NAVIGANT

CITY OF PALO ALTO UTILITIES: IMPACT EVALUATION OF THE COMMERCIAL ADVANTAGE, ENOVITY, AND RIGHTLIGHTS PLUS PROGRAMS

Prepared for:
City of Palo Alto

CITY of PALO ALTO

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Prepared by

Navigant Consulting, Inc.
1001 Officers Row
Vancouver, WA 98661

360-828-4000
www.navigant.com

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1 Introduction and Executive Summary

The City of Palo Alto Utilities (CPAU) is the only city-owned utility in California that includes electric, fiber optic, natural gas, water, and wastewater services for its citizens. CPAU has been providing quality services to the citizens and businesses of Palo Alto since 1896.

CPAU has a number of electricity and natural gas energy efficiency programs in both the residential and non-residential sectors. About 89% of the FY 2012 gross *ex-ante* electricity savings is from the non-residential sector. This is an increase from a 72% share in FY 2011. Five non-residential programs contribute to this 89% savings share. The largest share at just fewer than 50% is from the Enovity Program. The RightLights Plus Program provides about 26% and the Custom Advantage Program provides about 18%. The remaining 6% come from the Hospitality and Keep Your Cool Programs. In the residential sector, over 60% of the sector's savings is from the Home Energy Report Program, about 25% from the Smart Energy Program, and the balance from the Low Income Program.

Given 80% of CPAU's FY 2012 gross *ex-ante* electricity savings are from the three non-residential programs: Enovity, RightLights Plus, and Custom Advantage, Navigant's FY2012 EM&V efforts were directed at these three programs. The largest residential program, the Home Energy Report, was part of Navigant's FY 2011 EM&V efforts and was not re-evaluated in FY 2012. The remaining combined residential and non-residential programs only represent about 10% of the FY 2012 gross *ex-ante* electricity savings and are not part of the FY 2012 EM&V efforts.

CPAU also provides energy efficiency programs designed to save natural gas. The program that saves the most natural gas is the Home Energy Report. In its FY 2011 evaluation of this program, Navigant estimated savings of about 175,000 therms. It is anticipated that about this same level of savings was achieved in FY 2012 but the program is not being re-evaluated in FY 2012. Navigant's FY2012 EM&V efforts include EM&V assessments of the Enovity and Custom Advantage Programs natural gas savings. The non-residential Enovity and Custom Advantage Programs have FY 2012 *ex-ante* natural gas savings of about 64,000 therms.

1.1 Background

Two legislative bills (SB1037 and AB2021) were signed into law a year apart. SB1037 requires that the Publically 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. 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 and 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 four years that highlights cost-effective electric potential savings from energy efficiency and established annual targets for electricity energy efficiency and demand reduction over 10 years.

1.2 Objectives

The goals of the 2012 non-residential EM&V effort at CPAU are to provide unbiased, objective and independent program evaluations of electric and natural gas energy efficiency measures 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.

1.3 Impact Evaluation Results

In FY 2012 there were 48 total projects with claimed energy savings in the Commercial Advantage Program (CAP) and Enovity Program. Of these 48 projects, 43 have electric savings and eleven include natural gas savings. Ten are Enovity projects with the remaining 38 CAP projects. Four Enovity and 10 CAP projects are included in the sample. Measures included within the sampled sites were refrigeration, motors/VFDs, chillers, computer room cooling, cleanroom air handlers, economizers, temperature reset, and pressure reset.

In the RightLights Plus Program, there were a total of 55 projects with 21 of them included in the evaluation sample.

The methodologies employed to measure and verify electricity savings attributed to these programs 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, billing records, and data reviews.

Table 1-1 provides the individual commercial program electric realization rates and the resultant *ex-post* program impacts. Since no evaluation was conducted for the Keep Your Cool or Hospitality Programs, the combined affects from the CAP, Enovity and RightLights Plus program realization rate assessments are used. These combined assessments are provided in Table 1-2. The RightLights Plus Program realization rate used in the estimation of the overall Commercial Sector electric realization rate is based on actual hours of operation. Although the realization rate based on deemed measure savings for the RightLights Plus Program could be used, Navigant wanted to use as proxy for the Keep Your Cool and

Hospitality Programs realization rates those most reflective of actual achievement. Overall, the commercial sector electricity realization rate is estimated to be 95%.

Table 1-1. Commercial Sector Electric Utilization Rates and *Ex-Post* Impacts

Non-Residential Programs	Gross *Ex Ante* Energy (kWh)	Energy Realization Rate	Gross *Ex Post* Energy (kWh)
Commercial Advantage	2,311,377	108%	2,496,287
RightLights Plus (Calculated)	3,381,531	74%	2,502,333
Enovity	6,434,592	108%	6,482,679
Keep Your Cool	165,196	95%	156,936
Hospitality	619,027	95%	588,076
Total	12,911,722	95%	12,226,311

Table 1-2. Combined Realization Rates from the CAP, Enovity, and RightLights Plus Programs

Non-Residential Programs	Gross *Ex Ante* Energy (kWh)	Energy Realization Rate	Gross *Ex Post* Energy (kWh)
Commercial Advantage	2,311,377	108%	2,496,287
RightLights Plus (Calculated)	3,381,531	74%	2,502,333
Enovity	6,434,592	108%	6,482,679
Total	**12,127,500**	**95%**	**11,481,299**

Table 1-3 provides the individual commercial program natural gas realization rates and the resultant *ex-post* program impacts. Natural gas projects only occurred in the CAP and Enovity programs. The CAP realization rate is applied to the total CAP gross *ex ante* therms and the Enovity realization rate is applied to the to the total Enovity gross *ex ante* therms. These two values are added together and provide the overall commercial sector natural gas realization rate of 89%.

Table 1-3. Commercial Sector Natural Gas Utilization Rates and *Ex-Post* Impacts

Non-Residential Programs	Gross *Ex Ante* Energy (therms)	Energy Realization Rate	Gross *Ex Post* Energy (therms)
Com. Advantage	35,474	81%	28,734
Enovity	28,450	100%	28,380
Total	**63,924**	**89%**	**57,114**

1.4 Recommendations

Overall the City of Palo Alto Utilities commercial sector energy efficiency programs are performing very well with the overall electric program realization rate at 95% and the natural gas realization rate at 89%. Navigant offers the following observations and recommendations.

1.4.1 RightLights Plus

The RightLights Plus program realization rates can be calculated from two very different perspectives. The first is based on using the appropriate deemed energy savings per measure in use in FY 2012. In this method, the evaluation focuses on verifying measure installations and wattages. The second takes this a step further by modifying one of the key variables in the calculation of the deemed energy savings. This variable is hours of operation, whereas the wattages remain the same as used in the deemed savings calculations. Wattages are generally based on the Table of Standard Fixture Wattages in Appendix B of the California Statewide Customized Offering Procedures Manual for Business, although manufacturers' specifications may be used if fixtures are not included in the table. In addition, baseline wattages for incandescent lamps have been decreased to meet the new national lighting efficiency standards. Navigant recommends that savings evaluation based on the standard wattages with actual hours of operation and verification of installation and wattages be the method used to estimate FY 2012 program realization rates. The realization rates and associated *ex-post* based energy savings calculated using actual hours of operation are of more importance from the perspective of identifying program impacts on resource requirements and for providing input to update assumptions for future program years. In general, Navigant recommends the use of actual hours of operation to estimate energy savings when they are significantly different from the deemed hours.

1.4.2 Commercial Advantage and Enovity Programs

The CAP and Enovity Programs include custom projects for both electric and gas savings. Overall these projects are well documented, but in some cases the project file does not include complete information on what equipment was included in the savings and the baseline. This results in some difficulties in evaluating the program since it is not always possible to accurately verify the baseline without additional information. Navigant recommends that CPAU confirm that the baseline and affected equipment list is included in all program files. Baseline data in the project file should include photographs of nameplates of removed baseline equipment whenever possible. For new construction, if energy models were used in the analysis, detailed month by month kWh and therm predictions should be included in the project file in order to support comparison to bills. In particular the ECON-1 page of DOE2.2 model outputs, which details monthly gas and electric baseline and savings, should be included in the project file along with the Title 24 compliance certificates.

Enovity works directly with the Utility's customers to recommend and implement custom energy efficiency projects. As part of this, Enovity performs detailed studies of the projects in advance of the project and performs detailed post-installation verifications. Many of the facilities have systems in place which monitor the affected systems in detail and can store trend data, but not all of them have enabled the systems to keep trend data. Several of the projects in the program included savings for chillers and

other seasonally dependent equipment. Since the evaluation is performed in the winter, some of the equipment is not operating and none of its operation can be manually logged in hot weather. This introduces substantial uncertainties in the analysis of some of the projects. Navigant highly recommends that Enovity work with customers to set up long term trend logging on large projects where monitoring systems are in place. In addition Navigant recommends working with customers to confirm that the data being logged by the system is appropriate for energy analysis and accurate: some of the available trend logs did not include data on power which was in the monitoring system and the data being logged by one customer was not accurate after the upgrades to the system. The availability of long term logging data would substantially reduce the cases in which 100% realization rates were applied based on modeled operation for systems.

2 FY 2012 *Ex-ante* Gross Energy Savings

Table 2-1 identifies CPAU's 2012 *ex-ante* gross electric and natural gas program savings for the Enovity, Commercial Advantage, and RightLights Plus Programs. As can be seen in the table, about 80% of the electric *ex-ante* and 74% of the natural gas *ex-ante* gross savings from these three programs are included within the projects comprised in the sample population.

Table 2-1. FY 2011 *Ex-ante* Gross Electricity and Natural Gas Savings and Sample Populations for the Enovity, Commercial Advantage, and RightLights Plus Programs

Non-Residential Programs	Program Total Gross Annual Ex-ante Savings (kWh)	Sample Total Gross Annual Ex-ante Savings (kWh)	Sample Share as % of Program Total
Commercial Advantage	2,311,377	1,068,248	46%
RightLights Plus	3,381,531	2,556,777	76%
Enovity	6,434,592	6,025,372	94%
Total	**12,127,500**	**9,650,397**	**80%**
	Program Total Gross Annual Ex-ante Savings (therms)	**Sample Total Gross Annual Ex-ante Savings (therms)**	**Sample Share as % of Program Total**
Com. Advantage	23,701	22,754	96%
Enovity	**40,223**	**28,450**	71%
Total	**63,924**	**51,204**	**80%**

The Enovity Program was new in 2011 and is now the single largest program offered by CPUA. These three programs represent over 80% of all the claimed energy savings by CPAU in FY 2012.

3 Sampling Methodology

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-variant 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

3.1 Stratified Ratio Estimation Sampling

Stratified ratio estimation combines a stratified sample design with a ratio estimator. Both stratification and ratio estimation take advantage of supporting information available for each project in the population. In the case of these three programs, the supporting information is *ex-ante* energy savings per project.

By using the *ex-ante* energy savings per project as the stratification variable, the coefficient of variation in each stratum is reduced thereby improving the statistical precision. Moreover, the sampling fraction can be varied from stratum to stratum to further improve the statistical precision. In particular, a relatively small sample can be selected from the accounts with small energy savings, but the sample can be forced to include a higher proportion of the projects with larger levels of energy savings.

3.1.1 Enovity and CAP Program Project Samples

The initial sample draw included both CAP and Enovity projects. This was done to ensure that the projects with the greatest savings, regardless of whether they were CAP or Enovity projects, were included in the sample. Three energy savings strata were utilized with the sample, based on the *ex-ante* estimates of savings, represents statistical confidence of 90 percent +/- 10 percent. There were a total of 48 CAP/Enovity projects.

The population of accounts with electric savings consisted of a total of 43 projects. These projects had a very wide range of energy savings extending from 1,020 kWh to 4,941,200 kWh. The population coefficient of variation of the energy savings is large and stratified ratio estimation sampling provided the best methodology to attain both a sampling precision of 90 percent +/- 10 percent at the project level as well as a very high percentage of overall sampled *ex-ante* savings. The final sample consisted of 14 projects (33%) and more importantly 84% of the *ex-ante* electric energy savings. However, this 84% was reduced to 81% when it was found that insufficient baseline data existed to evaluate one of the project measures (a site 33 measure).

In reviewing the electric sample draw, it was found that four of the ten (40%) Enovity projects were included in the sample, representing 94% of the *ex-ante* electric energy savings. The 10 sampled CAP projects represent 30% of the total CAP number of projects and 58% of the *ex-ante* electric energy savings. This 58% was reduced to 46% after the exclusion of the before mentioned measure at site 33.

The natural gas sample was drawn as part of the overall Enovity/CAP project sample. A total of 11 projects included natural gas savings, eight that were CAP projects and three that were Enovity projects. The 11 projects had a range of energy savings extending from 306 therms to 27,590 therms. The natural gas sample included eight projects representing 80% of the *ex-ante* natural gas energy savings. Of the eight Projects in the sample, two were Enovity projects and six CAP projects.

Table 3-2. Sampled CAP and Enovity Sites as a percentage of Gross Total Program *Ex-Ante* Energy Savings

Non-Residential Programs	Program Total Gross Annual Ex-ante Savings (kWh)	Sample Total Gross Annual Ex-ante Savings (kWh)	Sample Share as % of Program Total
Commercial Advantage	2,311,377	1,068,248	46%
Enovity	6,434,592	6,025,372	94%
Total	**8,745,969**	**7,093,620**	**81%**
	Program Total Gross Annual Ex-ante Savings (therms)	**Sample Total Gross Annual Ex-ante Savings (therms)**	**Sample Share as % of Program Total**
Com. Advantage	23,701	22,754	96%
Enovity	**40,223**	**28,450**	71%
Total	**63,924**	**51,204**	**80%**

3.1.2 RightLights Plus Sample

There were a total of 55 Right Light projects with a range of energy savings from 2,189 kWh to 718,784 kWh. As with the Enovity/CAP sampling, the large population coefficient of variation made the stratified ratio estimation sampling methodology a good choice to attain both a sampling precision of 90 percent +/- 10 percent at the project level as well as a very high percentage of overall sampled *ex-ante* savings. Based on this sampling methodology, a total of 21 projects (38%) are included in the sample representing 76% of the *ex-ante* electric energy savings.

4 CAP and Enovity Projects

Navigant conducted 14 site visits covering 17 Commercial Advantage and Enovity Program projects in December 2012. In the course of analysis, it was determined that insufficient baseline data existed for one measure (in site 33) to do an *ex*-post analysis. Therefore, this measure is not included in the analyses results provided in Table 4-1. A demand impact assessment is not included for the CAP and Enovity projects; first, because demand impacts were identified for only one of the projects included in the sample and, second, because of the custom nature of these measures and the December timeframe during which Navigant's on-site visits occurred.

Table 4-1. Commercial Advantage and Enovity Energy Savings

Site ID	Non-Residential Programs	Gross *Ex-Ante* Energy (kWh)	Gross *Ex-Post* Energy (kWh)	kWh Realization Rate	Gross *Ex-Ante* Energy (therms)	Gross *Ex-Post* Energy (therms)	Therm Realization Rate
3	CAP				5,980	5,980	100%
22	CAP	399,230	396,480	99%			
22	CAP	360,753	360,753	100%			
23	CAP	53,076	40,972	77%			
24	CAP	20,109	20,109	100%	744	744	100%
25	CAP	26,425	42,525	161%	7,159	3,553	50%
26	CAP	2,580	2,580	100%	0	0	
27	CAP	80,451	80,451	100%	690	690	100%
28	CAP	40,946	21,500	53%	3,341	3,341	100%
29	CAP	76,978	176,145	229%			
30	Enovity	4,941,200	5,654,951	114%			
31	Enovity	399,172	402,128	101%			
32	Enovity	326,400	67,000	21%			
33	Enovity	358,600	358,600	100%	27,590	27,590	100%
33	CAP	7,700	7,700	100%	4,840	4,031	83%
34	Enovity				860	790	92%
Total	**All**	7,093,620	7,631,894	108%	51,204	46,719	91%
Total	**CAP**	1,068,248	1,149,215	108%	22,754	18,339	81%
Total	**Enovity**	6,025,372	6,482,679	108%	28,450	28,380	100%

4.1 Commercial Advantage and Enovity Electric Sites

4.1.1 Site 22

Site 22A is a four story medical facility with a basement which replaced 1,331 lighting fixtures with new, efficient models on a one-for-one basis and installed 208 occupancy sensors throughout the facility. On the first, second, and third floors, about 95% of the fixtures have been replaced. In the basement area, about 70% of the fixtures have been replaced and on the fourth floor, around 50% of the fixtures have been replaced. Of the 1,331 lighting retrofits, about 85% were T8 retrofits and 14% were CFL screw-ins. The remaining 1% consisted of exit fixtures and miscellaneous replacements.

Navigant performed spot checks for about 15% of the fixtures. Navigant's evaluation consisted of visual inspection of the lighting system, a sensor and lighting fixture count, a study of lighting layout for the site and an open-ended customer satisfaction survey.

Most of the occupancy sensors were installed in private offices. Data collected during site visit showed that about 10% of the sensors have been removed due to the personal preference of the office occupants. Apart from this, all other occupancy sensors, including both the remaining units in offices and those installed in common areas and conference rooms are in place and working as expected. Interviews with on-site staff confirmed the operating hours used in the original savings calculations. All the retrofitted fixtures and lamps are in place.

Ex-ante savings for the lighting retrofits done at site 22A are 371,730 kWh and *ex-post* savings are 371,730 kWh, resulting in a 100% realization rate. For the occupancy sensors Navigant used the standard reductions from the Statewide Customized Offering Procedures Manual for Business[1], resulting in a realization rate of 90%, as 10% of the sensors have been removed.

Site 22B is a large, four-level parking facility for the medical facility. The parking garage replaced 585 old 8' T8 fixtures (4' 4-lamp configuration) on a one-for-one basis with a new, high output, 4' 2-lamp T8 system and installed a time-clock on 12 of the new fixtures. Navigant confirmed the lighting retrofits by visual inspection and counted fixtures for one floor to confirm the fixture quantity matched with the project file. A wall mounted time-clock was installed to facilitate day-lighting by controlling the 12 fixtures at the entrance of the parking facility. This wall clock turns the fixtures off for an average of 12 hours/day, varying throughout the year based on daylight hours. Navigant confirmed the installation of the clock. All other fixtures remained on 24 hours a day, 365 days a year.

All the lighting measures at the parking garage were in place and operating as expected. Thus, Navigant estimates that facility has achieved 100% of the estimated savings.

[1] 2011 Statewide Customized Offering Procedures Manual for Business, Table 9.4, page 2-45

Table 4-2. Site 22 Electric Savings

Project	Ex-ante kWh	Ex-post kWh	Realization Rate
Replace old lighting system with new, efficient substitutes	371,730	371,730	100%
Occupancy sensors	27,500	24,750	90%
Replace old T8s with new, efficient T8s and install time clock	360,753	360,753	100%
Total	759,983	757,233	99.6%

4.1.2 Site 23

Site 23 is a 14,000 sq. ft., two story office building which installed 44 wall-box type lighting sensor switches, 31 wall/ceiling mounted occupancy sensors, and custom lighting retrofits throughout the building. Navigant's evaluation at this location consisted of a visual inspection of the sensor switches, sensors and lighting retrofits, as well as lighting fixture counts.

All sensors and sensor-switches were in place and are working as expected. Therefore, 100% of the deemed savings have been achieved for the sensors. In the case of the lighting retrofits at the facility, the lighting retrofits in the mechanical room were not in place and those in suite 205 had been removed completely. Because of this, part of the custom retrofit project resulted in zero savings, and a 23% decrease in energy savings for the project. The remaining retrofits were done and operating as expected. The realization rate for the site is 77%.

Table 4-3. Site 23 Electric Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Occupancy sensors and fixture retrofits	53,076	40,972	77%

4.1.3 Site 24

Site 24 is a school which installed several energy efficiency measures as a part of a new construction project. The school installed new efficient T8 lighting systems, with daylight controls and occupancy sensors, and an energy management system (EMS), to operate windows and exhaust fans in order to facilitate free cooling.

Navigant's evaluation at the site consisted of a visual observation of the new lighting system, confirmation of operation of the EMS controls, and a discussion of the installation with facility personnel. Navigant confirmed that all the measures were in place and working as expected. A whole building billing analysis approach could not be used to quantify the savings, because the building is on the same meter as the portable classroom units and the usage of those units varies. Based on the installation and operation of the specified equipment and the energy model, Navigant estimates that this project has achieved 100% of its claimed energy savings.

Table 4-4. Site 24 Electric Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
New, Efficient Lighting System	21,222	21,222	100%
EMS Controls	1,181	1,181	100%
Pumps[2]	(2,295)	(2,295)	100%
Total	20,108	20,108	100%

4.1.4 Site 25

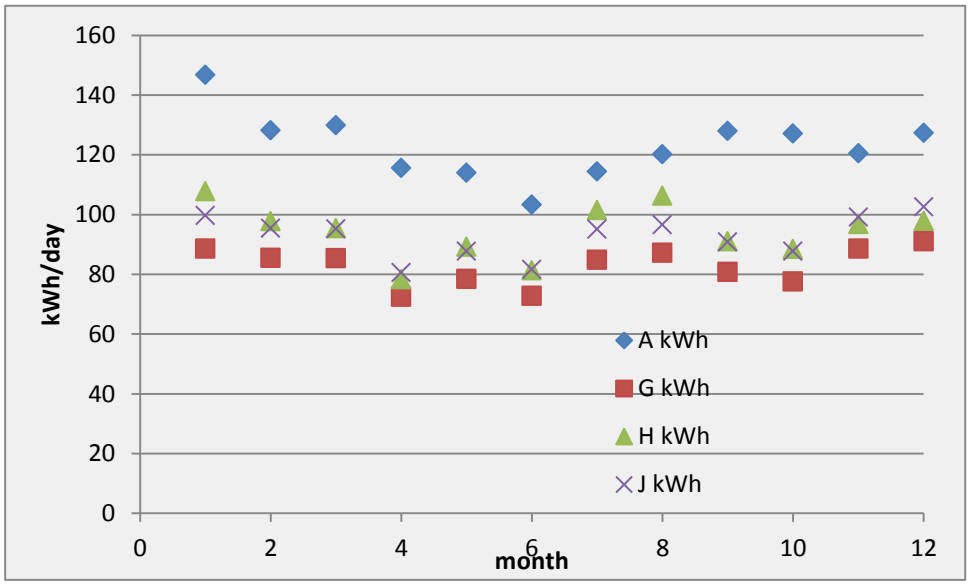
Site 25 is a housing association consisting entirely of new townhouses. The Utility issued both electric and gas rebates as part of this project, and two separate incentives were issued, only one of which was included in the 2011-2012 program year. The development consists of 103 townhomes with nine floor plans. Forty-two homes with eight floor plans received rebates from the Utility as part of this portion of the project. Although the first incentive issued for this project was in a prior program year and used Title 24 as the baseline, Palo Alto has since shifted to a baseline of 15% better than Title 24, but this project is not affected since it was approved prior to the change.

Since the incentive was issued to the developer and the townhomes were now owner occupied, Navigant could not arrange a site visit. However Navigant had reviewed the first phase of this project in a prior evaluation cycle and confirmed installation of the incentivized equipment. The property manager confirmed that no overall changes had been made to the homes, although it is possible individual owners may have made some equipment changes.

All of the townhomes receive their hot water from a central 1,000 kBtu/h boiler in the parking garage, which has its own gas meter. Each townhome also has a gas meter that includes its space heating and cooking and an electric meter. Electric savings in the project came from the installation of efficient HVAC units, including distribution fans, for each townhouse and efficient building envelope for all buildings. In evaluating this project, the Navigant team reviewed the utility bills for all of the occupied townhomes in the development. Facility personnel supplied a list of closing dates for the townhomes, and calculations assumed units were typically occupied within two weeks after closing. Figure 4-1 shows the average daily electric use for each of the four buildings included in this project.

[2] The pumps at the site 24 contribute towards negative electricity savings. But, these pumps enable the hydronic water heating system which saves 744 therms/year.

Figure 4-1. Average Townhome Electric Use by Building



Navigant averaged bills for each of the townhomes included in the project and used a weighted average to estimate overall usage to allow for different occupancy periods. It should be noted that seven of the townhomes in Building A, comprising approximately a quarter of the conditioned space, do not have gas, so the electric use is higher in the winter to provide heating. The monthly bills indicate electric use is not heavily seasonal in the gas heated units. This may be because of increased lighting use in the winter and the relatively mild climate in which the units are situated, or due to somewhat seasonal occupancy. This lack of seasonality makes it difficult to disaggregate the cooling and conditioning fans' electric use from other uses, but based on the lowest monthly bills, Navigant estimates increased electric savings due to the upgraded equipment.

Table 4-5. Site 25 Electric Savings Compared to Title 24

Building	kWh/yr	Estimated Conditioning kWh/yr	*Ex-ante* Savings kWh/yr	Modeled Conditioning kWh/yr	Increased *Ex-post* Savings
A	44,880	19,000	18,025	24,000[3]	5,000
G	30,221	5,000	2,615	8,333	3,333
H	34,446	7,000	2,537	10,452	3,452
J	33,838	6,000	3,248	10,325	4,325
Total	143,385	37,000	26,425	53,420	16,100

Overall the savings for this project are larger than expected, based on the available data, however the baseline shift to 15% below Title 24 reduces them somewhat. Although it is difficult to accurately disaggregate electricity used for space conditioning from other loads in such a small population, the overall energy use is low relative to the models provided and so the increased savings are likely correct.

[3] Estimated based on floor area of electrically heated units.

Table 4-6. Site 25 Electric Savings

Measure	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
New Construction	26,425	42,525	161%

4.1.5 Site 26

Site 26 is a small food service establishment that installed 16 linear feet of gasket and one door closer unit on the door of the walk-in freezer. Navigant's evaluation of the measure at this location consisted of visual inspection of the gasket and the door closer, measurement of the gasket length and an open-ended customer satisfaction survey.

The length of the installed gasket matched the reported length and the door closer is operating as expected. It is difficult to quantify the amount of energy savings in the absence of baseline energy consumption and a detailed evaluation of the freezer energy use. However, as the verified length of gasket matches with the installed length and the door closer is operating properly, as a part of this evaluation sample, Navigant accepts that the savings for this measure are 100% of the deemed savings.

Table 4-7. Site 26 Electric Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Commercial Refrigeration	2,580	2,580	100%

4.1.6 Site 27

Site 27 is 18,000 sq. ft commercial building that installed two new 17.5 ton air conditioning (AC) units in place of older, inefficient AC units. Navigant's evaluation of the measure at this location consisted of a visual inspection of the AC units, review of savings calculation model from the CAP file and an open-ended customer satisfaction survey.

Since Navigant was unable to obtain trend data for the AC units from the facility, and the evaluation was performed during the winter months, Navigant reviewed the calculations used to estimate savings for the project. Inputs and assumptions for savings calculation model from the CAP file are reasonable and thus, Navigant accepts that 100% savings for this measure have been achieved.

Table 4-8. Site 27 Electric Savings

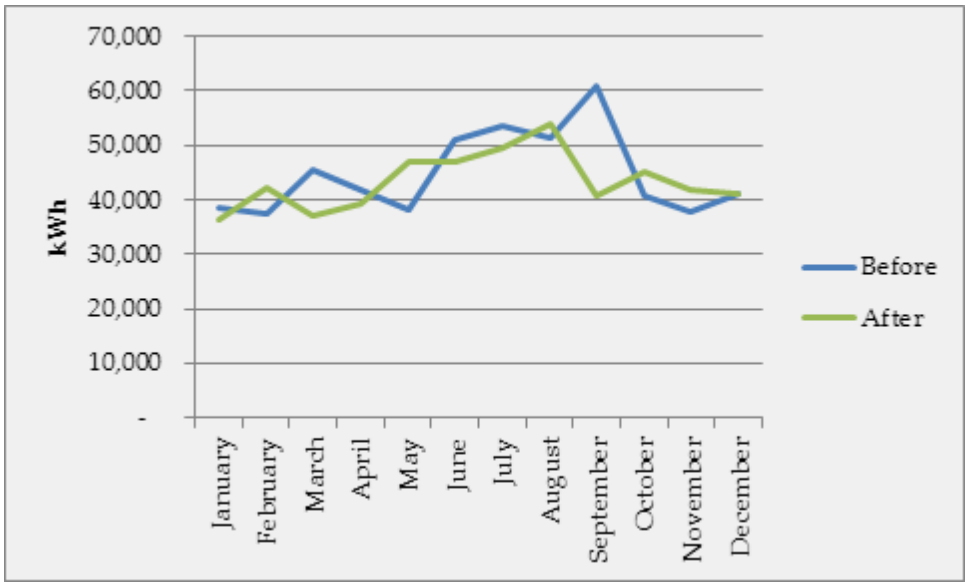
Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
New 17.5 ton AC units	80,451	80,451	100%

4.1.7 Site 28

Site 28 is a multifamily residential facility that increased its summer cooling set point from 60 °F to 66 °F. Navigant confirmed that the summer set point had been increased as claimed, which shows that the measure is in place and is working as expected. Navigant could not obtain trend data for the HVAC units and billing analysis approach was adopted to verify the savings.

Ex-ante savings for site 28 are 40,946 kWh and *ex-post* savings are 21,500 kWh, resulting in a realization rate of only 52%. The realization rate is very low based on an analysis of utility bills. The facility has multiple electric meters and the cooling load should be the primary driver of the utility bill for the affected meter. Figure 4-2 shows the total electric consumption for the affected meter, before and after the measure was implemented.

Figure 4-2. Electricity Consumption for Site 28



A drop in electricity consumption during summer months is evident from the graph, however it is not as large as predicted by the *ex-ante* savings estimates. This is most likely due to overestimating the overall cooling load in the building.

Table 4-9. Site 28 Electric Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Reduce summer cooling set point	40,946	21,500	53%

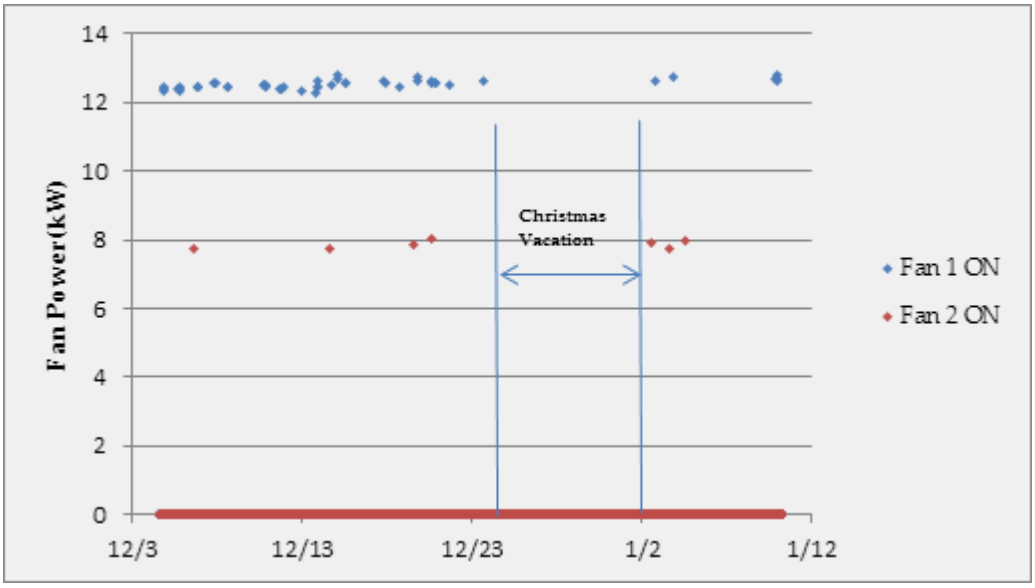
4.1.8 Site 29

Site 29 is a 72,000 sq.ft. office building that installed a CO_2 monitoring system on the exhaust fans in the garage. Navigant's evaluation of the measure at this location consisted of visual inspection of the

exhaust fans, spot measurements of the power consumption of the fans, a customer survey, and operational monitoring by installing current data loggers. Navigant confirmed that the measure is in place.

The nameplate data of the first exhaust fan matches the described fan motor size (10 HP) in the project file. However, Navigant was unable to get the nameplate data of the second exhaust fan and the power measurement taken for the second exhaust fan shows it is larger than indicated in the project file, resulting in an increased baseline for this project. Navigant monitored electric current to both fans for approximately a month's period using data loggers. Navigant's analysis of the trend data obtained shows that the fans were rarely on. Figure 4-3 shows the trend data for both the exhaust fans.

Figure 4-3. Exhaust Fan Operation



From the figure, it is clear that the fans were on for substantially less time than originally estimated. The fans are operating for less than 1% of the monitoring period, even when the vacation period is removed, whereas the original estimate was about 7%. Also, baseline energy consumption for the fans has been modified based on the spot measurements taken at the site as shown in Table 4-10.

Table 4-10. Site 29 Adjusted Baseline

Measure	*Ex-ante* Baseline kWh	*Ex-ante* kWh Consumption	*Ex-ante* kWh Savings	*Ex-post* Baseline kWh	*Ex-post* kWh Consumption	*Ex-post* kWh Savings
Exhaust Fan CO_2 Sensor	82,168	5,190	76,978	177,924	1,779	176,145

Minimal usage of these fans coupled with the adjusted baseline resulted in a very high realization rate of over 200% as shown in Table 4-11.

Table 4-11. Site 29 Electric Savings

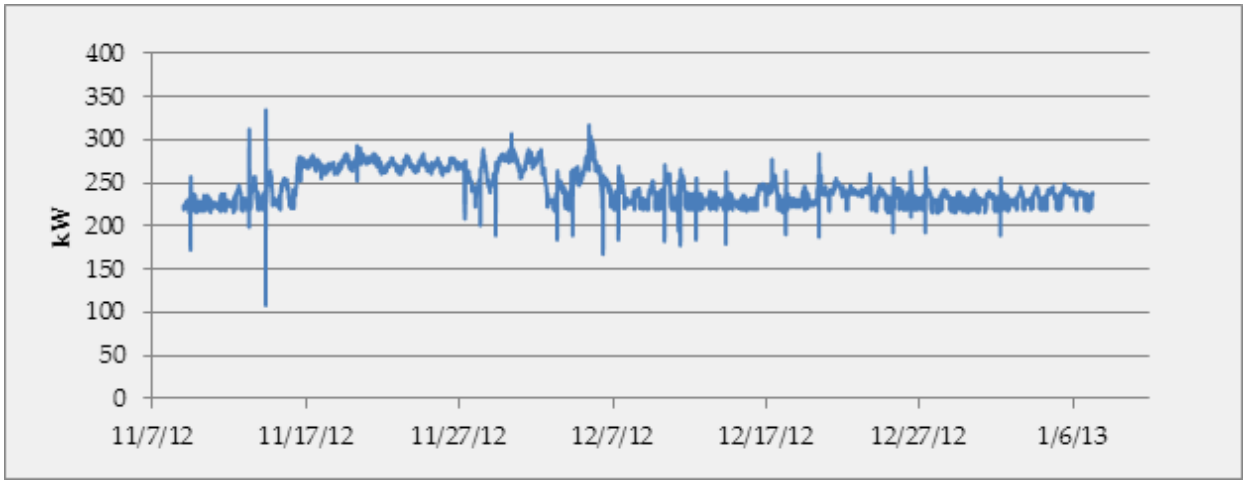
Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Exhaust Fan CO_2 Sensors	76,978	176,145	229%

4.1.9 Site 30

Site 30 is a large manufacturing site that installed an outside air economizer and variable frequency drive chillers at its new on-site data center. The site completed construction of a new datacenter and a chiller plant that consists of three 950 ton chillers to provide chilled water to the computer room air handlers (CRAHs). The site also installed chillers with VFDs instead of standard, constant speed chillers. The outside air economizer units installed provide free cooling when ambient conditions are suitable and further reduces the cooling load.

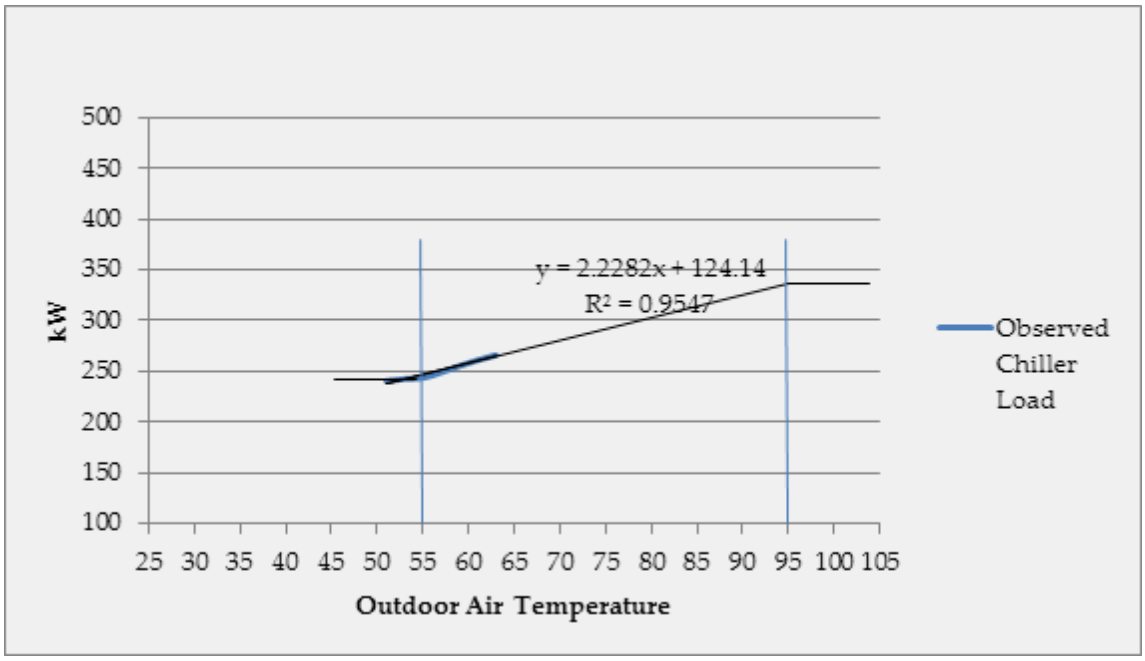
Navigant's evaluation at this location consisted of a visual inspection of the chiller units, data center and economizer units. Also, Navigant obtained trend data on the chiller units for approximately two months. Navigant's analysis of the trend data shows that the VFDs on the chiller units are working as expected as shown in Figure 4-4.

Figure 4-4. Observed Chiller Energy



Navigant was not able to obtain trend data for the summer months when the demand on the chillers would be higher. The trend data obtained consisted of two winter months (November and December 2012) since the system did not store older data. Navigant extrapolated the observed trend values as a function of outside air temperature to calculate the expected chiller loads for summer months with higher outside air temperatures. With these expected chiller loads, TMY3 data were used to estimate annual energy consumption. Figure 4-5 shows estimated chiller load as a function of outdoor air temperature.

Figure 4-5. Chiller Load as a Function of Outdoor Air Temperature



Ex-ante savings for site 30 are 4,941,200 kWh, *ex-post* savings are 5,654,951 kWh, resulting in a realization rate of 114%. *Ex-post* savings were calculated using estimated chiller loads for summer months as Navigant could not obtain trend data for summer months. Summer trend data could reduce the uncertainty in this analysis, but due to the timing of the evaluation they were not available. However, the primary reasons for the change in savings are a combination of increased loading in the data center relative to that predicted for the *ex ante* savings, and the use of three chillers instead of two. The facility keeps the third chiller idling for quick backup in case there are problems with either of the two loaded chillers. The original model did not include this since the facility is implementing this operational scheme for reliability rather than efficiency purposes.

Table 4-12. Site 30 Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Chiller VFDs and economizer.	4,941,200	5,654,951	114%

4.1.10 Site 31

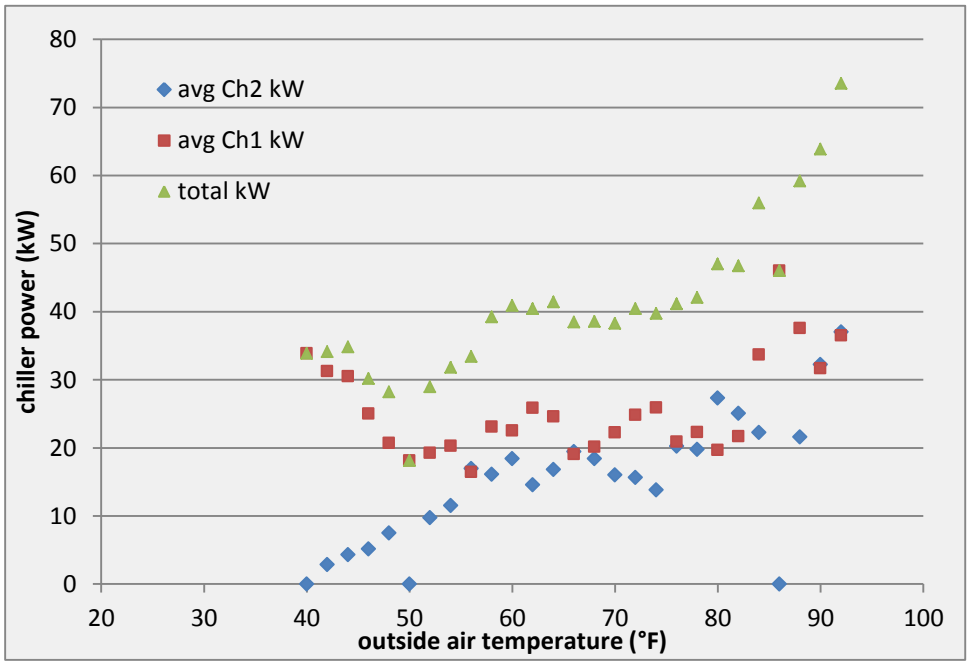
Site 31 is a large manufacturing facility that installed four measures:

1. Variable frequency drives (VFDs) were installed on two existing chillers;
2. The existing direct expansion cooling (DX) coil was replaced with chilled water loop;
3. VFDs were installed on two condenser water pump motors; and
4. The cooling tower fan VFDs were replaced with new VFDs.

Navigant's evaluation of the measures installed at the site consisted of a visual inspection and an open-ended customer satisfaction survey. Navigant confirmed that all the measures are in place and are working as expected. In addition, Navigant obtained trend data from the facility showing three months of operation for the chillers, cooling tower fans, and chilled water pumps. Using these data along with outside air temperature, Navigant calculated power for each piece of equipment at different outside air temperature conditions and normalized it to weather data for a typical meteorological year (TMY3 data).

Chiller trend data was provided in tons load, so Navigant used data from the original project verification report to convert this to energy use as it provided a more detailed study of kW/ton than the manufacturer's specifications. Figure 4-6 shows the average chiller power as a function of outdoor air temperature. Based on this, the chillers will use a little over 310,000 kWh/year, slightly less than the verification study found, resulting in a 104% realization rate for the measure.

Figure 4-6: Chiller Operation



Navigant estimated that the site achieved 100% savings for measure 2 as DX coil for air conditioning unit was completely removed and new chiller loop was in place. For the fans and pumps, Navigant obtained spot measurements of power and used the affinity law with a coefficient of 2.5 to calculated energy. This resulted in energy use of 41,462 kWh/year for the pumps, slightly more than the verification study reported. However, the fans were running at a very low speed during the site visit and it was not possible to obtain accurate calibration data. Consequently, for measure 4, Navigant confirmed that the VFDs are in place and operating as expected. Figure 4-7 illustrates cooling tower fan speed for the month of November, 2012. This data confirms that fan VFD is operating and varying fan speed according to the load. Based on this observation and data collected on site visit, Navigant estimates that the site has achieved 100% savings for the cooling tower fan measure.

Figure 4-7: Cooling tower fan speed vs. time

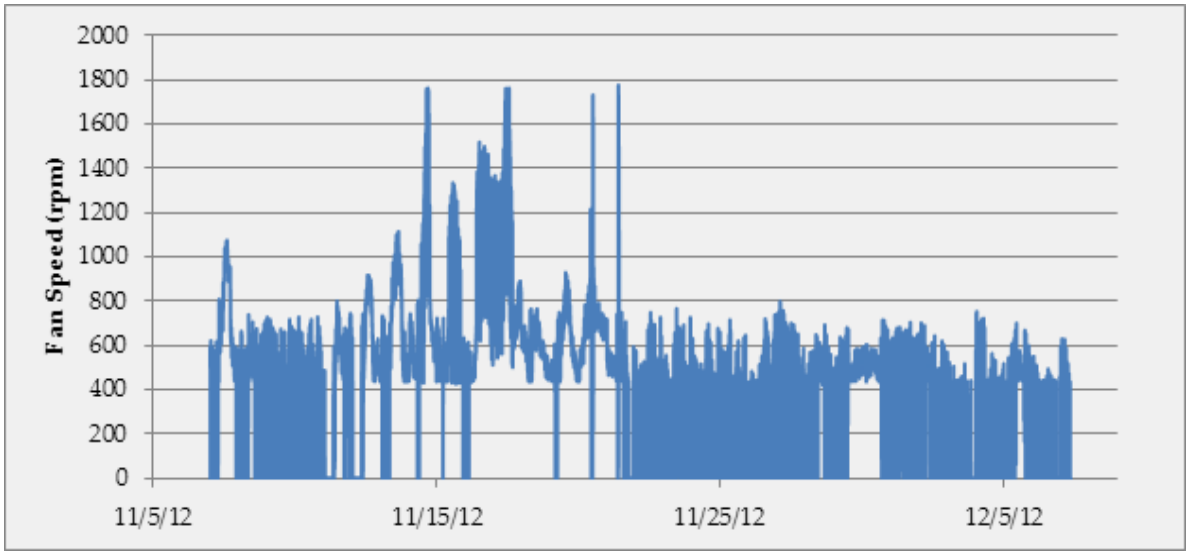


Table 4-13. Site 31 Electric Savings

Project	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
Installation of chiller VFDs	288,887	299,124	104%
Replacement of DX coil with chilled water loop	57,309	57,309	100%
Installation of condenser fan VFDs	51,636	44,355	86%
Replacement of cooling tower fan VFDs	1,340	1,340	100%
Total	**399,172**	**402,128**	**101%**

4.1.11 Site 32

Site 32 is an industrial manufacturing facility with two centrifugal chillers used to supply process water. The facility outfitted one chiller with a variable frequency drive (VFD) and implemented a condenser water temperature reset. Navigant discussed the project with site personnel and obtained trend data for both chillers. Unfortunately, the six months of trend data stored for the variable speed chiller turned out to be incorrect, as the monitoring point had not been updated when the drive was installed. Consequently, Navigant was only able to obtain limited trend data for the upgraded chiller and none of it was at high outdoor air temperatures. Navigant extrapolated high temperature operation from the available data.

Based on the trend data from the non-variable speed chiller, the baseline appears to have dropped by 24,000 kWh/year. In addition, the condenser water reset has been disabled. According to facility staff the chillers were not designed for operation at loads as low as those seen when the reset was operating correctly.

The realization rate is low, in part because of the alternating operation of the two chillers and in part because of the disabling of the condenser water temperature reset. Because the variable speed chiller being used only half of the expected time and there are no savings from the disabled condenser water reset. However, in addition to this, based on the limited data available, the variable speed drive does not appear to save as much energy as expected. Trend data show the non-variable speed chiller using only 10-20 kW more than the variable speed chiller at outside air temperatures below 55 °F, where the usage of both chillers bottoms out, but where the savings would be expected to be greatest. It is possible that additional data would show higher savings than the 21% realization rate calculated here, but savings will remain lower than the *ex ante* values due to the reduced hours of operation and lack of the condenser water reset.

Table 4-14. Site 32 Electric Savings

Measure	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
VFD on Chiller	326,400	67,000	21%

4.1.12 Site 33

Site 33 is a large, multi-building industrial and office facility. Navigant reviewed three projects, including a total of eight electric measures, at site 33 which were incentivized under the City of Palo Alto Utilities CAP program. Two of these projects also achieved natural gas savings, which are reviewed separately in the gas program portion of this report.

4.1.12.1 33A VFDs on Cooling Tower Motors and HVAC Control Changes

Project 33A consisted of six measures focused around optimizing the HVAC system for one of the buildings at site 33. The measures installed were:

1. VFDs on Cooling Towers and Optimize Condenser Water Supply Temperature;
2. Optimize Secondary Chilled Water Pump Differential Pressure Set point;
3. Optimum Start on air handling units (AHUs);
4. Supply Air Temperature Reset on All AHUs;
5. Supply Air Static Pressure Reset on AHU 1-8, 12; and
6. Improve AHU Economizer Operation.

Unfortunately the automation system controlling the systems affected by project 33A did not have long term trends available for any of the equipment due to issues with their control system. Navigant was able to obtain some pre-installation data and a few days of recent operational data for all of the systems. However, all of these measures require a significant quantity of trend data over a wide range of outside air temperatures to accurately analyze savings, so it was not possible to perform an independent analysis of these measures.

Navigant reviewed the data used for the initial project verification and the limited trend data available from the automation system. Based on the available data all of the measures continue to operate as intended, and the initial evaluation included some trending data which supported the reported savings. Based on the continued operation of the controls measures and the previous evaluation data, Navigant accepts the savings for all six of these projects as a 100% realization rate.

4.1.12.2 33B 800 Ton Chiller and Cooling Tower Replacement

The second project Navigant reviewed at site 33 consisted of the replacement of an 800 ton chiller and cooling tower with more efficient units. This is a follow up project to one reviewed in the previous program year which replaced the 400 ton chiller and another cooling tower on this system. This project affects a different building and cooling system than 33A so the cooling tower retrofit in 33A does not affect project 33B.

Navigant obtained long term trend data from the facility showing chiller loading, cooling tower fan speed, set-points, pump operation, and outside air temperature. It appeared that the facility had adjusted the load on the chillers since the project was originally installed, since neither cooling tower was operating below around 50 °F outside air temperature. This complicates analysis of the system since the baseline used at the time of the project appears to no longer be valid. In addition, the 800 ton chiller does not operate at temperatures below about 60 °F, making installation of loggers on the system in the winter months impractical.

Navigant concludes that as a result of so much data is missing for this measure, an estimation of a realization rate is impossible. This measure will not be included in the evaluation.

4.1.12.3 33C VFD on Hot Water Pump

Navigant's evaluation of the hot water pump VFD installed at this location consisted of a visual inspection of the VFD and an open-ended customer satisfaction survey. Navigant confirmed that the VFD is in place and operating as expected. Navigant could obtain very few data points for the trending data for the measure as there was no historic trend data available for the pump. These limited data and the onsite inspection confirmed that the pump VFD is operating and varying pump power according to the load. Based on observed operation and limited trend data, Navigant estimates that the site has achieved 100% savings for this measure.

Table 4-15. Site 33 Electric Savings

Measure	*Ex-ante* kWh	*Ex-post* kWh	Realization Rate
33A VFDs on Cooling Towers and Optimize Condenser Water Supply Temperature	82,400	82,400	100%
33A Optimize Secondary Chilled Water Pump Differential Pressure Set point	18,500	18,500	100%

33A Optimum Start on AHUs	58,200	58,200	100%
33A Supply Air Temperature Reset on All AHUs	127,600	127,600	100%
33A Supply Air Static Pressure Reset on AHU 1-8, 12	14,200	14,200	100%
33A Improve AHU Economizer Operation	57,700	57,700	100%
33B Replace 800 ton Chiller and Cooling Tower	350,733	Not evaluated	
33C VFD on Hot Water Pump	7,700	7,700	100%
Total (does not include 33B)	366,300	366,300	100%

4.2 Commercial Advantage and Enovity Natural Gas Sites

4.2.1 Site 3

Site 3 is an educational facility that installed a new efficient hot water boiler (97% thermal efficiency at full load) in place of an old, inefficient one. Navigant's evaluation of the measure at this location consisted of a visual inspection of the boiler and an open-ended customer satisfaction survey. Navigant was unable to confirm the boiler efficiency since there was no test port available in the exhaust line. Additionally, billing analysis was not practical because the facility had a natural gas furnace and a water heater on the same gas meter. Navigant confirmed that the boiler is in place and operating as expected. Based on the initial project calculations, Navigant determined that 100% of the claimed savings for this project have been achieved.

Table 4-16. Site 3 Gas Savings

Project	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
Hot Water Boiler Replacement	5,980	5,980	100%

4.2.2 Site 24

Site 24 is an educational facility that installed a hydronic, instant heating system in the classrooms of the site's new building. Navigant's evaluation at the site consisted of a visual observation of the hydronic water heating system because it was not possible to test the heating system efficiency due to its intermittent operation.

Navigant confirmed that the measure is in place and working as expected. A billing analysis approach could not be used to quantify the savings because the building is on same meter as the portable classroom units at the site, and the usage of those units is substantial compared to the expected usage of the hydronic heater. Navigant estimates that this project has met 100% of its deemed savings, as all the measures are operating as expected.

Table 4-17. Site 24 Gas Savings

Project	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
Hydronic space heating	744	744	100%

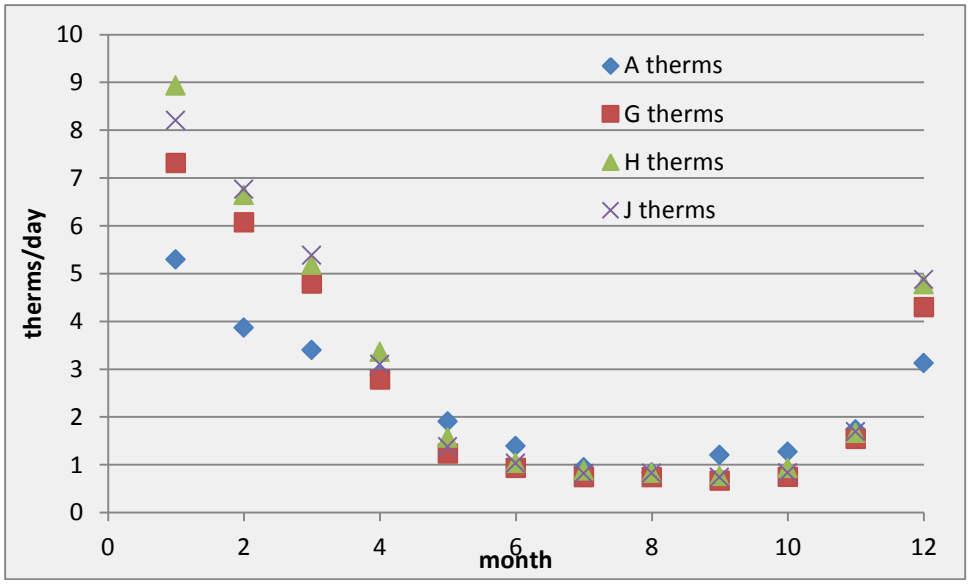
4.2.3 Site 25

Site 25 is a housing association consisting entirely of new townhouses. The Utility issued both electric and gas rebates as part of this project, and two separate incentives were issued, only one of which was included in the 2011-2012 program year. The development consists of 103 townhomes with nine floor plans. Forty-two homes with eight floor plans received rebates from the Utility as part of this portion of the project.

Since the incentive was issued to the developer and the townhomes were now owner occupied, Navigant could not arrange a site visit. However Navigant had reviewed the first phase of this project in a prior evaluation cycle and confirmed installation of the incentivized equipment. The property manager confirmed that no overall changes had been made to the homes, although it is possible individual owners may have made some equipment changes.

All of the townhomes receive their hot water from a central 1,000 kBtu/h boiler in the parking garage, which has its own gas meter. Each townhome also has a gas meter that includes its space heating and cooking and an electric meter. In evaluating this project, the Navigant team reviewed the utility bills for all of the occupied townhomes in the development. Facility personnel supplied a list of closing dates for the townhomes, and calculations assumed units were typically occupied within two weeks after closing. Figure 4-8 shows the average daily gas use for each of the four buildings included in this project.

Figure 4-8. Average Townhome Gas Usage by Building



Based on the bills for the townhouses, the total heating use for the four buildings is 2,160 therms/year, as shown in Table 4-18.

Table 4-18. Site 25 Usage

Building	Therms/yr	Heating Therms/yr	Model Therms/yr	Baseline Therms/yr
A	845	519	609[4]	2,118
G	963	694	540.4	1,097
H	1,107	794	600.7	1,273
J	1,078	778	603.5	1,224
Total	3,993	2,160	3,226.6	5,713

The *ex-ante* information found by Navigant in the building model files received from CPAU did not match the value Navigant found in the master CAP database. The value in the CAP database is 7,159 therms while Navigant found in the building model files 3,359 therms. However, since the value claimed by CPAU is the 7,159 therms, and therefore it is used as the *ex-ante* value. Table 4-19 reflects this assessment, which provides a realization rate of 106%.

Table 4-19. Site 25 Gas Savings

Measure	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
New Construction	7,159	3,553	50%

4.2.4 Site 27

Site 27 is an 18,000 sq. ft. commercial building that installed a new, 87% efficient boiler in place of old, less efficient unit. Navigant's evaluation of the measure at this location consisted of a visual inspection of the boiler, a combustion analysis test, and an open-ended customer satisfaction survey. The verified boiler efficiency through the combustion analyzer test was slightly higher (87.1%) than indicated in its product specifications.

Navigant confirmed that the boiler is in place and operating as expected. As the verified efficiency for the boiler matches with estimated efficiency, Navigant calculates that 100% savings for this measure have been achieved.

Table 4-20. Site 27 Gas Savings

Project	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
Boiler Replacement	690	690	100%

[4] Estimated based on floor area of electrically heated units.

4.2.5 Site 28

Site 28 is a multifamily residential facility that reduced its winter heating set point from 60 °F to 58 °F. Navigant confirmed that the heating set point is now 58 °F, which shows that the measure is in place and is operating as expected. However the facility does not maintain trend data for the HVAC units and therefore analysis of the gas bills was employed as an attempt to verify the savings.

Ex-ante savings for site 28 are 3,341 therms and based on the billing analysis, *ex-post* savings could be 10,000 therms, resulting in a very high realization rate of 299%. However, this realization rate is from basic billing analysis, and although facility personnel indicated there have not been major tenancy changes, it is impossible to determine if gas usage may have changed due to factors other than the project. Since Navigant could confirm that the set point was changed but could not confirm what could be influencing the billing analysis, it must conclude that the realization rate should be 100% rather than 299%. Table 4-21 represents this conclusion.

Table 4-21. Site 28 Gas Savings

Project	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
Reduce winter heating set-point	3,341	3,341	100%

4.2.6 Site 33

Site 33 installed four measures resulting in natural gas savings as part of two projects.

4.2.6.1 33A HVAC Controls

Project 33A consisted of six measures focused around optimizing the HVAC system for one of the buildings at site 33. Two of the measures resulted in natural gas savings:

1. Optimum Start on air handling units (AHUs) and
2. Supply Air Temperature Reset on All AHUs.

Unfortunately the automation system controlling the systems affected by project 33A did not have long term trends available for any of the equipment due to issues with their control system. Navigant was able to obtain some pre-installation data and a few days of recent operational data for all of the systems. However, all of these measures require a significant quantity of trend data over a wide range of outside air temperatures to accurately analyze savings, so it was not possible to perform an in-depth independent analysis of these measures.

Navigant reviewed the data used for the initial project verification and the limited trend data available from the automation system. Based on the available data all of the measures continue to operate as intended, and the initial evaluation included some trending data which supported the reported savings. Based on the continued operation of the controls measures and the previous evaluation data, Navigant accepts the savings for all six of these projects as a 100% realization rate.

4.2.6.2 33C Boiler Replacement and Domestic Hot Water Temperature Set-point

Site 33 installed a new efficient boiler (88% thermal efficiency at full load) in place of an old, inefficient one. Navigant's evaluation of the measure at this location consisted of a visual inspection of the boiler, a combustion analyzer test and an open-ended customer satisfaction survey. Navigant confirmed that the boiler is in place and operating as expected. Verified boiler efficiency through combustion analyzer test was 87.4% which was lower than originally estimated, resulting in a reduced realization rate for the measure resulting in a realization rate for this measure of 78%.

Navigant confirmed with the site that the domestic hot water temperature set-point had been lowered from 140 °F to 120 °F. As there was no good way to independently meter the savings for this measure, and it is operating correctly, Navigant accepts the *ex ante* savings for this measure resulting in a 100% realization rate.

Table 4-22. Site 33 Gas Savings

Measure	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
33A Optimum Start on AHUs	1,630	1,630	100%
33A Supply Air Temperature Reset on All AHUs	25,960	25,960	100%
33C Boiler Replacement	3,740	2,931	78%
33C Lower Domestic Hot Water Temperature Set-point	1,100	1,100	100%
Total	32,430	31,621	98%

4.2.7 Site 34

Site 34 is a school that installed a new, 85.1% efficient boiler in place of old, less efficient one. Navigant's evaluation of the installation at this location consisted of a visual inspection of the boiler, a combustion analyzer test, and an open-ended customer satisfaction survey. The verified boiler efficiency through the combustion analyzer test was slightly lower (84.7%) than specified by the manufacturer (85.1%), however it is still more efficient than the old system. Because the entire school shares one gas meter and the boiler only serves one area it was not possible to use utility bills to confirm the savings.

Navigant confirmed that the boiler is in place and operating normally, and that the methodology employed to estimate savings for the project was reasonable. However, the reduced combustion efficiency resulted in reduced savings at the site.

Table 4-23. Site 34 Gas Savings

Project	*Ex-ante* Therms	*Ex-post* Therms	Realization Rate
Boiler Replacement	860	790	92%

5 RightLights Plus Projects

Navigant conducted 21 site visits in December 2012 to evaluate the City of Palo Alto Utility's "RightLights Plus" program. A summary of these analyses is provided in Table 5-1.

Table 5-1. RightLights Plus Electric Savings

Site ID	Site Description	Ex-ante Energy Savings (kWh)	Calculated Actual Ex-post Energy Savings (kWh)	Actual Energy Savings Realization Rate	Calculated Deemed Ex-post Energy Savings (kWh)	Calculated Deemed Energy Savings Realization Rate
1	Restaurant - Sit-Down (RSD)	38,018	38,018	100%	38,018	100%
2	Residential Multifamily (MFM)	36,084	36,660	102%	31,072	86%
3	Health/Medical - Hospital (HSP)	89,342	70,824	79%	86,966	97%
4	Manuf. - Bio/Tech (MBT)	332,435	180,401	54%	330,896	100%
5	Manuf. - Bio/Tech (MBT)	114,067	68,286	60%	112,784	99%
6	Retail - Single-Story Large (RTL)	19,053	23,163	122%	18,767	98%
7	Restaurant - Fast Food (RFF)	11,638	9,241	79%	11,638	100%
8	Health/Medical - Hospital (HSP)	85,583	20,504	24%	85,652	100%
9	Education - Secondary School (ESE)	80,667	76,637	95%	80,182	99%
10	Lodging - Hotel (HTL)	294,106	237,346	81%	289,823	99%
11	Retail - Single-Story Large (RTL)	13,836	13,880	100%	13,836	100%
12	Health/Medical - Hospital (HSP)	18,772	7,411	39%	18,428	98%
13	Retail - Single-Story Large (RTL)	98,035	75,310	77%	97,303	99%
14	Manuf. - Bio/Tech (MBT)	718,784	517,775	72%	736,561	102%
15	Retail - Single-Story Large (RTL)	237,446	247,826	104%	237,446	100%
16	Retail - Multi-story Large (RT3)	54,019	58,837	109%	50,989	94%
17	Retail - Single-Story Large (RTL)	33,432	27,923	84%	33,432	100%
18	Retail - Multi-story Large (RT3)	41,061	27,218	66%	41,493	101%
19	Manuf. - Bio/Tech (MBT)	101,528	71,835	71%	101,528	100%
20	Manuf. - Bio/Tech (MBT)	121,393	79,208	65%	120,762	99%
21	Retail - Single-Story Large (RTL)	17,478	13,614	78%	17,109	98%
	Total	**2,556,777**	**1,901,917**	**74%**	**2,554,685**	**100%**

5.1 Calculation Methodology:

Navigant calculated project savings in two ways and compared the results in order to determine the realization rate for each site. Both calculated actual savings and calculated deemed savings are acceptable methods of determining savings for projects and in each case, Navigant has provided the realization rates for the both types of savings. The assessment using deemed savings provides insight as

to how the program operated within the guidelines considered acceptable for that implementation year. Actual savings, based on actual hours of operation, provide the planners at CPAU a true picture of actual achievements from their programs. The actual savings and the hours of operation associated with them may support future modifications to deemed "hours of operation" values for the RightLights Plus program. Before describing the savings methodology, it is important to understand the methodology behind claimed (ex-ante) energy savings. It is described below.

5.1.1 Claimed (Ex-ante) Energy Savings:

Ex-ante energy savings were calculated as follows:

(Delta wattage) * (Appropriate Database for Energy Efficient Resources [DEER] operating hours for the building/business type) * (DEER factor for Energy Interactive Effects [EIE] Factor)

Where:

Delta wattage = (Baseline fixture quantity * baseline fixture wattage) – (Installed fixture quantity * installed fixture wattage)

Here, fixture wattages have been drawn from the following resources:

- California 2010 NRR-DR Procedures Manual Appendix B Table of Standard Fixture Wattages;
- Consortium for Energy Efficiency (CEE) database (linear fixtures);
- Design Lights Consortium (DLC) database (LED fixtures);
- Energy Star certification list (LED lamps); and,
- Manufacturer cut sheets (mainly for old existing fixtures).

Appropriate DEER operating hours have been taken from the DEER 2008 database for 16 out of 21 sites that Navigant evaluated. For the remaining 5 sites, the DEER 2005 database was used because these sites were part of legacy jobs begun just before the transition from DEER 2005 to DEER 2008 in July 2011.

Energy Interactive Effects [EIE] factor: This factor is taken from the DEER databases for appropriate building types. When efficient lights are installed in place of old, inefficient lights, they reduce the heating load on the building HVAC (because inefficient lights emit more heat than efficient lights). Thus, the EIE factor represents additional energy (kWh) savings apart from the basic savings achieved by installing efficient lights/fixtures.

5.1.2 Calculated Actual Energy Savings:

Actual energy savings were calculated as follows:

(Delta wattage) * (Actual hours of operation) * (DEER factor for Energy Interactive Effects [EIE] Factor)

Where:

Delta wattage = (Baseline fixture quantity * baseline fixture wattage) – (Confirmed installed fixture quantity * confirmed installed fixture wattage)

Here, fixture wattages were taken from the *"California 2010 NRR-DR Procedures Manual Appendix B Table of Standard Fixture Wattages"* and the resources/references were provided by *"Ecology Action"* (the program contractor for RightLights Plus Program [2011-2012]) for the fixtures with different wattages than provided in the *"Table of Standard Wattages"* mentioned above.

Actual hours of operation = Actual hours of operation drawn from the data collected at the site visits and discussions with site personnel/customers at each site.

5.1.3 Calculated Deemed Energy Savings:

To calculate deemed savings, Navigant used the same methodology adopted in calculating *ex ante* savings mentioned in section 5.1.1.

The only change that Navigant made was to use the actual confirmed fixture quantity and confirmed fixture wattages instead of the installed quantity and wattages to get delta wattage. These confirmed quantities are drawn from visual inspections, fixture counts and discussions with site personnel/customers conducted by Navigant during each site visit.

5.1.4 Calculating savings due to controls:

Navigant calculated savings achieved due to controls and sensors using the values included in Table 5-2. Control/ Sensors Savings.

Table 5-2. Control/ Sensors Savings[5]

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
Dining	35	Open Office	15	Warehouse	45
Gymnasium	35	Private Office	30	Other	15
Hallway	25	Process	45	Parking Garage	15
Hospital Room	45	Public Assembly	35		

[5] 2011 Statewide Customized Offering Procedures Manual for Business, Table 9.4, page 2-45

Navigant's calculation of energy savings due to controls and sensors is as follows:

- For Calculated Actual Energy Savings:

(Delta wattage) * (Actual hours of operation) * (% Savings due to controls/sensors) * (DEER factor for Energy Interactive Effects [EIE] Factor)

Where:

Delta wattage and actual hours of operation are calculated as mentioned in section 5.1.2 and % savings due to controls/sensors is drawn from the Table 5-2.

- For Calculated Deemed Energy Savings:

(Delta wattage) * (Appropriate Database for Energy Efficient Resources [DEER] operating hours for the building/business type) * (DEER factor for Energy Interactive Effects [EIE] Factor) * (% Savings due to controls/sensors)

Where:

Delta wattage, DEER operating hours and the EIE factor are calculated as mentioned in section 5.1.3 and % savings due to controls/sensors is drawn from the Table 5-2.

Note:

1. Claimed (*ex ante*) energy savings due to controls/sensors were calculated using a flat 30% reduction in energy consumption for all the fixtures with sensors/controls installed on them.
2. Navigant adjusted wattages for 100 watt incandescent lamps and 75 watt incandescent lamps to 72 watts and 53 watts for all the analyses. These adjustments resulted in slightly lower realization rates for the sites that had these lamps in the baseline. Calculations for claimed (*ex ante*) energy savings for the sites under evaluation did not include these wattage adjustments. Navigant made these wattage adjustments to account for the new light bulb standards released by California Energy Commission on January 1, 2011 and January 1, 2012.

5.2 Site 1

Site 1 is a small sit-down restaurant that installed variable frequency controls (VFDs) on four exhaust fans in the kitchen. Navigant's evaluation of the measures at this location consisted of a visual inspection of the VFD control system and a discussion with site personnel.

Navigant's team was unable to log the fans as the power inlet to the fans and VFD system could not be located. The fans were inside the kitchen exhaust and therefore inaccessible, so Navigant was not able to note down the power ratings. As the system was clearly operating (confirmed by the visual inspection and customer feedback), Navigant estimates that this measure has achieved 100% of the deemed savings.

The realization rate for site 1 is provided in the following table:

Table 5-3. RightLights Plus Electric Savings – Site 1

Project	Ex-ante kWh	Ex-post kWh	Realization Rate
Exhaust fan VFDs	38,018	38,018	100%

5.2.1 Site 2

Site 2 is a residential multifamily site. The RightLights Plus measures installed at the facility included the following:

- 110 4-foot 2-lamp first generation T8 fixtures were replaced with new, efficient T8 fixtures;
- Four T8 fixtures were removed;
- Four outdoor mercury vapor lamps were replaced by CFL screw-ins ; and,
- Six photocells and 108 high bay occupancy sensors were installed.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measures at this location consisted of a visual inspection of the lighting systems, a lighting fixture count and a discussion with site personnel.

Data collected during site visit confirms the number of fixtures and sensors installed. The following table shows calculated actual energy savings at site 2.

Table 5-4. RightLights Plus Calculated Actual savings – Site 2

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**36,084**	**36,660**	**102%**

The actual calculated energy savings have a higher realization rate because Navigant used the occupancy sensor savings calculation method as outlined in section 5.1.4. *Ex ante* occupancy sensor savings were calculated using a 30% flat reduction in energy consumption for the fixtures operated by the occupancy sensors. Also, actual operating hours (8,760 hours/year) are 10% higher than the deemed operating hours (7,884 hours/year) for this type of facility.

The realization rate for site 2, based on deemed operating hours, is given in the following table.

Table 5-5. RightLights Plus Calculated Deemed Savings – Site 2

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**36,084**	**31,072**	**86%**

Again, the lower realization for the calculated deemed energy savings for site 2 is due to the occupancy sensor energy savings calculation approach as mentioned above.

5.2.2 Site 3

Site 3 is a small health/medical facility. The RightLights Plus measures installed at the facility included the following:

- 51 old T12 fixtures were replaced with T8 fixtures;
- Three outdoor metal halide fixtures were replaced with CFL wall packs;
- Eight T8 4-lamp fixtures were replaced with new generation T8 2-lamp fixtures;
- 92 incandescent lamps were replaced with CFL screw-in lamps; and,
- 10 incandescent exit fixtures were replaced with LED fixtures.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measures at this location consisted of a visual inspection of the lighting systems, a lighting fixture count and a discussion with site personnel.

Data collected during site visit confirms the number of fixtures installed. From the discussion with site personnel, most of the interior lamps are operating less often than originally estimated.

The following table shows calculated actual energy savings at site 3:

Table 5-6. RightLights Plus Calculated Actual savings – Site 3

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**89,342**	**70,824**	**79%**

The reasons for the lower realization rate at site 3 are as follows:

1. Most of the interior lamps have lower operating hours than originally estimated.
2. The site had twenty-five 75-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.
3. Actual operating hours for interior and exterior fixtures at site 3 are about 90% of the deemed operating hours (DEER 2008) for a small health/medical facility.

The realization rate for site 3, calculated using deemed operating hours, is given in the following table.

Table 5-7. RightLights Plus Calculated Deemed Savings – Site 3

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**89,342**	**86,966**	**97%**

The slightly lower realization rate for calculated deemed energy savings is due to the incandescent wattage adjustments done for the twenty-five 75-watt incandescent lamps in the baseline.

5.2.3 Site 4

Site 4 is a pharmaceutical manufacturing facility. The RightLights Plus measures installed at the facility included the following:

- 522 old T12 fixtures were replaced with T8 fixtures;
- 11 outdoor metal halide fixtures and five 250-watt high pressure sodium fixtures were replaced with efficient, smaller metal halide kits;
- Five small 70-watt metal halide fixtures were replaced with CFL screw-in lamps;
- 46 incandescent lamps were replaced with energy efficient substitutes;
- 23 incandescent exit fixtures were replaced with LED fixtures; and,
- Two wall-mount sensor-switches were installed to operate fixtures in the storage and hallways.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel. Data collected during the site visit confirms the number of fixtures and sensors installed.

The following table shows calculated actual energy savings at site 4.

Table 5-8. RightLights Plus Calculated Actual savings – Site 4

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**332,435**	**180,401**	**54%**

The reasons for the lower realization rate at site 4 are as follows:

1. Actual operating hours for interior and common areas for the site 4 are about 45% of the deemed operating hours for bio/pharmaceutical manufacturing facilities (DEER 2005).
2. The site had eight 75-watt and fifteen 100-watt incandescent lamps in the baseline. The baseline has been adjusted to match California's new energy efficiency standards for incandescent lamps (as mentioned in the calculation methodology).

The realization rate for site 4, calculated using deemed operating hours (DEER 2005) for Bio/ Pharmaceutical manufacturing facilities, is given in the following table:

Table 5-9. RightLights Plus Calculated Deemed Savings – Site 4

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**332,435**	**330,896**	**100%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.4 Site 5

Site 5 is a pharmaceutical manufacturing facility. The RightLights Plus measures installed at the facility included the following:

- 218 old T12 fixtures were replaced with T8 fixtures;
- Four outdoor metal halide fixtures were replaced with induction wall-pack units;
- Five induction lamps and two high pressure sodium lamps were replaced with energy efficient CFL substitutes; and,
- Six incandescent exit fixtures were replaced with LED fixtures.

The site has replaced all the fixtures on a nearly one-for-one basis. Navigant's evaluation of the measures at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel. Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 5.

Table 5-10. RightLights Plus Calculated Actual savings – Site 5

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**114,067**	**68,286**	**60%**

The reasons for the lower realization rate at site 5 are as follows:

1. Actual operating hours for the interior areas of site 5 are about 60% of the deemed operating hours for a bio/pharmaceutical manufacturing facility (DEER 2008).
2. Also, the site had three 100-watt incandescent lamps in the baseline. The baseline has been adjusted to match California's new energy efficiency standards for incandescent lamps (as mentioned in the calculation methodology).

The realization rate for site 5, calculated using deemed operating hours (DEER 2008) for bio/pharmaceutical manufacturing facilities, is given in the following table.

Table 5-11. RightLights Plus Calculated Deemed Savings – Site 5

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**114,067**	**112,784**	**99%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.5 Site 6

Site 6 is a large, single-story retail facility. The RightLights Plus measures installed at the facility included the following:

- 25 old T12 fixtures were replaced with T8 fixtures;
- Six 400-watt metal halide indoor fixtures were replaced with 4-foot 2-lamp T8 fixtures; and,
- Two 100-watt incandescent lamps were replaced by CFL lamps.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and discussions with the customers.

Data collected during the site visit confirms the number of fixtures installed. Old operating hours for the site were less than the current operating hours; therefore Navigant adjusted the original baseline hours to match the current operating hours.

The following table shows calculated actual energy savings at site 6:

Table 5-12. RightLights Plus Calculated Actual savings – Site 6

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**19,053**	**23,163**	**122%**

60% of the lights included in the RightLights Plus measures are operating more often than deemed operating hours (DEER 2008) for single-story retail facility, Thus, realization rate for actual energy savings is on higher side for site 6.

The realization rate for site 6, calculated using deemed operating hours (DEER 2008) is given in the following table.

Table 5-13. RightLights Plus Calculated Deemed Savings – Site 6

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**19,053**	**18,767**	**98%**

The site had two 100-watt incandescent lamps in the baseline. The baseline has been adjusted to match California's new energy efficiency standards for incandescent lamps (as mentioned in the calculation methodology). Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.6 Site 7

Site 7 is a fast food restaurant. The RightLights Plus measures implemented at the facility included the following:

- 17 old T12 fixtures were replaced with T8 fixtures;
- Two old T12 fixtures were removed; and,
- Five incandescent lamps were replaced with CFL lamps.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measures at this location consisted of a visual inspection of the lighting system and a lighting fixture count. Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 7:

Table 5-14. RightLights Plus Calculated Actual savings – Site 7

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**11,638**	**9,241**	**79%**

Actual operating hours for the interior areas for site 7 are about 75% of the deemed operating hours for a fast food restaurant facility (DEER 2008). Thus, calculated actual energy savings are lower than claimed *ex ante* energy savings, which are calculated using deemed operating hours. Therefore, the realization rate is on the lower side.

Calculated deemed energy savings for site 7 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-15. RightLights Plus Calculated Deemed Savings – Site 7

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**11,638**	**11,638**	**100%**

5.2.7 Site 8

Site 8 is a small hospital/medical facility. The RightLights Plus measures installed at the facility included the following:

- 47 old T12 fixtures were replaced with T8 fixtures;
- 87 U-shaped T12 fixtures were replaced with 2-foot T8 fixtures;
- 18 incandescent lamps were replaced with CFL screw-in lamp fixtures; and,
- 29 incandescent lamps were replaced with new, efficient 35-watt incandescent floods.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measures at this location consisted of a visual inspection of the lighting systems, a lighting fixture count and a discussion with site personnel. Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 8:

Table 5-16. RightLights Plus Calculated Actual savings – Site 8

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**85,583**	**20,504**	**24%**

Actual operating hours for the interior areas for site 8 are about 20% of the deemed operating hours for a small hospital/medical facility (DEER 2005). Thus, calculated actual energy savings are lower than claimed *ex ante* energy savings, which are calculated using deemed operating hours. Therefore, the realization rate is on the lower side.

Calculated deemed energy savings for site 8 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-17. RightLights Plus Calculated Deemed Savings – Site 8

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**85,583**	**85,652**	**100%**

5.2.8 Site 9

Site is a secondary school. The RightLights Plus measures installed at the facility included the following:

- 209 old T12 fixtures were replaced with T8 fixtures;
- 94 first generation T8 lamp fixtures were replaced with new, efficient T8 fixtures and lamps;
- Eight incandescent lamps were replaced with CFL screw-in lamps; and,
- Three incandescent exit fixtures were replaced with LED fixtures.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel. Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 9:

Table 5-18. RightLights Plus Calculated Actual savings – Site 9

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**80,667**	**76,637**	**95%**

The reasons for the lower realization rate at site 9 are as follows:

1. The average of actual operating hours for all fixtures at site 9 are about 90% of the deemed operating hours (DEER 2008) for a secondary school type facility.
2. The site had eight 75-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.

Calculated deemed energy savings for site 9 are shown in the following table. For deemed savings, the realization rate is 99%.

Table 5-19. RightLights Plus Calculated Deemed Savings – Site 9

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**80,667**	**80,182**	**99%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.9 Site 10

Site 10 is a lodging/hotel facility. The RightLights Plus measures installed at the facility included the following:

- 35 old T12 fixtures were replaced with T8 fixtures;
- 393 indoor incandescent lamps were replaced with CFL screw-in lamps;
- 282 old, incandescent lamps were replaced with smaller, efficient incandescent lamps;
- Four exterior, 70-watt high pressure sodium fixtures were replaced with 42-watt CFL wall-packs; and,
- Eight incandescent exit fixtures were replaced with LED fixtures.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

According to the data collected during the site visit, many lamps and fixtures were changed after the retrofits were done. In both the banquet rooms, the retrofits for 50-watt incandescent lamps were undone. Also, out of remaining lights in the banquet rooms, 50% of the lights were changed to more efficient lights. During the discussion, site personnel mentioned that these changes were made due customer suggestions/preferences. These types of changes are normal in the lodging/hotel business.

The following table shows calculated actual energy savings at site 10:

Table 5-20. RightLights Plus Calculated Actual savings – Site 10

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**294,106**	**237,346**	**81%**

The reasons for the lower realization rate at site 10 are as follows:

1. On average, actual operating hours for all the fixtures at site 10 are about 80% of the deemed operating hours (DEER 2005) for a lodging/hotel type facility.
2. The site had eight 75-watt incandescent lamps in the baseline. The Incandescent wattage adjustment is also one of the factors in the lower realization rate.
3. Changes in the proposed lighting system for the 50-watt incandescent lamps and banquet rooms have resulted in a lower realization rate.

Calculated deemed energy savings for site 10 are shown in the following table. For deemed savings, the realization rate is 99%.

Table 5-21. RightLights Plus Calculated Deemed Savings – Site 10

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**294,106**	**289,823**	**99%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments and changes in the proposed lighting.

5.2.10 Site 11

Site 11 is a retail store. The RightLights Plus measures installed at the facility included the following:

- 18 old T12 fixtures were replaced with T8 fixtures;
- Four incandescent lamps were replaced with CFL screw-in lamps; and,
- One incandescent exit fixture was replaced with an LED fixture.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed. Old operating hours for the site were less than the current operating hours, thus Navigant adjusted the original baseline hours to match the current operating hours.

The following table shows calculated actual energy savings at site 11:

Table 5-22. RightLights Plus Calculated Actual savings – Site 11

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**13,836**	**13,880**	**100%**

For site 11, actual operating hours are similar to the deemed operating hours, thus realization rate is 100% for calculated actual energy savings.

Calculated deemed energy savings for site 11 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-23. RightLights Plus Calculated Deemed Savings – Site 11

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**13,836**	**13,836**	**100%**

5.2.11 Site 12

Site 12 is a medical facility. The RightLights Plus measures installed at the facility included the following:

- 32 old T12 fixtures were replaced with T8 fixtures; and,
- 10 incandescent lamps were replaced with CFL screw-in lamps.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 12.

Table 5-24. RightLights Plus Calculated Actual savings – Site 12

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**18,772**	**7,411**	**39%**

The reasons for the lower realization rate at site 12 are as follows:

1. Actual operating hours for the site 12 are about 35% of the deemed operating hours for a small hospital/medical facility (DEER 2008).
2. The site had three 100-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.

Calculated deemed energy savings for site 12 are shown in the following table. For deemed savings, the realization rate is 98%.

Table 5-25. RightLights Plus Calculated Deemed Savings – Site 12

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**18,772**	**18,428**	**98%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.12 Site 13

Site 13 is a large, single-story retail facility. The RightLights Plus measures installed at the facility included the following:

- 56 old T12 fixtures were replaced with T8 fixtures;
- Seven old T12 fixtures were disabled;
- 39 outdoor metal halide fixtures and 2 halogen incandescent fixtures were replaced with energy-efficient substitutes;

- Five small, 70-watt metal halide fixtures were replaced with CFL screw-in lamps;
- 22 Incandescent lamps were replaced with CFL lamps;
- Two wall sensor-switches were installed in two restrooms; and,
- Seven photocells were installed on seven outdoor fixtures.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 13:

Table 5-26. RightLights Plus Calculated Actual savings – Site 13

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**98,035**	**75,310**	**77%**

The reasons for the lower realization rate at site 13 are as follows:

1. Actual operating hours for the interior fixtures at site 13 are about 70% of the deemed operating hours for a single-story retail facility (DEER 2008).
2. The site had four 100-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.

Calculated deemed energy savings for site 13 are shown in the following table. For deemed savings, the realization rate is 99%.

Table 5-27. RightLights Plus Calculated Deemed Savings – Site 13

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**98,035**	**97,303**	**99%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.13 Site 14

Site 14 is a large, bio/tech manufacturing facility. The RightLights Plus measures installed at the facility included the following:

- 1,763 old T12 fixtures were replaced with 1,242 T8 fixtures;
- Seven exterior metal halide fixtures were replaced with CFL wall-packs;

- 29 high pressure sodium lamps were replaced with CFL screw-in lamps; and,
- 59 wall sensors and 39 ceiling sensors were installed in the facility.

The site has replaced 376 cubicle task lights on a one-for-one basis. About 1,000 old 4-foot T12 3-lamp fixtures were replaced on nearly a two-for-one basis with 4-foot 4-lamp T8 fixtures with low ballast factors. The remaining lamps/fixtures were replaced on nearly one-for-one basis. Sensors were installed primarily in restrooms, common areas, conference rooms, vending machines and less-used office spaces.

Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 14.

Table 5-28. RightLights Plus Calculated Actual savings – Site 14

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**718,784**	**517,775**	**72%**

Actual operating hours for the interior areas for site 14 are about 60% of the deemed operating hours for a large bio/tech manufacturing facility (DEER 2005). Thus, the calculated actual energy savings are lower than the claimed *ex ante* energy savings, which are calculated using deemed operating hours. Therefore, the realization rate is on the lower side.

Calculated deemed energy savings for site 14 are shown in the following table. For deemed savings, the realization rate is 102%.

Table 5-29. RightLights Plus Calculated Deemed Savings – Site 14

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**718,784**	**736,561**	**102%**

The slightly higher realization in calculated deemed energy savings was because Navigant used occupancy sensor standard reduction according to "2011 Statewide Customized Offering Procedures Manual for Business, Section 2: Estimating Energy Savings" Table 9.4. *Ex ante* savings were calculated using a flat 30% reduction in energy savings for all the fixtures controlled by occupancy sensors.

5.2.14 Site 15

Site 15 is a large, single-story retail store. The RightLights Plus measures installed at the facility included the following:

- 234 old T12 fixtures were replaced with T5 fixtures;
- 19 U-shaped T12 fixtures were replaced with T8 fixtures;
- Three first generation T8 lamp fixtures were replaced with new, efficient T5 fixtures;
- 82 exterior metal halide fixtures were replaced with xenon fixtures;
- 17 incandescent fixtures were replaced with energy efficient CFL and LED substitutes; and,
- Five incandescent exit fixtures were replaced with LED fixtures.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 15.

Table 5-30. RightLights Plus Calculated Actual savings – Site 15

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**237,446**	**247,826**	**104%**

80% of the lights included in the RightLights Plus measures are operating more often than deemed operating hours (DEER 2008) for single-story retail facility, Thus, realization rate for actual energy savings is on higher side for site 15.

The calculated deemed energy savings for site 15 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-31. RightLights Plus Calculated Deemed Savings – Site 15

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**237,446**	**237,446**	**100%**

5.2.15 Site 16

Site 16 is a multi-story retail store. The RightLights Plus measures installed at the facility included the following:

- 82 old T12 fixtures were replaced with T8 fixtures;
- 41 Incandescent lamps were replaced with CFL screw-in lamps;
- 16 first generation T8 lamp fixtures were replaced with new, efficient T8 fixtures and lamps; and,

- 59 U-shaped T8 lamp fixtures were replaced with 2-foot 2-lamp T8 fixtures.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 16.

Table 5-32. RightLights Plus Calculated Actual savings – Site 16

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**54,019**	**58,837**	**109%**

All the lights included in the RightLights Plus measures are operating more often than deemed operating hours (DEER 2008) for single-story retail facility, Thus, realization rate for actual energy savings is on higher side for site 16.

Calculated deemed energy savings for site 16 are shown in the following table. For deemed savings, the realization rate is 99%.

Table 5-33. RightLights Plus Calculated Deemed Savings – Site 16

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**54,019**	**50,989**	**94%**

The site had 33 75-watt incandescent lamps in the baseline. The baseline has been adjusted to match California's new energy efficiency standards for incandescent lamps (as mentioned in the calculation methodology). Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.16 Site 17

Site 17 is a large, single-story retail facility. The RightLights Plus measures installed at the facility included the following:

- 28 old T12 fixtures were replaced with T8 fixtures;
- Eight 400-watt metal halide fixtures were replaced with 4-foot T8 fixtures; and,
- Eight 400-watt metal halide fixtures were replaced by 100-watt LED canopy lamp fixtures.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 17.

Table 5-34. RightLights Plus Calculated Actual savings – Site 17

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**33,432**	**27,923**	**84%**

Actual operating hours for the interior areas for site 17 are about 90% of the deemed operating hours for a large, single-story retail facility (DEER 2008). Thus, realization rate for calculated actual energy savings is on the lower side.

Calculated deemed energy savings for site 17 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-35. RightLights Plus Calculated Deemed Savings – Site 17

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**33,432**	**33,432**	**100%**

5.2.17 Site 18

Site 18 is a multi-story retail complex. The RightLights Plus measures installed at the facility included the following:

- 43 old T12 fixtures were replaced with T8 fixtures;
- Seven outdoor metal halide fixtures were replaced with CFL wall packs;
- Seven Incandescent lamps were replaced with CFL screw-in lamps; and,
- One incandescent exit fixture was replaced with an LED fixture.

The site has replaced all the fixtures on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with plant personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 18:

Table 5-36.RightLights Plus Calculated Actual savings – Site 18

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**41,061**	**27,218**	**66%**

Actual operating hours for the interior areas for site 18 are about 55% of the deemed operating hours for a multi-story retail complex type facility (DEER 2005). Thus, calculated actual energy savings are lower than claimed *ex ante* energy savings, which are calculated using deemed operating hours. Hence, the realization rate is on the lower side.

Calculated deemed energy savings for site 18 are shown in the following table. For deemed savings, the realization rate is 101%.

Table 5-37. RightLights Plus Calculated Deemed Savings – Site 18

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**41,061**	**41,493**	**101%**

The slightly higher realization in calculated deemed energy savings was because Navigant used the occupancy sensor standard reduction according to "2011 Statewide Customized Offering Procedures Manual for Business, Section 2: Estimating Energy Savings" Table 9.4. *Ex ante* savings were calculated using a flat 30% reduction in energy savings for all the fixtures controlled by occupancy sensors.

5.2.18 Site 19

Site 19 is a large, bio/tech manufacturing facility. The RightLights Plus measures installed at the facility included the following:

- 134 old 4-foot T12 fixtures were replaced with T8 fixtures;
- 106 old 8-foot T12 fixtures were replaced with 4 foot T8 fixtures;
- Six first generation T8 fixtures were replaced with new, efficient T8 fixtures; and,
- Five external metal halide fixtures were replaced with energy efficient substitutes.

Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 19:

Table 5-38.RightLights Plus Calculated Actual savings – Site 19

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**101,528**	**71,835**	**71%**

The reasons for the lower realization rate at site 19 are as follows:

Actual operating hours for the interior areas for site 19 are about 70% of the deemed operating hours for a large, bio/tech manufacturing facility (DEER 2008). Thus, realization rate for calculated actual energy savings is on the lower side.

Calculated deemed energy savings for site 19 are shown in the following table. For deemed savings, the realization rate is 100%.

Table 5-39. RightLights Plus Calculated Deemed Savings – Site 19

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**101,528**	**101,528**	**100%**

5.2.19 Site 20

Site 20 is a large, bio/tech manufacturing facility. The RightLights Plus measures installed at the facility included the following:

- 86 old 4 foot T12 fixtures were replaced with T8 fixtures;
- 299 old 8 foot T12 fixtures were replaced with 4 foot T8 fixtures;
- One first generation T8 fixture was replaced with a new, efficient T8 fixture; and,
- 12 incandescent lamps were replaced with CFL screw-ins.

Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 20.

Table 5-40.RightLights Plus Calculated Actual savings – Site 20

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**121,393**	**79,208**	**65%**

The reasons for the lower realization rate at site 20 are as follows:

1. Actual operating hours for the interior areas for site 20 are about 70% of the deemed operating hours for a large, bio/tech manufacturing facility (DEER 2008).
2. The site had seven 75-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.

Calculated deemed energy savings for site 20 are shown in the following table. For deemed savings, the realization rate is 99%.

Table 5-41. RightLights Plus Calculated Deemed Savings – Site 20

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**121,393**	**120,762**	**99%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

5.2.20 Site 21

Site 21 is a large, single-story retail facility. The RightLights Plus measures installed at the facility included the following:

- Three old T12 fixtures were replaced with T8 fixtures;
- Nine 400-watt metal halide fixtures were replaced with 4 foot 4-lamp T8 fixtures;
- Four incandescent lamps were replaced by CFL lamps; and,
- One incandescent fixture was de-lamped.

The site has replaced all the fixtures and lamps on a one-for-one basis. Navigant's evaluation of the measure at this location consisted of a visual inspection of the lighting system, a lighting fixture count and a discussion with site personnel.

Data collected during the site visit confirms the number of fixtures installed.

The following table shows calculated actual energy savings at site 21.

Table 5-42.RightLights Plus Calculated Actual savings – Site 21

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Actual	**17,478**	**13,614**	**78%**

The reasons for the lower realization rate at site 21 are as follows:

1. Actual operating hours for the interior areas for site 21 are about 80% of the deemed operating hours for a large, single-story retail facility (DEER 2008).
2. The site had four 100-watt incandescent lamps in the baseline. The incandescent wattage adjustment is also one of the factors in the lower realization rate.

Calculated deemed energy savings for site 21 are shown in the following table. For deemed savings, the realization rate is 98%.

Table 5-43. RightLights Plus Calculated Deemed Savings – Site 21

	Ex-ante (Claimed)	Ex-post	Realization Rate
	kWh	kWh	
Deemed	**17,478**	**17,109**	**98%**

Slightly lower calculated deemed energy savings are due to the incandescent wattage adjustments.

6 Gross Impact Evaluation Results

6.1 CAP and Enovity Gross Impact

Table 6-1 provides a site by site summary as well as program total summaries of CAP and Enovity program energy realization rates for both electricity and natural gas. The electric realization rates by site range from a low of 21% at site 32 to a high of 229% at site 29. The natural gas realization rates by site range from a low of 50% at site 25 to a high of 100% at several sites.

Overall, the program level realization rates for CAP is 108% for electricity and 81% for natural gas. The Enovity program rates are 108% for electricity and 100% for natural gas. The combined CAP and Enovity realization rates are 108% for electricity and 91% for natural gas.

Table 6-1. Commercial Advantage and Enovity Energy Savings

Site ID	Non-Residential Programs	Gross *Ex-Ante* Energy (kWh)	Gross *Ex-Post* Energy (kWh)	kWh Realization Rate	Gross *Ex-Ante* Energy (therms)	Gross *Ex-Post* Energy (therms)	Therm Realization Rate
3	CAP				5,980	5,980	100%
22	CAP	399,230	396,480	99%			
22	CAP	360,753	360,753	100%			
23	CAP	53,076	40,972	77%			
24	CAP	20,109	20,109	100%	744	744	100%
25	CAP	26,425	42,525	161%	7,159	3,553	50%
26	CAP	2,580	2,580	100%	0	0	
27	CAP	80,451	80,451	100%	690	690	100%
28	CAP	40,946	21,500	53%	3,341	3,341	100%
29	CAP	76,978	176,145	229%			
30	Enovity	4,941,200	3,970,783	80%			
31	Enovity	399,172	402,128	101%			
32	Enovity	326,400	67,000	21%			
33	Enovity	358,600	358,600	100%	27,590	27,590	100%
33	CAP	7,700	7,700	100%	4,840	4,031	83%
34	Enovity				860	790	92%
Total	**All**	**7,093,620**	**7,631,894**	**108%**	**51,204**	**46,719**	**91%**
Total	**CAP**	**1,068,248**	**1,149,215**	**108%**	**22,754**	**18,339**	**81%**
Total	**Enovity**	**6,025,372**	**6,482,679**	**108%**	**28,450**	**28,380**	**100%**

6.2 *RightLights Plus Gross Impact*

Table 6-2 provides a site by site summary as well as a program total summary of both deemed based and actual based energy realization rates. The assessment using deemed savings provides insight as to how the program operated within the guidelines considered acceptable for that implementation year (FY 2012). Actual savings, based on actual hours of operation, provide the planners at CPAU a true picture of actual achievements from their programs. The actual savings and the hours of operation associated with them may support future modifications to deemed "hours of operation" values for the RightLights Plus program. Deemed based energy realization rates by site range from a low of 86% at site 2 to a high of 102% at site 14. Actual based energy realization rates by site range from a low of 39% at site 12 to a high of 122% at site 6. Overall, the program level realization rate is 100% for deemed based and 74% for actual based.

Table 6-2. RightLights Plus Electric Savings

Site ID	Site Description	Ex-ante Energy Savings (kWh)	Calculated Actual Ex-post Energy Savings (kWh)	Actual Energy Savings Realization Rate	Calculated Deemed Ex-post Energy Savings (kWh)	Calculated Deemed Energy Savings Realization Rate
1	Restaurant - Sit-Down (RSD)	38,018	38,018	100%	38,018	100%
2	Residential Multifamily (MFM)	36,084	36,660	102%	31,072	86%
3	Health/Medical - Hospital (HSP)	89,342	70,824	79%	86,966	97%
4	Manuf. - Bio/Tech (MBT)	332,435	180,401	54%	330,896	100%
5	Manuf. - Bio/Tech (MBT)	114,067	68,286	60%	112,784	99%
6	Retail - Single-Story Large (RTL)	19,053	23,163	122%	18,767	98%
7	Restaurant - Fast Food (RFF)	11,638	9,241	79%	11,638	100%
8	Health/Medical - Hospital (HSP)	85,583	20,504	24%	85,652	100%
9	Education - Secondary School (ESE)	80,667	76,637	95%	80,182	99%
10	Lodging - Hotel (HTL)	294,106	237,346	81%	289,823	99%
11	Retail - Single-Story Large (RTL)	13,836	13,880	100%	13,836	100%
12	Health/Medical - Hospital (HSP)	18,772	7,411	39%	18,428	98%
13	Retail - Single-Story Large (RTL)	98,035	75,310	77%	97,303	99%
14	Manuf. - Bio/Tech (MBT)	718,784	517,775	72%	736,561	102%
15	Retail - Single-Story Large (RTL)	237,446	247,826	104%	237,446	100%
16	Retail - Multi-story Large (RT3)	54,019	58,837	109%	50,989	94%
17	Retail - Single-Story Large (RTL)	33,432	27,923	84%	33,432	100%
18	Retail - Multi-story Large (RT3)	41,061	27,218	66%	41,493	101%
19	Manuf. - Bio/Tech (MBT)	101,528	71,835	71%	101,528	100%
20	Manuf. - Bio/Tech (MBT)	121,393	79,208	65%	120,762	99%
21	Retail - Single-Story Large (RTL)	17,478	13,614	78%	17,109	98%
Total		**2,556,777**	**1,901,917**	**74%**	**2,554,685**	**100%**

6.3 *Commercial Sector Electric Realization Rate*

Table 6-3 provides the individual commercial program electric realization rates and the resultant *ex-post* program impacts. Since no evaluation was conducted for the Keep Your Cool or Hospitality Programs, the combined affects from the CAP, Enovity and RightLights Plus program realization rate assessments are used. These combined assessments are provided in Table 6-4. The RightLights Plus Program realization rate used in the estimation of the overall Commercial Sector electric realization rate is based on actual hours of operation. Although the realization rate based on deemed measure savings for the RightLights Plus Program could be used, Navigant wanted to use as proxy for the Keep Your Cool and Hospitality Programs realization rates those most reflective of actual achievement. Overall, the commercial sector electricity realization rate is estimated to be 95%.

Table 6-3. Commercial Sector Electric Utilization Rates and *Ex-Post* Impacts

Non-Residential Programs	Gross *Ex Ante* Energy (kWh)	Energy Realization Rate	Gross *Ex Post* Energy (kWh)
Commercial Advantage	2,311,377	108%	2,496,287
RightLights Plus (Deemed Based)	3,381,531	74%	2,502,333
Enovity	6,434,592	108%	6,482,679
Keep Your Cool	165,196	95%	156,936
Hospitality	619,027	95%	588,076
Total	12,911,722	95%	12,226,311

Table 6-4. Combined Realization Rates from the CAP, Enovity, and RightLights Plus Programs

Non-Residential Programs	Gross *Ex Ante* Energy (kWh)	Energy Realization Rate	Gross *Ex Post* Energy (kWh)
Commercial Advantage	2,311,377	108%	2,496,287
RightLights Plus (Deemed Based)	3,381,531	74%	2,502,333
Enovity	6,434,592	108%	6,482,679
Total	**12,127,500**	**95%**	**11,481,299**

6.4 *Commercial Sector Natural Gas Realization Rate*

Table 6-5 provides the individual commercial program natural gas realization rates and the resultant *ex-post* program impacts. Natural gas projects only occurred in the CAP and Enovity programs. The CAP realization rate is applied to the total CAP gross *ex ante* therms and the Enovity realization rate is applied to the to the total Enovity gross *ex ante* therms. These two values are added together and provide the

overall commercial sector natural gas realization rate of 89%. This 89% is lower than the 91% listed for the combined sample results listed in Table 6-1, which is a realization of the combined sample results.

Table 6-5. Commercial Sector Natural Gas Utilization Rates and *Ex-Post* Impacts

Non-Residential Programs	Gross *Ex Ante* Energy (therms)	Energy Realization Rate	Gross *Ex Post* Energy (therms)
Com. Advantage	35,474	81%	28,734
Enovity	28,450	100%	28,380
Total	**63,924**	**89%**	**57,114**

7 Recommendations

Overall the City of Palo Alto Utilities commercial sector energy efficiency programs are performing very well with the overall electric program realization rate at 102% and the natural gas realization rate at 118%. Navigant offers the following observations and recommendations.

7.1.1 RightLights Plus

The RightLights Plus program realization rates can be calculated from two very different perspectives. The first is based on using the appropriate deemed energy savings per measure in use in FY 2012. In this method, the evaluation focuses on verifying measure installations and wattages. The second takes this a step further by modifying one of the key variables in the calculation of the deemed energy savings. This variable is hours of operation, whereas the wattages remain the same as used in the deemed savings calculations. Wattages are generally based on the Table of Standard Fixture Wattages in Appendix B of the California Statewide Customized Offering Procedures Manual for Business, although manufacturers' specifications may be used if fixtures are not included in the table. In addition, baseline wattages for incandescent lamps have been decreased to meet the new national lighting efficiency standards. Navigant recommends that savings evaluation based on the standard wattages with actual hours of operation and verification of installation and wattages be the method used to estimate FY 2012 program realization rates. The realization rates and associated *ex-post* based energy savings calculated using actual hours of operation are of more importance from the perspective of identifying program impacts on resource requirements and for providing input to update assumptions for future program years. In general, Navigant recommends the use of actual hours of operation to estimate energy savings when they are significantly different from the deemed hours.

7.1.2 Commercial Advantage And Enovity Programs

The CAP and Enovity Programs include custom projects for both electric and gas savings. Overall these projects are well documented, but in some cases the project file does not include complete information on what equipment was included in the savings and the baseline. This results in some difficulties in evaluating the program since it is not always possible to accurately verify the baseline without additional information. Navigant recommends that CPAU confirm that the baseline and affected equipment list is included in all program files. Baseline data in the project file should include photographs of nameplates of removed baseline equipment whenever possible. For new construction, if energy models were used in the analysis, detailed month by month kWh and therm predictions should be included in the project file in order to support comparison to bills. In particular the ECON-1 page of DOE2.2 model outputs, which details monthly gas and electric baseline and savings, should be included in the project file along with the Title 24 compliance certificates.

Enovity works directly with the Utility's customers to recommend and implement custom energy efficiency projects. As part of this, Enovity performs detailed studies of the projects in advance of the project and performs detailed post-installation verifications. Many of the facilities have systems in place which monitor the affected systems in detail and can store trend data, but not all of them have enabled the systems to keep trend data. Several of the projects in the program included savings for chillers and

other seasonally dependent equipment. Since the evaluation is performed in the winter, some of the equipment is not operating and none of its operation can be manually logged in hot weather. This introduces substantial uncertainties in the analysis of some of the projects. Navigant highly recommends that Enovity work with customers to set up long term trend logging on large projects where monitoring systems are in place. In addition Navigant recommends working with customers to confirm that the data being logged by the system is appropriate for energy analysis and accurate: some of the available trend logs did not include data on power which was in the monitoring system and the data being logged by one customer was not accurate after the upgrades to the system. The availability of long term logging data would substantially reduce the cases in which 100% realization rates were applied based on modeled operation for systems.