Impact and Process Evaluations of Energy Efficiency Programs

2012 - 2013

Prepared for:
Imperial Irrigation District

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Executive Summary

This report presents the results of the impact and process evaluations of the Custom and Standard incentive components of the energy efficiency programs that Imperial Irrigation District (IID) offers to its residential and commercial customers. This report presents results for activity during the years 2012 and 2013.

The main features of the approach used for the evaluation are as follows:

- Data for the study were collected through review of program materials, on-site inspections, end-use metering, interviews with IID staff members, program implementation contractor staff members, and participating customers and contractors.
- Gross savings were estimated using proven techniques, including analytical desk reviews, industry Standard engineering calculations and verification of computer simulations developed by program contractors to determine energy savings.
- For Custom Incentive components, Custom Energy Solutions Program (CESP) and New Construction Energy Efficiency Program (NCEEP), on-site visits were used to collect data for savings impact calculations, to verify measure installation, and to determine measure operating parameters. Facility staff were interviewed to determine the operating hours of the installed system and to locate any additional benefits or shortcomings with the installed system. When necessary, lighting equipment, HVAC equipment, or motors/VFDs were monitored in order to obtain accurate information on hours of operation. Based on data provided by IID a sample design was developed for on-site data collection. Samples were drawn for the Custom Incentive components that provide savings estimates for each component with ±10% precision at the 90% confidence level. Actual precision is 5.95%. The 21 projects for which including on-site measurements and verification data were collected (14) or verification and/or Custom energy savings were calculated (21) accounts for approximately 58% of Custom Incentive expected kWh.
- Overall, 2012 programs saved 16,845,747 kWh and 5,146.59 kW and 2013 programs saved 16,251,906 kWh and 5,613.84 kW. This resulted in realization rates are 87% and 95% respectively. Total savings is 33,097,653 kWh and 10,760.43 kW, resulting in a 91% realization rate.

Table ES-1 below summarizes savings by year.

Table ES-1 Summary of total kWh savings for all energy efficiency programs in 2012 and 2013.

Program Year	*Expected kWh Savings*	*Realized Gross kWh Savings*	*Gross Realization Rate*	*Realized Net kWh Savings*	*kW Savings*
2012	19,276,820[1]	16,845,747	87%	13,934,739	5,146.59
2013	17,040,327[1]	16,251,906	95%	12,960,159	5,613.84
Total	**36,317,147**	**33,097,653**	**91%**	**26,894,898**	**10,760.43**

Table ES-2 below summarizes savings by year and by program. Please note: Refrigerator Recycling and Attic Insulation are segments of the Energy Rewards Rebates program, however IID has requested that these components be analyzed and presented separately. In this report "Energy Rewards Rebates" savings figures are the remaining program measures once these two components have been separated.

Table ES-2 Summary of kWh savings for all energy efficiency programs by year, by program.

Program Component	*Expected kWh Savings*	*Realized Gross kWh Savings*	*Gross Realization Rate*	*Net to Gross Ratio*	*Realized Net kWh Savings*	*kW Reduction*
CESP	11,539,618[1]	9,404,402	81%	83%	7,791,591	
NCEEP	392,850	320,160	81%	84%	268,934	
Learning Energy Awareness	1,068,473	1,095,596	103%	100%	1,095,418	
Keep Your Cool	475,424	475,424	100%	52%	246,697	
Energy Rewards Rebates[2]	1,981,267	2,115,101	107%	76%	1,597,223	
Refrigerator Recycling	317,682	152,042	48%	55%	82,877	
Attic Insulation	885,927	1,104,450	125%	89%	982,960	
Weatherization	2,615,579	2,178,572	83%	86%	1,869,039	
2012 Total	**19,276,820**	**16,845,747**	**87%**	**83%**	**13,934,739**	**5,146.59**
CESP	4,379,343[1]	3,569,018	81%	83%	2,961,124	
NCEEP	365,683	298,019	81%	84%	250,336	
Keep your Cool	49,275	49,275	100%	78%	38,673	
Quality AC Maintenance	8,162,797	8,162,797	100%	75%	6,122,378	
Energy Rewards Rebates[2]	2,879,187	3,023,431	105%	87%	2,634,160	
Refrigerator Recycling	424,628	206,728	49%	55%	114,538	
Attic Insulation	779,414	942,638	121%	89%	838,948	
2013 Total	**17,040,327**	**16,251,906**	**95%**	**80%**	**12,960,159**	**5,613.84**
Total	**36,317,147**	**33,097,653**	**91%**	**81%**	**26,894,898**	**10,760.43**

[1] These numbers have been modified at IID's request. Please refer to section 2.1.

[2] Remaining program measures once Refrigerator Recycling and Attic Insulation have been removed.

- Surveys of customer decision makers provided the information to corroborate the net-to-gross analysis and process evaluation.
- Relevant IID staff members were interviewed to provide information for the process evaluation.

Table ES-3 Sample Points by Data Collection Activity

Data Collection Activity	*Sample Points*
On-Site Measurement and Verification	14
Custom Savings Calculations	21
Customer Interviews	10
IID Staff Member Interviews	5

1. Introduction and Programs

This report presents the results of the impact evaluations of the Custom and Standard incentives components of the energy efficiency programs that Imperial Irrigation District offers its residential and non-residential customers for activity during 2012 and 2013.

1.1 Overview of Evaluation Approach

The overall objective for the impact evaluation of the Custom and Standard components of the energy efficiency programs was to determine the gross and net energy savings (kWh) and demand (kW) reductions resulting from program Custom and Standard projects during the periods of 2012 and 2013.

The approach for the impact evaluation had the following main features.

- Available documentation (e.g., audit reports, savings calculation work papers, etc.) was reviewed for a sample of projects, with particular attention given to the calculation procedures and documentation for savings estimates.
- An analytical desk review was performed on program measures to verify gross savings estimates.
- On-site data collection was conducted for a sample of Custom projects to provide the information needed for estimating savings and demand reductions. Monitoring was also conducted at some sites to obtain more accurate information on the hours of operation for lighting, HVAC equipment, and motors/VFDs.
- Gross savings were estimated using proven techniques:
  - Analysis of lighting savings was accomplished using ADM's custom-designed lighting evaluation model with system parameters (fixture wattage, operating characteristics, etc.) based on information on operating parameters collected on-site and, if appropriate, industry Standards.
  - For HVAC measures, the original analyses used to calculate the expected savings were reviewed and the operating and structural parameters of the analysis were verified. For custom measures or relatively more complex measures, simulations with the DOE-2 energy analysis model were used to develop estimates of energy use and savings from the installed measures.
- A customer survey was conducted of a sample of program participants to gather information on their decision making and factors corroborating net-to-gross savings ratios for the Custom programs.

1.2 Descriptions of Programs for 2012 and 2013

In this section is a list of programs with brief descriptions of each. This report refers to CESP and NCEEP as 'Custom' energy efficiency programs, as they rely on custom-calculated project-level savings instead of deemed savings values per measure rebated. Remaining programs offered by IID are considered 'Standard.'

Custom Energy Solutions Program (CESP) (2012 & 2013)
This program offered financial incentives for annual energy savings to medium and large commercial customers. The financial incentives are intended for the customer's use in the purchase and installation of qualifying lighting, refrigeration, air conditioning, food service, agricultural, and/or controls equipment. Qualifying energy efficient measures must have retrofitted, replaced, or upgraded old equipment with new, energy efficient technologies that exceed the applicable Title 24 energy efficiency requirements established by the California Energy Commission or current industry Standards using IID approved project baselines, if Title 24 Standards are not applicable.

New Construction Energy Efficiency Program (NCEEP) (2012 & 2013)
This is a non-residential new construction and renovation energy efficiency program that combines an integrated design process with financial incentives for energy saving design at least 10% over the current Title 24 requirements. The NCEEP assists customers in moving beyond initial cost considerations and towards the realization of long-term energy cost savings and avoidance of lost opportunities as new non-residential buildings are designed and constructed. The NCEEP was designed for commercial, agricultural and industrial new construction and renovation/remodel projects.

Learning Energy Awareness Program (LEAP) (2012)
Open to all public, private and chartered schools (K-12) in IID's service territory, the program is designed to improve the energy efficiency of participating school's facilities, by lowering their energy consumption through energy efficient upgrades. Qualifying energy efficient upgrades include lighting and HVAC measures and must retrofit, replace or upgrade old equipment with new, energy efficient technologies that exceed the applicable Title 24 energy efficiency requirements established by the California Energy Commission or current industry Standards using IID-approved project baselines, if Title 24 Standards are not applicable.

Keep Your Cool (2012 pilot & 2013)
Keep Your Cool is a 3rd party program for commercial utility customers with significant refrigeration loads. The program is designed to customer cut costs, improve efficiency and extend the life of their equipment by providing a comprehensive mix of energy efficient measures:

- Electronically Commutated Motors (ECMs)
- Motor Controls
- Anti-Sweat Heater Controls

- LED Case Lighting
- Replacement gaskets
- Strip curtains
- Automatic door closers

Quality AC Maintenance Program (2013)
This is an efficiency program for existing central air conditioner units designed to ensure that both refrigerant charge and airflow through the evaporator are properly tested and correctly adjusted, and also that duct leakage is detected and properly sealed. Early retirement rebates for replacement of inefficient systems were also covered under this program.

Energy Rewards Rebate Program (2012 & 2013)
IID offered customer rebates for qualified energy efficient products. The 2012 and 2013 qualifying equipment for nonresidential customers must have retrofitted, replaced, or upgraded old equipment with new, energy-efficient technologies that meet and exceed the Title 24 Standards in effect at the time of installation. The program offered rebates for the following product categories:

- Energy Star Refrigerators
- ENERGY STAR qualified programmable thermostats
- Commercial and Industrial HVAC equipment
- Energy-efficient central air conditioners/heat pumps
- ENERGY STAR qualified room air conditioners
- ENERGY STAR qualified dual pane windows
- Variable Speed Pool Pumps (See 'Swimming in Savings')
- Energy efficient motors
- Lighting

Refrigerator Recycling and Attic Insulation are segments of the Energy Rewards Rebates program, however IID has requested that these components be analyzed and presented separately. In this report "Energy Rewards Rebates" savings figures are the remaining programs components once these two have been separated.

Refrigerator Recycling (2012 & 2013)
This segment of the Energy Rewards Rebates Program is designed to remove old refrigerators and freezers from use by offering IID customers a $50 rebate for recycling the item through the Appliance Recycling Centers of America.

Attic Insulation (2012 & 2013)
This segment of the Energy Rewards Rebates Program is designed to increase home insulation levels, reducing the need for heating and cooling. Customers can receive rebates for installing

new insulation where none existed prior or upgrading existing insulation (existing must be no deeper than 7", or R-11) to a minimum of R-38.

Weatherization (2012)
This program assists qualifying residential customers control their energy costs by providing a comprehensive energy audit/education and energy weatherization services. The program is free to customers who are currently enrolled in IID's Residential Energy Assistance Program. Measure include (but are not limited to) attic fans, shade screens, weather stripping and insulation.

Table 1-1 Summary of expected kWh savings for all energy efficiency programs by year, by program.

Program Component	*Expected kWh Savings*
CESP	11,539,618
NCEEP	392,850
Learning Energy Awareness	1,068,473
Keep Your Cool	475,424
Energy Rewards Rebates[3]	1,981,267
Refrigerator Recycling	317,682
Attic Insulation	885,927
Weatherization	2,615,579
2012 Total	**19,276,820**
CESP	4,379,343
NCEEP	365,683
Keep your Cool	49,275
Quality AC Maintenance	8,162,797
Energy Rewards Rebates[3]	2,879,187
Refrigerator Recycling	424,628
Attic Insulation	779,414
2013 Total	**17,040,327**
Total	**36,317,147**

1.3 Organization of Report

This report of the Custom and Standard components of the energy efficiency program for 2012 and 2013 is organized as follows:

- Chapter 3 presents and discusses the methods used for and the results obtained from estimating gross savings for measures installed under the Custom and Standard program components.
- Chapter 4 presents and discusses the methods used for and results obtained from estimating net savings for the programs.

[3] Remaining program measures once Refrigerator Recycling and Attic Insulation have been removed.

- Chapter 5 presents process evaluation and recommendations for the various programs offered during 2012 and 2013.
- Appendix A provides site-level measurement and verification reports for each project for which data were collected on-site and/or a custom analysis was conducted by ADM.
- Appendix B presents the survey given to participant decision makers.
- Appendix C presents the regression model used to measure insulation savings.

2. Estimation of Gross Savings

This chapter addresses the general methodology for estimation, and results of gross kWh savings and kW reductions resulting from measures installed in facilities and homes of customers that received Custom or Standard incentives under the energy efficiency programs during the period 2012 through 2013. Section 2.1 describes the methodology used for estimating gross savings for CESP and NCEEP measures and section, details data collection and results. Section 2.1 discusses gross realized savings. Individual reports for each site sampled can be found in Appendix A. Section 2.3 describes the methodology used for estimating gross savings for Standard measures and section 2.4 discusses the results.

2.1 Methodology for estimating gross savings for custom projects

2.1.1 Sampling Plan for CESP and NCEEP.

For an in depth analysis of CESP and NCEEP (Custom) components of the energy efficiency programs, ADM selected a sample, conducted on-site measurement and verification and performed in-house custom analyses of each site sampled.

Inspection of data on kWh savings for individual projects provided by IID indicated that the distribution of savings was generally positively skewed, with a relatively small number of projects accounting for a high percentage of the estimated savings. Estimation of savings for each program component is based on a ratio estimation procedure, which allows precision/confidence requirements to be met with a smaller sample size. Data provided by IID showed that during the period of January 2012 through December 2013, there were 98 Custom incentive projects for CESP and NCEEP programs, which were expected to provide a total savings of 16,677,494 kWh. ADM selected a sample with a sufficient number of projects to estimate the total achieved savings with 10% precision at 90% confidence. For the Custom sample, the actual precision is ±5.95%.

> Please note: Originally IID reported a 2012 and 2013 CESP savings of 15,951,602 kWh (both years combined). However upon review of the program's documentation, ADM discovered savings figures in the EE tool which could not be accounted for with IOMs, as well as the converse. At IID's request ADM used the IOMs to develop *ex ante* savings for each year, resulting in 11,539,618 kWh for 2012 and 4,379,343 kWh for 2013. Their combined *ex ante* savings is 15,918,961 kWh. These program's realizations rates are calculated with respect to these numbers.

Table 2-1 shows the number of projects and expected energy savings of the Custom programs' component sample by stratum. **Error! Reference source not found.**shows the sample and total expected savings by stratum.

Table 2-1 Population statistics used for sample design for Custom components

	Stratum 1	*Stratum 2*	*Stratum 3*	*Stratum 4*	*Stratum 5*	*Totals*
Strata boundaries (kWh)	< 60,000	60,001 - 250,000	500,001 - 700,000	700,001 - 3,000,000	> 3,000,000	
Number of projects	51	26	12	6	3	98
Total kWh savings	1,187,454	2,658,943	3,948,918	3,378,285	5,503,894	16,677,494
Average kWh Savings	23,283	102,267	329,077	563,048	1,834,631	170,179
Standard deviation of kWh	16,809	37,939	43,171	42,968	765,861.63	351,925
Coefficient of variation	0.722	0.371	0.131	0.076	0.417	1.86
Final design sample	6	4	4	4	3	21

Table 2-2 Expected savings for Custom incentive sampled projects by stratum

Stratum	*Sample Expected Savings*	*Total Expected Savings*
1	206,223	1,187,454
2	372,158	2,658,943
3	1,358,874	3,948,918
4	2,291,314	3,378,285
5	5,503,894	5,503,894
Total	**9,732,463**	**16,677,494**

After the samples of projects were selected, ADM reviewed the documentation provided by IID pertaining to the projects. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort.

For each project, the available documentation (e.g., audit reports, savings calculation work papers, etc.) for each rebated measure was reviewed, with particular attention given to the calculation procedures and documentation for savings estimates. Documentation that was reviewed for all projects selected for the sample included program forms, data bases, reports, billing system data, weather data, and any other potentially useful data. Each application was reviewed to determine whether the following types of information had been provided:

- Documentation for the equipment changed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Documentation for the new equipment installed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Information about the savings calculation methodology, including (1) what methodology was used, (2) specifications of assumptions and sources for these specifications, and (3) correctness of calculations

If there was uncertainty regarding a project, or apparently incomplete project documentation, ADM staff contacted the site contact to seek further information to ensure the development of an appropriate project-specific M&V plan.

2.1.2 On-Site Data Collection Procedures

On-site visits were used to collect data that were used in calculating savings impacts. The visits to the sites of the sampled projects were used to collect primary data on the facilities participating in the program.

The activities specified above produced two estimates of gross savings for each sample project: an expected gross savings estimate (as reported in the project documentation and program tracking system) and the verified gross savings estimates developed through the M&V procedures employed by ADM. ADM developed estimates of program component-level gross savings by applying a ratio estimation procedure in which achieved savings rates estimated for the sample projects were applied to the program component-level expected savings.

2.2 Gross Savings Results for Custom Projects

Overall Custom *ex post* savings for both years is 13,591,599 kWh and 3,070.33 kW. These numbers are equal to 81% and 91% of *ex ante* estimates, respectively.

Table 2-3 show expected savings, realized savings and realization rate by site. Table 2-4 shows expected and realized savings by stratum for both sampled and non-sampled projects. Tables 2-5 and 2-6 show expected and realized savings by program.

Table 2-3 Expected and realized savings for Custom sampled projects

Project	*Stratum*	*Expected Savings*	*Realized Savings*	*Realization Rate*
CESP 12-HOA	1	2,363	2,327	98%
CESP 13-Retail Store (Indio)	1	18,215	25,659	141%
NCEEP 12-Credit Union	1	21,459	13,280	62%
CESP 13-School Facility	1	25,052	22,642	90%
CESP 13-Restaurant (La Quinta)	1	38,737	42,662	110%
CESP 12-Country Club (La Quinta)	1	45,554	54,577	120%
CESP 12-Water Facility	1	54,843	60,761	111%
CESP 12-Auto Parts Store (Indio)	2	92,044	120,928	131%
CESP 12-Big Box Store (multiple locations)	2	105,694	121,536	115%
CESP 12-Big Box Store (El Centro)	2	174,420	164,166	94%
CESP 13-Hardware Store (La Quinta)	3	284,565	244,791	86%
CESP 13-Agriculture Facility	3	327,796	253,338	77%
NCEEP 12-School Facility	3	371,391	33,343	9%
CESP 12-Produce Facility	3	375,122	128,500	34%
CESP 12-Grocery Store (Indio)	4	516,073	314,619	61%
CESP 12-HOA	4	546,277	545,392	100%
CESP 12-Residential Association	4	598,286	589,134	98%
CESP 12-Big Box Store (Palm Desert)	4	630,678	895,623	142%
CESP 12-Residential Association	5	1,063,289	1,047,024	98%

CESP 13-Industrial Facility	5	1,845,713	1,351,225	73%
CESP 12-Industrial Facility	5	2,594,892	1,635,349	63%
Non-Sampled		6,945,031	5,924,723	85%
Total		**16,677,494**	**13,591,599**	**81%**

Table 2-4 Expected and realized savings for Custom sampled and non-sampled projects by stratum

Stratum	*Sample Expected Savings*	*Total Expected Savings*	*Sample Realized Savings*	*Total Realized Savings*	*Realization Rate*
1	206,223	1,187,454	221,908	1,277,771	108%
2	372,158	2,658,943	406,630	2,905,239	109%
3	1,358,874	3,948,918	659,972	1,917,893	49%
4	2,291,314	3,378,285	2,344,768	3,457,098	102%
5	5,503,894	5,503,894	4,033,598	4,033,598	73%
Total	**9,732,463**	**16,677,494**	**7,666,876**	**13,591,599**	**81%**

Table 2-5 Summary of total kWh savings for Custom energy efficiency programs by program.

Program Component	*Total Expected kWh Savings*	*Total Realized Gross kWh Savings*	*Total Gross Realization Rate*	*kW Reduction*
CESP	15,918,961	12,973,420	81%	2,941.80
NCEEP	758,533	618,179	81%	128.53

Table 2-6 Summary of kWh savings for Custom energy efficiency programs by year, by program.

Program Component	*Expected kWh Savings*	*Realized Gross kWh Savings*	*Gross Realization Rate*	*kW Reduction*
CESP	11,539,618	9,404,402	81%	2,100.33
NCEEP	392,850	320,160	81%	113.23
2012 Total	**11,932,468**	**9,724,562**	**81%**	**2,213.56**
CESP	4,379,343	3,569,018	81%	841.47
NCEEP	365,683	298,019	81%	15.30
2013 Total	**4,745,026**	**3,867,037**	**81%**	**856.77**
Total	**16,677,494**	**13,591,599**	**81%**	**3,070.33**

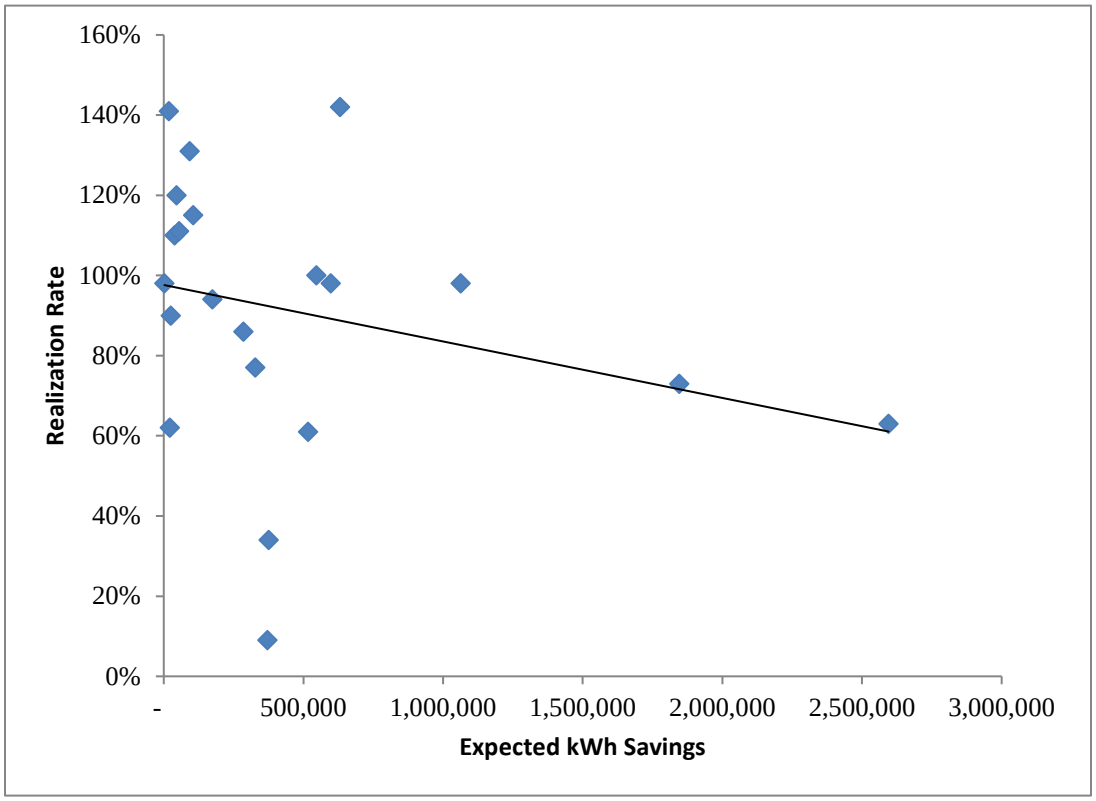
2.2.1 Discussion of Gross Savings Analysis of Custom Programs

For the Custom incentive projects, sample project realization rates and expected kWh savings are plotted in Figure 2-1. There is an association between realization rates and expected kWh savings. Projects with lower *ex ante* savings, the first two strata, tend to have higher realization rates than projects in higher strata. Sites' realization rates vary by site-specific factors. However, general trends in *ex ante* calculations include the underestimation of annual lighting hours of operation in lower-strata sites, overestimation of hours in high-strata sites and heating-cooling interactive effects are not taken into account in either. Different from previous years, *ex ante* calculations

now include corrections for ballast factors of lighting systems. Additionally, non-lighting (HVAC and refrigeration) sites consistently had much lower realization rates.

Project-Level Reports can be found in Appendix A.

Figure 2-1 Custom incentive sample project realization rate versus expected kWh savings



2.3 Methodology for Estimating Gross Savings for Standard Projects

The methodology used for estimating gross savings is described in this section.

2.3.1 Review of Documentation

IID provided documentation pertaining to the projects. The first step in the evaluation effort was to review this documentation and other program materials that were relevant to the evaluation effort. For each project, the available documentation (e.g., audit reports, savings calculation work papers, etc.) for each rebated measure was reviewed, with particular attention given to the calculation procedures and documentation for savings estimates. Documentation that was reviewed for all projects included program forms, data bases, reports, billing system data, weather data, and any other potentially useful data. Each application was reviewed to determine whether the following types of information had been provided:

- Documentation for the equipment changed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Documentation for the new equipment installed, including (1) descriptions, (2) schematics, (3) performance data, and (4) other supporting information
- Information about the savings calculation methodology, including (1) what methodology was used, (2) specifications of assumptions and sources for these specifications, and (3) correctness of calculations

2.3.2 Analytical Desk Review

For sites that did not require and M&V visit ADM performed a review of the deemed savings values (savings calculations for installed measures using deemed (per unit) savings) used to estimate energy savings by measure. The review included reviewing measures associated with their respective programs according to IID's Energy Efficiency Tool (EE Tool). Documentation provided to ADM by IID was reviewed by verifying invoices, re-calculating claimed savings using *ex ante* assumptions (i.e. fixture quantities, motor horse-powers, EFLHs, etc). In this review ADM compared the applied values to the 2013-14 Database for Energy Efficient Resources (DEER 2013-14) deemed savings estimates, investor-owned utility (IOU) workpapers, the Savings Estimation Technical Reference Manual for the California Municipal Utilities Association and independent publicly-available studies. In addition to reviewing deemed savings estimates, ADM performed an engineering review of key assumptions used in weather sensitive measure algorithms (i.e. insulation, duct sealing, etc.). ADM developed correction factors necessary to ensure that the deemed savings used by the evaluation are appropriate for IID Territory in Southern California.

If there was uncertainty regarding a project, or apparently incomplete project documentation, ADM staff contacted the implementation contractor to seek further information to ensure the development of an appropriate project-specific M&V plan.

The evaluation reviewed the energy savings algorithms to verify that the assumptions were reasonable and the algorithm was correct for assigning *ex ante* gross kWh and kW savings per measure. ADM reviewed and verified the mathematical soundness of the savings calculations for each measure. The measure algorithm's components were verified with the savings assumptions provided by IID and the implementation contractor. The calculations were checked to ensure that the reported results could be replicated. Once the calculation methods were verified, the reasonableness of the calculation was assessed. The assessment of reasonableness of the savings estimates was based on the reputable measure savings evaluation from other sources and ADM's own engineering calculators for similar measures.

Energy savings was calculated using the following savings algorithms:

$$\text{Per Unit kWh Savings} = HOU*(\text{Baseline Wattage} - \text{Retrofitted Wattage})/1000$$

Where:

HOU = Hours of Use

Annual kWh Savings = Program units * Per Unit kWh Savings

Per Unit kW Savings = (Baseline Wattage – Retrofitted Wattage) /1000

Annual kW Savings = Program units * Per Unit kW Savings

2.4 Gross Savings Results and Discussion for Standard projects

Table 2-7 summarizes expected and realized savings by year, by program, for Standard programs.

Table 2-7 Summary of expected and realized kWh savings for Standard energy efficiency programs by year, by program.

Program Component	*Expected kWh Savings*	*Realized kWh Savings*	*Gross Realization Rate*	*kW Reduction*
Learning Energy Awareness	1,068,473	1,095,596	103%	
Keep Your Cool	475,424	475,424	100%	
Energy Rewards Rebates*	1,981,267	2,115,101	107%	
Refrigerator Recycling	317,682	152,042	48%	
Attic Insulation	885,927	1,104,450	125%	
Weatherization	2,615,579	2,178,572	83%	
2012 Total	**7,344,352**	**7,121,185**	**97%**	**2,933.03**
Keep your Cool	49,275	49,275	100%	
Quality AC Maintenance	8,162,797	8,162,797	100%	
Energy Rewards Rebates*	2,879,187	3,023,431	105%	
Refrigerator Recycling	424,628	206,728	49%	
Attic Insulation	779,414	942,638	121%	
2013 Total	**12,295,301**	**12,384,869**	**101%**	**4,757.07**
Grand Total	**19,639,654**	**19,506,054**	**99%**	**7,690.10**

*Remainder of program once Refrigerator Recycling and Attic Insulation have been removed.

2.4.1 Discussion of Standard Gross Savings Projects

Learning Energy Awareness Program (LEAP)

ADM determined that HVAC input assumptions and calculations were reasonable and sound. Lighting calculations and assumptions were also sound, however did not include a heating and cooling interactive factor (HCIF). When ADM applied this appropriate HCIF by building type lighting savings increased slightly. The overall program realization rate is 103%.

Keep Your Cool (KYC)

ADM determined that all input assumptions and calculations were reasonable and sound, resulting in a 100% realization rate.

Quality AC Maintenance Program (QAMP)

ADM determined that all input assumptions and calculations were reasonable and sound, resulting in a 100% realization rate.

Energy Rewards Rebates

Energy Rewards Rebates (ERR) consisted of a total of 102 separate measures. At IID's request, ERR was separated into three categories: Refrigerator and freezer recycling measures (3), attic/ceiling insulation measures (6) and remaining measures (102). The 93 remaining measures were reviewed and minor corrections and updates were made, resulting in a 107% realization rate. While these are part of ERR and not standalone programs, IID requested that ADM perform in-depth reviews of appliance recycling and insulation measures.

Table 2-8 Summary of expected and realized kWh savings for Energy Rewards Rebates by measure category, by year.

Program Component	*IID Expected kWh Savings*	*Realized Gross kWh Savings*	*Gross Realization Rate*	*kW Reduction*
Energy Rewards*	1,981,267	2,115,101	107%	804.97
Refrigerator Recycling	317,682	152,042	48%	25.77
Attic Insulation	885,927	1,104,450	125%	324.29
2012 Total	**3,184,876**	**3,371,593**	**106%**	**1,155.03**
Energy Rewards*	2,879,187	3,023,431	105%	1,207.78
Refrigerator Recycling	424,628	206,728	49%	35.03
Attic Insulation	779,414	942,638	121%	242.01
2013 Total	**4,083,229**	**4,172,797**	**102%**	**1,484.82**
Grand Total	**7,268,105**	**7,544,390**	**104%**	**2,639.85**

*Remainder of program once Refrigerator Recycling and Attic Insulation have been removed.

Refrigerator and freezer recycling measures used savings estimates from an outdated study. More efficient federal appliance standards have increased efficiency of home appliances in recent years, resulting in smaller loads for refrigeration. In turn this reduces energy savings when these units are removed from the grid, comparatively. The resulting realization rate for these measures is 48%. ADM recommends using an updated workpaper or the Savings Estimation Technical Reference Manual for the California Municipal Utilities Association (TRM) to inform future savings estimates.

ERR included two attic insulation measures; the first measure was the installation of R-38 insulation to structures in which no baseline insulation was installed and the second was the addition of more insulation on top of existing insulation. These measures account for approximately 9% and 91% of *ex ante* savings estimates (by kWh), respectively. For both measures e*x ante* savings figures came from the KEMA 2009 "MEASURE QUALIFICATION and Statewide Savings and Cost" report[4] which were developed using weighted estimates from DEER 2005. ADM examined these estimates and the assumptions found them to be appropriate and reasonable. For the first measure, "no insulation baseline" to R38, values were checked using more recent DEER 2014 estimates. The current database attributes more savings to insulation than

[4]https://ethree.com/downloads/NCPA%20EE%20Tool/NCPA_SCPPA_Measure%20Quantification%20Report_KEMA_12092009.pdf

the KEMA report, resulting in a 158% realization rate for this measure. Due to most of the program savings coming from the second measure, adding more insulation to an existing baseline level of insulation, ADM used a billing analysis approach rather than deemed estimates to evaluate energy savings. Using customer billing data provided by IID, an analysis was performed on 463 homes[5] receiving this measure, resulting approximately 605 kWh/year savings per single-family home or .462 kWh per square foot; a 119% realization rate.[6] These results are higher than what would typically be expected in this climate zone according to DEER. However, DEER's values may be weighted based on different proportions of HVAC configurations than found in IID's insulation retrofit population. Additionally, while DEER weather zones represent different areas with similar climates actual conditions can vary throughout parts of each zone, further accounting for variation in savings estimates. Despite the difference in *ex ante* and *ex post* savings figures ADM recommends that IID use TRM (which is based on DEER 2014) to inform future savings estimates.

The regression model used and the results can be found in Appendix 3.

Weatherization

ADM determined that largely input assumptions and calculations were reasonable and sound. As in Energy Rewards Rebates, attic insulation savings figures were underestimated. The refrigerator recycling measure[7] was also underestimated. Measures constituting 50% of the *ex ante* savings, CFL direct-install and on-site energy assessments were overestimated, resulting in an overall program realization rate of 83%.

[5] Single-family dwellings. While 7.4% of the homes were multi-family dwellings the billing analysis to determine savings for that housing type is beyond the scope of this EM&V effort. Since these dwellings would likely see similar energy saving from this measure, the realization rate was extended from single-family dwellings to multi-family.

[6] With the exception of the intercept, all variables were significant at the 5% level and the overall R^2 was .73.

[7] This deemed *ex ante* savings value was different than those reported as part of the ERR program.

3. Estimation of Net Savings

This chapter reports the results from estimating the net impacts of energy efficiency programs offered by IID during 2012 and 2013, where net savings represents the portion of gross savings achieved by program participants that can be attributed to the effects of the program. The total number of respondents did not create a statistically significant sample, but the findings in this section were used to corroborate DEER deemed net-to-gross values.

3.1 Procedures Used To Estimate Net Savings

The basic issue in net savings analysis is determining what part of gross savings achieved by program participants can be attributed to the effects of the program. The savings induced by the program are the "net" savings that are attributable to the program.

Net savings may be less than gross savings because of free ridership impacts, which arose to the extent that participants in a program would have adopted energy efficiency measures and achieved the observed energy changes even in the absence of the program. Free riders for a program are defined as those participants that would have installed the same energy efficiency measures without the program.

The goal of the net-to-gross analysis was to estimate the impacts of energy efficiency measures attributable to the energy efficiency programs that were net of free ridership. That is, because the energy savings realized by free riders are not induced by the program, these savings should not be included in the estimates of the program's actual impacts. Without adjustment for free ridership, some savings that would have occurred naturally would be attributed to the program. The measurement of the net impact of the program requires estimation of the marginal effect of the program over and above the "naturally occurring" patterns for installation and use of energy efficient equipment.

For deemed measures ADM compared the net-to-gross values from DEER 2013-14, investor-owned utility (IOU) workpapers and independent publicly-available studies.

Information collected from a sample of Custom program participants through a customer survey was used for the net-to-gross analysis of the CESP and NCEEP programs. Appendix B provides a copy of the survey instrument. Based on review of this information, the preponderance of evidence regarding free ridership inclinations was used to attribute a customer's savings to free ridership.

Several criteria were used for determining what portion of a customer's savings for a particular project should be attributed to free ridership. The first criterion was based on the response to the question: "Would you have been financially able to install the equipment or measures without the financial incentive from the energy efficiency program?" If a customer answered "No" to this question, a free ridership score of 0 was assigned to the project. That is, if a customer required financial assistance from the energy efficiency program to undertake a project, then that customer was not deemed a free rider.

For decision makers that indicated that they were able to undertake energy efficiency projects without financial assistance from the program, three factors were analyzed to determine what percentage of savings may be attributed to free ridership. The three factors are:

- Plans and intentions of firm to install a measure even without support from the program
- Influence that the program had on the decision to install a measure
- A firm's previous experience with a measure installed under the program

For each of these factors, rules were applied to develop binary variables indicating whether or not a participant's behavior showed free ridership. These rules made use of answers to questions on the decision maker survey questionnaire. (this questionnaire is provided as Appendix B.)

The first factor required determining if a participant stated that his or her intention was to install an energy efficiency measure even without the program. The answers to a combination of several questions were used with a set of rules to determine whether a participant's behavior indicates likely free ridership. Two binary variables were constructed to account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free ridership.

The first, more restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the energy efficiency program?"
- The respondent answered "definitely would have installed" to the following question: "If the financial incentive from the energy efficiency program not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"
- The respondent answered "did not affect timing of purchase and installation" to the following question: "How did the availability of information and financial incentives through the energy efficiency program affect the timing of your purchase and installation of [Equipment/Measure]?"
- The respondent answered "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "How did the availability of information and financial incentives through the energy efficiency program affect the level of energy efficiency you chose for [Equipment/Measure]?

The second, less restrictive criteria indicating customer plans and intentions that likely signify free ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the energy efficiency program?"
- Either the respondent answered "definitely would have installed" or "probably would have installed" to the following question: "If the financial incentive from the energy efficiency program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"
- Either the respondent answered "did not affect timing of purchase and installation" to the following question: "How did the availability of information and financial incentives through the energy efficiency program affect the timing of your purchase and installation of [Equipment/Measure]?" or the respondent indicated that that while program information and financial incentives did affect the timing of equipment purchase and installation, in the absence of the program they would have purchased and installed the equipment within the next two years.
- The respondent answered "no, the program did not affect level of efficiency that we chose for equipment" in response to the following question: "How did the availability of information and financial incentives through the energy efficiency program affect the level of energy efficiency you chose for [Equipment/Measure]?

The second factor required determining if a customer reported that a recommendation from a program representative or past experience with the program was influential in the decision to install a particular piece of equipment or measure.

The criterion indicating that program influence may signify a lower likelihood of free ridership is that either of the following conditions are true:

- The respondent answered "very important" to the following question: "How important was previous experience with the energy efficiency program in making your decision to install [Equipment/Measure]?
- The respondent answered "yes" to the following question: "Did a representative of the energy efficiency program recommend that you install [Equipment/Measure]?"

The third factor required determining if a participant in the program indicated that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure is considered to have a likelihood of free ridership.

The criteria indicating that previous experience may signify a higher likelihood of free ridership are as follows:

- The respondent answered "yes" to the following question: "Before participating in the energy efficiency program, had you installed any equipment or measure similar to [Rebated Equipment/Measure] at your facility?"

- If a responded answered "no" to the following question: "Would you have been financially able to install [Rebated Equipment/Measure] without the financial incentive from the program?" a free ridership score of 0 was assigned to the project. That is, if a participant required financial assistance from the energy efficiency program to undertake a project, then that participant was judged to not be a free rider.

- Under this criterion, the other free ridership scoring criteria were applied only to projects for participants who answered "Yes" to the question: "Would you have been financially able to install the equipment or measures without the financial incentive from the energy efficiency program?" However, respondents who answered "No" to this question would be judged to have zero free ridership even if the other free ridership criteria were applied, due to the nature of their specific survey responses.

- Table 3-1 shows the percentage of survey respondents who relayed the following: They had plans and intentions to install the measures without any program incentive (under two alternative definitions as described in the preceding section), that the program influenced their decision to install the measure, or that they previously installed a similar energy efficiency measure without an energy efficiency program incentive during the last three years. Percentages reported are averages weighted by project gross realized savings.

Table 3-1 Weighted average indicator variable values

Had Financial Ability	*Had Plans and Intentions to Install Measure without the program (Definition 1)*	*Had Plans and Intentions to Install Measure without the program (Definition 2)*	*The program had influence on Decision to Install Measure*	*Had Previous Experience with Measure*
9	0	1	1	2

- Table 3-2 shows the number of respondents that are associated with different combinations of free ridership indicator variable values.

Table 3-2 Estimated free-ridership

Had Plans and Intentions to Install Measure without the program? (Definition 1)	*Had Plans and Intentions to Install Measure without the program? (Definition 2)*	*The program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*Number of Respondents*	*Free Ridership Score*
Y	N/A	Y	Y	0	100%
Y	N/A	N	N	0	100%
Y	N/A	N	Y	0	100%
Y	N/A	Y	N	0	67%
N	Y	N	Y	1	67%
N	N	N	Y	0	33%
N	Y	N	N	0	33%
N	Y	Y	N	0	0%
N	N	N	N	7	0%
N	N	Y	N	0	0%
N	N	Y	Y	1	0%
Required program incentive to implement measures.				1	0%
Total				10	6%

- Total free ridership is 6%. To calculate the net to gross ratio, this number is subtracted from 100%. The net to gross ratio is 92%.
- The realized energy savings of the energy efficiency program during 2012 and 2013 are summarized by program component in Table 3-3.

Table 3-3 Summary of expected and realized kWh savings for Standard energy efficiency programs by year, by program.

Program Component	*Expected kWh Savings*	*Realized kWh Savings*	*Gross Realization Rate*	*Net-To-Gross Ratio*	*Net kWh Savings*
CESP	11,539,618	9,404,402	81%	83%	7,791,591
NCEEP	392,850	320,160	81%	84%	268,934
Learning Energy Awareness	1,068,473	1,095,596	103%	100%	1,095,418
Keep Your Cool	475,424	475,424	100%	52%	246,697
Energy Rewards Rebates	1,981,267	2,115,101	107%	76%	1,597,223
Refrigerator Recycling	317,682	152,042	48%	55%	82,877
Attic Insulation	885,927	1,104,450	125%	89%	982,960
Weatherization	2,615,579	2,178,572	83%	86%	1,869,039
2012 Total	**19,276,820**	**16,845,747**	**87%**	**83%**	**13,934,739**
CESP	4,379,343	3,569,018	81%	83%	2,961,124
NCEEP	365,683	298,019	81%	84%	250,336
Keep your Cool	49,275	49,275	100%	78%	38,673
Quality AC Maintenance	8,162,797	8,162,797	100%	75%	6,122,378
Energy Rewards Rebates	2,879,187	3,023,431	105%	87%	2,634,160
Refrigerator Recycling	424,628	206,728	49%	55%	114,538
Attic Insulation	779,414	942,638	121%	89%	838,948
2013 Total	**17,040,327**	**16,251,906**	**95%**	**80%**	**12,960,159**
Grand Total	**36,317,147**	**33,097,653**	**91%**	**81%**	**26,894,898**

4. Process Evaluation Findings

The process evaluation of the Imperial Irrigation District (IID) program portfolio includes an assessment of the following areas:

- Program Design;
- Program Administration; and
- Program Implementation and Delivery.

The process evaluation phase consists of the following activities:

- Telephone interviews with utility staff; and
- Review of program literature other relevant documentation related to program structure, design, and delivery.

The process evaluation focuses on general program trends, design features, and operational characteristics. Specifically, topics that the process evaluation of the 2012 and 2013 programs seeks to address include:

- Whether the programs and/or portfolio provide the education, training, marketing, or outreach needed to address market barriers to the adoption of energy efficiency measures;
- Whether the programs and/or portfolio, have adequate budgetary, management, and program delivery resources to plan, design, and operate energy efficiency programs;
- Whether the programs have sufficient quality control and quality assurance procedures, and have addressed such issues as they arise; and

Additional topics were identified and discussed as appropriate during the in-depth interviews conducted with IID staff and participating contracting firms.

4.1 Summary of Key Findings

The primary sources of information for the process evaluation were in-person interviews that were conducted with Imperial Irrigation District (IID) staff members involved with the energy efficiency programs for the purposes of developing structural, operational, and internal program management perspectives. In order to gather information regarding the operational efficiency and program delivery process for the portfolio of programs, in-depth telephone interviews were conducted with four IID staff members who are responsible for managing specific programs or are involved in documentation, delivery, marketing, and other aspects of program operation.

The following section presents a summary of key findings from the process evaluation of the IID portfolio of energy efficiency programs for 2012 and 2013. These findings are based on a combination of research activities including customer surveys, interviews with program staff, and reviews of program tracking data and other documentation.

4.1.1 Overall Portfolio and Organizational Findings

The following findings are related to multiple programs, to the IID portfolio of energy efficiency programs as a whole, or to IID's organizational structure and internal resources or procedures:

- **Successful Organizational Transition:** Program staff noted that while IID had undergone a significant re-organization in 2013, with widespread changes in staffing and shifting of roles and responsibilities, the overall process had gone fairly smoothly. Some staff members had to take on additional program management roles, and staffing resources had to be increased in order to meet program needs.

  However, program staff generally noted that this had not caused any delays in program delivery, and that IID's programs performed very well in 2013 despite the organizational transition. This is partially due to the fact that during the re-organization, some IID staff members who were leaving their program roles took time to train incoming staff in order to ensure a smooth transition. Currently, roles appear to be clearly defined and allocated across IID staff, and planned staffing increases suggest that the programs will have even more operational and managerial resources moving forward into the 2015 program cycle.

- **Increased Marketing Activity for 2013:** Multiple program staff members commented on the substantial marketing effort that was conducted during 2013, which involved promoting IID's programs through media such as billboards, newspapers, and television commercials. IID staff reported that this promotional activity significantly increased program uptake. Although future marketing efforts of this scale are not currently planned, the 2013 campaign likely developed program awareness in the market.

  This residual benefit will contribute to program participation and support through word-of-mouth marketing. In the absence of a continued large-scale marketing effort, it may be useful to conduct a survey with program non-participant customers in future program years in order to gauge persisting market awareness of IID's programs.

- **Stabilized Organizational and Staffing Resources:** When asked about organizational changes and staffing resources, several IID staff members stated that the organization has been in a continual state of change over the past few years. However, the general consensus among staff members was that current management and operational resources and procedures are effective, and that IID's organizational structure has improved significantly since 2011 and 2012. For example during the prior evaluation, individual staff roles and responsibilities appeared less defined, and it was difficult to identify the appropriate program manager for individual IID programs.

  Currently, each program has a specific manager with supporting staff members, and overall staffing resources appear to be fairly sufficient. Although staffing changes have continued to occur, it appears that the IID's current organizational structure is better suited to meeting individual program goals and delivering a comprehensive portfolio of energy efficiency programs.

- **Improved Customer Support Procedures:** Interviewed staff members also discussed IID's customer support mechanisms. When customers have a question, complaint, or other issue

related to IID energy efficiency programs, they typically contact IID by telephone or through email. IID staff reported that in 2012 and 2013, there were some organizational and efficiency issues regarding internal customer support, which may have led to some customer dissatisfaction and other issues. IID has since obtained third party contractor services for customer support and quality assurance purposes, which has helped to streamline program delivery. Overall, IID noted that customer support and quality assurance resources had been substantially improved after the 2013 program year.

- **Active Cross-program Outreach:** The IID portfolio of energy efficiency programs incorporates cross-program outreach within its marketing and program management procedures. All programs are listed and described on the IID website, which acts as a hub for the various energy efficiency services and incentive offerings. Additionally, IID uses energy assessments to direct customers towards relevant programs, and program staff actively inform participants of additional energy efficiency opportunities.

  For example, when customers apply for one program and do not meet that program's requirements, but would be eligible for a different program, IID staff direct that customer towards the appropriate program (e.g. CESP has received applications from customers who actually qualify for the NC program). Cross-promotion and outreach is an important aspect of effective energy efficiency portfolios, and helps increase program awareness and drive customers to the appropriate program offering.

- **Active Staff Engagement:** Based on findings from the impact and process evaluation, it appears that IID actively responds to issues with program performance and operation. For example, when IID began to identify issues with the quality of attic insulation work conducted by contractors during 2013, program staff greatly increased the inspection rates for that measure and ultimately ensured that program incentives and requirements were updated in order to prevent such issues moving forward. Additionally, IID staff members have expressed an interest in maintaining customer satisfaction, and have modified program offerings to address customer and contractor feedback.

- **Effective Trade Ally Management:** Having an approved contractor list is useful for ensuring consistent work quality and procedures among projects, and allows the utility to efficiently conduct outreach and training to active contractors. The decision to require an approved contractor for attic insulation installation in the Energy Rewards Program was an appropriate and important response to widespread program issues, and will likely minimize further contractor issues moving forward. Expanding this requirement to other measures or programs would likely help to address similar issues if they occur in future program years.

Key trends and findings identified for individual programs include:

4.1.2 Custom Energy Solutions Program

- **Program Activity Trends:** Program staff explained that program activity typically increases substantially during the fourth quarter of the year. This is likely due to some customers having

remaining budgets in their capital improvement funds, who need to spend the money by the end of the year.

Staff noted that the largest portion of program savings is from process load improvements as well as HVAC and refrigeration projects. Specifically, many cold storage facilities have applied to the Custom Energy Solutions Program. As the savings from these measures is high, IID was able to increase the incentives for process loads and HVAC/refrigeration measures while maintaining cost-effectiveness. The higher incentives have somewhat increased participation, although not to the extent that was originally expected.

- **Reduced Program Budgeting:** Moving forward, program staff reported that the budget for the Custom Energy Solutions Program will be significantly reduced for the 2015 program cycle. Additionally, the effective date of the California Energy Commission Title 24 codes is July 1, 2014. Title 24 increases the baseline requirements for residential and non-residential buildings, which decreases the need for incentives on some lighting measures. These factors may create challenges for the CESP in achieving savings during the 2015 cycle, particularly for lighting. Thus, the CESP will likely continue to achieve savings primarily through process load and HVAC/refrigeration measures in the near term.
- **Sufficient Quality Assurance Procedures:** The Custom Energy Solutions Program has quality assurance procedures in order to ensure that savings are accurately reported and that measures are properly implemented. This includes pre- and post-inspections, as well as engineering desk reviews of claimed energy savings. Program staff noted that rather than performing an onsite pre-inspection for some smaller projects, IID instead requests pre-implementation photos of baseline measures.

  Once the photos are received, the project is approved, and the measure is implemented, program staff will then conduct an onsite post-inspection. Overall, program staff explained that every participant either receives a pre-inspection or submits pre-implementation photos for review. These procedures demonstrate that the Custom Energy Solutions Program has thorough quality assurance procedures that cover a census, rather than only a sample, of participants.
- **Improved Market Awareness and Customer Management:** Market awareness and interest in the Custom Energy Solutions Program appears to have increased over the past two program years. For example, the program recruited participants by ranking and conducting outreach to the highest energy-using customers. However, program staff reported that this approach is no longer necessary due to sufficient interest in the program. Much of this increased awareness may be due to the extensive marketing efforts that were conducted during 2012 and 2013; the program exhausted its incentive budget in both of those years. Additionally, IID staff have actively conducted follow-ups with potential participants in order to answer their questions and encourage their participation. Continuing these outreach and customer management efforts in future years will likely further increase program awareness and customer familiarity with program offerings.

- **Detailed Application Review:** If IID determines that an existing application does not contain sufficient information or that the listed project does not qualify for an incentive, program staff will work with the customer by providing recommendations and commentary about why the application cannot be accepted. This provides the customer with an opportunity to revise the project or provide additional information as needed. Additionally, providing feedback to customers helps to maintain customer satisfaction levels, even if those customers' incentive applications are ultimately denied.

4.1.3 New Construction Energy Efficiency Program

The New Construction Energy Efficiency Program (NCEEP) seeks to provide incentives for new construction or remodel projects that achieve at least 10% energy savings over Title 24 requirements. The program offers two tracks for qualifying participants: the Whole Building approach, and the Systems approach. The Whole Building approach involves in-depth energy analysis and design assistance that seeks to optimize building energy efficiency and achieve substantial cost savings from multiple building systems.

In contrast, the Systems approach is a more simplified method that allows participants to focus on individual building components. Under the Whole Building approach, the program would seek to achieve the 10% target throughout the building, while the Systems approach would focus on achieving at least 10% above Title 24 requirements for particular equipment systems.

- **Management of Budgeting Resources:** The number of participating projects for the New Construction Energy Efficiency Program is fairly low, with an expected rate of between three and five projects in a given year. Program staff reported that the program averaged two or three projects per year during 2012 and 2013.[8] As the program did not exhaust its funds during 2012 and 2013, the remaining budget was shifted to the Custom Energy Solutions Program. IID is able to shift funds between programs as long as they are comparable (e.g. both programs are commercial incentive programs, etc.). This level of budget flexibility is not typical for many utilities, and it is beneficial for portfolio management and cost-effectiveness.
- **Detailed Application Review:** Once an application is submitted and IID reviews the design plans, program staff provides suggestions for energy efficiency measures and overall project specifications. The level of assistance provided by the program varies based on the specific project and whether the applicant decides to pursue the Whole Building approach or the Systems approach of the NCEEP.
- **Potential Effectiveness of Design Phase Recruitment:** Currently, the program requires customers to apply within the same calendar year of the commissioning date,[9] but there is no specific requirement that the project must still be early in the design phase in order to be eligible for incentives. Although many projects may still be within the design phase when customers apply, projects could potentially be in the final stages of design at the time the

[8] Although the evaluation focuses on the 2012 and 2013 program years, program staff noted that participation for the New Construction Energy Efficiency Program significantly increased during 2014.

[9] Previously, customers could submit applications up to 365 days after the commissioning date.

application is submitted. As the program's potential influence on a project is likely highest during the design phase of new construction, recruiting participants early in the process and directing them towards the Whole Building approach will allow for the greatest potential net savings.

- **Maintaining Program Cost-effectiveness:** Rebates for the NCEEP are capped at $150,000 and 50% of the overall new construction project cost. The previous cap was 50% of the cost of incremental design improvements, but this was changed due to difficulties in obtaining precise incremental cost details from participants. Participants who receive incentives from the NCEEP are not allowed to receive additional incentives from other programs for the same equipment or measures. This helps to maintain portfolio cost-effectiveness and avoids double-counting of savings.

4.1.4 Learning Energy Awareness Program

The Learning Energy Awareness Program (LEAP) is designed to assist public, private, and chartered educational institutions with energy efficiency upgrades such as HVAC and lighting. The program provides up to $35,000 towards project implementation, including equipment and installation costs. Participating facilities are required to select a California-licensed contractor to conduct project implementation, although the contractor does not have to originate from an IID-approved list. Prospective participants enroll in the program by submitting an application that details their needs and the details of their proposed energy efficiency project. Although the program initially considered offering a wide array of measures, but IID later decided to focus on HVAC and lighting efficiency in order to maximize program benefits to the customer.

- **Increased Program Awareness:** IID staff reported that customer awareness of LEAP has grown significantly since the program's inception. Specifically, many educational facilities were not aware of the program during its first round, but by the second round IID began to receive many applications from a wide range of schools and districts. In order to increase program awareness and familiarity, IID held a workshop for customers and contractors. This workshop focused on describing program requirements and outlining the potential savings that could be achieved through a LEAP project. Additionally, IID has a list of all of the school districts in its service area, and conducted outreach with contacts at these facilities in order to further promote the program.
- **Thorough Application Review and Approval:** Once a school submits the program application, IID conducts a cost-benefit analysis for the project and reviews the contractors' quotes to ensure that the proposed costs are reasonable. IID staff noted that some schools do not yet have quoted costs when they submit the application, but would obtain quotes after the project has been reviewed and approved. IID has rejected some applications due to low cost-benefit scores. In these cases, IID staff attempts to work with these facilities to determine whether the project can be modified in order to meet cost-effectiveness requirements. These procedures are in place to maintain program cost-effectiveness and maximize benefits to the customer while providing effective communication and assistance to both approved and denied applicants.

- **Sufficient Quality Assurance Procedures:** Based on review of program guidelines and interviews with IID staff, it appears that the current quality control procedures for LEAP are sufficient and that there have been few to no issues with the quality of project implementation. Schools are required to submit the LEAP application prior to implementing the proposed energy efficiency project, and must submit photos of pre-existing equipment. IID staff also conduct onsite inspections of participating facilities in order to ensure that equipment has been installed as specified in the approved application.

  Program staff noted that there was a learning curve for some contractors and customers in terms of accurately and fully completing the program application, but that this has since been resolved. Overall, IID staff stated that there have not been any major quality issues with the work conducted by participating contractors, and that the working relationships with contractors have been effective.

Overall, LEAP has served as a unique program in the IID portfolio by targeting a specific business sector that may be unlikely to implement energy efficiency programs without financial and informational assistance. In addition to providing energy efficiency benefits to participating schools, LEAP also helps to improve comfort levels and reduce maintenance costs in the serviced facilities. Moving forward, it may be useful to consider providing additional measures through the program such as lighting and HVAC controls or computer power management, as these are commonly offered measures in other school-targeting utility energy efficiency programs.

4.1.5 Keep Your Cool Program

The Keep Your Cool Program provides energy efficient measures for non-residential facilities such as schools and grocery stores. The program uses a direct installation approach to provide a mix of energy efficiency measures including motors, controllers, and lighting for retrofitting coolers, freezers, and refrigerated display cases.

Program implementation responsibilities for KYC are distributed between two firms: Efficiency Services Group (ESG), which is responsible for program development, quality assurance, and reporting; and Blue Earth Energy Management Services (BEEMS), which handles marketing, auditing, and installation of measures. IID is a member of the Southern California Public Power Authority (SCPPA), which is a power authority consisting of eleven municipal utilities and one irrigation district. Project management for the program is conducted by IID through a service agreement between SCPPA and ESG.

The program seeks to target facilities representing hard-to-reach customers, typically focusing on economically disadvantaged areas where facilities are less likely to make energy efficiency improvements on their own. Once participants are selected, IID contacts the chosen customers to inform them about the program and ask if they are willing to receive direct install services with a budget of up to $7,500. In 2012 and 2013, the program selected a school district of 10 sites, along with three grocery stores, as participants.

Once the customer agrees to participate in the program, the program implementation contractor conducts an audit of the facility in order to identify energy saving opportunities. Program staff explained that during the audit and consultation process, customers were also informed of other

IID programs that would provide incentives for measures outside the scope of the KYC Program. This is another example of cross-promotion within the IID portfolio, and is an important aspect of effective portfolio management.

- **Very Thorough Quality Assurance Procedures:** Although the KYC contract agreement with SCPPA specifies that on-site quality control will be conducted for at least 25% of projects, the program implementers inspected all participating facilities. Additionally, IID staff conducted inspections for some of these facilities in order to verify that the work was being performed as specified. Program staff reported that the quality assurance procedures had gone very smoothly, and that there were no issues with the quality of work performed.
- **Positive Customer Reception of Program:** Program staff reported that the KYC pilot program was well-received by customers. As the program focuses on implementing cost-effective energy efficient refrigeration measures, it is able to operate effectively without the need for a customer co-payment. Additionally, KYC programs have been successfully implemented for other utilities, and the program has a turnkey structure that does not require extensive staffing resources from IID. Overall, the program impact analysis and program staff feedback indicate that the KYC Program was an effective component of the IID program portfolio in 2012 and 2013, serving as a straightforward method of managing IID's refrigeration loads.

4.1.6 Quality AC Maintenance Program

The Quality A/C Maintenance Program is designed to provide both residential and commercial customers with air conditioning services including duct testing and sealing, refrigerant charging, detailed equipment inspection, and cleaning of the unit. The program is provided at no additional cost to participating IID customers. Enalasys serves as the program implementation contractor, and recruits contractors to deliver program services.

IID customers are required to use one of the program-approved contractors in order to have the services paid for by IID; the list of approved contractors is available on IID's website. Prospective contractors are instructed to contact Enalasys in order to become approved.

Once a customer applies to the program, Enalasys schedules an assessment appointment in order to evaluate the customer's air conditioner maintenance needs. During the onsite assessment, contractors conduct data collection using Enalasys diagnostic tools. This ensures consistency across projects and helps to minimize the range of errors that can be committed by the various participating contractors. Additionally, the collected data are transmitted to IID electronically rather than through a manual call-in process; this ensures that data are reported as collected.

After the assessment, services were provided as appropriate in order to maximize energy savings and improve equipment operation. Commercial and residential renters are eligible to receive services through the program if the owner of their building completes the program consent form that is provided during the equipment assessment.

- **Shift from Onsite Quality Assurance to Document Reviews:** Program staff reported that during the 2013 program year, IID was able to physically visit participant facilities in order to

conduct visual inspections and collect equipment data. However, due to the large scheduling volume and resources required to conduct these visits, IID later began to rely more heavily on administrator analysis of data collected by program contractors. This involved having IID staff review assessment and maintenance data in order to verify that the collected parameters were reasonable and consistent. According to program staff, very few issues or inaccuracies have been identified through this approach, suggesting that the program contractor data collection and maintenance has been satisfactory.

- **Sufficient Contractor Activity:** Currently, there are 10 approved contractors listed on IID's website, and program staff noted that there are about 30 air conditioning technicians among the current approved contractors. Although IID had initially expected to have 70-80 technicians performing the maintenance, the program has been able to meet IID's energy savings expectations. This is emphasized by the fact that the Quality A/C Maintenance Program is one of IID's most active and successful programs, consistently achieving a high portion of total portfolio savings.
- **Effective Utility-Implementer Communication:** When asked about the level of communication between IID and Enalasys, program staff stated that the two organizations have a positive working relationship with frequent and open communication. Overall, IID staff reported that Enalasys has been able to meet IID's needs and that program operation and management had gone very smoothly. Enalasys has provided program implementation and software services for numerous energy efficiency programs, and is likely very experienced with the technical and operational needs of programs such as the Quality A/C Maintenance Program.
- **Minor Contractor Performance Issues Have Been Resolved:** When asked if there had been any issues with the technicians who had visited homes and businesses to conduct maintenance through this program, IID staff explained that there had initially been some instances where contractors had tried to use the opportunity to upsell their products or other services. IID received a few calls from customers about this, but the issue has since subsided and there have been no major problems with participating contractors or technicians. Overall it appears that the current set of approved contractors is sufficient in terms of both quantity and quality of services.
- **Minor Contractor Preference Issues:** When asked about the program's success in recruiting active contractors, program staff explained that the initial interest in the program had been high, although some contractors do not find the program structure to be appealing. Specifically, some air conditioning contractors have experience with maintenance programs that allow the contractor to report their onsite data through a call-center rather than using the wireless technology used by the Quality A/C Maintenance Program. Program staff noted that many contractors prefer the manual approach, but that it allows for too many inaccuracies in the data reporting process.

4.1.7 Energy Rewards Rebate Program

The Energy Rewards Standard Rebates Program is designed to provide Standardized incentives to both residential and non-residential IID customers. The program offers incentives for a variety of measures, including attic insulation, lighting, motors, and HVAC equipment. Residential customers are able to choose their own contractor or self-install most measures; contractors installing attic insulation must be selected from IID's approved contractors list.

The Energy Rewards Program specifies that the incentive maximum is 50% of the net purchase price. This requirement is in place in order to maintain program cost-effectiveness and to manage free-ridership potential by preventing customers from receiving incentives for measures that have already been incentivized by another source.

- **Contractor List Management:** Currently, IID requires that any attic insulation measures rebated through the Energy Rewards Program must be installed by an approved contractor. Contractors can request to be added to the list, but must meet IID's requirements including attending contractor training, having current attic insulation licensing, and having sufficient liability insurance. Once a contractor is added to this list, they will only be removed if there are licensing or work quality issues. Program staff noted that IID attempts to work with contractors to correct issues and encourage compliance before removing the contractor from the list, and that few contractors had been removed thus far.
- **Application Management Procedures:** Program staff explained that while there are no waiting lists for the Standard program rebates, many applications have been put on hold due to limited funding availability later in the program year. These customers receive a denial letter response to their application, but their records are kept on hand in case additional funding is available at the end of the program year. If funding permits, IID sends rebates to customers with on-hold applications. This system allows IID to remain within its funding limitations without completely rejecting customer applications, which likely helps to maintain customer satisfaction levels.
- **Quality Assurance Procedures Appear Sufficient:** The Energy Rewards Rebate Program requirements include detailed specifications for the installation and placement of qualifying measures. For example, the incentive application for shade screens requires placement information such as the direction of the shaded windows, and confirmation that the unit is not being placed on a window that borders an air conditioner controlled space. During the onsite inspection, program staff verify that all measure installation requirements are met. Overall, IID staff conduct quality assurance, including eligibility reviews and onsite verifications, for 10% to 15% of all submitted rebate applications.
- **Attic Insulation Benchmarking:** In order to provide a basic benchmark of IID's current attic insulation incentives, ADM reviewed the attic insulation incentive levels for a sample of utilities in California and other states.[10] There is substantial variation in attic insulation incentives, both in incentive type and incentive level. For example, some utilities offer an

[10] Data obtained from www.dsireusa.org and utility websites.

incentive as a fixed percentage of the total attic insulation cost (e.g. 50% of project cost, up to $800), while other utilities offer a fixed incentive amount per home (e.g. $150 for any home that brings insulation up from R-19 to R-38 or greater).

For the reviewed California utilities that offer attic insulation incentives per square foot (sqft.), the incentive amount ranged from $0.10/sqft. to $0.30/sqft., with an average of about $0.18/sqft. In terms of measure requirements, the majority of utilities require that the baseline attic insulation be R-19 or lower (two utilities specified that existing insulation must be below R-11 to qualify). Similarly, utilities required that the total post-implementation insulation level must be greater than either R-30 or R-38, depending on the utility. By comparison, IID currently offers $0.30/sqft, with the requirement that existing insulation can be up to seven inches (approximately equivalent to R-25).

Based on this review, it appears that IID's current incentive per square foot is fairly high, but is within the overall range offered through other programs. IID allows for more pre-existing insulation than most of the other reviewed utilities; a 5 or 6-inch limit would be more consistent with the average that was identified through this review.

4.1.8 Refrigerator Recycling

The Refrigerator Recycling Program is designed to help customers reduce their energy consumption by removing old, working refrigerators, and freezers from their homes for recycling. There is a limit of two refrigerators or freezers per household. IID generates energy savings because the old appliances, which are generally inefficient, are permanently removed from the system.

The goal of the program is to reduce the number of old, inefficient refrigerators and freezers that customers have moved to their garages or other locations such as basements and patios. Many areas in which spare units are placed are not space conditioned and most refrigerators used in that environment operate under a heavy thermal load during the summer. This is exacerbated by the fact that the appliances are usually fairly old and energy inefficient.

IID contracts with Appliance Recycling Centers of America (ARCA) to implement the program. The program targets existing multi- and single-family households, renters and homeowners who have old, inefficient refrigerators or freezers. To be eligible for the program, appliances to be recycled must be in working condition, plugged in and cooling at the time of pick-up. The customer receives pick-up and removal service in addition to a $50 rebate per recycled refrigerator or freezer. Program staff reported that a workpaper was used in order to determine the per-unit savings for the appliance recycling program, which accounts for unit operating hours and unit type.

As the Refrigerator Recycling Program is designed as a turnkey, stand-alone energy efficiency initiative, and ARCA has served as a subcontractor for numerous recycling programs, IID staff did not note any significant program issues or challenges. The program appears to have operated efficiently since its implementation, and program design and delivery will likely remain consistent moving forward into future program years.

4.1.9 Residential Weatherization Program

The Residential Weatherization Program was designed to provide residential IID customers with an inspection of their home's energy usage and with a variety of energy efficiency measures including CFLs, shade screens, ceiling insulation, and building shell improvements. The program was initially offered in 2011 as a partnership program with the local gas utility, and was limited to offering CFLs, occupancy sensors, and building shell improvements. In 2012 and 2013, IID shifted the program's focus towards electricity savings, and the measure list was expanded in order to reflect these new goals.

In 2012 and 2013, participating customers paid $100 to participate in the program, which provided an energy audit and up to a total of $1,000 of measures and weatherization services. The Weatherization Program is not exclusively targeted towards income-qualified customers, although the $100 co-pay is waived for customers who qualify for IID low income discounts through the Residential Energy Assistance Program (REAP).

- **Concurrent Participation in Gas Program:** During 2012 and 2013, both IID and the gas utility offered separate weatherization programs, and customers receiving service from both companies were eligible to participate in both programs concurrently. The distribution of measures between programs depended on the type of heating and water heating in the home; for example, a home with a gas water heater or gas furnace would primarily receive measures through the gas company, and homes with all-electric service would only receive measures through IID. This helped to ensure that IID was not implementing measures that would not generate electric savings, and that program resources were allocated effectively.
- **Program Marketing and Outreach:** IID staff noted that promotion of the Weatherization Program was mainly conducted by Richard Heath and Associates (RHA), the program implementation contractor. RHA marketed the program using IID's logo and conducted various outreach tasks including the onsite audit and installation visits.
- **Customer Engagement and Interest:** IID staff noted that the majority of interest in the Weatherization Program has been from income-qualified customers who also participate in REAP. In terms of interest in specific measures, staff explained that participants were particularly interested in receiving shade screens. However, IID did not guarantee the installation of specific measures prior to the audit, as RHA determined the most cost-effective measures for each home using its auditing software.
- **Sufficient Quality Assurance:** IID conducted onsite verification for a random sample of the homes that were serviced by RHA through the Weatherization Program. The purpose of these visits was to ensure that measures had been installed correctly, and that the implementation data received from RHA was accurate and complete. IID staff noted that if an issue was discovered during these visits, the contractor would be notified and would be required to return to the home in order to resolve the issue. Additionally, all participating customers were provided with information regarding how to resolve any equipment warranty issues that may occur. Overall, staff reported that there had been few quality issues in 2012 and 2013.

4.2 Recommendations

Although the impact and process evaluations identified several operational and performance issues that occurred during the 2012 and 2013 program year, it appears that nearly all of these issues have been addressed for the 2014 program year and moving forward. The overall organization and operation of IID's energy efficiency offerings have substantially improved, and at this time, there are few persisting program or portfolio-wide issues. However, ADM provides the following recommendations for consideration:

- **Consider Reducing Application Grace Period:** Both the Standard and custom incentive programs have previously allowed for incentive applications to be submitted within 365 days of the equipment purchase, and currently allow incentive applications to be submitted as long as the equipment was purchased in the same calendar year. While this potentially wide time frame does provide a grace period for customers to prepare their applications and decide to submit for a rebate, it also increases the risk of free-ridership participation.

  A wider grace period increases the chance that customers who have already purchased qualifying equipment to find out about the program and apply, even though their purchase was not influenced by the program. Many similar programs in other regions use a window of 30 to 90 days, which should be a sufficient time window for anyone who is aware of the program when they purchase their equipment. In order to avoid future free-ridership issues related to this, IID should consider reducing the application time window to a few months at most.

- **Consider Conducting a Persistence Survey for Previously Installed Equipment:** According to program documentation, the Custom Energy Solutions Program requires customers to agree that they will continue to operate the energy efficiency measure for five years after it is installed, or for its expected useful life. Participants are notified within the rebate application that IID may request partial rebate reimbursement if measures are removed early. Additionally, if a customer submits a rebate application for the same project type that was already incentivized for that customer within the five-year time frame, IID does not approve the rebate.

  This helps to avoid incentivizing projects that will not generate cost-effective energy savings. These procedures are place in order to ensure that energy savings will persist for multiple years. However, IID staff noted that the rule relies on the honor system and IID does not actively conduct verification of measure persistence. Although widespread early replacement of energy efficiency measures is unlikely, it may be useful to conduct a persistence survey in order to gauge participant compliance with this program requirement.

- **Ensure Consistency Among Program Documents:** Although the CESP Rebate Agreement indicates that measure savings must persist for five years, the Program Guidelines document states that "…you agree to continue using the installed EEMs for at least one year from the commission date."[11] In order to avoid customer confusion regarding this rule, IID should ensure that all CESP documentation specifies the five year, rather than one year, requirement.

[11] From Page 7 of the Custom Energy Solutions Program (CESP) Guidelines, v. 3

Appendix A: Project-Level Analyses

Presented in this section are the individual site-level reports for each site individually analyzed by ADM in the Custom projects sample, as well as basic methodology.

Methodology

Lighting retrofit energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times t \times \left(N_{base} \times W_{base} - N_{as-built} \times W_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of fixtures*
W	= *Wattage of each fixture*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interactive factor*

Lighting occupancy sensor energy savings are calculated as:

$$kWh_{savings} = \sum_{Area} \left[HCIF \times W \times N \times \left(t_{base} - t_{as-built} \right) / 1000 \right]$$

Where:

$kWh_{savings}$	= *Annual energy savings*
N	= *Number of occupancy sensors*
W	= *Wattage controlled by each occupancy sensor*
t	= *Lighting operating hours*
$HCIF$	= *HVAC interactive factor*

Non-daylight hours were calculated using data from the National Oceanic and Aeronautic Administration website, calibrated with a latitude appropriate for IID's service territory.

Non-lighting savings methodology is discussed as needed per individual site.

CESP 12- HOA

The HOA installed (71) new LED lamps at the HOA's common areas. These lamps operate via photocell and are in non-daylight hours.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
Halogen to LED	71	71	20	12.40	4,313	1.00	2,363	2,327	98%
Total							**2,363**	**2,327**	**98%**

Results

Non-daylight hours are slightly less than those used in *ex ante* calculations, resulting in a 98% realization rate.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	2,363	2,327	98%	.54
Total	**2,363**	**2,327**	**98%**	**.54**

CESP 13- Retail Store (Indio)

This retail convenience/grocery store received rebates for a lighting retrofit performed at their store in Indio, CA. Lights in the sales floor were changed from F32 T8s to F28 and F25 T8s. Beverage coolers lights were changed from T12s to LEDs.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
F32T8 to F028T8	490	476	32	28	5,642	1.13	12,877	14,995	116%
F32T8 to F025T8	3	3	32	25	5,642	1.13	115	134	116%
F72T12 to LED	18	18	72	19	8,760	1.26	5,223	10,530	202%
Total							**18,215**	**25,659**	**141%**

Results

Verified sales lighting hours were slightly higher than those used in *ex ante* calculations and case lights were on 24 hours/day. Also HCIF values were not included in *ex ante* calculations. The overall realization rate is 141%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	18,215	25,659	141%	3.33
Total	**18,215**	**25,659**	**141%**	**3.33**

NCEEP 12-Credit Union

The Credit Union constructed a new branch with numerous energy efficiency upgrades above the energy efficiency code baseline. The project was permitted under 2008 California Title 24 for non-residential facility. The customer received incentives from IID for installing high performance glazing, additional wall insulation, roof insulation, demand control ventilation, and duct seating. The following table provides a summarized list of the energy efficiency measures compared against IECC 2006:

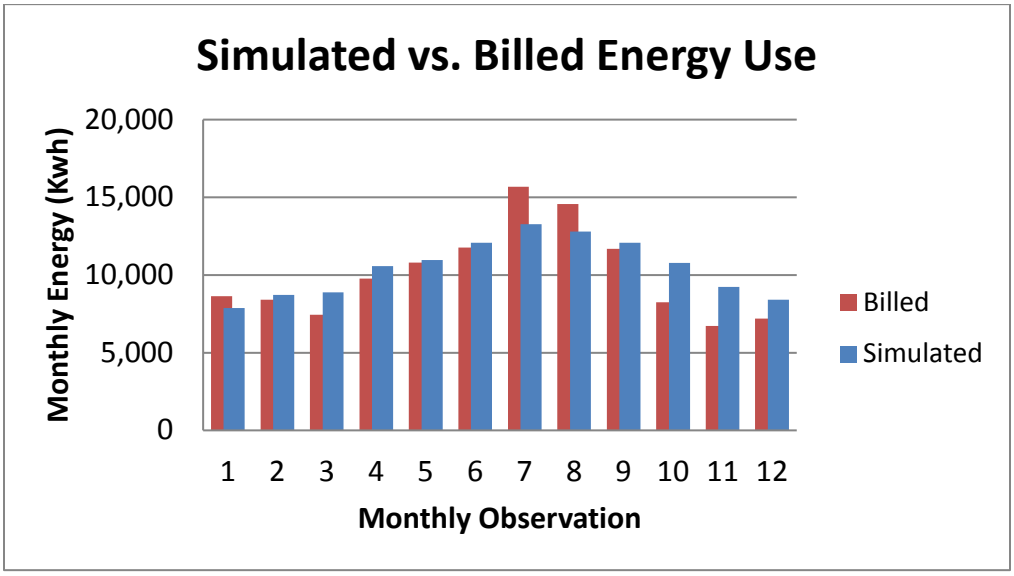
Summary of Measures

Model Input Parameters	***Baseline Definition (2008 CA Title 24)***	***As-Built***
Window Construction:	Overall U-value: 0.47, RHGC = 0.61 for north and RHGC = 0.36	Overall U-value = 0.353, RHGC[12] = 0.62
Building Envelop Exterior Wall Construction:	Overall U-value: 0.042	R-21 Insulation in cavity and R-4 insulation on exterior Overall U-value: 0.040
HVAC: Demand Control Ventilation	No DCV	DCV
HVAC: Duct Sealing and Third Party Duct Leakage Testing	Duct Air Loss < 15%	Duct Air Loss = 1%

Measurement and Verification Effort

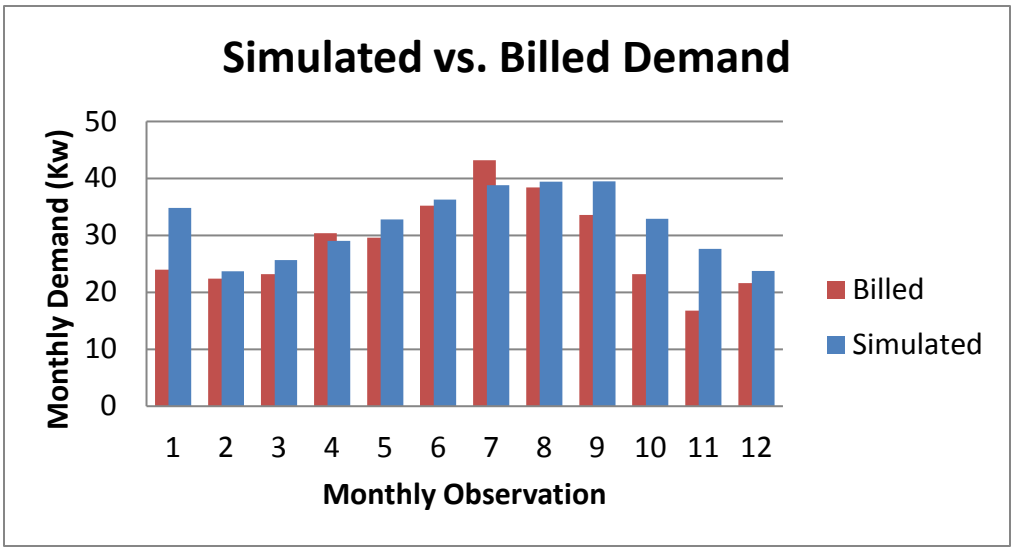
ADM used calibrated eQuest building models to calculate the *ex post* savings for this project. Using the information collected from Title-24 document for new construction, ADM created design building and calibrate the model to 2013 billing data with the 2013 weather data from NOAA.

2013 Monthly kWh Calibration



[12] RHGC is Relative Solar Heat Gain Coefficient which includes the effect of overhang on windows

2013 Monthly kW Calibration



After the design model is calibrated to the billing data, the baseline model was created in which all of the energy efficiency measures were removed. The baseline model's inputs were based on 2008 California Title 24 for non-residential facility. Both the baseline and as-built model were run using TMY3 weather data for the region. The typical year annual savings is the difference between the two models' annual consumption and can be seen below:

As-Built Vs. Baseline Annual Energy Consumption

End-Use	*Baseline kWh (IECC 2006)*	*As-Built kWh*	*Annual kWh Savings*
Space Cool	39,144	37,405	1,739
Hot Water	3,378	3,374	4
Vent. Fans	6,898	6,317	581
Misc. Equip.	84,813	84,813	0
Area Lights	26,687	15,731	10,956
Total	**160,920**	**147,640**	**13,280**

Results

The project-level realization rate is 62%. ADM suspects the calibrate model uses less HVAC due to temperature setback and economizer, even with larger internal load compare to the *ex-ante* model.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
New Construction	21,459	13,280	62%	4.32
Total	**21,459**	**13,280**	**62%**	**4.32**

CESP 13-School District

School District replaced lighting

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
F40T12 34w to F32T8 28W	128	128	34	28	2,305	1.15		2,036	
F32T8 to F32T8 28W w/26 sensors	670	488	32	28	1,614	1.15		14,429	
HPS 100w to LEDWP-656	4	4	100	29.4	4,313	1.00		1,218	
MH 175w to RAB ALED4T78	10	10	175	78	4,313	1.00		4,184	
FB31T8 32w to F17T8	9	9	32	17	2,305	1.15		358	
Total								**22,224**	

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
			Old	*New*				
T32 T8s with 26 occ sensors	26	526	2,305	1,614	1.15		418	
Total					**1.15**		**418**	

Results

A combination of slightly lower-than-expected operating hours and higher post wattages after including correct ballast factors, resulted in a 90% realization rate.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	25,052	22,642	90%	9.93
Total	**25,052**	**22,642**	**90%**	**9.93**

CESP 13-Restaurant (La Quinta)

Restaurant received a rebate for replacing incandescent downlights with LED lamps in the dining and display areas.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent to LED (DFN 16 W27 FL)	102	102	50	6	5,564	1.15	29,486	28,717	97%
Incandescent to LED (DFN 19 WW 120)	44	44	40	8	5,564	1.15	9,251	9,009	97%
Total							**38,737**	**37,726**	**97%**

Results

An HCIF was not included in *ex ante* calculations, however savings are still slightly lower than expected due to lower-than-expected verified hours of operation. The realization rate is 97%

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	38,737	37,726	97%	5.90
Total	**38,737**	**37,726**	**87%**	**5.90**

CESP 12-Country Club

Country Club received a rebate for replacing (222) incandescent candelabra lamps with LEDS in their street lighting.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
Incand. to LED candelabra	222	222	60	3	4,313	1.00	45,554	54,577	120%
Total							**45,554**	**54,577**	**120%**

Results

Ex ante calculations assumed lower lighting hours of operation than those verified, resulting in a 120% realization rate.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	45,554	54,577	120%	12.65
Total	**45,554**	**54,577**	**120%**	**12.65**

CESP 12-Water Facility

The Water Facility received a rebate for retrofitting and delamping existing T12 fixtures and installing occupancy sensors. These took place in the office/break room and auto shop areas.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
T12 to T5	48	48	227	54	2,600	1.00	19,812	21,590	109%
T12 to T5	110	408	227	54	2,600	1.00	3,563	7,639	214%
T12 to T5 delamp	50	-	227	-	2,600	1.00	27,658	29,510	107%
Total							**51,033**	**58,739**	115%

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
			Old	*New*				
Occupancy Sensors	30	86	2,600	1,820	1.00	127	2,022	1,592%
Total					**1.00**	**127**	**2,022**	**1,592%**

Results

Occupancy sensors savings are higher than those assumed in *ex ante* assumptions. Saving of 127 kWh/year is a deemed value, so the higher verified savings could be from either a greater connected load or a greater reduction in lighting operating hours than those assumed in *ex ante* calculations, resulting in an overall site realization rate of 111%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	54,843	60,761	111%	22.59
Total	**54,843**	**60,761**	**111%**	**22.59**

CESP 12-Auto Parts Store (Indio)

Auto Parts Store received a rebate for retrofitting the lighting on their sales floor, parts/stock room, storefront, tire area and restrooms. The majority of the retrofits were T12 to T8 fluorescents, however exterior wall packs were HPS to induction.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
T12 to T8	476	248	32	32	5,486	1.11	31,398	44,429	142%
T12 to T8	134	172	96	32	5,486	1.11	34,426	44,818	130%
T12 to T8	158	83	48	32	5,486	1.11	24,182	30,009	124%
HPS wall pack to Induction	3	3	175	84	4,313	1.00	1,502	1,177	78%
T12 to T8	4	2	32	32	5,486	1.11	282	390	138%
Total							**91,790**	**120,823**	**132%**

Lighting Controls Savings Calculations

Measure	*Quantity*	*Controlled Wattage*	*Hours*		*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
			Old	*New*				
Occupancy Sensors	2	32	5,486	3,840	1.00	254	105	41%
Total						**254**	**105**	**41%**

Results

The verified ballast factors of the EE lights were lower than those used in *ex ante* calculations. When the HCIF in included savings increase further, leading to a realization rate of 131%

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	92,298	120,928	131%	19.92
Total	**92,298**	**120,928**	**131%**	**19.92**

CESP 12-Big Box Retail (El Centro)

The Big Box Retail store received incentives from IID for installing LED lights, anti-sweat heater controls, and electronically commutated motors in their refrigerated cases.

Measurement and Verification Effort

Anti-Sweat Heater control savings is calculated based on regression of humidity vs. ASH percent runtime. The monitored data is based on ADM's ASH controller study done in New Mexico, however, ADM used humidity profile from Imperial's TMY3 weather data.

There was no specification of evaporative fans supplied with the project document. ADM was not able to verify ECM because it will require removing food items in reach-in refrigerators. ADM assumed the facility replaced 1/50 HP motors. Typical shaded-pole motor efficiency is 23% and ECM is 52%.

ADM calculated savings from LED refrigerated lights as follows,

$$kWh = Q \times \left(W_{baseline} \times H_{baseline} - W_{as\_built} \times H_{as\_built}\right) \times CIF$$

Where,

Q	Fixture Quantity
$W_{baseline}$	Baseline Wattage
W_{as_built}	As-Built Wattage
$H_{baseline}$	Operating Hours
H_{as_built}	Operating Hours
CIF	Cooling Interactive Factor

LED Gross Savings

Items	*Qty*	$W_{baseline}$	*Baseline Hours*	W_{as_built}	*As Built Hours*	*CIF*	*kWh Savings*	*kW Reduction*
High Temp (center)	3	46	5,423	18	4,609	1.400	699.22	0.12
High Temp (LR)	2	46	5,423	9	4,609	1.400	582.31	0.10
Medium Temp (center)	31	46	5,423	18	4,609	1.667	8,601.56	1.45
Medium Temp (LR)	32	46	5,423	9	4,609	1.667	11,091.55	1.97
Medium Temp (center)	31	46	5,423	18	4,609	1.667	8,601.56	1.45
Medium Temp (LR)	18	46	5,423	9	4,609	1.667	6,239.00	1.11
High Temp (Top)	16	46	5,423	10	5,423	1.400	4,372.99	0.81
Total							**40,188.18**	**7.00**

Results

The project-level realization rate is 115%. The project realization is good but *ex ante* savings methodology on LED lights must be updated. The current methodology gives certain savings per number of doors which is not an appropriate method to do it. LED case lights have center, left, and right type, and center light bar consumes almost twice of energy compare to the light bars on

left or right. Also the number of lights is one more than the number of doors. For an example, a 5 door reach-in case has 4 center lights, 1 left light, and 1 right light. LEDs in open deck has lower realization rate because the ex-ante savings estimate used 400W for baseline 4' T12 fixture and 110W for the new LED. Both wattages are one magnitude large than actual. ASH controllers have higher savings because ASH consumes about 175W per door and reducing the number of hours provides great savings.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
New reach in with LEDs	22,950	20,975	91%	3.64
LED Retrofits	18,000	14,841	82%	2.56
ASH/ECMs	41,544	81,348	196%	7.65
LEDs in Open Deck	23,200	4,373	19%	0.81
Total	**105,694**	**121,536**	**115%**	**14.65**

CESP 12-Big Box Retail Store #554

Big Box Retail store #554 received a rebate for retrofitting their incandescent downlighting with LED lamps on their sales floor.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
Incandescent 47W PAR 38 to MSI LED 12W PAR 38	811	811	47	12	4,238	1.11	132,842	133,528	101%
Incandescent 47W PAR 38 to OSRAM LED 18W PAR 38	171	171	47	18	4,238	1.11	23,208	23,328	101%
Incandescent 47W PAR 38 to OSRAM LED 10W PAR 38	42	42	47	10	4,238	1.11	7,273	7,310	101%
Total							**163,323**	**164,166**	**101%**

Results

Verified hours of operation were slightly lower than those used in *ex ante* calculations, however when the HCIF was included the realization rate was brought up to 101%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	163,323	164,166	101%	34.90
Total	**163,323**	**164,166**	**101%**	34.90

CESP 13-Hardware Store (La Quinta)

The Hardware Store received a rebate retrofitting their sales floor lighting from 6-lamp to 4-lamp F45T5HOs.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
6-to-4 F45T5HO	2,556	1,804	49	51	6,812	1.11	284,565	244,791	86%
Total							**284,565**	**244,791**	**86%**

Results

Verified ballast factors were higher than those used in *ex ante* calculations, resulting in a higher post-retrofit connected load and a lower realization rate.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	284,565	244,791	86%	32.37
Total	**284,565**	**244,791**	**86%**	**32.37**

CESP 13-Agriculture Facility

Agriculture Facility received a rebate for retrofitting lighting at their site in Coachella. Fluorescent lighting in the plant interior, offices and part of the exterior canopy were changed from T12s to LED and metal halide and high pressure sodium lamps under the exterior canopy were changed to high output LEDs.

Site contacted-reported operating hours were verified using photo logging.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
1000W MH to LED	1	1	1080	232	4,313	1.00	4,643	3,657	79%
400W MH to LED	9	9	458	116	4,313	1.00	16,852	13,275	79%
250W HPS to LED	29	29	290	90	4,313	1.00	31,755	25,015	79%
8ft T12 to LED	104	104	126	17.5	4,313	1.00	61,780	48,668	79%
4ft T8 to LED	273	273	32	17.5	3,019	1.04	21,673	12,429	57%
8ft T12 to LED	144	72	126	150	4,140	1.04	40,208	31,623	79%
8ft T12 to LED	424	218	126	119	4,140	1.04	150,464	118,338	79%
4ft T12 to LED	2	2	56	17.5	4,140	1.04	422	332	79%
Total							**327,796**	**253,338**	**77%**

Results

Verified lighting hours of operation were lower than those used in *ex ante* calculations, resulting in a realization rate of 79%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	327,796	253,338	77%	327,796
Total	**327,796**	**253,338**	**77%**	**327,796**

NCEEP 12-School Facility

The School built a new library and band building. The school district received incentives from IID for installing high efficiency lights and temperature setback. The realization rate for this project is 9%.

Project Description

The customer constructed a new library and band building with high efficiency lights and temperature setback. The project was permitted under 2008 California Title 24 for non-residential facility.

The following table provides a summarized list of the energy efficiency measures compared against IECC 2006:

Terminal 3 Measure Summary

Model Input Parameters	*Baseline Definition (2008 CA Title 24)*	*As-Built*
Lighting Power Density: Indoor	Allowed Watt = 13,787 W	As-Built Watt = 12,800 W
Lighting Power Density: Outdoor	Allowed Watt = 4,388 W	As-Built Watt = 3,630 W
HVAC: Setback	No Set Back	Temperature Set Back

Measurement and Verification Effort

ADM used Standard method on lighting portion of the evaluation. The Standard method to calculate the savings is as follows:

$$kWh = \left(W_{baseline} - W_{as\_built}\right) \times H$$

Where,

$W_{baseline}$	Baseline Allowed Wattage
W_{as_built}	As-Built Wattage
CIF	Cooling Interactive Factor
H	Hours of Operation

Annual Energy Savings from Lighting Measures

Type	*Baseline kW*	*Design kW*	*HCIF for kWh*	*Hours*	*kWh Savings*
Indoor Lights	13.787	12.8	1.21	2,445	2,919
Outdoor	4.388	3.63	1.00	4,180	3,168
Total					**6,087**

The demand reduction is calculated as follows:

$$kWh = \left(W_{baseline} - W_{as\_built}\right) \times CIF$$

Demand Reduction from Lighting Measures

Type	*Baseline kW*	*Design kW*	*HCIF for kW*	*kW Reduction*
Indoor Lights	13.787	12.8	1.30	1.28
Outdoor Lights	4.388	3.63	1.00	0.76
Total				**2.04**

The facility installed heat pump units on the roof and they all perform as the code but temperature setback is installed. ADM calculated the savings using heating and cooling degree days as equivalent full load hours for heating and cooling system. The actual equivalent full load hours are less therefore this method would generate more HVAC energy consumption. ADM estimates the temperature setback could save 10% of total HVAC energy consumption and this approach yields upper limit of energy savings.

The savings calculation is as follows:

$$kWh = \left(kW_{Cooling} \times CDD + kW_{Heating} \times HDD\right) \times 0.1$$

Where,

$kW_{Cooling}$	Total Full Load kW of Cooling
$kW_{Heating}$	Total Full Load kW of Heating
CDD	Cooling Degree Days at Reference Temperature of 65F
HDD	Heating Degree Days at Reference Temperature of 65F
0.1	10% Energy Reduction

Annual Energy Savings from Temperature Setback Measure

	Full Load kW	*Degree Days*	*kWh Savings*
Cooling	43.6	4,584	19,988
Heating	57.1	1,272	7,268
Total			**27,256**

Results

The project-level realization rate is 9%. The baseline annual kWh calculated during *ex ante* analysis was 1,997,514 kWh. This facility can't use that magnitude of energy on heating and cooling because the entire campus used 642,000 kWh from October 2013 to September 2014, one year period. *Ex ante* models used incorrect inputs for kBtu per sf/yr and the square footage of the conditioned space. ADM calculated the savings in conservative way using heating and cooling degree days with giving 10% energy savings by temperature setback.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
EE Lighting	6,742	6,087	90%	2.04
HVAC Setback	364,649	27,256	7%	57.14
Total	**371,391**	**33,343**	**9%**	**59.18**

CESP 12-Produce Facility

Produce Facility received an incentive for installing (3) fast opening and closing roll-up doors in their refrigerated warehouse. The 72,000 ft2 refrigerated warehouse is used to process, package, refrigerate, and ship dates. The original wooden doors were left open for the duration of each workday in the warehouse (9 hrs a day, Mon-Fri, from August through December). The new doors are able to open and close throughout the day such that they are only open for a small fraction of the time.

Measurement and Verification Effort

ADM applied IPMVP Option A, in the form of a bin analysis, to calculate refrigerator door savings. Engineering algorithms (sourced from the refrigeration ASHRAE Handbook) were used to estimate the heat losses and gains do to infiltration through the affected doors in the refrigerated warehouse.

The analysis was performed by separating the year into (4) bins, one for each quarter, and applying average weather data for that bin. Weather data is sourced from typical weather data for California Weather Zone CZ15. The Excel file used to perform this bin analysis also provides additional information regarding the precise algorithms and assumptions ADM leveraged in our analysis.

Results

The main factor contributing to the difference in *Ex ante* and *Ex post* Annual Energy savings estimates is the assumption of operating hours used in the analyses. In our review of the *Ex ante* energy savings calculations, it appears that an assumption of 180 hours per month for 12 months (for a total of 2160 hours/year) was used to estimate annual energy usage/impacts. However; it was recorded in the pre-installation inspection and confirmed through our site inspection that the affected doors are only in operation in the months August through December – a total of 936 hours.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Refrigeration	750,000	128,500	35%	114
Total	**750,000**	**128,500**	**35%**	**114**

CESP 12-Grocery Store

Grocery Store installed high-efficiency refrigeration and HVAC hardware. Through use of VFDs, the store was able to reduce floating head and floating suction pressures, the anti-sweat heater control motors and the space conditioning system's air handler fan motors throughout its refrigeration cycle. The VFD measure reduces the run time duty cycling and operational capacity full run time loads. ECMs replaced existing motors for evaporator fans at all walk-in coolers and display cases. Both measures reduce the consumption load while allowing the motors to run at full capacity, with less consumption.

The following table summarizes projects for this site:

Summary of Measures

EEM Desc.	*Ex ante Annual Savings [kWh]*
Floating Head Pressure	184,281
Floating Suction Pressure	38,668
Anti-Sweat Heaters	48,467
ECM Fans (Walk-ins)	42,499
ECM Fans (Display)	66,141
VFDs on AHUs	136,017
Total:	**516,073**

Algorithms for Estimating Savings

ADM applied IPMVP Option A, in the form of a deemed analysis, to calculate savings for this project. Unit energy savings estimates were sourced from the California Municipal Utilities Association Technical Resource Manual as well as from the Database for Energy Efficiency Resources (DEER).

The Excel file used to perform this bin analysis also provides additional information regarding the precise assumptions ADM leveraged in our analysis, including their sources.

Results

The *ex post* Verified Annual Energy and Demand Impacts for this project are 314,619 kWh and 44.24 kW respectively. The project realization rate is 61%.

It is difficult to comment on specific factors leading to the project realization rate as no specific regarding the assumptions and algorithms used to calculate the *Ex ante* estimates were provided. It can be pointed out that two measures, Floating head pressure and AHU VFDs, account for the majority of the *Ex ante* savings estimates (62%). In both cases the *Ex post* savings estimates are much lower (with measure realization rates of 37% and 11% respectively). The per-horsepower savings implied by the *Ex ante* estimates for Floating Head Pressure are 1,307 kWh/HP. This is 3 times higher than listed in DEER. For Supply Fan VFDs the *Ex ante* calculations estimate 3,400 kWh/HP. This is 7 times higher than listed in DEER.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Floating Head Pressure	184,281	67,845	37%	10.47
Floating Suction Pressure	38,668	12,885	33%	1.59
Anti-Sweat Heaters	48,467	45,230	93%	3.48
ECM Fans (Walk-ins)	42,499	74,466	175%	8.48
ECM Fans (Display)	66,141	98,700	149%	10.22
VFDs on AHUs	136,017	15,492	11%	10.0
Total	**516,073**	**314,619**	**61%**	**44.24**

CESP 12- HOA

HOA received a rebate for retrofitting incandescent and fluorescent lamps on their grounds with LED lamps.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
MR-16 to 6W LED	397	397	35	6	4,313	1.00	49,736	49,656	100%
35W MR-16 to 6W LED	28	28	35	6	4,313	1.00	3,508	3,502	100%
60W A-19 to 8W LED	1998	1998	60	8	4,313	1.00	448,831	448,103	100%
13W fluoro to 6W LED	82	82	13	6	4,313	1.00	2,480	2,476	100%
36W PAR36 to 6W LED	153	153	36	6	4,313	1.00	19,829	19,797	100%
75W PAR 30 to 26W LED	32	32	75	26	4,313	1.00	6,774	6,763	100%
DL-20 50W PAR 20 to 19W PAR 38 LED	56	28	50	19	4,313	1.00	9,798	9,782	100%
75W PAR38 to 19W PAR 38 LED	22	22	75	19	4,313	1.00	5,322	5,314	100%
Total							**546,277**	**545,392**	**100%**

Results

The hours of operation were slightly adjusted to match the site latitude, however the project realization rate is 100%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	546,277	545,392	100%	126.45
Total	**546,277**	**545,392**	**100%**	**126.45**

CESP 12-Residential Association

The Residential Association received a rebate for retrofitting fluorescent lamps on their grounds with LED lamps.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
CFL to LED	1,135	1,135	26	5	4,313	1.00	104,397	102,800	98%
CFL to LED	4,346	4,346	26	6	4,313	1.00	380,709	374,886	98%
CFL to LED	1,520	1,520	26	9	4,313	1.00	113,180	111,448	98%
Total							**598,286**	**589,134**	**98%**

Results

The hours of operation were slightly adjusted to match the site latitude, however the project realization rate is 98%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	598,286	589,134	98%	136.60
Total	**598,286**	**589,134**	**98%**	**136.60**

CESP 12-Big Box Store

Big Box Store # 441 received a rebate for retrofitting their existing metal halide lamps with more efficient ceramic discharge metal halide lamps on their sales floor.
During certain hours of the day and week the lighting was partially on, so a weighted lighting operation profile was developed.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realizatio n Rate*
	Old	*New*	*Old*	*New*					
MH to Ceramic Discharge MH	567	567	465	231	6,081	1.11	630,678	895,623	142%
Total							**630,678**	**895,623**	**142%**

Results

Ex ante calculations did not include an HCIF and assumed lower lighting operating hours than those verified on site, resulting in a 142% realization rate.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	630,678	895,623	142%	132.68
Total	**630,678**	**895,623**	**142%**	**132.68**

CESP 12-Residential Association

The Residential Association received a rebate for retrofitting fluorescent lamps on their grounds with LED lamps.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
Incand. To LED - Oblong	1,608	1,608	21	6	4,313	1.00	105,646	104,030	98%
Incand. To LED - Bullet	832	832	50	9	4,313	1.00	149,411	147,125	98%
Incand. To LED - Low Voltage	1,142	1,142	20	9	4,313	1.00	55,022	54,180	98%
Incand. To LED - 4" Recessed	294	294	50	6	4,313	1.00	56,660	55,793	98%
Incand. To LED - 6" Recessed	817	817	50	6	4,313	1.00	157,452	155,044	98%
Incand. To LED - House	1,652	1,652	50	9	4,313	1.00	296,666	292,128	98%
Incand. To LED - Candelabra	2,334	2,334	25	3	4,313	1.00	224,904	221,464	98%
Incand. To LED - Path	129	129	15	5	4,313	1.00	5,650	5,564	98%
Incand. To LED - Path	452	452	15	9	4,313	1.00	11,879	11,697	98%
Total							**1,063,289**	**1,047,024**	**98%**

Results

The hours of operation were slightly adjusted to match the site latitude, however the project realization rate is 98%.

Verified Gross Savings/Realization Rates

Measure Category	*kWh Savings*			*Realized kW Reduction*
	Expected	*Realized*	*Realization Rate*	
Lighting Retrofit	1,063,289	1,047,024	98%	242.76
Total	**1,063,289**	**1,047,024**	**98%**	**242.76**

CESP 13-Industrial Facility

In two phases over 2012 and 2013 Industrial Facility performed major retrofits of their lighting. This site report is for phase 2 in 2013. Changes were from HID, T12 and incandescent lamps to induction, EE HID, T8, T5 and CFL lamps. Occupancy sensors were also installed in some areas. These changes took place in the production, warehouses and offices of this light industrial facility. ADM obtained lighting schedules from facility staff and corroborated lighting operating hours using photo loggers. Lighting profiles were developed for each area.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
HPS 100W to induction lamp	44	44	138	84	4,313	1.00	17,517	10,248	59%
INCAND 100W to induction lamp	2	2	100	42	4,313	1.00	824	500	61%
HPS 150W to induction lamp	11	11	188	84	4,313	1.00	8,154	4,934	61%
MH 175W to induction lamp	18	18	215	84	4,313	1.00	16,680	10,170	61%
MH 1000W to induction lamp	3	3	1,080	210	4,313	1.00	18,121	11,257	62%
MH 400W to induction lamp	130	130	458	210	4,313	1.00	230,219	139,051	60%
MH 250W to induction lamp	31	31	295	120	4,313	1.00	37,237	23,398	63%
MH 175W to MH pulse start	144	144	215	70	5,117	1.00	143,320	106,834	75%
INCAND 100W to MH pulse start	1	1	100	70	5,117	1.00	206	153	75%
INCAND 175W to MH pulse start	16	16	175	70	5,117	1.00	11,532	8,596	75%
INCAND 100W to CFL	5	5	100	40	5,117	1.00	2,059	1,535	75%
INCAND 150W to CFL	2	2	150	40	5,117	1.00	1,510	1,126	75%
MH 175W to CFL	153	153	215	40	5,117	1.00	183,784	136,996	75%
HPS 150W to CFL	11	11	188	40	5,117	1.00	11,175	8,330	75%
MH 250W to CFL	41	41	295	40	8,760	1.00	71,763	91,586	128%
MH 150W to CFL	5	5	188	40	5,117	1.00	5,079	3,786	75%
MH 250W to MH pulse start	43	43	295	70	5,117	1.00	66,409	49,503	75%
HPS 150W to MH pulse start	28	28	188	70	5,117	1.00	22,679	16,905	75%
MH 400W to MH pulse start	15	15	458	70	5,117	1.00	39,948	29,778	75%
4FT T12 34W to 4FT T8 32W	391	234	36	32	5,117	1.00	45,220	33,708	75%
U SHAPE T12 to F017T8	8	8	40	17	5,117	1.00	1,263	941	75%
8FT T12 95W to *T5 HO w/ 1 occ sensor	2	4	103	58	3,582	1.00	(178)	(93)	52%
8FT T12 60W to 4FT T8 32W	52	52	60	32	2,642	1.00	9,994	3,847	38%
4FT T12 40W to 4FT T8 32W	262	208	40	32	2,642	1.00	26,248	10,105	38%
MH 250W to *T5 HO w/ 11 occ sensors	11	22	295	58	3,582	1.00	13,515	7,053	52%

Measure	Quantity		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
	Old	New	Old	New					
MH 250W to T5 HO	22	44	295	58	5,117	1.00	27,030	20,149	75%
HPS 250W to T5 HO	4	8	295	58	5,117	1.00	4,915	3,663	75%
MH 175W to T5 HO	95	190	215	58	5,117	1.00	64,556	48,121	75%
INCAND 100W to CFL	12	12	100	23	5,117	1.00	6,342	4,728	75%
INCAND 65W to CFL	10	10	65	23	5,117	1.00	2,883	2,149	75%
MH 400W to *T5 HO w/ 27 occ sensors	27	108	458	58	3,582	1.00	41,884	21,857	52%
MH 400W to MH pulse start	17	17	458	320	5,117	1.00	16,103	12,003	75%
MH 1000W to MH pulse start	16	16	1,080	750	5,117	1.00	36,242	27,016	75%
MH 400W to T5 HO	336	1,344	458	58	5,117	1.00	521,225	388,532	75%
MH 1000W to T5 HO	32	256	1,080	58	5,117	1.00	135,303	100,858	75%
Total							**1,840,760**	**1,339,324**	**73%**

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
			Old	New				
Occupancy Sensors	1	232	5,117	3,582	1.00	127	356	280%
Occupancy Sensors	11	116	5,117	3,582	1.00	1,397	1,959	140%
Occupancy Sensors	27	232	5,117	3,582	1.00	3,429	9,616	280%
Total						**4,953**	**11,931**	**241%**

Results

Lighting hours of operation for all areas were significantly lower than those used in *ex ante* calculations, this resulted in a realization rate of 73%

Verified Gross Savings/Realization Rates

Measure Category	kWh Savings			Realized kW Reduction
	Expected	Realized	Realization Rate	
Lighting Retrofit	1,845,713	1,351,255	73%	266.55
Total	**1,845,713**	**862,242**	**73%**	**266.55**

CESP 12-Industrial Facility

In two phases over 2012 and 2013 Industrial Facility performed major retrofits of their lighting. This site report is for phase 1 in 2012. Changes were from HID, T12 and incandescent lamps to induction, EE HID, T8, T5 and CFL lamps. Occupancy sensors were also installed in some areas. These changes took place in the production, warehouses and offices of this light industrial facility. ADM obtained lighting schedules from facility staff and corroborated lighting operating hours using photo loggers. Lighting profiles were developed for each area.

Lighting Retrofit Savings Calculations

Measure	*Quantity*		*Wattage*		*Hours*	*Heating Cooling Interaction Factor*	*Expected kWh Savings*	*Realized kWh Savings*	*Realization Rate*
	Old	*New*	*Old*	*New*					
HPS 100W to induction canopy	2	2	138	42	4,313	1.00	1,345	828	62%
MH 175W to induction canopy	5	5	215	42	4,313	1.00	6,006	3,731	62%
INCAND 100W to induction canopy	10	10	100	42	4,313	1.00	4,118	2,502	61%
HPS 150W to pulse start	20	20	188	70	5,117	1.00	16,199	12,075	75%
MH 175W to pulse start	238	238	215	70	5,117	1.00	236,877	176,573	75%
INCAND 100W to CFL	5	5	100	40	5,117	1.00	2,059	1,535	75%
HPS 175W to CFL	47	47	213	40	5,117	1.00	55,811	41,603	75%
HPS 175W to CFL	11	11	213	40	5,117	1.00	13,062	9,737	75%
MH 250W to CFL	9	9	295	40	5,117	1.00	15,753	11,743	75%
MH 1000W to induction flood	4	4	1,080	210	4,313	1.00	24,161	15,009	62%
MH 400W to induction flood	8	8	458	210	4,313	1.00	14,167	8,557	60%
MH 175W to induction wall pack	1	1	215	84	4,313	1.00	927	565	61%
MH 250W to induction wall pack	1	1	295	84	4,313	1.00	1,476	910	62%
MH 1000W to pulse start	19	19	1,080	750	5,117	1.00	43,037	32,081	75%
INCAND 100W to 4FT T8 32W	9	18	100	32	5,117	1.00	2,224	1,658	75%
exit sign to LED exit sign	3	3	40	4	8,760	1.00	745	951	128%
8FT T12 95W to 4FT T8 32W	2	2	103	32	2,924	1.17	975	486	50%
4FT T12 34W to 4FT T8 32W	785	500	36	32	2,924	1.17	84,153	41,938	50%
MH 250W to T5 HO	24	48	295	58	5,117	1.00	29,488	21,981	75%
MH 175W to T5 HO	11	22	215	58	5,117	1.00	7,475	5,572	75%
MH 175W to T5 HO w/ 7 occ sensors	7	14	215	58	3,582	1.00	4,757	2,482	52%
MH 1000W to T5 HO w/ 22 occ sensors	308	2,464	1,080	58	3,582	1.00	1,302,293	679,530	52%
MH 400W to T5 HO w/ 10 occ sensors	10	40	458	58	3,582	1.00	15,513	8,094	52%
MV 400W to T5 HO w/ 20 occ sensors	20	80	455	58	3,582	1.00	30,613	15,974	52%
MH 1000W to T5 HO w/ 7 occ sensors	7	28	1,080	58	3,582	1.00	40,745	21,260	52%

Measure	Quantity		Wattage		Hours	Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
	Old	New	Old	New					
MH 400W to T5 HO	404	1,616	458	58	5,117	1.00	626,711	467,164	75%
MH 1000W to T5 HO	1	4	1,080	58	5,117	1.00	5,821	4,339	75%
Total							**2,586,510**	**1,588,877**	**61%**

Lighting Controls Savings Calculations

Measure	Quantity	Controlled Wattage	Hours		Heating Cooling Interaction Factor	Expected kWh Savings	Realized kWh Savings	Realization Rate
			Old	New				
T5 HO w/ 7 occ sensors	7	116	5,117	3,582	1.00	889	1,246	140%
T5 HO w/ 22 occ sensors	22	812	5,117	3,582	1.00	2,794	27,421	981%
T5 HO w/ 10 occ sensors	10	232	5,117	3,582	1.00	1,270	3,561	280%
T5 HO w/ 20 occ sensors	20	232	5,117	3,582	1.00	2,540	7,122	280%
T5 HO w/ 7 occ sensors	7	663	5,117	3,582	1.00	889	7,122	801%
Total						**8,382**	**46,473**	**544%**

Results

Lighting hours of operation for all areas were significantly lower than those used in *ex ante* calculations, this resulted in a realization rate of 73%

Verified Gross Savings/Realization Rates

Measure Category	kWh Savings			Realized kW Reduction
	Expected	Realized	Realization Rate	
Lighting Retrofit	2,594,892	1,635,349	63%	376.66
Total	**2,594,892**	**1,635,349**	**63%**	**376.66**

Appendix B: Decision Maker Survey

As part of the evaluation work effort, a survey was made of a sample of decision makers for facilities that received rebates under one of IID's EE programs. That survey provided the information used in Chapter 3 to estimate free ridership for projects in the programs.

Each participant was interviewed using the survey instrument provided in Appendix B. The interviews were conducted by telephone. During the interview, a participant was asked questions about (1) his or her general decision making regarding purchasing and installing energy efficient equipment, (2) his or her knowledge of the program and (3) the influence that the program had on his or her decision to install EE measures (e.g., lighting measures, HVAC measures,).

Imperial Irrigation District

DECISION-MAKER SURVEY QUESTIONNAIRE

Hello, my name is _____. I am calling on behalf of **your utility company, Imperial Irrigation District.**

May I please speak to _____ *(Contact Person)?*

Hello, my name is _____. I am calling on behalf of your utility company, Imperial Irrigation District. Through its rebate programs IID has been working with firms and building owners to help them improve the energy efficiency of their operations. Because your company participated in their equipment rebate program, we are interested in receiving feedback from you regarding your experience with the program.

SECTION ONE - INTERVIEWEE SCREENING

SCRN-Q.1 According to our records your company participated in the rebates program for one or more projects at the following facility:

(Name of facility _____

You are shown as the contact person. Is that correct?

(If contact seems confused, ask if they remember the rebate program. If necessary, describe program and distinguish from other programs.)

- ❑ Yes (GO TO SCRN-Q.2)
- ❑ No (GO TO SCRN-Q.3)

SCRN-Q.2 Many of our questions focus on your company's decision to participate in the program and on your decisions to purchase and install energy efficient equipment for your facility. Are you familiar with these topics?

- ❑ No. (GO TO SCRN-Q.3)

SCRN-Q.3 Who would be the best person to talk to about this?

Name: _____

Title: _____

Phone Number: _____

(You are finished with this person.)

Thank you very much for your time

(START SHEET FOR NEW CONTACT PERSON ABOVE)
CALL THIS PERSON AND GO TO BEGINNING OF INTRODUCTION.

- ❑ Yes. "I am the best person to talk to". *(GO TO Q 1)*

*TO BEGIN, I HAVE SOME QUESTIONS REGARDING HOW **DECISIONS ABOUT ENERGY EFFICIENCY** IMPROVEMENTS ARE MADE FOR YOUR FACILITY.*

1. Which financial methods does your organization typically use to evaluate energy efficiency improvements for your facility? (READ ALL. YES, NO OR DK FOR EACH.) (CAN BE MULTIPLE RESPONSES)
   - ❑ Initial Cost
   - ❑ Simple payback *(Go to question 1.**a**)*
   - ❑ Internal rate of return *(Go to question 1.**b**)*
   - ❑ Life cycle cost *(Go to question 1.**c**)*
   - ❑ Don't know *(Go to question 11)*

   1.a What **payback** *length of time* do you normally require in order to consider an energy investment cost effective?
   _____ Years *(Go to question 11.)*

   1.b What **rate of return** do you normally require in order to consider an energy investment cost effective? _____%
   (Expect answers 10 to 30 %.) (Go to question 11.)

   1.c What **discount rate** do you normally use in determining the life-cycle costs of various equipment options?_____%
   (Expect answers 3 to 30 %.) (Go to question 11.)

QUESTIONS 2 through 11 ASKED FOR EACH TYPE OF END USE EQUIPMENT OR MEASURE FOR WHICH CUSTOMER RECEIVED A FINANCIAL INCENTIVE. LISTED FROM PROGRAM RECORDS.:

I now have some questions about particular types of equipment for which you received financial incentives.

According to IID's records, you received incentives for (insert Equipment/Measure _____

2. Before participating in the rebate program, had you installed any equipment or measure similar to [Rebated Equipment/Measure] at your facility?
   - ❑ Yes
   - ❑ No

3. Did you have plans to install [Equipment/Measure] before participating in the program?
   - ❑ No
   - ❑ Yes

   If Yes: 3a Would you have gone ahead with this planned installation even if you had not participated in the program?
   - ❑ Yes
   - ❑ No

4. How important was previous experience with the rebate program in making your decision to install [Equipment/Measure]? Is it… (READ LIST)
   - ❑ Very important
   - ❑ Somewhat important
   - ❑ Only slightly important
   - ❑ Not important at all
   - ❑ Or you did not have previous experience with the program
   - ❑ Don't know *(DON'T READ)*

5. Did an Energy Efficiency Specialist or account representative recommend that you install [Equipment/Measure]?
   - ❑ No
   - ❑ Yes

   If Yes: 5a If the program representative had not recommended installing [Equipment/Measure], how likely is it that you would have installed [Equipment/Measure] anyway? You… (READ LIST)
   - ❑ Definitely would have installed
   - ❑ Probably would have installed
   - ❑ Probably would not have installed
   - ❑ Definitely would not have installed
   - ❑ Don't know *(DON'T READ)*

6. Would you have been financially able to install [Equipment/Measure] without the financial incentive from the rebate program?
   - ❑ Yes
   - ❑ No
   - ❑ Don’t know

7. If the **financial incentive** from the rebate program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway? You… (READ LIST)
   - ❑ Definitely would have installed

- ❑ Probably would have installed
- ❑ Probably would not have installed
- ❑ Definitely would not have installed
- ❑ Don't know *(DON'T READ)*

8. How did the availability of information and financial incentives through the program affect the quantity (or number of units) of [Equipment/Measure] that you purchased and installed? Did you purchase and install more [equipment/measure] than you otherwise would have without the program?
   - ❑ Yes
     IF YES: 8a How much more? _____
   - ❑ No, Did not affect quantity purchased and installed

9. How did the availability of information and financial incentives through the program affect the level of energy efficiency you chose for [Equipment/Measure]? Did you choose equipment that was more energy efficient than you otherwise would have chosen because of the program?
   - ❑ Yes
     IF YES: 9a How much more efficient? (could be expressed in different ways. Ask for percentage: e.g., 10% more efficient) _____
   - ❑ No, program did not affect level of efficiency that we chose for equipment

10. How did the availability of information and financial incentives through the program affect the timing of your purchase and installation of [Equipment/Measure]? Did you purchase and install [equipment/measure] earlier than you otherwise would have without the program?
    - ❑ Yes
      ⬇
      IF YES: 10a When would you otherwise have installed the equipment? (READ IF NEEDED)
      - ❑ In less than 6 months later
      - ❑ In 6-12 months later
      - ❑ In 1-2 years later
      - ❑ In 3-5 years later
      - ❑ In more than 5 years later
    - ❑ No, did not affect timing of purchase and installation

11. When did you learn of the program? (READ)
    - ❑ You had participated in other energy efficiency incentive programs
    - ❑ Before planning for replacing the equipment began
    - ❑ During your planning to replace the equipment
    - ❑ Once equipment had been specified but not yet installed
    - ❑ After equipment was installed
    - ❑ Some other time (When? _____)

- ❑ Don't know *(Don't Read)*

12. On a five-point scale, where 1 is very dissatisfied, 5 is very satisfied, and 3 is neutral, how would you rate your satisfaction with the following?

	1	**2**	**3**	**4**	**5**	**DK**
a. Performance of the equipment installed _____						
b. Savings on your monthly bill_____						
c. Incentive amount_____						
d. The effort required for the application process_____						
e. Information provided by I&M Account Representative_____						
f. Quality of the work provided by your contractor_____						
g. The elapsed time until you received the incentive_____						
h. Overall program experience_____						

Appendix C: Regression Model

To further investigate attic insulation measures (a part of Energy Rewards Rebates) the following difference-in-difference (DiD) regression model was used.

Meter data form January of 2011 through November of 2014 for both the treatment group (463) and control group (177) was used. The meter data was divided into pre- and post-treatment periods, where the treatment date varied per customer throughout 2013. The DiD approach compares the pre-to-post change in electricity usage between the treatment and control groups. It follows the form:

Equation 1

$$Average\ daily\ kWh = \alpha + Post + Treatment + Post * Treatment + CDD + HDD + \varepsilon$$

Where:

Average daily kWh =each household's average daily use per the given month

α *= intercept*

Post = dummy variable indication before/after treatment (1=P)

Treatment = dummy variable indicating treatment/control group (1=T)

*Post*Treatment = the interaction of Post and Treatment, indicating treatment individuals in the post=treatment group*

CDD = cooling degree days (base 65)

HDD = heating degree days (base 65)

ε *= error term*