EVALUATION, VERIFICATION, AND MEASUREMENT STUDY

July 2007 to June 2008

For the City of Alameda

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SUMMIT BLUE
CONSULTING, LLC

Submitted to: Alameda Municipal Power

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1 INTRODUCTION

Alameda Municipal Power (AMP) is a department of the City of Alameda and has been in existence since 1887. AMP has one of the highest percentages of renewable resources of any electric utility and rates that are well below the California average. The revenue from this utility helps support such essential City services as Alameda's police, parks, and libraries. Currently, AMP has approximately 33,900 electric meters, 9,600 cable television customers, and 6,600 Internet customers. (Effective in early 2009, AMP changed its name to Alameda Municipal Power and is no longer in the telecommunications business.)

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), must by law 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 expanding 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.

1.2 Objectives

The primary objective of this EM&V effort at AMP is to verify the estimates of energy impacts from energy efficiency activities during FY 2007/2008 and adjust the savings estimates if necessary. A secondary objective is to field a commercial sector customer attitude survey.

The first objective was achieved through on-site visits to five of AMP's largest rebated projects in the Commercial Retrofit Program. The second objective was achieved through a telephone survey of program participants and non-participants. The participant survey included four of the five large participating customers. The fifth was the US Coast Guard, which did not participate in any utility evaluation efforts. The non-participant survey included 70 randomly selected commercial customers.

2 CUSTOMER SURVEYS

AMP's program evaluation focused primarily on conducting surveys with program participants and non-participants for its commercial programs. The customer surveys addressed the following key issues:

- Customer satisfaction with the programs and with AMP;
- Likely free ridership rates for each targeted measure;
- Measure persistence;
- Spillover – the effect the program had on encouraging other energy efficiency actions;
- Additional measures to consider in upcoming program years; and
- Areas for program improvement.

2.1 Methodology

These results primarily focus on the findings from the non-participant surveys. The goals of these surveys were to identify the major barriers to program participation and identify areas for program improvement. The Summit Blue team contracted with Ward Research to complete these surveys

Ward Research completed 70 commercial customer telephone interviews of non-participants, which exceeded the survey requirements for a statistically valid customer survey at the 90%/10% level. Telephone interviews were also completed for four Commercial Retrofit Program participants.

The participating customer sample consisted of trying to interview all program participants, except for military installations, as described in program tracking database. All customers were contacted and four surveys were completed. Therefore, the findings from the participant survey are qualitative and the results cannot be generalized to a larger population.

Three of the four program participants interviewed completed retrofits at more than one of their facilities in Alameda. For example, a drugstore retrofitted their old control system with a new efficient energy management system at all three of their stores in Alameda.

The non-participating sample was based on the current commercial customer database. The program participant information was provided by AMP.

2.2 Summary of Customer Surveys

This section summarizes the key findings from the participant and non-participant surveys. The results are most informative in identifying barriers to program participation among non-participants, as well as assessing the current level of awareness and interest in installing the types of energy efficiency measures targeted in AMP's commercial program.

2.2.1 Participant Characteristics

To date, the program has not attracted significant numbers of participants. However, the interviews with the four program participants represent six completed jobs, which represented 74 percent of the total rebates paid during the year and 23 percent of the total kilowatt hour savings estimates**.**

Table 2-1: Comparison of Program Participant Results to Total Program Results

	Rebate Amt Paid	kWh Savings	kW Saved	Reduction (lbs CO2e)	No. of participating customers
Total Program Results	$32,317	1,736,615	184.1	1,231,955	8
Survey Participant Results	$23,900	400,381	33	284,030	4
% of Total	74%	23%	18%	23%	50%

Equipment Installation

The participants were asked to describe the projects they completed through AMP's program. All of these projects combined several types of energy efficiency measures into one project. The participants represented a variety of projects including high efficiency lighting projects (3 participants); energy efficient motors/VFD (1 participant) and one HVAC project.

None of the nonparticipants had installed any qualifying equipment.

2.2.2 Non-participant Awareness

Of the nonparticipants, 76% were not aware of AMP's energy efficiency programs.

2.2.3 Program Participation

The program participants provided their reasons for deciding to participate in this program. Three of the projects were for chain stores, and so it is the company policy to apply for rebates for energy efficient equipment they install. The other participants indicated that they are also looking to participate in these programs as they become aware of them. Their responses are summarized in the following comments:

> *"We do 10,000s of rebates that we qualify for but did not recall any details at each project location."*
>
> *"We are taking a comprehensive approach and working our way throughout the state; we are implementing programs throughout CA at 150 stores."*
>
> *"We looked at the energy costs and the rebate and decided to go ahead, but would have probably done it without the rebate, we have to get approval for energy efficiency upgrades and the rebate made it easier."*
>
> *"We wanted to save money."*

Barriers to Program Participation

Nearly all (91%) of the non-participants said they did not participate in the program because they were not aware of it. Of the seven entities who were aware of the program, three respondents said they could not participate because they did not own the facility; three said they did not have the money for projects and one was not interested.

Most non-participants indicated they would be interested in participating in the program at a future time, if they knew more about it. Additional information regarding this finding is discussed in Section 2.3 Key Findings and Recommendations.

2.2.4 Electricity Usage

For three of the four participants, electricity comprises a relatively small amount of their overall operating budget, 5 percent or less. One participant said that electricity represented between 11 and 25 percent of the total operating budget.

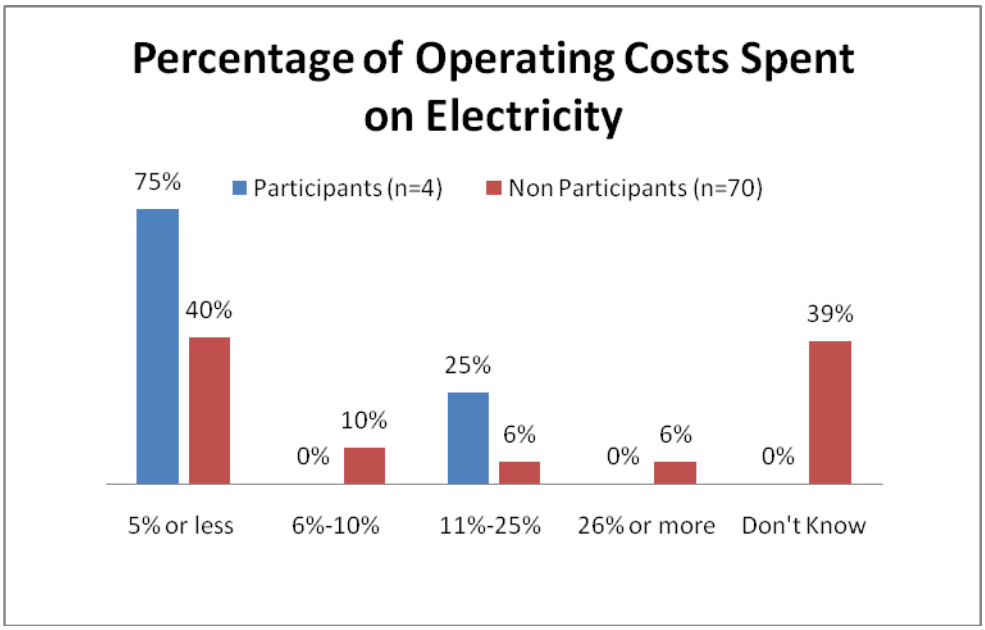
Table 2-2: Reported Percentage Spent on Electricity

	All Respondents	Participants (n=4)	Non-participants (n=70)
5% or less	42%	75%	40%
6%-10%	9%	0%	10%
11%-25%	7%	25%	6%
26% or more	5%	0%	6%
Don't Know	36%	0%	39%

As Figure 2-1 shows, electricity costs represent a relatively low percentage of respondents overall costs for both groups. However, this finding is consistent with the diverse nature of the commercial and industrial building segment. In manufacturing, restaurants, and supermarkets, electricity represents a much smaller percentage of overall operating costs, less than 5 percent based on estimates from the Environmental Protection Agency, while electricity represents a significantly higher percentage of operating costs for commercial buildings—up to 30 percent, according to the EPA. This is because other factors, such as labor and costs of materials comprise a much higher percentage of the total operating costs for a commercial facility.[1] This finding helps to explains why energy efficiency is typically not "top of mind" for many business owners and managers. However, there are still significant savings to be achieved in these facilities that will directly affect a company's overall profitability.

[1] For more information about the role of energy costs by building types, visit EPA's Building and Plants website at http://www.energystar.gov/index.cfm?c=business.bus_index

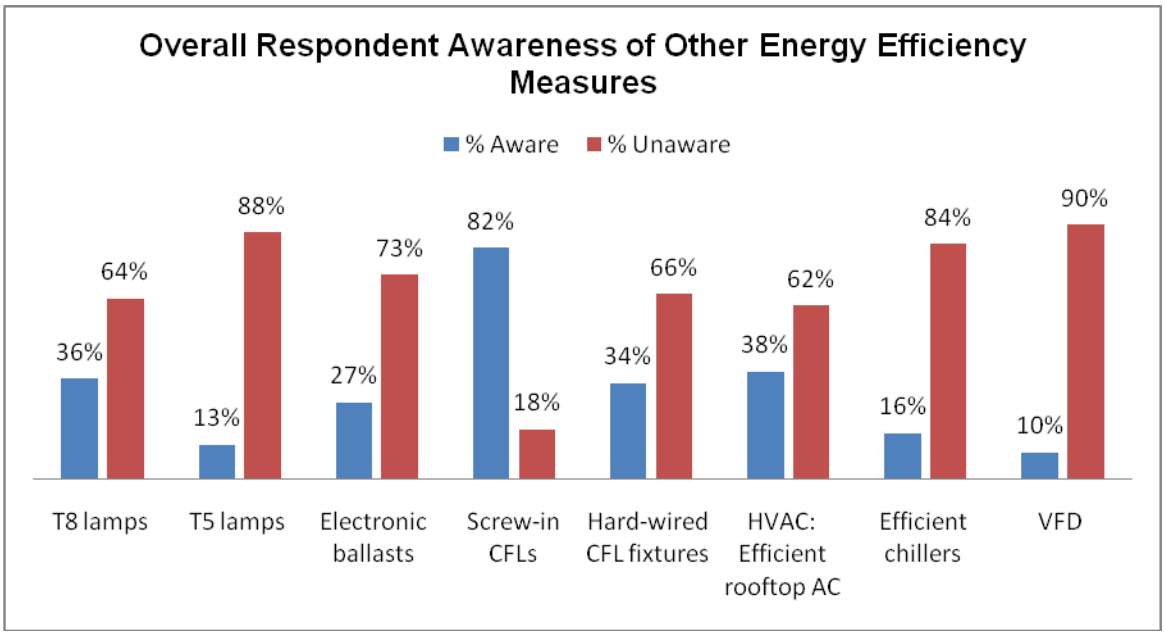
Figure 2-1: Comparison of Estimated Operating Costs between Groups



2.2.5 Awareness of Other Energy Efficiency Measures

All of the respondents were also asked about their level of awareness of other types of energy efficiency measures. As Figure 2-2 illustrates, most of the commercial customers were aware of CFLs (82%), but awareness levels dropped sharply regarding other energy efficient technologies. This finding suggests that in general, commercial customers in AMP's service territory are not familiar with the types of energy efficient equipment available through this program.

Figure 2-2: Overall Awareness of Other Energy Efficiency Measures



Although not statistically significant, these findings illustrate the differences in awareness levels between participants and non-participants. For example, all of the participants (n=4) were familiar with VFDs compared to the only 4 percent of the non-participants. Similarly, participants reported much higher awareness levels for lighting technologies compared to non-participants. These findings suggest an increased need to educate commercial and industrial customers about the availability and benefits of these energy efficient technologies.

Those non-participants, who were actually aware of this energy efficient equipment, also provided their reasons for not installing this equipment. Table 2-3 displays these findings for each type of energy efficient lighting equipment currently available through AMP's program. As the responses show, the major barrier for not installing energy efficient lighting equipment is because the non-participants said they had already installed a variety of measures including CFLs and T8 lamps.

Table 2-3: Reasons for Not Installing Energy Efficient Lighting Equipment

Reasons	Total	% of Total	T8 lamps (n=21)	T5 lamps (n=8)	Electronic ballasts (n=13)	Screw-in CFLs (n=29)	Hard-wired CFL fixtures (n=22)
Implemented already	54	57%	48%	25%	54%	64%	73%
Not aware of measure	5	5%	14%	13%	8%	0%	0%
Cost effectiveness concerns	9	9%	14%	25%	15%	2%	5%
Existing equipment still works	7	8%	10%	13%	8%	7%	5%
Don't Need The Equipment	7	8%	5%	0%	8%	11%	9%
Tenants Decide	6	7%	5%	13%	8%	7%	5%
Don't Know	4	4%	5%	13%	0%	2%	5%
Safety concerns	1	1%	0%	0%	0%	2%	0%
Equipment Availability Problems	1	1%	0%	0%	0%	2%	0%
Landlord Decides	1	1%	0%	0%	0%	2%	0%
Total	94	100%	100%	100%	100%	100%	100%

The non participants were allowed to give more than one response, so the answers do not total 100%. Table 2-3 displays these findings for each type of energy efficient lighting equipment currently available through Alameda's program. As the responses show, the major barrier for not installing energy efficient lighting equipment is because the non participants said they had already installed a variety of measures including CFLs and T8 lamps.

Table 2-4: Reasons for Not Installing Energy Efficient HVAC Equipment

Reasons	Total	% of Total	HVAC: Efficient Rooftop AC (n=22)	Efficient Chillers (n=7)	VFDs (n=3)
Don't Need the Equipment	19	59%	55%	57%	100%
Implemented already	8	25%	27%	29%	0%
Cost effectiveness concerns	2	6%	5%	14%	0%
Measure first cost/capital constraints	1	3%	5%	0%	0%
Landlord Decides	1	3%	5%	0%	0%
Don't Know	1	3%	5%	0%	0%
Total	32	100%	100%	100%	100%

Table 2-4 displays the responses given by the 32 non participants who were aware of energy efficient HVAC equipment, but chose not to install it. The remaining 38 non participants were not aware of energy efficient HVAC equipment. The non participants provided similar reasons for not installing energy efficient HVAC equipment. A strong majority (59%) said they did not need this equipment while another 25% said they had already installed it.

These findings suggest that additional barriers to participation may be that the respondents either have or think they have already installed this type of equipment or they do not think this equipment will provide them any benefits.

2.2.6 Free Ridership and Spillover

Given the qualitative nature of these findings, the data are not sufficient to assess free-ridership levels. One of the four participants indicated they would have installed the equipment without the program, while two said the program was the major reason for the installation. One was not sure.

All four participants said that they would install additional energy efficiency measures now that they are aware of the program. Similarly, 58 percent of the non-participants also said they would be interested in participating in this program in the future, now that they are aware of it. These findings suggest that there are still significant savings opportunities available to commercial customers in AMP's service territory and that program free ridership is relatively low, given the extensive number of installations of energy efficient equipment without the program rebates.

2.2.7 Customer Satisfaction

The customer surveys also addressed several issues that drive customer satisfaction. All the participants were asked about their satisfaction with the program and their contractors, if they used them to install the equipment, on a five-point scale where "1" is "Not at all Satisfied" and "5" is "Very Satisfied."

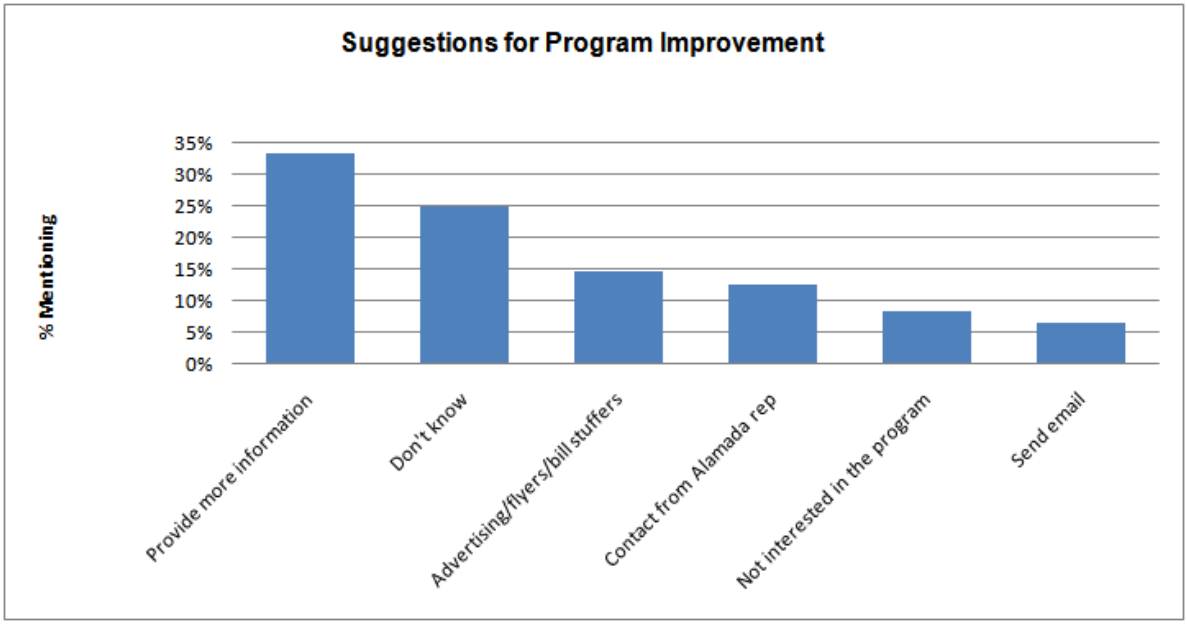
Program Satisfaction

Overall, the participants are "Very Satisfied" with the program, with 75 percent ranking their satisfaction a "5." The following comments expand on these ratings.

> *"We have seen enormous energy savings… we are saving money and the customers are seeing a more pleasant atmosphere…we have already seen enormous energy savings from July 07 to July 08 with a $2,600 reduction in energy costs and a saving $5,000 to $6,000 annually."*
>
> *"We are saving money."*
>
> *"The outcome was great."*
>
> *"It is a pretty flawless program…it was pretty easy to set up."*

While the participants did not provide any suggestions for program improvement, the non-participants did offer some insights (see Figure 2-3). Most of these suggestions focused on ways that Alameda should increase program awareness either by sending out more information to commercial customers or by setting up visits with customer representatives. The lack of awareness is the biggest barrier to participation and the non-participants are definitely interested in learning more about this program from AMP.

Figure 2-3: Suggestions for Program Improvement



Contractor Satisfaction

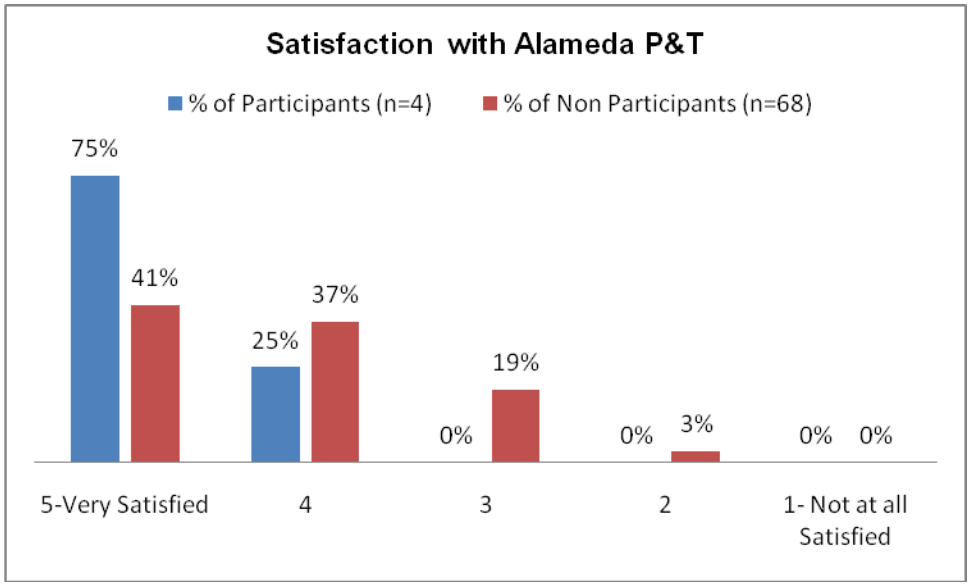
Two of the participants used outside contractors to install the equipment, but both were "Very Satisfied" with the result. Overall, contractor satisfaction was very high for this program, albeit this is a qualitative finding only.

Satisfaction with AMP

Both the participants and non-participants were also asked to rate their overall satisfaction with AMP. Overall, the participants reported much higher satisfaction levels with AMP compared to the non-participants. However, both groups were generally pleased with the utility company, as shown in Figure 2-4.

While these findings are not statistically significant, they do suggest that program participation does have a positive effect on the respondent's overall assessment of AMP.

Figure 2-4: Satisfaction with AMP



Most of the reasons given by non-participants who indicated some level of dissatisfaction with AMP were based on their lack of awareness about the rebate programs. These non-participants indicated a strong interest in the program and want to know more about how to participate in the future.

2.2.8 Respondent Demographics

The following four tables (Tables 2-5 through 2-8) summarize the overall characteristics of these survey respondents. As these tables show, the participating firms tended to be part of a larger organization, such as a chain, branch office, or franchise while the majority of the non participating firms were single-establishments.

Table 2-5: Type of Firm

Type of Firm	Participants (n=4)	Non-participants (n=70)
Single Establishment	0	66%
Headquarters	0	4%
Branch office	25%	4%
One of a chain	50%	4%
Franchise	25%	2%
Property Management Company	0%	9%
Government Facility	0%	2%
Non-Profit Organization	0%	9%

The participants tended to lease their facilities, while the non-participants were nearly evenly divided between owned and leased.

Table 2-6: Owned vs. Leased

Owned vs. Leased	Participants (n=4)	Non-participants (n=70)
Owned	25%	55%
Leased	75%	46%

As Table 2-7 shows, both respondent groups were evenly divided regarding the types of organizations that managed their properties.

Table 2-7: Property Managed By:

Property Managed By:	Participants (n=4)	Non-participants (n=70)
Organization	50%	42%
Management Company	25%	36%
Building Owner	25%	22%

Table 2-8 illustrates the sharpest distinction between the two respondent groups in that the participating customers work for large organizations, while the non-participants tended to employ five or less.

Table 2-8: Number of Employees

Number of Employees	Participants (n=4)	Non-participants (n=70)
< 5	0	71%
5-24	0	19%
23-99	50%	3%
100+	50%	5%

2.3 Key Findings and Recommendations

The customer surveys revealed the following key findings:

- Program participants had a much higher level of awareness regarding the program and targeted measures.
- Lack of program awareness is the biggest barrier to program participation.
- Most customers, from both groups, are familiar with energy efficiency lighting technologies; however, awareness declines sharply among non-participants regarding the benefits of energy efficient HVAC equipment.
- The findings are not sufficient to draw any conclusions regarding free ridership or spillover; however, qualitatively they suggest that many non-participants are installing lighting equipment on their own, without the program. This is true among both participants and non-participants, especially for energy efficient lighting.

- Overall program satisfaction among participants is very high and all are pleased with the program and the savings it has achieved at their facilities.

- Overall satisfaction with AMP is higher among participants compared to non-participants.

These findings have led to the following recommendations for AMP to consider regarding program improvements.

- AMP should consider reducing or eliminating its rebates for screw-in CFLs, These measures are already in place at many non-participating facilities and therefore the rebate funds should be allocated to technologies that encourage energy efficient savings, including additional lighting technologies, as well as broadening its focus to include other end uses, such as motors, compressed air, and pumps.

- AMP should consider increasing the frequency of contacts with potential customers. These increased communications could include sending monthly emails, monthly or quarterly updates to the website, and electronic newsletters and other information designed to increase awareness of the savings and benefits of energy efficient technologies.

- AMP may want to document the participants' overall savings and benefits in the form of case studies and testimonials that could be included in these mailings and posted on the website. These case studies could provide additional information about the benefits of installing the targeted equipment.

- Given the difficulty of reaching out to commercial customers, combined with the staffing constraints, AMP may want to consider outsourcing its commercial program to a third-party administrator. This third party could provide additional "feet on the street" to supplement AMP's current activities, and provide marketing and advertising support which may lead to increased program participation.

- AMP should consider leveraging the educational materials provided by Department of Energy and the Environmental Protection Agency. These resources are free of charge. More information is available at the Department of Energy's Building Technologies Program, (http://www1.eere.energy.gov/buildings/, EPA's Portfolio Manager Program, (https://www.energystar.gov/istar/pmpam), and related programs such as Motor Decisions Matter (www.motorsmatter.org).

3 IMPACT EVALUATION OF THE COMMERCIAL CUSTOM PROGRAM – LIGHTING AND CONTROLS

The primary objectives of an impact analysis are to assess gross and net demand and energy savings and the cost-effectiveness of the installed systems. An impact evaluation verifies measure installations, identifies key energy assumptions, and provides the research necessary to calculate defensible and accurate savings attributable to the program. The methodology and activities used in the impact evaluation are discussed below.

The FY 2008 impact evaluation focused on the five largest rebated projects in the Commercial Retrofit Program. However, they only account for 23% of total efficiency savings for the utility. This is because of the presence of a Coast Guard facility in the utility's territory. Although the facility installs energy efficient equipment, because of national security, they do not allow the utility to inspect the installations and therefore do not request rebates through the Program.

3.1 Impact Evaluation Methodology Overview

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

1. Verify 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 AMP.
3. Developed adjusted measure savings values based on field activities and data reviews.
4. Provided conclusions and recommendations for the AMP Commercial Retrofit Program.

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

3.2 Measure Installation Verification

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 operating schedules, seasonal variations in schedules, and control strategies. Although only short-term performance data could be reviewed, trends can be observed and general conclusions made.

3.2.1 Installation Verification Sample

The five largest projects that received rebates in FY 2008 were included in the evaluation. The evaluation focused on lighting retrofits primarily involving new both T-8 to premium T-8 and T-12 to T-8 fluorescent fixtures. The remaining three sites installed new controls systems.

The AMP includes a Coast Guard station, which accounted for 76% of the utility's claimed savings, but for which no rebates were issued. Summit Blue was unable to reach anyone who could provide details on the installation. According to the utility, this has been a long-standing issue. National security regulations do not permit inspection by the utility or third parties, so no verification was performed on these measures.

Table 3-1 details the verification results of the energy efficient installations and savings sampled that occurred under the Commercial Custom Retrofit Program for the AMP. For privacy, the customer names are not given, but rather a site number assigned.

Table 3-1: Verified Program Installations and Savings

Customer	Retrofit Measures	kW	kWh
Site 1	T-12, standard T-8, and MV to premium low wattage T-8 fixtures	32.9	164,480
Site 2	T-12 to T-8 retrofits	1.2	7,164
Site 3	Energy management system	0	25,165
Site 4	Energy management system	0	32,230
Site 5	Energy management system	0	103,536
Program Total		34.1	332,575

The lighting retrofits involved replacing either T-12 or older T-8 fluorescent systems with higher efficiency T-8 units. The energy management systems replaced older, locally operated and overridable controls with a system controlled from a centralized system with limited local override capability.

In evaluating these projects, particular attention was paid to reviewing the program documents and supplementing them with field verifications. The evaluation of the lighting retrofits involved the International Performance Measurement and Verification Protocol (IPMVP) Option A approach by reviewing engineering calculations and performing site interviews. The evaluation of the energy management systems involved the IPMVP Option C approach by analyzing billing data. The table below provides a brief explanation of the various IPMVP evaluation approaches.

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
Option A: Engineering calculations using spot or short-term measurements, and/or historical data	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

In some cases, deemed values were compared to calculated savings values. The Alameda E-3 calculator uses a site based pre- and post-installation verification approach and does not always use deemed values. However, in the case of the one site that implemented measures with standard deemed values typically used in California, these were compared to the calculated savings values. These are considered an acceptable alternative to calculated values for CEC verification. At Site 2 deemed values for the T-12 to T-8 fluorescent retrofits were compared to the calculated values. However, no deemed values were available for the efficient T-8 upgrade or energy management systems, so calculated values were used for comparison to claimed and verified savings.

3.2.2 Site Verification 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 October 20, 2008. At the time, it was anticipated that all expected installations were completed and finalized. However, in the case of the EMS retrofits, only a few months of post-installation data were available for the evaluation and this significantly increased the uncertainties in the evaluation.

3.2.3 Installation Verification Results

Verification work, discussions with participants subsequent to field verification activities, and an analysis of the verified installations indicated that all of the installations attributed to the Commercial Retrofit Program were installed, but the savings were not necessarily accurately calculated. Most notably the assumptions used for the baselines of the EMS replacements at sites 3, 4, and 5 were not clearly explained in the applications and appear to have overstated the savings at some of the sites based upon four months of data.

Site 1

Site 1 is a retail facility that retrofitted standard 32-watt T-8 lamps and ballasts to premium efficiency low power 28-watt units. It also retrofitted T-12 and mercury vapor fixtures to premium efficiency units. A small number of 250-watt mercury vapor fixtures were also replace with four-foot, four-lamp T-8 fluorescent units.

The application indicated 4,900 hours of operation. Based on discussions with facility personnel, this was determined to be close. The store is open 8AM to 9PM weekdays, 9AM to 7PM on Saturdays, and 10AM to 6PM on Sundays. Staff frequently overrides the setbacks for an additional 15 minutes before opening and up to an hour after closing time. Additionally, ten percent of the lights remain on 8,760 hours per year for security reasons. A weighted average of these conditions, allowing for the emergency lights, gives around 5,000 hours per year of operation.

This sort of retrofit often carries the risk that although the premium efficiency ballasts are unlikely to be changed, lamps can be switched out at any time. However, inspection of the site showed that 28-watt lamps were still in use. Summit Blue used standard wattages for the efficient fixtures, although these match the ballast type, they assume a 30-watt rather than a 28-watt lamp for the four-foot fixtures. However, this affected a relatively small percentage of the retrofit, and the increased hours of operation due to the emergency fixtures more than made up for the decrease.

Overall 214 eight foot, two-lamp, high output T-8 fixtures and 65 eight foot, three-lamp, high output fixture retrofits, made up the majority of the site's savings. Standard wattages were used for these units on the application. There were also 18 four foot, four lamp, 12 four foot, two-lamp, and four U-type two-lamp T-8 fixtures retrofitted. Ten 250-watt mercury vapor lamps were replaced with four foot, four-lamp T-8 premium fixtures. The application accurately represented these numbers. Table 3-2 summarizes both the claimed and adjusted energy savings for Site 1.

Table 3-2: Site 1 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	32.9	161,386
Verified Calculated Savings	32.9	164,480

Site 2

Site 2 was a commercial space and parking area and consisted of T-12 to T-8 retrofits of fluorescent fixtures. It constituted only a portion of the facility, but all fixtures in the immediate area were retrofitted as described in the application. The site retrofitted 50 eight-foot, two-lamp T-12 and 36 four-foot, two-lamp T-12 magnetically ballasted fluorescent fixtures with electronically ballasted T-8 fixtures on a one-for-one basis. The observed retrofit matched the application exactly. The hours on the application ranged from 1,000 for a storage area to 4,110 for outdoor fixtures and were determined to be reasonable based on discussions with facility personnel.

The savings claimed on the application were found to be reasonable. However, the standard deemed savings for a T-12 to T-8 retrofit are higher than the application's values. This is because deemed savings are based on longer hours of operation than those for which this facility operates. This results in a decreased demand value, but an increased energy savings relative to the claimed savings. It was noted that although these standard deemed savings, which are detailed in Appendix A, are allowable under the program rules, they are not listed in the E3 calculator used by the AMP because actual pre- and post-installation verified values are used at each site by the utility. Nevertheless, they have been used in place of the calculated savings for this project since they are permissible and result in higher savings numbers.

Table 3-3: Site 2 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	1.9	4,893
Verified Actual Savings	1.9	5,161
Verified Allowable Savings	1.2	3,063
Deemed Savings	1.2	7,164

Sites 3, 4, and 5

Sites 3, 4, and 5 were all moderately sized drug stores and all received similar controls retrofits. Only site 4 had any HVAC units with economizers. All three sites were controlled remotely and the setback schedules were operating correctly. Staff at the stores had the ability to override the main lighting shutoffs and did so on a regular basis to accept deliveries two days a week. Since all of these sites were only adjusting scheduling, not retrofitting equipment, no demand savings were expected for them. According to the company, none of the new scheduling was activated until June of 2008, although staff at some locations indicated the control unit was installed as early as May in the case of Site 3.

Site 3 used one 8.5 ton and two 7.5 ton roof top units (RTU) for cooling. All three of these units, as well as the facility lighting are controlled by the energy management system (EMS).The facility was occupied from 6AM to midnight most days, although twice a week staff arrive at 5AM for deliveries. The system turned off the lights at 10:30PM every night except Sundays, when they were shut off at 9:30PM, except on the sales floor, where they shut off a half hour earlier. Lights automatically turned on at 6AM on weekdays and 7AM on weekends, and an hour later on the sales floor. Staff has the ability to override the main lighting settings. The HVAC system was set back between 11:45PM and 7AM every day. The pharmacy area had reduced hours in the system.

Site 4 had one 7.5 ton and one 2.5 ton RTU as well as two 20 ton RTUs with economizers. The store was open from 7AM to 10:30PM Monday through Saturday and 7AM to 9:30PM on Sundays. On Tuesday and Friday, the lights turn on at 5AM for deliveries. Staff claimed that temperatures inside the store were

noticeably hotter after the retrofit. Although this indicates that the setbacks were indeed operational, it is not an optimal situation since staff complained that it was uncomfortable. The current operation schedules indicated the HVAC system was set back at 9:45PM every day except Sunday, when the setback occurred an hour earlier. The system shifted to a daytime schedule at 7AM every day. The lighting was set to turn on at 7AM every day and off at10:15PM except on Sundays when it shut off at 9:15PM. Sales floor lighting turned on at 8PM and off at 10PM, except on Sundays when it shut off at 9PM. The pharmacy had reduced hours.

Site 5 had one 60-ton air handling unit (AHU) with four zones and 1 cooler, but no economizer. The store was occupied from 6AM to 10:30PM Mondays, Wednesdays, and Thursdays and from 5AM to 10:30PM on Tuesdays and Fridays. On Saturdays, it was occupied from 7AM to 10:30PM and on Sundays from 7:30AM to 9:30PM. Staff claimed that temperatures inside the store were noticeably hotter after the retrofit. Although this indicates that the setbacks were indeed operational, it is not an optimal situation since staff complained that it was uncomfortable. As with site 4, staff indicated that the temperature inside the store had increased since the retrofit. The sales floor lighting was on from 8AM until midnight and the remaining lights, except in the pharmacy, were set to turn on at 7AM and off at midnight every day. HVAC setbacks occurred at 9:45PM except on Sundays when it was at 8:45PM. The system shifts to a daytime schedule at 6AM on weekdays and 7AM on weekends.

For each site, Summit Blue compared daily energy use before and after the retrofit to average daily temperatures. Unfortunately, the retrofit had only been in place for a few months prior to the verification, and daily energy usage was not available for any of the sites. Because of this, savings from the retrofit cannot be determined as accurately as might otherwise be possible, however Summit Blue has used a linear regression to estimate the reduction in energy use at each site.

Since each billing period consisted of a slightly different number of days, Summit Blue took a daily average of the kWh for the billing period and compared it to the average temperature for the same period. Temperature data was obtained from NOAA's databases for the Oakland airport, which is only a few miles from the Alameda sites.

A linear regression was performed on the energy and temperature data for each site. Since only HVAC savings were claimed on the application, the energy use was assumed temperature dependent. The small number of data points makes it difficult to accurately estimate the savings, however the linear trend was used to estimate energy usage for both the pre- and post-retrofit conditions compared to long-term average temperatures for a yearly cycle. The results were used to estimate energy savings. It should be noted, however, that there is a significant amount of uncertainty in the result due to the limited amount of data available at the time of the evaluation.

The first figure for each site (Figures 3-1, 3-3, and 3-5) show the monthly energy usage for each of the sites. The second figure for each site (Figures 3-2, 3-4, and 3-6) show the comparisons of the energy use as a function of temperature before and after the retrofits. A linear regression can be seen to appear reasonable in most cases as shown in the figures. As can be seen in figure 3-2, the post-installation site 3 data did not appear to depend upon temperature. However, the usage did appear to be less than that pre-installation. Therefore, the minimum savings was taken as an estimate for lower temperatures where no data was available. This should provide a very conservative savings estimate.

Figure 3-1: Site 3 Monthly Energy Use

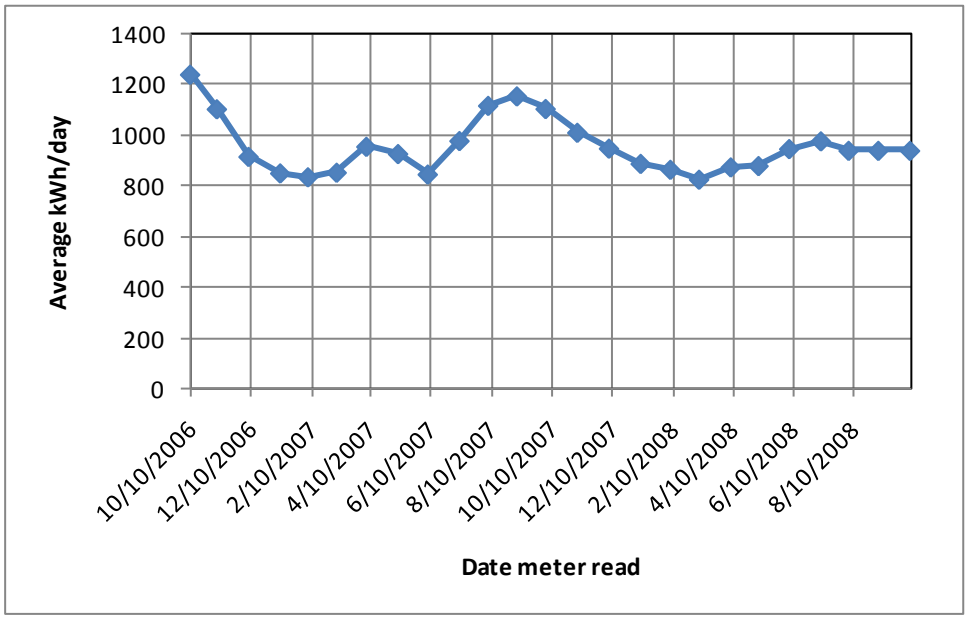


Figure 3-2: Site 3 Temperature Dependence of Energy Use

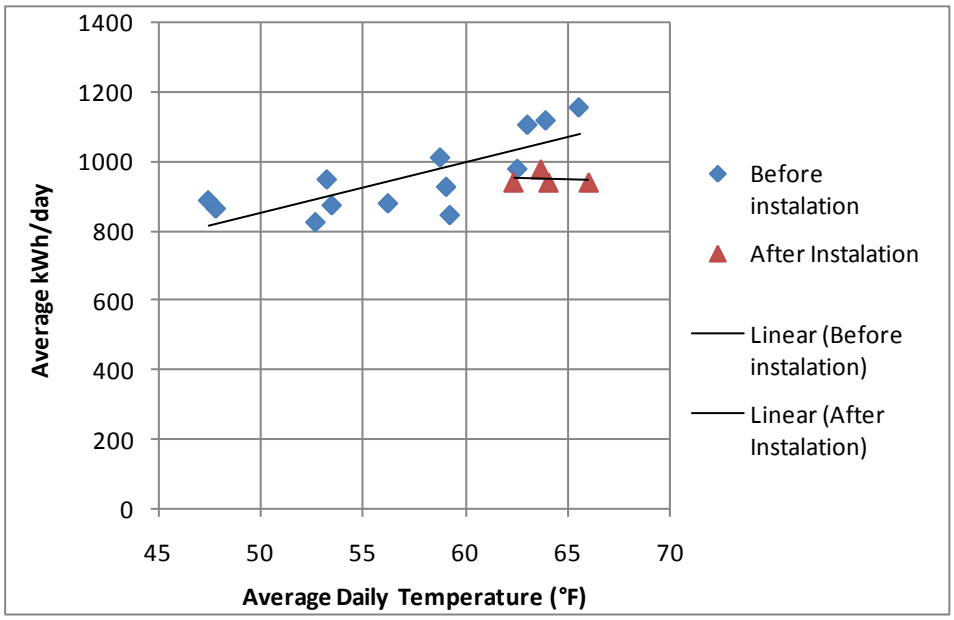


Table 3-4 shows the claimed and calculated savings for the site 3 installation. Because of the minimal amount of data available after the retrofit, and the large amount of scatter in it, Summit Blue has taken a conservative estimate that the minimum savings conditions seen around 62-63 °F as shown on the graph above apply to lower temperatures as well. This results in 50% of the claimed savings. Given that the site was already using some setbacks prior to the retrofit, the initial savings estimate may have been too high. However, without both longer term post-installation usage data and details of the assumptions used in the baseline calculations a great deal of uncertainty remains for savings at this site.

Table 3-4: Site 3 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	0	50,364
Verified Calculated Savings	0	25,165

Figure 3-3: Site 4 Monthly Energy Use

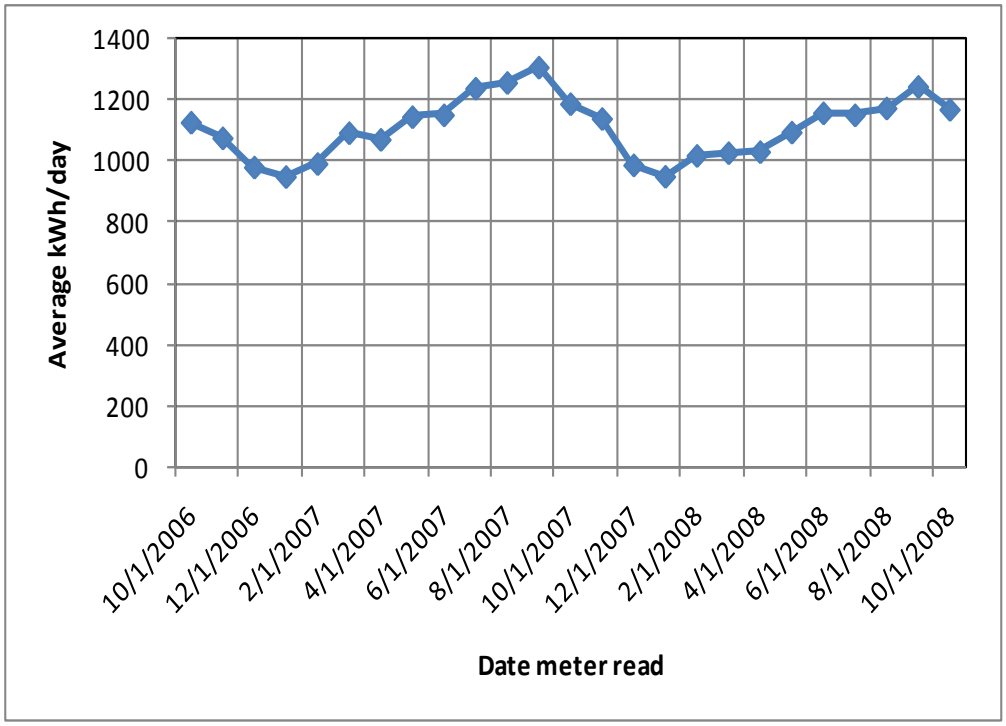


Figure 3-4: Site 4 Temperature Dependence of Energy Use

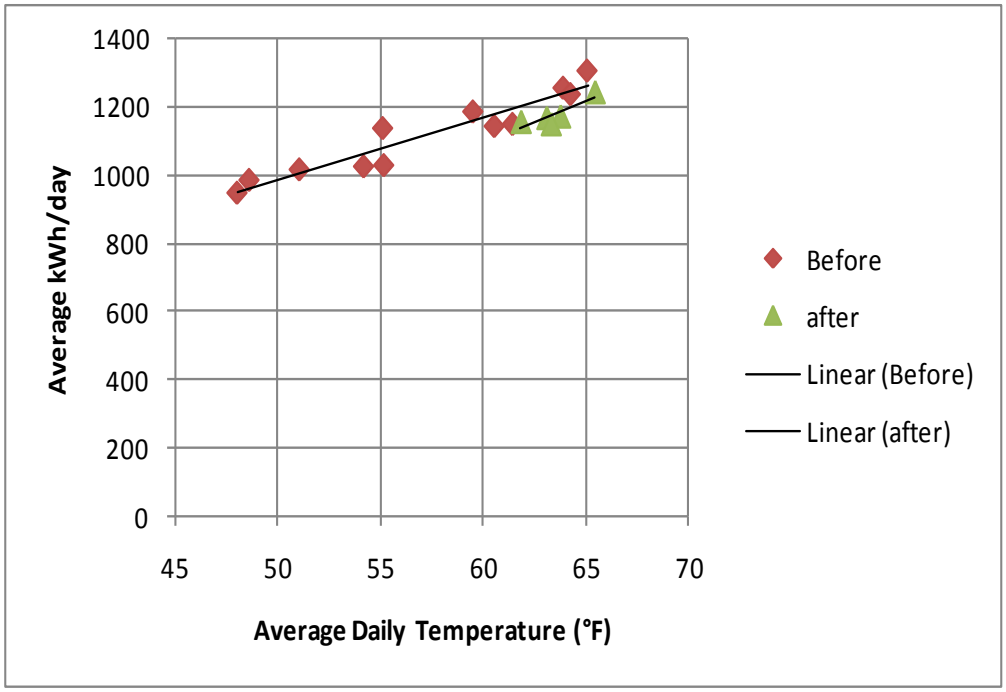


Table 3-5 summarizes both the claimed and adjusted energy savings for Site 4. As with site 3, site 4 shows significantly decreased energy savings using observed values compared to the application's claimed savings. The calculated savings are only 43% of those expected, the lowest of the three sites. This was the only site with economizers, and they may have already been providing savings during the relatively warm period for which the data was available, which might explain the lower realization rate.

As at site 3, both the lack of long-term post-installation usage data and details of the assumptions used for the baseline calculations, significant uncertainties remain in the actual savings values.

Table 3-5: Site 4 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	0	74,865
Verified Calculated Savings	0	32,230

Figure 3-5: Site 5 Monthly Energy Use

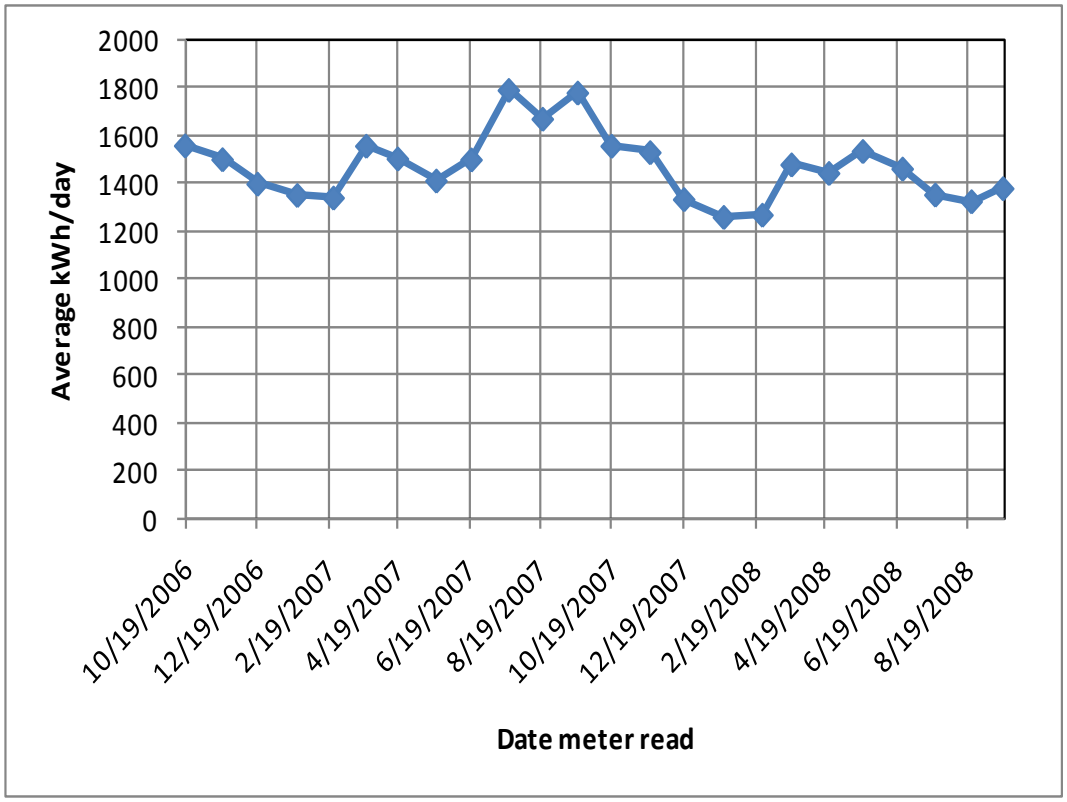


Figure 3-6: Site 5 Temperature Dependence of Energy Use

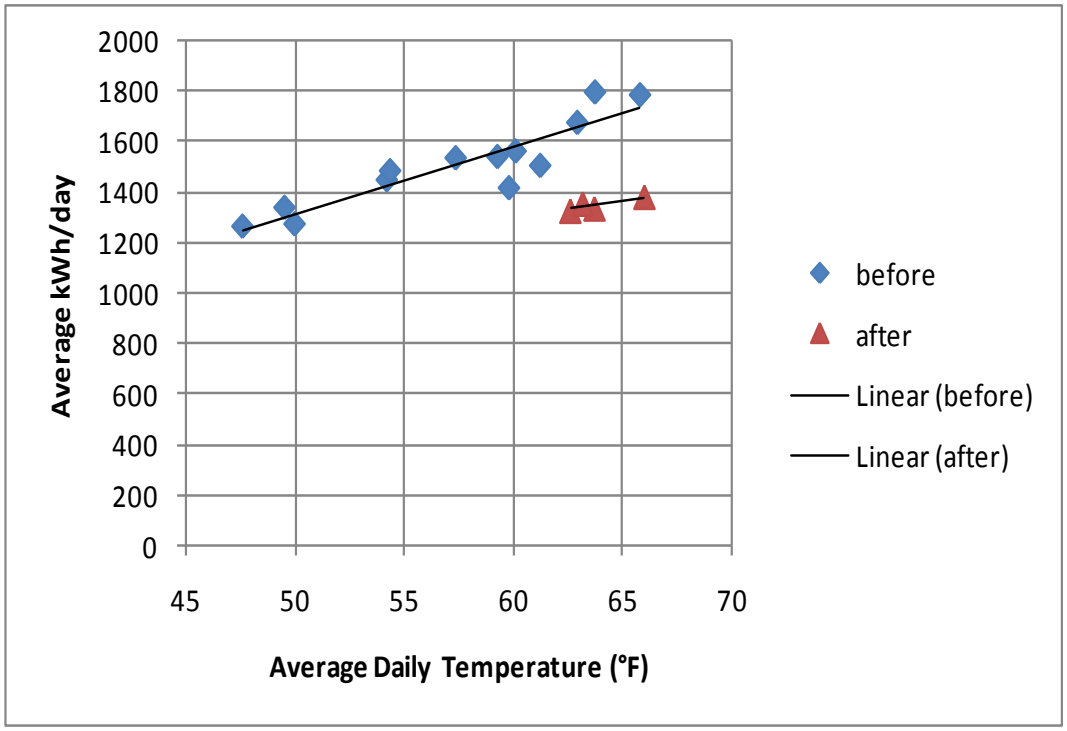


Table 3-6 shows the total estimated savings for Site 5. The estimated savings for this site based on billing information are 91% of those predicted on the application, the highest of the three sites. It is possible that the baseline was more accurate at this site than at sites 3 and 4, however without details of the assumptions it is not possible to determine the reason for the differences with certainty.

Table 3-6: Site 5 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	0	113,766
Verified Calculated Savings	0	103,536

3.3 Analysis

3.3.1 Overall Site Observations

Only a couple of issues emerged from the impact evaluation efforts:

1. *Overestimating savings due to new controls.* Three of the sites installed new controls systems, but the savings did not appear to be as high as expected at two of the sites. Detailed calculations were not provided with the applications for sites 3, 4, and 5, so it was difficult to determine the basis for the savings. However, since a different control system had been in place prior to the retrofit at each site, savings may have been improperly baselined.
2. *Inability to obtain detailed information about Coast Guard savings.* This is a known problem for the utility. Although the Coast Guard claimed 634,596 kWh of HVAC controls savings, 596,668 kWh of lighting savings, and 92,370 kWh of motors savings, which were supposed to be installed in 2007, no noticeable usage decrease is apparent on facility bills. The bills range between just over 400,000 kWh and just under 600,000 kWh per month, for a total of around 6,000,000 kWh/year, and the projected savings should account for around 20% of facility usage, so these retrofits would normally be expected to result in noticeable savings on the billing. The lack of a noticeable decrease could be the result of additional load being added, which is common at the Coast Guard site due to the docking and departure of ships on a regular basis and the upgrading of existing ships to more energy intensive newer ships.

3.3.2 Program Record Observations

The final program records submitted by the implementation contractor to the AMP 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

The primary observation from this review was that at two of the three sites, the HVAC control systems measures were overestimated.

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

1. The adjusted final realization rate was determined to be 82%. This was due to reductions estimated controls savings. However, the lighting realization rate was 103%.

2. The savings from control systems appeared to be overestimated, saving only 67% of the expected energy. However it should be noted that due to the limited time period of post-installation billing data there remains a great deal of uncertainty in this estimate. Summit Blue recommends that detailed savings calculations be provided with future applications so that their accuracy can be assessed.

3. As the utility is aware, the presence of the Coast Guard facility presents some problems for claiming savings, as they do not permit the utility to inspect retrofits. Summit Blue recommends that the AMP continue to attempt long term monitoring of energy use at the facility and compare any changes to claimed savings. While this is not an ideal solution, it might provide some sense of whether any savings are being achieved in the long term. However, due to the highly variable load with ships sometimes in dock, it is unlikely to achieve a high degree of certainty in estimates.

3.4 Impact Evaluation Results

Table 3-7 provides the savings reported in the final installation review documents submitted for the Program and the verified gross savings. The recommended adjustments are attributable to revised savings estimates for deemed savings values and adjustments to estimated control system savings.

Table 3-7: Claimed Savings and Verified Gross Savings

	Claimed		Verified	
Project	**kW Savings**	**Annual kWh Savings**	**kW Savings**	**Annual kWh Savings**
Site 1	32.9	161,386	32.9	164,480
Site 2	1.9	4,893	1.2	7,164
Site 3	0	50,364	0	25,165
Site 4	0	74,865	0	32,230
Site 5	0	113,766	0	103,536
Total	34.8	405,274	34.1	332,575
Measure Realization			**98%**	**82%**

Calculated savings have been used for all of the sites except site 2, where deemed values were used because they provided a higher savings value. At the other sites, no deemed values were available for comparison.

4 CONCLUSIONS AND RECOMMENDATIONS

Overall, the Summit Blue team found AMP to have well run DSM programs, especially in light of their limited resources. The customer base of AMP is very unique for a California utility and provides challenges for offering high impact energy savings programs. The climate is mild with little cooling or heating load. Of AMP's 33,000 customers, 85% are residential units that do not have air conditioning.

Another barrier AMP faces in terms of evaluating impacts from its DSM programs is the Coast Guard station, which accounted for 76% of the utility's claimed savings. Summit Blue was unable to reach anyone who could provide details on the installation. According to the utility, this has been a long-term problem. The facility has a high staff turnover and security regulations do not permit inspection by the utility or third parties, so no verification has ever been performed on these measures. Although the Coast Guard claimed 634,596 kWh of HVAC controls savings, 596,668 kWh of lighting savings, and 92,370 kWh of motors savings, which were supposed to be installed in 2007, no noticeable usage decrease is apparent on facility bills. The bills range between just over 400,000 kWh and just under 600,000 kWh per month, for a total of around 6,000,000 kWh/year, and the projected savings should account for around 20% of facility usage, so these retrofits would normally be expected to result in noticeable savings in billing. The lack of a noticeable decrease could be the result of additional load being added, but it is impossible to say without more information.

Measure realization from the commercial sector participants that were included in this evaluation is a respectable 82%.

More care needs to be made to have control system measure applications include greater detail on assumptions. The evaluation we performed for these systems was limited because of this lack of detail, and only four months of data. The remaining evidence indicated measure realization of only 67%.

APPENDIX A: COMMERCIAL CUSTOM SITE DETAILS

Table A-1: Deemed Savings for Selected Measures

Category	Measure	Peak kW Savings	Annual kWh Savings
T-8 linear fluorescent	T-12 to T-8 8′ lamp	0.008	45
T-8 linear fluorescent	T-12 to T-8 4′ lamp	0.006	37

Source: NCPA E3 Calculator