



ENERGY EFFICIENCY PROGRAM EVALUATION, VERIFICATION, AND MEASUREMENT STUDY

FY 2009/2010 Programs

Prepared for:
Lodi Electric Utility



Navigant Consulting, Inc.
1001 Officer's Row
Vancouver, WA 98661

360-828-4000
www.navigantconsulting.com



November 5, 2010

Table of Contents

Table of Contents ii

Introduction 1

 General Utility Background Information 1

 Key Customer Markets 1

 Efficiency Programs Offered 2

 FY 2009/2010 Program Summary 2

 Evaluation Priorities 4

Impact Evaluation Plan 6

Gross Impact Evaluation Results 8

 Measure Installation Verification 8

 Installation Verification Sample 8

 Site Verification Activities 9

 Installation Verification Results 10

 Site 1 10

 Site 2 10

 Site 3 11

 Site 4 12

 Site 5 13

 Site 6 14

 Site 7 15

 Site 8 16

 Site 9 16

 Site Observations 17



Program Record Observations.....	17
Gross Impact Evaluation Results.....	19
Net-to-Gross Assessment.....	21
Appendix A: Non-Residential Custom Site Details.....	23

Introduction

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

Assembly Bill 2021, signed by the Governor a year later (September 29, 2006), reiterated the loading order and annual report stated in SB1037 as well as expanding on the annual report requirements. The expanded report must include investment funding, cost-effectiveness methodologies, and an independent evaluation that measures and verifies the energy efficiency savings and reductions in energy demand achieved by the energy efficiency and demand reduction programs. AB2021 additionally requires a report every three years that highlights cost-effective electrical and natural gas potential savings from energy efficiency and established annual targets for energy efficiency and demand reduction over 10 years.

The legislative reports require both an on-going 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 2010 energy efficiency program plan is to assist the City of Lodi Electric Utility (Lodi) to meet these requirements.

General Utility Background Information

Lodi Electric Utility was established in 1910. Currently, this utility serves 24,500 residential customers and 4,000 commercial/industrial customers. This is a summer peaking utility with a peak demand of 141 megawatts. Its annual energy usage in FY 2008/2009 was 452,075,554 kilowatt hours (kWh).

Lodi is located in Climate Zone 12. This part of the Northern California Central Valley is situated just inland of the Bay Area. This climate zone experiences cool winters and hot summers. Winter rains fall from November to April. On average, it experiences about 1,057 cooling degree days and 2,710 heating degree days.

Key Customer Markets

Lodi offers energy efficiency programs to its residential and commercial/industrial markets. It also has specialized offerings for its low-income population and a school outreach and education campaign. These activities are included as part of its residential energy efficiency program portfolio.

Efficiency Programs Offered

Since 1998, Lodi has spent more than \$7.8 million on energy efficiency measure rebates and programs. These expenditures have resulted in a 16 percent peak demand reduction and an 14 percent reduction in energy use.

FY 2009/2010 Program Summary

Current Residential Customer Programs:

- *Lodi Appliance Rebate Program:* Provides rebates to all customers who purchase an ENERGY STAR[®] refrigerator, dishwasher and or front-loading clothes washer.
- *Lodi Energy Efficient Home Improvement Rebate Program:* Provides rebates to customers who install qualifying measures as described next. Rebates are capped at a per customer amount of either \$500 per customer, until funds are exhausted, plus an additional \$250 allowance for air duct repairs, OR an additional \$800 allowance for air duct replacement, if eligible.
 - **HVAC Refrigerant Charge and Tune-Up** – A maximum rebate of up to \$60 is available for a one-time (once every 12 months) central heating/air conditioning system refrigerant charge and maintenance tune-up.
 - **HVAC System Performance Test** – A maximum rebate of up to \$125 is available when a certified, Lodi Electric Utility-approved HVAC contractor performs this air delivery (air duct) diagnostics test and inspection.
 - **HVAC Replacement** – Customers who purchase and install new heating, ventilation and air conditioning (HVAC) with a high-efficiency seasonal energy efficiency rating (SEER) can receive a rebate: \$250 for a 15+ SEER HVAC unit or 15 SEER rooftop unit with variable speed drive or \$350 for installation of an ultra-high efficiency of 17+ SEER HVAC unit. (Requires participation in the HVAC System Performance Test.);
 - **Heat Pump** – A maximum rebate of \$150; customer must install 8.5+ HSPF for split system or 8.2+ HSPF for package unit. (Requires participation in the HVAC System Performance Test.);
 - **Attic Insulation** – A rebate of \$0.30 per square foot is available if you install attic insulation up to an R-38 (energy efficiency) value;
 - **Radiant Barrier/Thermal Shield** – A maximum rebate of \$150 for radiant barrier/thermal shield is available;
 - **Wall Insulation** – A rebate of \$0.30 per square foot is available if you install wall insulation with an R-8 or greater energy efficiency value;
 - **Air Duct Repairs** – A maximum rebate of \$250 is available if you have leaky or damaged air ducts repaired (Requires participation in the HVAC System Performance Test.);

- **Air Duct Replacement** – A maximum rebate of \$800 (Requires participation in the HVAC System Performance Test.);
- **Whole House Fan** – Install a whole house fan in your home and receive a rebate of \$100;
- **Attic Fan** – Install an attic fan and receive a rebate of \$40;
- **Shade Screen/Window Tinting** – Install shade screens or window tinting and receive a rebate of \$0.50 per square foot. *Note: the shade screen or window tinting must block at least 70% of the solar heat gain or sun’s rays and the shade screens or window tinting must cover (at a minimum) the west and south facing windows of the home.*
- **Swimming Pool Pump** – A maximum rebate of up to \$200 is available for the purchase and installation of a variable speed only pool pump.

Current School (In-Classroom) Programs:

- *Lodi LivingWise Program:* Provides energy efficiency “kits” and manuals to 445 6th grade students in Lodi schools; the program is designed to teach the students the basics of energy and water conservation.
- *Lodi Solar Schoolhouse Program:* Provides teacher mini-grants and teacher training regarding solar/renewable energy resources; also via this program, we sponsor the annual Lodi Solar Olympics (the event, held each May, features solar-powered model race cars, fountains, ovens, and model homes built by area students).
- *Youth Energy Summit:* Provides scholarship opportunities for juniors and seniors in high school. The eligible student must participate in a two-day workshop and then complete a community learning project that is based on the information taught in the workshop. After completing their projects, the students present their findings and projects to a panel of judges who, based on their presentation and project, awards the scholarship funds.

Current Low-Income Residential Programs:

- *Lodi C.A.R.E. Package Program:* Provides grants to very low-income customers in need of assistance paying their electric utility account; the program coordination/customer screening is performed by the Lodi Salvation Army. In order to secure a grant payment, customers must consent to in an in-home energy audit.
- *Lodi Share Discount Rate:* Lodi provides a rate discount of 30% for qualifying residential customers.

Current Commercial/Industrial Customer Programs:

- *Commercial (G-1 & G-2) Rebate Program:* Provides rebates for small and medium-sized commercial customers who install designated energy efficiency measures, such as: attic insulation, window tinting/shade screens, programmable thermostats, ceiling fans, appliances, high efficiency lighting retrofits, and maintenance of refrigeration/HVAC equipment.

- *Lodi Commercial/Industrial (G-3 to I-1) Rebate Program:* Provides rebates of up to \$20,000 to large commercial and industrial customers; the rebate is for pumps/motors, process equipment improvements, building envelope improvements, HVAC/chiller replacements, and high efficiency lighting retrofits.

Table 1 summarizes the Lodi program accomplishments for the fiscal year ending 6/30/2010.

Table 1: FY 2009/2010 Summary of Lodi’s Energy Efficiency Programs

Residential Programs	Net Peak kW Savings	Net Annual kWh Savings	Total Program Costs
HVAC- Residential Shell and Cooling	81	64,252	\$182,289
Residential Appliances	12	67,094	\$32,642
Residential Lighting	0	7,882	\$541
TOTAL Residential	93	139,228	\$215,472
Non-Residential Programs	Net Peak kW Savings	Net Annual kWh Savings	Total Program Costs
Non-Res Lighting	400	1,439,726	\$197,240
Non-Res Refrigeration	13	657,446	\$262,059
Non-Res Shell	6	99,972	\$18,579
Non-Res Motors	39	14,173	\$23,282
Non-Res Cooking	9	60,668	\$9,273
TOTAL Non-Residential	467	2,271,985	\$510,433

Evaluation Priorities

As shown in Table 1, the non-residential programs provide over 16 times more energy savings than the residential programs. Non-residential lighting provides more than one-half of the non-residential energy savings followed by non-residential refrigeration. All of the non-residential programs are high evaluation priorities. Residential programs have been evaluated in past EM&V efforts and are not a high priority for this year’s EM&V effort.

Based on these evaluation priorities, nine projects were selected for inclusion in the 2010 impact evaluation. These sites together represent claimed energy savings of over 980,000 kWh, which is over 40% of the total claimed non-residential energy savings.

- » Reflecting the large share of lighting, the first seven sites are lighting retrofit projects.
- » The eighth site replaced cooking equipment.
- » The ninth site tinted windows to reduce building cooling load.

Impact Evaluation Plan

A useful construct for thinking about the range of efficiency measures offered by the City of Lodi 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
<p>Option A: Engineering calculations based on spot or short-term measurements, and/or historical data. Deemed energy savings fall in this Option.</p>	Constant performance	<ul style="list-style-type: none"> » Verified installation » Nameplate or stipulated performance parameters » Spot measurements » Run-time hour measurements
<p>Option B: Engineering calculations using metered data.</p>	Constant or variable performance	<ul style="list-style-type: none"> » Verified installation » Nameplate or stipulated performance parameters » End-use metered data
<p>Option C: Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multi-variate regression analysis.</p>	Variable performance	<ul style="list-style-type: none"> » Verified installation » Utility metered or end-use metered data » Engineering estimate of savings input to SAE model
<p>Option D: Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering</p>	Variable performance	<ul style="list-style-type: none"> » Verified installation » Spot measurements, run-time hour monitoring, and/or end-use metering to prepare inputs to models » Utility billing records, end-use

IPMVP M&V Option	Measure Performance Characteristics	Data Requirements
		metering, or other indices to calibrate models

The nine 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. Evaluation option “A” was used for all projects in the evaluation, although a previous non-site specific equipment report using more detailed measurements was also used to determine savings at site 8.

Gross Impact Evaluation Results

The methodologies employed to measure and verify energy savings attributed to the Non-Residential 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 Lodi Electric Utility.
3. Developed adjusted measure savings values based on field activities and data reviews.

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

Measure Installation Verification

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

1. Establishing the presence of energy efficient measures by comparing the number of installations observed with the number of installations recorded in the rebate application.
2. Providing input on the quality of installations observed – including whether or not they were operating correctly.
3. Where observed equipment did not match program reported installations, determine if retrofits/installations were ever present, and/or the reason that the installation plan changed.
4. Recording key facility performance data, such as daily schedules, seasonal variations in schedules, and control strategies.
5. Reviewing available literature and reports to determine savings expected from the installed equipment.
6. In one case, comparing utility billing data to predicted savings to determine if more accurate savings could be calculated.

Installation Verification Sample

Nine of the projects that received rebates in FY 2009/2010 were selected for on-site evaluation. Sites 1-7 installed lighting equipment. Site 8 replaced cooking equipment and site 9 tinted windows to reduce the cooling load of an office building.

Table 3 details the verification results of the energy efficient installations and savings sampled that occurred under the Non-Residential Custom Program for Lodi Electric Utility. For privacy, the customer names are not given, but rather a site number assigned.

Table 3 Verified Sampled Installations and Savings

Customer	Retrofit Measures	kW	kWh
Site 1	Lighting	10.3	25,320
Site 2	Lighting	3.7	32,745
Site 3	Lighting	4.0	32,719
Site 4	Lighting	37.2	316,493
Site 5	Lighting	25.1	153,990
Site 6	Lighting	15.2	89,582
Site 7	Lighting	4.1	19,360
Site 8	Food Service Equipment	4.6	30,334
Site 9	Window Tinting	9.6	81,821
Total		113.8	782,364

In evaluating these projects, particular attention was paid to reviewing the program documents and supplementing them with field verifications. None of the sites required onsite measurements, since all but site 8 involved well established energy savings values. The evaluation of site 8 incorporated the results of a detailed study performed for the same type of equipment in a laboratory. All of the evaluations involved the IPMVP Option A approach by reviewing engineering calculations and performing site interviews. Deemed values were used in calculating savings for the project at site 9 because of the uncertainties in operational characteristics at the site.

Site Verification Activities

Field activities typically involved two components:

1. Evaluators coordinated with the utility 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 August 30-31, 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 most of the equipment attributed to the Non-Residential Custom Program was installed as expected, although there were some discrepancies in lighting fixture numbers; the savings were not necessarily accurately calculated and in one case the equipment savings had accidentally been doubled.

Site 1

Site 1 was a church with daycare and school. Operational hours were short, ranging from around only eight hours a week up to forty hours a week. The church replaced 206 T12 fluorescent fixtures with T8 fixtures and 19 incandescent lamps with screw-in compact fluorescents.

During the site visit, Navigant discussed the lighting retrofit and operating hours with site personnel and performed a detailed survey of the new equipment. Non-Residential Retrofit-Demand Response (NRR-DR) standard wattages were used along with these hours to estimate operational savings and compare them to prescriptive savings values.

The actual calculated savings at the site was found to be substantially less than the claimed calculated savings. This was primarily due to an error in the claimed number of fixtures, although the hours of operation indicated by personnel were also less than the 2,730 used on the application. Most importantly, the application listed 158 4-lamp, 4-foot, T12 fixtures retrofitted to 2-lamp T8 fixtures, but the invoice, listed inventory, and site visit all found only 108 of these units. Other minor discrepancies were typical of most lighting inventories and did not substantially affect the realization rate at this site.

Table 4 Site 1 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	21.0	57,218
Verified Calculated Savings	10.3	25,320

Site 2

Site 2 was a gym. The facility completed a lighting upgrade of several rooms in the facility, 33 4-lamp 4-foot T-12 fixtures were delamped to include 2-lamp 4 foot T-8 ballasts, while maintaining the 4-lamp

luminaire. Additionally, 7 2-lamp 8-foot T-12 fixtures were replaced with 2-lamp 4 foot T-8 fixtures. The facility is open and fully lit 24 hours per day, 365 days per year.

The Navigant team visited the facility and found only 31 of the 33 4-lamp to 2-lamp conversions. All of the 8-foot to 4-foot conversions were found. Additionally, 12 more new fixtures were found in another area of the facility. Site personnel indicated that these were installed at a later date and were not included in the project application. The Navigant team considers these additional lights to be spillover and they are not included in any savings calculations.

The facility seemed under-lit in the area where the 31 2-lamp lights were located. Site personnel indicated that they prefer a dim atmosphere, however, the fixture covers were not in place, indicating they were left off to allow more light into the space. There exists a possibility that additional ballasts may be added to the luminaries before the end of the 12 year expected life, which would decrease future savings.

The verified savings was calculated to be 32,745 kWh/year, which is 93.5% of the claimed savings, and a demand savings of 3.738 kW, as shown in Table 5. The difference between claimed and verified savings is due to the two fixtures unverified fixtures. There is no deemed savings value for retrofits involving changes from 8 foot to 4 foot lamps, so there is no verified deemed savings at this site.

Table 5 Site 2 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	4.0	35,040
Verified Calculated Savings	3.7	32,745

Site 3

The project at site 3 was a lighting retrofit at a convenience store. The previously existing T-12 fixtures were replaced with T-8 fixtures.

The Navigant team found several issues with the savings claimed in the application. First, as at other sites, some of the wattages used in calculations did not match the standard values typical in California. The application claimed the 33 T-8 fixtures to have a total demand of 1.98 kW, which indicates 0.06 kW/fixture. The Navigant team is unable to identify such a fixtures, so a standard wattage of 0.109 kW, as indicated by the NRR-DR Table of Standard Fixture Wattages. Additionally, the savings claimed in some cases were based on actual installations of standard ballast and wattage T-12 units, but Title 24 restrictions do not allow the claiming of savings exceeding that of reduced wattage (34 watt) T-12 lamps and standard electronic ballasts. Although the listed wattages may reflect the actual pre-retrofit situation and the savings may be realized by the site, they cannot be claimed for verification purposes.

The application listed 19 4-foot single lamp fixtures, however during the site visit, The Navigant team observed only 14 4-foot single lamp fixtures and 5 3-foot single lamp fixtures. The single lamp lighting was used in shelving throughout the store and the dimensions of this furniture indicate that the original T-12 lamps had included a mix of 4-foot and 3-foot lamps. The calculated verified savings use the new mix of lamp lengths as both the baseline and retrofit condition. There is no deemed savings value for retrofits involving changes from 8 foot to 4 foot lamps, so there is no verified deemed savings at this site.

Savings at Site 3 were 79% of claimed savings as demonstrated in Table 6.

Table 6 Site 3 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	4.7	41,435
Verified Calculated Savings	4.0	32,719

Site 4

Site 4 was a lighting upgrade in areas of one building at a multi-building food processing facility. Lighting retrofits were done in both manufacturing and office areas. A variety of lighting types were upgraded, including T-12 to T-8 retrofits, metal halide to T-8 retrofits and exit sign retrofits. Occupancy sensors were installed in many of the office areas and hallways.

Although the retrofit largely matched the description in the application, there were a few notable issues. First, as at other sites, some of the wattages used in calculations did not match the standard values typical in California. The application lists the wattage of these T-8 fixtures as 45 watts for 2-lamp fixtures and 88 watts for 4-lamp fixtures. However, the cut sheet for fixture model included in the invoices lists them as 51 watts for 2-lamp fixtures and 90 watts for 4-lamp fixtures. Additionally, while the proposed fixture descriptions for the new T-8 fixtures all include 30 Watt lamps, and the invoices provided in the application include sufficient quantity of 30 watt lamps, in a few areas where ceiling heights allowed for inspection of individual lamps, The Navigant team found 32 watt lamps. Also, the project application did not list any savings from the installed occupancy sensors. Occupancy sensor savings were based on standard NRR-DR values for the area types in the verified calculated savings, which are listed in the appendix.

Savings at the Site 4 is calculated to be 316,493 as indicated in Table 7. There is no deemed savings value for several of the specific lighting types at site 4, so there is no verified deemed savings at this site. This is a realization rate of 93.9%.

Table 7 Site 4 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	38.9	336,929
Verified Calculated Savings	97.2	316,493

Site 5

Site 5 was a large retail store which had been completely renovated when it changed ownership. All of the lighting was replaced as a part of this construction. As such the lighting is treated as a new installation rather than a retrofit. The building occupied 68,017 square feet, consisting primarily of retail space supplemented by a few small office and storage areas. Occupancy sensors were used in some of the office and storage areas.

Navigant conducted a thorough count of all the lighting in the facility. Most of the fixtures listed on the application were found; however there were large discrepancies in some of the smaller areas. According to facility personnel, the mezzanine area listed in the application had been removed, which appeared to account for most of the discrepancies between the application and the observed fixtures.

Operating hours for the facility of fourteen hours a day six days a week and twelve hours a day on Sundays were used to calculate energy use and savings. In addition ten percent of the main overhead lighting was estimated to remain on continuously to comply with safety and code requirements. Occupancy sensor and timer reductions were based on standard NRR-DR values for the area types, as listed in the appendix.

NRR-DR standard wattages were used for all fixtures if they were available. In the case of some of the metal halide display lighting and 42 watt compact fluorescent units, the table of standard wattages did not include appropriate fixtures. In these cases manufacturers’ specifications were used to determine wattages for the fixtures.

Since the facility was basically new, the code maximum lighting density of 1.5 W/ft² was used along with operational hours to calculate baseline demand and energy usage. As shown in Table 8, this site showed savings that are substantially below those listed in the application. The primary reason for this is that the application assumed 6,292 hours of operation per year, substantially more than the 5,369 hours indicated by facility staff and listed hours. This resulted in a reduction in both the current usage and the baseline usage at the facility. The project realization rate is 71.1%.

Table 8 Site 5 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	28.1	216,637
Verified Calculated Savings	25.1	153,990

Site 6

Site 6 was a moderately sized hardware store. According to the project application, all of the lighting had been upgraded from standard four-foot T8 fixtures to high performance two- and four-lamp units on a one-for-one basis. One two foot fixture was also retrofitted. The store operated 6:30 AM to 9 PM six days a week and from 7:30 AM to 8 PM on Sundays. In addition, three days a week staff arrived an hour early for stocking. Ten percent of the lights remained on 24 hours a day, and around a quarter of those in the retail area were shut off continuously.

The application referenced an energy audit which was not provided to Navigant with the site data. However, the supplied application did include a list of installed fixtures and a description of the removed units. During the audit, Navigant performed a detailed count of the installed lighting. Only 428 lighting fixtures were observed during the audit, although 484 were claimed on the application. Nine units had clearly been removed in the center of the retail area to accommodate the store’s displays, however this did not account for all of the missing units. Store personnel could not confirm if additional fixtures had been removed, but in the absence of additional information this was assumed to be the case as it is not uncommon for stores to reconfigure their lighting.

Around a quarter of the 730 T8 lamps in the retail area were found to be shut off at the time of the site visit. According to site personnel this was typically the case, and had been so before the retrofit as well. In addition, around 10% of the lights remained on continuously regardless of store operation. This is typical of commercial buildings for safety and code requirements. Based on this, the average operating hours of the lights was estimated to be 5,673 hours per year, with the display area fixtures reduced to 4,474 hours to account for the quarter of the lights which were typically off.

Navigant used standard wattages for most of the fixtures to estimate savings. However in one case the particular ballast specified was not represented in the list of standard wattages and so the manufacturer’s specification of 74 watts for the two lamp high output T8 fixture was used. No detailed audit data for the pre-retrofit installation was available, although the application did state that the fixtures were retrofitted on a one-for-one basis and the old units used 32 watt, four-foot T8 lamps. Based on this and discussions with store personnel, it was assumed that reduced wattage ballasts were retrofitted, the lamps were replaced on a one-for-one basis, but where high output ballasts were used the lamps were reduced from two to one in the fixtures. All ballasts in the old fixtures were assumed to be standard output based on the limited description available for the project. The realization rate of only

79.3% as shown in Table 9 is largely due to the quarter of lights in the retail area that are continuously off, a factor which did not appear to be accounted for in the application.

Table 9 Site 6 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	not available	112,971
Verified Calculated Savings	15.2	89,582

Site 7

Site 7 is a grocery store. At Site 7, 80 2-lamp 8-foot T-12 fixtures were replaced with an equal number of 2-lamp 8-foot T-8 fixtures. Additionally, 2 60 watt incandescent lamps were replaced with 13 watt CFLs and an incandescent exit light was replaced with an LED exit light.

The Navigant team visited the facility and verified that all lights were upgraded and verified store hours. It was found that the CFLs were placed in walk-in coolers. Standard CFLs are not suited to the low temperature in these areas. One of the CFLs had burned out and been replaced with a 60 watt incandescent. It is expected that the other CFL will also be replaced. All other lights were found to be as reported.

The claimed savings presumed the original 8 foot fixtures to have the wattage of high-output lamps, without designating them as high-output. While Navigant was unable to verify the previous existence of high output lights, these are presumed to have been the baseline system for verified savings calculations. Additionally, the application claimed the 80 T-8 fixtures have a total demand of 4.8 kW, which indicates 0.06 kW/fixture. The Navigant team is unable to identify such a fixtures, so a standard wattage of 0.109 kW, as indicated by the NRR-DR Table of Standard Fixture Wattages, which are the standard wattages used by IOUs in the state of California.

The savings at the site are calculated to be 19,360 kWh/yr and demand savings of 4.1 kW. As shown in Table 10, this is 50% of the claimed savings. This low realization is due to the application’s use of non-standard fixture wattages, and the removal of the CFL lamps.

Table 10 Site 7 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	8.1	38,730
Verified Calculated Savings	4.1	19,360

Site 8

Site 8 was a quick service restaurant. The restaurant installed new production line preparation equipment consisting of a dual line Grill-to-Order (GTO) unit. Each line consists of an electric griddle and 2 hot food wells. This replaced two similar sized steam tables and two steam cabinets.

The application for site 8 included a research report for the fast food chain which examines the energy savings from this Grill-to-order production unit in comparison to a steam system. The Navigant reviewed this report and found it to be thorough and reputable. The Navigant team visited the restaurant and verified that the GTO at the restaurant matched the model included in the research report and confirmed operational hours at the store are sufficiently similar to those used in the research methodology.

Based on the provided research report, each new production line would consume 9,740 kWh/yr as compared to 24,907 kWh/yr consumed by the previously existing equipment, which is a savings of 15,167 kWh/yr. The research also suggests a demand savings of 2.32 KW per line. The restaurant installed a dual line, therefore the saving are 30,33k kWh/yr. However, the project application lists a savings of 60,668 kWh/yr. This discrepancy between the actual and claimed savings is due a paperwork error where the savings for a single line were doubled at two stages in the application process.

Table 11 Site 8 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	4.64	60,668
Verified Calculated Savings	4.64	30,334

Site 9

Site 9 was a relatively new office building. Shortly after construction, in April of 2010, the facility began increasing the tinting on many of its windows, on the south and west sides of the building. This was done to reduce both building cooling loads and glare. The windows were already lightly tinted and double paned.

Cooling loads for the building were expected to be a major portion of the electric load, particularly in the summer months. Navigant therefore examined the electric utility billing records for the facility to determine if any savings could be observed in overall building electric usage. Unfortunately however, this was not possible because of the relatively new status of the building. Billing records for two years, from September 2008 through August 2010 were provided to Navigant. From these records it was clear that the building was increasing in occupancy in 2009. Usage in the summer of 2010 was slightly higher

than in 2009, but there were inadequate data to determine if this was simply due to an increase in occupancy rather than being evidence of lack of savings due to the window tinting. Consequently deemed savings values were used in verifying savings for this site. Because of the previous status of the windows as already having some tinting, it is difficult to determine if these savings are completely appropriate, but no other values are available so they were used. Since the deemed values are based on an average over the climate zone, use of these values is acceptable.

Both the utility and Navigant used the prescriptive savings of 17 kWh and 0.002 kW demand savings per square foot for windows film as listed in the E3 calculator for climate zone 12, which includes the City of Lodi. The realization rate for the project was therefore 100%, as shown in Table 12.

Table 12 Site 9 Installation and Savings

	kW Savings	Annual kWh Savings
Claimed Savings	9.6	81,821
Verified Calculated Savings	9.6	81,821

Site Observations

There were several notable issues with the applications and projects at the nine sites:

1. *Changes to lighting from original claimed installation.* Several sites showed discrepancies between the listed lighting installation and what was observed at the site. While some differences are to be expected with any extensive lighting count, in some cases the necessary adjustments were unusually significant.
2. *Non-standard lighting wattages on claimed savings.* At several sites of the wattages used in calculations did not match the standard values typical in California. Additionally, the savings claimed in some cases were based on actual installations of standard ballast and wattage T-12 units, but Title 24 restrictions do not allow the claiming of savings exceeding that of reduced wattage T-12 lamps and standard electronic ballasts. Although the listed wattages may reflect the actual pre-retrofit situation and the savings may be realized by the site, they cannot be claimed for verification purposes.
3. *Doubling of savings at site 8.* The dual cooker installed at site 8 was accidentally double-counted in the incentive calculation. This sort of error occurs from time to time, but it resulted in a 50% reduction in savings at the site.

Program Record Observations

The final program records submitted by the implementation contractors to Lodi Electric Utility were analyzed 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 available savings spreadsheets.

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

1. The measure savings assumptions were calculated to be representative of the program installations.
2. Although lighting documentation was generally good, post-installation verification of actual installations should be included in site files and note any discrepancies with original plans.

Gross Impact Evaluation Results

Table 13 provides the savings reported in the final installation review documents submitted for the Program and the verified gross savings. The overall energy measure realization rate is 78.5%. Site 8 had a low realization rate due to an error in savings calculations on the application. In addition, several of the lighting sites had either removed equipment or not installed it as expected, and the hours were overstated in some cases.

Table 13 Claimed Savings and Verified Gross Savings

Project	Claimed		Verified		Measure Realization Rate	
	kW Savings	Annual kWh Savings	kW Savings	Annual kWh Savings	kW Savings	Annual kWh Savings
Site 1	21.0	57,218	10.3*	25,320*	49.0%*	44.3%*
			12.8 [†]	75,602 [†]	70.0% [†]	132.1% [†]
Site 2	4.0	35,040	3.7	32,745	94.0%	93.5%
Site 3	4.7	41,435	4.0	32,719	85.1%	79.0%
Site 4	38.9	336,929	37.2	316,493	95.6%	93.9%
Site 5	28.1	216,637	25.1	153,990	89.2%	71.1%
Site 6	not available	112,971	15.2 [‡]	89,582	not available	79.3%
Site 7	8.1	38,730	4.1	19,360	50.4%	50%
Site 8	4.6	60,668	4.6	30,334	100%	50%
Site 9	9.6	81,821	9.6	81,821	100%	100%
Total	119.0	981,449	113.8	782,364	82.9%[‡]	79.7%

*Calculated savings using lighting count and reported hours.

[†]Deemed savings using E3 values included for comparison; not used for totals.

[‡]Site 6 not included in percentage realization as no claimed value was available for demand.

Calculated savings have been included for all of the sites except site 9, where deemed values were used since it was not possible to accurately estimate savings for the window tinting based on available data. At site 1, both deemed and actual savings were estimated for comparison. In the past deemed values have frequently been used when they exceeded calculated values. This practice is acceptable under both



CEC and CPUC rules, however it does result in overestimating of actual savings for the site. Consequently, Navigant prefers to use calculated actual savings whenever possible for EM&V purposes, and the calculated values are included in the total in the tables.

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 Lodi. Using these outside studies also allows Lodi to save valuable budgetary resources.

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

- » Linear fluorescent lighting
- » CFLs
- » Metal halide lighting
- » Occupancy Sensors
- » Exit signs
- » Cooking equipment
- » Window tinting

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. Six of the eight measure types assessed for Lodi are lighting. The remaining two included a cooking project and a window tinting project.

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. This report is also one of the few reports to include food service measures.

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

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

weighted average across the utilities. Exit signs and the cooking measure classifications are represented by non high impact measures (HIMs). The non-HIM group includes exit signs along with clothes washers, VFDs, food service equipment, HVAC, motors, and miscellaneous refrigeration.

- » Linear fluorescent lighting:
 - PG&E - 73%
 - SCE – 79%
 - SDG&E – 87%
 - Weighted (by savings) average – 81%
- » CFLs:
 - PG&E - 59%
 - SCE – 61%
 - SDG&E – 85%
 - Weighted (by savings) average – 63%
- » Metal halide lighting (represented by 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%
- » Exit signs and cooking (represented by non-HIMs)
 - PG&E - 34%
 - SCE – 90%
 - SDG&E – 58%
 - Weighted (by savings) average – 41%

Only one recent study in the CALMAC library included an assessment of net-to-gross for commercial sector window film. This report was prepared for the Northern California Power Agency and includes window film installations in Lodi, as well as in the Turlock Irrigation District.² This study utilized telephone surveys to evaluate net-to-gross ratios. For both the Lodi and Turlock window film installations, the study estimates the net-to-gross ratio to be 0.96.

² *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

Appendix A: Non-Residential Custom Site Details

Table A-1: Standard Occupancy Sensor Reductions by Area Type

Space Type	% Savings	Space Type	% Savings	Space Type	% Savings
Assembly	45	Industrial	45	Restroom	45
Break room	25	Kitchen	30	Retail	15
Classroom	30	Library	15	Stair	25
Computer Room	35	Lobby	25	Storage	45
Conference	35	Lodging (Guest Rooms)	45	Technical Area	35
Dinning	35	Open Office	15	Warehouses	45
Gymnasium	35	Private Office	30	Other	15
Hallway	25	Process	45	Parking Garage	15
Hospital Room	45	Public Assembly	35		

Source: 2008 NRR-DR Program Procedures Manual, Table 2-1

Table A-2. Deemed Savings for Selected Measures

Category	Measure	Peak kW Savings	Annual kWh Savings
Compact fluorescent	Screw-in 14-26W	0.038	220
Occupancy sensors	Occupancy Sensor: Wall Box	0.176	238
Delamping	Delamp 4' lamp	0.040	235/262
T-8 linear fluorescent	T-12 to T-8 4' lamp	0.006	37

Source: E3 Calculator