.

- Schrader core removal tool and core valves with locking Schrader caps.

When the lighting retrofits are completed the buildings will have less air conditioning loads. Train the auditors and HVAC technicians to perform air conditioning load calculations on the building so if the air conditioner fails, a smaller, properly sized unit can be installed to reduce peak air conditioning connected electric loads and demand.

3.2.3.3 Recommendations for Database

The verification inspections and participant surveys indicated a need to improve both the accuracy and reliability of the FCI ECEEP tracking database. FCI should implement Quality Control (QC) inspections and spot checking of direct install measures and conduct follow-up calls and site-visits to verify installation of measures to improve the accuracy and reliability of the tracking database. Tracking and reporting of program accomplishments is vital since without an accurate and reliable database the program cannot be properly evaluated.

3.2.3.4 Recommendations for HVAC Diagnostic Tune-up Measures

The verification inspections found HVAC diagnostic tune-up measures had a 64% verification rate. Technicians should be trained and equipped to perform HVAC diagnostic tune-up measures including checking, correcting, and verifying proper refrigerant charge and airflow, chemical cleaning and combing of condenser coils, and installing suction line insulation. Air conditioner information should be captured in the FCI ECEEP database including: make; model; tons; return/supply drybulb temperature split; factory charge (ounces); required/actual superheat; and refrigerant charge added/removed (ounces if performing AC diagnostic tune-ups), chemical cleaning and combing of air-cooled commercial air conditioning condensing coils, and suction line insulation.

A number of sites had condensing coils there were dirty or damaged, and it was obvious the coils at these sites had not been cleaned or combed. Pre/post photographs should be taken at each site to verify work. Chemical cleaning of condenser coils will emulsify baked-on dirt and grime so it can be rinsed away with water to restore the design heat transfer. An alkaline cleaner is recommended since baked-on dirt is particularly stubborn to remove. Combing coils will eliminate bent fins and improve airflow across the condenser. Condensing coils are similar to a vacuum cleaner sucking in greasy dirt and dust that collects on the coils that gets baked on over time. When finned coils get dirty, heat transfer is reduced. In turn, compressors have to work much harder, operating costs go up, and valuable equipment can break down when it is needed most. For every 2°F rise in condensing temperature caused by dirty coils, efficiency is reduced by 1% and power consumption is increased by 1%. Cleaning coils protects equipment and helps maintain peak operating efficiency. According to the 2004-05 DEER Update Study, cleaning condenser coils saves 12.4%.[21]

Consider giving customers twelve free air filters to allow quarterly replacement and persistence of the measure for three years. Every dollar spent on free air filters will increase net benefits by roughly $5 and provide a 5 percent improvement in the total resource cost effectiveness.

[21] Itron, Inc. *2004-2005 Database for Energy Efficiency Resources (DEER) Update Study Final Report.* 2005. page 7-40, Prepared for Southern California Edison Company. Prepared by Itron, Inc., Vancouver, WA. Available online: http://eega.cpuc.ca.gov/deer/.

Another recommendation is to consider installing washable plastic mesh air filters with an eight year measure life.

Installing suction line insulation on bare refrigeration suction lines will save 1-2%. Insulating the suction line maintains lower suction temperatures and pressures and saves energy. Heat gain to un-insulated suction lines add cooling loads and cause the compressor to run hotter and less efficiently. The liquid line should only be insulated if it runs through a freezer or refrigerated space. Otherwise, it should be left un-insulated.

Follow the California Energy Commission (CEC) requirements regarding installation of refrigerant line insulation and install minimum ¾" thick insulation according to manufacturers' installation instructions regarding seam and butt sealing joints as well as proper inside diameter of the insulation to match the outside diameter of the pipe (i.e., eliminate plastic ties). Consider using insulation with better UV protection and a guaranteed 10-year life for exterior applications or factory- or field-installed white UV coatings to protect insulation from solar radiation, reduce heat gain, and improve persistence and savings.

3.2.3.5 Programmable Thermostats

The inspections verified programmable thermostats at 95% of the sites, but not all were programmed properly.[22] This measure should include instructions for technicians to follow when programming the thermostat for both cooling and heating and all old and new settings should be documented in the tracking database. To improve persistence post thermostat schedules should be stored in ROM or backed up with an 11-year "leak-charge" NiCad battery.

3.2.3.6 Compact Fluorescent Lamps (CFLs)

The inspection verification rate for CFLs was 93%. Before installing CFLs, consider screening customers who express lack of interest or dislike for CFLs. It might be helpful to take pre/post photographs at each site to verify CFL installations. Pre/post wattages, hours of operation, and location should be documented in the tracking database.

3.2.3.7 T8 Fluorescent Lamps with Electronic Ballasts

The inspection verification rate for T8 fluorescent lamps and electronic ballasts was 98% due to small errors in the tracking database. It might be helpful to take pre/post photographs at each site to verify T8 lamps and electronic ballasts. Pre/post wattages, hours of operation, and location should be documented in the tracking database.

3.2.3.8 LED Exit Signs

The inspection verification rate for LED exit signs was 100%. No recommendations are provided for LED exit signs.

[22] Some thermostats were set to the same temperature and schedule as the pre-retrofit heating or cooling schedule.

Appendix A: Process Survey Instrument

FCI Emerging Communities Energy Efficiency Program 1396-04

Interview Instructions for Process Survey
1. Purpose

The purpose of the Process Survey is to evaluate what works, what doesn't work, customer satisfaction, and suggestions for improvement in the program's services and procedures.

2. Selection of Respondent

1. **Participants** must be the person responsible for allowing program measures to be installed at the site. If this person is unavailable locate someone who is at least familiar with how that decision was made. Participant question #31 is used to verify that participant is a small-business with one or more of the following attributes: 1) Primary language non-English; 2) <10 employees; 3) Lease; 4) Located in the following cities in the SCE service area: Compton, Inglewood, Hawthorne, Lawndale, Gardena, Paramount, Lynwood, South Gate, Huntington Park, Hawaiian Gardens, Bell, Cudahy, Bell Gardens, Commerce, Montebello, Maywood, Pico Rivera, and Los County Unincorporated areas
2. **Non-participants** must be a small-business in the local utility service area unaware of the program or decided not to allow program measures to be installed at their facility (see non-participant survey at end). Non-participant question #3 is used to verify one or more of the following attributes: 1) Primary language non-English; 2) <10 employees; 3) Lease; 4) Located in the following cities in the SCE service area listed above.
3. **Participant business was not selected for inspection or has not been inspected by SCE for this program.**

3. Two Types of Sites

This survey will be used for two types of sites:

1. **On-Site EM&V Only**. Sites that receive an EM&V on-site inspection or process survey.
2. **Telephone Only**. Sites that only receive a telephone survey (participants or non-participants).

4. How to Start a Survey
Complete the following steps to start one of these surveys:

1. Review FCI customer file information (for participants).
2. Make sure you understand what FCI installed prior to initiating the visit or call.
3. Participant Survey Introduction.
   Say: "Hello! My name is [_____], and I am conducting a survey regarding the *Emerging Communities Energy Efficiency* Program managed by FCI Management Consultants. The program installed no-cost energy efficiency improvements for your business. The program was funded by ratepayers under the auspices of the California Public Utilities Commission. Would you mind spending 10 minutes to answer a few questions to help us evaluate and improve the program?
4. Non-participant Survey Introduction.
   Say: "Hello! My name is [_____], and I am conducting a survey regarding the *Emerging Communities Energy Efficiency* Program managed by FCI Management Consultants. The program was funded by ratepayers under the auspices of the California Public Utilities Commission in 2004 and 2005. You didn't participate in the program, but your feedback will help us evaluate and improve the program. The program provided a comprehensive audit and installed a no-cost package of energy efficiency measures such as: 1) screw-in compact fluorescent lamps; 2) hardwired T-8/electronic ballasted fluorescent fixture replacement 3) air conditioning tune-ups; and provided rebates for window film and occupancy sensors. Would you mind spending 5 minutes to answer a few questions?

EMERGING COMMUNITIES PARTICIPANT SURVEY #_____

Business_____ Name _____ Title _____

ID #_____ Address _____ City _____ ZIP _____

Phone Number_____ Survey Date _____Surveyor Initials _____

1. Do you remember *Emerging Communities* program or their contractors installing no-cost energy efficiency improvements at your facility?
   ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer
2. How would you rate the program marketing information on a scale from 1 to 10?
   ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
3. How would you rate the attitude of the *Emerging Communities* crew in terms of being courteous and professional on a scale from 1 to 10?
   ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
4. How would you rate the quality of work performed on a scale from 1 to 10?
   ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
5. How would you rate the responsiveness of the program to your questions and concerns on a scale from 1 to 10?
   ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
6. Was the work scheduled and completed within the expected timeframe (i.e., 30 days)?
   ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer
7. How long were the *Emerging Communities* technicians at your business?
   7a. *EC* Representatives: ___ 1 hr ___2 hrs ___3 hrs ___4 hrs ___>4 hrs **98** Don't Know **99** Refused

   7b. Lighting Contractor: ___ 1 hr ___2 hrs ___3 hrs ___4 hrs ___>4 hrs **98** Don't Know **99** Refused

   7c. HVAC Contractor: ___ 1 hr ___2 hrs ___3 hrs ___4 hrs ___>4 hrs **98** Don't Know **99** Refused
8. Did you receive an *Emerging Communities Audit Report*? ___ **1** (Yes) ___ **2** (No, ***Skip to Q13***) **98** DK **99** Refused
9. How would you rate the usefulness of the *Emerging Communities Audit Report* on a scale from 1 to 10?
   ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
10. How would you rate the presentation of the *Emerging Communities Audit Report* on a scale from 1 to 10?
    ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
11. How would you rate the accuracy of the *Emerging Communities Audit Report* on a scale from 1 to 10?
    ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
12. Did you receive advice to obtain financing for non-free measures (i.e., efficient cooking or AC)?
    ___ **1** (Yes) ___ **2** (No) **98** DK **99** Refused
    If yes, how satisfied were you with the *Emerging Communities Audit* advice on a scale from 1 to 10?
    ___ Financing Advice (**1=low, 10=high**) ___ Rebate Advice (**1=low, 10=high**) **98** DK **99** Refused
13. How would you rate the overall service you received on a scale from 1 to 10?
    ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
14. How would you rate the program in terms of increasing your understanding of the link between energy efficiency, bill savings, and comfort?
    ___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer
15. Are you still using all the measures that were installed?
    ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

    Please list measures not used? _____

EMERGING COMMUNITIES PARTICIPANT SURVEY (cont'd) #_____

16. How would you rate your satisfaction with the measures installed at your business on a scale of 1 to 10?
___ Response (**1 is low and 10 is high**) **98** Don't Know **99** Refused to Answer

How would you rate your satisfaction on a scale of 1 to 10 with each installed measure at your business?

Question	Measure Installed	Satisfaction Rating (Circle)
17	Screw-In CFL 4-65 watt	N/A Low **1 2 3 4 5 6 7 8 9 10** High
18	T8 Fixtures with Electronic Ballasts	N/A Low **1 2 3 4 5 6 7 8 9 10** High
19	Delamp fluorescent or incandescent lamps	N/A Low **1 2 3 4 5 6 7 8 9 10** High
20	LED Exit Signs	N/A Low **1 2 3 4 5 6 7 8 9 10** High
21	Programmable thermostats	N/A Low **1 2 3 4 5 6 7 8 9 10** High
22	Re-program programmable thermostats	N/A Low **1 2 3 4 5 6 7 8 9 10** High
23	Reflective Window Film	N/A Low **1 2 3 4 5 6 7 8 9 10** High
24	Occupancy or Motion Sensors (Lighting)	N/A Low **1 2 3 4 5 6 7 8 9 10** High
25	AC Diagnostic Tune-up	N/A Low **1 2 3 4 5 6 7 8 9 10** High
26	Clean AC Coils	N/A Low **1 2 3 4 5 6 7 8 9 10** High
27	Strip Curtains	N/A Low **1 2 3 4 5 6 7 8 9 10** High
28	Emerging Communities Audit Report	N/A Low **1 2 3 4 5 6 7 8 9 10** High

29. Have you shared information with any of your business associates about the benefits of screw-in CFLs, hardwired T-8/electronic ballasted fluorescent fixtures, LED Exit Signs/retro-kit, AC tune-up, or other measures from the *Emerging Communities Audit Report*?
___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

With how many other businesses have you shared this information in the last 12 months? _____

About how many of these people have installed any of these measures? _____

30. Do you know any other businesses that would benefit from this program (name/address)? _____

_____

31. Please provide the following demographic information (*obtain utility bill from FCI to verify rate schedule*)?
Language ____# Employees___ Own Lease Floor Area _____ Outside LA __ Ethnicity__ **99** Refused

32. Do you have any suggestions to improve the program?
___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

If so, please provide the suggestion(s). _____
_____
_____

33. How many hours per day do you use the CFLs or Lighting Fixtures installed by FCI? **98** (DK) **99** (Refused)

Location	Old Type	Old Qty.	Old Hrs	Old W/Fix	New Type	New Qty.	New Hrs	New W/Fix
1.			hrs	W			Hrs	W
2.			hrs	W			Hrs	W
3.			hrs	W			Hrs	W
4.			hrs	W			Hrs	W
5.			hrs	W			Hrs	W
6.			hrs	W			Hrs	W
7.			hrs	W			Hrs	W
8.			hrs	W			Hrs	W

Type: 1= CFL; 2= LED Exit; 3= Replace Incandescent with Fluorescent; 4= Delamp T12-Mag with T8-EB; 5= Replace T12-Mag with T-8-EB

EMERGING COMMUNITIES PARTICIPANT SURVEY (cont'd) #_____

34. Did you receive a list of recommended measures with opportunities for saving more energy at your facility?
___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

35. Have *Emerging Communities* audit measures been installed or adopted by customer? (Ask 6 months after audit.)

#	Baseline	W	Emerging Communities Measure	W	Qty.	kW.	Ex ante hours	EM&V	kWh	Install	Cust
1	60/75 W Incandescent	60	CFL - 13W	13			4,685				
2	100W Incandescent	100	CFL - 23W	23			4,685				
3	150W Incandescent	150	CFL - 28W	28			4,685				
4	Incandescent Exit	40	LED Exit sign	6			8,760				
5	2 ft. 1-lamp T12 Magnetic	28	2 ft, 1-lamp T8 Elec. Ballast	15			4,685				
6	3 ft. 1-lamp T12 Magnetic	42	3 ft, 1-lamp T8 Elec. Ballast	27			4,685				
7	4 ft. 1-lamp T12 Magnetic	43	4 ft, 1-lamp T8 Elec. Ballast	27			4,685				
8	4 ft. 2-lamp T12 Magnetic	72	4 ft, 2-lamp T8 Elec. Ballast	52			4,685				
9	4 ft. 3-lamp T12 Magnetic	115	4 ft, 3-lamp T8 Elec. Ballast	76			4,685				
10	4 ft. 4-lamp T12 Magnetic	144	4 ft, 4-lamp T8 Elec. Ballast	102			4,685				
11	4 ft. 4-lamp T12 Magnetic	144	4 ft, 3-lamp T8 Elec. Ballast	76			4,685				
12	4 ft. 4-lamp T12 Magnetic	144	4 ft, 2-lamp T8 Elec. Ballast	65			4,685				
13	4 ft. 3-lamp T12 Magnetic	115	4 ft, 2-lamp T8 Elec. Ballast	65			4,685				
14	8 ft. 1-lamp F96 T12 Mag.	75	4 ft, 2-lamp T8 Elec. Ballast	52			4,685				
15	8 ft. 2-lamp F96 T12 Mag.	128	4 ft, 4-lamp T8 Elec. Ballast	102			4,685				
16	8 ft. 1-lamp F96 T12 Mag.	75	8 ft, 1-lamp T8 Elec. Ballast	58			4,685				
17	8 ft. 2-lamp F96 T12 Mag.	128	8 ft, 2-lamp T8 SLO Elec Ball.	109			4,685				
18	F40 2-lamp U-tube	72	F31/32 U-tube, 2-L T8 Elec.	59			4,685				
19	8 ft. 2-lamp F96 T12 Mag.	128	8 ft, 2-lamp T8 RLO Elec Ball.	98			4,685				
20	Manual Thermostat		Install Programmable Tstat								
21	Setback Prog Tstat 1-stage		Prog. Thermostat (1-Stage)								
22	Setback Prog Tstat 2-stage		Prog. Thermostat (2-Stage)								
23	Standard Window Coastal		Reflective Window Coastal								
24	Standard Window Inland		Reflective Window Inland								
25	Standard Window Desert		Reflective Window Desert								
26	Un-tuned HVAC (1)		HVAC Diagnostic Tune-up (1)				2,157				
27	Un-tuned HVAC (2)		HVAC Diagnostic Tune-up (2)				2,157				
28	Un-tuned HVAC (3)		HVAC Diagnostic Tune-up (3)				2,157				
29	Dirty AC Condenser Coil		Chemical Clean Cond. Coil				2,157				
30	Open Display Refrigeration		Strip Curtain								

36. Please provide your HVAC thermostat settings? **Tstat Reading:___ EM&V Check: _____**

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Old Cool																								
New Cool																								
Old Heat																								
New Heat																								

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Old Cool																								
New Cool																								
Old Heat																								
New Heat																								

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Old Cool																								
New Cool																								
Old Heat																								
New Heat																								

	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11
Old Cool																								
New Cool																								
Old Heat																								
New Heat																								

37. Ask permission from business owner for access to roof to obtain space cooling equipment information.
    Split-System Package HP Swampcooler Make: _____ Model:_____SN:_____
    Tons: ____ Capacity (kBtuh):_____ SEER:_____ TXV or Condition: Pass Fail Age:_____ Factory Charge: _____
    PRE Airflow: Ret. Wet Bulb_____ Ret Dry Bulb_____ Sup Dry Bulb_____ Delta-TS:_____
    POST Airflow: Ret. Wet Bulb_____ Ret Dry Bulb_____ Sup Dry Bulb_____ Delta-TS:_____
    PRE SH: Ret Wet Bulb_____ OAT_____ Suc Psi_____ Suc Temp _____ Delta-SH:_____ Refrig +/-: _____
    POST SH: Ret Wet Bulb_____ OAT_____ Suc Psi_____ Suc Temp _____ Delta-SH:_____
    PRE SC: Req. SC_____ Liq Temp _____ Liq Psi_____ Delta-SC: _____ Refrig +/-: _____
    POST SC: Req. SC_____ Liq Temp _____ Liq Psi_____ Delta-SC: _____
    New Filter Clean Filter Open Vents Increase Fan Speed Tighten Schrader Valves
    Chemical Clean Condenser Coil

EMERGING COMMUNITIES NON-PARTICIPANT SURVEY #_____

Business _____ Name _____ Title _____

Address _____ City _____ ZIP _____

Phone Number _____ Survey Date _____ Surveyor Initials _____

Non-Participant Survey

I am conducting a survey regarding the *Emerging Communities Energy Efficiency* Program managed by FCI, Inc. The program was funded by ratepayers under the auspices of the California Public Utilities Commission in 2004 and 2005. You didn't participate in the program, but your feedback will help us evaluate and improve the program. The program provided a comprehensive audit and installed a no-cost package of energy efficiency measures such as: 1) screw-in compact fluorescent lamps; 2) hardwired T-8/electronic ballasted fluorescent fixture replacement 3) air conditioning tune-ups; and provided rebates for window film and occupancy sensors. Would you mind spending 5 minutes to answer a few questions?

1. Would you have participated if you knew the program installed no-cost/low-cost energy efficiency improvements measures in businesses like yours?

   ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

2. Please tell me why you chose not to participate in the program?
   (Read list – Multiple answers are okay.)

   1 Didn't know about the program (i.e., information cost).

   2 Didn't understand energy savings benefits of the program (i.e., performance uncertainty).

   3 Don't own the building (i.e., renter–misplaced or split incentive).

   4 Unable to be available for crew to perform work (i.e., hassle cost).

   Would you have participated if someone else you know (i.e., an employee) could have been present at your business while the FCI crew did their work?

   ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

   5 Would you have participated if the program provided services at other times?

   ___ Evenings ___ Saturdays ___Sundays **98** Don't Know **99** Refused to Answer

   6 Was unhappy with a similar program. Name of program:_____

   7 Other _____

   98 Don't Know **99** Refused to Answer

3. Please provide the following demographic information?

   _____Language ____# Employees Own Lease _____ Floor Area **99** Refused

4. Do you have any suggestions that might have helped you participate in the program?

   ___ **1** (Yes) ___ **2** (No) **98** Don't Know **99** Refused to Answer

If so, please provide the suggestion(s).____