EVALUATION, MEASUREMENT, AND VERIFICATION OF MODESTO, TURLOCK, AND MERCED IRRIGATION DISTRICTS' (MTM) NON-RESIDENTIAL ENERGY EFFICIENCY PROGRAMS

FINAL REPORT

November 30, 2022

Program Year 2021 EM&V

Prepared for:

Submitted by:

TABLE OF CONTENTS

MTM Non-Residential Programs Impact Evaluation Report

PROGRAM YEAR 2021 EM&V

EXECUTIVE SUMMARY

Introduction

Modesto Irrigation District, Turlock Irrigation District, and Merced Irrigation District (MTM) contracted Anchor Blue Consulting (Anchor Blue) and subcontractor INCA Energy Efficiency Consulting (INCA) to conduct their Non-Residential Programs Impact Evaluation for Program Year 2021. The Non-Residential program impact 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 onsite visit data, analysis, and desk research
- Present actionable recommendation to MTM with the goal of improving program and tracking efficiencies and accuracies

The MTM 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. This evaluation report details the evaluation and research findings, as well as providing recommendations for program improvements in future years.

Portfolio-Level Ex-Post Savings

This evaluation aimed at a combined 15% precision level at 90% confidence for Program Year 2021, combining the three utilities population of projects using a stratified sampling strategy. The sampling resulted in 21 sites for evaluation. For each, Anchor Blue conducted project file reviews and onsite verification activities, which includes verifying installation, collecting operational data when appropriate, installing logging equipment as necessary and verifying equipment nameplates and model numbers.

The selected evaluation sample site savings represents 10,243,737 kWh and 626 kW which covers 54% of energy and 55% demand savings claimed for MTM's Non-Residential program savings in PY 2021. The overall energy and peak demand savings realization rates are 108.0% and 141.3% across MTM programs respectively, as shown in Table 1 below.

---

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

Table 1. MTM Utility Level PY 2021 Claimed and Evaluated Savings - Energy and Peak Demand

Utility	Total Gross Annual Ex-Ante Energy Savings (kWh)	Evaluated Gross Annual Ex-Ante Energy Savings (kWh)	% of the Total Energy Savings Evaluated	Total Gross Annual Ex-Ante Peak Demand Savings (kW)	Evaluated Gross Annual Ex-Ante Peak Demand Savings (kW)	% of the Total Demand Savings Evaluated
Modesto	12,821,114	6,132,871	48%	930	580	62%
Turlock	4,471,536	3,110,302	70%	213	46	22%
Merced	223,697	135,559	61%	0	0	NA
Total	**17,516,347**	**9,378,732**	**54%**	**1,143**	**626**	**55%**

Source: Utility program data and Anchor Blue analysis

The overall energy and peak demand savings realization rates results are 108% and 141%, respectively, across MTM programs. These realization rates are applied to each utility's 2021 non-residential program savings. Table 2 and Table 3 below summarize the gross and net savings results by end-use category for all utilities combined. Results by utility are reported in the *Portfolio Summary by Utility* section of this report.

Table 2. MTM Non-Residential Portfolio-Level Electric Energy Savings (kWh) – PY 2021

End-Use Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio (CA eTRM)	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	108%	-	0.6	-
Non-Res HVAC	98,951	108%	106,861	0.6	64,117
Non-Res Lighting	10,901,183	108%	11,772,595	0.91	10,713,061
Non-Res Motors	1,702,162	108%	1,838,229	0.6	1,102,937
Non-Res Pool Pumps	-	108%	-	0.6	-
Non-Res Refrigeration	594,965	108%	642,525	0.6	385,515
Non-Res Shell	6,471	108%	6,989	0.6	4,193
Non-Res Process	-	108%	-	0.6	-
Non-Res Comprehensive	13,465	108%	14,541	0.6	8,725
Non-Res Behavior	-	108%	-	0.6	-
Other	4,199,150	108%	4,534,819	0.6	2,720,891
TOTAL	**17,516,347**	**108%**	**18,916,558**	**0.79**	**14,999,439**

Source: Utility program data and Anchor Blue analysis

Table 3. MTM Non-Residential Portfolio-Level Peak Demand Savings – PY 2021

End-Use Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio (CA eTRM)	Net Annual Ex-Post Demand Savings (kW)
Non-Res Cooking	-	141%	-	0.6	-
Non-Res HVAC	13	141%	18	0.65	12
Non-Res Lighting	578	141%	816	0.91	743
Non-Res Motors	3	141%	4	0.6	2
Non-Res Pool Pumps	-	141%	-	0.6	-
Non-Res Refrigeration	6	141%	9	0.6	5

Non-Res Shell	-	141%	-	0.6	-
Non-Res Process	-	141%	-	0.6	-
Non-Res Comprehensive	4	141%	5	0.6	3
Non-Res Behavior	-	141%	-	0.6	-
Other	539	141%	762	0.6	457
TOTAL	**1,143**	**141%**	**1,614**		**1,223**

Source: Utility program data and Anchor Blue analysis

Key Findings and Recommendations

Anchor Blue has detailed 15 findings and recommendations for the MTM Non-Residential Programs in the *Program Findings and Recommendations* section of this report. The findings and recommendations are bucketed into four different categories: General, Lighting Projects, Non-Lighting Projects, and 2019 CA Title 24 Code. Though the programs have an excellent overall realization rate for the PY2021 evaluation, there was a large range in individual project level realization rates that led to a number of findings. Additionally, Anchor Blue researched the impacts of the current CA Title 24 Code in greater detail for this evaluation, which has large implications for the future of the MTM Non-Residential programs and is discussed further below. Anchor Blue has selected the most significant findings and recommendations for this section and the more detailed list of 15 findings and recommendations in the *Program Findings and Recommendations* section of this report.

- *Key Finding 1:* 2019 Title 24 Code has strict requirements for lighting that essentially requires LEDs in most all applications. Additionally, LEDs have gained significant market share and are considered standard practice in many jurisdictions, including the CA IOUs, which cannot claim savings from standard LEDs anymore. IOUs are allowed to claim ENERGY STAR LEDS compared to a standard LED baseline, but the savings are significantly lower than non-LED Baselines. Anchor Blue also suspects that the current lighting program has a very high free-ridership rate given the saturation of LED lighting in the CA market, meaning that the customer would have done the lighting upgrade without the incentive.

  - *Key Recommendation 1:* The Irrigation Districts should consider phasing out and ending the lighting programs due to likely high free ridership and code. Typical lighting remaining useful lives are around 4-5 years, meaning that 4-5 years after the code requiring LEDS, savings should all be attributed to code. The 2019 code went into effect in 2020, therefore Anchor Blue recommends that C&I lighting programs be phased out by the end of 2024 or transitioned to promoting ENERGY STAR LEDS using a code LED baseline in line with the IOUs.

- *Key Finding 2:* 2019 CA Title 24 impacts other end-uses as well, with the most significant impact on compressed air replacements. Other end-uses and measures may be impacted as well, but a more rigorous review of the code compared to current non-res program offerings is necessary.

  - *Key Recommendation 2:* Update eligibility requirements for compressed air replacement projects, detailed below. Conduct additional research in the next EM&V round or as a separate study to understand the full impacts of code on other end-uses and measures.

  - *Compressed Air Eligibility Requirements Questionnaire:*
    - Is this a healthcare facility? *If yes, all projects are eligible for rebate.*
    - Does the system include a centrifugal compressor? *If yes, all projects are eligible for rebate.*

- Does the proposed project affect more than 50% of the existing system total horsepower? *If yes, the project is not eligible and triggers code required VFDs*
- If code is triggered in the project, savings can be claimed as early retirement if the age of the equipment is verified to be less than 10 years old, which is about half of the typical measure life of air compressors. Verification would be a photo of the baseline compressor nameplate that shows the manufacture date or an old invoice showing the date of purchase.

- *Key Finding 3:* All three projects with prescriptive savings in the sample used out-of-date savings data or the incorrect selection of equipment type.

  - *Key Recommendation 3:* Ensure prescriptive savings are up to date with the latest CA eTRM savings values and set up a regular update cycle every year or two years to ensure that the latest savings are being used and consider the most recent CA Title 24 codes.

- *Key Finding 4:* Retrofit custom projects should utilize the dual baseline methodology as described in the CMUA TRM should be used to estimate lifetime savings for lighting projects and as applicable to other projects that may be impacted by code or standard practice. Dual baselines do not affect the first-year savings of an 'early retirement' replacement, only lifetime savings and for cost effectiveness calculations. A dual baseline uses two energy use baselines to determine lifetime energy savings where equipment with remaining useful life (RUL) is replaced. In general, the first baseline is based on preexisting conditions and the second baseline is current energy code or industry standard practice. Anchor Blue has implemented this method in this year's evaluation report for lighting savings only, as these are clear cut with the current 2019 Title 24 code that effectively requires LEDs. This is discussed in greater detail in the lifetime savings calculations section.

  - *Key Recommendation 4:* Consider adopting the dual baseline methodology for retrofit projects that are subject to code requirements in a natural replacement scenario if reporting systems allow for this. This would include lighting and compressed air projects at the minimum.

- *Key Finding 5*: The stringent updates to CA Title 24, high saturation of LEDs in the market, and other information in the project documentation leads Anchor Blue to suspect that some projects may have been 'free riders', meaning that the site would have done the upgrade without the incentive. This is taken into account with general NTG ratios and net savings within this report but can also be done as a part of a process evaluation, which has not been done on the C&I program for many years.

  - *Key Recommendation 5:* Anchor Blue recommends a process evaluation be done on the C&I portfolio for MTM in the coming years. These evaluations will provide estimates of free ridership to better inform net savings, as well as provide recommendations for the overall operation of the program beyond the savings impacts of the current study. Additionally, the statewide NTG ratios used in this report may not be representative of customers in MTM.

- *Key Finding 6:* One compressed air optimization controls project was found to have these controls overridden and not saving energy while onsite

  - *Key Recommendation 6:* For large projects that include these of controls/optimization measures, Anchor Blue recommends that the utility representative follows up with the site once a year for a set number of years after installation to ensure that the controls or optimization configuration is still in place.

INTRODUCTION

This report summarizes Anchor Blue's impact evaluation of the three Irrigation Districts of Modesto, Turlock, and Merced's (MTM) combined Non-Residential program energy and demand savings for PY 2021. To reduce EM&V costs while maintaining statistical confidence, the three Irrigation Districts implemented a joint EM&V effort. The three sets of Non-Residential programs are similar in scope, customer characteristics, and geographical proximity.

MTM conducts regular impact evaluations for their Non-Residential programs. The purpose of this impact evaluation is to develop 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 is summarized below, and this report follows this framework:

- **Contextual Reporting**: Evaluation covering a significant portion of the POU's portfolio, assess risk or uncertainty in selecting the components of the portfolio evaluated. EM&V savings reported are consistent with the 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, metering equipment and protocols.
- **Gross Savings**: Review of baseline assumptions, 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**: Provide recommendations for improving program processes, assesses the reliability of the verified savings and areas of uncertainty.

OVERVIEW OF MEASURE AND VERIFICATION APPROACH AND SAMPLING

General M&V Approaches

This study is an impact evaluation of MTM's energy and demand savings claimed for the Non-Residential programs for Program Years 2021. For this evaluation, Anchor Blue used a stratified sampling approach with target $\pm15\%$ precision at 90% confidence level. The overarching goals of the EM&V activities are to provide MTM with unbiased, objective, and independent program evaluation by providing the following:

- Useful recommendations and feedback to improve MTM program operation, tracking, and measure offerings.
- Assessment of the quality of the program tracking data and supporting project application data for impact evaluation purposes.
- Increased level of confidence in energy efficiency program results.

To achieve these goals, Anchor Blue undertook the impact evaluation of the MTM non-residential program using the following guidelines:

- CEC EM&V Guidelines
- California Energy Efficiency Evaluation Protocols
- California Evaluation Framework
- International Performance Measurement and Verification Protocols (IPMVP) to determine the best options for evaluating energy efficiency measures (EEMs).

For projects that received an onsite visit, Anchor Blue collected site-specific operating conditions, verified measure installations, placed metering equipment as necessary and took notes of conditions that might impact energy saving results. Using data collected onsite, the team developed a program level realization rate, which is the ratio of ex-ante vs. ex-post savings. From there, the realization rate is extrapolated to the population of participants to estimate ex-post savings for all projects in PY2021.

Net-to-Gross (NTG) ratios were estimated to account for spillover and free rider effects based on measure type. NTG values were derived from the CA eTRM[3], which were generally sourced from the DEER database.

Sample Design

The Anchor Blue team conducted this evaluation using a sample of sites form the population universe of the MTM C&I programs. Anchor Blue defines the EM&V population universe as the program participants identified within each Irrigation Districts program tracking databases for their non-residential programs. Information on installed measures, installation dates, key customer characteristics, and estimated savings are the primary data components that are reviewed for programs when developing the sample design. Anchor Blue insured that each of the three utilities had projects included in the final sample.

Statisticians have developed many approaches to sample design. Each of these approaches may be best suited for a particular evaluation based on the objectives of each program and the availability of the population data. Some commonly used sampling approaches include:

- **Simple Random Sampling.** Simple random sampling is a method of selecting sample cases out of the population such that every one of the distinct population cases has an equal chance of being selected.

- **Systematic Sampling.** In systematic sampling, each sample unit is chosen at a prescribed interval. Often this approach is used to ensure that the sample draw achieves a representative distribution of a particular characteristic, such as ex-ante project savings.

- **Stratified Random Sampling.** In this method, the sample population is divided into subgroups (i.e., strata) based on a known characteristic such as savings level or energy usage. Stratified random samples can produce estimates with smaller coefficients of variation than simple random samples. A sample is then randomly chosen from each stratum in one of three ways: proportional stratification, optimal stratification, or disproportionate stratification.

- **Cluster Sampling or Snowball Sampling.** Cluster sampling can be used to reduce the geographic distribution of the sample. The technique is employed where appropriate in sample selection or the scheduling of site visits to reduce travel times and more efficiently utilize field staff.

---

[3] https://www.caetrm.com/cpuc/table/nettogross/ - accessed 10/10/2022

- **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.

Sampling for Modesto, Turlock, and Merced

MTM conducts their EM&V study together as a means to reduce cost, while maintaining statistical confidence. The three Irrigation Districts are close in geographical proximity and their programs are similar in scope. For the PY 2021 Non-Residential evaluation, the population universe for the EM&V sample is all the PY 2021 participants within each of the utilities non-residential programs.

The entire MTM Non-Residential program saved 17,516,347 kWh from 141 projects in PY2021. They were evaluated and sampled together using a stratified ratio estimation sampling design. The sample was drawn with the goal of achieving a sampling precision of 90% (+/- 15%) at the project level. With this sampling precision, the sample size was 21

If each of the utilities had independently evaluated their non-residential programs with the same sampling precision, the combined number of sample sites would be 33. By combining the three utilities into one EM&V effort, a significant reduction in sample sites is achieved with corresponding budgetary savings. Table 4 provides a breakout by utility of claimed ex-ante savings, the number of projects completed in PY 2019-2020, and the sample of projects drawn from each utility.

Table 4. PY 2021 Claimed Gross Ex-Ante Savings, Completed Projects, and Sampled Projects by Utility

Utility	Gross Ex-ante kWh	kWh Share	Number of Projects	Projects Share	Sampled Projects	Sampled Share
Modesto	12,821,114	73.2%	92	65.2%	12	57.1%
Turlock	4,471,536	25.5%	44	31.2%	6	28.6%
Merced	223,697	1.3%	5	3.5%	3	14.3%
Total	17,516,347	100%	141	100%	21	100%

Source: MTM Program Data and Anchor Blue Analysis

Stratified Ratio Estimation Sampling

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

By using the ex-ante energy savings per project as the stratification variable, the coefficient of variance (CV) 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. A relatively smaller sample is selected from the accounts with small energy savings, but the sample is forced to include a higher proportion of the projects with larger levels of energy savings as well.

Non-Residential Projects Sample

The MTM population of the PY2021 non-residential programs consists of 141 projects. These projects have a very wide variance of energy savings, ranging from 112 kWh to 1,783,644 kWh, with the median being 37,747 kWh. The population CV of the energy savings is large, and the stratified ratio estimation sampling provides the best methodology to attain both a sampling precision of 90% (+/- 15%) at the project level, as well as a very high percentage of overall sampled ex-ante savings. The final sample consists of 21 projects, 15% of total projects, but more importantly, 54% of the total ex-ante electric energy savings. Backup sites were also selected but were not necessary in this evaluation as Anchor Blue was able to visit all the primary selected sites. Table 5 identifies each sampled site with utility, sample strata, ex-ante savings, and calculated sample weight. The stratum weight is used to scale the sample savings to overall programmatic savings and realization rate, which is discussed in later in this report in the section: *Program Level Realization Rates.*

Table 5. Sample with Utility, Ex-ante Savings, Sample Strata, and Sample Weight

Site	Utility	Sample Strata	Ex-Ante kWh Savings	Stratum Weight
Site 1	Turlock	Strata #1	1,528,489	1.31
Site 2	Turlock	Strata #1	1,362,221	1.31
Site 3	Turlock	Strata #2	191,102	1.70
Site 4	Turlock	Strata #3	11,480	16.63
Site 5	Turlock	Strata #3	9,150	16.63
Site 6	Turlock	Strata #3	7,860	16.63
Site 7	Modesto	Strata #1	1,783,644	1.31
Site 8	Modesto	Strata #1	1,002,680	1.31
Site 9	Modesto	Strata #2	738,660	1.70
Site 10	Modesto	Strata #2	692,259	1.70
Site 11	Modesto	Strata #2	530,895	1.70
Site 12	Modesto	Strata #2	318,780	1.70
Site 13	Modesto	Strata #2	271,346	1.70
Site 14	Modesto	Strata #2	216,254	1.70
Site 15	Modesto	Strata #2	203,399	1.70
Site 16	Modesto	Strata #2	154,092	1.70
Site 17	Modesto	Strata #2	134,912	1.70
Site 18	Modesto	Strata #3	85,950	16.63
Site 19	Merced	Strata #3	73,714	16.63
Site 20	Merced	Strata #3	40,000	16.63
Site 21	Merced	Strata #3	21,845	16.63

Energy and Demand Savings Estimation

EM&V Protocols

This evaluation was conducted in adherence to the CEC POU EM&V Guidelines, the California Energy Efficiency Evaluation Protocols and referencing the International Performance Measurement and Verification Protocol (IPMVP)[4] for appropriate energy efficiency measures evaluation protocol. For specific evaluation methodology by site, refer to the individual site-reports in the '

---

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

SUMMARY OF SITE LEVEL ACTIVITES, ANALYSES AND FINDINGS

On-Site Activities

Per the sample plan described above, Anchor Blue ' below.

Use of the CMUA Technical Reference Manual (TRM) and the CalTF eTRM

In this evaluation cycle, Anchor Blue used both the 2017 CMUA TRM[5] and/or CalTF's eTRM in some manner for most of the site analyses. Anchor Blue understands that the publicly owned utilities of California are members of the CalTF, contribute to the eTRM development and will be conforming to the eTRM as it rolls out, replacing CMUA TRM assumptions with eTRM assumptions as they become available. The TRMs provided the following data, with the actual source given next to it:

- Prescriptive HVAC and Refrigeration equipment savings - eTRM
- Custom lighting savings algorithms – CMUA TRM
- Baseline and default custom lighting inputs – CMUA TRM
- Baseline fixture wattage assumptions – CMUA TRM
- Default hours of use by space type, to be used if not provided by the site – CMUA TRM
- Lighting controls savings factors – CMUA TRM
- HVAC interactive effect factors by space type for lighting projects – CMUA TRM
  - Interactive effects provide additional electric savings to be claimed from reduced air-conditioning usage at the site due to the lower heat output of LED lighting compared to the baseline Both factors provide better estimations of the impact of the lighting project on the site.
- Coincident peak demand factors by space type for lighting projects – CMUA TRM
  - Peak coincident factors are an estimate of the percentage of full demand load that occurs during peak hours and applied to calculated demand savings

These algorithms, savings, lighting data and interactive/coincidence factors were applied as appropriate throughout the evaluation.

Recommended CalTF eTRM updates for PY2023

The eTRM has new data that is available for use in 2023 for several of the above data inputs, including HVAC interactive effect factors, coincident demand factors and default hours of use. There is no custom lighting savings or calculator in the eTRM, so the CMUA TRM will continue to be the source of lighting savings algorithms and baseline wattage assumptions for PY2023. Anchor Blue is aware that some of the MTM utilities have already implemented these eTRM inputs in their PY2022 calculators, however, there are updated values that are to be used starting in PY2023 that should be updated for use in PY2023. Anchor Blue has made this table available as a part of the deliverable of this evaluation.

---

[5] https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf

SUMMARY OF SITE LEVEL ACTIVITES, ANALYSES AND FINDINGS

On-Site Activities

Per the sample plan described above, Anchor Blue performed on-site visits to the 21 selected sites in June 2022. The purpose of the site visit is to confirm that the equipment is still operating as claimed and to obtain additional data for use in the ex-post analysis. At each of these site visits, Anchor Blue:

- Visually verified the existence, quantity, and operation of the efficient equipment.
- Interviewed site contact to collect or request additional data required for analysis including, but not limited to: updated hours of use, changes in operation or personnel, site plans, additional power trend data of efficient equipment, production data to normalize savings, and other custom data needs specific to the site.
- Noted any other observations that may impact savings estimates.
- Placed metering equipment as necessary.

At over half the sites, Anchor Blue installed and left metering loggers on equipment to measure either hours of use for lighting or power consumption of the efficient equipment over a three-week period for use in the ex-post analyses. Anchor Blue placed these loggers on equipment to gain better estimates of the efficient equipment's actual operation. This is necessary because often, ex-ante analyses use estimate or default assumptions for inputs such as lighting hours of use. These assumptions are often the best that can be done when little information is available, but actual site level hours of use are much more accurate for estimating savings. Additionally, some ex-ante calculations are based on estimated operation of the efficient equipment, not actual operation, and logging equipment after installation allows for savings estimates to be on actual operation rather than estimated operation. In many cases though, it is not necessary to place loggers, such as sites with outdoor lighting fixtures that are on photocell controls. These lights have a known dawn to dusk schedule that does not need logging to confirm.

The metering loggers were installed on the efficient equipment for three-weeks, at which point Anchor Blue retrieved the loggers and begin analyzing the collected data.

Site Level Analyses

Once the on-site data had been collected, Anchor Blue performed its ex-post analysis for each site using the project documentation, ex-ante calculations, data collected onsite and any external sources necessary. Anchor Blue reviewed each projects documentation well prior to the site visit to determine what data would need to be collected onsite, but in some cases, additional data was found to be required and was requested during the analysis phase. Crucial to the evaluation is understanding why there are differences in the ex-post analysis performed by Anchor Blue and the ex-ante analysis. To show this, Anchor Blue created a detailed site report for each site (APPENDIX A – Site Level Analysis Reports) that details the following:

- Project Summary
- Details on the ex-ante assumptions of baseline and efficient conditions
- Comments on the ex-ante calculations, often which are differences compared to the Anchor Blue analysis
- Summary of the site's EM&V plan and onsite visit

- Ex-post calculation methodology and assumptions
- Reasons for differences between ex-ante and ex-post savings, as applicable

Site Level Findings

For each site, Anchor Blue calculated a realization rate and identified the differences between the ex-ante and ex-post calculations. In this section, Anchor Blue consolidated the findings and differences between the calculations, which are presented in Table 6 on the next full page, with the full site level report provided in APPENDIX A – Site Level Analysis Reports. The findings and differences were distilled to seven general differences and Table 6 also provides detail on each site's differences. The seven differences are outlined below:

1. **Improved Data** – the ex-post analysis utilized improved data, either newer data or more data than the ex-ante analysis. This could be more trending data of the efficient equipment provided, longer periods of data, or simply newer data that is more relevant.
2. **Calculation Methodology** – in several cases, the ex-post analysis used different calculation methodologies. In some cases, this coincides with improved data, which allowed Anchor Blue to analyze the data differently than in the ex-ante analysis. In other cases, Anchor Blue found that there were errors in the ex-ante methodology. Additionally, Anchor Blue considered the 2019 CA Title 24 code during the ex-post analysis. These are outlined in the table below and each site report has specific details on the differences in methodology.
3. **Calculation Assumptions** – for many lighting projects and some non-lighting projects, Anchor Blue used different assumptions in the ex-post analysis compared to the ex-ante analysis. In the case of lighting projects, this includes differences in hours of use, space types, baseline wattages and lighting controls assumptions. For non-lighting projects, this often was the inclusion of calculation assumptions that were excluded in the ex-ante assumptions, such as motor load factors and efficiencies. Additionally, Anchor Blue considered the 2019 CA Title 24, which did not necessarily affect the first-year savings, but may affect lifetime savings.
4. **Equipment Count Discrepancies** – This difference is related to lighting projects and differences in lighting fixture counts found onsite compared to the ex-ante data.
5. **Logger Data** – Anchor Blue placed loggers on over half the sites and this data were generally at least somewhat different than the ex-ante data used. For lighting projects, this was changes in hours of use assumptions and for non-lighting projects, this was generally differences in logged power consumption of equipment compared to the estimated ex-ante data.
6. **Incorrect/Out of Date Deemed Savings –** There were three projects that used prescriptive savings, all of which were at issue. Two of the sites were completely out of date prescriptive savings with an unknown source and the other project used savings for a medium temperature refrigerated case rather than a low temperature case, which the units were and saved significantly more energy than medium temperature cases. In general, all utilities should update their prescriptive assumptions to match the new CA eTRM values, which Anchor Blue recognizes some utilities have done already or are planning to do.
7. **Unknown –** one project did not have proper documentation provided and therefore the differences between the ex-ante and ex-post savings could not be identified.

Table 6. Site Level Electric Energy Realization Rates and Reasons for Differences

Site	Utility	Category	Ex-Ante Savings (kWh)	Ex-post Savings (kWh)	kWh Realization rate	Reason for Difference - Categories	Reason for Difference Detail
Site 1	Turlock	Pumps and Motors	1,528,489	1,527,935	100%	Improved data; Calculation Methodology; Logger data	Logger data and data collected onsite provided larger datasets for ex-post analysis and used a different calculation method
Site 2	Turlock	Exterior Lighting	1,362,221	1,341,375	98%	Calculation Assumptions	Differences in assumed baseline wattages of lighting equipment
Site 3	Turlock	Interior Lighting	191,102	136,087	71%	Equipment Count Discrepancies; Calculation Assumptions; Logger data	Onsite count differences, differences in baseline wattage assumptions, T12 baselines adjusted, lower HOU, and inclusion of interactive effects/CDF
Site 4	Turlock	Refrigeration	11,480	127,920	1114%	Incorrect/Out of Date Deemed Savings	Medium temp case savings used instead of actual low temp case savings
Site 5	Turlock	Interior Lighting	9,150	3,824	42%	Logger data; Calculation Assumptions	T12 baselines adjusted, lower HOU, and inclusion of interactive effects/CDF
Site 6	Turlock	Interior Lighting	7,860	4,326	55%	Logger data; Calculation Assumptions	Logged HOU different than baseline, Interactive effects, differences in baseline wattages
Site 7	Modesto	Compressed Air	1,783,644	1,915,515	107%	Calculation Methodology	Differences in calculations and normalization to annual savings
Site 8	Modesto	Exterior Lighting	1,002,680	858,179	86%	Calculation Assumptions	Double counted lighting control savings
Site 9	Modesto	Pumps and Motors	738,660	1,252,371	170%	Calculation Methodology	Error in ex-ante calculations; VFD savings not accounted for
Site 10	Modesto	Compressed Air	692,259	779,414	113%	Calculation Assumptions	Improved data collected for ex-post analysis
Site 11	Modesto	Custom	530,895	375,497	71%	Calculation Methodology; Improved data	Improved data collected for ex-post; different calculation method
Site 12	Modesto	Compressed Air	318,780	328,908	103%	Calculation Assumptions	Differences in calculation assumptions and HOU
Site 13	Modesto	Interior Lighting	271,346	212,942	78%	Calculation Assumptions	Changes to HOU and Space Types
Site 14	Modesto	Interior Lighting	216,254	196,400	91%	Calculation Assumptions	Changes to HOU and Space Types
Site 15	Modesto	Exterior Lighting	203,399	191,110	94%	Calculation Assumptions; Equipment Count Discrepancies	Onsite count differences, changes to baseline wattages
Site 16	Modesto	Interior Lighting	154,092	220,507	143%	Calculation Assumptions	Changes to HOU
Site 17	Modesto	Compressed Air	134,912	139,284	103%	Improved data	More and better data provided onsite and post onsite
Site 18	Modesto	Interior Lighting	85,950	82,610	96%	Calculation Assumptions; Calculation Methodology	Changes to HOU and Space Types; errors in analysis spreadsheet
Site 19	Merced	Interior Lighting	73,714	71,774	97%	Unknown	Unknown, no ex-ante analysis file provided
Site 20	Merced	Refrigeration	40,000	1,176	3%	Incorrect/Out of Date Deemed Savings	Out of date deemed savings value used in ex-anted calcs
Site 21	Merced	HVAC	21,845	5,808	27%	Incorrect/Out of Date Deemed Savings	Out of date deemed savings value used in ex-anted calcs

PROGRAM LEVEL ANALYSIS AND RESULTS

Adhering to the CEC's guidelines, Anchor Blue delivers savings results in gross savings, net savings, and lifecycle savings. Three steps are required to estimate all these results:

1. Calculate program level realization rates
2. Research and update Net-to-Gross (NTG) ratios
3. Perform lifecycle savings calculations for all sites using a dual baseline methodology as necessary for early retirement projects

This section outlines the analysis steps taken in these three steps and presents the program level results.

Program Level Realization Rates

While developing the stratified sample design, Anchor Blue calculated the share of sampled ex-ante savings to total ex-ante savings within each stratum, which is the stratum weight. This is used as a multiplier to develop a total stratum weighted gross ex-ante and ex-post savings by applying that stratum weight to each sampled sites ex-ante and ex-post savings to reach an extrapolated program level ex-ante and ex-post savings. These extrapolated program level savings are used to calculate a stratum weighted program level realization rate that can be applied to all program savings.

Due to rounding and some minor changes to the sample data after the sample draw was complete, the extrapolated ex-ante savings numbers do not exactly match the actual ex-ante savings, but provides a means to calculate the program level, stratum weighted realization rate that is applied to the actual program savings in subsequent sections of this report. Table 7 summarizes the realization rates by project and the overall program realization rate weighted by stratum. The program level energy realization rate derived is 108%.

Table 7. MTM Program-Level Electric Gross Energy Ex-Post Savings and Realization Rates

Site	Utility	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	Turlock	1,528,489	100%	1,527,935	1.3	2,002,320	2,001,595	NA
Site 2	Turlock	1,362,221	98%	1,341,375	1.3	1,784,510	1,757,201	NA
Site 3	Turlock	191,102	71%	136,087	1.7	324,873	231,347	NA
Site 4	Turlock	11,480	1114%	127,920	16.8	192,653	2,146,710	NA
Site 5	Turlock	9,150	42%	3,824	16.8	153,558	64,173	NA
Site 6	Turlock	7,860	55%	4,326	16.8	131,904	72,597	NA
Site 7	Modesto	1,783,644	107%	1,915,515	1.3	2,336,574	2,509,325	NA
Site 8	Modesto	1,002,680	86%	858,179	1.3	1,313,511	1,124,214	NA
Site 9	Modesto	738,660	170%	1,252,371	1.7	1,255,722	2,129,031	NA
Site 10	Modesto	692,259	113%	779,414	1.7	1,176,840	1,325,004	NA
Site 11	Modesto	530,895	71%	375,497	1.7	902,522	638,345	NA
Site 12	Modesto	318,780	103%	328,908	1.7	541,926	559,144	NA
Site 13	Modesto	271,346	78%	212,942	1.7	461,288	362,001	NA
Site 14	Modesto	216,254	91%	196,400	1.7	367,632	333,880	NA
Site 15	Modesto	203,399	94%	191,110	1.7	345,778	324,887	NA

Site 16	Modesto	154,092	143%	220,507	1.7	261,956	374,862	NA
Site 17	Modesto	134,912	103%	139,284	1.7	229,350	236,783	NA
Site 18	Modesto	85,950	96%	82,610	16.8	1,442,384	1,386,333	NA
Site 19	Merced	73,714	97%	71,774	16.8	1,237,043	1,204,492	NA
Site 20	Merced	40,000	3%	1,176	16.8	671,266	19,735	NA
Site 21	Merced	21,845	27%	5,808	16.8	366,595	97,468	NA
TOTAL		9,378,732		9,772,962		17,500,207	18,899,128	108.0%

Source: Anchor Blue Analysis

Demand savings are calculated using the same stratified weighting method and results are shown in Table 8 below. Ex-post demand savings are estimated using the overall realization rate of 141.3%, mostly driven by the exclusion of ex-ante demand savings for Site 1, which could have had a large peak kW amount claimed.

Table 8. MTM Program-Level Electric Gross Peak Demand Savings and Realization Rate

Site	Utility	Ex-ante Savings (peak kW)	Project Realization Rate	Ex-post Savings (peak kW)	Stratum Weight	Extrapolated Ex-Ante Savings (peak kW)	Extrapolated Ex-Post Savings (peak kW)	Stratum Weighted Realization Rate
Site 1	Turlock	0.0	NA	149.2	1.3	0.0	195.5	NA
Site 2	Turlock	0.0	NA	0.0	1.3	0.0	0.0	NA
Site 3	Turlock	37.2	71%	26.4	1.7	63.2	44.9	NA
Site 4	Turlock	5.3	314%	16.7	16.8	89.4	280.8	NA
Site 5	Turlock	3.4	52%	1.8	16.8	57.8	30.2	NA
Site 6	Turlock	0.0	NA	0.0	16.8	0.0	0.0	NA
Site 7	Modesto	195.3	117%	228.0	1.3	255.9	298.7	NA
Site 8	Modesto	0.0	NA	0.0	1.3	0.0	0.0	NA
Site 9	Modesto	80.1	129%	103.2	1.7	136.2	175.4	NA
Site 10	Modesto	132.0	59%	77.4	1.7	224.4	131.6	NA
Site 11	Modesto	60.8	75%	45.7	1.7	103.4	77.7	NA
Site 12	Modesto	58.2	91%	52.7	1.7	98.9	89.6	NA
Site 13	Modesto	1.9	100%	1.9	1.7	3.2	3.2	NA
Site 14	Modesto	1.6	100%	1.6	1.7	2.8	2.8	NA
Site 15	Modesto	0.0	NA	0.0	1.7	0.0	0.0	NA
Site 16	Modesto	36.5	100%	36.5	1.7	62.1	62.1	NA
Site 17	Modesto	12.9	113%	14.6	1.7	21.9	24.8	NA
Site 18	Modesto	0.8	98%	0.8	16.8	12.9	12.7	NA
Site 19	Merced	0.0	NA	5.3	16.8	0.0	89.1	NA
Site 20	Merced	0.0	NA	0.1	16.8	0.0	2.3	NA
Site 21	Merced	0.0	NA	4.7	16.8	0.0	78.2	NA
TOTAL		626		767		1,132	1,599	141.3%

Source: Anchor Blue Analysis

Net-to-Gross Values

Net-to-gross (NTG) values are used as an estimate to account for spillover and free rider effects based on measure type. Anchor Blue updated NTG ratios at the end use level for this evaluation based on the most recent CA eTRM[6] publication. These values are derived from DEER 2019 and DEER 2020, and if both DEER versions are listed in the CA eTRM, Anchor Blue selected the most recent DEER value. In most cases, a specific value was not identified for the end use and Anchor Blue utilized the default 0.6 NTG value identified in the eTRM, which is to be applied to 'measures not covered by other NTG values.' The exceptions to this are the HVAC, which also has 0.6 NTG and lighting, which has a 0.91 NTG values identified.

The NTG ratios are applied to the gross energy and demand savings to yield net savings results in subsequent program summary tables. Table 9 below outlines the NTG ratios applied by end use for net program savings results in subsequent tables. The programs are heavily weighted by lighting savings, bringing the weighted average program total NTG to 0.85, near the 0.91 lighting NTG ratio.

Table 9. 2021 CA eTRM NTG Ratios by End Use Category

End-Use Category	Net-to-Gross Ratio	NTG ID from CA eTRM
Non-Res Cooking	0.6	Com-Default>2yrs
Non-Res HVAC	0.6	NonRes-sAll-mHVAC-Pkg
Non-Res Lighting	0.91	NonRes-In-Ltg-LEDFixt
Non-Res Motors	0.6	Com-Default>2yrs
Non-Res Pool Pumps	0.6	Com-Default>2yrs
Non-Res Refrigeration	0.6	Com-Default>2yrs
Non-Res Shell	0.6	Com-Default>2yrs
Non-Res Process	0.6	Com-Default>2yrs
Non-Res Comprehensive	0.6	Com-Default>2yrs
Non-Res Behavior	0.6	Com-Default>2yrs
Other	0.6	Com-Default>2yrs
Weighted Program Total NTG	**0.71**	

Source: CA eTRM & Anchor Blue Analysis

Anchor Blue suspects that the lighting net-to-gross ratio is high given the 2019 CA Title 24 requirement of LEDs and the overall saturation of LEDS both in the building stock and available on the market today. Separate evaluation efforts can be done to provide better insights into local NTG ratios, and Anchor Blue recommends that MTM engage in a free-ridership evaluation or a full process evaluation in 2023.

Ex-Post Lifecycle Savings Approach

Lifecycle savings are the expected cumulative program savings over the lifetime of a project's expected useful life. This section outlines Anchor Blue's approach to calculating lifetime savings for MTM's PY2021 C&I portfolio

Changes to Lifecycle Savings Methodology and Dual Baseline Methodology Description

This report presents an updated method to estimating lifetime savings compared to previous evaluations conducted by Anchor Blue. The updated method aligns with the CMUA TRM and other California savings methodologies and guidance. In previous evaluations, Anchor Blue estimated the program lifecycle ex-post

---

[6] https://www.caetrm.com/cpuc/table/nettogross/ - accessed 10/1/2021

savings by calculating weighted average measure lives (WAML) from the CEC 2020 SB1037 Report and multiplying these WAMLs by first-year savings values.

For this evaluation, Anchor Blue has implemented the dual baseline methodology for lifecycle savings, as described in the CMUA TRM[7], due to significant changes in the CA 2019 Title 24 code that went into effect in 2020. The code has very stringent LPD requirements, which effectively require LEDs in all commercial and industrial buildings. MTM utilities can still claim lighting savings for the short term but should align with the CMUA TRM baseline methodology for custom lighting, which requires a dual baseline for all custom lighting measures since custom lighting projects are considered 'early retirement'. A dual baseline uses two energy use baselines to determine lifecycle energy savings where equipment with remaining useful life (RUL) is replaced. In general, the first baseline is based on preexisting conditions and the second baseline is current energy code or industry standard practice. As such, dual baselines do not affect the first-year savings of an 'early retirement' replacement, only lifecycle savings and cost-effectiveness calculations.

A dual baseline approach to lifecycle savings requires two additional data points beyond the WAML used in previous evaluations. The first is the remaining useful life of the existing equipment and the second is a savings degradation factor for the second lifetime. Both inputs are often difficult to determine and are uncertain, which is why Anchor Blue has not included this method in previous evaluations. The standard practice for RUL calculations is that the RUL is 1/3 of the measure life. Savings degradation factors are often measure or project specific and are difficult to apply broadly to end-use categories. However, with the 2019 CA Title 24 code requirement of LEDs, Anchor Blue has strong data evidence to support a savings degradation factor of 100% for all lighting measures in the second baseline, meaning that the second life has no savings at all as the customer would have had to replace these with LEDS due to code in future years anyways upon burnout.

The calculation for calculating lifetime savings using the dual baseline method is as follows:

$$Lifecycle\ Savings \\ = (First\ Year\ Savings\ \times RUL) + (First\ Year\ Savings \times (1 \\ - Savings\ Degredation\ Factor)\ \times (WAML - RUL))$$

Calculating savings degradation factors for other end-uses has not been part of the scope for the MTM evaluations, and Anchor Blue has not attempted to calculate them for other end-uses that are not as obvious as lighting. However, other measures such as compressed air replacements are subject to the 2019 code as well and Anchor Blue recommends that studying savings degradation factors be a part of the next evaluation for all end-use categories. Anchor Blue has implemented this method in this year's evaluation report for lighting savings only, as there is clear cut evidence in the current 2019 Title 24 code that effectively requires LEDs. It is unclear if current reporting systems allow for reporting dual baselines for lifecycle savings, but Anchor Blue recommends that all utilities implement the dual baseline methodology for lighting projects and Anchor Blue can help to navigate that methodology and reporting as necessary.

Weighted Average Measure Lives (WAML), Remaining Useful Lives (RUL), and Savings Degradation Factors

Anchor Blue used the 2021 SB1037 report to develop WAMLs by end-use category for each utility. RULs were assumed to be 1/3 of this WAML for each end-use category, which is consistent with industry standard

---

[7] CMUA TRM 2017. https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf, Pg 3-1 and section 16.1

practice. As mentioned, savings degradation factors were only applied to the lighting end-use, since this was easily identified as a 100% degradation in the second life due to code requirements. All other end-uses have a degradation factor of 0%, meaning their second life savings are not impacted. Table 10 below outlines the WAMLs, RULs and Savings Degradation Factors by end-use category that applied to each utility's first year savings for lifecycle savings in subsequent results tables.

Table 10. WAMLs, RULs and Savings Degradation Factors by Utility and End-Use Category

End-Use Category	Modesto WAML	Modesto RUL	Turlock WAML	Turlock RUL	Merced WAML	Merced RUL	Savings Degradation Factor (All Utilities)
Non-Res Cooking	14.0	4.7	15.0	5.0	10.0	3.3	0%
Non-Res HVAC	14.0	4.7	16.0	5.3	10.0	3.3	0%
Non-Res Lighting	13.0	4.3	15.0	5.0	10.0	3.3	100%
Non-Res Motors	14.0	4.7	15.0	5.0	10.0	3.3	0%
Non-Res Pool Pumps	14.0	4.7	15.0	5.0	10.0	3.3	0%
Non-Res Refrigeration	10.0	3.3	15.0	5.0	10.0	3.3	0%
Non-Res Shell	17.0	5.7	18.0	6.0	10.0	3.3	0%
Non-Res Process	13.0	4.3	15.0	5.0	10.0	3.3	0%
Non-Res Comprehensive	14.0	4.7	15.0	5.0	10.0	3.3	0%
Non-Res Behavior	-	-	-	-	-	-	0%
Other	14.0	4.7	15.0	5.0	10.0	3.3	0%
TOTAL (weighted)	13.2	4.4	15.0	5.0	10.0	3.3	NA

Source: 2021 SB1037 Report, CA Title 24 2019, Anchor Blue Analysis

CA Title 24 2019 Implications on MTM Programs

The stringent 2019 CA Title 24 Code that went into effect in 2020 has implications for the future of MTM programs. LED lighting is required by code and under the dual baseline methodology, the remaining life of existing non-LED equipment will have mostly turned through the market by 2025 (assuming a 5-year remaining useful life on lighting, which is equivalent to 1/3 of average lighting WAML). **Utilities should consider ending their C&I lighting offerings by no later than 2025, potentially even earlier.** Anchor Blue recommends this not only due to code, but also due to the high likelihood of free ridership for lighting and the fact that IOUs can no longer claim lighting savings from non-LED baselines. One alternative option would be to transition the lighting programs to a similar program as the IOUs, where ENERGY STAR LED lighting is rebated using a standard LED as the baseline. However, updates to the baseline assumption will change the cost-effectiveness of lighting measures, which may impact whether to include them in programs or incentive levels.

In addition to lighting, compressed air is now covered by CA Title 24 and utilities should update their program eligibility, unless it can be proven that the compressed air equipment is an early retirement scenario (by documenting the manufacture date of the old equipment to prove that the equipment age is well before the average measure life of that equipment. For compressed air retrofits and replacements, VFDs are required if more than 50% of the total system HP is affected. The two exceptions to this are systems that include a centrifugal compressor and if the system is in a healthcare building.

Anchor Blue also recommends savings degradation factors be researched next year for all end-uses. These could be derived from code or from other industry standard practice documentation. This could be included as an additional research task in the next impact evaluation for C&I program savings in PY2022.

Program Level Ex-Post Energy and Demand Savings

Anchor Blue applied the stratified weighted realization rates to the gross program level ex-ante savings to calculate the overall program level gross energy and demand ex-post savings, as outlined in Table 11. These results apply to all the savings in in each utilities' portfolio in PY 2021.

Table 11. Summary of Program-Level Electric Gross Energy and Demand Ex-Post Savings

Gross Program Ex-Ante Savings (kWh)	Stratum Weighted Energy Realization Rate	Gross Program Ex-Post Savings (kWh)	Gross Program Ex-Ante Demand (kW)	Stratum Weighted Demand Realization Rate	Gross Program Ex-Post Peak Demand (kW)
17,516,347	108%	18,916,558	1,143	141%	1,614

Source: MTM Program Data and Anchor Blue Analysis

Anchor Blue applied the end-use level NTG ratios researched from the CA eTRM to the gross ex-post savings to estimate net ex-post savings, as shown in Table 12 below.

Table 12. Summary of Program-Level Gross and Net Energy and Demand Ex-Post Savings

Gross Program Ex-Post Savings (kWh)	Gross Program Ex-Post Demand (kW)	Weighted Average Net-to-Gross Ratio	Net Program Ex-Post Savings (kWh)	Net Program Ex-Post Peak Demand (kW)
18,916,558	1,614	0.79	15,004,782	1,223

Source: MTM Program Data and Anchor Blue Analysis

To estimate lifecycle savings, Anchor Blue applied dual baseline lifecycle savings method, described earlier in this report. This is done at the end-use category and then aggregated to the programmatic gross and net ex-post lifecycle kWh savings results shown in Table 13 below. The 2nd life savings degradation factor is not applicable at the program level since this is end-use specific. The end-use category specific results are shown in the next section and the last two columns of the table below are a summation of the lifecycle savings calculated in t

Table 13. Summary of Program-Level Gross and Net Ex-Post Lifecycle Electric Savings

Gross Program Ex-Post Savings (kWh)	Net Program Ex-Post Savings (kWh)	Weighted Average Measure Life (WAML)	Weighted Remaining Useful Life (RUL)	2nd Life Saving Degradation Factor	Gross Program Lifecycle Ex-Post Savings (kWh)	Net Program Lifecycle Ex-Post Savings (kWh)
18,916,558	15,004,782	13.3	4.4	NA at Program Level	153,105,614	108,479,532

Source: Anchor Blue Analysis

Ex-Post Energy and Demand Results by Measure Category

Table 14 report energy savings by end-use reporting category for PY 2021. Results of demand impacts are summarized in Table 15 and lifecycle kWh savings are summarized in Table 16

Table 14. MTM PY 2021 Gross and Net Ex-Post Portfolio-Level Electric Energy Savings

End-Use Category	Gross Annual Ex-Ante Energy Savings (kWh)	Energy Savings Realization Rate	Gross Annual Ex-Post Energy Savings (kWh)	Net-to-Gross Ratio (CA eTRM)	Net Annual Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	108%	-	0.6	-
Non-Res HVAC	98,951	108%	106,861	0.6	64,117
Non-Res Lighting	10,901,183	108%	11,772,595	0.91	10,713,061
Non-Res Motors	1,702,162	108%	1,838,229	0.6	1,102,937
Non-Res Pool Pumps	-	108%	-	0.6	-
Non-Res Refrigeration	594,965	108%	642,525	0.6	385,515
Non-Res Shell	6,471	108%	6,989	0.6	4,193
Non-Res Process	-	108%	-	0.6	-
Non-Res Comprehensive	13,465	108%	14,541	0.6	8,725
Non-Res Behavior	-	108%	-	0.6	-
Other	4,199,150	108%	4,534,819	0.6	2,720,891
TOTAL	**17,516,347**	**108%**	**18,916,558**	**0.79**	**14,999,439**

Source: Utility program data and Anchor Blue analysis

Table 15. MTM PY 2021 Gross and Net Ex-Post Portfolio-Level Peak Demand Savings

End-Use Category	Gross Annual Ex-Ante Demand Savings (kW)	Demand Savings Realization Rate	Gross Annual Ex-Post Demand Savings (kW)	Net-to-Gross Ratio (CA eTRM)	Net Annual Ex-Post Demand Savings (kW)
Non-Res Cooking	-	141%	-	0.6	-
Non-Res HVAC	13	141%	18	0.65	12
Non-Res Lighting	578	141%	816	0.91	743
Non-Res Motors	3	141%	4	0.6	2
Non-Res Pool Pumps	-	141%	-	0.6	-
Non-Res Refrigeration	6	141%	9	0.6	5
Non-Res Shell	-	141%	-	0.6	-
Non-Res Process	-	141%	-	0.6	-
Non-Res Comprehensive	4	141%	5	0.6	3
Non-Res Behavior	-	141%	-	0.6	-
Other	539	141%	762	0.6	457
TOTAL	**1,143**	**141%**	**1,614**		**1,223**

Source: Utility program data and Anchor Blue analysis

Table 16. MTM PY 2021 Gross and Net Ex-Post Lifecycle kWh Savings using Dual Baseline Methodology

End-Use Category	Gross Annual Ex-Post Energy Savings (kWh)	Net Annual Ex-Post Energy Savings (kWh)	Weighted Average Measure Life (WAML)	Weighted Remaining Useful Life (RUL)	2nd Life Savings Degradation Factor	Gross Lifecycle Ex-Post Energy Savings (kWh)	Net Lifecycle Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	-	14	4.7	0%	-	-
Non-Res HVAC	106,861	64,117	14	4.7	0%	1,197,597	718,558
Non-Res Lighting	11,772,595	10,713,061	13	4.3	100%	53,600,529	48,776,482

Non-Res Motors	1,838,229	1,102,937	14	4.7	0%	27,573,429	16,544,058
Non-Res Pool Pumps	-	-	14	4.7	0%	-	-
Non-Res Refrigeration	642,525	385,515	11	3.7	0%	6,909,665	4,145,799
Non-Res Shell	6,989	4,193	17	5.7	0%	118,805	71,283
Non-Res Process	-	-	13	4.3	0%	-	-
Non-Res Comprehensive	14,541	8,725	14	4.7	0%	218,120	130,872
Non-Res Behavior	-	-	NA	NA		-	-
Other	4,534,819	2,720,891	14	4.7	0%	63,487,467	38,092,480
TOTAL	**18,916,558**		**13**	**4.4**		**153,105,614**	**108,479,532**

Source: Utility program data and Anchor Blue analysis

PROGRAM FINDINGS AND RECOMMENDATIONS

Anchor Blue's findings and recommendations resulting from this impact evaluation are outlined below. There are four overall categories that these findings and recommendations fall into: general, lighting projects, non-lighting projects and 2019 CA Title 24 recommendations.

General Findings and Recommendations

- As is generally the case with evaluations, some of the changes in realization rates were due to unanticipated changes in equipment performance and/or operation hours that cannot be mitigated.

- In general, project documentation was detailed and sufficient to verify the equipment and savings, but a couple sites did not have proper documentation, such as analysis spreadsheets, which made it difficult to identify differences between ex-ante and ex-post savings.

  o *Recommendation 1: Ensure that all records, especially savings analysis workbooks, are kept for all projects. Other information that is useful are itemized invoices, pre and post inspection photos, and any communications related to the project, especially around scope changes.*

- Savings did not always match between the tracking data and analysis spreadsheets provided in the project documentation. It appeared that for a couple of sites, incorrect savings were actually rebated and if the savings calculated in the spreadsheets labeled 'final', realization rates would have been tighter on those sites.

  o *Recommendation 2: Prior to the approval of a rebate, perform one final check of the savings that the rebate is based on to ensure that it matches the final savings analysis.*

- The dual baseline methodology as described in the CMUA TRM should be used to estimate lifetime savings for lighting projects and as applicable to other projects that may be impacted by code or standard practice. Dual baselines do not affect the first-year savings of an 'early retirement' replacement, only lifetime savings and for cost effectiveness calculations. A dual baseline uses two energy use baselines to determine lifetime energy savings where equipment with remaining useful life (RUL) is replaced. In general, the first baseline is based on preexisting conditions and the second baseline is current energy code or industry standard practice. Anchor Blue has implemented this method in this year's evaluation report for lighting savings only, as these are clear cut with the current 2019 Title 24 code that effectively requires LEDs. This is discussed in greater detail in the lifetime savings calculations section.

  o *Recommendation 3: The Irrigation Districts should adopt the dual baseline methodology for retrofit projects that are subject to code requirements in a natural replacement scenario if reporting systems allow for this. This would include lighting and compressed air projects at the minimum.*

- Anchor Blue suspects that some projects, especially lighting projects, may have been 'free riders', meaning that the site would have done the upgrade without the incentive. This is taken into account with general NTG ratios and net savings within this report, but can also be done as a part of a process evaluation, which has not been done on the C&I program for many years.

  o ***Recommendation 4:*** *Anchor Blue recommends a process evaluation be done on the C&I portfolio for MTM in the coming years. These evaluations will provide estimates of free ridership to better inform net savings, as well as provide recommendations for the overall operation of the program beyond the savings impacts of the current study. Additionally, the statewide NTG ratios used in this report may not be representative of customers in smaller jurisdictions like MTM.*

Non-Lighting Projects Findings and Recommendations

- Three sites sampled used prescriptive savings and these sites had the widest variance in realization rates, both high and low. Anchor Blue used the most recent CA eTRM values for evaluating these sites. These variances are due to out of date or using the incorrect equipment type. The source for these prescriptive savings is either unknown or using the CMUA TRM, which has been supplanted by the CA eTRM for prescriptive savings.

  o ***Recommendation 5***: All Irrigation Districts should ensure that their prescriptive savings are up to date with the latest eTRM savings values and should set up a regular update cycle every year or two years to ensure that the latest savings are being used and considering most recent CA Title 24 codes.

- Several non-lighting sites placed logging meters to establish ex-ante savings, which is one of the best methods to estimate annual savings. However, in some cases the logged ex-ante data was a very short timeframe or the logged data was not representative of the entire project, though it was applied to the entire project. This led to inconsistencies between the ex-ante and ex-post savings.

  o ***Recommendation 6:*** *If logging a sample of measures in a project that is intended to be extrapolated to all other measures, ensure that logged data is representative of the entire project and operations.*

- For non-lighting projects such as compressed air and motors, insufficient data was provided in the ex-ante analysis, which was sometimes noted in the project files.

  o ***Recommendation 7:*** *When reviewing and/or calculating ex-ante savings, request as much data as possible, especially for the baseline equipment such as the nameplate data and long-term trend data. Often, the site will have trend data on the equipment for several months or years prior to the project on record. Anchor Blue was able to obtain more of this data while onsite for some projects, which led to better estimates of baseline usage and allowed for seasonal trends in consumption to be identified and applied to the efficient case data. The longer the trend data, the better and below is a list of ideal data to request:*

  o ***Optimal Data to request for complex custom projects:***

    ▪ For any piece of equipment, request one month of trend data that shows power or current at hourly intervals. At least one-month is ideal, especially for equipment that has variable consumption, however, if operation is consistent throughout the year, two to three weeks of trend data can suffice. For weather dependent measures that operate in both the winter and summer, the month of data should be during a time period that shows enough range of operation to extrapolate to operation during all seasons using TMY data. This does not need to be extreme highs or lows, but should

have some variability of warm and cold temperatures. For AC measures that only operate in the summer, or heating measures only in the winter, this type of variability is not necessary.

- ▪ For any equipment that is used to produce goods or is an agricultural project, request annual production data by week or month to determine seasonal variability of production over the year to estimate annual usage based on the month of trend data.
- ▪ For custom commercial or residential HVAC or HVAC controls projects, request data occupancy data for the year to determine any variability in monthly or weekly occupancy and whether changes to occupancy effect HVAC usage.
- ▪ Ask the site contact if any other variables affect the equipment usage over the year and understand that that is. The goal is to ensure that the logged data or trend data is able to be accurately extrapolated to annual consumption.

- One compressed air project in the sample added optimization controls to the compressed air system and saved significant energy, but while onsite, the controls were found to have been overridden and operating similar to baseline conditions. While Anchor Blue was able to verify that savings for this site did occur in 2021, staff turnover at the site caused them to override these controls in 2022 and effectively have no savings persistence, which leads to lower lifetime savings.

  - o ***Recommendation 8:*** *Projects that involve equipment controls, optimization and/or management are subject to situations such as this where the energy saving aspect of the project is overridden. For large projects that include these types of controls/optimization measures, Anchor Blue recommends that the utility representative follows up with the site once a year for a set number of years after installation to ensure that the controls or optimization configuration is still in place.*

Lighting Projects Findings and Recommendations

- HVAC interactive effects and peak coincident demand factors are not applied for some sites. These factors are outlined in the CMUA TRM savings algorithm and provided in the CMUA TRM by space type. Interactive effects provide additional savings to be claimed from reduced air-conditioning usage at the site due to the lower heat output of LED lighting compared to the baseline. Peak coincident factors are an estimate of the percentage of full demand load that occurs during peak hours. Both factors provide better estimations of the impact of the lighting project on the site.

  - o ***Recommendation 9:*** *Ensure all three Irrigation Districts adopt the use of interactive effects and coincident peak demand factors in their lighting rebate and savings calculators. Anchor Blue is aware that some Irrigation Districts implemented these factors starting in PY2022.*

- Lighting hours of use for interior spaces were often based on default values from the lighting spreadsheets when more accurate values could have been derived from conversations with the site contact. This is not applicable to exterior lighting projects, which should use the default 4,180 dusk to dawn hours of use from the eTRM.

  - o ***Recommendation 10:*** *For all lighting projects, attempt to derive site specific hours of use prior to assuming default values in the calculation spreadsheet. The exception to this would be for discrete space types within the sites that would typically have lower hours of use such as storage spaces and restrooms, for which Anchor Blue recommends using default, low hours of use unless it is confirmed that these are on the same building schedule.*

- Several sites used nonstandard baseline fixture wattage assumptions in the ex-ante calculations.

  - ***Recommendation 11:*** *The CMUA TRM provides a detailed list of standard baseline fixture wattages that should be used by all utilities.*

- T12 baseline wattages were used for several lighting projects. Like incandescent bulbs, T12s were phased out federally long ago and utilities can only claim savings from a T8 baseline.

  - ***Recommendation 12:*** *All utilities should update their default T12 baseline values to be a T8 equivalent wattage rather than the actual T12 baseline wattage*

- All three Irrigation Districts use different lighting rebate calculators, creating inconsistencies in assumptions, some of which are mentioned in earlier findings.

  - ***Recommendation 13:*** *Consider adopting a universal lighting calculator to be used by all three irrigation districts, resulting in more consistency across calculations and assumptions.*

2019 CA Title 24 Code Findings and Recommendations

- California Title 24 2019 covers compressed air replacement projects with some exceptions. Code is triggered and VFDs are required for any system over 25 horsepower if more than 50% of the overall system is affected. The two exceptions are for any healthcare building and for systems that include a centrifugal compressor. However, a utility may still claim savings if they can show that the project is retiring baseline equipment early, which is considered 'early retirement'. One project in the sample was exempt from code because it included a centrifugal compressor. One other project did trigger code as more than 50% of the system was replaced and there was not a centrifugal compressor in the system, but Anchor Blue was able to find evidence to support that the project was early retirement of the compressor by looking at the pre inspection photos of the baseline equipment's nameplate.

  - ***Recommendation 14a:*** *Anchor Blue recommends updating eligibility requirements for all compressed air projects to check if the project would be triggered by code. This includes:*
    - Understanding how much of the system is being replaced (if more than 50% of the total system horsepower, code required VFDs is triggered)
    - If any compressor in the system is centrifugal, the project is exempt from code
    - If the project is occurring in a healthcare site, the project is exempt from code
    - If code is triggered in the project, the utility can still claim savings if they can verify the age of the equipment is not more than 10 years, which is about half of the typical measure life of air compressors. Verification would be a photo of the baseline compressor nameplate that shows the manufacture date or an old invoice showing the date of purchase.

  - ***Recommendation 14b:*** *Alternatively, utilities could consider ending compressed air programs since code will likely be triggered for many projects*

- 2019 Title 24 Code has strict requirements for lighting that essentially requires LEDs in most all applications. Additionally, LEDs have gained significant market share and are considered standard practice in many jurisdictions, including the CA IOUs, which cannot claim savings from standard LEDs anymore. IOUs are allowed to claim ENERGY STAR LEDS compared to a standard LED baseline, but

the savings are significantly lower than non-LED Baselines. Anchor Blue also suspects that the current lighting program has a very high free-ridership rate, meaning that the customer would have done the lighting upgrade without the incentive.

- o **Recommendation 15:** *The Irrigation Districts should consider phasing out and ending the lighting programs due to likely high free ridership and code. Typical lighting remaining useful lives are around 4-5 years, meaning that 4-5 years after the code requiring LEDS, savings should all be attributed to code. The 2019 code went into effect in 2020, therefore Anchor Blue recommends that C&I lighting programs be phased out by the end of 2024 or transitioned to promoting ENERGY STAR LEDS using a code LED baseline in line with the IOUs.*

PORTFOLIO SUMMARY BY UTILITY

Evaluated Savings Summary by Utility

This section provides a view of evaluated savings by each utility. The sample draw was based upon all projects in all three utilities in PY 2021. The selected sample site savings represents 9,378,732 kWh and 626 kW which covers 54% of energy and 55% demand savings claimed for MTM's Non-Residential program savings in PY 2021. The overall energy and peak demand savings realization rates are 108.0% and 141.3% across MTM programs respectively.

Table 17 shows the breakdown of the project statistics by utility. There are a total of 141 projects from the three utilities, where Anchor Blue sampled 21 projects to achieve a sampling precision of 90% (+/- 15%).

Table 17. Claimed Gross Ex-Ante Savings, Completed Projects, and Sampled Projects by Utility in PY2021

Utility	Gross Ex-ante kWh	kWh Share	Number of Projects	Projects Share	Sampled Projects	Sampled Share
Modesto	12,821,114	73.2%	92	65.2%	12	57.1%
Turlock	4,471,536	25.5%	44	31.2%	6	28.6%
Merced	223,697	1.3%	5	3.5%	3	14.3%
Total	**17,516,347**	**100%**	**141**	**100%**	**21**	**100%**

Source: MTM Program Data and Anchor Blue Analysis

Table 18 summarizes the share of evaluated claimed savings as percentage of total claimed savings by each utility. This table shows the total savings with and without the Modesto mega project.

Table 18. Share of Evaluated Claimed Savings as Percentage of Total Claimed Savings by Utility in PY2021

Utility	Total Gross Annual Ex-Ante Energy Savings (kWh)	Evaluated Gross Annual Ex-Ante Energy Savings (kWh)	Percent of the Total Energy Savings Evaluated
Modesto	12,821,114	6,132,871	48%
Turlock	4,471,536	3,110,302	70%
Merced	223,697	135,559	61%
Total	**17,516,347**	**9,378,732**	**54%**

Source: MTM Project Tracking and Anchor Blue Analysis

Portfolio Level Gross and Net Savings by Utility

The tables below summarize the gross and net savings by end-use category specific to each utility. The Modesto data includes the mega project in its own line item with its own realization rate.

The realization rate is applied to each of the categories included in the EM&V combined sample. The net-to-gross ratios are taken from CA eTRM.

Modesto

Table 19. Modesto PY2021 Gross and Net Energy Savings by End-use Category

End-Use 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	-	108%	-	0.6	-
Non-Res HVAC	15,992	108%	17,270	0.6	10,362
Non-Res Lighting	8,134,249	108%	8,784,480	0.91	7,993,876
Non-Res Motors	-	108%	-	0.6	-
Non-Res Pool Pumps	-	108%	-	0.6	-
Non-Res Refrigeration	465,252	108%	502,443	0.6	301,466
Non-Res Shell	6,471	108%	6,989	0.6	4,193
Non-Res Process	-	108%	-	0.6	-
Non-Res Comprehensive	-	108%	-	0.6	-
Non-Res Behavior	-	108%	-	0.6	-
Other	4,199,150	108%	4,534,819	0.6	2,720,891
TOTAL	**12,821,114**	**108%**	**13,846,000**	**0.80**	**11,030,789**

Source: MTM Project Tracking and Anchor Blue Analysis

Table 20. Modesto PY2021 Gross and Net Peak Demand Savings by End-use Category

End-Use 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	-	141%	-	0.6	-
Non-Res HVAC	13.0	141%	18.4	0.65	12
Non-Res Lighting	377.4	141%	533.2	0.91	485
Non-Res Motors	-	141%	-	0.6	-
Non-Res Pool Pumps	-	141%	-	0.6	-
Non-Res Refrigeration	-	141%	-	0.6	-
Non-Res Shell	-	141%	-	0.6	-
Non-Res Process	-	141%	-	0.6	-
Non-Res Comprehensive	-	141%	-	0.6	-
Non-Res Behavior	-	141%	-	0.6	-
Other	539.3	141%	761.9	0.6	457
TOTAL	**930**	**141%**	**1,313**		**954**

Source: MTM Project Tracking and Anchor Blue Analysis

Table 21. Modesto PY2021 Gross and Net Lifecyle Energy Savings by End-use Category

End-Use Category	Gross Annual Ex-Post Energy Savings (kWh)	Net Annual Ex-Post Energy Savings (kWh)	Weighted Average Measure Life (WAML)	Weighted Remaining Useful Life (RUL)	2nd Life Savings Degradation Factor	Gross Lifecycle Ex-Post Energy Savings (kWh)	Net Lifecycle Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	-	14.0	4.7	0%	-	-
Non-Res HVAC	17,270	10,362	14.0	4.7	0%	241,779	145,067
Non-Res Lighting	8,784,480	7,993,876	13.0	4.3	100%	38,066,078	34,640,131
Non-Res Motors	-	-	14.0	4.7	0%	-	-
Non-Res Pool Pump	-	-	14.0	4.7	0%	-	-
Non-Res Refrig.	502,443	301,466	10.0	3.3	0%	5,024,432	3,014,659
Non-Res Shell	6,989	4,193	17.0	5.7	0%	118,805	71,283
Non-Res Process	-	-	13.0	4.3	0%	-	-
Non-Res Comphsve.	-	-	14.0	4.7	0%	-	-
Non-Res Behavior	-	-	-	NA		NA	NA
Other	4,534,819	2,720,891	14.0	4.7	0%	63,487,467	38,092,480
TOTAL	**13,846,000**	**11,030,789**	**13.2**	**4.4**		**106,938,562**	**75,963,621**

Source: MTM Project Tracking and Anchor Blue Analysis

Turlock

Table 22. Turlock PY2021 Gross and Net Energy Savings by End-use Category

End-Use 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	-	108%	-	0.6	-
Non-Res HVAC	9,246	108%	9,985	0.6	5,991
Non-Res Lighting	2,656,951	108%	2,869,341	0.91	2,611,100
Non-Res Motors	1,702,162	108%	1,838,229	0.6	1,102,937
Non-Res Pool Pumps	-	108%	-	0.6	-
Non-Res Refrigeration	89,713	108%	96,884	0.6	58,130
Non-Res Shell	-	108%	-	0.6	-
Non-Res Process	-	108%	-	0.6	-
Non-Res Comprehensive	13,465	108%	14,541	0.6	8,725
Non-Res Behavior	-	108%	-	0.6	-
Other	-	108%	-	0.6	-
TOTAL	**4,471,536**	**108%**	**4,828,979**	**0.78**	**3,786,883**

Source: MTM Project Tracking and Anchor Blue Analysis

Table 23. Turlock PY2021 Gross and Net Peak Demand Savings by End-use Category

End-Use 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	-	141%	-	0.6	-
Non-Res HVAC	-	141%	-	0.65	-
Non-Res Lighting	200	141%	283	0.91	258
Non-Res Motors	3	141%	4	0.6	2
Non-Res Pool Pumps	-	141%	-	0.6	-
Non-Res Refrigeration	6	141%	9	0.6	5
Non-Res Shell	-	141%	-	0.6	-
Non-Res Process	-	141%	-	0.6	-
Non-Res Comprehensive	4	141%	5	0.6	3
Non-Res Behavior	-	141%	-	0.6	-
Other	-	141%	-	0.6	-
TOTAL	**213**	**141%**	**301**		**268**

Source: MTM Project Tracking and Anchor Blue Analysis

Table 24. Turlock PY2021 Gross and Net Lifecyle Energy Savings by End-use Category

End-Use Category	Gross Annual Ex-Post Energy Savings (kWh)	Net Annual Ex-Post Energy Savings (kWh)	Weighted Average Measure Life (WAML)	Weighted Remaining Useful Life (RUL)	2nd Life Savings Degradation Factor	Gross Lifecycle Ex-Post Energy Savings (kWh)	Net Lifecycle Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	-	15.0	5.0	0%	-	-
Non-Res HVAC	9,985	5,991	16.0	5.3	0%	159,753	95,852
Non-Res Lighting	2,869,341	2,611,100	15.0	5.0	100%	14,346,703	13,055,500
Non-Res Motors	1,838,229	1,102,937	15.0	5.0	0%	27,573,429	16,544,058
Non-Res Pool Pump	-	-	15.0	5.0	0%	-	-
Non-Res Refrig.	96,884	58,130	15.0	5.0	0%	1,453,258	871,955
Non-Res Shell	-	-	18.0	6.0	0%	-	-
Non-Res Process	-	-	15.0	5.0	0%	-	-
Non-Res Comphsve.	14,541	8,725	15.0	5.0	0%	218,120	130,872
Non-Res Behavior	-	-	-	NA		NA	NA
Other	-	-	15.0	5.0	0%	-	-
TOTAL	**4,828,979**	**3,786,883**	**15.0**	**5.0**		**43,751,265**	**30,698,237**

Source: MTM Project Tracking and Anchor Blue Analysis

Merced

Table 25. Merced PY2021 Gross and Net Energy Savings by End-use Category

End-Use 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	-	108%	-	0.6	-
Non-Res HVAC	73,714	108%	79,607	0.6	47,764
Non-Res Lighting	109,983	108%	118,775	0.91	108,085
Non-Res Motors	-	108%	-	0.6	-

Non-Res Pool Pumps	-	108%	-	0.6	-
Non-Res Refrigeration	40,000	108%	43,197	0.6	25,918
Non-Res Shell	-	108%	-	0.6	-
Non-Res Process	-	108%	-	0.6	-
Non-Res Comprehensive	-	108%	-	0.6	-
Non-Res Behavior	-	108%	-	0.6	-
Other	-	108%	-	0.6	-
TOTAL	**223,697**	**108%**	**241,579**	**0.75**	**181,767**

Source: MTM Project Tracking and Anchor Blue Analysis

Merced did not claim any ex-ante kW savings in 2021

Table 26. Merced PY2021 Gross and Net Lifecyle Energy Savings by End-use Category

End-Use Category	Gross Annual Ex-Post Energy Savings (kWh)	Net Annual Ex-Post Energy Savings (kWh)	Weighted Average Measure Life (WAML)	Weighted Remaining Useful Life (RUL)	2nd Life Savings Degrada-tion Factor	Gross Lifecycle Ex-Post Energy Savings (kWh)	Net Lifecycle Ex-Post Energy Savings (kWh)
Non-Res Cooking	-	-	10.0	3.3	0%	-	-
Non-Res HVAC	79,607	47,764	10.0	3.3	0%	796,065	477,639
Non-Res Lighting	118,775	108,085	10.0	3.3	100%	1,187,748	1,080,850
Non-Res Motors	-	-	10.0	3.3	0%	-	-
Non-Res Pool Pump	-	-	10.0	3.3	0%	-	-
Non-Res Refrig.	43,197	25,918	10.0	3.3	0%	431,975	259,185
Non-Res Shell	-	-	10.0	3.3	0%	-	-
Non-Res Process	-	-	10.0	3.3	0%	-	-
Non-Res Comphsve.	-	-	10.0	3.3	0%	-	-
Non-Res Behavior	-	-	10.0	NA		-	-
Other	-	-	10.0	3.3	0%	-	-
TOTAL	**241,579**	**181,767**	**10.0**	**3.3**		**2,415,788**	**1,817,674**

Source: MTM Project Tracking and Anchor Blue Analysis

APPENDIX A – SITE LEVEL ANALYSIS REPORTS

Site 1 – Turlock

A greenhouse agricultural operation installed variable speed fans and pumps to supply its facility. The fans and pumps are new equipment and therefore the savings are compared to a standard practice baseline with staged fans and throttled pumps. Anchor Blue found savings close to the ex-ante value but had many differences in calculation methodology that coincidentally resulted in nearly a 100% realization rate. It is unclear why the available demand savings were not claimed for this project.

Table 27. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	1,528,489	1,527,935	99.96%
Peak Demand Savings (kW)	0	149.22	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The installed equipment was new, so it is compared to a standard practice baseline to determine savings. The standard practice for fans is staging in order to provide the same total average airflow as for a variable speed system. Standard practice for pumping is throttling pumps to vary the flow to satisfy facility requirements.

Description of Efficient Equipment and Operation

Variable speed drives were installed on 296 individual two horsepower fans, which provide airflow to the greenhouse in four ranges of 74 fans each. The fans are connected through supply cabinets, each containing between 7 and 13 fans. Each range is controlled such than all 74 fans operate at the same variable speed. Nine pumps supply the greenhouse: one reverse-osmosis pump, four nursery pumps, and four finishing pumps, all of which are on variable speed drives.

Comments on Ex-Ante Calculations

The ex-ante calculations are based on around ten months of logging one cabinet of 13 fans and a single pump, from mid-February through early December 2020. The calculations estimated that the remaining two months of operation would be the same as the logged data over the rest of that year. The ex-ante calculations also assume that these logged 13 fans and one pump were representative of the entire facility. The baseline power estimate used for the fans and pumps was a direct conversion from horsepower to kW that did not include any motor efficiencies or load factors.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue planned to log operation of the fans and pumps to determine their energy use. If any data trends are available from the site, these will be used to normalize the data to a typical year, since summer operation may not be representative of the entire year.

Summary of Site Visit

Anchor Blue visited the site and logged one cabinet of fans in each range and the entire pump cabinet for a month. The site also had long-term logs of fan speeds, and Anchor Blue obtained six months of fan speed data for one of the ranges of fans and one month for each of the other three ranges. Site personnel indicated that most of the time only one nursery or finishing pump runs, but that both a nursery and finishing pump are most often running simultaneously. There are also times at which multiple pumps of one type may stage on if needed.

Ex-post Calculations and Assumptions

To estimate savings, Anchor Blue performed separate analyses for the fans and pumps, using the logged month of data to represent the efficient case savings compared to a staged (fans) or throttled (pumps) operational baseline. Because this was new equipment, the baseline consumption was estimated based on the reduced speed operations of the installed efficient equipment.

In order to extrapolate the one-month ex-post logged data to an annual consumption, Anchor Blue compared the month of onsite data to the ten months of ex-ante data to determine if there were seasonal variations in fan or pump operation. Based on the long-term fan ex-ante data, Anchor Blue determined that the month of logged in the ex-post case was very close to average annual operation. The single pump logged in the ex-ante data did not provide enough data to determine seasonal variations. Based on this, Anchor Blue treated the ex-post month of logged data as representative of the long-term averages as shown by the available long term data comparison, extrapolating the month of ex-post logged data to annual consumption.

The fan baseline assumes that the total required airflow over time remains the same, but that the fans would stage on instead of running at reduced speed. The ex-post calculations for the baseline consumption are different than the ex-ante calculations and include the motor load factor, efficiency, and staging assumptions. Anchor Blue used the measured data to determine the baseline, which was higher than the ex-ante value due to the observed high load factor. Fan operation varied with time of day, so Anchor Blue used only peak demand hours to determine demand savings. There was no difference between weekday and weekend operation.

For the pumps, Anchor Blue used the measured trend data to determine a load factor of around 91% and used this to estimate baseline power. The measured trend logs show that the reverse osmosis pump operated continuously and that, in general, one nursery and one finishing pump also operate. About 15% of the time additional pumps run. Anchor Blue used a baseline of the same number of pumps running but at full speed with throttled output instead of reduced speed. Pump operation did not correlate heavily to time of day, so Anchor Blue used average power to determine demand savings for the pumps.

> **Annual Energy Savings Algorithm**
> $\Delta kWh = ((kW_{Baseline} \times HOURS_{Baseline} - kW_{EE} \times HOURS_{EE})$
>
> Where,
> $kW_{Baseline}$: Full power of operating fans and pumps based on measured data from loggers
> $HOURS_{Baseline}$: Hours of operation for each fan or pump
> kW_{EE}: Power of fans and pumps on variable speed drives based on logged data
> $HOURS_{EE}$: 8,760
>
> **Summer Coincident Peak kW Savings Algorithm**
> $\Delta kW = kW_{Baseline} - kW_{EE}$

Where,
kW$_{Baseline}$: Full power of operating fans and pumps based on measured data from loggers
kW$_{EE}$: Power of fans and pumps on variable speed drives based on logged data

Anchor Blue found savings very close to the ex-ante values but utilized different calculation assumptions compared to the ex-ante calculations and the realization rate of 100% is coincidental. The ex-ante fan calculations assumed a baseline that was all fans always operating at their rated horsepower, which does not account for load factor, motor efficiency, or the likely staging of baseline fans. In the ex-post calculations, these assumptions were included in the baseline, but the lower logged power data from the ex-post compared to the ex-ante resulted in slightly lower savings for the fans.

For the pumps, Anchor Blue found higher savings than the ex-ante calculations, but the pump savings are a small portion of the overall project and had less impact than the fan savings. The ex-ante pump data did not include any information on how many pumps actually ran at a time since it only used data from logging a single pump and assumed only one pump in the baseline usage. The logged data showed that there are two pumps running at a time, resulting in higher usage. The higher baseline usage resulted in more savings and canceled out the reduced savings from the fan analysis.

Site 2 – Turlock

Project Summary

This project is an ongoing effort by TID to retrofit all the TID owned streetlights and area lights with LEDs that scattered throughout the territory. Most of these fixtures are smaller area lights, with some higher wattage fixtures as well. Anchor Blue sampled several areas and confirmed the fixture counts in the sample. The main reason causing the small variance in the realization rate is a difference in the ex-ante baseline wattage of the 100-watt HPS fixtures (138-watts) compared to the CMUA TRM deemed value of 128-watts, which was confirmed with several other lighting tables from other utilities. Additionally, the CMUA deemed outdoor hours of use (4,180) are slightly higher than the ex-ante hours of use (4,100). These changes resulted in the 98% energy realization rate.

Table 28. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	1,362,221	1,341,375	98%
Peak Demand Savings (kW)	0.0	0.0	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The site had four different baseline fixture types:

- 100-Watt HPS lamps
- 175-Watt HPS lamps
- 200-Watt Mercury Vapor Lamps
- 400-Watt Mercury Vapor Lamps

The baseline fixtures were on controls with hours defined as 4,100 hours from dusk to dawn.

Description of Efficient Equipment and Operation

Each of the defined baseline lamps above were replaced with varying wattage LED fixtures. There are six different LED wattages that were installed: 36-, 40-, 54-, 56-, 60- and 90-watts.

The LEDS all have photo sensors and use the same dusk to dawn hours of 4,100.

Comments on Ex-Ante Calculations

The ex-ante data derived the baseline wattages from an older PG&E lighting input table. There are some differences in this table compared to the CMUA TRM deemed values. The main difference for this project is the input wattage of the 100-watt HPS fixture, which has a deemed value of 128-watts in the CMUA TRM compared to 138-watts in the ex-ante data. Anchor Blue looked at two other utility lighting input tables (Xcel Energy[8] and National Grid[9]) and found them to be consistent with the CMUA deemed value of 128-watts and we recommend that this baseline wattage be updated.

---

[8] https://www.xcelenergy.com/staticfiles/xe-responsive/Programs%20and%20Rebates/Business/MN-CO-NM-Bus-lighting-efficiency-Light-Wtt-Input.pdf
[9] https://www1.nationalgridus.com/files/AddedPDF/POA/RILightingRetrofit1.pdf

The 400-watt Mercury Vapor fixture ex-ante value matched the CMUA TRM. The other two fixtures were not in the TRM, so Anchor Blue used the ex-ante values as is. These values seemed reasonable as compared to the 100-HPS in terms of input watts to nominal watts ratio of similar bulbs.

Additionally, TID uses 4,100 hours as the default exterior HOU, which is slightly lower than the deemed CMUA value of 4,180 hours.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of a sample of the lights, since they were scattered over a large area. The realization rate of installed fixtures would be extrapolated to the rest of the project. An algorithm approach will be used to confirm savings using dusk to dawn HOU.

Summary of Site Visit

While onsite, Anchor Blue was able to confirm the installation of all the LED fixtures in the sample of the project, which represented about 10% of the total site. Some fixtures were difficult to identify as they were somewhat hidden on properties but were confirmed. This 100% realization rate of fixture installation was applied to the rest of the unsampled areas.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors (CDF) to calculate savings. These are outdoor fixtures, so there are no interactive effects, and the CDF is 0 since these are operating at night. Anchor Blue utilized the CMUA TRM deemed consumption for the 100-watt and 400-watt baseline fixtures, the ex-ante values for the 175-watt and 200-watt fixtures that were not in the CMUA TRM and LED fixture wattages from the project data for the efficient case.

No adjustments were made to the count of the fixtures since the sample confirmed 100% of the fixtures installed. The CMUA deemed dawn to dusk hours of 4,180 were used for the house of use for both baseline and efficient fixtures, which is slightly different than the 4,100 used in the ex-ante baseline calculations.

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 for streetlights = 1.00

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 peak demand savings for streetlights = 1.00
CDF: Coincident Diversity Factor for streetlights = 0.00

There are two differences between the ex-ante data and the ex-post data that caused the difference in the realization rate. The factor that is driving savings down is the difference in the ex-ante baseline wattage of the 100-watt HPS fixtures (138-watts) compared to the CMUA TRM deemed value of 128-watts, the latter of which was confirmed with input lighting tables from other utilities. The second factor that brings savings back up a bit is using the slightly higher CMUA deemed outdoor hours of use (4,180) as compared to the ex-ante hours of use (4,100). These changes resulted in the 98% energy realization rate. There are no peak demand savings for this project as it operates at night.

Site 3 – Turlock

Project Summary

This is a small metal fabrication manufacturing site that replaced all its lighting with LEDs. The ex-post analysis has many changes from the ex-ante data that contributed to the lower realization rates, including discrepancies in the number of fixtures found onsite, differences in ex-ante baseline wattages compared to the CMUA TRM, using T8 baseline wattages in place of T12, lower logged HOU than claimed, and the inclusion of interactive HVAC effects/coincident demand factors. The main contributing factor of the 71% energy realization rate is the changes to HOU, though all the factors mentioned contributed. The reasons for the 71% peak demand realization rate are the inclusion of coincident demand factors, changes to baseline wattages and the difference in fixture counts.

Table 29. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	191,102	136,087	71%
Peak Demand Savings (kW)	37.2	26.4	71%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures were:

- 4-Lamp, 4' High Bay T8 Fixtures
- 2-Lamp, 4' High Bay T8 Fixtures
- 2-Lamp, 8', T12 & T8 fixtures
- 2- and 4-Lamp T12 Fixtures
- 400-watt and 150-watt HPS Fixtures
- 500-watt Halogen lamps

The ex-ante HOU were defined as 6,760 hours the manufacturing areas and 3,024 in the office and exterior areas.

Description of Efficient Equipment and Operation

All manufacturing areas and exterior fixtures were replaced with LED luminaires of varying wattages and the office areas were replaced by LED tubes of varying wattages. The efficient equipment was assumed to have the same hours of use as the baseline in the ex-ante data.

Comments on Ex-Ante Calculations

The exterior HOU in the ex-ante calculations appear to have had the same office HOU inappropriately applied. These fixtures are on photocells and should have the standard 4,180 exterior hours applied. Additionally, T12 fixture wattages were utilized in the baseline. Per the CMUA TRM section 16.1.1[10], baselines should be adjusted for federal regulations that do not allow for the purchase of T12s on the

---

[10] https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf Section 16.1.1 "Baseline Examples – Federal Regulations Baseline Adjusment"

market and savings should be based on the lowest efficiency available on the market, which would be T8s in this case. T8 fixture wattage equivalents were used in the ex-post case, which significantly impacts savings. Finally, the ex-ante calculations did not include HVAC Interactive Effects or Coincident Demand Factors in the savings calculations.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of all the lights and place loggers in a few different locations to better estimate HOU. An algorithm approach will be used to confirm savings using logged HOU.

Summary of Site Visit

While onsite, Anchor Blue found discrepancies in the number of LED fixtures in a few areas, specifically in the paint areas of the manufacturing space and in several of the offices. All of the paint area fixtures were found onsite, but the exterior paint area had been 'decommissioned' and was being used as storage with the lights never used. The office areas fixture counts were about 10% less than claimed. This area was replaced with LED tubes rather than fixtures and Anchor Blue suspects extra LED tubes were purchased in case of burnouts, though this could not be confirmed onsite.

While onsite, Anchor Blue placed 3 loggers onsite:

- Logger 1 in the front open office area, which is on the same schedule as the manufacturing area: 5,219 Hours
- Logger 2 in an office: 2,841 Hours
- Logger 3 in the manufacturing area: NA – this logger was found on the floor and deemed to be unusable data.

Anchor Blue noted onsite that about 20% of the front office area was common areas/halls leading to the manufacturing area that were switched on using the same schedule as the manufacturing area.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized baseline wattages from the deemed CMUA lighting fixture database and the claimed LED fixture wattages in the efficient case. The T12 fixtures were assumed to have first generation T8 fixture wattages as per the CMUA TRM requirements for federal standards. Additionally, The CMUA deemed lighting fixture database had different fixture wattages than claimed for some of the other fixtures, some of which were higher than claimed and some lower.

Fixture counts in the office areas were adjusted to match the onsite counts in the baseline and efficient case. The fixture counts for the paint areas were reduced in the efficient case only since this area was only recently decommissioned.

Only two of the three loggers were usable but apply to the two different interior spaces. The areas used the office logged data of 2,841 hours. Several of the office areas fixtures (representing about 20% of the fixtures) were on the same schedule as the manufacturing areas, which used the same HOU as the manufacturing areas with 5,219 hours. The logged hours are slightly lower than the ex-ante data in the office areas and manufacturing areas are about 25% less logged hours than claimed. Additionally, it appears that the exterior areas were erroneously given the wrong HOU in the ex-ante data, which were 25% less than the

standard 4,180 exterior hours. The standard 4,180 hours were applied in both the baseline and efficient cases in the ex-post calculations.

> **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 for several different area types:
>> Manufacturing Areas: 1.04
>> Offices: 1.12
>> Exterior: 1.0
>
>
> **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 peak demand savings for several different area types:
>> Manufacturing Areas: 1.18
>> Offices: 1.31
>> Exterior: 1.00
> CDF: Coincident Diversity Factor for several different area types:
>> Manufacturing Areas: 0.92
>> Offices: 0.71
>> Exterior: 0.00

The ex-post analysis included many changes from the ex-ante data that contributed to the lower realization rate, including discrepancies in the number of fixtures found onsite, differences in ex-ante baseline wattages compared to the CMUA TRM, using T8 baseline wattages in place of T12 actual wattages in the baseline, lower logged HOU than claimed, and the inclusion of interactive HVAC effects/coincident demand factors. The main reasons for the lower demand realization rate (71%) are the inclusion of coincident demand factors, changes to baseline wattages (including converting T12 fixture wattages to T8 due to code) and the difference in fixture counts. The changes to wattages and fixture counts also impacted the energy realization rate of 71%, but was also impacted by the inclusion of HVAC interactive factors, changes to the HOU based on logged hours and updates to the exterior HOU.

Site 4 – Turlock

Project Summary

The site is a grocery store that installed seven new reach-in freezers in the retail area. All units operate continuously throughout the year and are accessible to customers. Savings were calculated based on prescriptive values for climate zone 12 from the most recent CA eTRM values for reach-in freezers. The ex-ante prescriptive values were based on the CMUA TRM, however, were mistakenly based on medium temperature cases instead of low temperature cases. The current eTRM values are higher than the previous TRM and low-temp freezer savings are much higher than medium temp cases, resulting in a 1,114% energy realization rate and a 315% peak demand realization rate.

Table 30. First-Year Project Savings Summary

	Ex-ante	**Ex-post**	**Realization Rate**
Energy Savings (kWh/Year)	11,480	127,920	1114%
Peak Demand Savings (kW)	5.3	16.7	315%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

No information on old cases was provided as this was a prescriptive rebate. The baseline is based on code requirements in the CA eTRM.

Description of Efficient Equipment and Operation

The site installed seven new Hussmann RL frozen food reach-in cases, six five-door and one two-door. All units stay on continuously with no shutdown time throughout the year. The five-door cases are each 153 3/8" wide and the two-door case is 62 inches wide.

Comments on Ex-Ante Calculations

The ex-ante calculations were based on linear feet of case installed and the CMUA TRM values for medium temperature cases in climate zone 12 (CZ12). Since these are freezers, the low temperature value should have been used, which is a much higher savings value.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue will verify the installation and operation of the expected low temperature reach-in cases.

Summary of Site Visit

Anchor Blue confirmed the installation and operation of the cases at the grocery store and checked the nameplates to verify that they were the expected models. The six new five-door RL model cases and one additional new two-door case provided the expected total of 82 linear feet of cases.

Ex-post Calculations and Assumptions

Anchor Blue used the CA eTRM deemed savings value for reach in, low temperature refrigerated cases in climate zone 12 to calculate savings for this project. Savings are based on linear feet of cases installed.

CA eTRM Measure Information[11]

Measure ID: SWCR021-02
Measure Name: Medium or Low-Temperature Display Case with Doors
Accessed: August, 2022

Annual Energy Savings Algorithm
ΔkWh = linear feet * TRM kWh/linear foot

Where,
Linear feet = 82 linear feet across 7 cases
eTRM kWh/linear foot = 1560 kWh/linear foot for low temperature reach in case with doors in CZ12

Summer Coincident Peak kW Savings Algorithm
ΔkW = linear feet * TRM kW/linear foot

Where,
Linear feet = 82 linear feet across 7 cases
eTRM kWh/linear foot = 0.204 kW/linear foot for low temperature reach in case with doors in CZ12

The ex-ante savings appear to have been based on medium temperature reach-in case values from an the CMUA TRM version. The low-temperature case values should have been claimed and the current eTRM prescriptive savings are higher than the CMUA TRM, resulting in significantly higher savings than claimed and a 1,114% energy realization rate 315% peak demand realization rate.

---

[11] https://www.caetrm.com/measure/SWCR021/02/

Site 5 – Turlock

Project Summary

This is a small office, with only about 5 people that work in the office total. There is a lot of unused or lightly used office areas, so Anchor Blue decided to log most of this site to get better HOU estimates than the default claimed HOU. The site replaced T12s and HPS fixtures with LEDs. Savings for T12s must be compared to a first generation T8 baseline rather than the actual T12 wattage because T12 lamps are no longer sold on the market and per the guidance of the CMUA TRM (Section 16.1.1). This is the primary driver for the lower 52% realization rate for peak demand savings, but is additionally impacted by the inclusions of coincident peak demand factors and HVAC interactive effects. The logged HOU were lower than claimed across the board for the interior fixtures, sometimes significantly lower. The lower HOU in combination with the changes to baseline wattages resulted in the 42% energy realization rate.

Table 31. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	9,150	3,824	42%
Peak Demand Savings (kW)	3.4	1.8	52%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures were:

- 4-Lamp, 4', 172-Watt T12 fixtures
- 2-Lamp, 4', 75-Watt T12 fixtures
- 2-Lamp, 8', 41-Watt T12 fixtures
- 20-Watt Screw-In CFL
- 250 HPS Fixture

The baseline HOU were defined as 2,346 Hours for all interior fixtures and 4,100 for exterior fixtures.

Description of Efficient Equipment and Operation

All T12 fixtures were replaced with LED tubes, reducing 4-lamp fixtures to 2-lamp. The exterior fixtures were replaced with LED Luminaires. The efficient case used the same HOU assumptions as the baseline.

Comments on Ex-Ante Calculations

T12 fixture wattages were utilized in the ex-ante data. Per the CMUA TRM section 16.1.1[12], baselines should be adjusted for federal regulations that do not allow for the purchase T12s on the market and savings should be based on the lowest efficiency available on the market, which would be T8s in this case. T8 fixture wattage equivalents were used in the ex-post case, which significantly impacts savings.

---

[12] https://www.cmua.org/files/CMUA-POU-TRM_2017_FINAL_12-5-2017%20-%20Copy.pdf Section 16.1.1 "Baseline Examples – Federal Regulations Baseline Adjustment"

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of all the lights and place loggers in a few different locations to better estimate HOU. An algorithm approach will be used to confirm savings using logged HOU.

Summary of Site Visit

While onsite, Anchor Blue was able to confirm the installation of all the LED fixtures and placed 4 loggers onsite:

- Logger 1 in the front open office area, also used as the proxy for hallways: 1,772 Hours
- Logger 2 in an office that was being used: 744 Hours
- Logger 3 in an office that served as a storage area: 0 Hours
- Logger 4 in the back storage area: 2,285 Hours

Anchor Blue noted that the office was large for the total number of employees, and it seemed that much of the space was not often used. For example, two of the offices were clearly storage and not used as offices.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized CMUA TRM wattages for the baseline, using the T8 equivalent of the T12 fixture as the baseline as per code. The claimed LED fixture wattages were used in the efficient case. No adjustments were made to the count of the fixtures since the sample confirmed 100% of the fixtures installed.

The HOU applied to each space was a combination of default hours and logged hours. The front office and halls used the front office logged data of 1,772 hours. The "storage" offices used the default HOU of 500 since logger data showed 0, which is likely not appropriate. The main offices used an average of the office logged areas (front open and one closed office), which equated to 1,258 hours. The back storage area used the logged hours for that area of 2,285. In all cases, these are lower than the claimed 2,346 hours.

> **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 for several different area types:
> > Storage: 0.98
> > Offices: 1.12
> > Exterior: 1.0
>
> **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 peak demand savings for several different area types:

> Storage: 1.25
> Offices: 1.31
> Exterior: 1.00

CDF: Coincident Diversity Factor for several different area types:

> Storage: 0.7
> Offices: 0.71
> Exterior: 0.00

The peak demand realization rate is lower due to the inclusion of peak coincident demand and HVAC interaction factors, but is most significantly driven by the change of using the T8 equivalent baseline wattage rather than the actual T12 wattage as required by code and the CMUA TRM. All of these factors resulted in a 52% realization rate for peak demand savings. Energy savings were also impacted by the change in the baseline consumption, but additionally driven down by the lower logged hours of use than claimed in the ex-ante calculations, resulting in a 42% realization rate.

Site 6 - Turlock

Project Summary

This is a small industrial site that replaced the lighting in its large, refrigerated warehouse area with LEDs from Highbay T8, and adding occupancy sensors. The baseline fixtures were on all the time with 8,760 hours applied. Anchor Blue logged this site to estimate actual hours of use and found that with the occupancy sensors, the hours of use are estimated to be 6,896 hours. This is higher than the ex-ante estimate of 6,044 hours with the occupancy sensors, and is the main driver for the low realization. Interactive effects were not included in the ex-ante calculations, which are large for refrigerated spaces and mitigated some of the savings lost due these higher logged HOU, ultimately resulting in an overall energy realization rate of 55%.

Table 32. First-Year Project Savings Summary

	Ex-ante	**Ex-post**	**Realization Rate**
Energy Savings (kWh/Year)	7,860	4,326	55%
Peak Demand Savings (kW)	0.0	0.0	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The 23 baseline fixtures at this site were all 6-lamp T8 fixtures with a fixture wattage of 223 watts, operating 24/7.

Description of Efficient Equipment and Operation

All 23 fixtures were replaced with 271-watt LED High Output fixtures, operating 24/7 but on occupancy sensors.

Comments on Ex-Ante Calculations

The efficient fixtures are higher wattage fixtures than the baseline fixtures, all the savings come from the occupancy sensors. This resulted in negative kW savings and therefore 0 savings were claimed. It is unclear where the baseline fixture wattage of 223 watts was sourced from, but Anchor Blue used a similar wattage fixture of the same type from the CMUA TRM database for the analysis, which was 227 watts.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation the lights and place two lighting loggers to capture the occupancy sensors effect on hours of use. An algorithm approach will be used to confirm savings using logged HOU estimates.

Summary of Site Visit

While onsite, Anchor Blue was able to confirm the installation of all of the LED fixtures and placed two lighting loggers to estimate hours of use.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. The claimed LED fixture wattage of 271 was used in the efficient case. No adjustments were made to the count of the fixtures since the sample confirmed 100% of the fixtures installed. Anchor Blue used estimated annual hours of use from the logger data that equates to 6,896 hours.

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 for refrigerated spaces = 1.57

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 peak demand savings for refrigerated spaces = 1.32
CDF: Coincident Diversity Factor for refrigerated spaces = 0.56

No peak demand savings were claimed for this site as the efficient fixtures have slightly greater wattages than the baseline. The energy savings all come from the inclusion of occupancy sensors, which are estimated to have decreased hours of use by 21% in the logger data compared to the baseline 8,760 hours. However, logged hours were higher than the estimated 30% reduction in hours of use in the ex-anted data. This, in combination with including the HVAC interactive effects factor, resulted in an overall energy realization rate of 55% since the hours of use were higher than claimed.

Site 7 - Modesto

Project Summary

The site is large manufacturing facility that upgraded the controls for its six high pressure and three low pressure air compressors. The new controls are designed to adjust the system pressure and stage compressors off based on plant requirements. The controls operated through 2021 except for the first half of March, during which the system was disabled in order to determine baseline operation for the project. However, in early 2022, the plant had a changeover in personnel and the system has since been overridden and has operated in mostly manual mode due to inadequate personnel training.

The ex-ante savings were based on two weeks of baseline conditions in early March 2021during which the controls were shut off and the efficient savings are based on the last two weeks of March when the controls system was back online. The efficient system was also at least partially operational in January and February of 2021, but the data showed that it was not fully optimized, and therefore Anchor Blue calculated savings based on March 2021 only when the system was operating properly.

It is important to note that the savings in 2022 are now zero since the controls have been overridden, and the lifetime savings of this project are impacted, but the first-year savings in 2021 are listed below, resulting in a 107% energy realization rate and 117% peak demand realization rate. Anchor Blue found higher savings for the March 2021 data than the ex-ante calculation because of differences in the calculation methodology when normalizing the short observed periods of data to a full year.

Anchor Blue strongly recommends that MID contact the site to have them turn these controls back on and recommends this type of follow-up for all projects with system controls and/or optimization controls.

Table 33. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	1,783,644	1,915,515	107%
Peak Demand Savings (kW)	195.3	228	117%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The manufacturing facility has a large, compressed air system with three low pressure compressors supplying 100-115 psig air for general use and six high pressure compressors supplying 525-575 psig air to specialized manufacturing equipment. Generally, only two low pressure and five high pressure compressors operate, with the other units as backup. The compressors are listed in Table 34, below.

Table 34. Air compressor list

Compressor Number	Compressor Type	Rated pressure	Horsepower	Rated airflow
1	Reciprocating	650	300	944
2	Reciprocating	650	300	944
3	Reciprocating	650	300	944
4	Reciprocating	650	300	944

5	Reciprocating	650	400	1024
6	Reciprocating	650	500	1244
7	Oil Free Rotary	125	200	855
8	Oil Free Rotary	125	150	691
9	Oil Free Rotary	150	250	905

Source: Project documentation, Anchor Blue site visit

Description of Efficient Equipment and Operation

The project installed a new controls system to optimize air usage. The controls are designed to allow for air pressure reduction and staging off compressors to match production requirements. According to company personnel the system operated properly throughout 2021 but has been largely disabled throughout 2022 due to changeover in plant personnel and inadequate training on the controls for new personnel.

Comments on Ex-Ante Calculations

The ex-ante calculations were based on two weeks of pre-installation and two weeks of post-implementation production and compressed air data during March 2021. Compressed air usage was normalized to production levels, which were assumed to be typical of all time during the year and adjusted for a full year of production. The files indicated that the system was in operation in early 2021 might not yet have been fully optimized and so was not used in the analysis, as noted in the notes in the MID spreadsheets. Airflow data in the trends does not appear to be accurate and was not used in the analysis.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue arranged to visit the site, but due to personnel changes, the site project contact who had been involved in the project was no longer at the location. Anchor Blue spoke with the original project contact over the phone since current personnel were not familiar with the project.

Summary of Site Visit

Anchor Blue visited the site and obtained a month of daily production and hourly air compressor data for May 2022. During the site visit Anchor Blue discussed the system with site personnel, but as they had not been at the plant during the project, they were not familiar with its implementation. The data showed that the system was not operational, so Anchor Blue contacted the original contact, who was still with the company, just at another site. That contact confirmed that the controls system was operational until he left that site at the beginning of 2022, but that it has since been overridden post his departure. For this reason, Anchor Blue acknowledges the first-year savings of this project but will assign a measure life of 1 for this project since the lifetime savings of the project are not being realized.

Ex-post Calculations and Assumptions

The data from May 2022 showed that the system is not operating in the same efficient mode as it was in March 2021, so the savings calculated are first year savings only. Anchor Blue requested additional compressor trends from January and February 2021 to match production data already in the project files. The ex-post calculations used the same data as the ex-ante calculations to determine savings in 2021 since the controls are currently overridden and not saving energy. Anchor Blue used two weeks of baseline data

from March 2021 and the last two weeks of March 2021 when the system was operational data to determine savings. The data from May 2022 showed minimal reduction from the March 2021 baseline, but Anchor Blue did not include it in the baseline as it was not possible to determine if the controls were still having some effect or were completely disabled in 2022.

Annual Energy Savings Algorithm

$\Delta kWh = ((Wh/lb_{Baseline} - Wh/lb_{EE}) / 1000) \times lbs/year$

Where,

$Wh/lb_{Baseline}$: Daily load of operating air compressors from trend data normalized to daily production levels

Wh/lb_{EE}: Daily load of operating air compressors from trend data normalized to daily production levels

Lbs/year: Average annual production in lbs

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = \Delta kWh/8760$

Where,

ΔkWh: annual energy savings from above, averaged because hourly production data are not available

The ex-post calculations normalized the baseline and efficient data from March 2021 to annual estimates differently that the ex-ante calculation, resulting in an increase in savings for this project. However, there are essentially no savings as of 2022 and these savings are effectively first year savings. Anchor Blue was able to confirm with previous site personnel that the controls were in operation until early 2022 when a staff change caused the new staff to override the controls. Therefore, Anchor Blue recognizes the savings in 2021, but there are no additional lifetime savings that will be assigned to the project in this evaluation. Anchor Blue recommends that site personnel be trained to use the system and it be re-enabled as energy savings are significant.

Site 8 - Modesto

Project Summary

This site is a small community that replaced all of its street lighting from HPS Metal Halides to LEDs. There are several neighborhoods within the community and all of the neighborhoods with HIDs were part of this project. A sample of the fixtures were all confirmed to be installed. However, the realization rate is only 84% because of double counted savings with the inclusion of additional savings from photocells in the ex-ante savings calculations as the baseline fixtures were confirmed to already have controls as well. The removal of the additional photocell control savings resulted in the overall realization rate of 86%.

Table 35. First-Year Project Savings Summary

	Ex-ante	**Ex-post**	**Realization Rate**
Energy Savings (kWh/Year)	1,002,680	858,179	86%
Peak Demand Savings (kW)	0.0	0.0	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The site had two different baseline fixture types:

- 1017, 100-Watt HPS lamps
- 944, 250-Watt HSP lamps

The baseline fixtures were on controls with hours defined as 4,180 hours from dusk to dawn.

Description of Efficient Equipment and Operation

The 100-Watt HPS lamps were replaced with 70-Watt LEDs and the 250-Watt HPS lamps were replaced with 140-Watt LEDs.

The LEDS all have photo sensors and use the same dusk to dawn hours of 4,180.

Comments on Ex-Ante Calculations

The default exterior HOU of 4,180 are based on a photocell's (or timeclock) sunrise to sunset hours, essentially taking the controls into consideration within the default HOU. The ex-ante savings added an additional savings percentage on top of all of the wattage savings, which is double counting savings in this case since the default HOU for exterior fixtures are already dusk to dawn. Additionally, it was confirmed that the baseline fixtures were already on controls as well, so this additional savings percentage is inappropriate for this project.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of a sample of the lights, since they were scattered over a large area. The realization rate of installed fixtures would be extrapolated to the rest of the project. An algorithm approach will be used to confirm savings using dusk to dawn HOU.

Summary of Site Visit

While onsite, Anchor Blue was able to confirm the installation of all of the LED fixtures in the sample of the project, which represented about 20% of the total site. This 100% realization rate of fixture installation was applied to the rest of the unsampled areas.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. LED fixture wattages of 70 and 140 were used in the efficient case. No adjustments were made to the count of the fixtures since the sample confirmed 100% of the fixtures installed. The dawn to dusk hours of 4,180 were used for the house of use, consistent with the rebate spreadsheet. However, Anchor Blue removed the additional 17% photocell savings applied in the ex-ante calculations.

> **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 for parking lot lights = 1.00
>
> **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 peak demand savings for parking lights = 1.00
> CDF: Coincident Diversity Factor for parking lot lights = 0.00

As discussed, the reason for the lower realization rate is due to the double counting of photocell savings. The ex-ante calculations include additional savings for photocell controls, but the default exterior HOU already take into account the operation of photocells. This resulted in an overall energy realization rate of 86%. There are no claimed demand savings as these fixtures operate off-peak.

Site 9 – Modesto

Project Summary

A manufacturing plant installed upgraded controls to its cooling systems and added variable speed drives to nine existing water pumps. The new controls allowed control of the cooling tower approach temperature based on wet bulb temperature. With these new controls, the chiller and tower process water pumps now operate based on temperature differential and required pressures. Anchor Blue found significantly higher savings (170% energy realization rate) than the ex-ante values since the ex-ante calculations used a post-VFD installation baseline at reduced speed rather than the actual full speed pump baseline. This was due to multiple projects being installed at this site and the timing of ex-ante logging data for this project.

Table 36. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	738,660	1,252,371	170%
Peak Demand Savings (kW)	80.1	103	129%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

Prior to the project the three process pumps, three condenser water pumps, and three chilled water pumps operated at constant speed regardless of demand. The four cooling tower fans had variable speed drives, but controls were limited and did not optimize fan operation based on outdoor air conditions.

Description of Efficient Equipment and Operation

The facility installed variable speed drives on the nine pumps and upgraded the cooling tower controls to allow for fan speed control based on outdoor air wet bulb temperature.

Comments on Ex-Ante Calculations

The ex-ante savings are based on the comparison of two weeks of trend data for the fans and pumps before and after the project. Production levels were similar during both two-week periods and loads did not vary significantly with temperature. The pumps were clearly operating at reduced speed after the project, however trend data indicated they were already operating under speed controls in the baseline period, with the process pumps at a constant 70% speed, the condenser water pumps at 71% speed, and the chilled water pumps around 86% speed. This shows that the ex-ante baseline trend data were obtained after the variable speed drives were installed. According to company staff, the VFDs and controls were installed one after the other and in order to obtain the baseline condition, the controls were shut off for two weeks to log consumption of the baseline. It is unclear why the pumps operated at reduced speed during this two weeks but should have been set to 100% power for a true baseline. Additionally, only limited temperature variations occurred during the two weeks of ex-ante efficient trend data, and although the fan speeds were reduced it was difficult to determine a correlation to temperature.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue planned to discuss operations with facility staff and obtain updated trend data for the affected fans and pumps.

Summary of Site Visit

Anchor Blue visited the site and discussed operations with facility staff. The facility staff had seen significant turnover since the project and staff did not have full details of the project. However, staff did provide six months of trend data for the affected equipment and one month of production data for the facility.

Ex-post Calculations and Assumptions

Anchor Blue calculated savings for both the addition of VFDs and the added controls, using the ex-post trend data to create temperature-based trends for the affected pumps and fans to estimate the annual consumption of the efficient equipment. The baseline pump powers were based on calculated full speed power for the pumps using speed and power trends provided by the site, and assuming a standard practice 3% power penalty for the VFD. The baseline fan speed was based on the two weeks of data from the ex-ante trends, but since not all of the typical temperature range in a typical meteorological year was covered during this time, Anchor Blue extrapolated to estimate the power at the high and low ends of the temperature range based on the available data. The single month of production data provided to Anchor Blue showed very similar levels to the ex-ante data, so Anchor Blue did not adjust savings for production levels.

> **Annual Energy Savings Algorithm**
> $\Delta kWh = ((W_{Baseline} - W_{EE}) / 1000) \times HOURS$
>
> Where,
> $W_{Baseline}$: Baseline power of the affected fans and pumps at TMY3 temperature based on trend logs from the facility
> W_{EE}: Power of affected fans and pumps in the efficient case at TMY3 temperature
> HOURS: Average hours of use per year, weighted for TMY3 weather = 8,760
>
>
> **Summer Coincident Peak kW Savings Algorithm**
> $\Delta kW = ((W_{Baseline} - W_{EE}) / 1000)$
>
> Where,
> $W_{Baseline}$: Baseline power of the affected fans and pumps based on trend logs from the facility
>
> W_{EE}: Power of affected fans and pumps in the efficient case based on trend logs from the facility

Anchor Blue found significantly increased savings, primarily due to the use of a post-VFD installation baseline for the affected pumps in the ex-ante calculations, when full speed motors were the proper baseline. Anchor Blue found less savings due to the controls than indicated in the two weeks of efficient ex-ante data, however the additional savings due to the pump VFDs substantially increased overall savings resulting in the 170% energy realization rate.

Site 10 – Modesto

Project Summary

A large industrial production facility replaced two 250 HP Gardner Denver air compressors with two 200 HP trim compressors. The facility has a total of six air compressors, one of which is primarily used for nitrogen production, but also provides any excess air not used for nitrogen production to the main system of five compressors. Efficiency codes do not apply to this project because the nitrogen compressor is centrifugal. Anchor Blue found higher than the ex-ante energy savings but significantly less than the ex-ante demand savings. The reported ex-ante energy savings were based on the AirMaster+ based calculator in the project files instead of the provided, adjusted and 'final' ex-ante calculation file and the reported ex-ante demand savings were inconsistent with both ex-ante calculation files. The difference in realization rates is due to more data provided to Anchor Blue in the ex-post analysis. The energy savings resulted in a higher realization rate of 113% using this updated data. However, since the peak demand savings in the tracking database are much higher than that the provided ex-ante analysis spreadsheets, it is difficult to determine the exact reason for the 59% realization rate. In the ex-ante data, no hourly data were available for the ex-ante analysis, where Anchor Blue had enough data to analyze demand during peak hours.

Table 37. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	692,259	779,413	113%
Peak Demand Savings (kW)	132.0	77.4	59%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The facility had six air compressors, five for the main compressed air plant, and one centrifugal compressor used to supply air to its nitrogen generation plant with excess air provided to the main compressed air system. The compressors are listed in Table 34, below.

Table 38. Air compressor list

Compressor Number	Compressor Brand	Compressor Type	Horsepower	Rated airflow and pressure
1	Gardner Denver	Constant speed rotary screw	250	1133 acfm at 125 psig
2	Gardner Denver	Constant speed rotary screw	250	1133 acfm at 125 psig
3	Gardner Denver	Constant speed rotary screw	250	1134 acfm at 125 psig
4	Ingersoll Rand	Constant speed rotary screw	100	429 acfm at 125 psig
5	Ingersoll Rand	Constant speed rotary screw	250	1066 acfm at 125 psig
6	Ingersoll Rand	Centrifugal	400	1100 acfm at 100 psig

Source: Project documentation, Anchor Blue site visit

Description of Efficient Equipment and Operation

The facility replaced the constant speed 250 HP compressors 1 and 2 with new, 200 HP Ingersoll Rand variable speed units. Normally this would be considered a code required upgrade since no variable speed compressors were on the system, but since a centrifugal compressor is connected into the system energy code does not apply. Compressor 6 always operates and supplies any air not needed for nitrogen production to the compressed air system. Compressor 5 is base loaded with compressor 1 or 2 used as trim. If air requirements exceed the sum of compressor 1 or 2 and 5, compressor 4 will also turn on. Compressor 3 is the last air compressor to turn on.

Comments on Ex-Ante Calculations

The ex-ante calculations included both an AirMaster+ based calculator and custom calculations based on a single week of data for compressor operation showing only total power and flow for the system. They also incorrectly classified compressor 4 as a variable speed unit. The provided ex-ante calculation file did not match the tracked savings for this project, as shown in Table 39 below, but the reason for the discrepancy is unclear. The values in the table below were derived from the tracking system data provided for sampling, the MID analysis spreadsheet labeled 'final', the MID AM+ calculator, and Anchor Blue's analysis results for reference. It appears that the AirMaster+ calculated energy savings was used in the final tracking data, but not the peak demand savings, and it is unclear why. The peak demand savings in either of the workbooks provided would have been much closed to the ex-post analysis peak demand savings.

Table 39. Ex-Ante Savings Comparison from Tracking Database to Project File Analysis Spreadsheet

	Ex-ante – Tracking System	Ex-ante – MID Analysis Spreadsheet	Ex-ante – MID AM+ Calculator	Ex-post – Anchor Blue Calculated
Energy Savings (kWh/Year)	692,259	812,448	692,259	779,413
Peak Demand Savings (kW)	132.0	85.6	73.7	77.4

Source: Project Documentation, Anchor Blue Analysis

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue planned to visit the facility to confirm installation and operation of both the remaining old air compressors and the new compressors. If possible, Anchor Blue would obtain trend data showing operation of the compressed air system over a period of several weeks.

Summary of Site Visit

Anchor Blue visited the facility and confirmed the installation and operation of both the new air compressors and the four old compressors and confirmed staging order of the air compressors. The facility provided a month of current trend data for all six air compressors and intermittent data on nitrogen production during that month.

Ex-post Calculations and Assumptions

Anchor Blue obtained a month of hourly amperage data for all six compressors, which is more than the week of data that the ex-ante calculations were based on. No data were available showing either airflow or pressure in the trends. Anchor Blue converted amperage to kW at 480 volts assuming power factors of 0.99 for the variable speed compressors, 0.85 for the constant speed air compressors, and 0.9 for the centrifugal compressor, based on its motor nameplate. During the month of trend data, compressors 5 and 6 ran continuously as expected, compressors 3 and 4 were never used, and generally either compressor 1 or 2 operated. Short periods showing both compressors 1 and 2 operating are likely due to switchover and averages over the hour interval.

Anchor Blue calculated airflow for the compressors based on available manufacturer data for the Ingersoll Rand units and industry standard curves for the Gardner Denver units since they were too old to obtain manufacturer specific data. The savings are based on replacing compressors 1 and 2 and assuming staging and air requirements have not changed.

> **Annual Energy Savings Algorithm**
> $\Delta kWh = (kW_{Baseline} - kW_{EE}) \times HOURS$
>
> Where,
> $kW_{Baseline}$: Load of operating air compressors required to produce baseline air demand
> kW_{EE}: Load of operating air compressors based on ex-post trend data
> HOURS: Average hours of use per year = 8,760
>
> **Summer Coincident Peak kW Savings Algorithm**
> $\Delta kW = kW_{Baseline} - kW_{EE}$
>
> Where,
> $kW_{Baseline}$: Load of operating air compressors required to produce baseline air demand during peak demand hours
> kW_{EE}: Load of operating air compressors based on trend data during peak demand hours

Anchor Blue found energy savings 113% of the ex-ante value but demand savings only 59% of the ex-ante value. The differences are due to more available data for the ex-post evaluation for energy savings, providing better kWh savings estimates, but the reason for the difference in peak demand savings is unclear as the source of the tracked demand is unknown and does not match the values in the ex-ante spreadsheets. Anchor Blue was able to use actual hourly demand hours data to determine peak demand savings, which was not available for the ex-ante calculations.

Site 11 – Modesto

Project Summary

A large industrial production facility replaced its twin tower nitrogen generation plant with a more efficient modular system. Compressed air from a combined system of six compressors supplies the plant, with a single centrifugal compressor supplying the majority of the input. Ex-ante savings were based on reduced compressed air required to generate nitrogen and expected turndown of the centrifugal compressor, however, the ex-ante calculations were based on very limited efficient system data for calculations. Anchor Blue obtained data for most of a month for the air compressors and intermittent data for nitrogen production and found that savings were significantly lower than the ex-ante value. The 71% energy realization rate and the 75% peak demand realization rate are lower based on the additional data obtained from the site.

Table 40. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	530,895	375,497	70.7%
Peak Demand Savings (kW)	60.8	45.7	75.2%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The facility formerly used a twin tower nitrogen generation plant attached to a centrifugal air compressor to generate nitrogen for the plant. Excess compressed air from the centrifugal air compressor supplies the main compressed air system along with five other air compressors. A 2019 study used for the ex-ante baseline estimated that the ratio of supplied air to produced nitrogen was 4.93.

Description of Efficient Equipment and Operation

The facility installed a more efficient, modular nitrogen generation plant that requires less air to create the same amount of nitrogen. Power is not directly required by the nitrogen generation, but the nitrogen plant operates off compressed air from the centrifugal compressor as before. The ex-ante calculations show the average ratio of supplied air to produced nitrogen after the installation of the efficient equipment was 3.5.

Comments on Ex-Ante Calculations

The ex-ante calculations assumed savings based on turndown of the centrifugal compressor because of estimated maximum capacity of the pipe connecting the centrifugal compressor to the main compressed air system. However, Anchor Blue obtained additional compressed air trends and nitrogen data for the analysis and found the ex-ante assumption is incorrect and the extra airflow is currently not limited by the connection capacity. This was due to lack of data on the ex-ante calculations, which did not have adequate compressor capacity or operational data.

The ex-ante calculations appear to have used standard centrifugal compressor curves that do not match the available, albeit limited manufacturer data for compressor capacity. The compressor is old and no longer in production, so it was not possible to locate detailed manufacturer data, but Anchor Blue located a summary page showing the horsepower did not match the capacity used in the ex-ante calculations. The trend data provided confirmed that the compressor was operating significantly below the ex-ante assumed capacity.

There were inconsistencies in the project files about the compressed air to nitrogen ratios as well that were used in the ex-ante savings analysis, but the project file did mention that there was a lack of supporting data for this project.

Finally, the savings in the ex-ante calculation file (the MID Final Version) did not match the tracked data provided by the utility for sampling, as shown in Table 39 below. It is unclear why the savings do not match the analysis file, but the realization rates would have been closer to 100% had the savings from the MID analysis spreadsheet being used.

Table 41. Ex-Ante Savings Comparison from Tracking Database to Project File Analysis Spreadsheet

	Ex-ante – Tracking System	Ex-ante – MID Analysis Spreadsheet	Ex-post – Anchor Blue Calculated
Energy Savings (kWh/Year)	530,895	480,895	375,497
Peak Demand Savings (kW)	60.8	50.6	45.7

Source: Project Documentation, Anchor Blue Analysis

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue planned to visit the facility to confirm installation and operation of the new nitrogen plant. Since the ex-ante data was very limited, Anchor Blue will attempt to obtain additional trend data showing longer term operation of both the new nitrogen plant and the air compressors. Anchor Blue will confirm nameplate data for the air compressors as well as the nitrogen plant equipment.

Summary of Site Visit

Anchor Blue visited the facility and confirmed the installation and operation of the new nitrogen plant, as well as the operation of the air compressors. The facility provided a month of current (amperage) trend data for all six air compressors and intermittent instantaneous data on nitrogen production during that month. Based on the output screen the new nitrogen plant required around a ratio of supplied air to produced nitrogen of 4.0 at the time of the visit, but that ratio is not necessarily constant over long term operation. Anchor Blue also confirmed with facility staff that the excess air from the nitrogen centrifugal compressor is going to the main compressed air system.

Ex-post Calculations and Assumptions

Anchor Blue first looked at the existing and new data available to determine the best savings calculation methodology. Amperage data was not included in the ex-ante calculations and Anchor Blue first converted the compressor amperage to kW at 480 volts assuming power factors of 0.99 for the variable speed compressors, 0.85 for the constant speed air compressors, and 0.9 for the centrifugal compressor, based on its motor nameplate. Based on this and the month of current data showing amperage for each of the six air compressors, it does not indicate that the pipe capacity was typically resulting in significant turndown of the centrifugal compressor. Less than 10% turndown was observed during the month of hourly trend data based on the compressor specifications and based on the available nitrogen data. The turndown did not appear to correlate to the decreased nitrogen production. As mentioned in the ex-ante calculations comments, since the baseline nitrogen plant would have required more air, even less excess air would feed the main compressed

air plan and therefore the pipe would be adequate to transport the decreased excess air amount under baseline operation, as well as under the efficient conditions.

Therefore, Anchor Blue based savings on the overall decreased air production for the main plant since the excess air from the nitrogen centrifugal compressor is put toward the main plant and is not limited by the connecting pipe size. This is different than the ex-ante assumptions that found the connecting pipe would not be able to handle the excess air and that the centrifugal compressor would need to be turned down to achieve savings. The ex-ante assumptions incorrectly estimated the centrifugal compressor at 400 HP. The trend data obtained showed that the compressor was operating well below that at 250 HP and therefore Anchor Blue based the ex-post calculations on adequate pipe sizing to accommodate the actual excess air and savings would be from reduced air production of the *other* compressors, not a turndown of the centrifugal compressor.

A key input into the ex-post calculations is the conversion ratio of compressed air to nitrogen, which is variable. The lower conversion ratio in the efficient case is effectively the source of savings for this project since less compressed air is required to convert to the same amount of nitrogen. The ex-ante calculations used 4.93 and 3.5 for the baseline and efficient cases respectively. While onsite, Anchor Blue observed the instantaneous ratio read out of 4.0. However, since the ratios are variable over time and the site did not provide any additional data on current conversion ratios, Anchor Blue used the ex-ante data baseline ratio of 4.93 and estimated efficient ratio of 3.5 in the ex-post analysis, which was reasonable given the single readout of 4.0. Savings for a compressed air upgrade project that took place at the same time were calculated separately.

Annual Energy Savings Algorithm

$\Delta kWh = (kW_{Baseline} - kW_{EE}) \times HOURS$

Where,

$kW_{Baseline}$: Load of operating air compressors required to produce baseline air demand, based compressor curves and calculated airflow reduction

kW_{EE}: Load of operating air compressors based on ex-post trend data

HOURS: Average hours of use per year = 8,760

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = kW_{Baseline} - kW_{EE}$

Where,

$kW_{Baseline}$: Load of operating air compressors required to produce baseline air demand during peak demand hours, based compressor curves and calculated airflow reduction

kW_{EE}: Load of operating air compressors based on ex-post trend data during peak demand hours

Anchor Blue's calculation used additional data not available for the ex-ante analysis, resulting in decreased savings. The analysis method was different than the ex-ante calculations because this additional data showed that the assumptions in the ex-ante calculations were incorrect around the assumed operating horsepower of the compressor that would provide savings. The ex-ante files specifically state that the data supplied were not adequate to definitively determine savings and that additional data should have been required. With this new calculation method and additional data, Anchor Blue found just over 70% realization rates for both energy and peak demand for the project.

Site 12 – Modesto

Project Summary

The site is an industrial facility that replaced one of its two 100 HP cooling water circulation pumps with a 15 HP variable speed booster pump. The cooling tower and circulation pumps provide cooling for the facility's air compressor. Prior to the project, both 100 HP pumps operated at 40-45 psi and after the project, only one 100 HP pump operates at 40 psi along with the 15 HP booster pump that raises the necessary flow to 60 psi to prevent overheating the air compressor. The booster pump speed is set at a constant, reduced speed. Anchor Blue found the project to have 103% of the ex-ante energy savings and 91% of the ex-ante demand savings. The ex-ante savings appeared to be based on full speed operation of the new 15 HP pump without adjusting for motor efficiency or load, but also do not include any load factor for the 100 HP pumps in the baseline or efficient case. Increased hours compared to the baseline resulted in minimal overall change in the energy savings when paired with the differences in calculation assumptions around load factors for the pumps that resulted in a decrease in the demand savings.

Table 42. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	318,780	328,908	103%
Peak Demand Savings (kW)	58.2	52.7	91%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The facility had two 100 HP pumps operating 5,040 hours per year, supplying 40-45 psi water circulating from the cooling tower. The facility air compressor requires cooling water at closer to 60 psi and has been overheating due to inadequate cooling.

Description of Efficient Equipment and Operation

The facility replaced the use of one of the 100 HP pumps with a 15 HP booster pump. This allows the main system to operate at only 40 psi and the booster pump to supply higher pressure cooling water to the air compressor that requires it. Hours of operation are unchanged.

Comments on Ex-Ante Calculations

The raw ex-ante calculations were not supplied with the project files, but a summary pdf file was included, from which Anchor Blue was able to determine the calculations. The calculations were based on 200 HP of baseline pumps running continuously and 115 HP of new pumps operating 5,040 hours per year. They did not appear to account for motor loading or efficiency, but were based on a direct conversion from HP to kW and annual hours of operation, resulting in an overestimation of the actual pump power output and resulting ex-ante savings.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue arranged to visit the site and verify installation and operation of the pumps, but the site safety rules did not permit live measurements of pump power and the site did not have any trend data connected for the pumps. The M&V plan was to confirm the size and operation of the pumps and take any available power readings from the new VFD itself. The site indicated that the new booster pump speed is not designed to vary with its current controls settings, but rather is set to a fixed, reduced speed to accommodate the air compressor cooling water needs.

Summary of Site Visit

Anchor Blue met with the site contact and verified installation and operation of the equipment. There is no logging system and site safety did not permit direct measurement of pump power, but the 15 HP VFD pump had a readout of power and energy use. There were two identical 100 HP pumps installed, but only one is currently operating. They are both Paco pumps attached to 100 HP Baldor motors with 95.4% rated efficiencies.

The new pump is a Grundfos model CRE20-6 Ak-GJ-A-E-HQQE-NCB 15 HP unit rated for 111 GPM and up to 232 PSI. It is controlled by an integrated 15 HP variable speed drive and motor. The unit speed was set to 80% but varying slightly and operating at 78.6% (2,830 rpm) during the site visit. According to the control screen it was using 7.96 HP and had consumed 86,040 kWh since starting.

The site contact indicated that the main overall system was now at 40 PSI, which was confirmed by pressure gauges on the system. No pressure reading was available for the booster pump output. The system operates continuously during the work week except for minor maintenance downtime but is often down on weekends. Typical operating hours are form 7AM Monday until 7AM Saturday every week. Site records showed cumulative 4,719 hours for production line 1, 5,848 hours for production line 2, and 2,576 hours for production line 3 during 2021. No data were available on how much of the time was simultaneous for the three lines.

Ex-post Calculations and Assumptions

No pump curves were available for the old Paco pumps and direct power measurements could not be obtained due to site safety regulations, so ex-post calculations assumed a typical 75% loading for the 100 HP pumps both before and after the project.

Anchor Blue used the site supplied annual hours of 120 per week to calculate 6,240 annual hours of operation. This was consistent with operational data on the pump control screen and 2021 data on production line operation but higher than the ex-ante value of 5,040 annual hours.

Annual Energy Savings Algorithm

$$\Delta kWh = (kW_{Baseline} - kW_{EE}) \times HOURS$$

Where,
$kW_{Baseline}$: Connected load baseline pumps, based on estimated loading
kW_{EE}: Connected load of efficient pumps, based on estimated load for the 100 HP unit and controller readout for the new 15 HP pump
HOURS: Average hours of use per year = 6,240

Summer Coincident Peak kW Savings Algorithm

$\Delta kW = kW_{Baseline} - kW_{EE}$

Where,

$kW_{Baseline}$ = # pumps * pump HP * 0.746 kW/HP * 75% load factor/95.4% motor efficiency

kW_{EE} = (100 HP * 75% load factor/95.4% efficiency + VFD readout HP) * 0.746 kW/HP

The ex-post energy savings resulted in a 103% realization rate and peak demand realization rate of 91%. The demand realization rate is lower due to the inclusion of motor load factors and efficiencies when calculating the pump power output for the baseline and the efficient pumps. This also affects the energy realization rate, but the higher ex-post hours of use resulted in a slightly higher realization rate for energy.

Site 13 – Modesto

Project Summary

This is a high school that did a full interior retrofit of its lights to LEDs. Three schools from Modesto were in the sample this year for evaluation, all of which were similar in scope and size. Because of how large these sites were, Anchor Blue sampled about 20% of the lighting fixtures to verify for two of the sites and completed a full verification of the other school. All of the fixtures in the sample and the full site had 100% of the fixtures installed, except for one outlier exception. Based on this sample data, Anchor Blue assumed that all the fixtures in all three sites were verified as installed, except the outlier exception, which is only considered in one site (not this site), leading to the 100% realization rate for peak demand savings. Changes in hours of use are the reason for the 78% realization rate for energy savings. The ex-ante calculations utilize the default school hours of use for all spaces (2,280). Anchor Blue estimated hours by looking at the school's schedule and calendar found online, which equated to 1,930 hours and are more aligned with updated 2023 DEER default HOU (see comments on ex-ante calculations for more detail). Additionally, there were several spaces that were marked as storage, mechanical or electrical that used the same default school HOU. Anchor Blue updated these spaces HOU to match the CMUA TRM low usage area HOU (500) since these space types get much lower usage than the rest of the school.

Table 43. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	271,346	212,942	78%
Peak Demand Savings (kW)	1.9	1.90	100%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures were mostly 32-watt, 4-ft T8s with varying number of lamps. There were also some CFLs and Halogen bulbs.

The baseline HOU used the CMUA TRM default hours of use for schools for all space types of 2,280 hours.

Description of Efficient Equipment and Operation

The efficient fixtures are all LEDs, mostly troffer retrofit kits, with some other LED luminaire retrofit kits and screw-in LEDs, all of varying wattages. The efficient fixtures are assumed to be on the same schedule as the baseline fixtures, using the default CMUA Hours of Use of 2,280.

Comments on Ex-Ante Calculations

The ex-ante calculations use the CMUA default hours for schools. Anchor Blue looked at the website of each school evaluated to determine hours of use based on the daily schedule and yearly calendar. In all cases, the hours of use calculated were lower than the CMUA TRM values. Anchor Blue looked at the updated 2023 eTRM HOU values that will be recommended for use in the next program year, and all school hours have been lowered (1,300 or 1,800 for a primary or secondary school, respectively) compared to the current CMUA TRM values (2,280 for both primary and secondary schools). These lower HOU assumptions are more in line with the calculated values, therefore, in the ex-post analysis, Anchor Blue utilized the calculated hours and recommends updating default HOU to the updated eTRM values in 2023.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The three schools selected in the sample draw were visited in succession and considered together since the size and scope of all three were similar. Anchor Blue completed a full inventory of one of the schools and sampled about 20% of the fixtures for verification from the two other schools. No logging was done as schools were not in normal session.

Summary of Site Visit

Anchor Blue visited all three schools after school was out for the summer. At this school, it was noted that very few staff were onsite, with only one custodial staff onsite and essentially all lights were off. The onsite contact was able to take Anchor Blue to the sampled areas of this site and confirm that installation of all lamps within the sample. No loggers were placed as school was out for the summer and was not on normal schedule.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. LED fixture wattages found in the ex-ante calculations were used in the efficient case after being confirmed in the specifications sheets. No adjustments were made to the count of the fixtures Anchor Blue confirmed 100% of the fixtures were installed in the sampled area. Anchor Blue calculated hours of use for the site by looking at the school's daily schedules and calendar from its website, resulting in 1,930 HOU. For areas that were clearly storage or mechanical rooms, Anchor Blue further reduced these hours to 500, as these are low use areas of the site.

> **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 for School = 1.07
>
> **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 peak demand savings for School = 1.00
> CDF: Coincident Diversity Factor for School = 0.02

The peak demand realization rate is 100% due to all the fixtures being verified and the inclusion of the HVAC interactive effects and Coincident Demand factors in the ex-ante calculations. The lower hours of use in all areas, and significant reduction in HOU for storage areas is the driver of the 78% energy savings realization rate.

Site 14 – Modesto

Project Summary

This is one of two high schools sampled that did a full interior retrofit of its lights to LEDs. Three schools from Modesto were in the sample this year for evaluation in total, all of which were similar in scope and size. Because of how large these sites were, Anchor Blue sampled about 20% of the lighting fixtures to verify for two of the sites and completed a full verification of the other school. All of the fixtures in the sample and the full site had 100% of the fixtures installed, except for one outlier exception. Based on this sample data, Anchor Blue assumed that all the fixtures in all three sites were verified as installed, except the outlier exception, which is only considered in one site (not this site), leading to the 100% realization rate for peak demand savings. Changes in hours of use are the reason for the 78% realization rate for energy savings. The ex-ante calculations utilize the default school hours of use for all spaces (2,280). Anchor Blue estimated hours by looking at the school's schedule and calendar found online, which equated to 2,123 hours. Additionally, there were several spaces that were marked as storage, mechanical or electrical that used the same default school HOU. Anchor Blue updated these spaces HOU to match the CMUA TRM low usage (500) since these space types get much lower usage than the rest of the school.

Table 44. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	216,254	196,400	91%
Peak Demand Savings (kW)	1.63	1.63	100%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures were mostly 32-watt, 4-ft T8s with varying number of lamps. There were also some CFLs and Halogen bulbs.

The baseline HOU used the CMUA TRM default hours of use for schools for all space types of 2,280 hours.

Description of Efficient Equipment and Operation

The efficient fixtures are all LEDs, mostly troffer retrofit kits, with some other LED luminaire retrofit kits and screw-in LEDs, all of varying wattages. The efficient fixtures are assumed to be on the same schedule as the baseline fixtures, using the default CMUA Hours of Use of 2,280.

Comments on Ex-Ante Calculations

The ex-ante calculations use the CMUA default hours for all schools. Anchor Blue looked at the website of each school evaluated to determine hours of use based on the daily schedule and yearly calendar. In all cases, the hours of use calculated were lower than the CMUA TRM values. Anchor Blue looked at the updated eTRM HOU values that will be recommended for use in the next program year, and all school hours have been lowered (1,300 or 1,800 for a primary or secondary school, respectively) compared to the current CMUA TRM values (2,280 for both primary and secondary schools). These lower HOU assumptions are more in line with the calculated values, therefore, in the ex-post analysis, Anchor Blue utilized the calculated hours and recommends updating default HOU to the updated eTRM values in 2023. This current site is closer to the

estimated CMUA HOU than the other two schools as it appears to operate later into the day, but is still lower than the CMUA TRM values.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The three schools selected in the sample draw were visited in succession and considered together since the size and scope of all three were similar. Anchor Blue completed a full inventory of one of the schools and sampled about 20% of the fixtures for verification from the two other schools. No logging was done as schools were not in normal session.

Summary of Site Visit

Anchor Blue visited all three schools after school was out for the summer. At this school, it was noted that very few staff were onsite, with only one custodial staff onsite and essentially all lights were off. The onsite contact was able to take Anchor Blue to the sampled areas of this site and confirm that installation of all lamps within the sample. No loggers were placed as school was out for the summer and was not on normal schedule.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. LED fixture wattages found in the ex-ante calculations were used in the efficient case after being confirmed in the specs sheets. No adjustments were made to the count of the fixtures Anchor Blue confirmed 100% of the fixtures were installed in the sampled area. Anchor Blue calculated hours of use for the site by looking at the school's daily schedules and calendar from its website, resulting in 2,123 HOU. For areas that were clearly storage or mechanical rooms, Anchor Blue further reduced these hours to 500 as these are low use areas of the site.

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 for School = 1.07

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 peak demand savings for School = 1.00
CDF: Coincident Diversity Factor for School = 0.02

The peak demand realization rate is 100% due to all the fixtures being verified and the inclusion of the HVAC interactive effects and Coincident Demand factors in the ex-ante calculations. The lower hours of use in all areas, and significant reduction in HOU for storage areas is the driver of the 91% energy savings realization rate.

Site 15 – Modesto

Project Summary

This is a shopping mall that replaced all of its exterior parking lot and area lights from HIDs to LEDs. The main driver of the lower energy savings for this site has to do with the efficient counts of the LED fixtures. Several of the parking lot light poles were enhanced from 2 lamps on the pole to 3 lamps, which was not taken into account with the rebate, resulting in additional efficient load in the ex-post analysis. This brought the savings down about 10%, but the ex-post analysis also identified a misclassification of the baseline lamps for the 400w metal halides. This changed the baseline and efficient calculations from assuming electronic ballasts to magnetic ballasts (consistent with the other fixtures) and drove the savings back up for an overall realization rate of 94%.

Table 45. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	203,399	191,110	94%
Peak Demand Savings (kW)	0.0	0.0	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

This project was to upgrade exterior parking lot lights. The site had 30, 400-Watt Metal Halides with magnetic ballasts and 48, 1000-Watt Metal Halides with magnetic ballasts parking lot lights in the baseline case. The baseline fixtures were on a photocell with hours defined as 4,180 hours from dusk to dawn.

Description of Efficient Equipment and Operation

The 400-Watt fixtures were replaced one for one with 150-Watt LEDs. The 48, 1000-Watt Metal Halides were on taller poles, with 1-2 lamps on each pole. In the efficient case, several of the poles had a third lamp added, with 64 total, 240-Watt LEDs found total onsite.

Comments on Ex-Ante Calculations

The Ex-Ante calculations reported one for one replacement of all lamps. However, while onsite, Anchor Blue observed 16 more LED lamps of the larger size than were reported in the calculations. It appears that several of the light poles had additional lamps added to them, as several of the poles were three lamp poles, but all photos of the pre-inspection only had 2 poles. Additionally, one line item of the ex-ante analysis file misidentified the 400-Watt metal halides as electronic ballasts, rather than magnetic ballasts as all the other fixtures were.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of all lights and use an algorithm approach to confirm savings using dusk to dawn HOU.

Summary of Site Visit

While onsite, Anchor Blue found a mix of 1-lamp, 2-Lamp and 3-lamp high light poles, and overall, 64 of the larger wattage lamps compared to 48 in the documentation. All 30 of the smaller, 150-Watt LEDs attached to shorter poles were confirmed onsite. Upon more detailed review of the documentation pre-inspection photos, it appears that all of the baseline poles only had a maximum of 2-lamps, which led to the discrepancy, meaning that several of the 2-lamp baseline fixtures had an additional lamp added.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the deemed consumption for the 400-Watt Magnetic Ballast Metal Halide of 158 watts for the baseline consumption calculation and 1080 watts for the 1000-Watt Magnetic Ballast Metal Halides. LED fixture wattages of 150 and 240 were used in the efficient case, respectively to the aforementioned baseline wattages. Note that in the rebate calculations, the 400-Watt lamps were identified as having electronic ballasts, but this was updated to a magnetic ballast to be consistent with the other lamps.

Since more of the higher wattage lamps were found onsite, Anchor Blue used this updated count of 64 in the efficient case, rather than the claimed 48. The dawn to dusk hours of 4,180 were used for the house of use, consistent with the rebate spreadsheet.

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 for parking lot lights = 1.00

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 peak demand savings for parking lights = 1.00
CDF: Coincident Diversity Factor for parking lot lights = 0.00

There are two drivers of difference in the evaluated savings compared to the ex-ante savings. The first is the change of the ballast type for the 400-Watt MH in the baseline from electronic to magnetic, which increased savings. However, the inclusion of 16 additional LED fixtures in the efficient case decreased the savings for an overall realization rate of 94%. There are no claimed demand savings as these fixtures operate off-peak.

Site 16 - Modesto

Project Summary

This is a department store that completed a full store lighting upgrade to LEDs from CFLs and linear fluorescents fixtures. This project is only for part of the full store upgrade, and it was impossible to distinguish which lights were part of the project and which were not. Anchor Blue counted all the lights in the store, and it was well over the amount rebated. Therefore, Anchor Blue assumed that 100% of the rebated lights were installed. The hours of use were increased compared to the ex-ante HOU after discussions with the site contact, which should have been applied in the ex-ante calculations as well. Additionally, about 20% of the total lights remain on 100% of the time as security lights, both in the ex-ante and ex-post case. The increase in hours of use for all lights and the inclusion of the security lights resulted in the 143% energy realization rate. The peak demand realization rate is 100%, reflecting the 100% fixture count match.

Table 46. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	154,092	220,507	143%
Peak Demand Savings (kW)	36.52	36.52	100%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures in this site were a mix of linear fluorescents and CFLs. The linear fluorescents were 1-, 2-, and 3-lamp, 4ft fixtures, with a few 2ft fixtures. Similarly, the CFLs were a mix of 1-, 2-, and 3-lamp CFLs.

The baseline fixtures were on every day from 6 am to 10 pm, except for two holidays for a total of 5,808 annual hours. These hours were confirmed by the onsite staff and by looking at the interval billing data. About 20% of the baseline fixtures were on 24/7 for security.

Description of Efficient Equipment and Operation

The efficient fixtures are all LEDs, mostly troffer retrofit kits, some plug in TLEDs, and other LED luminaire retrofit kits. The efficient fixtures are on the same schedule as the baseline fixtures, operation 5,808 hours annually, with 20% of the fixtures on a 24/7 schedule for security.

Comments on Ex-Ante Calculations

The ex-ante calculations used a lower HOU estimate of 4,204 annual hours and no estimates were made for security lighting. The 5,808 hours reflect that the lights come on earlier than the store opens and stay on later than closing time. The ex-ante calculations did not take into account the security 24/7 security lighting.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The M&V plan for this site was to confirm the installation of the lights and to use site reported hours of use in the ex-post analysis. No logging was done on this site due to risk of losing loggers in retail areas.

Summary of Site Visit

While onsite, Anchor Blue talked to the site contact who confirmed that the entire store had been retrofitted with LEDs and the hours of use for about half the lights were 6am to 10pm. The site contact also said that 20% of the lights were on 8,760 for security purposes. Anchor Blue counted all the lights in the store, which were well beyond the number of fixtures rebated – though all the fixture types were confirmed to have at least the number of fixtures rebated. The site contact reported that several lighting projects had happened over the past few years and he wasn't sure which project was actually being evaluated.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. LED fixture wattages found in the ex-ante calculations were used in the efficient case after being confirmed in the specification sheets. No adjustments were made to the count of the fixtures Anchor Blue confirmed more than 100% of the fixtures installed. No additional fixtures were credited to this project though since other projects had taken place. The hours estimated by the site contact of 5,808 were used for both the baseline and efficient case. Additionally, Anchor Blue delineated about 20% of the fixtures as security fixtures and applied 8,760 hours to these fixtures.

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 for retail = 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 peak demand savings for retail = 1.20
CDF: Coincident Diversity Factor for retail = 0.88

The peak demand realization rate is 100% due to all the fixtures being verified. The increase in HOU and the inclusion of the 24/7 security fixtures

Site 17 - Modesto

Project Summary

A small manufacturing facility replaced a modulated, constant speed 20 HP air compressor with a new, variable speed 30 HP rotary screw compressor, retaining their existing 25 HP constant speed compressor for backup. The system operates at 100 psig continuously throughout the year, with minimal load many weekends. Anchor Blue monitored the air compressor for around a month and found savings 103% of the ex-ante value for energy and 113% for demand. The increased demand savings appeared to be due to the ex-ante use of average savings instead of peak hours to calculate demand.

Table 47. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	134,912	139,284	103%
Peak Demand Savings (kW)	12.9	14.6	113%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The facility operated with two Sullivan Palatek constant speed air compressors, a 25 HP baseload unit and a 20 HP unit used during higher demand times. The 25 HP unit operated constantly with no modulation. The 20 HP unit was shut down during non-production hours, generally weekends, and operated in a largely load/unload pattern during production hours. The system operated at around 100 psig.

Description of Efficient Equipment and Operation

The site installed a new, variable speed 30 HP Gardner Denver air compressor and retained the 25 HP Sullivan Palatek unit for backup. The new unit operates constantly at 100 psig, but varies its speed according to load.

Comments on Ex-Ante Calculations

The ex-ante savings were based on a week of logged power for the two Sullivan Palateks compared to logged operation of the new Gardner Denver unit. Demand savings were based on average usage without regard to weekday or time. It should be noted that current California Title 24 building codes now cover compressed air, but projects that are considered 'early retirement' may still be claimed if program influence can be shown to have taken the inefficient equipment out of service early, as appears to be the case here. The 2019 Building Energy Efficiency Standards for Residential and Nonresidential Buildings Title 24, Part 6, Section 120.6(e), Mandatory Requirements for Compressed Air Systems specifies that any compressed air system over 25 HP replacing more than half its horsepower must include a variable speed compressor. This would make the installed system at this site a code requirement, but it is considered 'early retirement' for this analysis based on evidence from project documentation. The pre-inspection photos showed the nameplate of the Sullivan Palatek baseline air compressors, which included the manufacture date of December 2016, which is well before the average life of air compressors (15-20 years), rendering an 'early retirement' assumption valid.

For future air compressor replacement projects, utilities should determine if the project is eligible under code. If the project triggers code (more than 50% of the total system replaced), then the utility must document the

age of the existing equipment in a similar manner to verify an early retirement scenario, if it is applicable. A photo of the baseline equipment nameplate with the manufacturer date or invoices of the baseline compressor purchase date qualifies as evidence of early retirement if the age of the equipment is less than 2/3 of the average measure life for the equipment. Utilities may also consider ending compressed air programs because of code.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue's M&V plan was to visit the site to confirm operations and installation of the new compressor, and that the old compressors were no longer in use. If possible, Anchor Blue would install a data logger to take additional data on operations, preferably for more than a single week. Using compressor specifications, Anchor Blue will then convert compressor power to airflow to determine savings compared to the baseline system.

Summary of Site Visit

Anchor Blue visited the site and confirmed the installation and operation of the new air compressor. Site staff explained that the current operational hours were typical of year-round operations, although they have occasional production spikes that require extended hours. During the site visit Anchor Blue installed a data logger on the compressor to monitor operation for several weeks.

Ex-post Calculations and Assumptions

Based on current operations from the logger data and the baseline operational data provided for the project, Anchor Blue calculated savings for the new air compressor compared to the existing compressors. The baseline data showed the Palatek 25D4 operating continuously at full load with the Palatek 20D acting as a trim compressor, idling during low use times such as weekends and modulating during most facility operational hours. Anchor Blue's logged data showed the new system using its variable speed drive to continuously adjust to compressed air demands as expected. Using the manufacturer's compressor data, Anchor Blue converted the logged data from power to airflow and then used this airflow data to determine how much power the Palatek 20D would use at each aiflow level. The Palatek 25D4 was assumed to operate continuously, providing it's rated airflow at all times, as in the provided baseline data logs. System operation does not vary significantly seasonally, so all weekday operation between 4PM and 9PM was averaged to determine peak operation.

Annual Energy Savings Algorithm

$$\Delta kWh = \sum_{all\ hours} (W_{baseline} - W_{EE})/1000$$

Where,

$W_{Baseline}$: Load of all operating baseline compressors based on compressor curves for airflow
W_{EE}: Load of new operating compressor based on amperage from the data logger
All hours: Annual hours of system operation = 8,760

Summer Coincident Peak kW Savings Algorithm

$$\Delta kW = \frac{\sum_{peak\ hours} (W_{baseline} - W_{EE})/1000}{number\ of\ peak\ hours}$$

Where,
$W_{Baseline}$: Load of all operating baseline compressors based on compressor curves
W_{EE}: Load of new operating compressor based on logged data
Peak hours: Peak demand hours, 4-9 PM weekdays

Anchor Blue found actual savings to be 103% of the ex-ante value and demand to be 113% of the ex-ante value. The increase in energy savings is from differences in logged ex-post data readings and the increased demand is due to Anchor Blue's use of weekday peak demand hours to determine demand instead of overall average usage.

Site 18 - Modesto

Project Summary

This is an elementary school that did a full interior and exterior retrofit of its lights to LEDs. Three schools from Modesto were in the sample this year for evaluation, all of which were similar in scope and size. Because of how large these sites were, Anchor Blue sampled about 20% of the lighting fixtures to verify for two of the sites and completed a full verification of the other school. All of the fixtures in the sample and the full site had 100% of the fixtures installed, except for one outlier exception at this elementary school. The outlier was a trailer room that was removed from this site last year and had 7 connected fixtures inside, which are no longer present. Additionally, this site had several outdoor fixtures replaced, but these fixtures were incorrectly given the school space type hours of use, HVAC interactive factors and coincident demand factors. Anchor Blue updated the space type and default hours and factors for these fixtures. Additionally, two-line items towards the end of the savings calculations ex-ante workbook were missing baseline fixture wattages, which resulted in increased usage from the LEDs, which was updated in the ex-post data. All of these changes affected both the peak demand (98%) and energy savings (96%) realization rates.

Changes in hours of use additionally affected the energy savings realization rate. The ex-ante calculations utilize the default school hours of use for all spaces (2,280). Anchor Blue estimated hours by looking at the school's schedule and calendar found online, which equated to 2,079 hours and are more aligned with updated 2023 DEER default HOU (see comments on ex-ante calculations for more detail). Additionally, there were several spaces that were marked as storage, mechanical or electrical that used the same default school HOU. Anchor Blue updated these spaces HOU to match the CMUA TRM low usage area HOU (500) since these space types get much lower usage than the rest of the school. Finally, the outdoor fixtures were updated and given the typical dusk to dawn HOU of 4,180. All of the changes to the HOU essentially canceled each other out to result in nearly the same realization rate for energy savings (98%) as the peak demand realization rate (95%).

Table 48. First-Year Project Savings Summary

	Ex-ante	**Ex-post**	**Realization Rate**
Energy Savings (kWh/Year)	85,950	82,610	96%
Peak Demand Savings (kW)	0.77	0.757	98%

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The baseline fixtures were mostly 32-watt, 4-ft T8s with varying number of lamps. There were also some CFLs and Halogen bulbs, as well as some exterior high pressure sodium and metal halide fixtures.

The baseline HOU used the CMUA TRM default hours of use for schools for all space types of 2,280 hours.

Description of Efficient Equipment and Operation

The efficient fixtures are all LEDs, mostly troffer retrofit kits, with some other LED luminaire retrofit kits and screw-in LEDs, all of varying wattages. The efficient fixtures are assumed to be on the same schedule as the baseline fixtures, using the default CMUA Hours of Use of 2,280.

Comments on Ex-Ante Calculations

The ex-ante calculations use the CMUA default hours for schools. Anchor Blue looked at the website of each school evaluated to determine hours of use based on the daily schedule and yearly calendar. In all cases, the hours of use calculated were lower than the CMUA TRM values. Anchor Blue looked at the updated eTRM HOU values that will be recommended for use in the next program year, and all school hours have been lowered (1,300 or 1,800 for a primary or secondary school, respectively) compared to the current CMUA TRM values (2,280 for both primary and secondary schools). These lower HOU assumptions are more in line with the calculated values, therefore, in the ex-post analysis, Anchor Blue utilized the calculated hours and recommends updating default HOU to the updated eTRM values in 2023.

Specific to this site, there were two errors that were corrected in the ex-post analysis. The first error was that all the outdoor fixtures at the site were not given the outdoor fixture space type assumptions and had school space type assumptions applied. This underestimated the HOU for these fixtures and applied both HVAC and Coincident Demand factors that should not be applied to outdoor fixtures. The second error was with two of the last line items of, both of which were outdoor fixtures and missing baseline wattages. The appropriate baseline wattages were applied in the ex-post case, resulting in more savings rather than these line items showing increased lighting loads.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

The three schools selected in the sample draw were visited in succession and considered together since the size and scope of all three were similar. Anchor Blue completed a full inventory of this school and sampled about 20% of the fixtures for verification from the two other schools. No logging was done as schools were not in normal session.

Summary of Site Visit

Anchor Blue visited all three schools after school was out for the summer. At this school, summer school and daycare were in session, unlike the other two schools. Therefore, hours were estimated for the entire year in the ex-post analysis rather than simply for the school year as the other two schools. The onsite contact was able to take Anchor Blue through the entire site and confirm that installation of all lamps onsite except for 7 fixtures. These fixtures had been in a mobile classroom trailer that had recently been removed permanently from the site. No loggers were placed as school was not on normal schedule, even though it was occupied and in use.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings. Anchor Blue utilized the CMUA TRM deemed consumption for the baseline fixtures. LED fixture wattages found in the ex-ante calculations were used in the efficient case after being confirmed in the specification sheets. Several adjustments were made compared to the ex-ante calculations:

- Removed the 7 fixtures from the removed mobile classroom trailer (labeled Media Trailer in the ex-ante data) from the efficient case only.

- Anchor Blue calculated hours of use for the majority of the site by looking at the school's daily schedules and calendar from its website, resulting in 2,079 HOU (as compared to 2,280 in the ex-ante calcs).

- For areas that were clearly storage or mechanical rooms, Anchor Blue further reduced these hours to 500 as these are low use areas of the site and should not have the same HOU as the other spaces

- Outdoor fixtures were updated to have outdoor fixture default values for HOU (4,180), no HVAC interactive factors, and coincident demand factors of 0.

- Missing baseline wattages for two of the last line items in the calculator were filled in with the appropriate baseline wattages.

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 for School = 1.07; Exterior = 1.0

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 peak demand savings for School = 1.00;
Exterior = 1.0

CDF: Coincident Diversity Factor for School = 0.02; Exterior = 0.0

The peak demand realization rate is 98% due the removal of the 7 fixtures, the change of the CDF for the outdoor fixtures to 0, and the correction to the missing baseline wattages for two-line items. These changes and the changes in the HOU for all areas the drivers of the 96% energy savings realization rate. However, the changes to the HOU essentially canceled each other out since most areas saw a small reduction in HOU, but the outdoor fixture HOU are much higher than the ex-ante calculations.

Site 19 - Merced

Project Summary

The site is a three-story, multi-unit residential care facility with common areas including a dining room and activity areas. The facility retrofitted lighting in the internal common areas and exterior parking areas, replacing linear T8 and compact fluorescent lamps with LEDs in the indoor common area. The exterior parking areas had metal halide and compact fluorescent lights replaced with LEDs. Anchor Blue calculated a 97.4% energy realization rate based on the onsite and inventory data provided by the site. However, detailed ex ante calculations were not provided and therefore the exact reason for the small variation cannot be determined. No peak demand savings were claimed, though they could have been.

Table 49. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	73,714	71,774	97.4%
Peak Demand Savings (kW)	0	5.3	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

Prior to the project, the facility interior was lit with a combination of T8 linear fluorescent and compact fluorescent lights. The common area lights were largely on timers but around a quarter of the lights were continuously on as emergency lights. Laundry and storage areas used light switches to control lights. The exterior lights were a mixture of HID fixtures and compact fluorescents on dusk-to-dawn controls.

Description of Efficient Equipment and Operation

All existing fluorescent and HID lights were retrofitted with LEDs. No controls were changed.

Comments on Ex-Ante Calculations

The ex-ante files did not provide details of the calculations, just an invoice showing fixtures purchased. Anchor Blue obtained a detailed list of fixtures retrofitted from the implementer, but no detail on how savings were calculated was included in the ex-ante data.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue planned to verify the installation and operation of the new LED lights and data loggers would be installed in various space types to determine hours of operation where appropriate. Anchor Blue would also confirm the control types during the site visit in each area.

Summary of Site Visit

Anchor Blue found the lights mostly in agreement with the detailed list provided by the implementer, with a few small variations in total counts. Anchor Blue estimated between 20 and 30% of the hall and assembly area lights were on continuously.

The corridor and assembly area lights were on timers, but site personnel could not provide the actual hours so Anchor Blue used data loggers to determine hours of operation. Storage and laundry areas had light switches and restrooms had motion sensors. Anchor Blue installed data loggers in two laundry areas, two restrooms, the mechanical room, the activity room, and the kitchen, but determined that storage areas were too diverse to select a representative sample.

Ex-post Calculations and Assumptions

The ex-post calculations used a standard algorithm with onsite findings to determine the energy savings using interactive effects and peak coincident demand factors to calculate savings that include HVAC interactive effects and coincident peak demand factors. Anchor Blue changed the hours of operation based on logger data for all areas logged and used TRM default HOU for the storage and exterior areas.

Annual Energy Savings Algorithm

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

Where,

$W_{Baseline}$: Connected load of baseline fixtures
W_{EE}: Connected load of LED fixtures
HOURS: Average hours of use per year
DIE_{Energy}: DEER Interactive Effects Factor for energy savings (*see table below by space type*)

Summer Coincident Peak kW Savings Algorithm

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

Where,

DIE_{Demand}: DEER Interactive Effects Factor for peak demand savings (*see table below by space type*)
CDF: Coincident Diversity Factor for peak demand (*see table below by space type*)

Table 50. HVAC Interactive Effect Factors and Coincident Peak Demand Factors for Site 19

Space Type	Coincidence Peak Demand Factor	HVAC Interactive Effect (Energy)	HVAC Interactive Effect (Demand)
Restaurant	*0.80*	*1.03*	*1.18*
Office space < 250 sf	*0.69*	*1.07*	*1.23*
Corridors, restrooms, stairs, support areas	*0.71*	*1.12*	*1.31*
Lounge/recreation	*0.53*	*1.04*	*1.18*
Kitchen, food preparation	*0.80*	*1.03*	*1.18*
All others	*0.69*	*1.07*	*1.23*
Library, reading area	*0.69*	*1.07*	*1.23*
Lobbies	*0.71*	*1.12*	*1.31*
Religious, worship areas	*0.53*	*1.04*	*1.18*
Exterior	*0.00*	*1.00*	*1.00*

Since the detailed ex-ante calculations were not included in the provided files and the pdf provided by the implementer did not match the database savings, it is not possible to determine the exact reasons for variations in savings between ex-ante and ex-post calculations. Based on the limited available data, changes

in hours of use applied by Anchor Blue based on logger data resulted in a reduction in savings that was largely cancelled out by corrections to fixture wattages and interactive effects, resulting in a 97.4% realization rate. No ex-ante demand savings were claimed, but Anchor Blue found 5.3 kW of peak demand reduction.

Site 20 - Merced

Project Summary

The site is a large retail store that installed two new, medium temperature reach-in refrigerators to temporarily store refrigerated items for curbside pickup. The units operate continuously, even when the store is closed. The source of the ex-ante savings was unclear but was significantly higher than indicated for two glass door reach-in refrigerators over 50 cubic feet in a commercial facility in the current eTRM. The current eTRM has per-unit savings of 588 kWh, while it appears that the ex-ante savings value is 20,000 kWh per unit, which is well over what these units actually consume. This results in an extremely low realization rate (2.9%) and Anchor Blue recommends that deemed program savings for all prescriptive measures be reviewed and updated.

Table 51. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	40,000	1,176	2.9%
Peak Demand Savings (kW)	0	0.1342	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

The units were new for curbside pickup items and did not replace any existing equipment.

Description of Efficient Equipment and Operation

Two new True T-49G-HC-FGD01 LORA refrigerated cases were purchased to hold perishable items for curbside pickup. They are located near the service desk checkout area and operate continuously.

Comments on Ex-Ante Calculations

No ex-ante calculations were provided with the project files.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Anchor Blue will use TRM based prescriptive savings for this project. The site visit is intended to verify installation and operation of the units.

Summary of Site Visit

Anchor Blue visited the site, located the units near the checkout counter by the service desk, and confirmed the model numbers from their nameplates. They were labeled with Energy Star logos and operating as expected. There was also a new freezer that was not part of the project and did not appear to be an Energy Star unit.

Ex-post Calculations and Assumptions

Anchor Blue used the TRM calculation for reach in, medium temperature, glass door, refrigerated cases greater than 50 cubic feet in all climate zones to calculate savings for this project. The case volume is 73.5 cubic feet.

CA eTRM Measure Information

Measure ID: SWCR018-03[13]
Measure Name: Reach-In Refrigerator or Freezer, Commercial
Accessed: August, 2022

Annual Energy Savings Algorithm
ΔkWh = number of cases * eTRM kWh/case

Where,
Number of cases = 2
eTRM kWh/case = 588 kWh/case for commercial medium temperature reach in case over 50 cubic feet with glass doors in all climate zones

Summer Coincident Peak kW Savings Algorithm
ΔkW = number of cases * eTRM kW/case

Where,
Number of cases = 2
eTRM kW/case = 0.0671 kWh/case for commercial medium temperature reach in case over 50 cubic feet with glass doors in all climate zones

Since there were no ex-ante calculations or deemed savings were provided, the reason for the savings discrepancy is unclear. Anchor Blue recommends a review of all prescriptive measure savings in all utility programs to align with the current eTRM.

---

[13] https://www.caetrm.com/measure/SWCR018/03/

Site 21 - Merced

Project Summary

A large retail store installed four new rooftop air conditioners. The ex-post savings were based on the new CA eTRM values for air conditioners of at least EER of 12 for single story large retail buildings in climate zone 12. The ex-ante calculations or deemed savings were not provided and the project documentation showed lower savings than the claimed savings in the tracking database, so the source of the ex-ante savings is unclear, but is significantly higher than the current eTRM values, resulting in the low 27% realization rate for energy. Anchor Blue suspects these savings are out of date and are based on previous code baselines and recommends all utilities update their prescriptive savings with the most current eTRM values. Peak demand savings could have been claimed for this project but were not.

Table 52. First-Year Project Savings Summary

	Ex-ante	Ex-post	Realization Rate
Energy Savings (kWh/Year)	21,845	5,808	27%
Peak Demand Savings (kW)	0	4.66	NA

Source: Project Documentation, Anchor Blue Analysis

Description of Baseline Equipment and Operation

Prior to the project the facility had four Carrier rooftop AC units in use: one 50DP020 with an EER of 8, one 50DP016 with an EER of 8.3, and two 48DP016 units with EERs of 8.3.

Description of Efficient Equipment and Operation

The store installed four 15 ton rooftop AC units with VFDs and economizers, York model number ZJ180C00D4B5ACATC1, and one 3 ton rooftop AC unit with an economizer, York model number ZT037C00P4B5BCAGR2. The 3 ton unit is not included in the efficiency project. The units are for cooling only and the facility uses gas heat. The 15 tons units have a rated EER of 12.20 and an IEER of 13.4, according to the included AHRI certificate, but the specification sheet shows an IEER of 12.3.

Comments on Ex-Ante Calculations

The ex-ante rebate was based on a prescriptive replacement, but savings appear to have used some sort of modeled or semi-prescriptive calculations that were not provided or based on old deemed values with out-of-date codes. There is a summary sheet in the project documentation showing the baseline and efficient efficiencies and unit capacities along with entry fields and outputs which shows 8,147.36 kWh savings, substantially less than the 21,845 kWh listed in the program database. The source and algorithm for the calculations sheet were not provided.

Onsite Visit and Ex-Post Savings Calculations

M&V Method and Plan

Savings are based on eTRM values for climate zone 12 for the purchased equipment. Anchor Blue planned to verify installation and operation of the four new rooftop AC units.

Summary of Site Visit

Due to staff changes at the company, Anchor Blue was unable to obtain permission to access the roof at their Merced store and could not verify the physical installation of the units, although Anchor Blue did visit the site to verify another project. Based on invoices, the units are assumed to be installed as claimed, but staff could not provide any information about rooftop HVAC units at the site.

Ex-post Calculations and Assumptions

Anchor Blue used the current CA eTRM deemed savings values for this analysis. The site installed four 15 ton rooftop AC units with VFDs and economizers, York model number ZJ180C00D4B5ACATC1, and one 3 ton rooftop AC unit with an economizer, York model number ZT037C00P4B5BCAGR2. The 3 ton unit is not included in the efficiency project. The units are for cooling only and the facility uses gas heat. The 15 tons units have a rated EER of 12.20 and an IEER of 13.4, according to the included AHRI certificate.

The current eTRM provides savings for 12-17 ton AC units with EER greater than 12 in climate zone 12 based on end of life replacement.

> **CA eTRM Measure Information[14]**
>
> Measure ID: SWHC013-02
> Measure Name: Unitary Air-Cooled Air Conditioner, Over 65 kBtu/hr, Commercial
> Accessed: August, 2022
>
> **Annual Energy Savings Algorithm**
> ΔkWh = # of units * TRM savings/ton * tons/unit
>
> Where,
> # of units = 4
> TRM savings = 96.8 kWh/ton for replace on burnout 12-17 ton air conditioner in CZ 12 for EER of at least 12 in large single story retail buildings
> Tons = 15/unit (60 Total)
>
> **Summer Coincident Peak kW Savings Algorithm**
> ΔkW = # of units * TRM savings/ton * tons/unit
>
> Where,
> # of units = 4
> TRM savings = 0.0776 kW/ton for replace on burnout 12-17 ton air conditioner in CZ 12 for EER of at least 12 in large single story retail buildings
> Tons = 15/unit

The eTRM based savings are lower than the savings provided by the calculator sheet in the project which are, in turn, lower than the savings listed in the program database. The source of the calculation sheet is unclear, but does not match either the natural replacement or remaining useful life values in the eTRM for climate zone 12. Anchor Blue recommends updating all prescriptive measure assumptions with the current CA eTRM

---

[14] https://www.caetrm.com/measure/SWHC013/02/