EVALUATION, MEASUREMENT, AND VERIFICATION OF THE MODESTO IRRIGATION DISTRICT'S NON-RESIDENTIAL ENERGY EFFICIENCY PROGRAMS (FINAL)

Nov 1, 2018

Program year 2016-2017

Prepared for:

MID Modesto Irrigation District Water and Power

Submitted by:

ANCHOR BLUE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

MID Non-Residential Programs Impact Evaluation

PROGRAM YEAR 2016-2017

EXECUTIVE SUMMARY

Introduction

Modesto Irrigation District (MID) contracted Anchor Blue Consulting (Anchor Blue) to conduct their Non-Residential Programs Impact Evaluation for Program Years 2016 and 2017. This evaluation report details evaluation findings. Program evaluation objectives are as follow:

- Review and assess quality of program tracking data, project files, and documentations
- Provide an unbiased and independent program evaluation combining on-site visit data and analysis
- Present actionable recommendations to MID with the goal of improving program and tracking efficiencies and accuracies

Portfolio-Level Ex-Post Net-to-Gross Savings

The MID Non-Residential Program Impact Evaluation follows the California Evaluation Framework[1] and the California Energy Efficiency Evaluation Protocols[2] for reporting and adhere to International Performance Measurement and Verification Protocols (IPMVP) as our approach to estimating energy and demand savings including the following areas:

- Reporting Context
- Overview and Documentation of Specific Evaluation Effort
- Gross Savings
- Net Savings
- EM&V Summary and Conclusions

This evaluation aimed at a combined ±15% precision at 90% confidence level for combined Program Years 2016 and 2017 using a stratified sampling strategy. This resulted in 18 samples where Anchor Blue conducted project file reviews, on-site verification activities including verifying installation, collecting operational data when appropriate, and verifying equipment nameplates and model numbers.

[1] CPUC California Evaluation Framework June 2014
[2] CPUC California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals April 2006

The sampled evaluated ex-ante energy and demand savings represents 12,581,948 kWh and 1, 724 kW, which covers 50% of energy and 41% demand savings claimed for MID's Non-Residential program savings combining program years 2016 and 2017. Table 1 and Table 2 summarizes the key metrics of this program evaluation, for results disaggregated by program year, refer to Section "Energy and Demand Results by Program Year and Measure Category":

Table 1 MID Non-Residential Portfolio-Level Electric Savings 2016-2017

Modesto E3 Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	97%	-	0.6	-
Non-Res Cooling	319,457	97%	311,113	0.85	264,446
Non-Res Heating	-	97%	-	0.6	-
Non-Res Lighting	16,670,354	97%	16,234,935	0.8	12,987,948
Non-Res Motors	20,989	97%	20,441	0.6	12,264
Non-Res Pumps	642	97%	625	0.6	375
Non-Res Refrigeration	221,109	97%	215,334	0.6	129,200
Non-Res Shell	74,658	97%	72,708	0.6	43,625
Non-Res Process	7,862,124	97%	7,656,770	0.6	4,594,062
Non-Res Comprehensive	86,228	97%	83,976	0.6	50,385
Non-Res Behavior	-	97%	-	0.7	-
Other	-	97%	-	0.7	-
TOTAL	**25,255,561**				**18,082,306**

Source: Anchor Blue analysis of MID 2016 and 2017 Non-Residential program data, 2016 DEER Database NTG values

Table 2 MID Non-Residential Portfolio-Level Demand Savings 2016-21017

Modesto E3 Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio	Net Annual Ex-Post Demand Savings (kW)
Non-Res Cooking	-	64%	-	0.6	-
Non-Res Cooling	176	64%	113	0.85	96
Non-Res Heating	-	64%	-	0.6	-
Non-Res Lighting	2,941	64%	1,882	0.8	1,505
Non-Res Motors	-	64%	-	0.6	-
Non-Res Pumps	-	64%	-	0.6	-
Non-Res Refrigeration	36	64%	23	0.6	14

Modesto E3 Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio	Net Annual Ex-Post Demand Savings (kW)
Non-Res Shell	-	64%	-	0.6	-
Non-Res Process	992	64%	635	0.6	381
Non-Res Comprehensive	45	64%	29	0.6	17
Non-Res Behavior	-	64%	-	0.7	-
Other	-		-	0.7	-
TOTAL	**4,190**				**2,013**

Source: Anchor Blue analysis of MID 2016 and 2017 Non-Residential program data, 2016 DEER Database NTG values

Key Findings

The gross impact evaluation results are based on 18 sites, the samples are drawn from all MID Non-Residential Programs namely, MPower Business Rebate, Custom Rebate, Business New Construction, and Direct Install. After reviewing relevant project files and datasets specific to each site, the team designed the Measurement &Verification (M&V) specific site plans. One site from the original sample rejected the on-site visit due to timing conflict, hence, a back-up site is evaluated as a replacement for the original site. Another site was the final phase of a project with multiple energy claims and rebate installments. Since the project was recently evaluated, Anchor Blue reviewed the evaluation analysis and report and did not conduct additional site data collection.

When on-site, our team performed data collection activities such as verifying installation count, make and model of equipment, operational data, and other relevant variables supporting M&V activities. Where appropriate, Anchor Blue installed lighting loggers on-site to collect a minimum of 4 weeks of operational data. Some sites required billing data analysis. Anchor Blue worked with MID to acquire customer usage data to support our ex-post analysis.

Once the on-site analyses were completed, Anchor Blue aggregated the site result by the three strata. The realization rates of each site are weighted by its stratum weight which aggregate to a stratum weighted program realization rate. The gross savings are extrapolated using the stratum weighted program realization rate. Anchor Blue conducted a desk research on the net-to-gross ratios by measure category reviewing the DEER 2016 database, the E3 Program Savings Reporting Tool, and the 2015 Statewide ESPI Lighting Program Evaluation Reports. The NTG ratios by category were applied to the program level gross ex-post savings to derive the program level net savings.

Program recommendations from Anchor Blue's evaluations activities are outlined below:

- **Enhance documentation of ex-ante savings by project:** While direct install projects and custom projects have ex-ante savings documented in MID's Rebate Summary Details Report and project files, Business Rebate projects do not have the ex-ante savings easily assessible. Anchor Blue highly

encourages the documentation of the savings in MID's Rebate Details Summary Report for the following reasons:

  - Capturing ex-ante savings for all projects could enhance the accuracy of the evaluation. Sampling designs are ideally constructed using ex-ante savings, without the information on ex-ante savings by project up front, sampling would have to be conducted using the rebate amount. For future program cycles, if MID can include ex-ante savings, the sample design can be tied to savings instead of incentives, which will make the sampling strategy more robust.
  - Having the ex-ante savings documented within MID's Rebate Details Summary Report or project files can clear up ambiguity with ex-ante savings claimed. Currently, evaluators have to review each rebate code and match the specific code to the E3 Program Savings Reporting Tool by line item. While this method is workable, there could be confusion at times as occasionally the rebate code does not match with equipment found on-site.

- **Demand savings for exterior lighting fixtures:** Exterior lighting fixtures and lamps mostly operate at off peak hours and therefore do not yield demand reduction. This assumption is consistent with Section 6.4 of the California Municipal Utilities Association (CMUA) Technical Reference Manual (TRM) for exterior LED lighting measures. Some MID projects using deemed savings applied demand savings for exterior lighting. One of these projects is a streetlight project, which covered a substantial proportion of MID's ex-ante demand savings claimed, this project was a key driver of a demand realization rate significantly lower than 100%. Anchor Blue recommends applying no demand savings to exterior lighting that operates off-peak for future ex-ante savings claim.
- **Work with Direct Install implementation contractor to document evidence of T12 baseline if such is claimed in a Direct Install project**: For Direct Install projects that claimed early replacement measures with baseline listed below Title 24 code baseline (e.g., T12s), documentation of baseline should be provided. Guidance from CPUC on Linear Fluorescent disposition using T12 as a baseline stated that claiming an early retirement measure invokes the requirement for documentation of the pre-existing condition as well as evidence that program intervention caused the early retirement project (per D.12-05-015). In one of the evaluated sites, the project claimed T12 as the baseline while the evaluation team found evidence of T8 lamps instead of T12s. Anchor Blue recommends MID to work with the direct install implementation contractor to document baseline equipment so as to ensure the correct baseline assumption is used when calculating savings.
- **Verify ballast change as part of the Direct Install project process:** Type A Tubular LED (TLED) lamps could work with some existing ballasts suitable for T8s, however, an old ballast is not optimal for TLEDs and may cause shorter fixture lifetime due to ballast failure. At one of the Direct Install sites, the evaluation team found old ballasts that were not replaced with the new TLEDs installation. Anchor Blue recommends MID to work with the implementation contractor to confirm replacement of existing ballasts with new ballasts, ideally ones that are confirmed to be compatible with the efficient TLEDs replacement lamps.
- **Additional quality control on rebate codes**: For deemed savings lighting measures, occasionally rebate codes of a similar measure were applied, for examples:
  - Interior vs. Exterior fixture replacements with same efficient measure
  - Same efficient measures with different baseline wattages such as 150W Metal Halide vs. 400W Metal Halide

  Applying a mismatched rebate code causes differences in savings driven by discrepancies in baseline wattages and adjustment factors such as energy and demand interactive factors.

- **Consider a Custom project approach for large scale projects**: The advantage of using the deemed rebate amount is efficiency for both the customer and the MID team. Most projects of small to medium scales are great candidates for the deemed savings approach. However, larger projects have more complexities and a custom approach might be more suitable. One of the projects evaluated was a heat pump mini-split upgrade for an apartment building. Based on usage data, customers utilize their heat pumps in both summer and winter and the baseline included electric resistance heat. The deemed savings approach only captures the cooling savings, which underestimated annual energy savings for heat pump measures when the baseline is an electric heating equipment. For the heat pump mini-split project evaluated, the ex-post savings is higher than the ex-ante savings by multiples due to including heating savings in the ex-post savings. Anchor Blue confirmed that the specific project had electric heating prior to heat pump upgrades. Anchor Blue recommends considering a custom approach for future large-scale projects.
- **Enhance savings calculation documentations**: Most projects evaluated had clear documentation on assumptions and savings approaches, however, there are several projects that include assumptions that Anchor Blue was not able to trace back to the source. Anchor Blue recommends documenting assumptions to the extent possible and practical. This is especially important for custom projects where the assumptions going into savings calculations are not standardized. There were several instances where the location and count of lighting measures were different from what is noted in the project files. Without documentation from ex-ante calculation, verifying the calculations became challenging and introduced uncertainty.

INTRODUCTION

This report summarizes Anchor Blue's impact evaluation of Modesto's Non-Residential program energy and demand savings for Program Years 2016 and 2017. MID conducts regular impact evaluations for their Non-Residential programs. The purpose of this impact evaluation is to develop program ex-post energy and demand savings results adhering to the CEC POU EM&V Guidelines and the California Energy Efficiency Evaluation Protocols.

The CEC POU EM&V Guidelines specify the reporting requirements for EE program evaluations. The components of an impact study include sampling and statistical precision, gross savings, net-to-gross estimation, and EM&V reporting requirements. The CEC Framework are summarized below:

- **Contextual Reporting**: Evaluation should cover a significant portion of the POU's portfolio, assess risk or uncertainty in selecting the components of the portfolio evaluated. EM&V savings reported consistent with the California SB 1037 annual report.
- **Overview and Documentation of Specific Evaluation Effort**: States the portion of portfolio evaluated, including EUL and lifecycle savings. Documents all engineering and analysis algorithms, assumptions, survey instruments, and methodology. Documentation of data collection instruments and metering equipment and protocols.
- **Gross Savings**: Review of program baseline, characterizes the population of participants, discussion of sampling approach, design, and precision. Reports ex-post savings extrapolated to program population, and explanation of differences between ex-ante and ex-post savings.
- **Net Savings**: Includes a quantitative assessment of net-to-gross or indicating the sources of NTG assumptions.
- **EM&V Summary and Conclusions**: Report clearly recommendations for improving program processes, assesses the reliability of the verified savings and areas of uncertainty.

PROGRAM DESCRIPTION

MID has four programs under their Commercial and Industrial offerings: MPower Business Rebate, Custom Rebate, New Construction, and Direct Install.

The MPower Business Rebate program includes deemed savings measures where customers can apply for qualifying energy efficient product rebates listed in the MPower Business Rebate catalog. These products include but are not limited to lighting, refrigeration, HVAC measures, high efficiency motors, and window shades. The MPower Custom Rebate program is available to larger Commercial, Industrial, and Agricultural customers that replace existing equipment or systems with high efficiency equipment. A custom project should exceed current California Title 24 standards when applicable and operate for a minimum of 5 years after installation.

The Direct Install program contracts an implementation contractor to conduct energy efficiency upgrades for customers. The Commercial New Construction program caters to projects with new high-efficiency equipment in new facilities or during major remodel or expansion of existing facilities. New construction projects should operate for a minimum of 5 years after installation and be completed within one year of submitting the rebate.

OVERVIEW OF MEASURE AND VERIFICATION APPROACH AND SAMPLING

General M&V Approaches

This impact evaluation study aims at evaluating MID's energy and demand savings claimed for the Non-Residential programs for Program Years 2016 and 2017. The Anchor Blue team used a stratified sampling approach to balance efficiency with target ±15% precision at 90% confidence level. The C&I projects are divided into three strata. The sampling approach results in 18 sample projects.

For each project that received an on-site visit, the team collected site-specific operating conditions, verified measure installations, and took notes of conditions that might impact energy saving results. Using data collected on-site, the team developed a realization rate, which is the ratio of ex-ante vs. ex-post savings. Detail results of each site visit is documented in this report, Section "Site Level Gross Ex-Ante and Estimating Ex-Post Savings".

From there, the site-specific realization rates are aggregated and weighted by its stratum weight to determine a stratum weighted realization rate, which is extrapolated to the population of participants to estimate ex-post savings for all projects in Program Years 2016 and 2017. Net-to-Gross (NTG) ratios were estimated to account for spillover and free rider effects based on measure category. NTG ratios were derived from the E3 Program Savings Reporting Tool cross-verified with the DEER database. Anchor Blue also reviewed the 2015 California Statewide ESPI Lighting Program Evaluation reports, a summary of the NTG results from the reports are captured in Section "Net-to-Gross Ratio" of this report.

Sample Design

The EM&V population universe of projects consists of the 2016 and 2017 participants in MID's Non-Residential Business Rebate, Custom, New Construction, and Direct Install Programs. Two sources of data are of importance for this evaluation cycle.

The first is the SB1037 Report by year, submitted to the California Energy Commission as documentation of the MID's annual program achievements. Data within in the SB1037 Report includes:

- Measures installed
- Program under which the measure was installed
- Installation date
- Gross energy and peak demand savings
- Incentives provided

The SB 1037 Report provides an overview of results at the measure and program level, but not at the project level.

Project level information was provided by MID for the years 2016 and 2017 from their Rebate Details Summary Report. At the project level, this data includes:

- Application number/project ID
- Customer or project name
- Rebate identifier number
- Customer account number
- Measure type
- Measure description

- Rebate amount

Energy savings by project is not included for all projects in the Rebate Details Summary Report. Project level energy savings information is included in the detailed project information datasets, which Anchor Blue received after the sample population was selected.

In past evaluations, gross energy saving by project was used as the sampling variable. For this evaluation, the rebate amount was used. Anchor Blue employed a stratified ratio estimation sampling method. The sample was drawn with the goal of achieving a sampling precision of 90 percent +/- 15 percent at the project level. With this sampling precision, the sample size was estimated to be 18 sites.

Stratified Ratio Estimation Sampling

Stratified ratio estimation combines a stratified sample design with a ratio estimator.

- ***Stratified Random Sampling.*** In this method, the sample population is divided into subgroups (i.e., strata) based on a known characteristic such as savings or incentive level. Stratified random samples can produce estimates with smaller coefficients of variation than simple random samples. Stratum one includes the largest projects, stratum 2 the intermediate, and stratum 3 the smaller projects
- ***Ratio Estimation*** is a sampling method that can achieve increased precision and reliability by taking advantage of a relatively stable correlation between an auxiliary variable and the variable of interest. For the evaluation of energy efficiency programs, the most frequency utilized ratio is the realization rate between ex- ante savings and ex- post savings and incentive levels.

By using the incentive level 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 smaller sample is selected from the accounts with small incentive levels, but the sample is forced to include a high proportion of the projects with larger incentive levels.

Non-Residential Projects Sampled

The population of accounts for the Non-Residential Programs consists of a total of 213 projects. These projects have a very wide range of incentives from $10 to $144,252. The population coefficient of variation of the energy savings is large and stratified ratio estimation sampling provides the best methodology to attain both a sampling precision of 90 percent +/- 15 percent at the project level as well as a very high percentage of overall incentives provided. The final sample consists of 18 projects (8%) and more importantly 41% of the total amount of incentives distributed. A summary of weights by stratum is provided in Table 3.

Table 3: Stratum Weights Based on Initial Sample Draw

Stratum	Total Incentives	Sampled Incentives	Stratum Weight
Stratum 1	$452,364	$378,312	1.20
Stratum 2	$373,210	$138,862	2.69
Stratum 3	$430,145	$3,246	132
Total	**$1,255,720**	**$520,421.60**	**2.41**

Source: Anchor Blue analysis of Rebate Details Summary Report

Site-Level Energy and Demand Savings Estimation

EM&V Protocols

This evaluation was conducted adhering to the CEC POU EM&V Guidelines, the California Energy Efficiency Evaluation Protocols and referencing the International Performance Measurement and Verification Protocol (IPMVP)[3] for appropriate energy efficiency measures evaluation protocol. For specific evaluation methodology by site, refer to the individual site-reports in Section "Site Level Gross Ex-Ante and Estimating Ex-Post Savings".

Interactive Effects and Coincidence Factors

MID is located in California's Climate Zone 12. Some energy efficient equipment's energy and demand savings are impacted by their interaction with other equipment or system. Anchor Blue reviewed the CMUA TRM for assumptions appropriate for Climate Zone 12, these variables are:

- Lighting/HVAC/Refrigeration Energy and Demand Interactive Factors
- Baseline and Efficient Coincidence Factors

These factors are applied to measures of evaluated projects when appropriate.

[3] For IPMVP document, access at: https://www.nrel.gov/docs/fy02osti/31505.pdf

SITE LEVEL GROSS EX-ANTE AND ESTIMATING EX-POST SAVINGS

This section reports detailed assumptions, calculations, and evaluation activity by site. Anchor Blue organized the site reports in the following order:

- **Project summary**: Includes project information, summary of ex-ante savings, ex-post savings, realization rate, description of baseline and efficient equipment as well as ex-ante calculation assumptions.
- **On-site visit and ex-post savings calculations**: Summary of site visit observations and ex-post calculations assumptions.

Site 1: Streetlights

Project Summary

This site was a portion of the street lights in the City of Modesto that were replaced with Cree XSP LED fixtures.

Table 4. First-Year Project Savings Summary- Site 1

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	4,263,013	4,331,550	102%
Peak Demand Savings (kW)	635.4	0.0	0%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

Replacement of the following baseline fixtures with LED street lights:

Table 5. Baseline and Efficient Fixtures Replacements for Site 1

Baseline Fixtures	Efficient Fixtures
(40) 400W HPS Street Lights	(40) 101W Cree XSP Street Lights
(2062) 200W HPS Street Lights	(2062) 91W Cree XSP Street Lights
(4674) 150W HPS Street Lights	(4674) 73W Cree XSP Street Lights
(2420) 100W HPS Street Lights	(2420) 48W Cree XSP Street Lights
(201) 100W HPS Street Lights	(201) 73W Cree XSP Street Lights
(12) 100W HPS Street Lights	(12) 91W Cree XSP Street Lights

Description of Baseline Equipment and Operation

In the baseline, the site had 9,049 High Pressure Sodium Light Fixtures of varying wattages (100W – 400W). Hours of use are dusk to dawn, for a total of 4,150 hours per year.

Description of Efficient Equipment and Operation

The project replaced all 9,049 with Cree XSP Light Fixtures of varying wattages (48W – 101W) on a one-to-one basis.

Comments on Ex-Ante Calculations

This project utilized both business rebates and custom rebates. The ex-ante calculations used a standard lighting algorithm for the energy savings. The ex-ante savings claimed using the deemed savings included interactive factors and deemed demand savings.

For the **deemed savings** portion of the application, the algorithms used are listed as follow:

Energy Savings:

$\Delta kWh = N \times \Delta kWh/fixture$

Where,
ΔkWh = Annual energy saved (in kWh),
N = Number of fixtures replaced,
$\Delta kWh/fixture$ = Deemed annual energy saved per fixture.

Demand Savings:

$\Delta kW = N \times \Delta kW/fixture$

Where,
ΔkW = Peak demand saved (in kW),
N = Number of fixtures replaced,
$\Delta kW/fixture$ = Deemed demand savings per fixture.

For the **custom rebate** portion of the application, the algorithms used are listed as follow:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times HOURS$

Where,
ΔkWh = Annual energy saved (in kWh),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.
HOURS = Average hours of use per year

Demand Savings:

N/A, no demand savings claimed for the custom rebate portion of the project.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue confirmed the wattage and quantity of a sample of street lights in Modesto. All sample lights matched location and wattage as shown on data lists with GPS coordinates of the fixtures.

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count and operational hours with a subset of the streetlights based on project file documentation including fixture types, wattages, and GPS coordinates of the LED streetlights.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to calculate energy savings. Since all streetlights are exterior fixture, no interactive effect is applied to the savings calculations. The operating hours are from dusk till dawn in which the streetlights are off during on-peak hours, therefore, there is no demand savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy}DEER Interactive Effects Factor for energy savings = 1.00

Summer Coincident Peak kW Savings Algorithm
$\Delta kW = ((kWBaseline - kWEE) / 1000) \times DIE_{Demand} \times CDF$
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.00
CDF = Coincident Diversity Factor for peak demand
= 0.0

The difference in ex-ante and ex-post savings is due to difference in interactive factors and coincidence factors applied. The ex-ante deemed savings included interactive factors and coincidence factors to the savings calculations. Since streetlights are exterior fixtures and operate at off-peak hours, Anchor Blue applied 1 as the interactive factor and 0 as the coincidence factor because the fixtures are outside.

Site 2: Church Parking Lot Lighting

Project Summary

The site is a church located Modesto, California. The site upgraded 12 of the floodlights throughout the parking lot. The difference in the realization rate for the energy savings at the site is due to slight difference in efficient fixture wattage between ex-ante and ex-post assumption. The peak demand savings realization rate is 0% as the exterior fixtures were only on during non-peak hours.

Table 6. First-Year Project Savings Summary-Site 2

	Ex-ante	***Ex-post***	***Realization Rate***
Energy Savings (kWh/Year)	*15,121*	*15,301*	*101%*
Peak Demand Savings	*2.4*	*0*	*0%*

(kW)			

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

The site upgraded five of their parking lot floodlights with one 4-headed Westgate LED floodlight fixtures and four 2-headed Westgate LED floodlight fixtures. Each head has a 160W LED lamp (based on the spec sheets provided for the purchased lights). Anchor Blue assumed that the additional fixtures were added due to increase lighting needs for the parking lot, thus assumed a 400W Metal Halide baseline for the additional fixtures.

Description of Baseline Equipment and Operation

In the baseline, the site had five single-metal halide 400W fixtures. Lights are on from dusk to dawn.

Description of Efficient Equipment and Operation

The site upgraded five of their parking lot floodlights with one 4-headed Westgate LED floodlight fixtures and four 2-headed Westgate LED floodlight fixtures. Each head has a 160W LED lamp (based on the cut sheet provided for the purchased lights). The operating hours for the new fixtures are also from dusk to dawn with sensors.

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = N \times \Delta kWh/fixture$

Where,
ΔkWh = Annual energy saved (in kWh),
N = Number of fixtures replaced,
$\Delta kWh/fixture$ = Deemed annual energy saved per fixture.

Demand Savings:

$\Delta kW = N \times \Delta kW/fixture$

Where,
ΔkW = Peak demand saved (in kW),
N = Number of fixtures replaced,
$\Delta kW/fixture$ = Deemed demand savings per fixture.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures

- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.0 (for outdoor fixtures)

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kW_{Baseline} - kW_{EE}) / 1000) \times DIE_{Demand} \times CDF$

Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.0 (outdoor fixtures)
CDF = Coincident Diversity Factor for peak demand = 0 (outdoor lights)

The difference in the realization rate for the energy and demand savings at the site is due to slight difference between the specific efficient fixture wattages and that assumed in the deemed savings. The realization rate for demand savings is 0% since the on hours do not overlap with utility peak demand.

Site 3: Gym Lights Upgrade

Project Summary

The site is a small gym in Modesto, California. The site upgraded the lighting in different phases throughout the space. The difference in the realization rate for the energy and peak demand savings is due to differences between deemed hours and hours of use specific to the site.

Table 7. First-Year Project Savings Summary- Site 3

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	5,040	5,409	107%
Peak Demand Savings (kW)	0.8	0.9	118%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

Replaced four 400W Metal Halide Fixtures with four McGraw Edison LED Low Bay Fixtures.

Description of Baseline Equipment and Operation

In the baseline, the site had four Metal Halide Lamps. Hours of use are 11AM-8PM Monday, 9:30am-8:30pm Tuesday & Thursday, 9:30AM-9:30PM Wednesday & Friday, Saturday 9am-noon. Birthday parties are from noon-7PM on Saturday and 10AM-5:00PM on Sundays. The site is open 48 weeks of the year.

Description of Efficient Equipment and Operation

For this rebate, the site replaced four (4) of the Metal Halide fixtures with four LED Low Bay fixtures. The operating hours for the new fixtures are the same as the baseline fixtures.

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the deemed energy and demand savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = N \times \Delta kWh/fixture$

Where,
ΔkWh :h: Annual energy saved (in kWh),
N: Number of fixtures replaced,
ΔkWh/fixture: Deemed annual energy saved per fixture.

Demand Savings:

$\Delta kW = N \times \Delta kW/fixture$

Where,
ΔkW = Peak demand saved (in kW),
N = Number of fixtures replaced,
ΔkW/fixture = Deemed demand savings per fixture.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the new fixtures
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$= Connected load of baseline fixtures
kW_{EE}= Connected load of LED fixtures
HOURS= Average hours of use per year
DIE_{Energy}= DEER Interactive Effects Factor for energy savings = 1.04

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kWBaseline - kWEE) / 1000) \times DIE_{Demand} \times CDF$
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.18
CDF = Coincident Diversity Factor for peak demand
= 0.53

The difference in realization rate for the energy and demand savings at the site is due to difference between specific site hours used in the ex-post savings calculation compared to deemed savings hours.

Site 4: Refrigerated Case Lighting

Project Summary

The site convenience store located in Modesto, California. The site upgraded all the case lighting in the site. The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue using site-specific operating hours, specific efficient lighting wattages, and a coincidence demand factor referenced in the 2017 CMUA TRM, which is different than the one in the deemed calculation spreadsheet.

Table 8. First-Year Project Savings Summary- Site 4

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	8,436	15,572	144%
Peak Demand Savings (kW)	1.3	1.3	102%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

The site replaced all fluorescent refrigerated lighting with new LED 60" refrigerated case lighting. The replacements consisted of both center mount fixtures and end mount fixtures.

Description of Baseline Equipment and Operation

In the baseline, it was assumed that there were 60" fluorescent refrigerator lighting. It was assumed that the old lighting consisted of a similar center and end fixture locations as the new LED lighting.

Description of Efficient Equipment and Operation

The site replaced all fluorescent refrigerated lighting with new Optimax Pro 24 60" LED refrigerated lighting. The operating hours for the new fixtures are the same as the baseline fixtures (6:45 AM – 10 PM, 7 days per week).

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = N \times \Delta kWh/fixture$

Where,
ΔkWh =Annual energy saved (in kWh),
N =Number of fixtures replaced,
ΔkWh/fixture = Deemed annual energy saved per fixture.

Demand Savings:

$\Delta kW = N \times \Delta kW/fixture$

Where,
ΔkW = Peak demand saved (in kW),
N = Number of fixtures replaced,
ΔkW/fixture= Deemed demand savings per fixture.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Counted the number of fixtures
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue found more refrigerated case lighting than shown on the rebate form. Rebate shows 114 linear feet of replaced LED fixtures, Anchor Blue found 135 linear feet. Anchor Blue used the quantity on the rebate form for ex-post calculations. During the site visit, Anchor Blue was able to confirm the operating hours of the fixtures.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

ΔkWh = ((kWBaseline – kWEE) / 1000) x HOURS x DIEEnergy
Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.59

Summer Coincident Peak kW Savings Algorithm

ΔkW = ((kWBaseline – kWEE) / 1000) x DIE_{Demand} x CDF
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.29
CDF = Coincident Diversity Factor for peak demand = 0.56

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue using site-specific operating hours, specific efficient lighting wattages, which is lower than the deemed values assumed, and a coincidence demand factor referenced in the 2017 CMUA TRM (0.56), which is different than the one used the deemed calculation spreadsheet (0.71).

Site 5: Sunscreen

Project Summary

This site is a small barber shop located in Modesto, California. The site added sunscreens to the front window and the glass entry door. The difference in realization rate is due to an ex-ante savings data entry error and differences in the estimated screen size compared to the actual installed screen size.

Table 9. First-Year Project Savings Summary- Site 5

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	1,074	36.05	3.4%
Peak Demand Savings (kW)	0	0.04	N/A

Source: Project Documentation, Anchor Blue Analysis

Sun Screen Addition

The site added two sunscreens:

1. 2 feet x 6 feet
2. 5 feet x 6.5 feet

The two sunscreens have a total area of 44.5 square feet.

Description of Baseline Equipment and Operation

The site had an un-shaded 2 foot x 6 foot glass door and 5 foot x 6.5 foot glass window, which caused very high temperatures in the space. The business runs an AC unit in the summer and doesn't run any heating in the winter as there is a series of refrigerators along the units shared wall and produces enough heat for the space during winter months.

Description of Efficient Equipment and Operation

The site added two sun screens to the exterior front window and door for a total of 44.5 square feet of sunscreens.

Comments on Ex-Ante Calculations

The ex-ante calculations intended to use a deemed savings value of 1.7 kWh/sq ft of sunscreen based on deemed energy savings value developed for residential buildings. However, a data entry error occurred when entering the claimed ex-ante savings. The ex-ante savings were recorded as 17 kWh/sq ft as opposed to 1.7 kWh/sq.ft. The algorithm is as follow:

Energy Savings:

$\Delta kWh = N \text{ sq.ft} * \Delta kWh/\text{sq ft}$

Demand Savings:

N/A

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue confirmed the size of sunscreens on-site.

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue confirmed the installation and measurements of the sunscreens.

Ex-post Calculations and Assumptions

The ex-post calculations used the deemed Residential savings based on the 2017 CMUA Savings Estimation TRM. Anchor Blue multiplied the onsite screen size measurement with the deemed savings value to calculate the total energy savings. The algorithm uses interactive effects to calculate demand savings.

Annual Energy Savings:

ΔkWh = N sq.ft* ΔkWh/sq ft

Annual Demand Savings:

ΔkW= N sq.ft* ΔkW/sq ft

Where,
ΔkWh= Annual energy saved (in kWh), 0.81 kwh/sq ft.
ΔkW= Annual demand saved (in kW), 0.001 kw/sq.ft
N = sq. ft of sunscreen, 44.5 sq. ft

The difference in the realization rate for the energy savings at the site is due to Anchor Blue confirming 44.5 square feet of sunscreen compared to the 63 square feet of sunscreen on the application. The ex-ante savings data entry error contributed to the magnitude difference in realization rate.

Site 6: Appliance Store Direct Install Lighting Retrofit

Project Summary

The site is an appliance store located in Modesto, California. The site upgraded all the lighting in their new retail space to TLEDs through MID's Direct Install program. The difference in the realization rates for the energy and demand savings at the site are due to the ex-ante savings assuming T12 fluorescent lamps as the baseline while T8 should be used as the baseline. During Anchor Blue's on-site visit, the site contact confirmed to Anchor Blue that the baseline lamps were T8 fluorescent lamps and the ballasts were not switched out during the lamp replacement. As a result, the baseline wattages were lower than that assumed in the ex-ante savings calculations.

Table 10. First-Year Project Savings Summary- Site 6

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	33,668	25,072	74%
Peak Demand Savings (kW)	9.7	6.0	62%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

The site completed a lighting upgrade from 2-lamp T8s to 2-lamp 17W TLEDs with electronic ballasts.

Description of Baseline Equipment and Operation

In the project file, the contractor documented 252 4ft 2-lamp T12 fixtures. During the site inspection, the site contact confirmed with Anchor Blue that the baseline fixtures were 4ft 2-lamp T8s. The space was just purchased by the store owner, and the hours of use from the previous business was unknown. Anchor Blue estimated the baseline hours to be the same as the current operating hours.

Description of Efficient Equipment and Operation

The site replaced the T8 fixtures on a one-to-one basis with new 2-lamp 17W TLED with electronic ballasts. During the field visit, Anchor Blue could only verify 249 fixtures that existed on site. The business is open from 8AM to 7PM, 7 days a week. The total annual operating hours are 4,004.

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times$ Annual Operating Hours

Where,
ΔkWh = Annual energy saved (in kWh),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Demand Savings:

$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000)$

Where,
ΔkW = Peak demand saved (in kW),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected the following data during the onsite visit:

- Confirmed the wattage and presence of 249 of the new fixtures
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count and operating hours. Anchor Blue wasn't able to confirm the operating hours of the lights prior to the new installation as the store just moved into the new site.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to calculate the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.06

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kWBaseline - kWEE) / 1000) \times DIE_{Demand} \times CDF$
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.20
CDF = Coincident Diversity Factor for peak demand = 0.88

The difference in the realization rate for the energy and demand savings at the site is due to the implementer using T12s as the baseline, while the actual baseline fixtures were T8s. In addition, the hours of operation might be different from ex-ante assumptions, but the files did not document the ex-ante baseline hours. Lastly, Anchor Blue was able to find 249 installed fixtures compared to 252 fixtures documented in the project documentation, resulting in a slightly lower realization rate.

Site 7: Church Lighting

Project Summary

The site is a church located in Modesto. The site upgraded all the lighting in their space to LED lighting. The majority of the fixtures were upgraded to TLEDs with new electronic ballasts. The remaining fixtures were changed from incandescent PAR lamps to LED PAR lamps.

Table 11. First-Year Project Savings Summary- Site 7

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	11,434	10,209	89%
Peak Demand Savings (kW)	2.7	2.7	98%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

The site upgraded its lighting to have 2-lamp or 4-lamp 17W TLED with new electronic ballastss. They also upgraded incandescent PAR lamps to 8W LED PAR lamps.

Description of Baseline Equipment and Operation

In the baseline, the site had seventy-nine 4-ft T8 4-lamp fixtures, two 4-ft T8 2-lamp fixtures and twenty-one incandescent 50W PAR20 lamps.

Description of Efficient Equipment and Operation

The site replaced the T8 fixtures on a one-to-one basis with new 2-lamp or 4-lamp 17W TLEDs with new electronic ballasts. The site also replaced the incandescent PAR20 fixtures with new LED PAR20 8W fixtures. The business is open from 7:30am – 4:00pm Monday thru Friday and a few hours on Sunday. There are two (2) 4-lamp TLED that are on continuously.

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times$ Annual Operating Hours

Where,
ΔkWh: Annual energy saved (in kWh),
$Watts_{BASE}$: Connected load of the baseline fixtures,
$Watts_{EE}$: Connected load of energy efficient fixtures.

Demand Savings:

$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000)$

Where,
ΔkW = Peak demand saved (in kW),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue performed the following tasks during the onsite visit:

- Confirmed the wattage of new fixtures
- Confirmed quantity of new fixtures, and found two extra 4-lamp 17W TLEDs
- Installed lighting loggers to confirm operating hours

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count and operational hours. Anchor Blue installed two lighting loggers on site from the first week of May to first week of July.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite lighting operating hours findings to calculate the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.04

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kWBaseline - kWEE) / 1000) \times DIE_{Demand} \times CDF$
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.18
CDF = Coincident Diversity Factor for peak demand = 0.53

The difference between the ex-ante and ex-post savings are due to difference in operating hours assumptions. Anchor Blue used on-site logging data to calculate ex-post savings.

Site 8: Clothing Store Direct Install Lighting Upgrade

Project Summary

The site is a clothing store in Modesto, California. The site upgraded all lighting fixtures on a one for one basis with LED lamps through MID's Direct Install program. The difference in the realization rate for the energy and peak demand savings at the site is due to differences in ex-ante and ex-post operating hours assumptions. Anchor Blue applied site-specific operating hours to the ex-post calculations.

Table 12. First-Year Project Savings Summary- Site 8

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	21,350	19,644	92%
Peak Demand Savings (kW)	5.8	6.9	120%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

The site upgraded all interior lighting on a one-to-one basis with LED fixtures.

Description of Baseline Equipment and Operation

The site originally had 2-lamp fluorescent 48" and 96" T8 lights in the back of the retail space (the stocking area) and 2-lamp fluorescent 48" T12 lights in the front of the store. In addition, there were a few T12 lamps in 1-lamp fluorescent 48" fixtures, as well as a few PAR lamps for which wattages were assumed. There was a mix of 48" and 96" lamps in the back – baseline quantities are assumed to be the same as project documentation as the owner did not remember original quantities. Lights are on during business hours which are Monday through Wednesday and Friday 10AM-6PM, Thursday 10AM-7PM, Saturday 10AM-5PM. And 40% of the lights are on 3-4 hours during the weekends for stocking hours. During prom season, the store extends their weekend hours from 10AM-7PM.

Description of Efficient Equipment and Operation

New fixtures included 2-lamp 17W TLED, 4-lamp 17W TLED, 1-lamp 17W TLED, LED PAR20 (8 Watts), 42W LED Medium Wall Pack and a 20W LED Small Wall Pack. The operating hours for the new fixtures are the same as the baseline fixtures. Comments on Ex-Ante Calculations

The ex-ante calculations used the standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times HOURS$

Where,
ΔkWh = Annual energy saved (in kWh),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Demand Savings:

$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000)$

Where,
ΔkW = Peak demand saved (in kW),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Interactive factors might have been applied to the calculation, Anchor Blue do not have the assumptions that the contractor used for these factors.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue confirmed the following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2017. Anchor Blue verified the lighting count and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to calculate energy savings. The modified algorithm uses interactive effects to calculate savings. Guidance from CPUC on Linear Fluorescent disposition using T12 as a baseline stated that claiming an early retirement measure invokes the requirement for documentation of the pre-existing condition as well as evidence that program intervention caused the early retirement project. For measures that meet the requirement, the lighting retrofit shall use a code compliant baseline for the second baseline period, which is at the end of the equipment remaining useful life[1]. Anchor Blue calculated ex-post savings adhering to the guidance referencing the first baseline period wattage from the CMUA TRM[2]. The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.06

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kW_{Baseline} - kW_{EE}) / 1000) \times DIE_{Demand} \times CDF$

Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.20
CDF = Coincident Diversity Factor for peak demand = 0.88

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue using specific operating hours assumptions and energy and demand interactive factors specific to small retail building type.

Site 9: Training Site Lighting Upgrade

Project Summary

The site is a small computer training facility in Modesto, California. The site upgraded the lighting through MID's Direct Install program. The difference in the realization rate for the energy and peak demand savings at the site is due to site specific operating hours used in the ex-post calculations.

Table 13. First-Year Project Savings Summary- Site 9

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	2,204	1,882	85%
Peak Demand Savings (kW)	0.63	0.7	110%

Source: Project Documentation, Anchor Blue Analysis

LED Upgrade

Replaced all eleven fluorescent, 48" T12 lamps in 3-lamp fixtures (40W lamps) with eleven new sets of 3=-lamps with 17W TLEDs.

Description of Baseline Equipment and Operation

In the baseline, the site had eleven fluorescent, 48" T12 3-lamp fixtures (40W lamps) that were on only during business hours (9AM-6PM Monday thru Friday and 10AM-4PM on Saturday). The old lamps were confirmed on site with an old T12.

Description of Efficient Equipment and Operation

The site replaced all the T12 fluorescent lamps with efficient TLED lamps on a one-to-one basis. The operating hours for the new fixtures are the same to the baseline fixtures.

Comments on Ex-Ante Calculations

The ex-ante calculations used a standard lighting algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times HOURS$

Where,
ΔkWh= Annual energy saved (in kWh),
$Watts_{BASE}$= Connected load of the baseline fixtures,
$Watts_{EE}$= Connected load of energy efficient fixtures.
HOURS= Average hours of use per year

Demand Savings:

$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000)$

Where,
ΔkW= Peak demand saved (in kW),

$Watts_{BASE}$= Connected load of the baseline fixtures,
$Watts_{EE}$= Connected load of energy efficient fixtures.

Interactive factors might have been applied to the calculation, Anchor Blue do not have the assumptions that the implementor used for these factors.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in May 2017. Anchor Blue verified the lighting count and operational hours. The fixtures throughout the location run from 8AM-5PM Monday thru Friday and 10AM-4PM on Saturdays (closed major holidays).

Ex-post Calculations and Assumptions

Guidance from CPUC on linear fluorescent disposition using T12s as a baseline stated that claiming an early retirement measure invokes the requirement for documentation of the pre-existing condition as well as evidence that program intervention caused the early retirement project. For measures that meet the requirement, the lighting retrofit shall use a code compliant baseline for the second baseline period which is at the end of the equipment remaining useful life. Anchor Blue calculated ex-post savings adhering to the guidance referencing the first baseline period wattage from the CMUA TRM which is 115 Watts for 3-lamp T12 fluorescent fixtures[2]. The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ connected load of baseline fixtures
kW_{EE} Connected load of LED fixtures
HOURS=Average hours of use per year
DIE_{Energy} =DEER Interactive Effects Factor for energy savings = 1.06

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kWBaseline - kWEE) / 1000) \times DIE_{Demand} \times CDF$

Where:

DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.20
CDF = Coincident Diversity Factor for peak demand = 0.88

The difference between the ex-ante and ex-post energy savings are due to operating hours differences while the demand savings are different due to different assumptions in Interactive effects. Anchor Blue applied interactive and CDF factors for small retails building type as referenced in the 2017 CMUA TRM.

Site 10: Grocery Store Lighting Upgrade

Project Summary

The site is a grocery store located in Modesto, California. The site upgraded its lighting from fluorescent, mostly four-foot T8 fixtures, to LEDs. The lights are controlled by timers and on from 6AM until 10PM every day, with one quarter of the overhead lights on continuously for emergency lighting. Parking lot lights operate only from sunset until a couple of hours after store closing. The realization rate is low because the ex-ante savings were based on a prescriptive rebate using higher wattage lights in the baseline than were likely installed. Additionally, the application claimed over 2,000 linear feet of case LEDs, but slightly under 1,500 feet were found during the ex-post site visit.

Table 14. First-Year Project Savings Summary- Site 10

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	429,021	243,009	57%
Peak Demand Savings (kW)	75.99	32.25	42%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had mostly two-lamp, four-foot T8 fixtures on standard ballasts. They also had T8 case lighting and some U-lamp T8 fixtures. A few indoor pendants and the outdoor parking lot lighting were HID fixtures. The indoor lights were on timers operating from 6AM to 10PM daily with one quarter of the overhead lights operating continuously as emergency fixtures. According to site personnel, outdoor lights operate only a "couple" of hours after store closing, so Anchor Blue estimated operation as sunset to midnight daily for the parking lot fixtures.

Description of Efficient Equipment and Operation

The site retrofitted the T8 and HID fixtures with efficient LEDs on a one-to-one basis. The operating hours for the new fixtures are the same as baseline fixtures, being controlled by the same timing system.

Comments on Ex-Ante Calculations

The ex-ante savings used prescriptive savings by fixture type for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = \sum_{fixtures} kWh/fixture$

Where,
ΔkWh: Annual energy saved (in kWh),
kWh/fixture: Prescriptive savings per fixture type,

fixtures: Total number of each fixture type.

Demand Savings:

$\Delta kW = \sum_{fixtures} kW/fixture$

Where,
ΔkW: Peak demand saved (in kW),
kW/fixture: Prescriptive savings per fixture type,
fixtures: Total number of each fixture type.

The ex-ante calculations do not include HVAC Interactive Effects Factors and coincident demand savings factors as outlined in the Customized Calculated Savings Guidelines for Non Residential Programs, Version 6.0.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the type and quantity of the efficient fixtures
- Confirmed the operating schedule from the timed control system
- Requested details of baseline fixtures, but only limited descriptions were available.

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Field personnel verified the lighting count, fixtures types, and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to calculate the energy savings. The modified algorithm uses interactive effects to calculate savings. Anchor Blue estimated the baseline fixtures using the measure codes used for the incentive application because site personnel could not confirm exact baseline fixture types. The majority of baseline fixtures were confirmed to be standard output T8s. The baseline wattages for HIDs, case lights, and incandescent lamps were estimated based on prescriptive measure codes and typical lighting levels in the areas.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 0.96 for grocery store, 1 for outdoor lights

Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = ((kW_{Baseline} - kW_{EE}) / 1000) \times DIE_{Demand} \times CDF$$

Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.28 for grocery store, 1 for outdoor lights
CDF = Coincident Diversity Factor for peak demand
= 1 for timed lights inside store, 0 for outdoor lights.

The difference in the realization rate for the energy and demand savings at the site is due to differences between actual fixtures power and operational hours and prescriptive values. Fixture counts found onsite varied only slightly from the numbers on the application, except for the case lighting, which consisted of slightly under three-quarters of the claimed fixtures. The store is one of several owned by the same company in Modesto, and it is possible that some of the case lighting claimed on this application was installed at another store. There was also back lighting behind some panels in a raised area of the ceiling that could not be examined during the site visit. Case lighting would not normally be used in such locations, and no information was available as to the type or quantity of the fixtures behind these panels. These lights did not appear to be part of the other items on the incentive application, so Anchor Blue did not credit these towards the savings.

Site 11: Unconditioned Warehouse High Bay Lighting Upgrade

Project Summary

The site is an unconditioned warehouse located in Modesto, California. The site upgraded overhead high bay lighting throughout the warehouse. The difference in the realization rate for the energy and peak demand savings at the site is due to:

- Actual usage as compared to deemed savings values
- Occupancy Sensors rebate code not aligning with the measure

Table 15. First-Year Project Savings Summary- Site 11

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	426,113.6	183,162.4	43%
Peak Demand Savings (kW)	54.56	76.28	140%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had 176 high pressure sodium (HPS) lamps operating from 7AM to around 5PM on weekdays and off on weekends throughout the year.

Description of Efficient Equipment and Operation

The site replaced the HPS fixtures by efficient LED fixtures with integrated motion and daylight sensors on a one-for-one basis. The operating hours for the new fixtures are similar to the baseline fixtures except that the controls reduce their operation and brightness during the operating hours. Based on the application, the site applied rebate code CL052, which assumed occupancy sensors/fixture integrated in

installation for fixtures of >500W. Based on Anchor Blue's on-site inspection, the baseline fixtures were <500W and Anchor Blue determined that rebate Code CL053 would be more appropriate.

Comments on Ex-Ante Calculations

The ex-ante calculations used a deemed savings algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = N \times \Delta kWh/fixture$

Where,
ΔkWh= Annual energy saved (in kWh),
N= Number of fixtures replaced,
$\Delta kWh/fixture$= Deemed annual energy saved per fixture.

Demand Savings:

$\Delta kW = N \times \Delta kW/fixture$

Where,
ΔkW =Peak demand saved (in kW),
N = Number of fixtures replaced,
$\Delta kW/fixture$ = Deemed demand savings per fixture.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures
- Confirmed the operating schedule
- Categorized and counted the fixtures as per the space type (air-conditioned or non-conditioned)
- Confirmed the installation of daylight and occupancy sensors
- Confirmed utility meter number feeding the facility and major loads

Summary of Site Visit

Anchor Blue performed a site visit on April 2018. During the visit, Anchor Blue verified the lighting type, fixture count, control sensors, and operational hours. It was not practical to install lighting loggers because of the height of the fixtures and presence of skylights. The facility manager indicated that the baseline fixtures operated from 7:00 AM until 5:00 PM on weekdays with some variable use on Saturdays. In addition, the facility sometimes closed as early as 3:30 PM. The hours have not changed, but sensors on the new fixtures shut many of the lights off during the operating hours. Anchor Blue found the following at the site:

- There were 176 fixtures, laid out in rows of 11 by 16.
- Each fixture was 4' x 2' and contained three rows of LEDs, consistent with the specifications in the project file
- Many of the fixtures were off, apparently due to sensors, and some of the facility lighting was provided through skylights. Motion sensors clearly sensed motion below them but some lights still did not

come on, indicating they might also contain daylight sensors and remain shut off due to skylights in the facility.

- The lights were a major portion of the load at the site, with the main warehouse also containing two battery pack chargers. The offices at the side of the warehouse had plug loads and AC units.
- There were three electric utility meters at the site, numbers 308623, 335426, and 326120, but facility staff did not know what each fed and Anchor Blue could not visually trace their loads.

Ex-post Calculations and Assumptions

The ex-post calculations both calculated savings using a standard algorithm with onsite findings and by reviewing the change in load on the electric meter, which appeared to feed the lights, based on a review of the three meters' bills and the timeline of the project. Anchor Blue received both monthly and hourly usage for all three meters from the facility, but the hourly usage only covered the date range after the project, so they were only used to calculate peak demand period efficient case load.

Standard Annual Energy Savings Algorithm

$$\Delta kWh = N \times ((W_{Baseline} \times HOURS_{Baseline} - W_{EE} \times HOURS_{EE}) / 1000) \times DIE_{Energy}$$

Utility Bill Based Annual Energy Savings Algorithm

$$\Delta kWh = [\sum(\text{monthly Usage}_{Baseline}) / \text{days}_{Baseline} - \sum(\text{monthly Usage}_{EE}) / \text{days}_{EE}] \times 365 \text{ days}$$

Standard Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = N \times ((WBaseline - WEE \times CDF) / 1000) \times DIE_{Demand}$$

Utility Bill Based Summer Coincident Peak kW Savings Algorithm

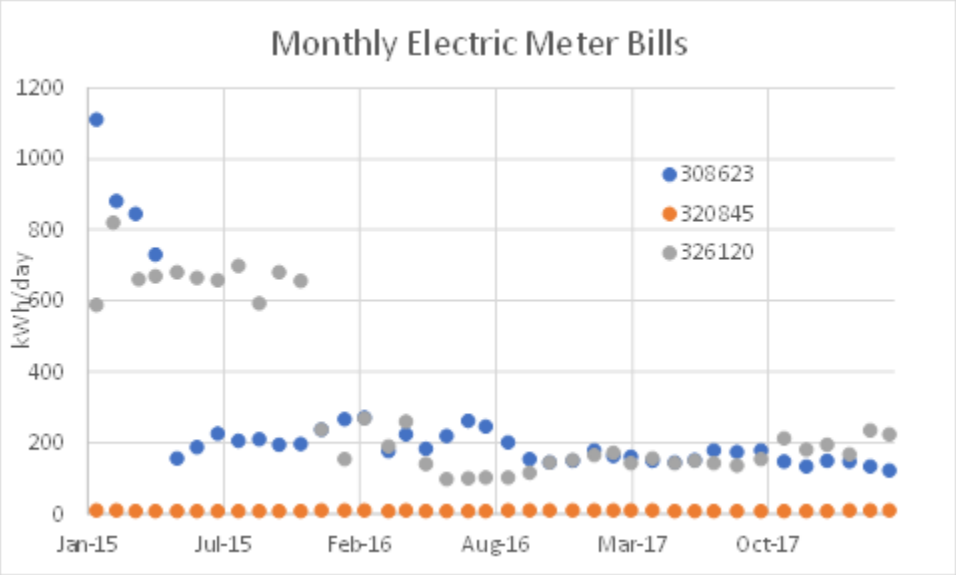
$$\Delta kW = (N \times W_{Baseline} - \sum (Wbill,peak) / hoursbill,peak) / 1000$$

Where:
N= Number of fixtures
$W_{Baseline}$ = Wattage of one baseline fixture
$HOURS_{Baseline}$ = Operational hours of baseline fixtures
W_{EE} = Wattage of one LED fixture
$HOURS_{EE}$ = Operational hours of LED fixtures, based on deemed operation for combined occupancy/daylight sensors = 0.4 x $HOURS_{Baseline}$
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1
$\text{monthly usage}_{Baseline}$ = Electric usage for meter 326120 prior to the project, around December 2015
$\text{days}_{Baseline}$ = Number of days covered by all baseline period monthly bills for meter 326120
$\text{monthly usage}_{EE}$ = Electric usage for meter 326120 after to the project, around December 2015
days_{EE} = Number of days covered by all post-installation period monthly bills for meter 326120
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1
CDF = Coincident Diversity Factor for peak demand with occupancy sensors = 0.7 for a warehouse
$W_{bill,peak}$ = Hourly watts from bill 326120 after the project for 2 to 5 PM from July through September
$\text{hours}_{bill,peak}$ = Total hours in peak period on hourly bills

The standard calculation resulted in 157,616 kWh and 57.23 kW of savings. The bills showed 183,162 kWh and 76.3 kW of savings. The differences are reasonable given the deemed nature of the sensor savings in the standard calculation. Anchor Blue based savings on the bills for utility meter 326120 because meter

320845 clearly had minimal load that could not support lights while meter 308623 had too low of a load by the project timeframe to support the lights, as shown in Figure 1. For demand savings, Anchor Blue conservatively assumed the lights were the only load on meter 326120. It is unclear what changed the facility made in early 2015 that reduced the load on meter 308623, but the change clearly predated this project and would not affect the lighting savings.

Figure 1 Comparison of Monthly Electric Bills



Anchor Blue based final ex-post energy savings for this project on the usage data because it provided a more accurate estimate of the effects of the sensors than deemed values.

Site 12: Anti-Sweat Heater Controls in a Convenience Store

Project Summary

The site is a convenience store located in Riverbank, California. The site installed anti-sweat heater controls on its refrigerated case doors. These controls shut the door heaters off when not needed. The difference in realization rate is due to Anchor Blue using the California Municipal Utilities Association (CMUA) TRM values for ex-post savings and the ex- ante values were based on calculations and values from a 2010 Focus on Energy Deemed Savings Manual.

Table 16. First-Year Project Savings Summary- Site 12

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	12,271.5	9,024	73.5%
Peak Demand Savings (kW)	0.33	1.15	349%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site continuous door heaters on the 12 medium temperature reach-in case doors.

Description of Efficient Equipment and Operation

The site replaced installed anti-sweat heater controls on the 12 medium temperature reach-in case doors. This allows the heaters to cycle off when not needed.

Comments on Ex-Ante Calculations

The ex-ante calculations used values from the 2010 Focus on Energy Business Programs Deemed Manual. The algorithms are listed as follow:

Energy Savings:

$\Delta kWh = (kW_{CoolerBase}/Door)*(8{,}760*CHA_{off})*(1+R_H/COP_{Cool})*Doors$

Where,
ΔkWh = Annual energy saved (in kWh),
$kW_{CoolerBase}$ = Power per heater per door,
CHA_{off} = Percent time controls shut off heaters, 0.85,
R_H: Residual heat fraction, 0.65,
COP_{Cool} = Coefficient of performance (COP) of cooler, 2.5 for medium temperature case

Demand Savings:

$\Delta kW = (kW_{CoolerBase}/Door)*(8{,}760*CHA_{off})*(1+R_H/COP_{Cool})*DF*Doors$

Where,
ΔkWh = Annual energy saved (in kWh),
$kW_{CoolerBase}$ = Power per heater per door,
CHA_{off} = Percent time during peak hours controls shut off heaters, 0.2,
R_H =Residual heat fraction, 0.65,
COP_{Cool} = Coefficient of performance (COP) of cooler, 2.5 for medium temperature case,
DF = Demand diversity factor, 1.

The ex-ante calculations are not consistent with the CMUA TRM. This may be in part due to the differing climate zones between Wisconsin and California, since Wisconsin standards were used for the Focus on Energy program.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the door heaters were off.
- Attempted to get the door heaters to cycle on,
- Counted the affected case doors,
- Confirmed the type of cases affected (i.e. medium temperature).

Summary of Site Visit

Anchor Blue performed a site visit in April 2018. Anchor Blue verified that there were 12 medium temperature case doors with the door heaters off using a voltage detector. Anchor Blue was unable to get the heaters to switch on by opening the doors but confirmed that the three low temperature doors had heaters, which is consistent with the project file indicating they were not retrofitted with controls.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm from the CMUA TRM with onsite findings to calculate energy savings. The modified algorithm uses the California deemed values for savings.

Annual Energy Savings Algorithm

ΔkWh = kWh reduction per linear foot x linear feet of affected case

Where:
kWh reduction per linear foot = 376 for medium temperature in California climate zone 12
linear feet of affected case = 12 doors x 2 feet/door = 24

Summer Coincident Peak kW Savings Algorithm

ΔkW = (kW reduction per linear foot) x linear feet of affected case

Where:
kWh reduction per linear foot = 0.048 for medium temperature in California climate zone 12
linear feet of affected case = 12 doors x 2 feet/door = 24

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue using the California TRM and the ex-ante savings using Wisconsin's Focus on Energy values.

Site 13: Light Manufacturing Lighting Upgrade

Project Summary

The site is an unconditioned warehouse located in Modesto, California. The site upgraded overhead high bay lighting throughout the warehouse. The difference in the realization rate for the energy and peak demand savings at the site is due to inclusion of HVAC interactive factors and coincident demand factors and adjustments to fixture wattages and hours of use for ex-post savings calculations.

Table 17. First-Year Project Savings Summary- Site 13

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	1,066,932	1,084,082	108%
Peak Demand Savings	143.14	88.3	85%

(kW)			

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had 2300 linear fluorescent T8 and T5 high output fixtures operating in hours that varied from continuous to shift hours. The lights in manufacturing areas all remain on during peak times but some lights in office and maintenance areas can be turned off using switches.

Description of Efficient Equipment and Operation

The site replaced the linear fluorescent fixtures with efficient LED fixtures on a one-for-one basis. The operating hours for the new fixtures are similar to the baseline fixtures.

Comments on Ex-Ante Calculations

The ex-ante calculations used a deemed savings algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - WattsEE) / 1000) \times Annual\ Operating\ Hours$

Where,
ΔkWh = Annual energy saved (in kWh),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

Demand Savings:

$\Delta kW = ((Watts_{BASE} - Watts_{EE}) / 1000)$

Where,
ΔkW = Peak demand saved (in kW),
$Watts_{BASE}$ = Connected load of the baseline fixtures,
$Watts_{EE}$ = Connected load of energy efficient fixtures.

The ex-ante calculations do not include HVAC Interactive Effects Factors and coincident demand savings factors as outlined in the Customized Calculated Savings Guidelines for Non-Residential Programs, Version 6.0.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures
- Confirmed the operating schedule
- Categorized and counted the fixtures as per the space type (air-conditioned or non-conditioned)
- Installed 7 data loggers for a data collection period of 6 weeks to determine hours of use for some lights which did not operate continuously

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count, occupancy sensors, and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$$\Delta kWh = ((kW_{Baseline} - kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.04

Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = ((kW_{Baseline} - kW_{EE}) / 1000) \times DIE_{Demand} \times CDF$$
Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings = 1.18
CDF = Coincident Diversity Factor for peak demand
= 0.71 for a warehouse.

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue inclusion of DEER 2016 HVAC interactive factors and coincident demand factors and adjustments to fixture wattages as well as using logger data for site-specific operation hours. Anchor Blue used fixture wattages from the California standard wattage list based on the fixture description for baseline fixtures and actual fixtures found for the efficient case. Some wattages did not always match the wattage assumed in the ex-ante calculations, though the variance is within a few percent of differences.

Site 14: Pool Pump in an Apartment Complex

Project Summary

The site is an apartment complex with a swimming pool located in Modesto, California. The site installed a variable speed pump for the pool. The ex-post savings were higher than the ex-ante values because because the ex-ante savings were not consistent with the deemed measure value for pump operation all year.. The ex-ante demand savings were also higher than the deemed value for the measure.

Table 18. First-Year Project Savings Summary- Site 14

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	321	674	210%

Peak Demand Savings (kW)	0.08	0.034	43%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had a constant speed pool pump.

Description of Efficient Equipment and Operation

The site replaced the pool pump with a new, variable speed model. This was treated as an end-of-life replacement.

Comments on Ex-Ante Calculations

The ex-ante calculations were based on the TRM values for residential pool pumps since there is no TRM measure for commercial pool pumps. This is generally reasonable because the pool pump for this facility is of comparable size to those used to determine the residential TRM values.

Energy Savings:

ΔkWh = ΔkWh/pump x Annual Operating Days/365

Where,
ΔkWh = Annual energy saved (in kWh),
ΔkWh/pump = Deemed energy savings per pool pump, 674 kWh,
Annual Operating Days = Days pool pump operates per year.

Demand Savings:

ΔkW = ΔkW/pump prorated by estimated operation

Where,
ΔkW = Peak demand saved (in kW),
ΔkW/pump = Deemed peak demand savings per pump, 0.034 kW.

The ex-ante calculations scaled the energy savings by a factor of 47.6% and the demand by 235%, which is not consistent with the values Anchor Blue confirmed during the site visit. The deemed values are based on an average pump size of 1.73 kW (2.32 HP), which does not account for the difference as the installed pump is 3 HP.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the installation and operation of the pump
- Confirmed the variable speed design of the pump
- Confirmed the operating schedule

Summary of Site Visit

Anchor Blue performed a site visit in April 2018. Anchor Blue confirmed the installation of the variable speed pool pump and the model installed. According to site personnel, the pool is open only from Memorial Day weekend through Labor Day each year, for a total of 101 days annually. Anchor Blue later confirmed with the site contact that the pool is filled year round thus the pool pump operating condition is year round.

Ex-post Calculations and Assumptions

The ex-post calculations used the deemed residential pool pump savings with onsite findings to calculate the energy savings. The modified algorithm uses 365 days of annual operation to calculate savings. The three horsepower pump was within the capacity range for the deemed assumptions. The deemed demand savings are not adjusted because the pump operates during all summer peak demand periods.

Annual Energy Savings:

$\Delta kWh = \Delta kWh/pump \times Annual\ Operating\ Days/365$

Where,
ΔkWh = Annual energy saved (in kWh),
ΔkWh/pump = Deemed energy savings per pool pump, 674 kWh,
Annual Operating Days = Days pool pump operates per year, 365.

Demand Savings:

$\Delta kW = \Delta kW/pump$

Where,
ΔkW = Peak demand saved (in kW),
ΔkW/pump = Deemed peak demand savings per pump, 0.034 kW.

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue use of the deemed savings value for pool pumps which is not consistent with the ex-ante value. Anchor Blue used the deemed demand savings of 0.034 kW, but it is not clear how the ex-ante value of 0.08 kW was developed.

Site 15: Ductless Mini-Splits Heat Pump Upgrade in Apartment Complex

Project Summary

The site is an apartment complex consisting of 134 efficiency apartments and an office suite located in Modesto, California. The site upgraded HVAC units in the individual apartments and site overall. The difference in the realization rate for the energy and peak demand savings at the site is due to the difference between deemed and custom calculated savings. Deemed savings do not include any heating savings occurring in winter months. Anchor Blue found that the site saved significantly more during the winter than the summer due to the replacement of electric resistance heat with heat pumps. Consequently, the energy realization rate is very high, but the demand realization rate is low.

Table 19. First-Year Project Savings Summary- Site 15

	Ex-ante	Ex-post	Realization Rate

Energy Savings (kWh/Year)	2,604	15,953	614%
Peak Demand Savings (kW)	1.806	0	0%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had wall unit air conditioning (AC) and forced air electric heating in each of 134 apartments.

Description of Efficient Equipment and Operation

The site replaced the air conditioning and heaters with efficient single-head ductless mini-splits in each apartment, 42 of which were covered by this project. The site also installed a larger multi-head ductless mini-split in the office area. The operating hours and setpoints for the HVAC units are controlled by each apartment individually.

Comments on Ex-Ante Calculations

The ex-ante calculations used a deemed savings algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = \Delta kWh_{unit}$ x number of units installed

Where,
ΔkWh= Annual energy saved (in kWh),
ΔkWh_{unit} = Deemed energy savings per ductless mini-split installed, 62 kWh
Number of units installed =42 on this application.

Demand Savings:

$\Delta kW = \Delta kW_{unit}$ x number of units installed

Where,
ΔkW =Peak demand saved (in kW),
ΔkW_{unit} = Deemed demand savings per ductless mini-split installed, 0.043 kW
Number of units installed = 42 on this application.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected the following data during the onsite visit:

- Confirmed the nameplate data, installation, and quantity of the ductless mini-splits
- Confirmed the operating schedule

- Confirmed the removal of the heating and cooling units and took nameplate data from some disconnected units at the site
- Obtained a list of which apartments had the same tenant in residence over the last few years
- Discussed installation scheduled with the site

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the installation and operation of the ductless mini-split units, verified removal of the old heating and cooling equipment, and discussed installation dates with site personnel. The site also provided Anchor Blue with a list of apartments with long term tenants.

Ex-post Calculations and Assumptions

The ex-post calculations used a billing analysis of monthly electric usage for 47 apartments with constant tenancy from 2015 through April 2018. The baseline period is from January 2015 through May 2016 and the efficient period is from March 2017 through the end of the data in spring 2018. The data between the baseline and efficient periods is the install period and is not included in calculations. The install period was excluded in the analysis since details of specific installation dates by apartment is not available.

Annual Energy Savings Algorithm

$$\Delta kWh = N * \sum_{M=Jan}^{Dec} \left[d_M * \left(kW_{MT,avg\ baseline} - kW_{MT,avg\ EE} \right) \right]$$

Where:
$kW_{MT,\ avg\ baseline}$ = Average baseline kW of apartments at average temperature of TMY3 month M
$kW_{MT,\ avg\ EE}$ = Average efficient kW of apartments at average temperature of TMY3 month M
M = Month
d_M = days in month M
$h_{T,TMY3}$ = TMY3 hours at temperature T
N = Number of apartments in project = 42

Anchor Blue also performed an analysis of the ten apartments with constant tenancy for which hourly bills were obtained. This produced substantially higher savings than the monthly analysis of 47 apartments. However, for 134 apartments, a sample of ten only provides confidence and precision of 80/20 whereas a sample of 47 provides 90/10 confidence and precision, so the discrepancy is likely to be caused by a small sample size. Savings from the hourly bills was calculated using:

$$\Delta kWh = N * \sum_{T=-2}^{43} \left[h_{T,TMY3} * \left(kW_{T,avg\ baseline} - kW_{T,avg\ EE} \right) \right]$$

Where:
$kW_{T,\ avg\ baseline}$ = Average baseline kW of apartments at temperature T
$kW_{T,\ avg\ EE}$ = Average efficient kW of apartments at temperature T
T = Temperature in degrees Celsius
$h_{T,TMY3}$ = TMY3 hours at temperature T
N = Number of apartments in project = 42

Figure 2 shows the averaged data used to calculate savings.

Figure 2. Average Monthly Usage for Apartments with Constant Tenancy

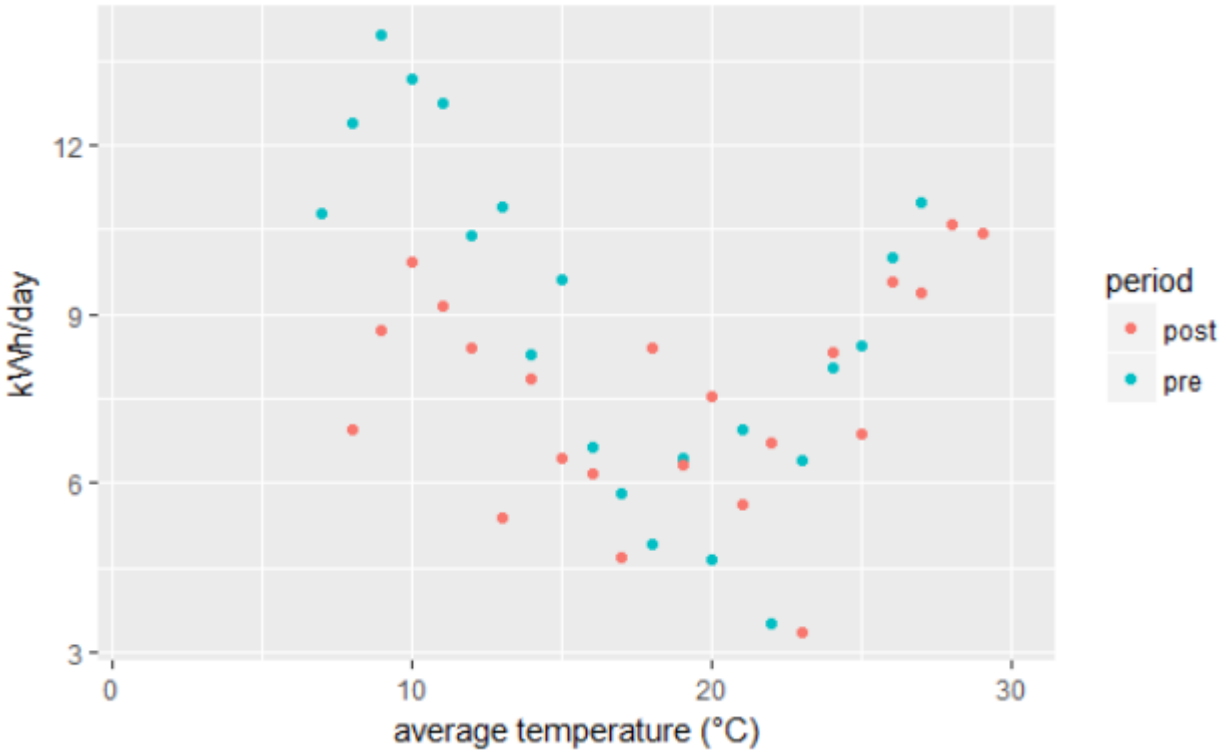
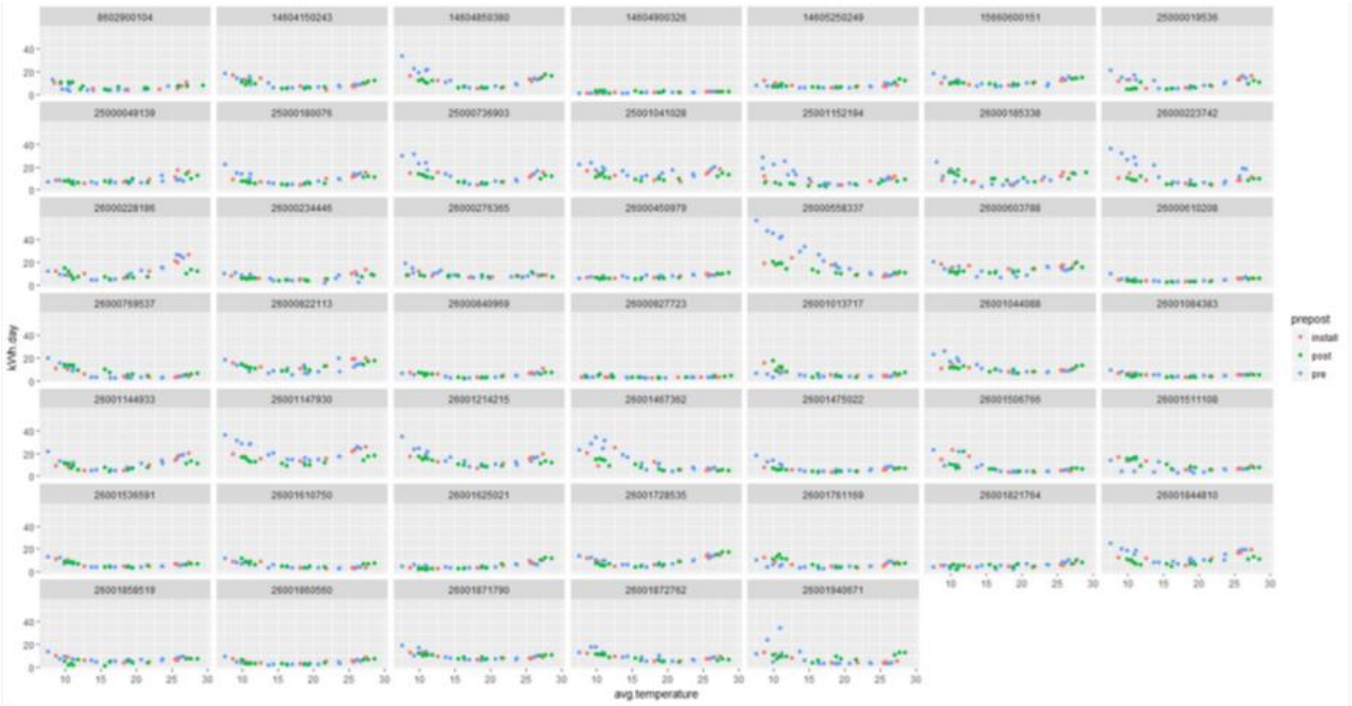


Figure 3 shows the individual apartment data averaged in Figure 2.

Figure 3. Monthly Usage for Apartments with Constant Tenancy



Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = (kW_{Baseline,\ T=37\text{-}39} - kW_{EE,\ T=37\text{-}39})$$

Where:

$kW_{Baseline,\ T=37\text{-}39}$ = Average baseline kW of apartments on hottest three days in peak periods, which were in temperature range 37-39 °C, based on the hottest days in 2017

$kW_{EE,\ T=37\text{-}39}$ = Average efficient kW of apartments on hottest three days in peak periods, which were in temperature range 37-39 °C, , based on the hottest days in 2017

As seen in Figure 4, the savings for these projects are at low temperatures. Since the heating efficiency of the ductless mini-split units is substantially higher than the baseline resistance heat, savings during heating hours are expected. However, based on the data analysis, no demand savings was found during the summer peak hours.

Figure 4. Hourly Average kW for Ten Apartments with Constant Tenancy

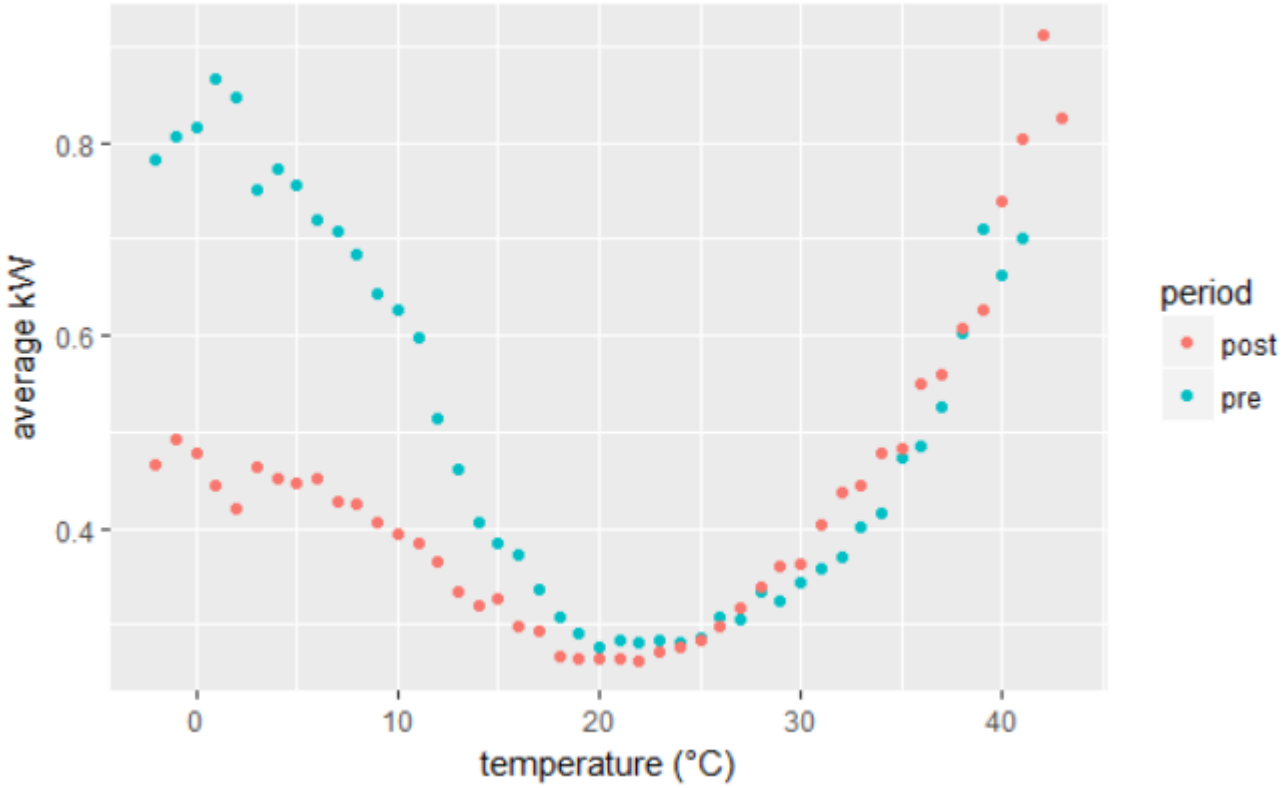
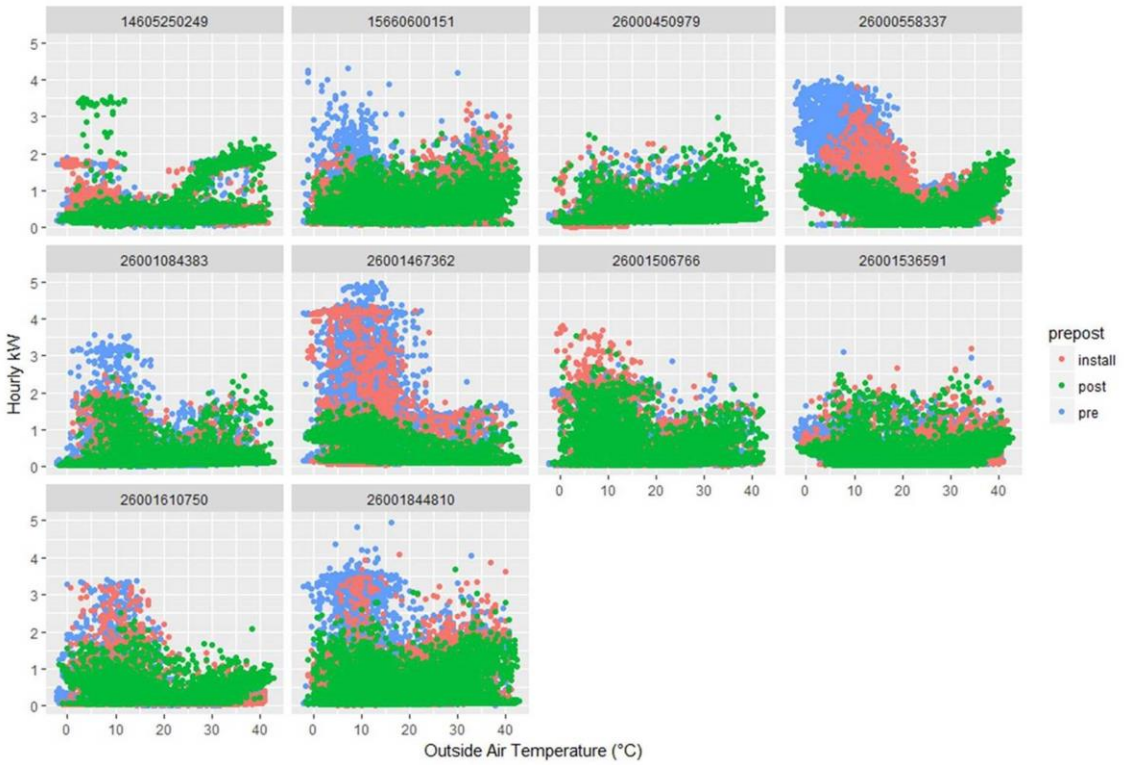


Figure 5 shows the raw data averaged to produce Figure 4

Figure 5. Raw Hourly Data for Ten Apartments with Constant Tenancy



The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue use of usage data to determine ex-post savings as opposed to the deemed savings used for the ex-ante values.

Site 16: Unconditioned Warehouse Lighting Upgrade

Project Summary

The site is an unconditioned warehouse located in Modesto, California. The site upgraded overhead linear fluorescent lighting to LEDs throughout the facility. The difference in the realization rate for the energy and peak demand savings at the site is primarily due to differences in deemed savings and calculated values as well as some inconsistencies between codes used in the prescriptive application and fixture descriptions in the detailed spreadsheet. Additionally, Anchor Blue included interactive effects in savings, which are not in the ex-ante assumptions, and adjusted hours of use for some areas based on findings from data loggers installed at the site.

Table 20. First-Year Project Savings Summary- Site 16

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	750,501	652,043	87%
Peak Demand Savings (kW)	110.15	61.6	56%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had 887 linear fluorescent and outdoor HID fixtures throughout the facility, primarily operating about 100 hours per week. The outdoor lighting operated dusk to dawn. An additional four linear LED fixtures and 16 incandescent exit signs were included in the baseline spreadsheet but not the prescriptive application, although the LED fixtures were included in the sensor rebate.

Description of Efficient Equipment and Operation

The site replaced the fluorescent fixtures with efficient LED fixtures, with some including integrated motion sensors and dimming on a one-for-one basis. The four existing LED fixtures were upgraded to newer LEDs but only received incentives for controls installation. The operating hours for the new fixtures are similar to the baseline fixtures except that the controls reduce their operation and brightness during the operating hours. However, the prescriptive rebate listed rebate codes not completely consistent with the descriptions provided in the detailed spreadsheet. Anchor Blue used the detailed spreadsheet for verification as the prescriptive codes did not provide enough details to locate and identify fixtures within a facility of this size.

Comments on Ex-Ante Calculations

The ex-ante calculations used a deemed savings algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((\text{Deemed Watts}_{BASE} - \text{Deemed Watts}_{EE}) / 1000) \times \text{Deemed Annual Operating Hours}$

Where,
ΔkWh = Annual energy saved (in kWh),
$\text{Deemed Watts}_{BASE}$ = Connected load of the deemed baseline fixtures,
Deemed Watts_{EE} = Connected load of deemed energy efficient fixtures.

Demand Savings:

$\Delta kW = ((\text{Deemed Watts}_{BASE} - \text{Deemed Watts}_{EE}) / 1000)$

Where,
ΔkW = Peak demand saved (in kW),
$\text{Deemed Watts}_{BASE}$ = Connected load of the deemed baseline fixtures,
Deemed Watts_{EE} = Connected load of deemed energy efficient fixtures.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures, using the detailed spreadsheet in the application
- Confirmed the operating schedule

- Categorized and counted the fixtures as per the space type
- Confirmed the installation of occupancy sensors and dimming
- Installed lighting loggers to determine hours of operation and dimming for fifteen of the fixtures

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count, occupancy sensors, and operational hours. Using light level sensors, Anchor Blue monitored the operation of 15 fixtures with controls over a period of four weeks to determine if the claimed hours of use were reasonable.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$$\Delta kWh = ((kW_{Baseline} \times HOURS_{Baseline} - kW_{EE} \times HOURS_{EE}) / 1000) \times HOURS \times DIE_{Energy}$$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
$HOURS_{Baseline}$ = Average baseline hours of use per year
$HOURS_{EE}$ = Average LED fixtures hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings (1.12 for office areas and 1.04 for production)

Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = ((kW_{Baseline} - kW_{EE}) / 1000) \times DIE_{Demand} \times CDF$$

Where:
DIE_{Demand} = DEER Interactive Effects Factor for energy savings (1.31 for offices and 1.18 for production)
CDF = Coincident Diversity Factor for peak demand (0.71 for office areas and 0.92 for production).

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue calculations of actual site hours using logger data and fixture wattages instead of use of deemed savings. Additionally, the ex-ante application only included 884 fixtures, very similar to the 872 coded for lamp incentives and four for sensors only in the detailed spreadsheet but varying significantly in some of the codes used for rebates between the two lists. The ex-ante prescriptive application included 829 sensors and 22 photocells, but the detailed spreadsheet showed only 817 sensors. Since the prescriptive application did not include installation locations, Anchor Blue could not determine the cause of the discrepancy. Anchor Blue used the detailed spreadsheet to verify the onsite installation and found it to be accurate. However, installed lighting loggers did show variations in usage in a few areas compared to the values in the ex-ante spreadsheet. Additionally, Anchor Blue included interactive effects in savings calculations, which were not in either the prescriptive savings or the ex-ante detailed spreadsheet.

Overall, Anchor Blue found the detailed spreadsheet provided with the application to be accurate, except for variations in hours of use in a few areas. Anchor Blue found savings of 652,043 kWh and 61.6 kW at the facility, which is lower than the deemed value of 750,501 kWh and 110.15 kW. The detailed spreadsheet in the file showed, 650,281 kWh and 99.5 kW of savings, significantly closer to the ex-post values, but it included the 16 exit sign and 15 hazardous location relamps, which were not coded for prescriptive rebates. Overall the differences in savings between the ex-ante and ex post calculations are due to a combination of

the difference between deemed and actual savings and inconsistencies in prescriptive codes used for the deemed savings.

Site 17: Unconditioned Warehouse and Manufacturing Area Lighting Upgrade

Project Summary

The site is an unconditioned warehouse located in Modesto, California. The site upgraded overhead high bay lighting throughout the warehouse. The difference in the realization rate for the energy and peak demand savings at the site is due to inclusion of DEER 2016 HVAC interactive factors and coincident demand factors, adjustments to lamp wattages, and changes in hours of use in the office areas.

Table 21. First-Year Project Savings Summary- Site 17

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	434,565	505,612	116%
Peak Demand Savings (kW)	58.4	63.9	109%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

In the baseline, the site had a mixture of 628 T8 and T5 high output linear fluorescent fixtures throughout the facility. The majority of these operated continuously throughout the year, although some office areas had off switches or local motion sensors installed.

Description of Efficient Equipment and Operation

The site replaced the fluorescent fixtures with efficient LED fixtures on a one-for-one basis and added some motion sensors in manufacturing areas. The operating hours for the new fixtures are similar to the baseline fixtures except that the new controls reduce operation.

Comments on Ex-Ante Calculations

The ex-ante calculations used a deemed savings algorithm for the energy savings. The algorithm is listed as follows:

Energy Savings:

$\Delta kWh = ((Watts_{BASE} - Watts_{EE}) / 1000) \times$ Annual Operating Hours

Where,
ΔkWh= Annual energy saved (in kWh),
$Watts_{BASE}$= Connected load of the baseline fixtures,

$Watts_{EE}$= Connected load of energy efficient fixtures.

Demand Savings:

$\Delta kW = ((Watts_{BASE} – Watts_{EE}) / 1000)$

Where,
ΔkW= Peak demand saved (in kW),
$Watts_{BASE}$= Connected load of the baseline fixtures,
$Watts_{EE}$= Connected load of energy efficient fixtures.

The ex-ante calculations do not include HVAC Interactive Effects Factors and coincident demand savings factors as outlined in the Customized Calculated Savings Guidelines for Non Residential Programs, Version 6.0.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

Anchor Blue collected following data during the onsite visit:

- Confirmed the wattage and quantity of the fixtures
- Confirmed the operating schedule
- Categorized and counted the fixtures as per the space type
- Confirmed the installation of occupancy sensors and installed data loggers on some fixtures to confirm operational hours

Summary of Site Visit

Anchor Blue performed a site visit in May 2018. Anchor Blue verified the lighting count, occupancy sensors, and operational hours.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to get the energy savings. The modified algorithm uses interactive effects to calculate savings.

Annual Energy Savings Algorithm

$\Delta kWh = ((kW_{Baseline} – kW_{EE}) / 1000) \times HOURS \times DIE_{Energy}$

Where:
$kW_{Baseline}$ = Connected load of baseline fixtures
kW_{EE} = Connected load of LED fixtures
HOURS = Average hours of use per year
DIE_{Energy} = DEER Interactive Effects Factor for energy savings = 1.04 for conditioned space, and 1 for unconditioned space

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = ((kWBaseline – kWEE) / 1000) \times DIE_{Demand} \times CDF$
Where:

DIE_{Demand} = DEER Interactive Effects Factor for demand savings = 1.18 for conditioned space, and 1 for unconditioned space
CDF = Coincident Diversity Factor for peak demand
=1 for a warehouse.

The difference in the realization rate for the energy and demand savings at the site is due to Anchor Blue inclusion of DEER 2016 HVAC interactive factors and coincident demand factors and changes claimed fixture wattages as well as hours of use for the lights in office areas.

Site 18: Furnace Upgrade

Project Summary

The site is manufacturing factory in Modesto, California. The site overhauled furnace 2 and included the energy efficiency components. The rebate was paid out in three phases and this is the third and final phase of the rebate. The total energy savings of the project was reviewed during the first phase of the project by Navigant Consulting. Site specific performance data was reviewed along with calculation method and installation verification. The prorated annual energy savings for this project is 5,098,278 kWh and 667 kW. Anchor Blue reviewed the M&V calculations and agree with Navigant Consulting's evaluation results.

Table 22. First-Year Project Savings Summary- Site 18

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	5,098,278	5,098,278	100%
Peak Demand Savings (kW)	667	667	100%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The site had an old glass melting furnace with electric boost. The baseline daily production of furnace was 310 tons/day. The furnace operated 354 days per year.

Description of Efficient Equipment and Operation

The site upgraded the furnace with more efficient components, as a result, the production increased to 410 tons/day, operating at 354 days per year.

Comments on Ex-Ante Calculations

The ex-ante calculations are outlined in the Evaluation, Measurement, and Verification of the Modesto, Turlock, and Merced Irrigation District's FY 2014 and FY 2015 Non-Residential Energy Efficiency Programs Report (Site 2). Since this project was evaluated, the ex-post savings from the M&V activity is used as ex-ante savings for this application.

The baseline energy consumption is calculated using 2012-2013 baseline period production data with a normalized cullet ratio of 50%. As noted in Navigant's report, the percentage fuel ratio had improved to 10% in the efficient case from 15% prior to upgrade. The application reflected the 10% fuel ratio as well as site-specific production data of 386 tons/day.

The energy consumption difference between the baseline and efficient is scaled to the efficient production level at 386 tons/day to normalize the savings for this project.

The demand savings for this project is derived by dividing the annual ex-ante savings by operational hours per year.

Onsite Visit and Ex-Post Savings Calculations

M&V Method

This project was evaluated in October, 2016 by Navigant Consulting, the team confirmed:

- Installation of the new furnace
- Daily production
- Production data trend

Summary of Site Visit

Based on Navigant's report, the field visit was conducted in October 2016, the furnace is running at 386 tons/day.

Ex-post Calculations and Assumptions

Navigant's analysis adhered to IPMVP Option B, they developed a multi-regression equation for the baseline energy consumption using daily production to estimate baseline energy consumption and efficient case energy consumption. Navigant extrapolated 6 months of data to the whole year to estimate the annual ex-post energy savings. Demand savings is obtained by dividing the total annual energy consumption by annual hours of operations. The ex-post savings is calculated by analyzing the utility meter-level electric bill.

Anchor Blue reviewed the application and Navigant's documentation and analysis and agree with Navigant's evaluation methodology and results with no proposed change to the ex-ante savings. The realization rate for this project is 100%.

ESTIMATING PROGRAM LEVEL EX-POST SAVINGS

The final evaluated energy and demand savings in sample represents 50% and 41% of the total program savings claimed respectively.

As detailed in Table 23 and Table 24, the share of sampled ex-ante savings to total ex-ante savings is used as a multiplier to develop a total stratum level gross ex-ante and ex-post savings. The next step was developing a weight that identifies the stratum share of the total ex-ante program savings to be extrapolated to the program-level. Table 23 summarizes the energy realization rates by project and the overall program realization rate weighted by stratum. The program level realization rate derived is 97%.

Table 23. Program-Level Electric Gross Energy Ex-Post Savings and Realization Rates

Site	Ex-ante Savings (kWh)	Project Realization Rate	Ex-post Savings (kWh)	Stratum Weight	Extrapolated Ex-Ante Savings (kWh)	Extrapolated Ex-Post Savings (kWh)	Stratum Weighted Realization Rate
Site-1	4,263,013	102%	4,331,550	1.20	5,097,461	5,179,414	**97.39%**
Site-2	15,121	97%	14,662	132.52	2,003,786	1,942,936	
Site-3	5,040	107%	5,409	132.52	667,929	716,774	
Site-4	8,436	185%	15,572	132.52	1,117,897	2,063,524	
Site-5	1,074	3%	36	132.52	142,321	4,777	
Site-6	33,668	74%	25,072	2.69	90,486	67,384	
Site-7	11,434	89%	10,209	2.69	30,729	27,438	
Site-8	21,350	92%	19,644	2.69	57,382	52,796	
Site-9	2,204	87%	1,912	132.52	292,121	253,369	
Site-10	429,021	57%	243,009	2.69	1,153,048	653,117	
Site-11	426,114	43%	183,162	2.69	1,145,234	492,272	
Site-12	12,272	74%	9,024	132.52	1,626,158	1,195,816	
Site-13	1,066,932	102%	1,084,082	1.20	1,275,775	1,296,282	
Site-14	321	210%	674	132.52	42,537	89,315	
Site-15	2,604	614%	16,000	2.69	6,999	43,002	
Site-16	750,501	87%	652,043	1.20	897,405	779,675	
Site-17	5,098,278	100%	5,098,278	1.20	6,096,222	6,096,222	
Site- 18	434,565	116%	505,612	2.69	1,167,948	1,358,896	
TOTAL	12,581,948		12,215,950		22,911,440	22,313,007	

Source: Anchor Blue Analysis

Demand savings are calculated using the same stratified weighting method, the results are detailed in Table 24. Ex-post demand savings are estimated using the overall realization rate of 64%.

Table 24. Program Level Electric Gross Demand Savings and Realization Rate

Site	Ex-ante Peak Demand (kW)	Project Realization Rate	Ex-post Peak Demand (kW)	Stratum Weight	Extrapolated Ex-Ante Peak Demand (kW)	Extrapolated Ex-Post Peak Demand (kW)	Stratum Weighted Realization Rate
Site-1	635.4	0%	0.0	1.20	759.8	0.0	**63.98%**
Site-2	2.4	0%	0.0	132.52	318.0	0.0	
Site-3	0.8	118%	0.9	132.52	106.0	124.6	
Site-4	1.3	104%	1.3	132.52	166.2	172.3	
Site-5	0.0	N/A	0.0	132.52	0.0	5.3	
Site-6	9.7	62%	6.0	2.69	26.0	16.1	
Site-7	2.7	98%	2.7	2.69	7.3	7.2	
Site-8	5.8	120%	6.9	2.69	15.5	18.5	
Site-9	0.6	117%	0.7	132.52	84.0	98.1	
Site-10	76.0	43%	32.3	2.69	204.2	86.8	
Site-11	54.6	140%	76.3	2.69	146.6	205.0	
Site-12	0.3	348%	1.2	132.52	43.7	152.4	
Site-13	143.1	62%	88.3	1.20	171.2	105.6	
Site-14	0.1	43%	0.0	132.52	10.6	4.5	
Site-15	1.8	0%	0.0	2.69	4.9	0.0	
Site-16	110.2	56%	61.6	1.20	131.7	73.7	
Site-17	611.8	100%	611.8	1.20	731.5	731.5	
Site-18	58.4	109%	63.9	2.69	156.9	171.7	
TOTAL	1,715		954		3,084	1,973	

Source: Anchor Blue Analysis

Table 25 summarizes gross energy and demand ex-post savings for all sample sites. Table 26 summarizes gross energy and demand ex-post savings at the program level by extrapolating the strata weighted energy realization rate to the program population.

Table 25. Summary of Sample Electric Gross Energy and Demand Ex-Post Savings for PY 2016-2017

	Sample Gross Ex-ante Savings (kWh)	Strata Weighted Energy Realization Rate	Sample Gross Ex-post Savings (kWh)	Sample Gross Ex-ante Peak Demand (kW)	Strata Weighted Peak Demand Realization Rate	Sample Gross Ex-post Peak Demand (kW)
Total	22,911,440	97.39%	22,313,007	3,084	64%	1,973

Source: Anchor Blue Analysis

Table 26. Summary of Extrapolated Program-Level Electric Gross Energy and Demand Ex-Post Savings for PY 2016-2017

	Gross Program Ex-ante Savings (kWh)	Strata Weighted Energy Realization Rate	Gross Program Ex-post Savings (kWh)	Gross Program Ex-ante Demand (kW)	Strata Weighted Demand Realization Rate	Gross Program Ex-post Demand (kW)
Total	25,255,561	97.39%	24,595,902	4,190	64%	2,681

Source: Anchor Blue Analysis

NET-TO-GROSS RATIO

The Anchor Blue Team conducted a desk research for recent Net-to-Gross (NTG) value updates with the objective of identifying the appropriate NTG values for the program evaluation. The following California data sources have been reviewed:

- DEER 2016 Net-to-Gross Table[4]
- E3 Program Savings Reporting Tool
- Recent California Impact Evaluations:
    - 2015 Non-Residential ESPI Custom Lighting Impact Evaluation[5]
    - 2015 Non-Residential ESPI Deemed Lighting Impact Evaluation[6]

The 2015 ESPI Custom and Deemed Lighting Impact Evaluation reports captured the California Statewide lighting program evaluation results. NTG values were researched by conducting phone surveys, collecting information on the influence of the program on the purchase and installation of the lighting measures. The NTG values of the deemed lighting program differed by IOU, ranging from 0.55 to 0.64 for Indoors LED. Similarly, occupancy sensors NTG ranged from 0.51 to 0.69. For Outdoors LED, the NTG values were reported as Statewide values, specifically 0.45 for exterior fixtures and 0.53 for streetlighting measures. For the Statewide Custom Lighting Program, the energy NTG values ranged from 0.46 to 0.54.

Anchor Blue decided to use the DEER 2016 Net-to-Gross Table as our primary source as it represents California Statewide NTG values. An important consideration is that Direct Install is a significant portion of MID's portfolio, based on the DEER NTG values, direct install lighting measures generally have a higher NTG value of 0.89. Therefore, a 0.8 NTG ratio is reasonable for MID's Non-Res Lighting end-use.

The NTG values from Table 27 are applied to the gross energy and demand savings to yield net savings results summarized in Table 28.

Table 27 Net-to-Gross Values by Measure Category

Modesto Measure Category	Net-to-Gross Ratio
Non-Res Cooking	0.6
Non-Res Cooling	0.85

[4] DEER 2016 NTG Workbook: http://deeresources.com/files/DEER2016/download/DEER2015-2016-NTG-Update-2015-10-16.xls
[5] 2015 Nonresidential ESPI Custom Lighting Impact Evaluation Net to Gross Analysis (Section 6-3)
[6] 2015 Nonresidential ESPI Deemed Lighting Impact Evaluation Net to Gross Analysis (Section 7-2)

Modesto Measure Category	Net-to-Gross Ratio
Non-Res Heating	0.6
Non-Res Lighting	0.8
Non-Res Motors	0.6
Non-Res Pumps	0.6
Non-Res Refrigeration	0.6
Non-Res Shell	0.6
Non-Res Process	0.6
Non-Res Comprehensive	0.6
Non-Res Behavior	0.7
Other	0.7

Source: DEER 2016 NTG Values and E3 Program Savings Reporting Tool

Table 28 Program-Level Gross and Net Energy and Demand Ex-Post Savings

	Gross Ex-ante Savings (kWh)	Gross Ex-ante Savings (kW)	Net-to-Gross Ratio	Net Program Ex-Post Savings (kWh)	Net Program Ex-Post Peak Demand (kW)
Total	24,595,902	2,681	0.73	18,082,306	2,013

Source: Anchor Blue analysis

EUL AND LIFECYCLE SAVINGS

To estimate the program lifecycle ex-post savings, Anchor Blue reviewed Effective Useful Life (EUL) estimates from the E3 Program Savings Reporting Tool. The first year estimated energy savings are multiplied to the EUL to estimate lifecycle savings. Each site project might contain multiple measures with different EULs. The EUL applied to the lifecycle saving estimates is the average of MID's E3 Program Savings Reporting Tool submittal. The lifecycle Electric Savings are summarized in Table 29.

Table 29 Program-Level Ex-Post Lifecycle Electric Savings

	Gross Program Ex-Post Savings (kWh)	Net Program Ex-Post Savings (kWh)	Effective Useful Life	Gross Program Lifecycle Ex-Post Savings (kWh)	Net Program Lifecycle Ex-Post Savings (kWh)
Total	24,595,902	18,082,306	12.3	309,707,387	217,854,344

Source: E3 Program Savings Reporting Tool EUL assumptions by measure category and Anchor Blue analysis

ENERGY AND DEMAND RESULTS BY PROGRAM YEAR AND MEASURE CATEGORY

Table 30 and *Table* 31report energy savings by program year and measure category. Results of demand impacts are summarized in *Table 32* and Table 33.

Table 30. PY 2016 Gross and Net Ex-Post Portfolio-Level Electric Savings

Modesto E3 Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	97%	-	0.6	-
Non-Res Cooling	224,956	97%	219,080	0.85	186,218
Non-Res Heating	-	97%	-	0.6	-
Non-Res Lighting	8,927,066	97%	8,693,897	0.8	6,955,117
Non-Res Motors	20,989	97%	20,441	0.6	12,264
Non-Res Pumps	-	97%	-	0.6	-
Non-Res Refrigeration	171,584	97%	167,102	0.6	100,261
Non-Res Shell	69,519	97%	67,703	0.6	40,622
Non-Res Process	2,763,846	97%	2,691,656	0.6	1,614,994
Non-Res Comprehensive	-	97%	-	0.6	-
Non-Res Behavior	-	97%	-	0.7	-
Other	-	97%	-	0.7	-
TOTAL	12,177,960		11,859,879		8,909,477

Source: Anchor Blue analysis

Table 31. PY 2017 Gross and Net Ex-Post Portfolio-Level Electric Savings

Modesto E3 Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	97%	-	0.6	-

Modesto E3 Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooling	94,501	97%	92,033	0.85	78,228
Non-Res Heating	-	97%	-	0.6	-
Non-Res Lighting	7,743,288	97%	7,541,038	0.8	6,032,831
Non-Res Motors	-	97%	-	0.6	-
Non-Res Pumps	642	97%	625	0.6	375
Non-Res Refrigeration	49,525	97%	48,231	0.6	28,939
Non-Res Shell	5,139	97%	5,005	0.6	3,003
Non-Res Process	5,098,278	97%	4,965,114	0.6	2,979,068
Non-Res Comprehensive	86,228	97%	83,976	0.6	50,385
Non-Res Behavior	-	97%	-	0.7	-
Other	-	97%	-	0.7	-
TOTAL	13,077,601				9,172,829

Source: Anchor Blue analysis

Table 32. PY 2016 Gross and Net Ex-Post Portfolio-Level Demand Savings

Modesto E3 Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio	Net Annual Ex-Post Demand Savings (kW)
Non-Res Cooking	0	64%	-	0.6	-
Non-Res Cooling	138	64%	88.29	0.85	75.05
Non-Res Heating	0	64%	-	0.6	-
Non-Res Lighting	1551	64%	992.32	0.8	793.86
Non-Res Motors	0	64%	-	0.6	-
Non-Res Pumps	0	64%	-	0.6	-
Non-Res Refrigeration	27	64%	17.27	0.6	10.36

Non-Res Shell	0	64%	-	0.6	-
Non-Res Process	325	64%	207.93	0.6	124.76
Non-Res Comprehensive	0	64%	-	0.6	-
Non-Res Behavior	-	64%	-	0.7	-
Other	-		-	0.7	-
TOTAL	2,041		1,305.82		1,004.03

Source: Anchor Blue Analysis

Table 33. PY 2017 Gross and Net Ex-Post Portfolio-Level Demand Savings

Modesto E3 Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio	Net Annual Ex-Post Demand Savings (kW)
Non-Res Cooking	0	64%	-	0.6	-
Non-Res Cooling	38	64%	24.31	0.85	20.67
Non-Res Heating	0	64%	-	0.6	-
Non-Res Lighting	1390	64%	889.32	0.8	711.45
Non-Res Motors	0	64%	-	0.6	-
Non-Res Pumps	0	64%	-	0.6	-
Non-Res Refrigeration	9	64%	5.76	0.6	3.45
Non-Res Shell	0	64%	-	0.6	-
Non-Res Process	667	64%	426.74	0.6	256.05
Non-Res Comprehensive	45	64%	28.79	0.6	17.27
Non-Res Behavior	-	64%	-	0.7	-
Other	-		-	0.7	-
TOTAL	2,149		1,374.92		1,008.89

Source: Anchor Blue Analysis

PROGRAM FINDINGS AND RECOMMENDATIONS

Anchor Blue developed program recommendations related to the findings of this evaluation aiming to help improve future MID Non-Residential program processes. MID may consider the following set of recommendations for future program years:

- **Enhance documentation of ex-ante savings by project:** While direct install projects and custom projects have ex-ante savings documented in MID's project tracker and project files, Business Rebate projects do not have the ex-ante savings easily assessible. Anchor Blue highly encourages the documentation of the savings in MID's project tracker for the following reasons:
    - Capturing ex-ante savings for all projects could enhance the accuracy of the evaluation. Sampling designs are ideally constructed using ex-ante savings, without the information on ex-ante savings by project up front, sampling would have to be conducted using the rebate amount. For future program cycles, if MID can include ex-ante savings, the sample design can be tied to savings instead of incentives, which will make the sampling strategy more robust.
    - Having the ex-ante savings documented within MID's Rebate Details Summary Report or project files can clear up ambiguity with ex-ante savings claimed. Currently, evaluators have to review each rebate code and match the specific code to the E3 Program Savings Reporting Tool by line item. While this method is workable, there could be confusion at times as occasionally the rebate code does not match with equipment found on-site.
- **Demand savings for exterior lighting fixtures:** Exterior lighting fixtures and lamps mostly operate at off peak hours therefore do not yield demand reduction. This assumption is consistent with Section 6.4 of the California Municipal Utilities Association (CMUA) Technical Reference Manual (TRM) for exterior LED lighting measures. Some MID projects using deemed savings applied demand savings for exterior lighting. One of these projects is a streetlight project, which covered a substantial proportion of MID's ex-ante demand savings claimed, this project was a key driver of a demand realization rate significantly lower than 100%. Anchor Blue recommend applying no demand savings to exterior lighting that operates off-peak for future ex-ante savings claim.
- **Work with Direct Install implementation contractor to document evidence of T12 baseline if such is claimed in a Direct Install project**: For Direct Install projects that claimed early replacement measures with baseline listed below Title 24 code baseline (e.g., T12s), documentation of baseline should be provided. Guidance from CPUC on Linear Fluorescent disposition using T12 as a baseline stated that claiming an early retirement measure invokes the requirement for documentation of the pre-existing condition as well as evidence that program intervention caused the early retirement project (per D.12-05-015). In one of the evaluated sites, the project claimed T12 as the baseline while the evaluation team found evidence of T8 lamps instead of T12s. Anchor Blue recommends MID to work with the direct install implementation contractor to document baseline equipment so as to ensure the correct baseline assumption is used when calculating savings.
- **Verify ballast change as part of the Direct Install project process:** Type A Tubular LEDs (TLEDs) lamps could work with some existing ballasts suitable for T8s, however, an old ballast is not optimal for TLEDs and may cause shorter fixture lifetime due to ballast failure. At one of the Direct Install sites, the evaluation team found old ballasts that were not replaced with the new TLEDs installation. Anchor Blue recommends MID to work with the implementation contractor to confirm replacement of existing ballasts with new ballasts, ideally ones that are compatible with the efficient TLEDs replacement lamps.

- **Additional quality control on rebate codes**: For deemed savings lighting measures, occasionally rebate codes of a similar measure were applied, for examples:
    - Interior vs. Exterior fixture replacements with same efficient measure
    - Same efficient measures with different baseline wattages such as 150W Metal Halide vs. 400W Metal Halide

  Applying a mismatched rebate code causes differences in savings driven by discrepancies in baseline wattages and adjustment factors such as energy and demand interactive factors.
- **Consider a Custom project approach for large scale projects**: The advantage of using the deemed rebate amount is efficiency for both the customer and the MID team. Most projects of small to medium scales are great candidates for the deemed savings approach. However, larger projects have more complexities and a custom approach might be more suitable. One of the projects evaluated was a heat pump mini-split upgrade for an apartment building. Based on usage data, customers utilize their heat pumps in both summer and winter times. The deemed savings approach only captures the cooling savings, which underestimated annual energy savings for heat pump measures when the baseline is an electric heating equipment. For the heat pump mini-split project evaluated, the ex-post savings is higher than the ex-ante savings by multiples due to including heating savings in the ex-post savings. Anchor Blue confirmed that the specific project had electric heating prior to heat pump upgrades. Anchor Blue recommends considering a custom approach for future large-scale projects.
- **Enhance savings calculation documentations**: Most projects evaluated had clear documentation on assumptions and savings approaches, however, there are several projects that include assumptions that Anchor Blue was not able to trace back to the source. Anchor Blue recommend documenting assumptions to the extent possible and practical. This is especially important for custom projects where the assumptions going into savings calculations are not standardized. Several instances, the location and count of lighting measures were different from what is noted in the project files. Without documentation from ex-ante calculation, verifying the calculations became challenging and introduced uncertainty.

APPENDIX

Site-specific analysis files are included in a separate attachment due to confidential customer information