NAVIGANT
CONSULTING

Energy Efficiency Program Evaluation, Verification, and Measurement for the Modesto Irrigation District

FY 2009 Programs

Prepared for:

Modesto Irrigation District

NAVIGANT
CONSULTING

Navigant Consulting
1001 Officer's Row
Vancouver, WA 98661

360-828-4000
www.navigantconsulting.com

November 5, 2010

Table of Contents

Introduction

Two legislative bills (SB1037 and AB2021) were signed into law in California a year apart. SB1037 requires that Publically Owned Utilities (POUs), similar to Investor-Owned Utilities, place cost-effective, reliable, and feasible energy efficiency and demand reduction resources at the top of the loading order. In addition, SB1037 (signed September 29, 2005) requires an annual report that describes the programs, expenditures, expected energy savings, and actual energy savings.

Assembly Bill 2021, signed by the governor a year later (September 29, 2006), reiterated the loading order and annual report stated in SB1037, and expanded on the annual report requirements. The expanded report must include investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and establishes annual targets for energy efficiency and demand reduction over ten years.

The legislative reports require both an ongoing assessment of what is occurring within the programs, along with a comparison of how much possible savings are left within the POU service territory. The goal of this fiscal year (FY) 2009 energy efficiency program plan is to assist the Modesto Irrigation District (MID) in meeting these requirements.

General Utility Background Information

The District is an irrigation district organized in 1887 under the provisions of the Wright Act (California Water Code §20,500 et seq.). The MID supplies water for irrigation, drinking water, and electricity to a service area that lies within portions of Stanislaus, Tuolumne, and San Joaquin Counties in California. Irrigation service began in 1904 and electric service in 1923.

The District provides electric service in a 160-square-mile area. To provide electric service, the MID owns and operates an electric system that includes generation, transmission, and distribution facilities. The District also purchases power and transmission service from others and participates in other utility power supply and transmission arrangements. MID have sales of about 2,700 GWh and a summer peak demand of about 700 MW.

Key Customer Markets

MID offers a full slate of energy efficiency programs to each of its customer segments. These programs encourage members to be more energy efficient, decrease their energy demand and costs, and conserve resources.

Although about 85 percent of MID's customers are residential, most of its sales are to the nonresidential sector. The District provides the residential market with a full array of energy efficiency programs;

however, more than 90 percent of the savings, both historical and expected, come from the nonresidential sector. Most of the savings comes from refrigeration, lighting, and process-related measures such as compressed air and motor energy efficiency measures.

Energy Efficiency Programs Offered

MID offers a variety of energy efficiency programs to encourage its members to reduce energy consumption. These programs include a combination of informational energy audits and rebates as a way to help increase member awareness of energy efficiency and encourage the wise use of electricity.

Residential Program Summaries

MID provides a number of rebates that include:

- Sunscreens or window film
- Whole-house fan
- Central air conditioner
- Room air conditioner
- Clothes washer
- Air duct sealing
- Electric water heater
- High-efficiency air-conditioning financing
- Lights
- Refrigerator and freezer recycling
- New home construction
- Windows

Nonresidential Program Summaries

MID provides nonresidential efficiency measure assistance through the following three general program initiatives.

- **Standard Rebates** – MID has a catalog of standardized rebates for a number of nonresidential efficiency measures. The catalog is extensive and includes measures for:
  - Refrigeration
  - Lighting
  - Heating, ventilating, and air conditioning (HVAC)
  - Motors
  - Window shade screens, awnings, and film
  - Computing

- **Custom Rebates** – MID's Custom Rebate Program is available to larger commercial, industrial, and agricultural customers who replace existing equipment or systems with high-efficiency equipment. The projects are subject to review and acceptance by MID and must:
  - Reduce electrical energy usage relative to the baseline.
  - Operate for a minimum of five years after installation.
  - Not be completed before submitting an application.
  - Be completed within one year of submitting the rebate application.
  - Not be otherwise eligible for an MID commercial rebate.
- **New Construction** – MID offers assistance for projects that involve the installation of new high-efficiency equipment in new facilities or during the major remodel or expansion of existing facilities. The program is open to commercial, industrial, and agricultural customers that presently or will soon receive electric service from MID. The projects are subject to review and acceptance by MID and must:
  - Reduce electrical energy usage relative to the baseline.
  - Operate for a minimum of five years after construction.
  - Not be completed before submitting an application.
  - Be completed within one year of submitting the rebate application.

2009 Program Summary

In fiscal year 2009, MID spent a total of $3,406,322 in program costs that led to total reported demand reductions of 2,390 peak demand kW and total reported annual energy reductions of 14,680,823 net kWh. Table 1 summarizes the claimed kW and kWh savings for MID's 2009 programs.

Evaluation Priorities

As shown in Table 1, nearly 90 percent of MID's energy savings accrues from its nonresidential programs, with lighting end use having the most claimed savings followed distantly by process/motors and refrigeration end uses. These savings primarily come from a combination of custom rebates based on the amount of energy saved and fixed rebates based on the installation of specific equipment and measures. Each of these non-residential end uses is a high evaluation priority.

Based on these evaluation priorities, ten projects at nine sites were selected for inclusion in the FY 2009 impact evaluation. These nine sites together represent claimed energy savings of 5,481,471 kWh, which is about 45 percent of the total claimed nonresidential energy savings for the 2009 program year. The nine sites also have unique applications of measures for the following.

- Refrigeration gaskets
- Refrigeration strip curtains
- Personal computer (PC) controls
- Lighting
- Air compressor with a variable-frequency drive (VFD)
- Industrial furnace
- HVAC equipment
- Wine tank insulation

Table 1 2009 Summary of MID's Programs

Program Sector	Net Annual Energy Savings (kWh)	Energy Savings % of Total	Net Peak Demand Savings (KW)	Demand Savings % of Total
Residential Appliances/Pool Pumps	23,459	0.2%	6	0.3%
Residential HVAC	315,346	2.1%	359	15.0%
Residential Lighting	295,966	2.0%	53	2.2%
Residential Refrigeration	1,146,692	7.8%	162	6.8%
TOTAL RESIDENTIAL	1,781,463	12.1%	580	24.3%
Non-Res Motors/Process	2,755,038	18.8%	402	16.8%
Non-Res HVAC	166,074	1.1%	80	3.3%
Non-Res Lighting	6,065,279	41.3%	1,019	42.6%
Non-Res Refrigeration	2,543,227	17.3%	200	8.4%
Non-Res Other	1,369,742	9.3%	109	4.6%
TOTAL NON-RES	12,899,360	87.9%	1,810	75.7%
TOTAL	14,680,823		2,390	

Impact Evaluation Plan

A useful construct for thinking about the range of energy efficiency measures offered by MID is the International Performance Measurement and Verification Protocol (IPMVP). Table 2 presents a listing of the IPMVP protocols, the nature of the performance characteristics of the measures to which M&V options typically apply, and an overview of the data requirements to support each option. Our approach to selecting M&V strategies followed these guidelines.

Table 2 Overview of M&V Options

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

The ten projects evaluated are both custom and prescriptive installed measures. The claimed savings are based on engineering calculations appropriate for the specific site or prescriptive savings from the E3 calculator. A combination of Options "A", "B", and "C" was used for the evaluation.

Impact Evaluation Results

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

1. Verified measure installation.
    a. Developed a sample for field verification activities.
    b. Conducted field verification activities and observations.
2. Reviewed applications and supporting documentation provided to the Modesto Irrigation District.
3. Developed adjusted measure savings values based on field activities and data reviews.

These activities are discussed in detail in the following sections.

Measure Installation Verification

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

1. Establishing the presence of energy-efficient measures by comparing the number of installations observed with the number of installations recorded in the rebate application.
2. Providing input on the quality of installations observed – including whether or not they were operating correctly.
3. Where observed equipment did not match program-reported installations, determining if retrofits/installations were ever present, and/or the reason that the installation plan changed.
4. Recording key facility performance data, such as daily schedules, seasonal variations in schedules, and control strategies.
5. Where appropriate, taking measurements of power consumption and usage directly on equipment.
6. In one case, comparing utility billing data to predicted savings to determine if they are realistic.

Installation Verification Sample

Ten of the projects that received rebates in FY 2009 were selected for on-site evaluation. These included two sites with refrigeration gasket projects, one site with PC controls, three facilities with lighting upgrades, one air compressor upgrade including a VFD, one industrial furnace, an HVAC retrofit, and an insulation measure on refrigerated tanks.

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

Table 3 Verified Program Installations and Savings

Customer	Retrofit Measures	kW	kWh
Site 1	Gaskets	11.78	73,600
Site 2	Strip Curtains	6.63	8,649
Site 3	PC Control Software	0	1,396,772
Site 4	Lighting	231	1,674,490
Site 5	Lighting	0	12,717
Site 6a	Lighting	91.2	985,416
Site 6b	Air Compressor	81.0	665,950
Site 7	Tank Insulation	184.0	944,905
Site 8	HVAC	41.5	56,316
Site 9	Industrial Furnace	78.1	467,390
Program Total		**725.21**	**6,286,205**

In evaluating these projects, particular attention was paid to reviewing the program documents and supplementing them with field verifications. The evaluations at sites 5, 6, 7, and 9 used the IPMVP Option B approach, calculating savings using metered data already available from the sites. The evaluation of the lighting retrofits involved the IPMVP Option A approach by reviewing engineering calculations, performing site interviews, and temporarily installing lighting loggers at sites with occupancy sensors. Deemed values were used in calculating savings for the project at site 8 because of the uncertainties in operational characteristics at the site.

Site Verification Activities

Field activities typically involved two components:

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

Field evaluation activities were conducted from March 30 through April 1, 2010. At the time, it was anticipated that all expected installations were completed and finalized.

Installation Verification Results

Verification work, discussions with participants subsequent to field verification activities, and an analysis of the verified installations indicated that the equipment attributed to the Nonresidential Custom Program was installed as expected; however, the savings were not necessarily accurately calculated, and in one case the project equipment was no longer operational.

Site 1

Site 1 was a grocery store. The store replaced gaskets on 43 glass cooler and freezer doors and 2 walk-in cooler doors for a total of 736 linear feet of gaskets. These constitute approximately 25 percent of the store's refrigerator doors.

The Navigant team visually verified the gaskets were in place and were not leaking. Prescriptive savings of 0.016 kW/linear foot and 100 kWh/linear foot were used to calculate savings. This is summarized in Table 4.

Table 4 Site 1 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	11.78	73,600
Verified Calculated Savings	11.78	73,600

Site 2

Site 2 was a liquor store. The store installed strip curtains on a walk-in cooler. The door area was 18.6 square feet.

The Navigant team visually verified the strip curtain was in place. Discussions with the store's staff indicate that the door is often left open during deliveries and stocking activities, totaling three hours per week. Prescriptive savings of 0.425 kW/sq ft and 465 kWh/sq ft were used to calculate savings. This is summarized in Table 5.

Table 5 Site 2 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	6.63	8,649
Verified Calculated Savings	6.63	8,649

Site 3

The project at site 3 involved the installation of remote PC control software on computers at multiple networked locations. The software was centrally controlled and monitored from the main office.

The Navigant team examined the PC control records to determine savings from the software installation. Baselines can be difficult to establish for projects such as this; however, the algorithm used appeared to be reasonable. The baseline assumed that a typical liquid crystal display monitor used 35 watts, and the computers used between 56 and 100 watts, depending upon their models. A weighted average showed each computer and monitor pair was assumed to use around 121 watts. The software included model details for each computer and accounted for variations in the model power use. Although these values are reasonable for PCs, it should be noted that computer power use is not a constant, and depends heavily on what the processor is doing at the time. Nevertheless, these usage values are reasonable for typical personal computers, and have been accepted because individual power measurements were not practical.

One of the biggest difficulties in assessing savings from controls software is establishing how much use each computer would have seen in the absence of controls software, because many models have internal software that puts them to sleep when not in use. In addition, some users shut their computers down at the end of the workday or on weekends. However, the software does not log savings if the user shuts the computer down manually, so this effect should be minimized. The provided calculations assumed that the computers would have averaged 78.5 percent use at their average power of 121 watts. This is equivalent to an average use of 131.9 hours per week, or a typical computer only being shut down for a day and a half per week. However, the actual software calculations used an average computer power of 95 watts, significantly below the input value of 121 watts. The reason for the disparity is unclear, although it is most likely due to either reduced processor power or time the monitor is in sleep mode. In addition, the software calculated using a baseline run time of only 6,284 hours per year, or 71.7 percent operation, implying shutdown time of 47.5 hours per week, a more reasonable assumption than the previous one.

The application was for the software control of 6,015 computers, which were in use at the time of the installation. However, additional computers have been added to the system since that time and, at the end of March 2010, 7,019 computers were being controlled. This corresponds to an increase of 16.7 percent in the systems controlled.

As shown in Table 6, this site showed savings that were in line with the incentive application. The savings were very close to the calculated values for the original number of computers; however, the increased number of computers being controlled results in a substantial increase in overall savings. However, because the software only shuts the computers down at night and on weekends, the coincident demand factor is expected to be zero, and no demand savings should be expected.

Table 6 Site 3 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	120.3	1,203,000
Verified Calculated Savings	0	1,396,772

Site 4

Site 4 was a large food-processing facility consisting of multiple buildings. A lighting retrofit was done in nine buildings. Previously, these areas were lit with 840 400-watt metal halide fixtures and 20 8-foot two-lamp T-12 fixtures. These were replaced with 840 six-lamp 4-foot T-8 hi-bay fixtures and 20 two-lamp 8-foot T-8 fixtures.

The Navigant team visually verified that lighting fixtures were replaced in all the claimed areas of the facility. Discussions with site personnel indicated that the hours of operation were greater in many areas than had been used in the pre- and post-installation reports. Those reports estimated 6,240 hours per year; however, no occupancy or lighting time study was conducted. Site personnel indicated that some facility lights are left on 24 hours a day with only a few days shut down per year, whereas others operate approximately 300 days per year, and lights are on 20 hours a day. Verified savings were calculated using these hours and standard wattages for both baseline and retrofit equipment.

As demonstrated in Table 7, this site showed greater demand savings and greater annual kWh savings than reported. MID reported savings at site 4 based on deemed values. The verified calculated savings were more in line with the pre-installation estimate and post installation report, indicating that the reporting is sound. The difference between the claimed and verified savings is due to longer operating hours than used for deemed rebate calculations.

Table 7 Site 4 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	189.8	1,067,516
Verified Calculated Savings	231	1,674,490

Site 5

Site 5 was an office building. At this facility, 31 occupancy sensors were installed in areas that have intermittent use, including restrooms, closets, and mechanical rooms. These areas were lit by a variety of lamp types including 100-watt incandescent lamps, T-8 lamps, and compact fluorescent lights.

The Navigant team verified that occupancy sensors were installed and operating correctly. The project team found that more than 31 sensors were installed at the site, some having been installed since the incentive was issued. These additional sensors are spillover and are not included in saving calculations. It was impossible to determine which sensors were those included in the application, so all sensors were included in our calculations and the results were prorated to include only 31. The project team used lighting loggers to determine actual lighting on/off times in seven locations.

The Navigant team assumed that these lights would be turned off manually at the end of the business day; however, it is likely that in some areas, particularly mechanical rooms which have infrequent use, lights could be left on or off for longer periods. With no pre-installation occupancy study to verify baseline lighting house, The Navigant team assumed the lights were on 55 hours per week before the retrofit based on personnel interviews. The Navigant team found that the lights in restrooms were on 32.6 hours per week, whereas closets and mechanical rooms averaged 16.4 hours per week. This resulted in higher savings than expected, as shown in Table 8. The higher than expected savings is likely due to the lower than average on-time for the lights in the mechanical rooms, which had high kWh before the retrofit.

Table 8 Site 5 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	0	4,619
Verified Calculated Savings	0	12,717

Site 6a

Site 6a was a large paper products manufacturing facility consisting of both manufacturing and warehouse spaces. Previously, this area was lit with 425 400-watt metal halide fixtures. These were replaced with 394 four-lamp T-5 high-output hi-bay fixtures and 31 61-lamp T-5 hi-bay fixtures. Occupancy sensors were installed on each new fixture.

The Navigant team visually verified that all the retrofit lights were at the facility and the occupancy sensors were all observed to be installed and operating. Fourteen lighting loggers were randomly placed on lighting fixtures to find average on/off times for the warehouse lighting.

MID is reporting savings at site 6a based on deemed savings values. As shown in Table 9, the annual kWh savings were higher than reported. The verified calculated savings were within 5 percent of the post-installation report and similarly close to the pre-installation estimate.

Table 9 Site 6a Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	114.2	708,341
Verified Calculated Savings	91.2	985,416

Site 6b

Site 6b was a large paper products manufacturing facility consisting of both manufacturing and warehousing spaces. A new 200-horsepower air compressor with a VFD was installed at the facility in place of five smaller continuous-run compressors.

The Navigant team installed an amp logger on the new compressor and did spot measurements of the operating conditions at the time of the visit. This data was used to estimate baseline power consumption from the five previously existing compressors. The project team found that the air use varies throughout the day and is higher on weekdays than on weekends, making this facility a prime user of VFD technology. With the assumption that all five of the previously existing compressors were always running, the calculated results are within 10 percent of those reported in the post-installation study, as shown in Table 10. However, if the smallest compressors were turned off during weekends or other extended periods of lower activity, the savings results would be less.

Table 10 Site 6b Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	88.4	728,132
Verified Calculated Savings	81.0	665,950

Site 7

Site 7 was a winery. A large number of tanks were used at the facility to ferment grapes and make wine. Fourteen new tanks were installed in 2009, 10 of which were 36,000-gallon and four of which were 74,000- gallon capacity. An incentive was issued for savings due to insulating the tanks, which are located outside, to an R-value of 6.2 per inch of insulation thickness using polyurethane spray foam. The tank walls have three inches of insulation and the roof has six inches. The tanks are mounted on concrete slabs. Without the insulation, the quarter-inch steel tank would have an R-value of zero. The winery has done similar projects in the past and most of their tanks are insulated in this manner.

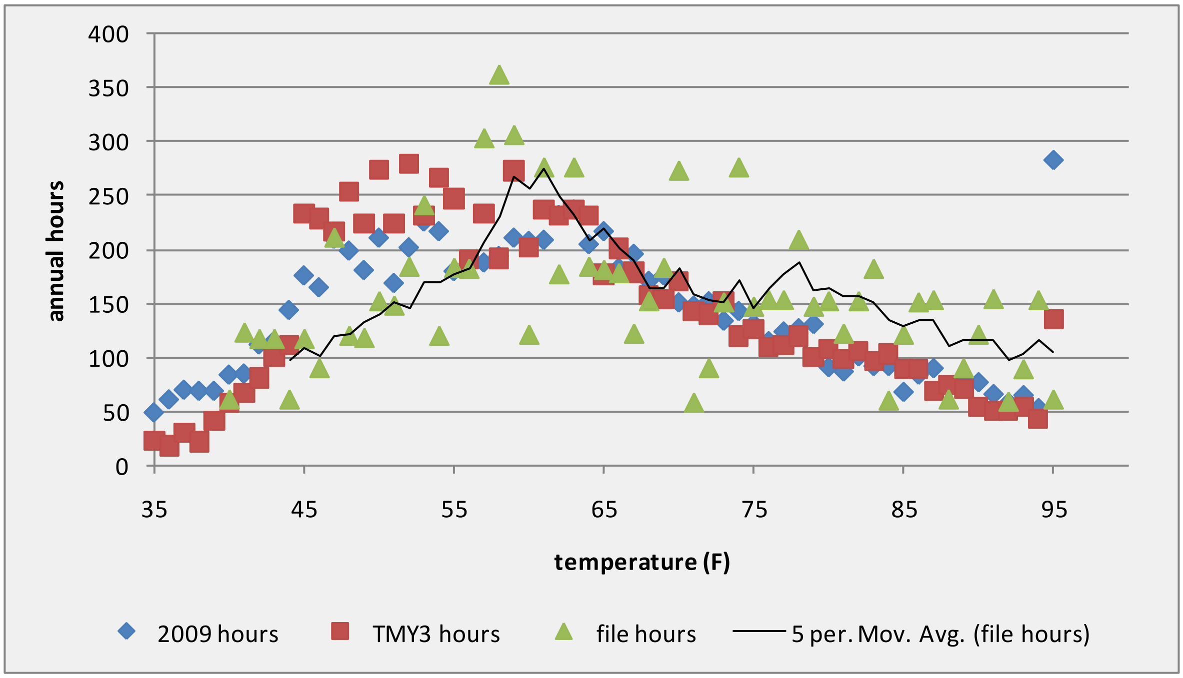
The tanks are all filled at harvest time and fermenting is started. The tanks are emptied in order to fill orders, so not every tank is full all of the time. However, which tanks will be empty for how long in any given year cannot be predicted; therefore, savings are calculated on an average basis for all installed tanks, not just the 14 new ones.

The calculations included with the application assumed half the tanks would be used for white wine and half would be used for red wine. In general, white wine tanks require more energy for cooling than red wine tanks. It was not possible to confirm exactly which tanks were the ones in question and some were empty at the time; therefore, this is considered to be a reasonable assumption. Thermal transfer calculations were used to estimate the ex ante savings, and an independent engineer performed the analysis. According to site personnel, the site contained a total of 112 tanks, 12 of the 74,370-gallon size and 100 of the 36,644-gallon type, comprising 4.8 million gallons of capacity. The tanks listed actually total only 4.56 million gallons; therefore, these totals are slightly off, but can be used for calculations within a reasonable margin of error. Site personnel indicated that typically four of the large tanks and 50 of the small tanks are full, with 8 of the larger tanks around 60 percent full and 50 of the smaller tanks around 75 percent full on average. Right after harvest the tanks are at their highest capacity, and this decreases throughout the year until the next harvest.

Heat transfer calculations, based on surface area of the tanks and U-value of the insulation, indicated 5,580 British thermal units per hour (BTUh)/°F for an un-insulated 36,000-gallon tank and 8,081 BTUh/°F for an un-insulated 74,000-gallon tank. With insulation, the 36,000-gallon tank required only 69.7 BTUh/°F and the 74,000-gallon tank required only 101.8 BTUh/°F. White wine was stored at 45 °F and red wine at 57 °F, with both being fermented at 48°F for three months and 27°F for one month. A chiller efficiency of one kW/ton was applied to calculate energy usage.

The provided calculations were detailed and generally reasonable, although the hours used for energy use estimates were not quite equivalent to typical meteorological year (TMY3) data obtained for Modesto, as they were based on temperature measurements at MID headquarters. Figure 1 shows a comparison of hours for each temperature in 2009, the pre-installation site evaluation report, and TMY3 data. The provided file treated the data in somewhat nonstandard temperature bins; therefore, a rolling average has been included to make comparison of the data clearer. This may be due to the use of temperature data from TMY, TMY2, or other sources. In addition, the report assumed no operation in July, during harvest, and reduced operation in June and August. The data did not support this; therefore, full operation was used in all months. For consistency, the provided baseline has been renormalized to TMY3 data and corrected for observed operation, resulting in 7,451,952 kWh/year compared to the original baseline of 7,432,493 kWh/year for the entire facility. Individual temperature bins were not included in the file above 95°F; therefore, these bins are quite large in the TMY3 and 2009 data because they include all temperatures above this point for ease of comparison.

Figure 1 Site 7 Temperature Hours



The Navigant team examined power consumption data from the site to see if the predicted energy consumption was realistic. A log of all power to the chillers was kept at the site; these post-installation data were provided to Navigant. Although the chiller loads will include line losses, the bulk of usage should be the cooling inside the tanks. This demonstrated a usage of only 428,501 kWh/year. As can be seen in Figure 1, the measured year of 2009 was similar to the TMY3 year, especially at higher temperatures when more cooling is required. Overall, the average hourly temperature in 2009 was 63.2 °F, slightly higher than the hourly average TMY3 temperature of 62.4°F. As such, the measured data should provide a conservative estimate of savings.

A comparison of modeled operation for 2009 to actual consumption indicated substantially higher power consumption than was actually observed. This indicates that the baseline may also be low in addition to an overestimation of the insulation's effectiveness, although it is difficult to determine this for certain given the complexity of the system. The renormalized baseline of 7,845,362 kWh/year for the entire facility based on 2009 temperatures has been used in calculations as it is not possible to provide a more accurate value.

Demand savings were estimated based upon peak months' usage May through September. Because cooling is expected to be higher in the daytime, operational hours are expected to be primarily during peak demand times. Average demand was used for these months in the application, and this is considered to be reasonable. Based on measured power and estimated operational hours, the average demand savings is expected to be 108.8 kW during peak months for the entire facility.

Because only 14 of the tanks were new, the savings were adjusted to account for only these tanks, not the entire facility, which prorates the usage to 13 percent based on the type of tanks. This corresponds to usage of 57,719 kWh/year by the new tanks, with a baseline of 1,002,624 kWh/year based on TMY3 temperatures. As shown in Table 11 Site 7 Installation and Savings, this site showed savings very similar to that predicted. The demand savings is greater than predicted because of full operation during summer months, which was not accounted for in the initial study.

Table 11 Site 7 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	97.6	951,725
Verified Calculated Savings	184.0	944,905

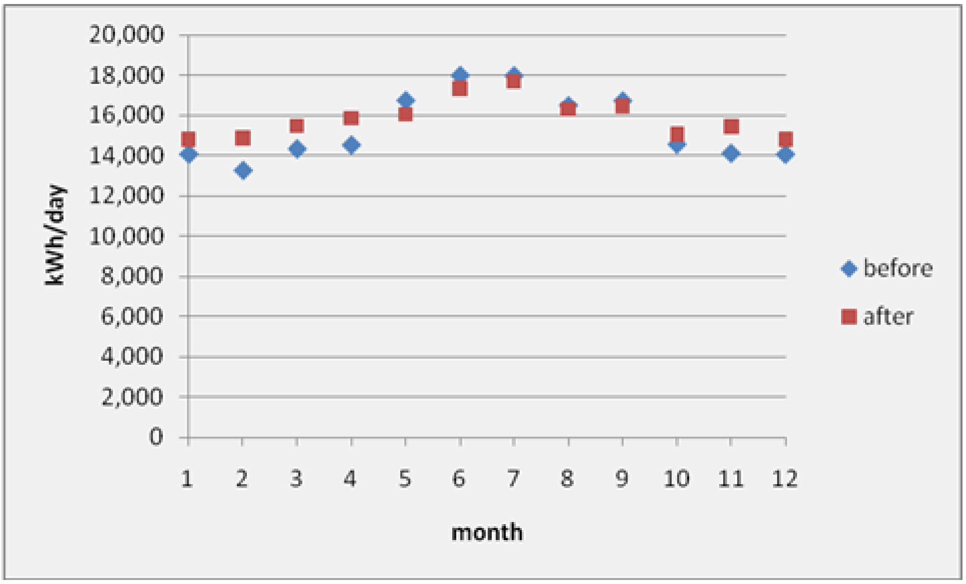
Site 8

Site 8 was an egg hatchery occupying around 70,000 square feet. The facility installed 13 new 12-ton rooftop air-conditioning units, replacing 9-ton units that had been installed between 1974 and 1988. The economizers on the old and new AC units at the facility were reported to be operational . Due to the age of the old units, this project was treated as natural replacement. MID used prescriptive savings of 361 kWh/year/ton for energy and 0.266 kW/ton for coincident peak demand.

All of the air conditioners operated continuously, 8,760 hours per year. Two of the new units were installed in the egg room with a set point of 64°F, and one supplied the break room and offices at 72°F. Two units supplied rooms at 80°F and the remaining eight unit rooms at 75 °F at the time of the site visit. However, it should be noted that these set points are changed on a regular basis to accommodate hatchery processes. Two smaller, four-ton units supplied the hallways and were not part of the retrofit.

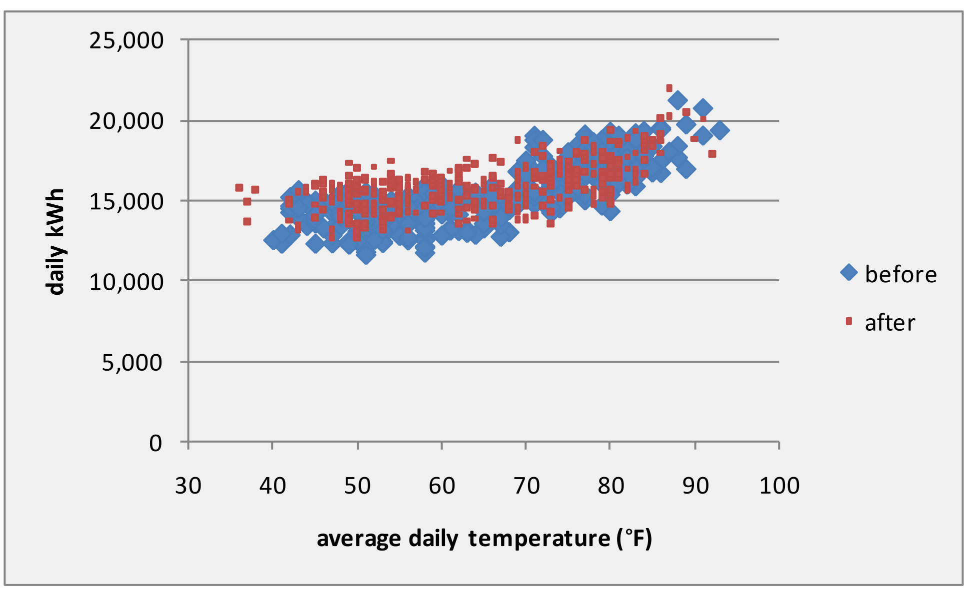
The Navigant team examined billing data from the site to see if the predicted savings were realized. Facility personnel claimed they had observed a 3 percent reduction in bills since the units had been installed. However, a comparison of bills for a year preceding and succeeding the retrofit does not appear to bear this out, as shown in Figure 2, which compares energy use for June 2008 through May 2009 to July 2009 through June 2010.

Figure 2 Site 8 Energy Use



The daily energy use at the facility was compared to daily kWh usage from utility data to determine if energy use had decreased. Figure 3 shows the comparison of energy use at the site before and after the retrofit. From this data it appears that one of three things has happened: either the economizers are no longer being used or there has been an increase in cooling needs at the facility.

Figure 3 Site 8 Daily kWh vs. Temperature



It was not possible to verify economizer operation during the site visit; however, facility staff indicated that the economizers were operating. Because the operation at higher temperatures would indicate no savings even though the new units are unquestionably more efficient than the old units, and facility staff indicated correct operation of the economizers, the project team believed that the increase in usage after the upgrade corresponds to increased operational requirements at the facility unrelated to the air-conditioning upgrade. Because of this, an adjusted baseline was created using operational data below 60 °F. If this is the case, savings are approximately 158,000 kWh/year, almost three times the prescriptive savings. However, if facility demand has not increased for other reasons, the HVAC units may not be saving anything at all. Because of this uncertainty, the prescriptive savings have been used for this site.

Unfortunately, the Navigant team could not observe the operation of the economizers, nor could it obtain specific information from the site operator regarding possible operational changes. However, the project team did confirm that the units were installed. Because of these factors, as shown in Table 12, the prescriptive savings in the E3 calculator were used for this site and are the same as the claimed savings.

Table 12 Site 8 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	41.5	56,316
Verified Calculated Savings	41.5	56,316

Site 9

Site 9 was a glass container manufacturing facility. The facility primarily used gas-fired furnaces to melt glass for manufacturing; however, one electric furnace was also present. The electric furnace had been idle for a few years before the project. Increased production in 2008 necessitated that it be brought back into service. At that time it was decided to upgrade the unit to a more efficient furnace with the assistance of an incentive from MID. Because of the previous downtime of the furnace, the project application indicated that the baseline condition was assumed to be operation of the old, idled unit under current conditions.

The new electric furnace used 5,000-kilovolt-amp (kVA), 12-kilovolt, variable on-line tap transformers. These units were controlled by a programmable logic controller, which allowed an exact kW set point to melt the glass. This reduced the energy per ton of glass melted by preventing the need to "overtap" the transformers to insure adequate power, as would be done on the baseline system.

A fire at the facility destroyed the transformers after only 16 months of operation. However, after the new furnace and transformers were installed, a detailed power use study was performed and provided to the utility as part of the verification process. At the time of the report, damage from the fire was expected to be repaired. However, at this time there are no plans to repair the units because of reduced production needs and the better relative cost-effectiveness of the gas furnaces at the facility.

Because of the fire, MID paid only the first installment of the rebate, based on the 16 months of operation that had already taken place. The expected effective useful life for the measure had been five years; therefore, the energy savings and rebate were prorated to 27 percent. The plan had been to pay the remaining 73 percent of the rebate in a second installment when the unit was brought back on line, but this now appears unlikely.

The Navigant team reviewed the project savings calculations in detail because it was not possible to take any new measurements due to the destruction of the unit. The post-installation verification study included 14 months of onsite logging of operation and power usage and incorporated production levels into calculations. Demand savings were based upon operation May–September between 2:00 and 6:00 p.m., and were also prorated by 27 percent. The most recent period of operation was in 1998, and the baseline efficiency was calculated from this data. It was compared on a kW/ton basis to the new system's measured operation and normalized to current production levels. Because these calculations are all based on straightforward measurements, performed over a long time period, the Navigant team finds this to be the most accurate savings estimate available under the circumstances and agrees with these savings values.

The baseline system was found to use 898.9 kWh/ton, with 865.5 kWh/ton at peak operation of 181.8 tons/day. The new system was measured at 840.9 kWh/ton, with 832.9 kWh/ton at peak operation. Peak operation is more efficient because the system is more fully used under these conditions. During the 14 months of monitoring, which made up the majority of the 16 months of overall operation, the average production was 200.7 tons/day, peaking at 215.6 tons/day. The verification report assumed savings of the difference in the average kWh/ton efficiency of the systems; however, the baseline peak production of 181.8 tons/day was below the new average production of 200.7 tons/day. Because of this, it is likely that the savings would be slightly less than calculated because the system would be running more heavily loaded and therefore more efficiently that it previously did on average. The savings per ton is therefore estimated to be 24.6 kWh/ton rather than the 58.0 kWh/ton claimed in the report. This is based upon the difference between the new furnace average operation, with 200.7 tons/day using 840.9 kWh/ton, and the old furnace highest available operation, with 181.8 tons/day using 865.5 kWh/ton. It is possible that this value could still overestimate savings because the baseline system was still at a lower production level than the average production of the new system; however, the project team also expects that there would be lower levels of production some of the time and that this would bring the average power usage up some as well. Because no more detailed data is available at higher production values, the peak savings have been accepted and used for demand as well as energy savings. Operation of 355 days/year from the verification report was accepted as reasonable. As shown in Table 13, the savings are estimated to be only 467,390 kWh, a 42.4 percent realization rate.

Table 13 Site 9 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	78.1	1,101,977
Verified Calculated Savings	78.1	467,390

Site Observations

There were several notable issues with the ten applications at the nine sites. Several points are worth stressing nonetheless:

1. The custom project files were very detailed and clearly explained all of the assumptions and calculations used in estimating savings. Supporting spreadsheets that were provided for some projects were also clear and well laid out.
2. The lighting projects are all based on prescriptive savings. There is nothing wrong with this; however, MID could, in some cases, claim increased savings by treating projects under custom rules and calculating actual energy and demand savings instead of using prescriptive values.
3. Final savings claimed for each individual prescriptive project, particularly where lighting is installed, are not clearly stated in the project file. MID enters the installed fixtures in their records and the savings are recorded as a part of overall savings for each lighting measure type. Unfortunately, this makes EM&V work difficult as there is no way to tell if any changes were made after the initial project application. It does not affect savings as reported to the CEC, which are still correctly included in overall program values.

Program Record Observations

The Navigant team analyzed the final program records submitted by the implementation contractor to the Modesto Irrigation District for accuracy and consistency, and to ensure that the underlying assumptions were reasonable. The key documents analyzed included the project applications provided to the program for each site and the savings spreadsheets when available.

Based on the review of program documents and on-site verification activities, the project team reached the following conclusions:

1. The measure savings assumptions were calculated to be representative of the program installations.

2. The incentive database does not break out savings for individual sites or projects, but instead lists totals by project type. The Navigant team recommends that the database include individual projects with a category classification to allow sorting or totaling by project type.

3. MID has the option to report lighting projects as custom projects rather than using deemed savings. The Navigant team recommends doing this is instances where the pre and post installation reports demonstrate savings above deemed values, such as at sites 4 and 6a. Custom reporting would allow MID to claim savings more accurately for these projects.

Impact Evaluation Results

Table 14 provides the savings reported in the final installation review documents submitted for the program and the verified gross savings. The overall energy realization rate is a respectable 106.1 percent with a similar demand realization rate of 103.2 percent.

Table 14 Claimed Savings and Verified Gross Savings

	Claimed		Verified		Measure Realization Rate	
Project	kW Savings	Annual kWh Savings	kW Savings	Annual kWh Savings	kW Savings	Annual kWh Savings
Site 1	11.78	73,600	11.78	73,600	100%	100%
Site 2	6.63	8,649	6.63	8,649	100%	100%
Site 3	120.3	1,203,000	0	1,396,772	0%	116.1%
Site 4	189.8	1,067,516	231	1,674,490	122%	157%
Site 5	0	4,619	0	12,717	100%	275%
Site 6a	114.2	708,341	91.2	985,416	64.2%	139%
Site 6b	88.4	728,132	81.0	665,950	91.5%	91.6%
Site 7	97.6	971,725	184.0	944,905	188.5%	97.2%
Site 8	41.5	56,316	41.5	56,316	100%	100%
Site 9	78.1	1,101,977	78.1	467,390	100%	42.4%
Total	**748.3**	**5,92,3875**	**725.2**	**6,286,205**	**103.1%**	**106.1%**

Net-to-Gross Assessment

Directly estimating net impacts was not part of the scope for this project. Rather, the approach to identifying appropriate net-to-gross values is to rely on the extensive number of net-to-gross assessments conducted primarily for the investor owned utilities (IOUs) in California. These studies relied on larger sample populations and they provide reasonable estimates of net-to-gross ratios for MID. Using these outside studies also allows MID to save valuable budgetary resources.

The ten projects evaluated for gross energy impacts included the following types of measures:

- Linear fluorescent lighting
- High bay lighting
- Occupancy sensors
- Refrigeration door gaskets
- Strip curtains
- Air compressor w/VFD
- HVAC A/C equipment
- Wine tank insulation
- PC controls
- Industrial furnace

The on-line searchable database for the California Measurement Advisory Council (CALMAC) was used as the source for the studies included in this net-to-gross literature review. The measures evaluated for MID represent a wide mix.

A good source for commercial sector lighting measure net-to-gross assessment is the 2010 report "Small Commercial Contract Group Direct Impact Evaluation Report".[1] This report presented the evaluation results for the 2006-2008 nonresidential energy efficiency high impact lighting measures (HIMs)and several non-HIM measures, both lighting and non-lighting. These measures were offered by programs implemented by Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), San Diego Gas and Electric (SDG&E) and third party implementers for the 2006-2008 program cycle.

The net-to-gross analyses are based on a self-report methodology that estimated four separate measurements of free ridership from different inquiry routes and then averaged the values to derive the final free ridership estimate at the measure level. The net-to-gross estimates often varied widely by utility within the same measure classification. No reasons were provided for the variance between the

[1] *Small Commercial Contract Group Direct Impact Evaluation Report*, CALMAC Study ID: CPU0019:01, prepared for the California Public Utilities Commission Energy Division, prepared by Itron, Inc et. al., February 9, 2010

utilities. Below are the estimates of net-to-gross by measure classification by utility and an overall weighted average across the utilities.

- Linear fluorescent lighting:
  - PG&E - 73%
  - SCE – 79%
  - SDG&E – 87%
  - Weighted (by savings) average – 81%
- High bay lighting:
  - PG&E - 68%
  - SCE – 68%
  - SDG&E – 95%
  - Weighted (by savings) average – 74%
- Occupancy Sensors
  - PG&E - 68%
  - SDG&E – 75%
  - Weighted (by savings) average – 72%

Another study that focused specifically on high bay lighting, estimated a similar net-to-gross factor of 69% compared to the Itron study findings that ranged from 68% to 95% with a weighted average of 74%. This 2010 report[2] was conducted by KEMA and Itron and is a market effects study of the PG&E, SCE, and SDG&E 2006-2008 energy efficiency programs on the commercial and industrial high bay lighting products.

Net-to-gross estimates for the refrigeration gasket and strip curtain measures can be found in a 2010 study by ADM Associates, Inc.[3] The evaluations focused on two PG&E programs offered during 2006-2008 to its high tech and commercial customers and focused specifically on these two measures. The net-to-gross estimates are based on a telephone survey of program participants. The estimated net-to-gross ratios are:

- Refrigeration door gaskets: 19%
- Strip Curtains: 40%

The extremely low estimate of 19% for refrigeration door gaskets indicates a very high level of free ridership and it may be in the best interest of MID to discontinue the program. Strip curtains also have a

---

[2] *High Bay Lighting Market Effects Study*, prepared for the California Public Utilities Commission Energy Division, prepared by KEMA, Inc and Itron, Inc., June 18, 2010

[3] *Commercial Facilities Contract Group 2006-2008 Direct Impact Evaluation*, , CALMAC Study ID: CPU0016:01, prepared for the California Public Utilities Commission Energy Division, prepared by ADM Associates et.al., February 18, 2010

high level of free ridership, though not nearly as high as door gaskets, and continuation of providing incentives for this measure may also be questioned by MID. TRC calculations that use these low net-to-gross values should be made to help MID in this determination.

A study conducted for the Northern California Power Agency included evaluating air compressors with VFDs. These specific measures had been part of the program offered by the Turlock Irrigation District.[4] This study utilized telephone surveys to evaluate net-to-gross ratios. The estimated net-to-gross ratio is:

- Air Compressor w/VFD: 84%

A recently completed study by KEMA[5] included evaluation of replacing commercial rooftop air conditioning units. As with the other studies, the net-to-gross estimates are based on a telephone survey. Included in the evaluation sample were participants from the three largest California IOUs. The results were very similar across the three utilities.

- HVAC A/C Equipment:
  - PG&E - 94%
  - SCE – 96%
  - SDG&E – 94%
  - Weighted (by savings) average – 94%

No studies were found that specifically targeted the last three types of measures; wine tank insulation, PC controls, and industrial furnace

A recent study by KEMA[6] evaluating PG&E's Agricultural and Food Processing Program. The evaluation included the entire program as well as a specific focus on two high impact measures; greenhouse heat curtains and greenhouse infrared film. Although the wine industry nor specific measures such as wine tank insulation was not directly addressed, the evaluation was for the appropriate industry and the finding can be used as guidelines for net-to-gross ratio estimates. As with the other studies, the net-to-gross ratios were developed using a telephone survey. The estimated net-to-gross ratio for the overall program is:

---

[4] *Measurement & Verification Load Impact Study for NCPA SB5X Commercial and Industrial Custom Incentive Programs*, prepared for the Northern California Power Agency, prepared by Robert Mowris & Associates, June 25, 2005

[5] *Evaluation Measurement and Verification of the California Public Utilities Commission HVAC High Impact Measures and Specialized Commercial Contract Group Programs,* prepared for the California Public Utilities Commission Energy Division, prepared by the KEMA Inc et.al., February 10, 2010

[6] *PG&E Agricultural and Food Processing Program; Greenhouse Heat Curtain and Infrared Film Measures,* prepared for the California Public Utilities Commission Energy Division, prepared by the KEMA Inc et.al., February 10, 2010

» Agriculture and food processing program: 70%

A study conducted for the Northern California Power Agency[7] included evaluating plug load sensors. This is a related, though not the same measure as PC controls and the finding can be used as a guideline for a PC controls net-to-gross ratio estimate. As with the other studies, the net-to-gross ratio was developed using a telephone survey. The estimated net-to-gross ratio is:

» Plug load sensor: 85%

Finally, a net-to-gross guideline for the industrial furnace can be an estimated net-to-gross for an entire Industrial program. A recent Itron report[8] evaluated Southern California Edison's industrial and agricultural measures. The industrial measures were evaluated as a group with net-to-gross being estimated based on a telephone survey. The estimated net-to-gross ratio is:

» Industrial measure group: 63%

---

[7] *Measurement & Verification Load Impact Study for NCPA SB5X Miscellaneous Rebate Programs*, prepared for the Northern California Power Agency, prepared by Robert Mowris & Associates, June 25, 2005

[8] *2006-2008 Evaluation Report for the Southern California Industrial and Agricultural Contract Group,* CALMAC Study ID: CPU0018:01, prepared for the California Public Utilities Commission Energy Division, prepared by Itron, Inc et. al., February 3, 2010