EVALUATION, VERIFICATION, AND MEASUREMENT STUDY

FY 2007/2008 PROGRAM

For the City of Palo Alto

February 19, 2009

SUMMIT BLUE
CONSULTING, LLC

Submitted to: City of Palo Alto

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EXECUTIVE SUMMARY

The City of Palo Alto has a number of energy efficiency and renewable energy programs offered through its utility department (CPAU). This report describes the results of an Evaluation, Measurement, and Verification (EM&V) study for CPAU's energy efficiency incentive programs. The programs and measures covered by the EM&V effort include:

- Residential Smart Energy
    - Refrigerator/freezer recycling
    - CFLs
- Commercial Sector Right Lights
    - CFLs
    - T8 fixtures
    - LED exit signs
    - Refrigeration controls and gaskets
- Commercial Advantage
    - T8 fixtures
    - High intensity discharge lamps
    - Occupancy sensors
    - CFLs
    - Variable frequency drives

Background

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 requires that the Publicly Owned Utilities (POUs), similar to the Investor Owned Utilities (IOUs), place cost effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the loading order. They must now procure 'negawatts' first. Additionally, SB1037 (signed September 29, 2005) requires an annual report that describes the programs, expenditures, expected energy savings, and actual energy savings.

Assembly Bill 2021, signed by the Governor a year later (September 29, 2006), reiterated the loading order and annual report stated in SB1037 as well as expanded on the annual report requirements. The expanded report must include investment funding, cost-effectiveness methodologies, and an independent

evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and established annual targets for energy efficiency and demand reduction over 10 years. The legislative reports require both an on-going assessment of what is occurring within the programs along with a comparison of how much possible savings are left within the POU service territory.

Objectives

The goals of the EM&V effort at CPAU are to provide unbiased, objective and independent program evaluations by giving:

- Useful recommendations and feedback to improve CPAU programs.
- Assessment of conservation program effectiveness.
- Assessment of the quality of the program data for impact evaluation purposes.
- Increased level of confidence in conservation program results through transparent protocols.

Through this study, the first goal was met through a process evaluation that included a review of the CPAU program offerings and the fielding of a residential customer survey. The latter three goals were met through impact evaluation of selected CPAU programs and the use of the CPAU databases to assist in the evaluation effort. The EM&V efforts reviewed the program impacts from 7/1/07 through 6/30/08 (FY 2007/08) but because of the recent significant changes to the CPAU programs, the process evaluation focused on the current program offerings.

Process Evaluation

The process evaluation efforts included the following activities:

1. Review of the Energy Smart Program on-line application form
2. Review of the materials available through the CPAU website for its Commercial Advantage Program
3. Review the 2006 utility rebate program on-line survey results
4. Review of the measures included in the portfolio and recommend appropriate program modifications
5. Conduct residential program participant and non-participant customer surveys

Impact Evaluation

Impact evaluations were performed for two measures (refrigerator/freezer recycling and CFLs) in the residential Smart Energy program and two non-residential programs. Sample sizes were determined based on a 90% +/- 10% confidence interval. For measures with reported savings based on deemed energy savings, Summit Blue chose the IPMVP M&V Option A. For the variable frequency drive custom measure, Summit Blue chose Option B, which included metered data for the M&V process.

Residential Refrigerator/Freezer Recycling

CPAU implements its refrigerator/freezer program through both its low income program and directly with JACO Environmental. There are deemed energy savings for these appliances and the primary purpose of this evaluation is to both verify that the proper deemed savings values were used and verify through records review that the measures were disposed. The secondary purpose of the evaluation is to identify the average characteristics of the refrigerators/freezers being recycled to see if the characteristics differ significantly from the characteristics used to develop the deemed energy savings. The newly released DEER database will also be reviewed to see if the deemed savings currently used should be adjusted.

The CPAU tracking database identifies 283 participants in FY 2007/08 for this measure. The JACO maintained detailed program information database includes 224 of the 283 participants. The entire JACO database was reviewed for the evaluation. Originally, only a sample of about 67 participants were going to have their data reviewed in order to meet the 90% +/- 10% confidence interval statistical guideline. However, it was incrementally not much more effort to review the entire dataset and the results provide higher statistical confidence.

Residential CFLs

There were 3,908 participants receiving 19,631 CFLs in FY 2007/08. Most of these participants received five CFLs each. Deemed savings are used for this measure and the primary objectives of the evaluation were first to verify that the CFLs were installed and still being used and second that the proper deemed energy savings values were used.

Verification was performed through telephone surveys of the program participants. These verification survey questions were part of the process evaluation survey of 100 CPAU program participants. About ½ of these participants received CFLs, which provides results of statistical confidence of about 90% +/- 10%.

Commercial Advantage Program

There were 14 unique participating sites in the FY 2007/2008 Commercial Advantage Program. Two were identified as custom measure projects and the remaining a mix of lighting, HVAC, hot water, and Motors/VSDs. Nearly one-half of the electricity savings came from the two custom measure sites. Both of these sites were selected for impact evaluation. The four lighting projects represented almost 40% of the electricity savings. All four of these sites were selected for impact evaluation. Overall, 87% of the claimed electricity savings under the program come from the six sites selected for impact evaluation. The high percentage of savings evaluated insured evaluation results that exceed the 90% +/- 10% confidence interval statistical guideline.

Right Lights Measures

Nearly 85% of the savings from the Right Lights Plus Program come from lighting measures installed beyond the minimum QSP package. The impact evaluation for this program primarily focused on this set of measures. The QSP portion of the program includes a standard set of measures that have deemed savings and since this portion of the program only provides 3% of the savings, the Summit Blue team did not evaluate this portion of the program. However, the Summit Blue team did evaluate the non-lighting portions of the program. These non-lighting measures are refrigeration measures and they are seen as growing in importance in the future. There are only six sites where non-lighting measures were installed. Three of those sites, representing over 60% of the savings from non-lighting measures, were installed at sites that also installed lighting measures beyond the QSP package minimum. These three sites were certainty-selected sites when the sample was drawn.

A review of engineering assumptions following IPMVP M&V Option A was employed for the evaluation. There were 66 unique sites in the program of which 34 installed lighting beyond the QSP package. The Summit Blue team drew a sample of sufficient size to achieve results with a confidence level of 90 percent with a confidence interval of +/- 10%. To meet the statistical confidence required a sample draw of 23 participants. The three participants that also implemented non-lighting measures were included in the sample. Measure verification was through the on-site visits.

Key Findings and Recommendations

The overall conclusion is that Palo Alto has very well run residential and commercial DSM programs, and the program offerings to its customers is extensive and comprehensive. The new program changes and enhancements are especially noteworthy.

The customer survey found very high satisfaction levels for the Smart Energy program and they also felt that the rebate levels were good. Free ridership was found to be low, with the possible exception of screw-in CFLs. It is one of our recommendations that CPAU consider dropping screw-in CFLs from their incentive offerings.

The impact evaluation efforts for the residential sector confirmed the claimed levels of energy savings reported by CPAU for these programs. The impact evaluations for the non-residential programs were very good. However, the process of performing the evaluation pointed out some issues that CPAU should be aware.

The most important is the issue of building client turnover with the potential result of remodeling and the loss of the energy efficiency improvements. This occurred at one site. In addition, changeover of site occupants can mean different operation schedules and conditions that can affect energy use and savings significantly. With the changing economic conditions, this could be a major issue.

The refrigerator gaskets appear to be an effective addition to the Right Lights program. However, installed CFLs were found to be no longer in use for a variety of reasons. Here, we recommend that screw-in CFLs be dropped from the Right Lights program with the only CFL option being CFL fixtures.

Another issue found at one site in particular was the purchase by the participant of many more lighting lamps and fixtures than for what they received a rebate. The lighting lamps and fixtures were all on the same invoice, but only a portion claimed under the program because of the funding cap. In the particular case of this participant, the measures were all being installed as a result of participating in the program. Summit Blue recommends that CPAU claim savings for all installations.

Summary of Program Level Measure Realization Rates

Two residential measures within the Smart Energy program and two non-residential programs were assessed within this evaluation effort. Overall, measure realization was found to be high with a sum total realization rate of 114.9%. Table EX-1 summarizes the measure realization rates estimated through this evaluation.

Table EX-1: Measure Realization Rates by Program for CPAU

Program	Savings Claimed (kWh)	Savings Verified (kWh)	Measure Realization Rate
Residential Refrigerator/Freezer Recycling	550,718	545,242	99%
Residential CFLs	765,609	765,609	100%
Commercial Right Lights	338,876	297,790	87.9%
Commercial Custom	1,819,460	2,382,031	130.9%
TOTAL EVALUATED	3,474,663	3,990,672	114.9%

The non-REAP natural gas measure evaluation effort has not been completed by the time of this report. The results of that evaluation will be provided in a later document.

1 INTRODUCTION

The City of Palo Alto has a number of energy efficiency and renewable energy programs offered through its utility department (CPAU). This report describes the results of an Evaluation, Measurement, and Verification (EM&V) study for CPAU's energy efficiency incentive programs. The programs and measures covered by the EM&V effort include:

- Residential Smart Energy
    - Refrigerator/freezer recycling
    - CFLs
- Commercial Sector Right Lights
    - CFLs
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    - LED exit signs
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    - High intensity discharge lamps
    - Occupancy sensors
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1.1 Background

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 requires that the Publicly Owned Utilities (POUs), similar to the Investor Owned Utilities (IOUs), place cost effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the loading order. They must now procure 'negawatts' first. Additionally, SB1037 (signed September 29, 2005) requires an annual report that describes the programs, expenditures, expected energy savings, and actual energy savings.

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expanded report must include investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and established annual targets for energy efficiency and demand reduction over 10 years. The legislative reports require both an on-going assessment of what is occurring within the programs along with a comparison of how much possible savings are left within the POU service territory.

1.2 Objectives

The goals of the EM&V effort at CPAU are to provide unbiased, objective and independent program evaluations by giving:

- Useful recommendations and feedback to improve CPAU programs.
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2 PROCESS EVALUATION PLAN

Initial process evaluation work was completed early in the project with results provided in the Task 2 Working Paper submitted on September 29, 2008. Some of this information is provided again in this report. The process evaluation efforts, including what has already been accomplished, are:

1. Review of the Energy Smart Program on-line application form.

2. Review of the materials available through the CPAU website for its Commercial Advantage Program.

3. Review of the measures included in the portfolio and recommend appropriate program modifications.

4. Conduct residential program participant and non-participant customer surveys.

2.1 Review of Energy Smart Program Application Form and Commercial Advantage Program Information

Both of these programs have been modified significantly since last fiscal year. Summit Blue conducted a review and provided an assessment of the application form and materials presented on the CPAU website.

2.2 Review of Energy Smart Measures

Another essential part of this process evaluation is to review the current measures included in this program. Given the comprehensiveness of the measures rebated in this program, it is important to determine if these remain the most appropriate measures for rebates. It is also important to determine more fully the role in which residential lighting measures, especially CFLs, play in this program. For CFLs, this is especially important given the passage of the 2007 Energy Bill. This federal legislation requires that certain lighting applications (primarily those associated with common residential and commercial incandescent lamps) must have improved energy efficiency of at least 30% starting in 2012. Either the current incandescent lamp technology must improve efficiency by 30% or CFLs and other fluorescent lamps become the standard lighting application.

This review will also provide CPAU with updated ENERGY STAR specifications for these measures, and recommendations for changes to the measure mix based on cost-effectiveness and market conditions.

2.3 Conduct Customer Surveys

A customer survey of participants and non-participants was conducted to assess current saturation levels of key energy efficient appliance stocks such as Energy Star refrigerators, freezers, clothes washers, and

dishwashers, as well as CFL lighting saturation levels and retention rates. Questions were asked regarding potential free ridership and spillover.

Included in the customer survey were 100 participants and 100 non-participating residential customers. These surveys addressed the following issues:

1. Customer satisfaction with the programs and CPAU;
2. Purchase information on appliances such as clothes washers, dishwashers, refrigerators, and freezers along with Energy Star central and room A/C units;
3. Purchase information on residential pool and type of pool pump (single speed vs. multi-speed);
4. Purchase information on CFL lighting;
5. Likely free ridership rates for each targeted measure;
6. Additional measures to consider in upcoming program years, and;
7. Areas for program improvement.

This customer survey could be integral in guiding decisions to refine the current program offerings and to offer new types of programs in 2009 and 2010.

The program participating customer sample was drawn randomly from CPAU's program tracking database. The non-participating sample was drawn from CPAU's current residential customer database less the customers identified as program participants in the program tracking database.

3 IMPACT EVALUATION PLAN

A useful construct for thinking about the range of efficiency measures offered by the CPAU is the International Performance Measurement and Verification Protocol (IPMVP). Table 3-1 presents a listing of the IPMVP protocols, the nature of the performance characteristics of the measures to which M&V options typically apply, and an overview of the data requirements to support each option. Our approach to selecting M&V strategies followed these guidelines.

Table 3-1: Overview of M&V Options

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations based on spot or short-term measurements, and/or historical data. Deemed energy savings fall in this Option.	Constant performance	• Verified installation • Nameplate or stipulated performance parameters • Spot measurements • Run-time hour measurements
Option B: Engineering calculations using metered data.	Constant or variable performance	• Verified installation • Nameplate or stipulated performance parameters • End-use metered data
Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multi-variate regression analysis.	Variable performance	• Verified installation • Utility metered or end-use metered data • Engineering estimate of savings input to SAE model
Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering	Variable performance	• Verified installation • Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models • Utility billing records, end-use metering, or other indices to calibrate models

Many of the energy saving estimates used by CPAU in its planning and reporting are deemed saving values developed for all of the Northern California Power Authority (NCPA) members and included in the E3 benefit/cost calculator used for reporting to the California Energy Commission (CEC). For measures that utilized deemed energy savings estimates, Option A was used. For these measures, the deemed saving estimates were reviewed to insure correct values were used.

The more complex measures, especially those installed under the commercial advantage program, needed to employ a form of Option "B". In one instance, short term metering was utilized and engineering calculations used the results of the metering.

3.1 Residential Energy Smart Program

The CPAU Smart Energy Program is a comprehensive energy efficiency incentive program directed towards the residential sector. All qualifying measures must be purchased by current residential account holders and are valid only on new/undamaged efficiency measures, purchased at retail price, and installed

in a residence within the CPAU service territory. Measures include both electric and natural gas measures. Among the measures are:

- Refrigerators;
- Dishwashers;
- Washing Machines;
- Gas Furnaces;
- Gas Boilers;
- Air conditioners;
- Water heaters (both standard tank and tankless);
- Pool pumps, and;
- Insulation for attic, roof and/or walls.

In addition to these purchased measures, the program also includes a refrigerator/freezer recycling element. To participate, a CPAU customer contacts the CPAU recycling contractor, JACO Environmental, to arrange a pickup. The refrigerator/freezer must be in working order to receive the rebate.

3.1.1 FY 2007/08 Energy Impacts

Table 3-2 provides a summary of both the electric and gas energy savings from the Residential Smart Energy Program for FY 2007/08. These values were derived from CPAU's program participant tracking database.

For electricity, nearly one-half of the savings (47%) comes from CFLs. The appliances measure group provides the next largest share at 37%. For natural gas, insulation measures provide the largest share at 51% followed by the low income REAP efforts at 27%. Water heater measures (21% share) also provide significant levels of natural gas energy savings.

Table 3-2: Energy Savings and Percent Share of Electric and Gas Energy Savings by Measure Group for FY 2007/08 Residential Smart Energy Program

Measure Group	Savings - Gas (Therms)	% of Total Gas Savings	Savings - Electricity (kWh)	% of Total Electric Savings
Additional Measures	0	0%	70,608	4%
Appliances	1,476.00	7%	609,626	37%
CFL Bulbs	0	0%	765,609	47%
Heating & Air Conditioning	63	0%	14,154	1%
Insulation	10,250	51%	23,311	1%
Water Heaters	3,097	15%	0	0%
Pool Equipment	0	0%	4,200	0%
REAP	5,392	27%	144,233	9%
TOTAL	**20,278**		**1,631,741**	

Table 3-3 provides detail into the types of measures included within each measure group and the level of energy savings coming from each.

From Table 3-2, it is seen that a significant share of the electricity savings (37%) comes from the appliances measure group. Within this group, the refrigerator/freezer recycling measure accounts for over 90% of it. Within the measures that save natural gas, the biggest contributors to energy savings are:

- Attic Insulation – 18%
- Tankless water heaters – 13%
- Wall Insulation – 12%
- Flat Roof Insulation – 9%
- Boilers – 7%
- Gas Furnaces – 5%

Table 3-3: Smart Energy Program FY2008 Measure Detail Information

Measure	Measure Group	Number of Units	Number of Applicants	Savings Electricity (kWh)	Savings Gas (Therms)
LED Holiday Lights	Additional	2,942	654	70,608	0
Dishwasher	Appliance	369	369	16,236	1,476
Refridgerator Recycling	Appliance	283	269	550,718	0
Refrigerator	Appliance	508	508	42,672	0
CFL Bulb	CFLs	19,631	3,908	765,609	0
Boiler	HVAC	8	8	0	1,600
Gas Furnace	HVAC	66	66	0	1,139
Gas Water Heater	Gas	21	21	0	197
Cent/AC SEER 14	Water	11	11	3,729	0
Cent/AC SEER 15	HVAC	25	25	10,425	0
Programmable Thermostat	HVAC	1	1	0	63
Attic Insulation R-30	Insulation	31	31	11,697	4,162
Attic Insulation R-38	Insulation	9	9	3,454	1,240
Flat Roof Insultation - R19	Insulation	21	21	3,570	2,121
Wall Insulation	Insulation	27	27	4,590	2,727
Pool Pump	Pool	3	3	4,200	0
REAP - Attic Access Install	REAP	5	5	0	0
REAP - Attic Access Weatherstripping	REAP	34	33	65	34
REAP - Attic Insulation	REAP	4,081	15	1,143	612
REAP - Caulking SFR Windows etc	REAP	101	101	192	101
REAP - CFL Replacement	REAP	780	95	54,600	0
REAP - Door Weather-Stripping	REAP	183	100	549	732
REAP - Duct Test & Seal	REAP	22	17	2,750	528
REAP - Education	REAP	37	37	0	0
REAP - Faucet Aerator	REAP	52	23	0	156
REAP - Furnace Replacement	REAP	9	9	0	945
REAP - Hardwire Interior Lights	REAP	152	48	17,024	0
REAP - Hardwire Porch Light	REAP	306	61	66,708	0
REAP - Hourly Rate Add. Wk.	REAP	14	12	0	0
REAP - Low Flow Showerhead	REAP	40	28	0	280
REAP - NGAT testingt	REAP	27	27	0	0
REAP - Outlet Gaskets	REAP	1,935	100	194	194
REAP - Programmable Thermostat	REAP	10	10	0	760
REAP - Refrigerator Replacement	REAP	12	12	1,008	0
REAP - Repairs Minor Wall	REAP	103	95	0	0
REAP - Water Heater Blanket	REAP	14	14	0	1,050
Tankless Water Heater	Water	25	25	0	2,900
Total				1,631,741	23,017

3.1.2 Impact Evaluation Plan

On a BTU basis, energy savings from electricity measures are about 2.7 times greater than savings from natural gas measures. Based on the information provided in Tables 3-2 and Table 3-3, the electricity energy savings come primarily (81%) from two measures; refrigerator/freezer recycling and CFLs. Natural gas savings are distributed among a number of different measures with five different measures providing significant levels of savings ranging from 5% to 18% of total natural gas savings.

Based on these facts, impact evaluations were performed for the following measures or groups of measures (the non-REAP natural gas measure evaluation results will be provided in a later document).

- Refrigerator/freezer recycling
- CFLs
- The non-REAP natural gas measures as a group

Refrigerator/Freezer Recycling

CPAU implements its refrigerator/freezer program through both its low income program and directly with JACO Environmental. There are deemed energy savings for these appliances and the primary purpose of this evaluation is to both verify that the proper deemed savings values were used and verify through records review that the measures were disposed. The secondary purpose of the evaluation is to identify the average characteristics of the refrigerators/freezers being recycled to see if the characteristics differ significantly from the characteristics used to develop the deemed energy savings. The newly released DEER database will also be reviewed to see if the deemed savings currently used should be adjusted.

The CPAU tracking database identifies 283 participants in FY 2007/08 for this measure. The JACO maintained detailed program information database includes 224 of the 283 participants. The entire JACO database was reviewed for the evaluation. Originally, only a sample of about 67 participants were going to have their data reviewed in order to meet the 90% +/- 10% confidence interval statistical guideline. However, it was incrementally not much more effort to review the entire dataset and the results provide higher statistical confidence.

CFLs

As identified in Table 3-2, there were over 3,900 participants receiving over 19,600 CFLs in FY 2007/08. Most of these participants received five CFLs each. Deemed savings are used for this measure and the primary objective of the evaluation is to verify receipt and installation of the CFLs. A secondary purpose of the evaluation is to identify the specific wattage of CFLs purchased. The entire CPAU tracking database was reviewed for CFL information.

Verification was performed through telephone surveys of the program participants. These verification survey questions were part of the process evaluation survey of 100 CPAU program participants. About ½ of these participants received CFLs, which provides results of statistical confidence of about 90% +/- 10%.

Natural Gas Measures

The distribution of natural gas savings is among many different measures with most of the measures being weather sensitive. The exceptions are the two water-heating measures. Deemed savings exist for many of the measures, but housing characteristics and vintages vary significantly and can have significant impacts on energy savings. Therefore, the Summit Blue team will perform a multi-variate regression statistically adjusted engineering (SAE) model that uses pre and post program participation billing data along with a number of other potential explanatory variables would be used. Among these other variables would be the *ex ante* estimates for the specific measures installed as well as weather data.

All of the non-REAP program participants would be in the universe of participants for the sample draw. To meet the statistical confidence of 90% +/- 10% will require a sample draw of 49 participants. However, billing analyses have much more success with as many participants in the analysis dataset as

possible and the extra cost for having the larger sample size is minimal. Therefore, Summit Blue will work with CPAU to obtain billing data for as many participants as possible.

Verification will be performed through telephone surveys of the program participants. These verification survey questions will be part of the process evaluation survey discussed earlier.

3.2 Commercial Advantage Program

The Commercial Advantage Program is a comprehensive non-residential program that in FY2007/08, provided incentives for the following measures:

- Commercial Clothes Washer
- Centrifugal Water Cooled Chiller
- Ceiling Insulation
- Unitary System A/C
- VFD on HVAC Fan
- Window Film
- CFLs
- LED or Electroluminescent Exit Signs
- Occupancy Sensor
- T8 Lamps
- Energy Efficient Motors

Beginning in FY2009, CPAU significantly expanded the portfolio of measures offered and funds available for rebates for the Commercial Advantage Program. The new program offerings are patterned after the comprehensive set of measures provided through PG&E's non-residential incentive program. Under the new program design, rebates can be paid to either the customer or the contractor. There are a variety of efficiency measures that qualify for a Commercial Advantage Program rebate. The categories are listed below:

- Lighting
- Boilers & Water Heating
- HVAC Equipment
- Chillers and Heat Rejection Equipment
- Food Service

- Refrigeration Equipment
- Custom Rebate Specifications
- Appliances and General

3.2.1 FY 2007/08 Energy Impacts

Table 3-4 provides a summary of both the electric and gas energy savings from the Commercial Advantage Program for FY 2007/08. These values were derived from CPAU's program participant tracking database. There were 14 unique program participants with one participant implementing measures from two separate measure groups (thus the total of 15 measure group participants).

For electricity, 49% comes from the two custom design program participants. The four participants from the lighting measure group provided the next largest share of electric energy savings at 38%. Motors and VSDs are a distant third at 13%. For natural gas, 81% of the energy savings comes from the two hot water measures. The three HVAC measures provide the remaining 19% of natural gas energy savings.

Table 3-4: Energy Savings and Percent Share of Electric and Gas Energy Savings by Measure Group for FY 2007/08 Commercial Advantage Program

Measure Group	Participants by Group	Savings - Gas (Therms)	% of Total Gas Savings	Savings - Electricity (kWh)	% of Total Electric Savings
Custom	2	0	0%	1,153,936	49%
Hot Water	2	1,493	81%	0	0%
HVAC	3	360	19%	45,667	2%
Lighting	4	0	0%	899,720	38%
Motors & VSDs	4	0	0%	310,059	13%
TOTAL	**15**	**1,853**		**2,366,262**	

Table 3-5 provides detail into the types of measures included within each measure group and the level of energy savings coming from each. Information on the number of participants for each measure is also provided.

Although there are only 14 unique participants for the Commercial Advantage Program, Table 3-4 shows that most participants implemented multiple measures. Outside of the measure, the greatest share of savings comes from hard-wired fluorescents > 27 watts (16%) and 4-foot premium T5s/T8s with electronic ballasts (13%).

Table 3-5: Commercial Advantage Program FY2008 Measure Detail Information

Measure	Measure Group	Number of Participants by Measure	Units per Installation	Units	Measure Fuel	Savings - Gas (Therms)	Savings - Electricity (kWh)
Custom	Custom	2	1,153,936	kWh	Electric	0	1,153,936
Heat Pump, Water Source < 11.2	HVAC	1	0	ton	Electric	0	0
Exit Sign New Exit Sign	Lighting	1	34	fixture	Electric	0	11,696
Hard-Wired Flourescent > 27 watts	Lighting	1	554	fixture	Electric	0	368,410
Hard-Wired Flourescent 5-26 watts	Lighting	1	154	fixture	Electric	0	43,120
Int. HID 0-35 watts	Lighting	1	81	fixture	Electric	0	20,817
Int. HID 36-70 watts	Lighting	1	24	fixture	Electric	0	12,360
Occupancy Sensor Wall or ceiling-mount lighting	Lighting	2	34	sensor	Electric	0	26,350
Occupancy Sensor Wall-box lighting sensor	Lighting	2	117	sensor	Electric	0	30,537
Pre.T5 or T8 w/ Elect. Ballast 4 ft.	Lighting	3	5,532	lamp	Electric	0	309,792
Reflec. w/Lamp Removal 4 ft.	Lighting	1	482	lamp removed	Electric	0	76,638
Motor 1 hp	Motor	1	1	motor	Electric	0	112
Motor 100	Motor	1	6	motor	Electric	0	91,476
Motor 5 hp	Motor	1	1	motor	Electric	0	336
Motor 50 hp	Motor	1	2	motor	Electric	0	19,876
Motor 60 hp	Motor	1	1	motor	Electric	0	10,009
Var. Freq. Drives Var. Freq. Drives	Motor	5	250	horsepower	Electric	0	188,250
Comm. Boiler Dom. Hot Water Heat (<300k Btuh, T1)	Hot Water	1	250	1k Btuh	Gas	17	0
Comm. Boiler Dom. Hot Water Heat (>=300k Btuh, T2)	Hot Water	1	1,500	1k Btuh	Gas	1,476	0
Comm. Boiler Hot Water Space Heat (>=300k Btuh, T2)	HVAC	1	500	1k Btuh	Gas	360	0
TOTAL		**29**				**1,853**	**2,366,262**

There were three natural gas measures installed. Each measure was a boiler; two for hot water and one for space heat. The hot water boiler greater than 300 Btuh provided 80% of the gas savings.

3.2.2 Impact Evaluation Plan

On a BTU basis, energy savings from electricity measures are over 40 times greater than savings from natural gas measures. Based on the information provided in Tables 3-3 and 3-4, the electricity energy savings come primarily (49%) from the two custom installations followed by hard-wired fluorescents > 27 watts (16%) and 4-foot premium T5s/T8s with electronic ballasts (13%) measures. Lighting measures in general provide 38% of the savings as a group. Motors and VSDs provide a smaller, but still significant, 13% of savings as a measure group.

Natural gas savings are minimal and are all provided by boiler applications. Because of their small share of overall savings, Summit Blue did not perform an impact evaluation for natural gas measures.

There are only six unique sites participating in this program. The diversity of the measures involved and the small number of sites required that all six sites be included in the impact evaluation in order to maintain results with statistical confidence of 90% +/- 10%.

Custom Measures

The Summit Blue team reviewed the two custom measure commercial energy audit reports. The two application forms consisted of one lighting application and one custom variable speed drive application. The custom lighting measure report was straightforward and did not raise any unusual evaluation issues. The second custom measure report was for the replacement of standard chemical fume hoods with variable speed units. This retrofit allows setbacks in the airflow through the fume hoods outside of

standard business hours. Although this is a fairly standard type of retrofit, the report did not include enough detail to verify the savings calculations. There was no explanation of the assumed operational hours or measurements provided with the calculations. The measured power consumption was based on current readings and did not appear to account for power factor. Therefore, in order to verify this installation's energy savings claim, additional data acquisition was required through short term metering.

For the lighting custom measures, the impact evaluation methodology consisted of on-site verification of measure installation and review of the engineering calculations made for each lighting measure installed.

Lighting Measures

As identified in Table 3-5, there were 13 different measure type participants receiving lighting measures in FY 2007/08. However, these 13 different measure applications only represent four different sites. The number of fixtures installed is significant with over 7,000 units installed. Almost 80% of these installed units were premium T5/T8s with electronic ballasts. Deemed savings are used for this measure and the primary objective of the evaluation is to verify receipt and installation of the measures and review of the engineering assumptions.

IPMVP M&V Option A, a review of engineering assumptions, was employed for the lighting evaluation. Since there were only four different sites participating in the lighting portion of this program in FY2008, all four sites were evaluated. Verification was performed through on-site visits to each location and included verifying installation and operation of the measures, as well as verifying hours of operation when possible.

3.3 The Right Lights Plus Program

The Right Lights Plus Program is a third party program designed for small commercial customers and primarily provides efficient lighting upgrades with minimum cost to the customer. In addition to lighting measures, some refrigeration and vending control measures are also implemented. Three types of measures are provided. The first are no cost lighting measures to the customer valued up to $250. This package of measures is known as the Quick-Saver Package (QSP). The second are more extensive lighting measures beyond the $250 QSP package. The third are the non-lighting refrigeration and vending machine control measures.

3.3.1 FY 2007/08 Energy Impacts

The Right Lights Plus Program tracking database for FY 2007/08, provided summary information by participant and by each of the three types of measures provided. Detailed measure information by customer is provided in individual customer agreements. For lighting, specific measures are identified and the measure savings are specific for each customer by the operating hours of each. The refrigeration and vending machine control measures appear to use a single deemed energy savings value, but no description of the measures appears within the customer agreements.

Table 3-6 provides the energy savings estimates by participant for each of the three types of measures provided. Overall, there were 66 unique participants. Four of the lighting participants also received non-lighting measures for a total of 70 different projects.

Nearly 85% of the savings for the Right Lights Plus Program come from the lighting measures beyond the basic QSP portion of the program. The QSP program element only accounts for about 3% of the program savings. The remaining balance comes from the non-lighting portion of the program. Even though the

QSP portion of the program only accounts for 3% of the energy savings, nearly one-half of the program participants are QSP participants.

Table 3-6: Right Lights Plus Program FY2008 Energy Savings by Participant

Property	Non-Lighting Savings (kWh)	QSP Savings (kWh)	Other Lighting Savings (kWh)	Total Savings (kWh)
A-1 Liquors	26,171			26,171
ABC Appliance		1,916		1,916
Accent Arts		252		252
American Red Cross		587		587
Aviation Supplies		80		80
Avis Car Rental		591		591
Betty Wright Swim Center			25,658	25,658
Black Diamond Sports			6,915	6,915
Blue and White Cleaners (High Street)		986		986
Cafe Pro Bono		332		332
California Shoe and Luggage Repair			4,616	4,616
Century Liquors			16,782	16,782
Charleston Cleaners		327		327
Children's Health Council		1,490		1,490
City of Palo Alto Animal Services			11,237	11,237
Congregation Kol Emeth-Phase 1			65,680	65,680
Creekside Inn	1,612			1,612
Dan Brown's			14,082	14,082
Diaz Market Stop		161		161
Domino's Pizza		405		405
Douce France			9,889	9,889
El Camino Animal Hospital		69		69
Ernie's Wines and Liquors	16,465	40		16,505
Fish Market			48,030	48,030
Fratelli Deli			21,853	21,853
Front of the Pack			14,036	14,036
Gordon Biersch	12,522		4,895	17,417
Happy Donuts			12,010	12,010
Hobee's Palo Alto			6,615	6,615
Hobee's Palo Alto Office			9,329	9,329
Hobee's Town & Country			26,502	26,502
Klutz		1,860		1,860
Kurt's and Dorn's Meters 1 & 2		138		138
Metro Sport		1,171		1,171
My Gym			6,404	6,404
Nature Gallery			5,941	5,941
Oreck Clean Home Center		282		282
Palo Alto Bicycles-Phase 1			31,117	31,117
Palo Alto Chamber of Commerce			7,844	7,844
Palo Alto German Car Corp.			3,698	3,698
Pizz'a Chicago	19,504	2,182	20,727	42,414
Polish Deli		164		164
Pommard's Cafe & Catering			20,893	20,893
Posh			5,111	5,111
Pure Cleaners			9,547	9,547
Roy's Cleaner		471		471
St. Thomas Aquinas Parish			19,007	19,007
Stanford Beauty Salon		602		602
Stanford Coin Wash			6,824	6,824
Stanford Driving School			8,192	8,192
Stanford Florists			22,046	22,046
Stanford Terrace Inn			40,960	40,960
State Farm			5,721	5,721
State Farm (Candice Kistner)			6,316	6,316
Stevens Printing Company		1,022		1,022
Studio Kicks		891		891
Subway (California Ave)		109		109
Supercuts		353		353
Telosa Software			6,844	6,844
United Nations Association			5,253	5,253
Victor Aviation		549		549
Wahoo's Fish Taco		474		474
West Coast Glass Company Inc.		964		964
Wilby Optical		276		276
Winter Lodge	1,999			1,999
World Centric		1,105		1,105
TOTAL	**78,273**	**19,851**	**530,572**	**628,696**
Percent of Total	**12.5%**	**3.2%**	**84.4%**	

3.3.2 Impact Evaluation

Nearly 85% of the savings from the Right Lights Plus Program come from lighting measures installed beyond the minimum QSP package. The impact evaluation for this program focused on this set of measures. The QSP portion of the program includes a standard set of measures that have deemed savings but since this portion of the program only provides 3% of the savings, the Summit Blue team did not evaluate this portion of the program. However, the Summit Blue team did evaluate the non-lighting portions of the program. As seen in Table 3-6, there are only six sites where non-lighting measures were installed. Three of those sites, representing over 60% of the savings from non-lighting measures, were installed at sites that also installed lighting measures beyond the QSP package minimum. These three sites were certainty-selected sites when the sample was drawn. The reason for including the non-lighting measures in the impact evaluation is that this portion of the program is expected to grow in importance.

Lighting Beyond the QSP Package and Non-Lighting Measures

The specific lighting and non-lighting measures installed at each site are not summarized in the CPAU database. However, the detail is available in each of the specific customer agreements. Reviews of these agreements indicates that standard lighting measures as well as refrigerator gaskets and vending machine controls are being installed and deemed savings, adjusted for actual hours of operation, are being used. Therefore, the primary objective of this evaluation is to verify receipt and installation of the measures.

A review of engineering assumptions following IPMVP M&V Option A was employed for the evaluation. There were 34 unique sites that installed lighting beyond the QSP package. The Summit Blue team drew a sample of sufficient size to achieve results with a confidence level of 90 percent with a confidence interval of +/- 10%. To meet the statistical confidence of 90% +/- 10% required a sample draw of 23 participants. The three participants that also implemented non-lighting measures were included in the sample. Measure verification was through the on-site visits.

4 PROCESS EVALUATION RESULTS

The process evaluation results provided in this section include:

1. Review of the Energy Smart Program on-line application form.

2. Review of the materials available through the CPAU website for its Commercial Advantage Program.

3. Review of the measures included in the portfolio and recommend appropriate program modifications.

4. Conduct residential program participant and non-participant customer surveys.

4.1 Residential Energy Smart Program – Online Application Form

The Residential Smart Energy Rebate Program online application form is easy to follow and captures the data needed to track program results and perform future EM&V studies. It also includes relevant evaluation questions regarding the reasons for selecting or replacing a measure that will help provide CPAU with important process information that could influence future program design. As long as only prescriptive measures are included in the program, this form should work well. A complication could arise if certain prescriptive measures, such as insulation or windows, are provided rebates on a per-square foot basis instead of on a per-home basis as currently designed. If this were to occur, then the form would need to be modified by adding another column so that quantity and rebate per unit could be provided.

Two additional questions could be added (the second is an expansion of one of the existing questions) to gather more process related information. However, these are not critical questions, though they would provide useful information that can be used in future program planning.

How did you hear about this program?

1. Utility Bill Insert
2. Newspaper
3. CPAU Website
4. Retailer
5. Other:_____

Why did you install the efficiency measure(s) for this rebate program? (allow multiple responses. This is an expansion of one of your current questions)

1. To lower energy consumption
2. To replace a unit no longer working
3. To replace an old, but still functioning unit
4. Part of a remodel project
5. Rebate dollars
6. Other:_____

An area that could be improved is with the database entry functionality. Currently, an application could be submitted with most information (besides the measure) missing. In addition, it is possible to enter a measure cost that is less than the incentive. Although the terms and conditions indicate that the incentive cannot be larger than the measure cost, it may be helpful if invalid entry checks were added to the database entry system. Such entry checks should also include having certain fields completed before moving onto the next data entry page and before being allowed to submit the application.

4.2 Commercial Advantage Program

The new Commercial Advantage Program offers a wide array of measures and is a significant expansion over the previous year's program offerings. Through the CPUA website, access is gained by clicking on the "Commercial Advantage Program" link. A good discussion of general information and guidelines about the program is given and links are provided to nine different catalogs of program measures. Each catalog identifies a number of different measures available. These nine catalogs include:

- Lighting
- Boilers and Water Heating
- HVAC Equipment
- Chillers and Heat Rejection Equipment
- Food Service
- Refrigeration Equipment
- Business Computing Equipment
- Custom Rebate Specifications
- Appliances and General

A link to Commercial Advantage application form is also provided on this webpage. However, it is easy to miss and it is suggested that it be highlighted by bold and or colored text to make it stand out. In addition, it does not appear that a link to the application form exists on any of the catalog pages. This may be a useful link to provide.

The application form itself provides good information on how to apply, program requirements, terms and conditions, and information that needs to be supplied by the applicant when sending in the form. The form is easy to follow and straightforward and should provide the necessary information needed for future EM&V activities. We also like the property information that is requested. This information can be used in future EM&V activities to see what building types are participating by size and ownership that should help in possible future program targeting. The information can also be used to see if the building type assumptions used to develop the deemed savings are similar to the participating stock.

Although some commercial and industrial efficiency measures, such as lighting retrofits, can be accurately estimated using deemed savings, other applications may require measured data to estimate or

verify savings. As an example, for many variable frequency drive applications, it can be difficult to estimate loading without supporting load measurements. Any application for measures requiring calculations, measurements, or data logging should include some information on the requirement and a section for calculations. Many applicants provide only calculations summaries if detailed instructions to the contrary are not included with the application. Full spreadsheets of data and calculations are necessary to accurately determine if the applicant has correctly calculated savings using reasonable assumptions where necessary.

For most commercial and industrial retrofits, work and purchase orders are required in order to verify installation. In addition to these items, the CPAU may wish to require on-site post-installation inspections for some measures, depending on their complexity.

Overall, the Summit Blue team found the website easy to use, the information provided on the program description webpage as well as the measure descriptions proved in each of the nine catalogs understandable and useful, and the application form easy to use and straightforward. The only recommendation is concerning the before mention links to the application form.

4.3 Review of Residential Program Measures

This review identified several areas for staff to consider regarding program modifications, especially for its residential programs. CPAU staff should consider making the following program modifications:

- CPAU should consider eliminating its rebates for screw-in CFLs.

- CPAU should consider increasing its energy efficiency requirements for refrigerators and dishwashers rebate beyond the minimum Energy Star guidelines. The reason for making these recommendations is based upon the widespread availability of products that meet the minimum Energy Star guideline. The program would be more effective to promote something like 10% above the Energy Star guideline.

- CPAU should consider adding a $25 rebate for ENERGY STAR Digital-to-Analog Converter Boxes.

  Beginning June 2009, the U.S. will shift to digital-only television broadcasts. As of this date, consumers with analog televisions, who do not subscribe to cable or satellite services and rely solely on over-the-air broadcasts for their TV-viewing will need a digital-to-analog converter box, or DTA, in order to continue receiving television broadcasts. The digital-to-analog (DTA) converter box is a device that converts digital television broadcast signals to analog signals. These boxes are currently being sold by a variety of retailers. These boxes are expected to cost between $40 and $70. The ENERGY STAR models consume no more than 8 watts in On Mode and 1 watt in Sleep Mode according to the Environmental Protection Agency (EPA). The product specifications are available on the following website: www.energystar.gov

- CPAU should consider providing a $25 rebate to encourage the purchase of ENERGY STAR television, DVDs, and related equipment.

  ENERGY STAR qualified TVs use about 30% less energy than standard units do. ENERGY STAR models are available on a range of TVs including standard TVs, to HD-ready TVs, and large flat-screen plasma TVs. The product criteria are provided in Appendix C.

4.4 Customer Surveys

The final portion of the process evaluation effort included conducting customer surveys with both program participants and non participants. This customer surveys will provide invaluable insight and guidance in program development and refinement for current CPAU programs. The customer surveys addressed the following key issues:

1. Customer satisfaction with the programs and CPAU;
2. Likely free ridership rates for each targeted measure;
3. Measure persistence including collecting information on the type and age of appliances and the saturation of Energy Star appliances and CFLs;
4. Additional measures to consider in upcoming program years, and;
5. Areas for program improvement.

Several questions in the customer survey allowed for multiple responses, therefore the responses will not add up to 100%. All multiple response questions are designated with an asterisk in the table's heading.

4.4.1 Methodology

The Summit Blue team contracted with Ward Research to complete a statistically valid number of customer surveys among both participating and non participating customers. Table 4-1 identifies the number of recommended and completed interviews.

Table 4-1: Number of Completed Customer Surveys- Recommend vs. Actual

Group	Recommended # of Completed Interviews	Actual # of Completed Interviews
Program Participants	100	103
Program Non-Participants	100	102
Total	200	205

Ward Research completed a total of 205 customer surveys of both program participants and non participants, which exceeded the survey requirements for a statistically valid customer survey at the 90%/10% level. The dataset of program participants was sorted to eliminate multiple participations (we wanted to insure that we did not call the same people twice) and eliminate those with missing phone numbers. The resulting participant universe was 1,659 participants. CPAU provided Summit Blue with a dataset of all residential customers. From this list, the participants were eliminated, which left a universe of 19,139 non-participants.

The participating customer sample was drawn randomly from CPAU's program tracking database. The participating customer sample was randomized to provide a sample that reflected overall participation rates based on equipment purchased.

The non-participating sample was based on the current residential customer database less the customers identified as program participants in the program tracking database. For the purposes of this survey, non-participants were defined as those customers who did not submit a rebate application. The customer samples were provided from CPAU.

4.4.2 Summary of Customer Surveys

This section summarizes the key findings from the participating and non participating customer surveys. Where appropriate, differences between and among the customer groups (i.e., participant vs. non participant) and demographic differences (such as income, household number, etc.) will be identified in these results.

Awareness

Both participating and non participating customers were asked about their overall awareness of CPAU's Smart Energy Program. They were asked to identify both the ways in which they first learned about the program, and then recall any other ways in which they may have heard about these programs. As the results in Table 4-2 show, not surprisingly, all the participants were aware of the program as well as 56% of the non-participants.

Table 4-2: Program Awareness Rates for Both Participants and Non Participants

Awareness of Program	Participants	% of Total	Non Participants	% of Total
Yes	103	100%	57	56%
No			42	41%
Don't Know			3	3%
Total	103		102	

The majority of both the participants (57%) and non participants (77%) first learned about this program from a utility mailing.

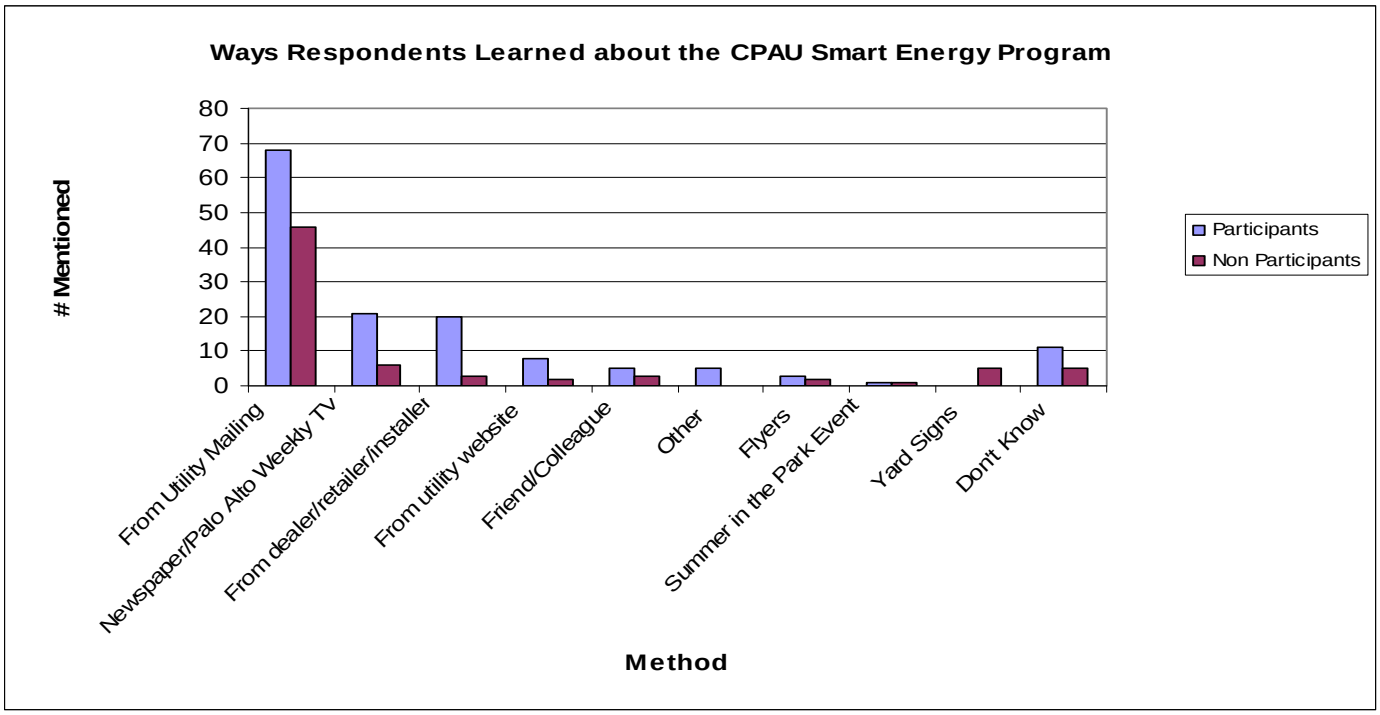
Table 4-3: How Respondents First Learned About the Program

How Respondents Learned of Program	Participants	% of Total	Non Participants	% of Total
From Utility Mailing	59	57%	44	77%
Newspaper/Palo Alto Weekly TV	13	13%	0	0%
From dealer/retailer/installer	9	9%	2	4%
From utility website	5	5%	0	0%
Friend/Colleague	1	1%	2	4%
Flyers	2	2%	1	2%

Yard Signs	0	0%	2	4%
Other	3	3%	1	2%
Don't Know	11	11%	5	9%
Total	103	100%	57	100%

The other program promotional methods were more often mentioned as an additional way that respondents learned about the program, rather than the first method (See Figure 4-1). These findings suggest that the utility mailings are the most effective way of reaching both participants and non participants, while the other methods, such as from the newspaper or weekly TV show, and from contractors/installers, further reinforce program awareness.

Figure 4-1: Ways Respondents Became Aware of the Program



Customer Participation

The customer surveys also identified the reasons that these respondents opted to participant or not participate in the CPAU Smart Energy programs. Environmental concerns (58%) and wanting to save energy (45%) were the most commonly mentioned reasons for participating in the program as Table 4-4 shows.

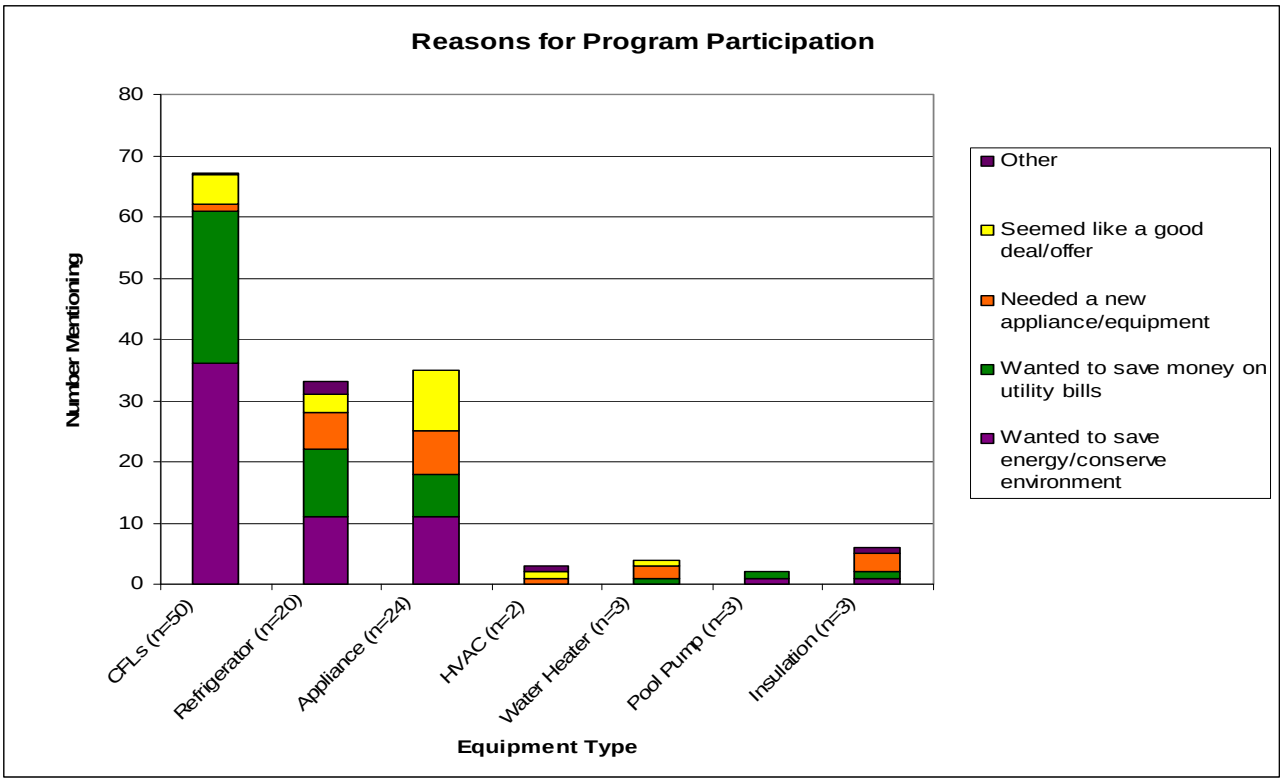
Table 4-4: Reasons for Participating in CPAU's Smart Energy Program*

Reason for participating	Participants	% of Total
Wanted to save energy/conserve environment	60	58%
Wanted to save money on utility bills	46	45%
Needed a new appliance/equipment	20	19%
Seemed like a good deal/offer	20	19%
Other	4	4%
Don't Know	2	2%
Total	103	

*Multiple response question

Figure 4-2 displays the reasons cited by the participants grouped by the qualifying equipment they purchased. As this figure shows, wanting to conserve energy was the most commonly mentioned reason among CFL purchasers while those participants who purchased new appliances (such as dishwashers, washing machines) and refrigerators were also more likely to also mention the need for replacing existing equipment.

Figure 4-2: Reasons for Program Participation



The non participants were also asked to indicate why they decided not to participate in the Smart Energy Program. As Table 4-5 shows, the biggest reasons mentioned by non participants included not buying qualifying equipment (16%) and not being aware of the program (9%). However, nearly one-quarter (23%) of these respondents could not answer this question.

Table 4-5: Reasons for Not Participating in CPAU's Smart Energy Program*

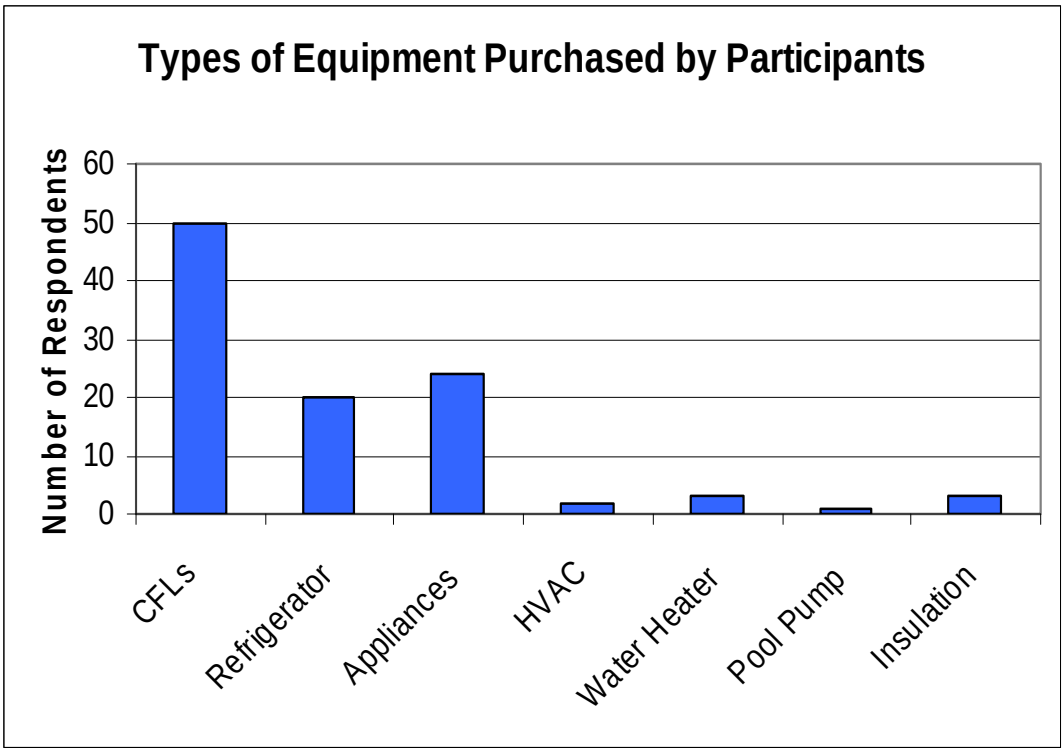
Reasons for Not Participating	Total	% of Total
Didn't buy qualifying equipment	16	16%
Wasn't aware of it	9	9%
Not interested/ don't believe in it	7	7%
Not enough time/not gotten around to it	7	7%
Not sure about the program	6	6%
I rent not buy appliances	6	6%
I don't have any money to buy appliances	4	4%
Didn't know about the program until after I purchased the equipment	3	3%
Didn't want to buy the more expensive model	2	2%
Other	11	11%
Don't know	23	23%
Total	102	100%

Equipment Purchased

This section summarizes the participant characteristics in terms of the types of qualifying equipment they purchased, the reason for making the purchase, and the age of the equipment they were replacing.

As Figure 4-3 shows, most of the participating customers in this survey purchased compact fluorescent lamps (CFLs). A smaller group of respondents purchased qualifying refrigerators, and energy efficient appliances (e.g. dishwashers and washing machines). There were only a few respondents in the survey who purchased either heating or cooling equipment such as natural gas furnaces, natural gas boilers, or air conditioners. Very few respondents purchased new water heaters, pool pumps, or insulation.

Figure 4-3: Types of Equipment Purchased by Program Participants



Measure Persistence

The survey respondents reported that all equipment purchased through this program was still in working order. This finding suggests that measure persistence for the program is very high

Table 4-6 shows that the nearly all the respondents (83%), across all equipment categories, purchased the new energy efficient equipment to replace existing equipment. Seventeen percent of the respondents were purchasing new equipment for a new home, and these were refrigerators (75%) and energy efficient appliances (25%).

Table 4-3: Reason for Equipment Purchase

Purchased for	Participants	% of Total	Refrigerator	Appliances	HVAC	Water Heater	Pool Pump	Insulation
New	8	17%	6	2	0	0	0	0
Replacement	39	83%	13	21	2	2	1	0
Total	47	100%	19	23	2	2	1	0

As Table 4-7 shows, the participants were upgrading significantly their older appliances and energy efficient equipment. The average age of the replaced equipment was 17.3 years.

Table 4-4: Average Age of Equipment that Was Replaced

Age of Replaced Equipment	Average	Refrigerator	Appliances	HVAC	Water Heater	Pool Pump	Insulation
Average Age of appliance replaced (years)	17.3	16.3	17.5	35	12	2.0	2.0

Free Ridership Findings

The program participants were also asked a series of questions designed to determine the likelihood of purchasing this type of energy efficient equipment without this program. As the following two tables indicate, overall free ridership rates for this program are fairly low, with only 13 respondents indicating they did have considering purchasing the qualifying equipment earlier. The majority (87%) did not consider making this purchase earlier (see Table 4-8).

Table 4-8: Did you Consider Purchasing This Equipment Earlier?

	Total	% of Total
Yes	13	13%
No	90	87%
Total	103	100%

To explore this response more fully, the respondents were also asked to indicate how likely they were to purchase this equipment without the rebate using a five point scale.

As Table 4-9 shows, 49 percent of the respondents said they were “Very Likely” to purchase this equipment on their own, without the program.

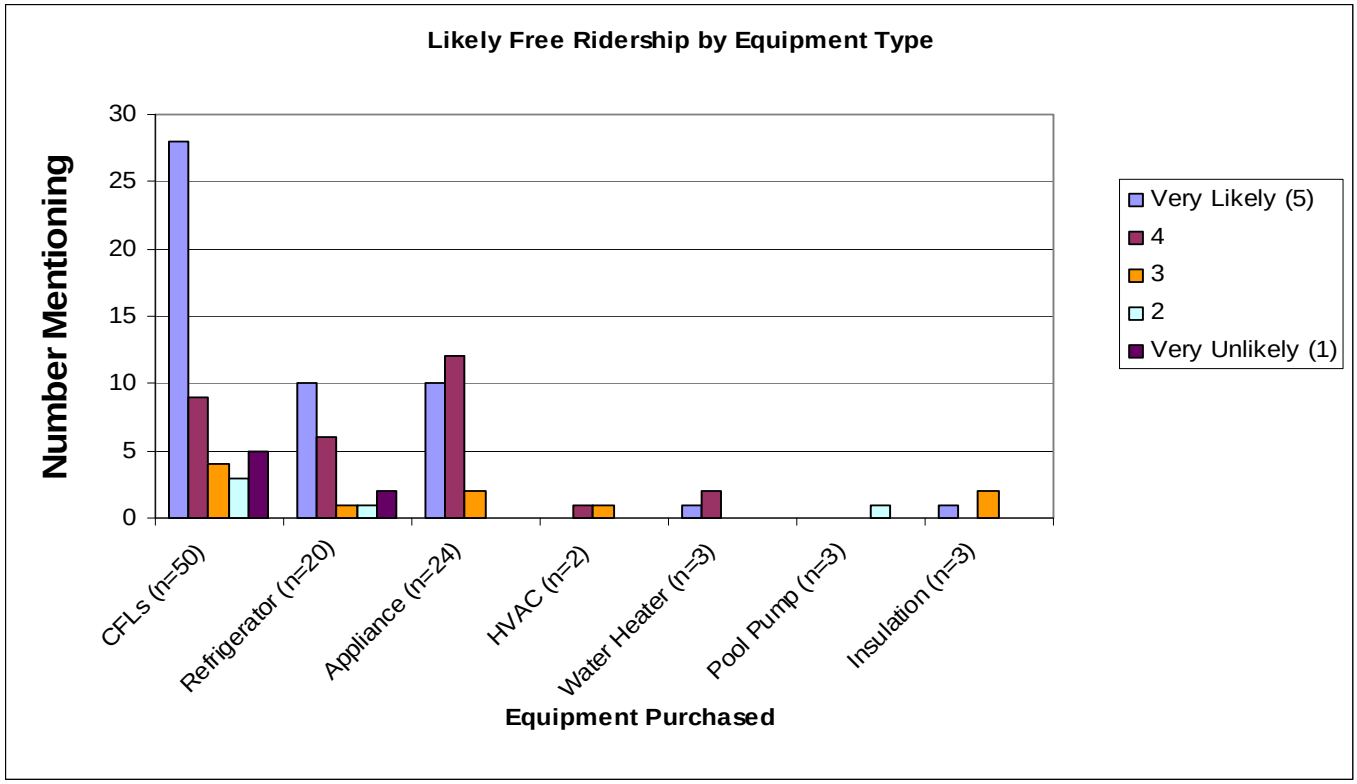
Table 4-9: Likelihood of Purchasing Equipment Without the Program

Likelihood of Purchase	Total	% of Total
Very Likely (5)	50	49%
4	30	29%
3	10	10%
2	5	5%
Very Unlikely (1)	7	7%
Don't Know/Refused	1	1%
Total	103	100%

In examining these results more fully, the potential free ridership rates were highest among those participants who purchased CFLs. Thirty-seven of the CFL respondents (74%) reported that they were “Very Likely” or “Somewhat Likely” to have purchased equipment on their own. This finding may be due, in part, to the fact that the price of CFLs sold at most retailers is discounted by a point-of-sale rebate

offered by PG&E. To participate in the CPAU rebate program, the customer will have to submit a form to one of two participating retailers in order to purchase CFLs at a discount price. This may be viewed as an inconvenience by the customer.

Figure 4-4: Likely Free Ridership by Equipment Type



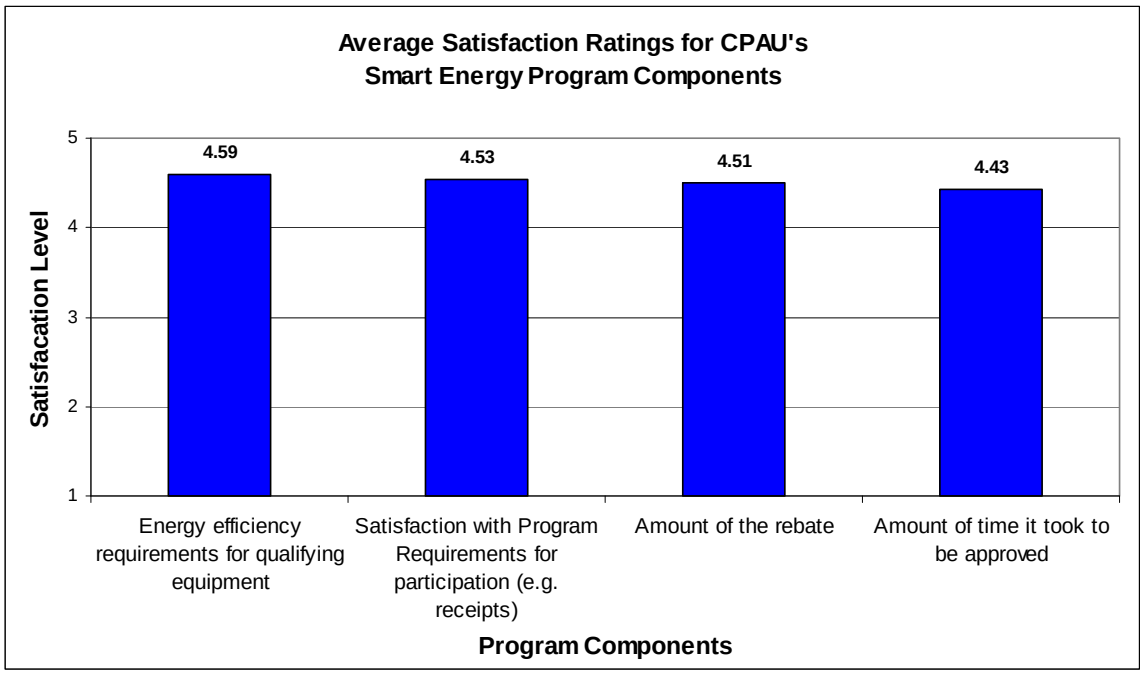
When looking at the free ridership rates for the other types of equipment, they decline dramatically. Participants who purchased refrigerators and appliances (clothes washers and dishwashers) reported slightly higher free ridership rates compared to those participants who purchased insulation, HVAC equipment, and pool pumps participants have the lowest free ridership rates.

These findings suggest that program free ridership rates could be reduced by phasing out the rebates on CFLs and raising the energy efficiency standards for refrigerators, clothes washers and dishwashers.

Program Satisfaction

The program participants were also asked to report their satisfaction with both the program itself and the various program components on a five-point scale. The scale ranged from "1" which meant "Not at all Satisfied" to "5" which meant "Very Satisfied." As Figure 4-5 shows, the satisfaction ratings from the program participants were very high, ranging from 4.43 for the length of time for application approval to 4.59 for the types of qualifying equipment. These findings were consistent across all equipment categories.

Figure 4-5: Average Satisfaction Ratings Smart Energy Program

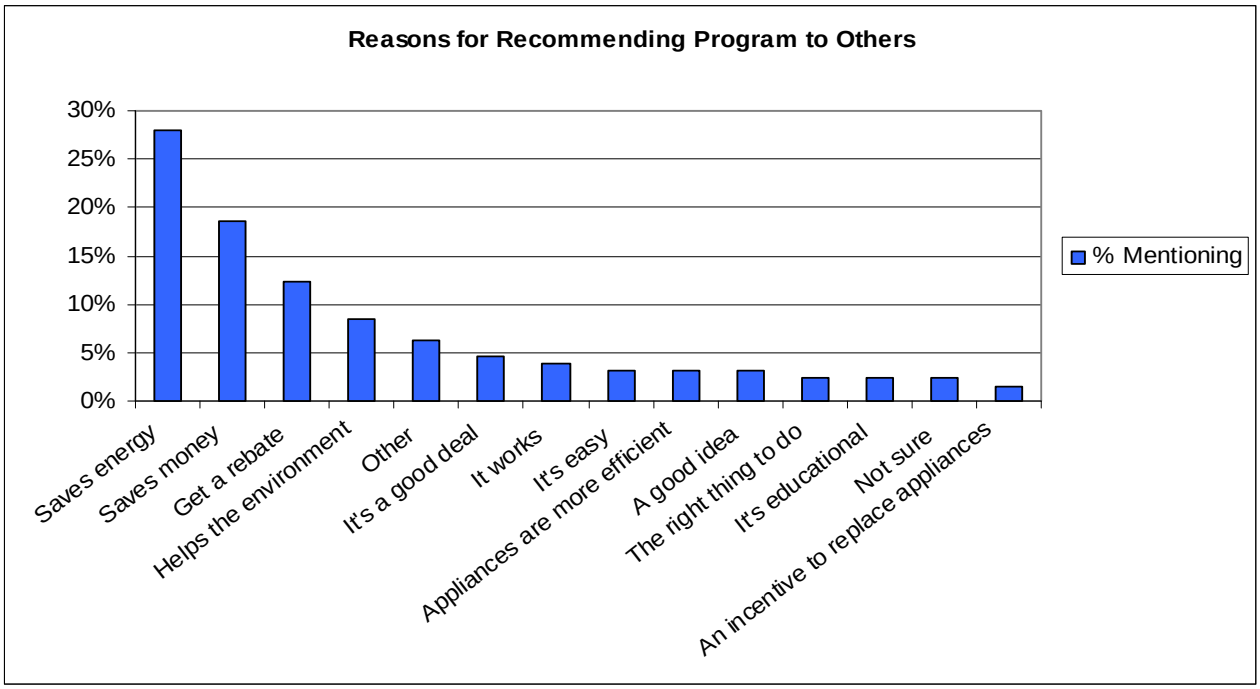


Of particular note, the 70 percent of CFL participants reported they were "Very Satisfied" with the amount of the rebate received from CPAU and 62 percent of these respondents were also "Very Satisfied" with the rebate application requirements. Overall, this program is very well-received by participants from all equipment groups.

The program participants rated their overall satisfaction with CPAU's Smart Energy Program of 4.56 on the five-point scale, which is a very high overall satisfaction rating. Sixty-five percent of the participants said they were "Very Satisfied" with this program, while another 26% provided a satisfaction rating of "4." Only two participants, one who had purchased a CFL and one, who had purchased a water heater, gave a satisfaction rating of "2," while none of the participants said they were "Very Dissatisfied" with the program.

As further evidence of the high satisfaction levels among program participants, 97 percent said they would recommend this program to others while 3 percent were not sure. Saving energy and saving money were the two most frequently mentioned reasons for recommending CPAU's Smart Energy Program to others. As Figure 4-6 shows, the participants also indicated that this program was "the right thing to do" as well as being "a good deal."

Figure 4-6: Reasons for Recommending This Program to Others

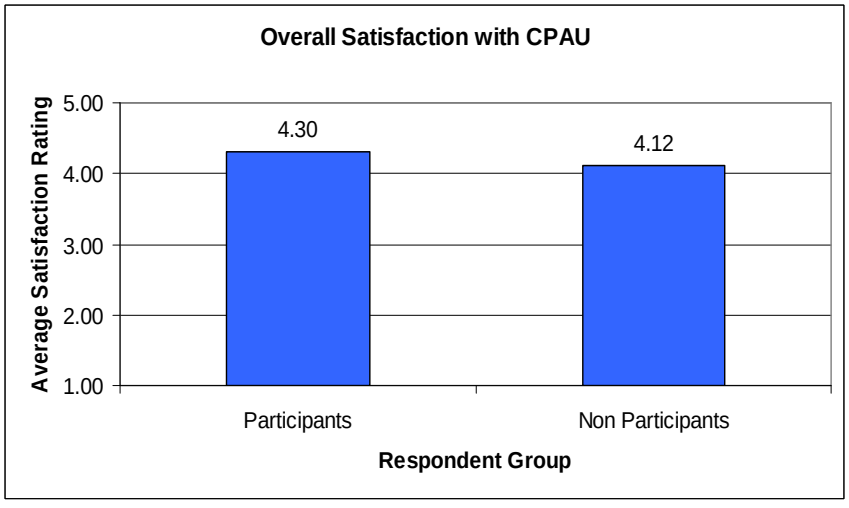


Satisfaction with CPAU

All the respondents, both participants and non participants, were also asked to rate their overall satisfaction with CPAU using the same five-point scale. Overall, the satisfaction rating for CPAU from all customers was 4.21.

As Figure 4-7 shows, both respondent groups reported high satisfaction scores for CPAU. The participants reported slightly higher scores compared to the non participants, but there was no significant difference in overall satisfaction from either group.

Figure 4-7: Average Satisfaction Ratings for CPAU



Nearly 50 percent (48%) of all respondents reported they were "Very Satisfied" with CPAU, with 53 percent of the participants and 44 percent of the non participants rating their satisfaction with CPAU as a "5." These findings suggest that participation in the CPAU's Smart Energy Program enhanced customers' already favorable impressions of CPAU.

Areas for Program Improvement

The program participants also provided suggestions on the ways in which this program could be improved. However, as Table 4-10 shows, most participants (63%) did not believe that the program needed to be improved. A few participants suggested increasing program publicity (7%) or increasing the size of the rebate (6%) but the majority felt the program was just fine the way it was current being offered.

Table 4-10: Ways CPAU's Smart Energy Program Could be Improved*

Ways Program Could be Improved*	Total	% of Total
No ideas	65	63%
Other	9	9%
Publicize program more	7	7%
Offer better rebate/more money	6	6%
Reduce paperwork/bureaucracy	6	6%
Expand list of qualified appliances	6	6%
Speed up process	5	5%
Total	104	100%

*multiple response question

These findings suggest that the majority of all participants are happy with the current program operations and are consistent with the findings regarding overall satisfaction with the program, CPAU, and the nearly unanimous agreement that the current participants would recommend this program to others.

Customer Demographics

The customer survey also captured some demographic information about these respondents. The results are summarized in this section for informational purposes.

Home Ownership Characteristics: Nearly three-quarters (74%) of the survey respondents owned their own homes (see Table 4-11). Of note, non participants were significantly more likely to rent (46%) compared to program participants (6%).

Table 4-11: Home Ownership Levels by Participant Group

Household Ownership	Total	% of Total	Participants	% of Total	Non Participants	% of Total
Own	151	74%	97	94%	54	53%
Rent	53	26%	6	6%	47	46%
Occupy without payment	1	0%	0	0%	1	1%
Total	205	100%	103	100%	102	100%

Table 4-12 shows that 75 percent of all respondents lived in single-family homes. However, non participants were significantly more likely to live in apartments (25%) compared to participants.

Table 4-12: Types of Residence by Participant Group

Type of Residence	Total	% of Total	Participants	% of Total	Non Participants	% of Total
Single-Family Home	154	75%	93	90%	61	60%
Apartment	30	15%	4	4%	26	25%
Condo/Townhouse	21	10%	6	6%	15	15%
Total	205	100%	103	100%	102	100%

These findings suggest that home ownership may be a key driver in determining program participation. Clearly, program participation is dominated by home owners living in single family homes.

Household Occupancy: As Table 4-13 shows, most respondents lived in two-person households. The average number of residents was nearly identical for both participants (2.56) and non participants (2.55) suggesting that household occupancy rates are not a factor in program participation.

Table 4-13: Household Occupancy by Participant Group

Number of People Currently in Home	Total	% of Total	Participants	% of Total	Non Participants	% of Total
1	39	19%	15	15%	24	24%
2	78	38%	48	47%	30	29%
3	40	20%	18	17%	22	22%
4	24	12%	11	11%	13	13%
5+	18	9%	9	9%	9	9%
Refused	6	3%	2	2%	4	4%
Total	205	100%	103	100%	102	100%
Mean	2.56		2.56		2.55	

As Table 4-14 shows, the number of occupants has stayed the same in the past year for the majority of all survey respondents (84%). These findings are consistent across both participant groups.

Table 4-14: Changes in Occupancy Rates

Has the Number?	Total	% of Total	Participants	% of Total	Non Participants	% of Total
Increased	15	7%	4	4%	11	11%
Decreased	12	6%	8	8%	4	4%
Stayed the Same	173	84%	89	86%	84	82%
Don't Know/Refused	5	2%	2	2%	3	3%
Total	205	100%	103	100%	102	100%

Household Income: While many respondents refused to answer this question (39%), 21 percent of the respondents reported household incomes of $150,000 or more. Overall, 39 percent of the respondents had annual household incomes above $100,000.

Table 4-15: Reported Annual Household Income

Household Income	Total	% of Total	Participants	% of Total	Non Participants	% of Total
Less than $20,000	6	3%	4	4%	2	2%
$2000 but less than $40,000	11	5%	5	5%	6	6%
$40 but less than $60,000	17	8%	6	6%	11	11%
$60,000 but less than $75,000	12	6%	5	5%	7	7%
$75,000 but less than $100,000	14	7%	9	9%	5	5%
$100,000 but less than $150,000	22	11%	13	13%	9	9%
$150,000+	43	21%	18	17%	25	25%
Don't Know/Refused	80	39%	43	42%	37	36%
Total	205	100%	103	100%	102	100%

Of interest, a higher percentage of non participants reported annual household incomes of $150,000 or more (25%) compared to participants (17%), which suggests that household income levels may not be a factor in determining participation.

Highest Education Level: The majority of all respondents were also well educated with 60 percent reporting receiving graduate degrees. These high educational levels were consistent for both participants (57%) and non participants (62%) which suggest that educational levels are not a factor driving the decision to participate in the program.

Table 4-16: Highest Education Level Completed

Highest Education Level Completed	Total	% of Total	Participants	% of Total	Non Participants	% of Total
Some High School	1	0%	0	0%	1	1%
High School Graduate	6	3%	4	4%	2	2%
Some College/Vocational School	13	6%	5	5%	8	8%
College	56	27%	32	31%	24	24%
Graduate	122	60%	59	57%	63	62%
Refused	7	3%	3	3%	4	4%
Total	205	100%	103	100%	102	100%

In summary, the survey respondents were characteristic of the CPAU's overall customer base, with the majority are home owners living in single family residences. The household occupancy rates are fairly stable, and are dominated by two-person households with annual incomes above $100,000. The CPAU customers are also very well educated with the majority having graduate degrees.

4.4.3 Summary Findings from Customer Surveys

The customer surveys revealed the following key findings and conclusions:

Program Awareness

Finding:

- Most customers, both participants and non participants, learned about the program through utility mailings. The other promotional methods enhance awareness, but are not the chief driver.

Conclusion and Recommendation:

- CPAU should continue to promote its CPAU Smart Energy Program through its utility mailings.

Program Participation:

Findings:

- Program participation is driven by the customers' desire to save energy more than to save money. These participants also indicated that they would recommend the program to others because it was "the right thing to do" as well as a way to "save money."

- Program participation is highest among those customers among home owners who live in single family residences.

- Most program participants purchased qualifying CFLs. However, both participants and non participants also purchased additional CFLs on their own, without the program. The program has

some spillover effects on energy efficient appliances purchases, but minimal spillover effects on more expensive items such as HVAC and insulation.

- Measure persistence rates are very high as all the installed equipment was still operational at the time of this survey.

Conclusions and Recommendations:

- CPAU should continue to incorporate its "green" messaging into its program materials as this continues to be an appealing feature of the program to participants.

- CPAU should continue to target homeowners, though income is not as important as home ownership.

- CPAU should consider eliminating rebates for its CFLs as both participants and non participants purchase these bulbs on their own, without rebates.

Free Ridership

Findings

- Overall program free ridership is relatively low.

- Free ridership rates are highest among those who purchased CFLs.

- Free ridership rates are lowest among those customers who purchased HVAC equipment, water heaters, and insulation.

Conclusions and Recommendations

- CPAU should consider reducing or eliminating its rebates for CFLs.

- CPAU should consider increasing the energy efficiency requirements for dishwashers and refrigerators as a way to address the changes in the market and to encourage customers purchase more energy efficient equipment.

Program Satisfaction

- The participants reported very high satisfaction levels for the overall Smart Energy Program as well as the specific program components.

- Rebate levels were not an area of program dissatisfaction.

- Most participants are pleased with the current program operation and did not offer any suggestions for program improvement.

Conclusions and Recommendations

- CPAU has done an excellent job in program administration and operations. No program operating refinements are needed at this time.

Overall Satisfaction with CPAU

Finding

- While both the participants and non participants are satisfied with CPAU, the participants reported slightly higher satisfaction levels with the utility.

Conclusions and Recommendations

- Although not statistically significant, program participation does have a positive impact on customers' overall satisfaction ratings for CPAU.

- CPAU should continue to offer its Smart Energy Program to its residential customers as way to encourage energy savings and enhance overall customer satisfaction.

5 IMPACT EVALUATION RESULTS

For this report, impact evaluations were performed for:

- Residential refrigerator/freezer recycling
- Residential CFLs
- Commercial custom measures
- Commercial lighting

The billing analysis for non-REAP residential natural gas measures will be provided separately.

5.1 Residential Refrigerator/Freezer Recycling

The CPAU tracking database identified 283 participants in FY 2007/08 for this measure. CPAU implements its refrigerator/freezer program through both its low income program and directly with JACO Environmental. For this evaluation, the JACO database was reviewed. This database includes 198 refrigerator and 26 freezer participants.

5.1.1 Measure Verification

Since the refrigerators and freezers are dismantled, it is impossible to perform on-site verification. Therefore, the JACO database was reviewed to see if pickup dates, model numbers, customer contact information, and other relevant facts were maintained in the database. This review found that all of the relevant information was collected and maintained in the database. Therefore, Summit Blue accepts this information as verifying that these refrigerators and freezers did participate in the program.

5.1.2 Claimed Savings at the Measure Level

The next part of the impact evaluation for these measures is to determine if:

- The claimed savings match the deemed values,
- Are the characteristics of the stock of refrigerators and freezers participating in the program similar to the characteristics used to estimate the deemed savings values, and
- Should CPAU consider revising its estimate of deemed savings for future years to both reflect changes in the characteristics of the stock collected and the new deemed values provided in the latest DEER update.

The claimed savings in the SmartData tracking database is 1,946 kWh/refrigerator. This value equals the value in DEER and in the E3 calculator. Freezers are not listed in the SmartData tracking database. If freezers are being collected and savings claimed, there should be an added savings value for them. There

is a savings value for freezers of 1,662 kWh/freezer in the E3 calculator. The 1,662 kWh value for savings matches the value found in the 2004-2205 DEER.

In reviewing the DEER documentation for appliance re-cycling, information is not provided on the appliance characteristics. The large kWh consumption estimates indicate an old very inefficient stock. Since the average age of refrigerators and freezers is 18 years, one would expect that the stocks being recycled are becoming more and more efficient over time.

The JACO database gives much information on appliance characteristics, age, and for about one-half of the appliances, an estimate of annual energy use. Table 5-1 provides summary characteristic information from the appliances gathered by JACO under the program.

Table 5-1: Refrigerator and Freezer Re-cycling Program Appliance Characteristics

Characteristic	Refrigerator		Freezer	
Number of Units:	198	88%	26	12%
Size:				
10 or less cf	2	1%	5	19%
11-15 cf	39	20%	5	19%
16-20 cf	98	49%	11	42%
21-25 cf	53	27%	5	19%
26 or more cf	6	3%	0	0%
Average	18.4		16.3	
Year Purchased:				
Before 1980	154	35%	13	20%
1980 to 1984	44	10%	13	20%
1985to1989	80	18%	16	24%
1990 to 1994	129	29%	22	33%
1995 or later	35	8%	2	3%
Average	1987		1982	
Location:				
Porch	1	1%	0	0%
Yard	89	46%	9	35%
Garage	56	29%	16	62%
Basement	1	1%	0	0%
First Floor	49	25%	1	4%
Use:				
Primary	88	44%	4	15%
Secondary	46	23%	13	50%
Not in Use	15	8%	4	15%
Unknown	49	25%	5	19%
Defrost Type:				
Manual	26	14%	10	40%
Frost Free	166	86%	15	60%
Icemaker:				
Yes	43	22%	4	15%
No	150	78%	22	85%

There are 198 refrigerators and 26 freezers included in the database. The average characteristics for refrigerators are:

- Size = 18.4 cf
- Year purchased = 1987
- 86% are frost free
- 22% have an ice maker

For the 26 freezers, the average characteristics are:

- Size – 16.3 cf
- Year purchased = 1982
- 60% are frost free

On average, these appliances are 30 or more years old and one would expect high energy use. However, it is likely that a growing percentage in the future will be newer refrigerators. Even if the average age remains about 30 years, the efficiency if these older refrigerators would still improve based on improved federal standards over time.

As mentioned earlier, the JACO database also includes estimates of energy use for about one-have of the appliances. Table 5-2 provides the estimated average use by appliance type from the JACO database.

Table 5-2: Estimated Energy Use from the JACO Database

	Refrigerator (kWh)		Freezer (kWh)	
Year Purchased:	Ave Use	% of Ave Use	Ave Use	% of Ave Use
Before 1980	944	89%	888	100%
1980 to 1984	1560	148%	NA	NA
1985to1989	1353	128%	946	106%
1990 to 1994	1229	116%	903	102%
1995 or later	681	64%	683	77%
Average	1058	100%	888	100%

The first noticeable observation is that all of the JACO energy use values are much lower than the deemed values. It is likely that the energy use cited is from manufacturer's data and reflects energy use for these units if they were new. In practice, refrigerators and freezers become much less efficient when they age due to such things as deteriorating door gaskets and compressor seals. This data show improving efficiency (when one does not consider the pre-1980 units) with each succeeding five year category. Summit Blue believes that this data provides support for having lower estimates of energy savings from these recycled appliances in future years.

The newest version of the DEER database has reduced the estimates of energy use from refrigerator and freezer recycling. The values now are 1,655 kWh/refrigerator and 1,257 for freezer.

Summit Blue recommends that the current energy savings of 1,946/refrigerator and 1,662 for freezers be used for FY 2007/2008 claimed energy savings with a verification rate of 100%. However, Summit Blue also recommends that the new lower DEER estimates of savings be used next fiscal year.

5.1.3 Savings Claimed in the E3 Calculator and Measure Realization

Although the SmartData tracking database identifies 283 participants in FY 2007/08, the E3 calculator has only 281 identified. CPAU should claim savings for all 283 participants. However, all of the participants both in the SmartData tracking database and the E3 calculator are identified as refrigerator recycling and each claim 1,946 kWh/participant.

The review of the JACO participant database did not include the full year of program participants, but did identify 198 refrigerator and 26 freezer participants, which together represent nearly 80% of the 283 SmartData identified participants. Both the JACO and the SmartData databases include customer name and utility customer IDs. Summit Blue checked the utility ID numbers of those in the JACO database that recycled a freezer to see if they were included in the SmartData database as participants. Each was found in both databases. Claimed energy savings should be adjusted to account for the fact that 11.6% of the JACO participants recycled freezers rather than refrigerators and that these freezer participants are part of the 283 SmartData participants.

Table 5-3 summarizes the findings and calculates the realization rate for the refrigerator/freezer recycling program. Overall, the realization rate is a very high 99.0%.

Table 5-3: Residential Refrigerator/Freezer Realization Rate

Measures	Installations Claimed in the E3 Calculator	Installation Adjustment	Savings/Unit Claimed in the E3 Calculator (kWh)	Savings/Unit Adjustment	Installation Verification	Savings Claimed (kWh)	Adjusted Savings (kWh)	Measure Realization Rate
Refrigerator/Freezer Recycling	281	100.7%	1,946	98.3%	100%	550,718	545,242	99.0%

5.2 Residential CFLs

According to the SmartData database, there were 3,908 program participants receiving 19,631 CFLs in FY 2007/2008. The impact evaluation for this measure will be simple. First, through use of the participant telephone survey, those indicated in the database as having received a CFL will be asked if they received one. This will provide an estimate of measure verification. The second part of the evaluation will be to review the value of per lamp energy savings and assess its reasonableness.

5.2.1 Measure Verification

The first set of equipment characteristics questions in the participant survey asked the following series of questions:

- "According to our records, you purchased a CFL (if a CFL program participant). Do you recall making this purchase?"
- "Is this CFL still in operation in your home?"
- "If not still in operation, why not?"

Fifty of the 103 program participant survey respondents were listed as having received a CFL through a CPAU program. Each of the 50 was asked if they recalled making the purchase and 100% said that they did. In response to the second question regarding if the CFL was still in operation in the home, again, all 50 respondents said that it was. Since there were no respondents who indicated that their CFL was not in operation, the third question was never asked. Based on these results, measure verification of installation is 100%.

5.2.2 Claimed Savings at the Measure Level

The per lamp energy impact estimates from CFLs as identified in the E3 calculator were compared to the DEER database estimates. The DEER and the E3 calculator values are essentially in agreement. From E3, the values are provided for three wattages:

- <= 15W = 32 kWh
- 16 – 24W = 39 kWh
- >=25W = 59 kWh

Within the E3 calculator, it appears that all of the lamps claimed through the program utilize the middle 39 kWh/lamp value. This is an appropriate value.

5.2.3 CFL Realization

The number of CFLs claimed in the E3 database is identical to the number identified in the SmartData database. Table 5-4 summarizes the elements included in the realization rate calculation. Residential CFLs have a realization rate of 100%.

Table 5-4: Residential CFL Realization Rate

Measure	Installations Claimed in the E3 Calculator	Installation Adjustment	Savings/Unit Claimed in the E3 Calculator (kWh)	Savings/Unit Adjustment	Installation Verification	Savings Claimed (kWh)	Adjusted Savings (kWh)	Measure Realization Rate
Residential CFLs	19,631	100.0%	39	100.0%	100%	765,609	765,609	100.0%

5.3 Right Lights Program

The methodologies employed to measure and verify energy savings attributed to the Right Lights Program included the following activities:

1. Verified measure installation.
   a. Developed a sample for field verification activities.
   b. Conducted field verification activities and observations.
2. Reviewed applications and supporting documentation provided to the City of Palo Alto Utilities.
3. Developed adjusted measure savings values based on field activities and data reviews.
4. Provided conclusions and recommendations for City of Palo Alto Non-Residential Right Lights Programs

These activities are discussed in detail in the following sections. Additional detailed information may be found in the appendices.

5.3.1 Measure Installation Verification and Impact Assessment

The objectives of the verification activities were to complete site visits and collect key energy program performance metrics including:

1. Establishing the presence of energy efficient measures by comparing the number of installations observed with the number of installations recorded in the rebate application.
2. Providing input on the quality of installations observed – including whether or not they were operating correctly.
3. Where observed equipment did not match program reported installations, determine if retrofits/installations were ever present, and/or the reason that the installation plan changed.
4. Recording key facility performance data, such as daily schedules, seasonal variations in schedules, and control strategies.

Right Lights Program Sample

All but two of the twenty projects sampled for the FY 2008 Right Lights program were simple lighting retrofits. One of the remaining projects included both lighting and gaskets on refrigerators. The other project was a prescriptive retrofit of refrigeration controls. The evaluation focused on lighting retrofits primarily involving new T8 fluorescent fixtures and T8 retrofits, compact fluorescents, and associated lighting occupancy controls.

Table 5-5 identifies the energy efficient installations and the verified savings from the sampled sites for the FY 2008 Non-Residential Right Lights Program. For privacy, the customer names are not given, but rather a site number assigned. The twenty sites included seven eating establishments, two liquor stores, an auto maintenance shop, an animal shelter, four retail stores, a bar, a small office location, a synagogue, a laundromat, and a florist.

Table 5-5: Sampled Program Installations and Savings

Customer	Retrofit Measures	kW	kWh
Site 1	Refrigeration controls	1.250	16,465
Site 2	Gaskets and compact fluorescents	1.844	15,347
Site 3	Compact fluorescents and T12 to T8 retrofits	4.744	16,867
Site 4	Compact fluorescents and T12 to T8 retrofits	5.614	33,736
Site 5	Compact fluorescents and T12 to T8 retrofits	2.163	9,458
Site 6	Compact fluorescents and T12 to T8 retrofits	0.999	3,348
Site 7	Compact fluorescents, T12 to T8 retrofits, and LED exit signs	0.737	3,179
Site 8	Compact fluorescents, T12 to T8 retrofits, and incandescent to halogen spotlights	6.302	30,908
Site 9	Compact fluorescents, T12 to T8 retrofit, and incandescent to halogen display lights	2.173	10,133
Site 10	Compact fluorescents, T12 to T8 retrofits, and incandescent to halogen spotlights	2.266	11,870
Site 11	Compact fluorescents and T12 to T8 retrofits	2.475	14,583
Site 12	Compact fluorescents and T12 to T8 retrofits	1.414	8,210
Site 13	Compact fluorescents, T12 to T8 retrofits, and LED exit signs	2.868	16,999
Site 14	Compact fluorescents, T12 to T8 retrofits, and incandescent to halogen spotlights	1.201	6,975
Site 15	Compact fluorescents, T12 to T8 retrofits, and LED exit signs	14.734	73,866
Site 16	Compact fluorescents and T12 to T8 retrofits	0.735	4,013
Site 17	Compact fluorescents and T12 to T8 retrofits	2.631	9,368
Site 18	Compact fluorescents and T12 to T8 retrofits	1.759	9,449
Site 19	Compact fluorescents and T12 to T8 retrofits	3.410	5,579
Site 20	Compact fluorescents and T12 to T8 retrofits	0.516	1,642
Program Total		59.8	301,995

The majority of the lighting retrofits involved replacing standard incandescent lights with screw-in compact fluorescents and retrofitting T12 fixtures to T8 systems. There were also some exit signs retrofitted to LED units and halogens used to replace incandescent display spot lights. One location included two occupancy sensors, but it was not clear if these were installed before or after the Right Lights retrofit.

In evaluating these projects, particular attention was paid to reviewing the program documents and supplementing it with field verifications. The evaluation of the lighting retrofits involved the IPMVP Option A approach by reviewing engineering calculations and performing site interviews.

The Right Lights program estimates savings on a prescriptive basis, however some of the measures included in the program do not have standard deemed savings values in the E3 calculator. Since deemed values are considered an acceptable alternative to calculated values for CEC verification, in cases where they were available they were compared to savings calculated using operational hours and fixture wattages. Incandescent to compact fluorescent, T12 to T8 retrofits, and incandescent exit sign replacement with LED units have standard deemed savings values. However, no deemed values were available for the incandescent to halogen retrofits or some of the less standard T12 retrofits, such as replacing one eight-foot lamp with two four-foot units, so calculated values were combined with the available deemed savings for comparison to claimed and calculated savings. Since most of these locations had relatively short operational hours, the deemed savings were generally higher than the calculated ones and so were typically used as the final savings values.

Site Activities

Field activities typically involved two components:

1. Evaluators coordinated with the primary customer contacts where possible to establish field activity dates and identify site level contacts. Where contacts could not be reached, evaluators either discussed the evaluation with onsite personnel or an alternative site was chosen.
2. While on-site, the evaluation team conducted an area-by-area, measure-by-measure audit, noting retrofit count, type, and operating conditions. Interviews were also conducted at the site representative's convenience.

Field evaluation activities were conducted on November 19-21, 2008. At the time all expected installations were completed and finalized, and a few had in fact already been removed.

Impact Assessments

Verification work, discussions with participants subsequent to field verification activities, and an analysis of the verified installations indicated that the installations attributed to the Non-Residential Right Lights Program were installed, but some fixtures had been removed either because of change of ownership of the location or because the site occupants were not satisfied with their performance.

Refrigeration Measures

Sites 1 and 2 included refrigeration measures rather than being solely based on lighting retrofits. Site 1 was a liquor store, which had installed refrigeration controls on its walk-in and display coolers. The gaskets on the under-cabinet coolers at site 2, a restaurant, had been replaced as part of the Right Lights program in addition to some compact fluorescent lighting retrofits.

The controls on the display coolers at site 1 were still operating as originally installed. There was no straightforward way to measure the savings onsite. However, discussions with the store manager and readings taken off the monitoring unit confirmed that no changes had been made to the installed settings. Furthermore, the door heaters were off during the onsite verification. The store manager confirmed that prior to the retrofit they had operated continuously. Based on this, Summit Blue recommends accepting the original savings estimate provided by the program for this facility.

Site 2 had 16 under-cabinet coolers, which had installed gaskets. During the site visit, the gaskets were checked for sealing using a sheet of paper. Of the under-cabinet coolers, one drawer had a loose gasket despite the retrofit. The coolers were all of similar sizes and temperatures, so this has been estimated to correspond to a 6.25% ($1/16^{th}$) reduction in savings on the gaskets. The program's standard savings estimates have been accepted for the remaining units.

Refrigeration Impact Results

Table 5-6 shows the claimed and verified refrigeration savings for the two sites sampled. The savings are only slightly reduced due to the failure of one gasket. This results in a 94% realization rate for energy savings and 93% for demand savings.

Table 5-6: Refrigeration Savings

	kW Savings	Annual kWh Savings
Claimed Savings	2.7	28,987
Verified Savings	2.5	27,174

T8 Lights

T12 to T8 retrofits were among the most common type associated with the Right Lights program. These are a fairly standard replacement as modern T8 lamps and electronic ballasts use around two thirds of the power of T12 lamps with magnetic ballasts. Furthermore, they provide higher light output for that lower energy usage.

The Right Lights program uses standard prescriptive savings estimates to calculate the savings associated with these retrofits. The customers of the Right Lights program generally have much shorter actual hours than those associated with deemed or prescriptive savings so in most cases the actual savings are less than the claimed savings. Since utilities are permitted to use deemed savings values, this is acceptable however, CPAU should be aware for planning purposes that the actual usage by the customers will not be reduced during the additional hours when they are not operating.

Summit Blue has used the standard deemed values from the E3 calculator to calculate deemed savings values. In most cases deemed values are used rather than calculated ones because the hours of operation are relatively short in these locations. Table 5-7 shows selected savings values for T8 retrofits.

Table 5-7: T8 Retrofit Savings

	kW Savings	Annual kWh Savings
Standard E3 T12 to T8 4' lamp replacement	0.006	37
One-lamp 4' T8 fixture early replacement	0.073	339
Delamp 4' lamp	0.040	235

Compact Fluorescents

Another common retrofit was changing incandescent lamps to screw-in compact fluorescents. Although compact fluorescents use only around a quarter of the power of standard incandescent lamps they are not suitable for use in all locations. Compact fluorescents can fail in damp locations and are typically dimmer than their rated light outputs in cold locations. Additionally, some newer types such as dimmable and small chandeliers units can be prone to failure.

Screw-in compact fluorescents are simple to install and have become a common retrofit choice because of the simplicity of simply replacing a bulb. However it is just as simple to remove a screw-in unit and replace it with a standard incandescent bulb as it is to remove the incandescent in the first place. This can severely affect the lifetime of these measures. Additionally, since the ballast is integral in screw type compact fluorescents, the ballast must be replaced with the lamp, significantly more often than it would be if it were not coupled with the lamp. Table 5-8 shows the CFL savings values from the E3 calculator.

During on-site verification several locations were observed to have removed screw-in compact fluorescents and reinstalled incandescent lamps, either because of problems or apparently simply because they were on hand or because the CFLs were not working as expected. Specifically, in addition to what appeared to incidental removals, four dimmable units had been intentionally replaced in a restaurant, a florist had removed the CFL from their cold storage, and a synagogue was experiencing repeated failures of chandelier lamps. In the case of both dimmable and chandelier units, significantly higher customer satisfaction might be obtained by replacing fixtures rather than bulbs. There are some attractive replacements for traditional chandeliers, which use circline or other hard-wired fluorescents, as well as reliable hard wired dimmable units available that should be considered for future replacements in similar situations.

Compact fluorescents were also installed as part of some wall box fixtures. Here removal is less likely because these are not simple screw-in replacements. The ballast is integrated into the fixture and the lamp plugs into it. Additionally, wall packs are not typically in locations where staff notices lighting level differences or simply change out lights. These are commonly external lighting fixtures along a building over walkways or parking lots. Consequently, the operational hours of these fixtures tends to be a consistent 4,380 hours per year, an average of twelve hours per day. These fixtures are usually on either a daylight sensor or timer so that they do not remain on during daylight hours.

Table 5-8: CFL Retrofit Savings

	kW Savings	Annual kWh Savings
Screw-In (1-13W)	0.021	121
Screw-In (14-26W)	0.038	220
Screw-In (>=27W)	0.054	314

Other Fixtures

In addition to the prevalent T8 and CFL retrofits, some efficient parabolic incandescents and pulse start metal halides were included in the retrofits. There were no reported problems with these units. One retail site expressed interest in information about efficient alternatives to display spot lighting. Ceramic metal halides such as those used in the custom program might be of interest to customers for similar applications.

Site Closures

The restaurant, which participated in the Right Lights program at site 7, had gone out of business. The new restaurant had maintained the fixtures in the back area of the building, but had replaced all of the fixtures in the customer area as part of their new layout.

Site18 was under new ownership, but the area had not been remodeled and the fixtures all remained in place. Site 5 was located in a shopping center, which may be sold and rezoned within the next year. It is possible that this will result in the near-term removal of the retrofitted fixtures, but at the time of verification all remained in place and operating.

Lighting Impact Results

Table 5-9 summarizes both the claimed and adjusted energy savings for lighting in the Right Lights program at the twenty sites visited. This shows a total realization rate for lighting projects' energy of 87% and 70% for demand savings. The majority of the discrepancy is due to the deemed values being used by Palo Alto as opposed to the standard ones in the E3 calculator used by Summit Blue. Some removals also contributed to the reduced savings.

Table 5-9: Right Lights Lighting Savings

	kW Savings	Annual kWh Savings
Claimed Savings	80.7	309,889
Verified Calculated Savings	64.1	242,969
Using Deemed Savings where Applicable	50.7	239,181

5.3.2 Right Lights Impact Results

Table 5-10 provides the savings reported in the final installation review documents submitted for the Right Lights Program and the verified gross savings. Overall, the Right Lights program realization rate was estimated to be 87.9%. The recommended adjustments are attributable to revised savings estimates for deemed values and removed fixtures.

Table 5-10: Right Lights Program Claimed Savings and Verified Gross Savings

	Claimed		Verified	
Customer	kW	kWh	kW	kWh
Site 1	1.25	16,465	1.250	16,465
Site 2*	2.135	17,417	1.844	15,347
Site 3	6.276	22,654	4.744	16,867
Site 4*	8.033	48,650	5.614	33,736
Site 5	2.531	10,020	2.163	9,458
Site 6*	1.142	3,698	0.999	3,348
Site 7	3.080	10,269	0.737	3,179
Site 8	9.676	31,606	6.302	30,908
Site 9	1.734	5,971	1.405	5,929
Site 10*	2.645	14,082	2.266	11,870
Site 11*	2.936	17,299	2.475	14,583
Site 12	1.901	9,889	1.414	8,210
Site 13*	3.705	22,128	2.868	16,999
Site 14	1.950	6,915	1.201	6,975
Site 15	21.010	65,680	14.734	73,866
Site 16	2.645	7,046	0.735	4,013
Site 17*	3.613	12,053	2.631	9,368
Site 18	1.359	6,008	1.759	9,449
Site 19	4.547	9,056	3.410	5,579
Site 20	1.199	1,970	0.516	1,642
Total	**83.37**	**338,876**	**59.1**	**297,790**
Percent Realization			**70.9%**	**87.9%**

* uses calculated rather than deemed lighting savings for final verified values

5.4 Custom Program

The objectives of the verification activities were to complete site visits and collect key energy program performance metrics including:

1. Establishing the presence of energy efficient measures by comparing the number of installations observed with the number of installations recorded in the rebate application.
2. Providing input on the quality of installations observed – including whether or not they were operating correctly.
3. Where observed equipment did not match program reported installations, determine if retrofits/installations were ever present, and/or the reason that the installation plan changed.
4. Recording key facility performance data, such as daily schedules, seasonal variations in schedules, and control strategies.
5. Where energy usage is not well documented, log energy use at the installation site.

5.4.1 Custom Program Sample

The evaluation included five lighting retrofit and one site where variable frequency drives had been installed. The lighting retrofits primarily involved T12 to T8 retrofits, although some compact fluorescents and ceramic metal halide spot lights were also installed. One site only added occupancy sensors to existing fluorescent systems. Another site replaced incandescent track lights with ceramic metal halide units. This site and the non-lighting one used custom calculated savings; the other four sites all used the prescriptive rebate program.

Table 5-11 details the verification results of the energy efficient installations and savings sampled that occurred under the Non-Residential Custom Program for the City of Palo Alto Utilities. For privacy, the customer names are not given, but rather a site number assigned.

Table 5-11: Verified Program Installations and Savings

Customer	Retrofit Measures	kW	kWh
Site 1	T12 to T8 retrofit	17.8	82,737
Site 2	T12 to T8 retrofit and delamping with some occupancy sensors	35.8	196,208
Site 3	T12 to T8 retrofit, compact fluorescents, and ceramic metal halides	111.8	538,551
Site 4	Addition of occupancy sensors to T8 and CFL fixtures	15.2	22,369
Site 5	Custom ceramic metal halide track lighting	67.8	338,729
Site 6	VFD installation on fume hood exhaust	77.0	1,203,437
Program Total		**325.4**	**2,382,031**

The lighting retrofits involved comprehensive retrofits of commercial office and retail type spaces and industrial areas. Retrofits included T12 to T8, exit signs, and occupancy sensors as well as compact fluorescents and ceramic metal halide track lighting. Overall, the lighting savings were significantly higher than those claimed by the program, however this was due to the massive underreporting of savings at the custom program at site 5, probably because of the 50% cost savings cap. Savings verified at site 4

were significantly lower than claimed because of low hours and adjustments in the types of occupancy sensors.

In evaluating these projects, particular attention was paid to reviewing the program documents and supplementing it with field verifications. The evaluation of the lighting retrofits involved the IPMVP Option A approach by reviewing engineering calculations and performing site interviews.

In some cases, deemed values were compared to calculated savings values. Only some of the implemented measures had standard deemed values available. These are considered an acceptable alternative to calculated values for CEC verification. Incandescent to compact fluorescent, T12 to T8 retrofits, and incandescent exit sign replacement with LED units have standard deemed savings values. In each case these results were compared to the calculated values. However, no deemed values were available for the ceramic metal halide retrofits, so calculated values were combined with the available deemed savings for comparison to claimed and calculated savings.

Site Activities

Field activities typically involved two components:

1. Evaluators coordinated with the implementation contractor and primary customer contacts to establish field activity dates and identify site level contacts.
2. While on-site, the evaluation team conducted an area-by-area, measure-by-measure audit, noting retrofit count, type, and operating conditions. Interviews were also conducted at the site representative's convenience.

Field evaluation activities were conducted on November 19-20, 2008. At the time, it was anticipated that all expected installations were completed and finalized. Appendix B provides additional installation details.

Impact Assessments

Verification work, discussions with participants subsequent to field verification activities, and an analysis of the verified installations indicated that the installations attributed to the Non-Residential Custom Program were installed, but the savings were not necessarily accurately calculated.

Site 1

Site 1 was primarily a manufacturing area. The retrofit project consisted of one-for-one replacements of T12 lamps and ballasts with T8 units. The incentive was paid on a prescriptive basis based on the number of lamps replaced. Both the application and facility personnel indicated that premium lamp-ballast combinations were installed. Visual inspections, where possible, also confirmed this. According to facility personnel, the majority of areas operated and were illuminated 17 hours per day, five days a week, with some additional operation on Saturdays. Based on this 4,760 hours/year of operation were used for most areas in the facility.

A full count was performed on fixtures in eleven production areas that were retrofitted. The count located 1,814 lamps in 533 fixtures. The application indicated the replacement of 1,895 lamps, however in examining building plans and the facility while onsite, Summit Blue was unable to locate the remaining 81 lamps. It is possible that these were in an area that facility personnel could not recall retrofitting, or in another building. However, it is also possible that the purchased units were used as spares. Based on the generally good knowledge of facility personnel of the retrofit and the availability of building plans,

Summit Blue has used the more conservative, counted number for this location. The reduced deemed savings are due to the larger values used for estimates by the CPAU program's prescriptive rebate program than the standard deemed values available in the E3 calculator. However, since premium lamps and ballasts were used and the facility hours are long, the calculated savings are somewhat higher than the deemed values and have been used for this site.

Table 5-12: Site 1 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	13.3	77,695
Verified Calculated Savings	17.8	82,737
Deemed Savings	10.9	67,118

Site 2

Site 2 included T12 to T8 retrofits in two buildings. The majority of the areas were office spaces although there were some maintenance and laboratory areas also included. Some wall occupancy sensors were installed in private offices, but were not included in the incentive application. Some delamping was included in the retrofit. During the on-site verification, Summit Blue checked the entire claimed 1,190 lamp retrofit and spot checked the retrofit and delamp containing 548 lamps. Of the claimed 1,190 lamps, 1,053 were found. However, facility personnel admitted some confusion as to exactly which areas were included in the retrofit. The entire facility appeared to be using T8 lamps at the time of the on-site verification. What was unclear was exactly which areas were retrofitted at what point and which units were delamped.

The application indicated the presence of premium lamps and ballasts, and spot checks where possible confirmed this. Consequently premium lamp energy values have been used except for U-lamps, where premium lamps are extremely uncommon. Operating hours of 3,060 per year were used in common areas and 2,550 were used for private offices based discussions with facility personnel. Exit signs are assumed to operate 8,760 hours per year. All of the exit signs located within the facility were LED type, but facility personnel could not recall which were included in the retrofit, so the application numbers of signs have been accepted.

Relatively low facility hours have reduced the calculated savings. The deemed savings for this site are only slightly lower than the program's claimed savings. The application numbers of retrofits were accepted based upon spot checks and the fact that facility personnel could not absolutely confirm exactly which areas were included in this retrofit.

Table 5-13: Site 2 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	41.9	217,602
Verified Calculated Savings	33.4	108,325
Deemed Savings	35.8	196,208

Site 3

Site 3 was a large, open shopping mall. Retrofits included T12 to T8 replacements, incandescent to compact fluorescent, and ceramic metal halide installations. During the site visit, the facility provided a list of retrofits for each area. These were spot-verified, however many areas included enclosed, outdoor fixtures at heights where the actual lamp could not be examined. Nevertheless, where visual inspection was possible, the fixtures matched the count and type listed on the provided spreadsheet. The only notable exceptions were that one hallway still contained T12 lamps despite being listed for T8 retrofits, and the parking garages contained more fixtures than were listed for the retrofit.

The office areas of the shopping center operate just over 2,000 hours per year. Outdoor fixtures operate 4,360 hours per year, turning on only after dark. Contrastingly, the parking garage lighting is on 24 hours per day, seven days a week, or 8,760 hours per year. Because a significant percentage of the retrofit wattage was in the parking garage, these long hours result in higher savings based on calculation than from deemed numbers.

The retrofit spreadsheet provided by the facility did not exactly match the application. The application claimed 1,899 T8 lamps, whereas the spreadsheet claimed 1,886 lamps. However, because extra fixtures were found in the parking garage, the confirmed number of T8 lamps was 1,935. Similarly the application claimed 554 compact fluorescent units greater than 27W. However, the spreadsheet showed 709 units in this wattage range. The lower wattage fluorescents showed 54 on the application and 51 on the spreadsheet. HID units on the spreadsheet and application matched.

Based on the site visit, the spreadsheet numbers for the retrofit have been accepted, except where variances were found. Since these variances resulted in a higher number of T8 retrofits with long hours, the verified savings are actually slightly higher than the claimed values. The demand savings are slightly lower because they are not affected by hours and because some fixtures are on only during off-peak hours.

The City of Palo Alto Utility program has used deemed savings numbers from the E3 calculator, substituting the most similar item when measures are not available in the E3 spreadsheet. This is generally reasonable, but Summit Blue has used calculated values in these cases for increased accuracy. The replacement of additional units over those listed on the application coupled with long operational hours in some areas has resulted in significantly higher calculated savings than those claimed by the Utility.

Table 5-14: Site 3 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	60.9	341,884
Verified Calculated Savings	111.8	538,551
Using Deemed Savings Where Available	85.9	473,294

Site 4

Site 4 installed a combination of wall and ceiling occupancy sensors in office areas leased to several different companies. The rebate application claimed 91 wall and 28 ceiling mounted sensors. During verification, Summit Blue located 75 wall and 44 ceiling sensors. In both cases, this is a total of 119

sensors, but there were significantly fewer wall and more ceiling sensors found during verification relative to the application.

The majority of sensors were installed controlling fixtures containing either 4' or 2' T8 lamps, with the remainder being on compact fluorescent or biax lamps. A full count of the number and type of fixtures operated by each motion sensor was performed and included in the savings calculations. Standard savings percentages are shown in appendix A and were used to calculate facility savings along with standard fixture wattages and facility hours.

Although deemed savings may be used for the wall box occupancy sensors, the E3 calculator used by CPAU does not have a deemed value for ceiling sensors. As with many of the other locations, since the hours are relatively low in these offices, the calculated savings are significantly lower than the deemed or prescriptive savings. This assumes, based on discussions with facility personnel, that lights were turned off after hours in most areas prior to the retrofit.

Table 5-15: Site 4 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	20.9	28,322
Verified Calculated Savings	5.7	12,869
Using Deemed Savings Where Applicable	15.2	22,369

Table 5-15 summarizes both the claimed and adjusted energy savings for Site 4. The reduced savings in the deemed numbers are due to the fact that no deemed value is available for ceiling sensors. The CPAU program uses deemed numbers for wall sensors for ceiling sensors as well. Although this is reasonable in applications such as this one, where the ceiling sensors are used in relatively small areas similar to those using wall sensors, Summit Blue has used calculated values for the ceiling occupancy sensors as a more accurate estimate. Consequently, the increased number of ceiling sensors coupled with the low hours have resulted in reduced savings at this site.

Site 5

Site 5 contained a large number of track lights used to illuminate displays. Prior to this project the facility used halogen track lights for this purpose. Some of the older units were installed alongside the new ones as described below.

Itemized invoices for the retrofit were provided with the application and showed significantly more units purchased than were listed on the application itself. It is to be expected that the store would want some spares on hand, but there were around 500 "extras" according to the invoice, compared to the 765 units listed on the application.

Replacing track lights, which are specifically designed to be modular, presents difficulty in calculating savings because the number of lamps changes in the retail space on a regular basis. Additionally, the store retains some of the older, halogen track lights because certain displays appear more attractive under them. There were 64 halogen track lights installed during the verification visit.

The hours listed on the application were 4,200/year. However, discussions with facility staff indicated that the actual hours, including times during which staff are working on the display layouts, are closer to

5,000/year. Specifically, the store is open 10AM-9PM, Monday through Friday, 10AM-7PM on Saturday, and 11AM-6PM on Sunday. In addition to this, designers and staff are in the store from 7AM-10PM Monday through Friday, 8AM-8PM on Saturdays, and 9AM-8PM on Sundays. Although full lighting levels may not be required by staff finishing up at cash registers, they will be required by designers working on display layouts. The staff also indicated that they did not usually reduce the lighting levels while in the store, so the extended hours were used for savings calculations.

Table 5-16 shows the total estimated savings. The rebate, however, was capped at half of the installed project cost of $17,661.89. The application provided to Summit Blue only claimed 765 new ceramic metal halide track lights. However, during verification 1,189 units were observed, along with 64 incandescent track lights still in use. The purchase orders provided with the application listed a total of 1,296 lamps and 1,245 housings. It is unclear why only 765 retrofits were listed on the application unless the store has undergone an expansion since the time of this project. It may be that either there were fewer lights installed at the time or that the customer chose not to request a rebate on all of the units since the program cap of 50% of installed cost had already been reached. However, since 1,245 full units were ordered it is fair to assume that the customer expected to use significantly more than the listed 765 units at the time the application was filed. Although it is difficult to say what average number of units may be in use at any given time, due to the high number observed during verification, it is fair to say that the total savings at this site are likely significantly underreported.

Table 5-16: Site 5 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	43.6	183,141
Verified Calculated Savings	67.8	338,729

Site 6

Site 6 added variable frequency drives to the exhaust on chemical fume hoods. Because of the variability seen in usage with this type of equipment, IPMVP M&V Option B was employed and several of the units were metered over multiple weeks to determine their loading. The application to the utility claimed 970,816 kWh of electric savings including cooling savings due to reduction in air exchange. No demand savings were provided in the application, however since the reduction during peak hours was stated to occur 60% of the time and there were some 21 fans that were not interactive in their operation, 60% of the stated kW were assumed to apply to peak demand. Although the retrofit largely matched the description in the application, there were a few notable issues with the savings estimates.

The site consisted of about 17 numbered buildings however, the majority of these did not contain any VFD retrofits. Four buildings had been previously retrofitted, and one more was covered by this retrofit. The building included in the retrofit had three floors, and three exhaust fans were removed and 12 exhaust and six supply fans had VFDs installed.

The power feeds for some of the fans were difficult to access, but spot measurements were performed on as many of the units as was feasible and five current loggers were installed on a variety of different motor sizes. It was assumed that the use of various fume hoods would be representative over a long enough logging period, so the loggers were left in place for five weeks. This period did, unfortunately, include Thanksgiving, but the data has been adjusted to allow for the two vacation days. The Thursday that was Thanksgiving has been removed and replaced with the Thursday at the end of the logging period. The

Friday after Thanksgiving, which was also a holiday, has been retained to account for the average one holiday that would occur within any five week period.

The metering was performed on two 15 HP and one 30 HP exhaust fans and one 75 HP and one 100 HP supply fans. The two 15 HP exhaust fans both showed relatively constant current for the entire five week period during which they were monitored. Since the first unit, R8FE01, was listed on the application as drawing 5 amps regardless of sash condition, the steady average current of just under 5 amps was expected. The second unit, R8FE07, was listed as 16 amps with the hood sashes open and 12 amps with them closed regardless of setback condition, so the average reading of 15.6 amps was consistent with the sashes remaining open for the entire five week period. This is somewhat surprising, and may actually indicate that the initial measurements for closed sashes were in error or that conditions have changed rather than that the sashes were continuously open.

The third exhaust fan, R8EF10, showed significant variation, over time in its current draw. The application claimed 26 amps with the hood sashes open, 14 amps with the hood sashes closed, and 9 amps with set-back when the hood sashes were closed. The metered data showed additional conditions, which are probably caused by multiple hood sashes in different positions. The metered amps for the fan are shown in figures 5-1 and 5-2, below. The highest peaks, on December 4, 5, and 8 average 25.8 amps, which corresponds well to the 26 amps claimed on the application for open hood sashes. The next highest peaks, on December 6 and 7, average 17.9 amps. The baseline averages slightly below 1 amp. None of the values really correspond to the reported 14 amps for hood sashes closed without set-backs, which is to be expected since the VFD should always allow for set-backs.

Figure 5-1: 30HP Exhaust Fan Current (Nov.20-Dec.10)

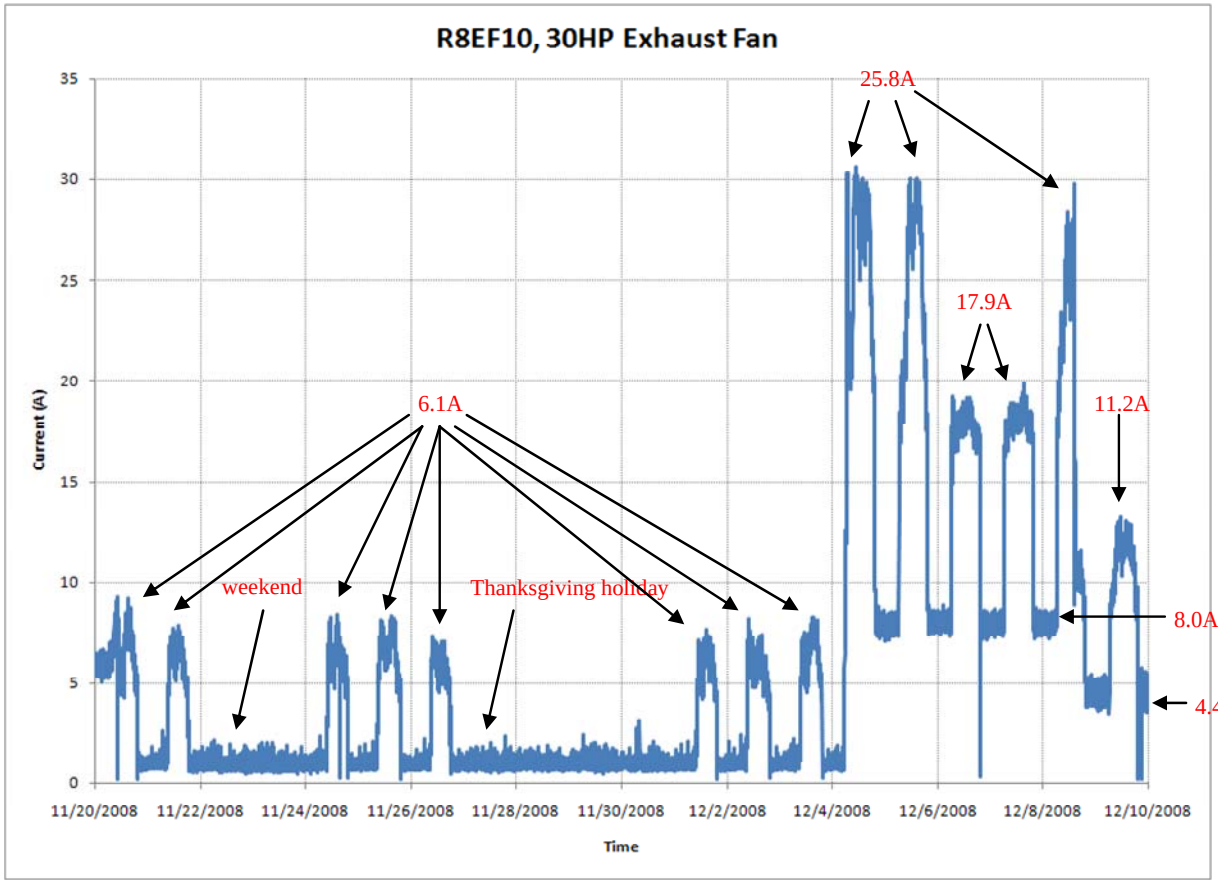
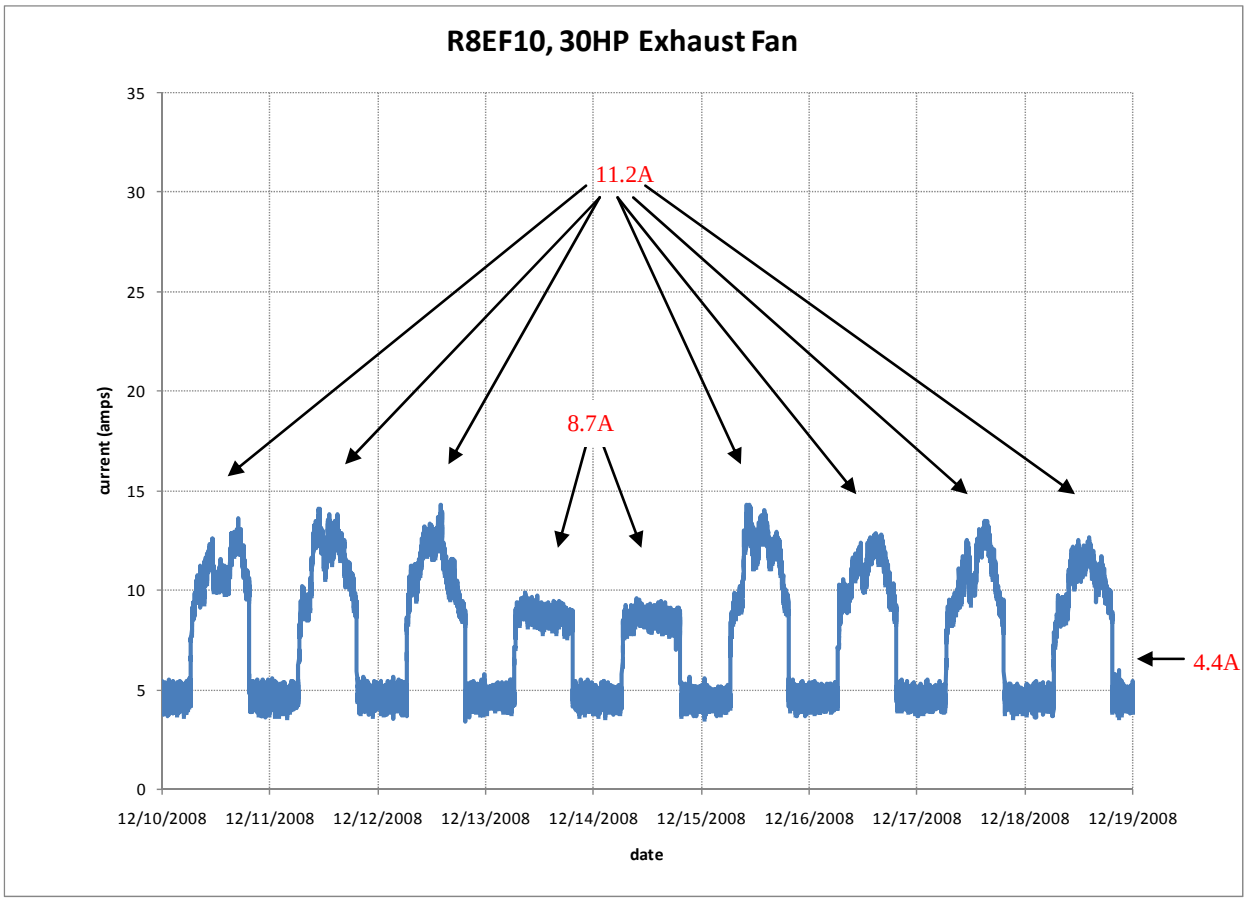


Figure 5-2: 30HP Exhaust Fan Current (Dec.10-Dec. 19)

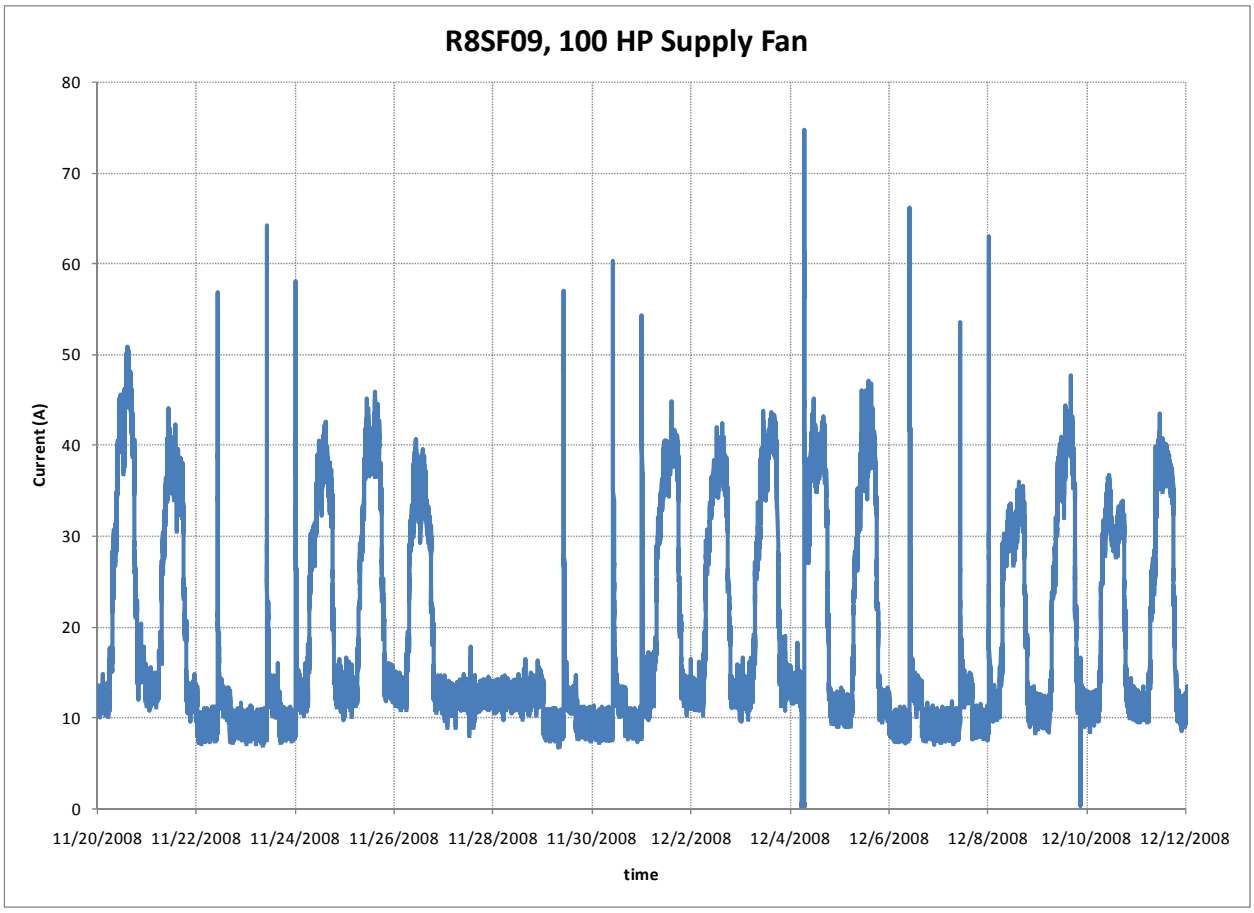


The two supply fans measured, R8SF08 and R8SF09, had much simpler profiles. R8SF08, the 75 HP fan exhibited three basic levels of operation. For just under half the measurement period, it operated at an average of 5.2 amps, far lower than any of the measurements reported on the application, which had 45 amps for sashes closed with set-back. For just under a quarter of the time, it operated at 9.9 amps and for around thirty percent of the time it peaked at an average of 16.7 amps, all well below the values reported on the application. However, the spot measurement of 15.1 watts with a power factor of 0.89 corresponds to around 20.5 amps per phase, also far lower than the values recorded on the application, but reasonably in line with the recorded peaks, which ranged from around 16 amps up to a maximum of 24.5 amps.

According to facility personnel, the metered 100 HP supply fan R8SF09 operated on shared controls with the second 100 HP supply fan, R8SF10, which was not logged. The metered data exhibited only two basic consumption levels, a baseline averaging 11.5 amps around two-thirds of the time, and a higher level averaging 33.9 amps the remaining one third of the time. As with the 75 HP fan this is vastly below the reported values of 78 amps for hood sashes open or 50 amps for hood sashes closed with set-backs. However, the maximum recorded peak of 74.6 amps does closely correspond to this. However, it is important to note that this peak level is not maintained for any significant length of time, as shown in

figure 5-3. In fact, although these peaks are of very short duration, they do not appear to be data errors, as the peaks rise and fall through several measurements and probably correspond to start-up spikes. Regardless, the spot measurement values of around 45 amps correspond well to the peaks of the logged data.

Figure 5-3: 100HP Supply Fan Current



Based on the measured data, and assuming that fans for similar applications (supply or exhaust) operate similarly over a five week period, a weighted average gives 101.6% of the expected current draw for the supply fans, but only 29.4% for the exhaust fans. Combining these adjustments with the current draws measured for the initial application, along with some corrections for missing power factors and incorrect hours, gives a total savings of 1,124,392 kWh/yr, excluding the removed fans. Assuming 60% reduction during peak hours corresponds to 77 kW of demand savings. Savings calculation formulas and details are shown in Appendix B. Since no baseline data is available on the three removed fans' loading they have not been included in the baseline used by Summit Blue. They were also not included in the baseline provided in the application, although their savings was estimated there at 197,100 kWh/yr. It is unclear why this was excluded, but Summit Blue has not included it since it is impossible to verify any baseline data and none is provided in the application.

The application included savings estimates for cooling reduction based on reduced exhaust air. Summit Blue reviewed these calculations and found them to be reasonable for the most part. However it was noted

that the 86% factor used for time the hoods were closed was not weighted to allow for less occupation at night than during the daytime. During the hottest part of the day, the building would typically be occupied five out of seven days. However, it is also possible that there would be a flow reduction mid-day corresponding with lunch hours. Using the estimated 60% set-back time during work days and 100% on weekends and holidays would correspond to only 71% set-back between 6AM and 8PM, which would correspond the hottest part of the day. The calculations used 86%, which is the overall percent of time during which set-backs are expected. Additionally, it appears that the 86% reduction was accidentally left out of the original calculation completely despite being explained in the write up. Although some evenings may have temperatures above 65 °F, the discharge temperature and minimum for which savings were calculated, and the measured fans showed lower than expected loads, the 71% figure is a more conservative estimate and has been used to reduce the expected cooling savings. It is not clear that the reduced fan loading corresponds to reduced airflow relative to the initial estimates, or if the estimates simply used a conservative high point measurement to estimate savings, so this has not been adjusted in the cooling savings. Based on this, the cooling savings should be reduced from 110,663 kWh/year to 79,045 kWh/year. No demand savings is included here because the majority of the savings are expected to be on weekends and therefore off peak.

The application provided for this site raised several questions with its savings calculations:

1. The calculation of savings due to removed fans is excluded from the rebated savings. No explanation of this exclusion is provided in the application. This would have provided an additional 197,100 kWh and 22.5 kW savings according to the application.

2. No power factor is included in savings calculations based on current measurements.

3. No efficiency is included in savings based on horsepower for removed fans. This could be included in the 67% load factor, but it is not clear from the application.

4. The baseline used for fan savings appears to assume the sashes are always open. However, the application only describes adding the setbacks, so the closure hours are included in the baseline calculation.

5. The percent of time for hood sash closure and set-backs does not appear to have been used in the final cooling savings calculation. Additionally, no provision has been made for the percentage of daytime as opposed to nighttime hours during which the set-backs occur.

Table 5-17 shows the total estimated savings. The claimed kW savings are estimated based on the application and 60% of load reduction during work hours, but were not explicitly provided. Based on these calculations, the savings appear to be significantly higher than predicted. This is true, despite the fact that the base case has been reduced by slightly over 20% due to the inclusion of hours with closed hoods but no set-backs, because of the exhaust fans using only around 30% of the predicted energy.

Table 5-17: Site 6 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	57.3	970,816
Verified Calculated Savings	77.0	1,203,437

5.4.2 Non-Residential Impact Evaluation Results

Table 5-18 provides the savings for the Custom Program. Overall, the program realization rate is 130.9%. However, it should be emphasized that since the City of Palo Alto Utilities Commercial Advantage Program only reports aggregate savings for each measure in the E3 calculator rather than itemizing each site, the claimed savings values have been calculated by Summit Blue based upon the assumptions provided by Utility personnel. Although every effort was made to accurately match the measures as discussed with program personnel, it is possible that there is some slight variation between the claimed values reported in these tables and those aggregated into the E3 calculator. However, any variation is expected to be minimal and so the realization rates are calculated based on these values. The recommended adjustments are attributable to revised savings estimates for deemed values and more measures implemented than claimed.

The larger of calculated or deemed energy savings have been used to obtain kWh. The demand savings used are the corresponding values. Only some of the fixtures had deemed savings available and since many of the T12 to T8 retrofits actually used premium T8 lamps and ballasts, the deemed values underestimated savings unless facility hours were low.

Table 5-18: Custom Program Claimed Savings and Verified Gross Savings

Project	Claimed		Verified	
	kW Savings	Annual kWh Savings	kW Savings	Annual kWh Savings
Site 1	13.3	77,695	17.8	82,737
Site 2	41.9	217,602	35.8	196,208
Site 3	60.9	341,884	111.8	538,551
Site 4	20.9	28,322	15.2	22,369
Site 5	43.6	183,141	67.8	338,729
Site 6	57.3	970,816	77.0	1,203,437
Total	**237.9**	**1,819,460**	**325.4**	**2,382,031**
Percent Realization			**136.8%**	**130.9%**

5.5 Non-Residential Program Site Observations

All but two of the projects sampled for on-site verification used deemed savings through prescriptive rebate programs. There were several notable issues with the applications at the sites:

1. *Inconsistencies between the application and the actual installation.* Variances, although not severe were present. Itemized invoices might help in some cases. Confusion over where the retrofit had taken place in some cases might be clarified if some sort of statement of the location was included with the application.
2. *Removal of screw-in CFLs.* This is notoriously hard to prevent, however reducing the use of dimmable screw-in CFLs, chandelier CFLs, and units in cold or damp areas would likely reduce the removal of units as customers would be less likely to have performance issues.

3. *Sale of properties.* This is a significant problem in the current down economy and probably cannot be avoided. Nevertheless it should be taken into account when considering the lifetime of measures.
4. *Under-reporting of savings, apparently due to rebate caps.* In the custom program, site 5 supplied an itemized invoice that showed significantly more units than claimed, but the application was not adjusted, possibly because of the rebate cap having been reached.

5.6 Non-Residential Program Record Observations

The final program records submitted by the implementation contractor to the City of Palo Alto Utilities were analyzed for accuracy and consistency, and to ensure that the underlying assumptions were reasonable. The key documents analyzed included the following:

- The project applications provided to the program for each site
- The invoices provided to the utility, where applicable

The primary observations from this review were that although the majority of the sites installed the measures listed on the applications, however savings were reduced due to discrepancies between the program's prescriptive savings estimates and those of the standard deemed values used in California.

Based on the review of program documents and on-site verification activities, the following conclusions were made.

1. The adjusted final realization rate for the Right Lights program was less than 100% due to the use of values for estimated savings that did not match the standard ones in the E3 calculator shown in the appendix.
2. The measure savings assumptions were calculated to be representative of the Program installations.
3. Itemized purchase orders should be required for applications, along with a list of the final retrofit plan.
4. Standard occupancy sensor reductions and deemed savings values should be used in calculations, or CPAU should clearly state their reasons for using alternative values.
5. Customers should be encouraged to report all savings, despite the rebate cap.

6 SUMMARY OF PROGRAM LEVEL MEASURE REALIZATION RATES

Two residential measures within the Smart Energy program and two non-residential programs were assessed within this evaluation effort. Overall, measure realization was found to be high with a sum total realization rate of 114.9%. Table 6-1 summarizes the measure realization rates estimated through this evaluation.

Table 6-1: Measure Realization Rates by Program for CPAU

Program	Savings Claimed (kWh)	Savings Verified (kWh)	Measure Realization Rate
Residential Refrigerator/Freezer Recycling	550,718	545,242	99%
Residential CFLs	765,609	765,609	100%
Commercial Right Lights	338,876	297,790	87.9%
Commercial Custom	1,819,460	2,382,031	130.9%
TOTAL EVALUATED	3,474,663	3,990,672	114.9%

Residential Refrigerator/Freezer Recycling

In this assessment, the JACO tracking database of participating recycled appliances was used. Measure implementation verification was assessed by reviewing what data was being collected and the completeness of these data entries for all measures tracked. We found that very detailed information was being collected and the most important variables, such as pick-up date, model number, and contact information for the participant was consistently collected for all appliances listed. We also checked to see if the number of appliances identified as participating in the program in the SmartData database matched with the number in the E3 calculator. The E3 calculator had two less participants. Therefore, we concluded that measure installation verification should be 100.7%.

Summit Blue also reviewed the claimed energy savings per unit. In our review of the JACO database, we found that 11.6% of the participants recycled a freezer rather than a refrigerator. However, in the E3 calculator, all participants were identified as recycling refrigerators. Therefore, we adjusted the savings per unit to reflect the freezers. This resulted in a downward adjustment in per unit savings to 98.3% of the original. The overall measure realization rate with these two adjustments was 99%.

For future years, we did recommend that savings estimates per unit be lowered to meet the most recent DEER update value.

Residential CFLs

Verifying the installation of CFLs is difficult. Going on-site to program participants and visually inspecting the light sockets is impractical. Therefore, CFL program participants were asked if they remember receiving the CFL and whether it is still in place as part of the telephone program participant survey. The results of this effort indicated 100% implementation verification.

Summit Blue also reviewed the claimed energy savings per unit. The claimed savings, as identified in the E3 calculator, are appropriate and accepted. Overall measure realization was found to be 100% for CFLs.

Commercial Right Lights

This program was found to have the lowest measure realization rate at 87.9%. Several inconsistencies were found between the program application and the actual installation. Some CFL applications were also found to be problematic. However, the greatest reason for lowered realization rates for some sites was caused by client turnover with resulting remodeling. Refrigeration measures were evaluated at two sites. For these specific measures, measure realization was estimated to be 93.7%.

Commercial Advantage Program

The City of Palo Alto Utilities Commercial Advantage Program uses savings values from the E3 calculator to estimate savings for prescriptive measures. When a measure in the program is not specifically listed in the E3 calculator, the most similar available measure is used in its place. Notably, wall occupancy sensors values are used for ceiling occupancy sensors, standard T8 lamp values are used for premium T8 lamps, and screw-in CFL values are used for hard-wired CFLs 27 watts and above. In general, these are very conservative estimates that tend to result in under reporting of savings. The Utility also uses savings values for lighting including interactive effects. Since the majority of the Utility's commercial customers are in climate controlled buildings rather than open industrial facilities, this is a reasonable assumption. However, since this is not the case in all areas, Summit Blue conservatively uses the values without interactive effects when performing calculations. Despite this, the Utility has generally underestimated savings compared to calculated values based upon site visits and this is reflected in the high realization rate for the Program.

Six sites were visited in order to evaluate custom measure installation. Five of the six sites involved lighting retrofits and the sixth was a VFD installation on a fume hood exhaust. The measure realization rate is estimated to be 130.9% for this program. However, realization rates varied significantly from site to site. The primary reason for the high realization rate was for site 5. At this site, the invoice being used for measure verification had many more lamp and fixture installations than what the site received a rebate for. It was obvious that the measures were being installed because of the program, but the participant hit the rebate maximum level, and therefore the lower rebate amount. For the cases with low measure realization, the reason was often different operating schedules between the actual installation and the generic operating hours used in the claimed savings calculation. Site 6, the VFD installation, proved to be challenging. Summit Blue conducted independent short term metering, interviewed the customer in depth on operation, and found errors in the claimed savings calculations. Overall, the measure realization at this site, because of these factors, improved to 124%.

7 CONCLUSIONS AND RECOMMENDATIONS

The overall conclusion is that Palo Alto has very well run residential and commercial DSM programs, and the program offerings to its customers is extensive and comprehensive. The new program changes and enhancements are especially noteworthy.

The customer survey found very high satisfaction levels for the Smart Energy program and they also felt that the rebate levels were good. Free ridership was found to be low, with the possible exception of screw-in CFLs. It is one of our recommendations that CPAU consider dropping screw-in CFLs from their incentive offerings.

The impact evaluation efforts for the residential sector confirmed nearly all of the claimed levels of energy savings reported by CPAU for these programs. The impact evaluations for the non-residential programs were also very good. However, the process of performing the evaluation pointed out some issues that CPAU should be aware.

The most important is the issue of building client turnover with the potential result of remodeling and the loss of the energy efficiency improvements. This occurred at one site. In addition, changeover of site occupants can mean different operation schedules and conditions that can affect energy use and savings significantly. With the changing economic conditions, this could be a major issue.

The refrigerator gaskets appear to be an effective addition to the Right Lights program. However, CFLs were found that were originally installed but no longer in use for a variety of reasons. Here, it is recommended that screw-in CFLs be dropped from the Right Lights program with the only CFL option being CFL fixtures.

Another issue found at one site in particular was the purchase by the participant of many more lighting lamps and fixtures than what they received a rebate for. The lighting lamps and fixtures were all on the same invoice, but only a portion claimed under the program because of the funding cap. In the particular case of this participant, the measures were all being installed as a result of participating in the program. Summit Blue recommends that CPAU claim savings for all installations.

APPENDIX A: NON-RESIDENTIAL CUSTOM SITE DETAILS

Table A-1. Standard Occupancy Sensor Reductions by Area Type

Space Type	% Savings	Space Type	% Savings	Space Type	% Savings
Assembly	45	Industrial	45	Restroom	45
Break room	25	Kitchen	30	Retail	15
Classroom	30	Library	15	Stair	25
Computer Room	35	Lobby	25	Storage	45
Conference	35	Lodging (Guest Rooms)	45	Technical Area	35
Dinning	35	Open Office	15	Warehouses	45
Gymnasium	35	Private Office	30	Other	15
Hallway	25	Process	45	Parking Garage	15
Hospital Room	45	Public Assembly	35		

Source: 2008 NRR-DR Program Procedures Manual, Table 2-1

Table A-2. Deemed Savings for Selected Measures Without Interactive Effects

Category	Measure	Peak kW Savings	Annual kWh Savings
Compact fluorescent	Screw-in 1-13W	0.021	121
Compact fluorescent	Screw-in 14-26W	0.038	220
Compact fluorescent	Screw-in ≥27W	0.054	314
Delamping	Delamp 4′ lamp	0.040	235
Exit signs	LED replaces incandescent	0.044	366
Occupancy sensors	Occupancy Sensor: Wall Box	0.176	238
T-8 linear fluorescent	T-12 to T-8 2′ lamp	0.008	47
T-8 linear fluorescent	T-12 to T-8 4′ lamp	0.006	37

Source: CPAU E3 Calculator

APPENDIX B: SITE 6 CALCULATIONS

Weighted average current draw realization was calculated separately for the three supply and two exhaust fans:

$$\%\ of\ expected\ current\ draw = \sum_{measured\ fans}\left(\frac{Iavg}{(IO \cdot TO)+(IC \cdot TC)+(ISB \cdot TSB)} \cdot \frac{Iavg}{\sum_{measured\ fans} Iavg}\right)$$

Iavg=measured average current draw for five week period on a given fan

TO=% of time sashes are open according to application=1,168hrs/8,736hrs

TC=% of time sashes are closed without set-backs according to application=3,760hrs/8,736hrs

TSB=% of time sashes are closed with set-backs according to application=3,808hrs/8,736hrs

IO=amps measured when sash open according to application

IC=amps measured when sash closed without set-backs according to application

ISB=amps measured when sash closed with set-backs according to application

Adjusted kWh fan savings:

$$kWh = \frac{(total\ fan\ current) \cdot (\sqrt{3} \cdot 480V) \cdot PF \cdot annual\ hrs}{1{,}000}$$

adjusting for a 8,760 hour year instead of a 52 week year on the applications gives:

sashes open 1,171.2 hrs/year

sashes closed with no set-backs 3,770.3 hrs/year

sashes closed with set-backs 3,818.5 hrs/year

PF=power factor≈0.85 for supply fans and 0.9 for exhaust fans based on spot measurements on site

Application values for post retrofit amps were adjusted by current realization (102% for supply fans; 29% for exhaust fans).

Application estimates for pre-retrofit conditions were accepted, but adjusted by power factor for savings calculations.

Before the retrofit, according to the application, the baseline is sashes always open. However since the retrofit is described as adding set-backs, Summit Blue has calculated baseline assuming sashes are open 1,171.2 hours per year and closed without set-backs for the remaining 7,588.8 hours per year. The unadjusted current measurements from the application are used for baseline calculations.

APPENDIX C: ENERGY STAR SPECIFICATIONS - RESIDENTIAL APPLIANCES

Dishwashers Key Product Criteria

Equipment	Criteria
Dishwashers	At least 41% more energy efficient than minimum federal government standards

Product Type	Federal Standard Energy Factor	ENERGY STAR Energy Factor
Standard (>= 8 place settings + six serving pieces)	>= 0.46	>= 0.65
Compact (< 8 place settings + six serving pieces)	>= 0.62	>= 0.88

The current ENERGY STAR criteria for dishwashers became effective January 1, 2007. This criteria is at least 41% above the federal standard and applies only to models manufactured after January 1, 2007.

Energy Performance Metric

Energy Factor (EF) is the dishwasher energy performance metric. EF is expressed in cycles per kWh and is the reciprocal of the sum of the machine electrical energy per cycle, M, plus the water heating energy consumption per cycle, W.

$$EF = \frac{1}{M + W}$$

This equation may vary based on dishwasher features such as water heating boosters or truncated cycles. The greater the EF, the more efficient the dishwasher is. The EF is the energy performance metric of both the federal standard and the ENERGY STAR qualified dishwasher program. The federal EnergyGuide label on dishwashers shows the annual energy consumption and cost. These figures use the energy factor, average cycles per year, and the average cost of energy to make the energy and cost estimates. The EF may not appear on the EnergyGuide label.

Refrigerators & Freezers Key Product Criteria

Equipment	Volume	Criteria
Full Size Refrigerators	7.75 cubic feet or greater	At least 20% more energy efficient than the minimum federal government standard (NAECA).
Full Size Freezers	7.75 cubic feet or greater	At least 10% more energy efficient than the minimum federal government standard (NAECA).
Compact Refrigerators and Freezers	Less than 7.75 cubic feet and 36 inches or less in height	At least 20% more energy efficient than the minimum federal government standard (NAECA).

On April 28, 2008, the ENERGY STAR criteria changed for all full-size refrigerators. All refrigerators greater than 7.75 cubic feet must be at least 20% more efficient than the federal standard. The ENERGY STAR criteria for full-sized freezers and compact refrigerators and freezers did not change at this time.

On January 1, 2004, the ENERGY STAR criteria for refrigerators changed to require all full-size models to be at least 15% above the minimum federal standard to qualify for ENERGY STAR. Please note, the ENERGY STAR criteria for full-sized freezers and compact refrigerators and freezers did not change at this time.

On January 1, 2003, the ENERGY STAR criteria for refrigerators expanded to include all sizes and configurations of refrigerators and freezers.

All refrigerators and freezers 7.75 cubic feet or greater in volume must be at least 10% above the minimum federal standard to qualify for ENERGY STAR.

All refrigerators and freezers less than 7.75 cubic feet in volume and 36 inches or less in height had to be at least 20% above the minimum federal standard to qualify for ENERGY STAR.

This expansion allowed the qualification of the previously ineligible products in the following categories:

Chest freezers

Upright freezers

Manual defrost freezers and refrigerators

Partial automatic defrost refrigerators

Single door refrigerators

Compact refrigerators and freezers

Federal Standards (NAECA)

The National Appliance Energy Conservation Act (NAECA) dictates minimum standards for energy consumption in refrigerators and freezers. The standard varies depending on the size and configuration of the refrigerator or freezer.

Refrigerators and freezers are categorized by:

Configuration (side-by-side, top freezer, bottom freezer, single door refrigerator and freezer, single door refrigerator only, chest freezer, and upright freezer)

Automatic or manual defrost

For refrigerators, whether or not they have through-the-door ice service

Adjusted Volume (AV) for refrigerators is calculated as follows: AV = (Fresh Volume) + 1.63 x (Freezer Volume).

For freezers, the adjustment factor is 1.73 so the calculation is: AV = 1.73 x Freezer Volume.

Fresh Volume is the total volume of the main refrigerator compartment.

Freezer Volume is the total volume of the freezer compartment.

Calculate the Federal Standard (NAECA) and the ENERGY STAR criteria for refrigerators and freezers.

You may still find refrigerator and freezer models designated as ENERGY STAR at retail that met the previous ENERGY STAR criteria for an extended period of time. If you have recently purchased one of these models, even though these models do not meet the current ENERGY STAR criteria for refrigerators and freezers, you can be confident that the product is highly efficient.

In addition, some of the ENERGY STAR qualified refrigerators and freezers displayed on the Web site were recently introduced into the market and may not be available for purchase in certain areas.

Air-Source Heat Pumps and Central Air Conditioners Key Product Criteria

Equipment	Specification
Air-Source Heat Pumps	>= 8.2 HSPF/ >=14 SEER/ >=11.5 EER* for split systems >= 8.0 HSPF/ >=14 SEER/ >=11 EER* for single package equipment including gas/electric package units
Central Air Conditioners	>=14 SEER/ >=11.5 EER* for split systems >=14 SEER/ >=11 EER* for single package equipment including gas/electric package units

*Energy Efficiency Ratio

TVs

TVs, VCRs, & Combination Units Key ENERGY STAR Product Criteria

Equipment	Specification
DCR TVs with POD Slots	**Consume three watts or less when no POD is installed** **Consume 15 watts or less when a POD is installed**
Analog TV Monitors, Televisions, Digital TV Monitors, Component TV Units, VCRs*, TV/VCR Combination Units*, TV/DVD Combination Units*, VCR/DVD Combination Units*, and TV/VCR/DVD Combination Units*	**Consume one watt or less when switched off**

*Units with illuminated or backlit displays or other electronic status indicators may add an additional one watt to the existing one watt specification.

APPENDIX D: PARTICIPANT SURVEY

PARTICIPANT SURVEY

Hello, I'm _____ with Ward Research, a professional market research firm. We are doing a survey for City of Palo Alto Utilities (or CPAU). We assure you that this is not a sales effort, but for research purposes only. According to our records, your household recently purchased a qualifying appliance and received a rebate for participating in CPAU's Smart Energy Program.

If the customer says: "I don't recall?"

Answer: The City of Palo Alto offers rebates to customers who purchase qualifying energy efficient equipment.

Were you involved with the decision to buy this equipment or

is there someone else in your household who made that decision?

Involved with/made decision 1	*(CONTINUE)*
Someone else decided 2	*(ASK TO SPEAK TO THAT PERSON, REPEAT INTRO AND THEN ASK Q1.)*

QQ1. Is that person available? If yes, continue, if not schedule call back

Equipment Characteristics

QC1. According to our records, you purchased a: <READ MEASURE FROM DATABASE> .

Code as follows:

A. CFL Light Bulb
B. Refrigerators
C. Dishwashers,
D. Washing Machines,

E. Gas Furnaces,
F. Gas Boilers,
G. Air conditioners
H. Water heater (both tank and tankless)
I. Pool pumps
J. Insulation for attic, roof and/or walls.

QC1A. Do you recall making this purchase?

1.	Yes	CONTINUE
2.	No	THANK AND TERMINATE
9.	Don't Know/Don't Remember	THANK AND TERMINATE

QC1B. Is this equipment/appliance still operational in your home?"

1. Yes- (Skip to QC2)
2. No
9. Don't Know (Skip to QC2)

QC1B1"If No, why not?

1. Never installed
2. It doesn't work anymore
3. I didn't like it, so I don't use it anymore
4. Other (specify) _____"

QC2: (ONLY FOR THE FOLLOWING APPLIANCES: Refrigerator ; Dishwasher ; Washing Machine : Gas Furnace : Gas Boiler : Air conditioner : Water heater OR Pool pump: ASK): Did you purchase this new or as a replacement for an existing appliance?

1. New (Skip to QA1)
2. Replacement (Continue)

3. Don't Know (Skip to QA1)

QC3. About how old was the appliance/equipment that you replaced?

_____number of years

99- Don't Know

ALL CONTINUE

Program Awareness

QA1. How did you first become aware of the CPAU's Smart Energy Program: *(Indicate first mention)*

1. From the website
2. From a utility mailing
3. From the dealer/retailer/installer where I purchased the equipment
4. Heard about it from a friend/colleague (word-of-mouth)
5. Other (Specify)
6. Don't Know- (SKIP to QP1)

QA2. What other ways did you become aware of the CPAU's Smart Energy Program: (Mark all that apply)

1. No other method
2. From the website
3. From a utility mailing
4. From the dealer/retailer/installer where I purchased the equipment
5. Heard about it from a friend/colleague (word-of-mouth)
6. Other (Specify)

Now, I'd like to ask you a few questions about your participation in the CPAU's Smart Energy Program.

Participation Process

QP1. Why did you decide to participate? (*Mark all that apply*)

1. Needed a new appliance/equipment
2. Wanted to save money on my utility bills
3. Seemed like a good deal/offer from the utility
4. Wanted to save energy/conserve the environment/be green
5. Other (specify)
9. Don't Know

QP2. Overall, please rate your satisfaction with the CPAU Smart Energy Program enrollment process on a five-point scale, where "5" means "Very Satisfied" and "1" means "Very Dissatisfied." How satisfied are you with the:

a. The requirements to complete the application such as

copies of the receipt, etc. 5 4 3 2 1 Don't Know

b. Amount of time it took for the application to be approved

after it was submitted 5 4 3 2 1 Don't Know

c. The energy efficiency requirements for

qualifying equipment	5 4 3 2 1	Don't know
d. Amount of the rebate received	5 4 3 2 1	Don't know

Now, I'd like to ask you a few questions about the purchase of the energy efficient equipment.

Free Ridership

QF1a. Prior to this purchase/installation of this equipment/appliance, have you ever considered purchasing this kind of equipment/appliance and then decided not to?

1. Yes **(**Skip to QF1b)
2. No (Skip to QF1c)
3. Don't Know (Skip to QF1c)

QF1b. What reasons prevented you from purchasing this equipment/appliance earlier? (ROTATE AND READ RESPONSES: (**Mark all that apply)**

1. I did not have the money at that time.
2. I was not sure how long I would remain in my home.
3. I did not have a contractor I felt I could trust.
4. The energy efficient equipment wasn't, available in my area
5. Other (Specify: DON'T READ)_____

QF1c. How likely is it that you would have purchased this type of energy efficient equipment/appliance on your own, if the utility had NOT OFFERED the rebate? On a five-point scale, would you say "5" Very Likely, "1" Very Unlikely" or some number in between?

Very Likely				Very Unlikely	Don't know
5	4	3	2	1	9

Satisfaction

QS1 Overall, how satisfied are you with the CPAU Smart Energy Program using the same five point scale

Very Satisfied				Very Dissatisfied	Don't know
5	4	3	2	1	9

QS2 Overall, how satisfied are you with CPAU?

Very Satisfied				Very Dissatisfied	Don't know
5	4	3	2	1	9

Barriers to Participation

QB1. Based on your experience, would you recommend this program to others?

1. Yes
2. No
9. Don't Know (Skip to QB2)

QB1a. Why do you say that?

QB2. How could the program be improved?

Spillover

QR1: Was this the first time you had purchased an energy efficient product?

1. Yes (Skip to QD1)
2. No (Continue)
3. Don't Know (Skip to QD1)

QR1: Have you purchased other energy efficient products without claiming the rebate from CPAU?

		Yes		No	DK
1. NONE					
2. CFL Light Bulbs		____		___	___
a. (IF so) How many?_____					
3. Refrigerator		____		____	____
4. Dishwasher	____		____	____	
5. Washing Machines,	____		____	____	
6. Gas Furnace	____		____	____	
7. Gas Boiler		____		____	____
8. Air conditioner		____		____	____
9. Water heater (both tank and tankless)		____		____	____
10. Pool pump		____		____	____
11. Insulation for attic, roof and/or walls.	____		____	____	

QR1B: When did you make this purchase? _____YEAR

QR2: When did you make this purchase?

_____YEAR

I just want to ask you a few questions for classification purposes only:

Customer Demographics

QD1. Do you own or rent your home?
1. Own
2. Rent
3. Occupy without payment

9. Don't know/refused

QD2. Is that a (***READ LIST***)
1. House
2. Apartment
3. Condominium
4. Townhouse
5. Other

9. Don't know/refused

QD3. How many people currently live in your home?

_____

QD3A. Has that number increased, decreased, or stayed the same during the past year?

1. Increased
2. Decreased
3. Stayed the same

9. Don't know

QD4. What is your total 2008 income before taxes for all members of your household? Was it (***READ LIST)***

1. Less than $20,000
2. $20,000-but under $40,000
3. $40,000 but under $60,000
4. $60,000 but under $75,000
5. $75,000 but under $100,000
6. $100,,000 but under $150,000
7. $150,000 or more
8. Don't know/refused (don't read)

QD5. What is the highest education level you completed?

1. Some high school
2. High school graduate
3. Some college/vocational school
4. College
5. Graduate

9. Refused

Thank you for taking the time to answer my questions!

APPENDIX E: NON-PARTICIPANT SURVEY

NON PARTICIPANT SURVEY

Hello, I'm _____ with Ward Research, a professional market research firm. We are doing a survey for City of Palo Alto Utilities. We assure you that this is not a sales effort, but for research purposes only. According to our records, you have not participated in the City of Palo Alto Utilities Smart Energy Program

If the customer says: "I don't recall, what is Smart Energy Program?"

Answer:: The City of Palo Alto offers rebates to customers who purchase qualifying energy efficient equipment.

Program Awareness

QA1. Are you aware of City of Palo Alto Utilities Smart Energy Program?

4. Yes
5. No
9. Don't Know

How did you learn about this program? (*Indicate first mention)*

1. From the website
2. From a utility mailing
3. From the dealer/retailer/installer where I purchased the equipment
4. Heard about it from a friend/colleague (word-of-mouth)
5. Other (Specify)
6. Don't Know- (SKIP to QP1)

QA2. What other ways did you become aware of the CPAU Smart Energy program (*Mark all that apply)*

1. No other method
2. From the website
3. From a utility mailing
4. From the dealer/retailer/installer where I purchased the equipment
5. Heard about it from a friend/colleague (word-of-mouth)
6. Other (Specify)

Barriers to Participation

QP1. Why did you decide NOT to participate? (*Mark all that apply*)

1. Didn't buy qualifying appliance/equipment
2. Didn't know about the program until after I purchased it
3. Didn't want to buy a more expensive model
4. Other (specify)

QR1: Have you purchased any of the following energy efficient appliances/equipment in the past year? (Read list; mark all that apply)

	Yes		No	DK
1. NONE				
2. CFL Light Bulbs	____		___	___
3. (IF so) How many?_____				
4. Refrigerator	____		____	____
5. Dishwasher ,	____	____	____	
6. Washing Machines,	____	____	____	
7. Gas Furnace	____	____	____	
8. Gas Boiler	____		____	____
9. Air conditioner	____		____	____
10. Water heater (both tank and tankless)	____		____	____

11. Pool pump ____ ____ ____
12. Insulation for attic, roof and/or walls. ____ ____ ____ ____

Satisfaction

QS1 Overall, how satisfied are you with the City of Palo Alto Utilities?

Very Satisfied				Very Dissatisfied	Don't know
5	4	3	2	1	9

I just want to ask you a few questions for classification purposes only:

Customer Demographics

QD1. Do you own or rent your home?
1. Own
2. Rent
3. Occupy without payment

9. Don't know/refused

QD2. Is that a (***READ LIST***)
1. House
2. Apartment
3. Condominium
4. Townhouse
5. Other
6. Don't know/refused

QD3. How many people currently live in your home?

_____

QD3A. Has that number increased, decreased, or stayed the same during the past year?

1. Increased
2. Decreased
3. Stayed the same
4. Don't know

QD4. What is your total 2008 income before taxes for all members of your household? Was it (***READ LIST)***

1. Less than $20,000
2. $20,000-but under $40,000
3. $40,000 but under $60,000
4. $60,000 but under $75,000
5. $75,000 but under $100,000
6. $100,,000 but under $150,000
7. $150,000 or more
8. Don't know/refused (don't read)

5. What is the highest education level you completed?

1. Some high school
2. High school graduate
3. Some college/vocational school
4. College
5. Graduate
6. Refused

Thank you for taking the time to answer my questions!