EM&V Report: 2014 Conservation Programs

Prepared for:

Truckee Donner Public Utility District

July 08, 2015

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Table of Contents

List of Figures

List of Tables

1. Executive Summary

ADM Associates was been contracted to evaluate the energy impacts of Truckee Donner Public Utility District's (TDPUD) 2014 energy efficiency program portfolio. The district implemented 16 energy and 4 water conservation programs with an ex post net impact of 1,634,738 kWh and 162 kW in the 2014 program year. A summary of the portfolio's performance for CY 2014 is provided in Table 1-1 and an overview of the evaluation's findings and recommendations are provided in Sections 1.1 and 1.2.

Table 1-1. Summary of Portfolio Performance

Ex Post Net Annual Energy Savings [kWh]	Ex Post Net Peak Demand Reductions [kW]	Ex Post Net Annual Water Savings [MG]	Net Lifecycle GHG Reductions [Tons]
1,634,738	162	18.4	6,970

Our EM&V report is organized into the following sections:

- Section 1 provides the reader an executive summary of the evaluation's findings and recommendations.
- Section 2 describes the general approaches used for the impact evaluation.
- Section 3 details specific EM&V activities, evaluation findings & recommendations, and overall performance for each of TDPUD's residential programs selected for evaluation.
- Section 4 details specific EM&V activities, evaluation findings & recommendations, and overall performance for each of TDPUD's commercial programs selected for evaluation.

1.1. Summary of Evaluation Findings

Detailed evaluation findings for specific programs can be found later in this report (Sections 3 and 4). This section provides a summary of the high level findings pertinent to TDPUD's 2014 portfolio of programs.

- **High participant satisfaction.** All programs for which ADM surveyed participants regarding their satisfaction indicated very high levels of satisfaction with the programs. The most common responses were regarding their appreciation of utility staff.
- **Generally High Performing Programs.**

The following table provides gross and net impacts by program:

Table 1-2 Summary of Program Impacts

Program	*Gross Impact Estimates*			*Net Impact Estimates*		
	Energy [kWh]	Demand [kW]	Water [MG]	Energy [kWh]	Demand [kW]	Water [MG]
Residential Energy Survey (RES)	253,123	14.1	-	182,249	10.2	-
Refrigerator Recycle	159,642	24.6	-	110,951	17.1	-
Residential - Green Partners CFL	102,972	6.5	-	66,932	4.2	-
Appliance	82,247	3.0	-	62,508	2.3	-
Residential Energy Survey (ESP/Income)	48,581	2.6	-	48,581	2.6	-
Residential - Lighting Rebate	43,295	2.7	-	28,142	1.8	-
Toilet Exchange	12,119	1.4	2.82	10,907	1.3	2.54
Toilet Rebate	5,430	0.6	1.28	4,887	0.5	1.15
Residential - Building Efficiency	2,288	5.4	-	1,785	4.2	-
Thermal Efficiency Windows	324	1.3	-	324	1.3	-
Million CFLs	1,018,389	63.9	-	661,953	41.5	-
Misc. Water Measures	137,040	15.6	6.66	105,521	12.0	5.13
Water Leak Rebate	43,891	5.0	12.18	33,796	3.9	9.38
Neighborhood Block Party	32,447	2.0	-	21,091	1.3	-
LED Holiday Swap	18,968	0.0	-	17,261	0.0	-
Green Schools Program	11,671	0.7	-	7,586	0.5	-
High Efficiency Washer Water Rebate	989	0.1	0.31	673	0.1	0.21
Electric Hot Water Heater	194	0.0	-	153	0.0	-
Refrigeration	113,551	9.2	-	76,079	6.2	-
Business Green Partners LED	89,229	25.9	-	73,168	21.3	-
Business Green Partners CFL	56,471	16.8	-	24,282	7.2	-
Commercial Custom	50,683	19.8	0.01	50,683	19.8	0.01
Commercial Lighting	45,228	2.8	-	45,228	2.8	-

1.2. Summary of Evaluation Recommendations

Again, detailed recommendations specific to each program can be found within Sections 3 and 4. This section lists high level recommendations identified by this evaluation to improve program implementation in future program years:

- **Develop comprehensive database of ex ante estimates for (non-custom) measures offered by each program.** The current ex ante estimates for most programs are generally custom calculated (each lighting project has a separate calculator for example) or based on aggregated per unit estimates from previous evaluations. ADM recommends that more rigorous savings estimates be developed for all non-custom measures. While this represents a significant level of effort at the front-end, it would allow for 1) More consistent incentive levels based on project energy impacts and 2) Less work for program staff

throughout the year as many measures can be treated prescriptively in the application process (e.g. $/Unit installed).

- **Create Prescriptive Lighting Measures.** Simple lighting measures in particular lend themselves to a prescriptive application process. In line with the previous recommendation ADM recommends that TDPUD establish a list of prescriptive lighting offerings with incentive levels set between $0.10 and $.20 per kWh saved. Example offerings should include:

    1. Standard T-8 to Super T-8 Fixture Change-outs (Indoor)
    2. T-8 to LED Fixture Change-outs (Indoor)
    3. Fluorescent Fixture De-lamping (Indoor)
    4. Metal Halide to LED Fixture Change-outs (Outdoor)
    5. LED Exit Signs
    6. Screw Based LEDs
    7. Refrigerated Case Lighting

- **Rotate Program Evaluations.** Given the limited amount of resources available to put towards program evaluation (EM&V), ADM recommends that TDPUD consider evaluating a sub-set of programs each year rather than the full portfolio. Programs contributing to the top 70% of portfolio savings should be evaluated followed by new programs, pilot studies, or programs for which additional information is desired.

- **Consider Funding a Potential Study.** Currently little is known regarding saturations and/or potentials for energy efficient equipment in TDPUD territory. While the lack of program participation seen this last year can be attributed to socio-economic factors, it is also likely that “standard” energy efficiency measures are reaching saturation and additional measures need to be considered. A Saturation/Potential study would provide TDPUD with the information necessary to identify where energy efficiency opportunities currently exist. A list of potential measures to explore are:

    1. Air compressor efficiency/leak repair
    2. Blower motors / process improvements at the waste water treatment plant
    3. TDPUD Utility infrastructure improvements (water pumps, etc.)

    Note that the cost of a potential study could be spread across several small municipals if additional municipal utilities need similar information.

- Track Additional Information on Rebates for Select Programs. Several programs were identified which would benefit from additional tracking data as the rebates

are processed. This additional data would improve the quality of evaluation results while also potentially reducing evaluation costs for those programs (as the evaluator would not need to survey participants for the extra data). The specific data needs are described in each of sections detailing the individual program evaluation results. The list of programs to which this recommendation applies are as follows:

1. Refrigerator Recycling Program
2. Building Efficiency Program

2. General Approach to EM&V

In real-time evaluations the various EM&V activities occurring during a program year are used to administer the implementation of the program. Information from the EM&V activities is used to provide real-time feedback to make real-time adjustments in program implementation that will help ensure that program targets are met. The various activities involved in the real-time EM&V effort are as follows:

- QA / QC of program applications / projects
- Tracking and verification of measure installations
- Measurement of savings impacts for measures / projects
- Program evaluation
- Savings impacts
- Program process evaluation
- Cost-effectiveness

Figure 2-1 is a schematic showing how these real-time EM&V activities relate to program planning and implementation. While we are not performing a formal process evaluation in this project, the concurrent nature of this evaluation allowed us to provide real-time commentary on program processes as we worked with TDPUD in the impact evaluations.

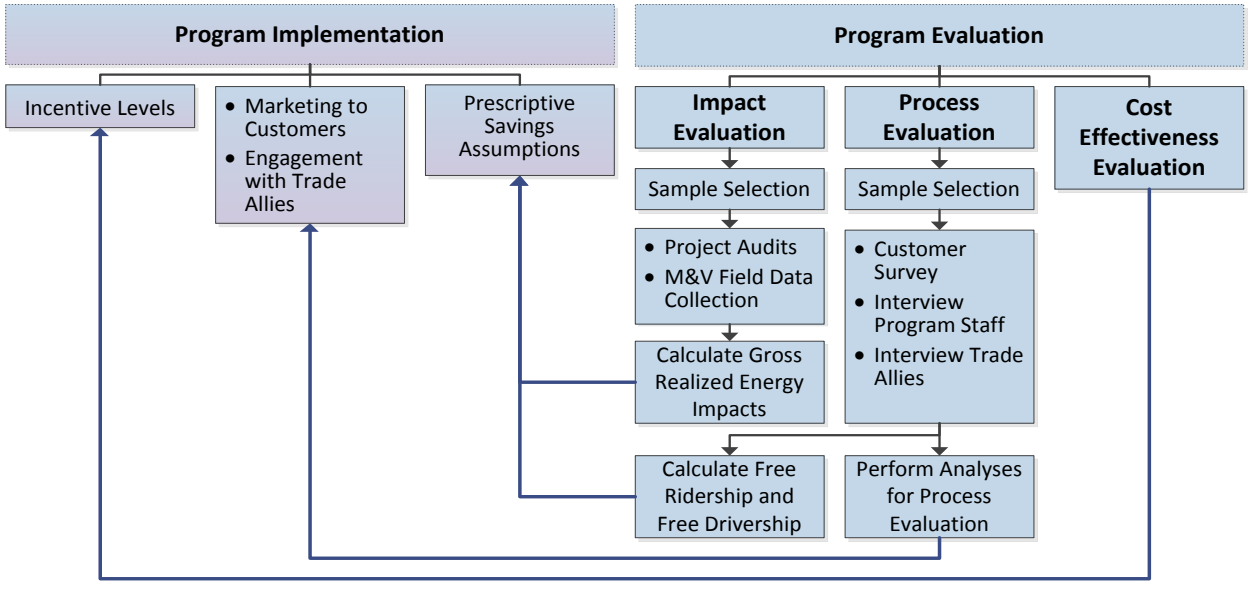


Figure 2-1 Integration of EM&V Activities with Program Planning and Implementation

All evaluation activities were informed by current EM&V industry standards. Additionally we review any literature relevant to the regulatory framework in which the programs were administered. Pertinent literature for this evaluation included:

- National Renewable Energy Laboratory, The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, April 2013.
- Savings Estimation Technical Resource Manual for the California Municipal Utilities Association. Prepared by energy & resource solutions. May 2014.
- American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE). Measurement of Energy and Demand Savings, Guideline 14. June 2002.
- California Public Utilities Commission. The California Evaluation Framework. June 2004.
- International Performance Measurement and Verification Protocol. IPMVP Volume I: Concepts and Options for Determining Energy and Water Savings. 2007.
- National Action Plan for Energy Efficiency. Model Energy Efficiency Program Impact Evaluation Guide. Prepared by Steven R. Schiller, Schiller Consulting, Inc. December 2007.

The various activities undertaken for this impact evaluation are shown in Figure 2-2. This section discusses our:

- General approach to gross impact evaluation for TDPUD's programs, and
- General Net-to-gross methodology

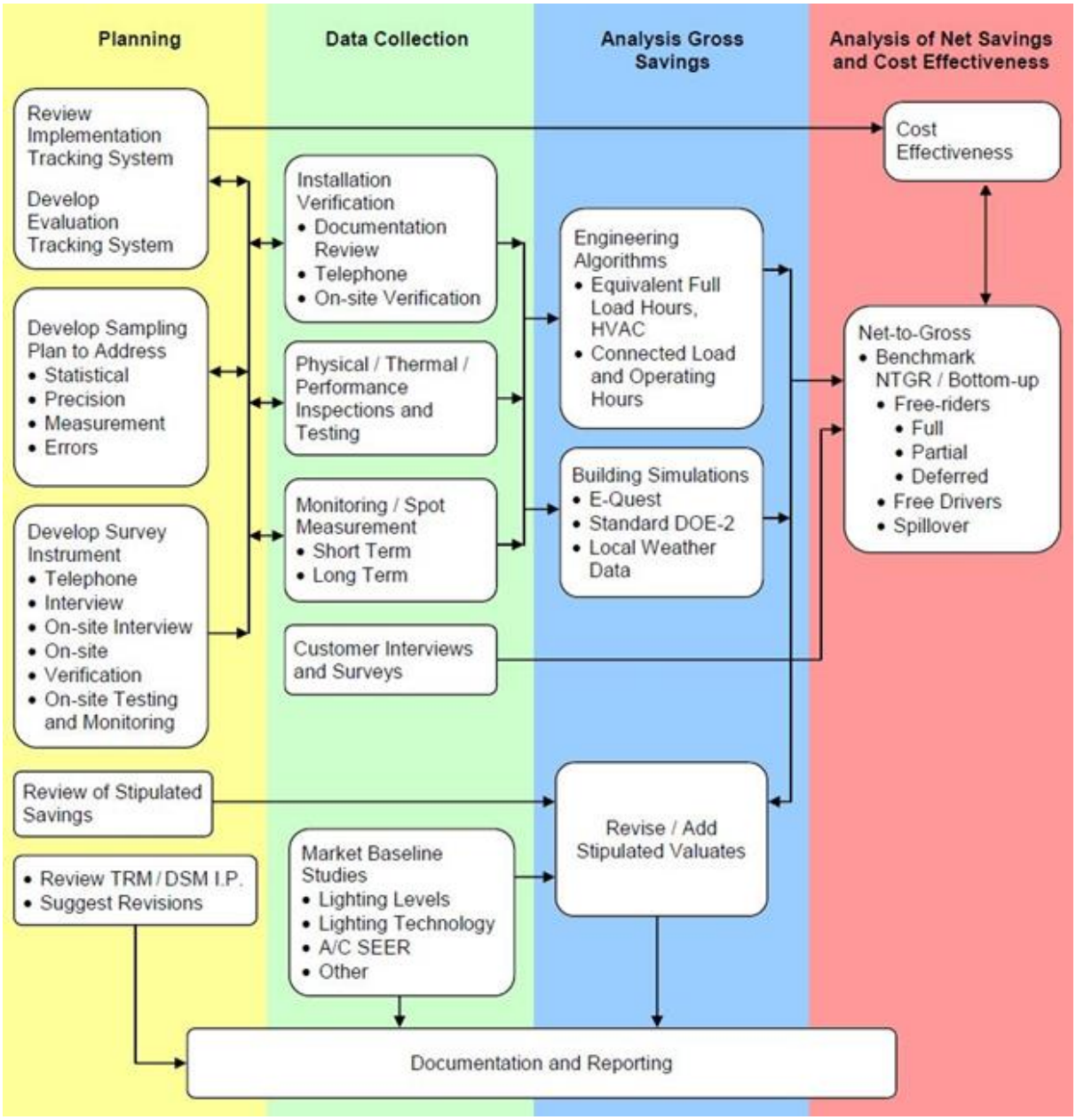


Figure 2-2 Flow Diagram for Impact Evaluation Activities

2.1. Gross Impact Analysis Methods

As delineated in the taxonomy presented in the Model Energy Efficiency Program Impact Evaluation Guide, there are three major approaches to determining gross savings for a program.

- A *deemed savings approach* involves using stipulated savings for energy conservation measures for which savings values are well-known and documented. For example, this approach may be acceptable for lighting retrofits where there is general agreement on the hours of use.

- A *site-specific M&V approach* involves (1) selecting a representative sample of customers or sites that participated in a project; (2) determining the savings for each customer or site in the sample, usually by using one or more of M&V Options defined in the IPMVP; and (3) applying the results of estimating the savings for the sample to the entire population in the project.
- A *large-scale data analysis approach* involves estimating energy savings and demand reductions by applying one or more statistical methods to measured energy consumption utility meter billing data and independent variable data. This approach usually (a) involves analysis of a census of project sites versus a sample and (b) does not involve onsite data collection for model calibration. However, a sample of customers or sites may be selected and visited to confirm that the energy conservation measures were properly installed and are still operating.

ADM examined documentation for each program to identify the types of energy efficiency measures from which savings were expected to be realized and which of these three types of analysis are most appropriate for estimating savings for those measures. We took account of several factors.

- The magnitude of expected savings from program measures affects the choice of savings estimation approach in that analysis of billing data may not be sufficient to detect savings of small magnitude for some measures.
- The number and complexity of the measures and technologies being promoted through a project is a factor in determining the savings estimation approach. For example, if multiple measures can be installed at a single customer site, there may be overlapping and/or interactive effects among the measures. Identifying the effects of individual measures therefore requires using a savings estimation approach that can account for the impact of interrelated measures.
- Costs associated with the different approaches are different and therefore are also considered in choosing the savings estimation approach.

Table 2-1 shows our assignment of the approaches used in the evaluation of each program in TDPUD's 2014 program portfolio.

Table 2-1 List of TDPUD Programs and Proposed Evaluation Methods

Program Name	*Portfolio Contribution*	*Gross Impact Method*
Electric Hot Water Heater	< 1%	Desk Review Only
Thermal Efficiency Windows	< 1%	Deemed
High Efficiency Washer Water Rebate	< 1%	Desk Review Only
Residential - Building Efficiency	< 1%	Deemed
Toilet Rebate	< 1%	Deemed
Green Schools Program	1%	Desk Review Only
Toilet Exchange	1%	Deemed
LED Holiday Swap	1%	Desk Review Only
Neighborhood Block Party	1%	Desk Review Only
Residential - Lighting Rebate	2%	Deemed
Water Leak Rebate	2%	Desk Review Only
Residential Energy Survey (ESP/Income)	2%	Deemed
Appliance	4%	Deemed
Residential - Green Partners CFL	4%	Deemed
Misc. Water Measures	6%	Desk Review Only
Refrigerator Recycle	7%	Deemed
Residential Energy Survey (RES)	11%	Deemed
Million CFLs	44%	Desk Review Only
Commercial Lighting	2%	Site-Specific
Commercial Custom	2%	Site-Specific
Business Green Partners CFL	2%	Deemed
Business Green Partners LED	4%	Deemed

It can be seen in Table 2-1 that a minority of programs account for the majority of portfolio impacts. Consequently, ADM allocated more resources to programs with the largest impacts in order to minimize uncertainty in the overall evaluation results within the available resources. In the remainder of this section we discuss a more detailed application of the EM&V methods used in our analysis of the TDPUD portfolio. Note that specific applications of these methods are discussed for each program in Sections 3 and 4.

2.1.1. **Deemed Savings Approach**

For most of the measures, unit-level savings due to installation of the measures are well documented and allow the use of such savings as deemed values from the CMUA TRM. For the evaluation of these programs, we identified appropriate unit-level savings for

program measures. For this review, we used information from program documentation as well as from the CMUA TRM, the DEER, the Regional Technical Forum, and measure databases/TRMs from other states. We identified savings calculations and estimates (1) whose methodologies used for calculating savings were appropriate, and (2) whose assumptions are reasonable and appropriate. In reviewing the methodologies for calculating energy savings, we focused on the main factors that determine energy use.

We verified measure installations by reviewing program tracking data and conducting customer surveys for statistically valid samples of projects from the program. When sampling, we focused on (1) projects accounting for a significant portion of estimated savings and (2) projects for which savings estimates seem most uncertain. The sample was selected so that results were representative of the population of projects to ±10% precision at the 90% confidence level.

2.1.2. **Site-specific M&V Approach**

A site-specific approach involves the following steps:

- Selecting a representative sample of customers or sites that participated in a program;
- Determining the savings for each customer or site in the sample, usually by using one or more of M&V Options defined in the IPMVP; and
- Applying the results of estimating the savings for the sample to the entire population in the program.

The above steps were tailored to each program evaluated in this manner (this accounts for the unique characteristics of each program). With the site-specific approach, we collect important items of data needed for the analysis of gross savings through on-site data collection. Using comprehensive data collection forms, our field personnel collected data from several sources during the on-site visit:

- We first collected data through interviews with the staff of the site. The interview with site staff provides information on occupancy schedules, lighting schedules, ventilation schedules, equipment schedules, operational practices, maintenance practices, and other factors that are associated with energy use at the site.
- We reviewed documents or records at the site. This includes reviewing basic building plans and architectural drawings. These data also include information on process equipment, HVAC systems and equipment, on lighting and on hot water systems from mechanical, electrical and plumbing plans.
- We visually inspected control settings, lighting levels, inventory of end use appliances and equipment, ventilation rates, building population, occupancy level, and other parameters.

During the on-site visit, we collect additional information about factors that affect energy use by end-uses. Data on these factors are needed in order to analyze and to verify the energy savings of rebated measures. Data also are needed that pertain to the present pattern of energy use at a site. We use electricity use data for the site to establish this pattern. We ask facility personnel to sign a waiver form that will allow us to request electric use data from the serving utility for twelve previous months (if available). (We use monthly data over a year in order to establish any seasonal aspects in the pattern of energy use.)

Our field personnel also take photographs of a site and of its electrical and mechanical systems during the on-site visit. Our experience has been that photographs taken during a visit are a highly useful means of verifying the data that are collected.

If appropriate, we conduct monitoring at a sub-sample of the sites selected for the onsite data collection. The sites chosen for monitoring are those sites with projects where there is some uncertainty about the values for important factors that affect the level of savings. For example, we may use monitoring to obtain information on operating hours for some types of lighting measures. To better inform the selection of sites for monitoring, we review any documentation that may have prepared for the sites chosen for the on-site sample. Based on this review, we determine whether monitoring measures at a site will be required to verify savings. The split between certainty and non-certainty sites is determined through the analysis of actual project data.

To verify savings for measures installed at project sites, we use methods that depend on the type of measure. Categories of measures include the following:

- Lighting;
- HVAC;
- Motors;
- VFDs;
- Compressed-Air;
- Refrigeration; and
- Process Improvements.

The general methods used by this evaluation to assess site-level impacts are summarized in Table 2-2:

Table 2-2 Typical Methods to Determine Savings for Custom Measures

Type	*Method to Determine Savings*
Lighting	ADM's lighting evaluation model, which uses data on wattages before and after installation of measures and hours-of-use data from field monitoring.

HVAC (including packaged units, chillers, cooling towers, controls/EMS)	eQUEST energy simulation model, which automates the analysis of energy use in buildings. eQUEST uses DOE-2 as its analytical engine for estimating HVAC loads and includes a pre-processor that uses billing data for a site to prepare a benchmark for the site.
Motors and VFDs	Measurements of power and run-time obtained through monitoring
Compressed Air Systems	Engineering analysis, with monitored data on load factor and schedule of operation
Refrigeration	Simulations with DOE2.2 refrigeration engineering analysis models and/or engineering analysis using monitored data
Process Improvements	Engineering analysis, with monitored data on load factor and schedule of operation

Activities specified in the Table above produce verified gross savings calculations for each sampled project. ADM developed estimates of program-level gross savings by applying a ratio estimation procedure in which achieved savings rates estimated for the sample projects were applied to the program-level expected savings.

We obtain the primary data needed to estimate savings and peak impacts by making on-site visits to a sample of sites, survey program participants, and/or reviewing program documentation (including invoices, cut-sheets, applications, etc.). The appropriate deployment of monitoring equipment was determined on a project-specific basis as part of the M&V planning for each sampled project. Table 2-3 presents a list of ADM's inventory of monitoring equipment used for collecting data required for our impact evaluation activities.

Table 2-3 Summary of Monitoring Equipment Employed by ADM

Equipment Description
Synergistic C-180E or K20 Logger (w/ 16 Chan., 512K Mem. & Analog)
Synergistic C-160E Logger (w/ 8 Chan., 512K Mem. & Analog)
Synergistic C-140 or K20 Logger (w/ 8 Channel, 128K Mem., No Analog)
DataTrap Logger (w/ 8 Chan., Single phase power)
Current Transformers, Split-Core or Solid (5, 20, 30, 50, 100, 200, & 400Amp)
Current Transformers, High Accuracy (5, 20, 50, & 200Amp)
Watt Node WNB-3D-480/240-P True RMS Wh transducer, pulse output
MadgeTech Pulse 101 Pulse logger, battery powered
Temperature Sensor, Indoor (1000 Ohm Platinum RTD)
Temperature Sensor, Outdoor (1000 Ohm Platinum RTD)
Temperature Sensor, Duct (1000 Ohm Platinum RTD)
Relative Humidity Sensor (Indoor or Outdoor)
Wind Speed Sensor
BTU Meter (for chilled water loops)
Insertion Flowmeter (Brass Body)
Omega FTB4605 In-line water flowmeter, ¾", pulse out
GE Panametric PT878 Ultra-sonic flowmeter, pipes 1" to 30"
TOU Lighting Logger (PST / Dent Instruments)
HOBO U09-002 Lighting On/Off logger
HOBO U12-006 4 Channels 0-2.5Vdc input logger
HOBO U12-013 Temperature, %RH, 2 ext chan. logger
HOBO U12-014 Thermocouple logger for type J, K, S or T
HOBO U09-004 Motor On/Off logger
HOBO U09-001 State logger for doors or switches
HOBO Pro U23-001 Outdoor temperature and % RH logger
HOBO H11-001 Carbon Monoxide logger
HOBO UX90-002 Light On/Off Logger
HOBO UX90-001M Pulse/State logger
StowAway Logger (Amperage)
Telaire Carbon Dioxide meter
ACR Smartbutton Temperature logger
Occupancy sensors passive IR detector
Plug-in loggers for120V appliances
Li-Cor Pyranometer
Omegaflo HH-600 Hot wire anemometer
Huba Control 694 Diff. Pressure Transducer, 0-1.2 " H2O
AEMC 3910 Hand held power meter w/ Volts, Amps, kW, pf (true RMS)
Extech Light Meter Light Meter (ft candles or LUX)
Blower Door Air infiltration & house leakage test equipment
Duct Blaster Air Duct Leakage Test Blower
Digital Pressure Gauge DG-7 Digital air flow and pressure meter
HOBO U30-WIF Wifi Data Logger
Onset S-TMB-MOO2 12-Bit Temp Smart Sensor
S-UCC0M001 Switch Pulse Adapter
S-THB-M008 Temp/RH Smart Sensor

We use site visits to accomplish two major things. First, our field personnel verify that the energy efficiency measures for which incentives were given were indeed installed, that they were installed correctly, and that they still function properly. Second, they collect the data needed to analyze the energy savings and kW impacts for the installed measures.

- For measures with deemed savings values (e.g., IPMVP Option A, or those for which values are included in a TRM), we make on-site verification visits to confirm the as-installed and used conditions that provide the expected savings. For projects where most measures have deemed savings values, no IPMVP metering or monitoring assessment was conducted.
- For measures for which deemed savings values are not available, we use site visits to accomplish two major things. First, our field personnel verify that the energy efficiency measures for which incentives were given were indeed installed, that they were installed correctly, and that they still function properly. Second, they collect the data needed to analyze the energy savings and kW impacts for the installed measures.

We have well-developed and tested procedures in place for collecting the data needed for detailed analysis of the energy performance of energy efficiency measures. The focus of our site visit data collection is to obtain appropriate information to analyze the performance of the different types of energy systems at a facility. This includes collecting information on the quantity, sizing, servicing, and scheduling for HVAC, lighting, refrigeration, motors, process and other equipment. We also collect information on the capabilities of building control systems (e.g., whether centralized or distributed, capabilities for control monitoring, automation possibilities, and expansion possibilities).

We have designed and use a standardized form for on-site data collection that ensures that the information needed to analyze energy efficiency measures is collected for each facility visited. Because we have done extensive M&V work for a variety of utility energy efficiency programs, we have a good understanding of the nature of the data that need to be collected during site visits and the procedures to use to collect that data most cost effectively. We extract items of information from the tracking systems that need to be provided to the field staff to facilitate error-free and efficient site visits.

As part of the data collection, we also may conduct monitoring of specific measures, as applicable and where it is feasible. ADM has experience with a wide variety of monitoring approaches and is well equipped with an extensive inventory of monitoring equipment available for use during this project. Overall, ADM has been responsible for monitoring projects exceeding $15 million dollars of revenue. Our staff members have developed the most efficient and technically viable approaches for conducting monitoring and data retrieval. ADM has considerable experience in conducting field monitoring of energy efficiency and demand reduction technologies, including field monitoring of lighting systems, motors, variable frequency drives, chillers, cooling towers, refrigeration

systems, compressed air systems, plug loads, and many other standard end uses and technologies. Having both the experience and the proper tools, ADM can provide field monitoring very cost efficiently for this evaluation effort. In many cases, a low level end use monitoring effort can save considerable engineering analysis and modeling while reducing measurement errors.

If a site is selected for field monitoring, the field personnel will have all the proper equipment available for installation at the time of the visit. We install the equipment with minimal intrusion on the participant's operation.

2.2. Method of Net Savings Analysis for Each Program

The basic issue in net savings analysis is determining what part of the 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.

ADM employed two methods of Net-to-Gross analysis for the programs implemented by TDPUD. The first method was used on programs for which the evaluation applied a *Deemed* evaluation approach and the second for programs receiving a site specific evaluation approach. These two approaches are discussed in this section.

2.2.1. Net-To-Gross Approach Programs Evaluated using a *Deemed Savings* Method

Rather than apply a binary scoring (0% vs. 100% free-ridership), the Evaluators applied a free-ridership probability to program participants, based upon four factors:

(1) Financial ability to purchase high efficiency equipment absent the rebate

(2) Importance of the rebate in the decision-making process

(3) Prior planning to purchase high efficiency equipment

(4) Demonstrated behavior in purchasing similar equipment absent a rebate

In this methodology, Part (1) is essentially a gateway value, in that if a participant does not have the financial ability to purchase energy efficient equipment absent a rebate, the other components of free-ridership become moot. As such, if they could not have afforded the high efficiency equipment absent the rebate, free-ridership is scored at 0%. If they did have the financial capability, we then examine the other three components, each contributing an equal scoring of 33% to free-ridership. It should be noted that having financial ability does not necessarily imply free-ridership; it just opens the possibility that other factors could contribute. A participant that was financially able to purchase high efficiency lighting, for example, could still be scored at 0% free-ridership if it is demonstrated that:

(1) The rebate factored into their decision-making process;

(2) They did not have prior plans to install high efficiency equipment before learning of the available rebates; and

(3) They did not demonstrate prior behavior of purchasing similar equipment absent a rebate.

There are other contributing factors to free-ridership, specifically in instances of programs that provide outreach to customers. For example, if in a large commercial retrofit, a sponsoring utility provides assistance in energy efficiency measure recommendation, or in providing cost-benefit analysis of a measure to a business, these could factor into the decision-making in ways that mitigate free-ridership, in that there are cases where a participant did not need a rebate to participate, but was induced to participate by the sponsoring utility's efforts in recommending and/or evaluating energy efficiency measures for them. Additional issues such as this are addressed on a program-by-program basis in methodology sections to follow.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. For business programs, a weighted average is taken of verified kWh savings, as the free-ridership scores of high-savers contribute a larger share of the overall free-ridership rate. Once free-ridership is determined, the Evaluators then estimate the Net-to-Gross Ratio (NTGR), calculated as:

$$NTGR = 1 - \% \text{ Free-Ridership}$$

2.2.2. **Net-To-Gross Approach for Programs Evaluated using a *Site-Specific Approach*.**

Information was collected from a sample of program participants through a customer survey. 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, binary variables were developed 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.

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 2-4 shows the free-ridership scores that are associated with different combinations of free-ridership indicator variable values.

Table 2-4 Free-ridership Scoring Matrix: Site-Specific Approach

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?*	*Free Ridership Score*
Y	N/A	Y	Y	100%
Y	N/A	N	N	100%
Y	N/A	N	Y	100%
Y	N/A	Y	N	67%
N	Y	N	Y	67%
N	N	N	Y	33%
N	Y	N	N	33%
N	Y	Y	N	0%
N	N	N	N	0%
N	N	Y	N	0%
N	N	Y	Y	0%

2.3. Sampling

Sampling is necessary to evaluate savings for the TDPUD portfolio insomuch as verification of a census of program participants is typically cost-prohibitive. As per evaluation standard practice, samples are drawn in order to ensure 90% confidence at the +/- 10% precision level. Programs are evaluated on one of three bases:

- Census of all participants
- Simple Random Sample
- Stratified Random Sample

2.3.1. Census of Participants

A census of participant data was used for select programs where such review is feasible. An example of this is the Residential Thermally Efficient Windows program for which we surveyed a census of customers.

2.3.2. Simple Random Sampling

For programs with relatively homogenous measures (largely in the residential portfolio), the Evaluators conducted a simple random sample of participants. The sample size for verification surveys is calculated to meet 90% confidence and 10% precision (90/10). The sample size to meet 90/10 requirements is calculated based on the coefficient of variation of savings for program participants. Coefficient of Variation (CV) is defined as:

$$CV = \frac{Mean_x}{Standard\ Deviation_x}$$

Where x is the average kWh savings per participant. Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated at:

$$n_0 = \left(\frac{1.645 * CV}{RP}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

RP = Required Precision, 10% in this evaluation

With 10% required precision (RP), this calls for a sample of 68 for programs with a sufficiently large population. However, in some instances, programs did not have sufficient participation to make a sample of this size cost-effective. In instances of low participation, the Evaluators then applied a finite population correction factor, defined as:

$$n = \frac{n_0}{1 + {}^{n_0}/_{N}}$$

Where

n_0 = Sample Required for Large Population

N = Size of Population

n = Corrected Sample

For example, if a program were to have only 100 participants, the finite population correction would result in a final required sample size of 41. ADM applied finite population correction factors in instances of low participation in determining samples required for surveying or onsite verification.

2.3.3. **Stratified Random Sampling**

For the TDPUD commercial portfolio, Simple Random Sampling is not an effective sampling methodology as the CV observed in commercial programs are typically very high because the distributions of savings are generally positively skewed. Often, a relatively small number of projects account for a high percentage of the estimated savings for the program.

To address this situation, we use a sample design for selecting projects for the M&V sample that takes such skewness into account. With this approach, we select a number of sites with large savings for the sample with certainty and take a random sample of the remaining sites. To further improve the precision, non-certainty sites are selected for the sample through systematic random sampling. That is, a random sample of sites remaining

after the certainty sites have been selected is selected by ordering them according to the magnitude of their savings and using systematic random sampling. Sampling systematically from a list that is ordered according to the magnitude of savings ensures that any sample selected will have some units with high savings, some with moderate savings, and some with low savings. Samples cannot result that have concentrations of sites with atypically high savings or atypically low savings.

3. EM&V Approach: Residential Programs

In this chapter we discuss the EM&V results (including findings and recommendations) for each residential program. Programs are listed in order of contribution to the overall portfolio. Note that several programs received a desk review only as their evaluation was either outside the scope of this report, or their size relative to the portfolio was such that the evaluation resources were better spent elsewhere.

Table 3-1 Summary of Residential Program Results

Evaluated	*Approach*	*Program Name*	*Net Ex Post Impacts [kWh]*
Y	Deemed Savings (Option A)	Residential Energy Survey (RES)	253,123
Y	Deemed Savings (Option A)	Refrigerator Recycle	159,642
Y	Deemed Savings (Option A)	Residential - Green Partners CFL	102,972
Y	Deemed Savings (Option A)	Appliance	82,247
Y	Deemed Savings (Option A)	Residential Energy Survey (ESP/Income)	48,581
Y	Deemed Savings (Option A)	Residential - Lighting Rebate	43,295
Y	Deemed Savings (Option A)	Toilet Exchange	12,119
Y	Deemed Savings (Option A)	Toilet Rebate	5,430
Y	Deemed Savings (Option A)	Residential - Building Efficiency	2,288
Y	Deemed Savings (Option A)	Thermal Efficiency Windows	324
N	Desk Review Only	Million CFLs	1,018,389
N	Desk Review Only	Misc. Water Measures	137,040
N	Desk Review Only	Water Leak Rebate	43,891
N	Desk Review Only	Neighborhood Block Party	32,447
N	Desk Review Only	LED Holiday Swap	18,968
N	Desk Review Only	Green Schools Program	11,671
N	Desk Review Only	High Efficiency Washer Water Rebate	989
N	Desk Review Only	Electric Hot Water Heater	194

3.1. Residential Energy Survey

Table 3-2 Residential Energy Survey: Summary Table

Final Project Count:	20
Ex Post Net Energy Savings [kWh]:	181,859
Ex Post Net Demand Savings [kWh]:	10.12
Ex Post Net Water Savings [MG]:	0.684
Program Contribution to Portfolio:	11%
General EM&V Approach	Option A

The TDPUD provides residential energy surveys to non-income limited customers through the Residential Energy Survey Program (RES). All residential energy surveys include a free energy survey and free energy and water-saving measures. The energy survey is a visual inspection only. Any measures recommended during the survey, which the District is providing for the program, are given to the residents at the time of survey. Customers are responsible for installing these free measures within 10 days of the receipt of these measures. Beginning in 2013, the program included installation of 24 compact fluorescent light bulbs (CFL) and two low-flow showerheads when provided permission by the program participant. Customers are also informed of District programs that they may benefit from and provided with associated literature.

3.1.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM randomly chose 68 participants out of the total participants of the RES and ESP programs to contact via telephone for the survey.

3.1.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Is the Unit energy savings estimate for the measure
N	Is the number of measures implemented

Several measures were offered through this program and various combinations/quantities were observed for each participant. ADM developed UES estimates for each measure as listed in Table 3-2.

Table 3-3 List of UES estimates for Measures offered in RES Program

Measure	*Savings Per [kWh]*		*Savings Per [kW]*	
	No Hot Water	W/ Hot Water	No Hot Water	W/ Hot Water
DR30 15/65	46	46	2.9E-03	2.9E-03
Globe G25 9/40	29	29	1.8E-03	1.8E-03
PAR 38 120/23	90	90	5.6E-03	5.6E-03
R20 14/50	33	33	2.1E-03	2.1E-03
R30 15/65	46	46	2.9E-03	2.9E-03
Spiral 13/60	43	43	2.7E-03	2.7E-03
Spiral 23/100	71	71	4.5E-03	4.5E-03
Bathroom Aerators	3	44	0.0E+00	0.0E+00
Kitchen Aerators	10	219	0.0E+00	0.0E+00
Showerheads	11	276	0.0E+00	0.0E+00
Spray Nozzle	4	4	0.0E+00	0.0E+00

The assumptions and sources used to develop each of the UES estimates in Table 3-2 can be found in the Excel workbook used to analyze the program's impacts. This workbook can be made available to TDPUD upon request.

3.1.3. **Net Impact Methods and Results**

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Residential Energy Survey program was conducted using the methodologies outlined in Section 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratios. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase. Rather than apply a binary scoring (0% vs. 100% free-ridership), ADM applied a free-ridership probability to program participants, based upon four factors. These factors, along with the survey questions used to address them are provided in Table 3-3.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. Once free-ridership is determined, ADM then estimated the Net-to-Gross Ratio (NTGR), calculated as:

NTGR = 1 – % Free-Ridership

Table 3-4 through Table 3-6 summarizes the responses to questions addressing free-ridership for the 2014 Residential Energy Survey Program. Based on survey responses for the 12 RES participants, ADM estimated a NTGR of 0.72 for the program. This value was multiplied by gross per-unit kWh to derive program net energy savings (kWh) and net peak demand reduction (kW).

Table 3-4 List of Net-To-Gross Factors w/ Questions: RES Energy Survey Program

#	Factor	Description	Question Used in Survey
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to make these home improvements without the incentive from the utility?
2	Importance of program assistance in the decision-making process	If the respondent answers "Definitely would", then the respondent would is considered to be 100% free-rider. If the respondent answers "Probably would" or "Probably would not", then the respondent is considered to have been planning to purchase the same measures with or without the rebate, and is thus a partial free-rider. If the respondent answers in Question 17 "Definitely would not", then the respondent is considered to be 0% free-rider.	How likely is it that you would have purchased the same energy efficiency measures if you had not received a rebate through the program?
3	Behavior without the Program Modified by Prior Planning	If the respondent answers "No", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	Did you have plans to make these improvements to your home prior to learning about the program?

Table 3-5 Financial Ability Results: RES Energy Survey Program

Factor	*Question*	*Yes*	*No*	*Other / DK*
Financial Ability	*Question 18: Would you have been financially able to purchase and install the measures without the rebate you received through the program?*	50%	42%	8%

Table 3-6 Behavior without Program Results: RES Energy Survey Program

Factor	*Question*	*Definitely Would*	*Probably Would*	*Probably Not*	*Definitely Not*
Importance of program	*Question 19: How likely is it that you would have purchased the measures if you had not received a rebate through the program?*	33%	17%	42%	8%

Table 3-7 Behavior w/o Program Modified by Prior Planning Results: RES Energy Survey Program

Factor	*Question*	*Yes*	*No*	*Other / DK*
Behavior W/O Program Modified by Prior Plan Existence	*Question 17: Before learning about the rebates available through the utility, were you already planning to replace the energy efficiency measures?*	50%	42%	8%

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for all measures based on results from the participant survey. Based on the survey responses for the 12 participants, specific to the RES program, ADM estimated NTGRs of 0.72. These values were multiplied by gross per-unit kWh. Net savings values are shown in Table 3-7.

Table 3-8 Net Impact Summary: RES Energy Survey Program

Appliance Type	*Net-to-Gross Ratio*	*Net Annual Savings (kWh)*	*Net Peak Demand Savings (kW)*
Residential Energy Survey	0.72	181,859	10.12

3.1.4. **Participant Satisfaction Survey Results**

ADM contacted 68 participants of the RES and ESP programs from which we received 18 total responses (26.5% response rate); twelve responses from RES participants and six from ESP participants. ADM sampled participants from both programs because they received the same services. The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer purchasing and installation habits; and
- Customer satisfaction with the Residential Energy Savings program.

The survey results in this chapter will also be used for the Energy Savings Partners report chapter.

3.1.4.1. Program Awareness

Respondents were asked how they learned about the program. Figure 3-1 summarizes how respondents learned about the program. Many respondents indicated they learned about the program from the utility (30%) and from a flyer (20%).

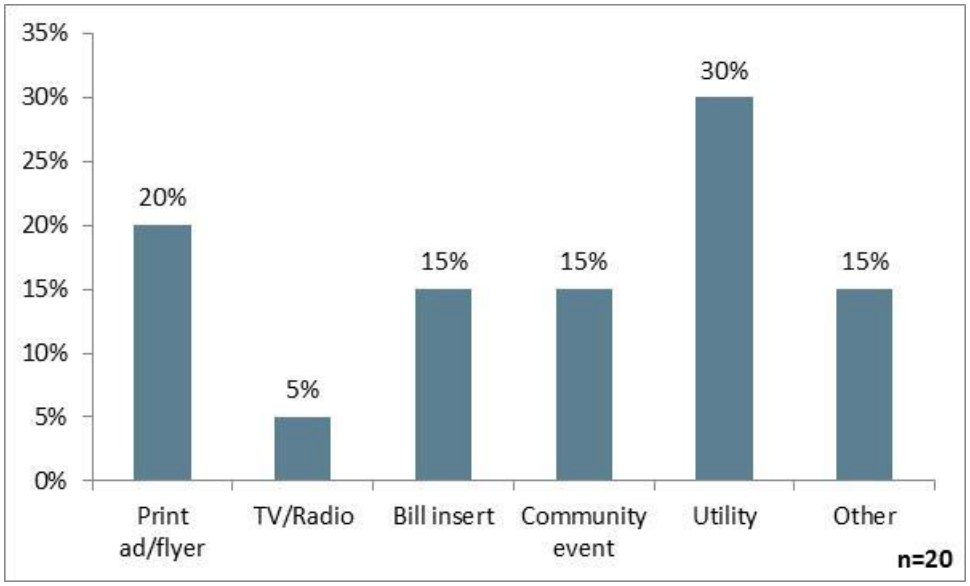


Figure 3-1 Sources of Program Awareness

1.1.1.1 Participant Decision-Making Processes

Respondents were asked several questions regarding their decision-making processes including why they chose to participate in the program, prior planning, financial ability, and likelihood to install the free devices without the program. Respondents were asked why those chose to participate in the program. The most frequent answer was to reduce

their utility bill (36%) followed closely by wanting to save energy (28%). Figure 3-2 summarizes these results.

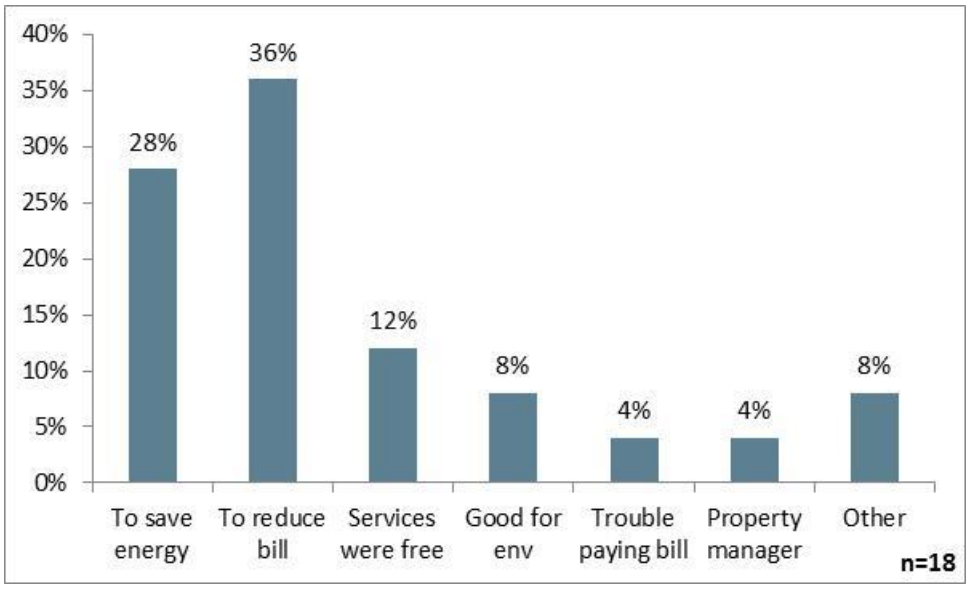


Figure 3-2 Reasons for Participation

Another reason respondents had decided to participate in the program included a credit on their utility bill (ESP only).

Forty-seven percent of respondents indicated that they did not have existing plans to make improvement on their homes prior to learning about the program. However, 55% of respondents stated that they would have likely installed the same home improvements without assistance from the program. Seventy-eight percent of respondents indicated that they would have been financially able to make the home improvements without the incentives from the utility.

3.1.4.2. Measure Installation Rates and Satisfaction

Respondents were asked several questions regarding the survey and installation work done in their homes by the surveyor. Participants could receive a range of direct install items through the program that included CFLs, low-flow showerheads. Participants could receive up to 24 CFLs for their home. Respondents said they had installed between two and 25 CFLs in their homes. They rated their satisfaction with the CFLs high with a mean score of 8.63 out of 10. Thirteen of 15 respondents had CFLs installed by the surveyor and rated the service with very high satisfaction (9.11). Fifty-seven percent of respondents believed that the CFLs were generally higher quality than the bulbs that they had installed while 43% said they were the same quality. Two respondents had removed the CFLs. Their reasons included that they did not work with their dimmer fixture, it had broken, and that they had concerns with the mercury content in the CFLs.

Respondents were asked about the low-flow showerheads that were installed in their homes. Thirteen respondents installed the showerheads in their homes; 19% installed one showerhead and 63% installed two showerheads. The respondents were satisfied with the quality of the showerhead (8.89), and for those that had the surveyor install the showerhead, they rated their satisfaction as moderate (6.57). Two respondents said they that had removed the showerheads because they did not like the spray.

3.1.4.3. Overall Program Satisfaction

Respondents were asked to rate several program elements on a scale of 1 to 10, where "10"; is very satisfied and "1" is very dissatisfied. Table 3-8 summarizes respondents' satisfaction towards each element.

Table 3-9 Residential Survey Participant Satisfaction

Element of Program Experience	*Score*	*Don't Know*
Information provided by the surveyor	9.59	6%
The quality of installation work by the surveyor	7.91	50%
The savings on your monthly bill	6.43	22%
The service provided by utility staff	8.88	11%
Information provided by TDPUD on how to reduce your utility bill	8.94	0%
Improvement in home comfort after receiving the home improvements	8.25	0%
Overall program experience	9.11	0%

Overall, respondents are highly satisfied with the program. Respondents had scored program elements with highest satisfaction included information provided by the surveyor (9.59), information provided by the utility (8.94), and the service provided by utility staff (8.88). The program element that scored the lowest was the savings on the monthly bill. Many respondents indicated that they were unsure if there was a difference in their bill and said that they had not noticed a difference or were experiencing other problems in their home that increased their bill.

Finally, respondents had comments and suggestions for improvement to the program. Many of the comments were very positive saying that they thought the utility was doing a good job, it was a good program, high praise for the surveyor who performed the work, and the program was a great experience. A few respondents suggested that they would like the program to include LED lights. Examples of some responses we received are:

- *"It's a great program. It's absolutely fantastic. They do the best to get out the information."*
- *"I was pretty happy with the person that came and they were very knowledgeable."*
- *"It's a great program and incentive to have the audit done to get more information on how to improve the home."*

1.1.2 Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Residential Energy Survey program:

- **High customer satisfaction with the program.** The evaluation found that participants in the RES Program were highly satisfied with the program surveyor and their interactions with program staff. Many participants also indicated high satisfaction with an improvement in home comfort after the measures were installed.
- **Participants report high levels of satisfaction with their surveyor.** Many of the participants were greatly appreciative of the information provided by their surveyor.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Additional follow-up with participants regarding measure installations.** For those that choose to self-install rather than have the surveyor install on-site, send a reminder to participants to install the measures. The reminder can be packaged as a thank you card, thanking the customer for their participation and reminding them of the savings they will see with full installation of the kit. This delivery mechanism can provide gentle a reminder to customers to install their equipment.
- **Consider the addition of LEDs to the program.** Participants mentioned they would be interested having LEDs instead of the CFLs as a lighting option. Inclusion of LEDs in the program would be contingent upon due diligence in cost-benefit screening at the measure and program level.
- **Update Ex Ante Estimates for Program (Lighting Measures Specifically).** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.

- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known.
- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.2. Residential - Refrigerator Recycle

Table 3-10 Residential - Refrigerator Recycle: Summary Table

Final Project Count:	147
Ex Post Net Energy Savings [kWh]:	110,951
Ex Post Net Demand Savings [kWh]:	17.1
Program Contribution to Portfolio:	7%
General EM&V Approach:	Deemed
Survey Sample Size	0

The Refrigerator Recycle program promotes the recycling of older, working refrigerators and freezers by providing customers with free pickup and a $30 rebate. This program is implemented through a 3rd party vendor. The vendor is responsible for verification of customer eligibility, scheduling, verification of unit operation, pick up from the customer and delivery to a recycling facility. The program is available to customers during vendor regular business hours.

3.2.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM chose participants with email addresses to conduct an online survey.

3.2.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES_{kWh} * N$$

$$kW_{Sav} = kWh_{Sav} * f_{kW}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES_{kWh}	Is the unit energy savings estimate for the measure
f_{kW}	Is a factor used to convert annual kWh to peak demand savings.[1] f_{kW} = *0.000154 kW/kWh*
N	Is the number of rebated units.

Insufficient data was present for the evaluation to implement the preferred method outlined in the Uniform Methods Project protocol for Refrigerator/Freezer recycling program evaluation. UES values for this program were therefore derived using secondary

[1] This factor derived using entries from DEER 2014 for this measure: $f_{kW} = kW_{DEER} / kWh_{DEER}$

literature research. In particular, ADM recently completed a Refrigerator/Freezer recycling program evaluation for SMUD in which we collected primary data. The unit energy savings estimates from this recent evaluation were compared to several other sources of UES estimates (previous TDPUD program evaluations, the CMUA TRM, and the Regional Technical forum). The final values used for this evaluation are listed in Table 3-10.

Table 3-11 List of UES Estimates: Residential - Refrigerator Recycle

Equipment	*UES (kWh/Unit)*
Refrigerator	1,083
Freezer	1,089

3.2.3. Net Impact Methods and Results

ADM attempted to contact participants of the Refrigerator Recycling program and received no responses (0% response rate). Therefore, ADM relied on NTG estimates from the 2013 TDPUD program evaluation and on the SMUD evaluation previously mentioned. Table 3-11 demonstrated the NTGR findings for the program.

Table 3-12 NTGR and Net Impacts for Refrigerator Recycling Program

Free Ridership	NTG Ratio	Ex Post Net Annual Energy Savings [kWh]	Ex Post Net Peak Demand Reductions [kW]
0.3	0.7	110,951	17.1

3.2.4. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Modify Application Process to Track Additional Data.** If additional data is tracked in Energy Orbit (or separate tracking database) regarding rebated customer equipment, the UMP protocol for this program-type can be applied directly. This would improve the quality of the evaluation results without any added cost.[2] These data include:
    1. Appliance age
    2. Appliance size (square feet)

[2] The UPM Protocol specifies a regression with specific variables based on equipment and population characteristics. Ideally monitoring/surveying would be done to establish regression coefficients specific to the program being evaluated. However; "stock" coefficients are provided where resources are not available for primary data collection.

3. Appliance manufacture date
4. Appliance primary Usage type
5. Appliance configuration (side-by-side, Single door, etc.)
6. Appliance location (Indoor vs. Outdoor)

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.3. Residential - Green Partners CFL

Table 3-13 Residential - Green Partners CFL: Summary Table

Final Project Count:	260
Ex Post Net Energy Savings [kWh]:	66,932
Ex Post Net Demand Savings [kWh]:	4.21
Program Contribution to Portfolio:	4%
General EM&V Approach	Option A
Survey Sample Size	11

The Residential – Green Partners CFL (Green Partners) program encourages customers to replace incandescent and halogen light bulbs with energy efficient lighting by distributing, in person and for free, 7-types of Compact Fluorescents (CFL's) to customers who visit the TDPUD Conservation Department or at a local event. CFL give-a-ways include a 12-pack of 60-watt equivalent spiral CFLs and up to 12 mix-n-match specialty CFLs.

3.3.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM randomly chose 74 participants out of the total participants of the Green Partners programs to contact via telephone for the survey.

3.3.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = (kW_{Base} - kW_{CFL}) * Hrs * HCIF * ISR$$

$$kW_{Sav} = (kW_{Base} - kW_{CFL}) * CDF * HCIF * ISR$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb[3]
kW_{CFL}	Is the connected load of the installed light bulb[4]

[3] Assessed using an assumed baseline wattage based on the wattage/type of the installed bulb and further informed through surveys

[4] Based on the records kept in the tracking system and further informed by the surveys

Hrs	Are the annual hours of operation[5]
HCIF	Heating/Cooling Interactive Factor[6]
CDF	Is the Coincident Demand Factor
ISR	Is the *In-Service Rate*

The *In-Service Rate* was derived using customer surveys to identify how many of the bulbs received had actually been installed. Additional questions were asked to identify the locations in which the bulbs were installed. The overall installation rate was found to be 91% and bulbs were distributed throughout the homes and outside. Table 3-12 provides a breakdown of the location in which bulbs were installed based on survey respondents. Table 3-12 also lists the assumed hours of use for each location and overall calculated hours of use (Hrs) used in the program analysis. The hours of use for each location are based on the results from the most recent evaluation on the California IOU's upstream lighting program for the 2006-2008 program cycle.[7] The values used were for PG&E's service territory.

Table 3-14 Summary of Installation Location: Residential Green Partners CFL

Location	*Hours of Use*	*% Observed*
Bathroom	1.2	15%
Bedroom	1.4	20%
Dining	1.6	0%
Exterior	3.7	11%
Garage	1.8	0%
Hall	1.2	1%
Kitchen	2.3	25%
Living	2.2	8%
Office	1.2	0%
Other	1.4	0%
Unknown	1.8	20%
Total	**2.5**	**100%**

The Coincident Demand Factor (CDF), and interactive factors (HCIF) were sourced from the DEER and then applied to program results. The Ex Post gross impacts are provided in Table 4-14.

[5] Per DEER 2013 for appropriate building type

[6] Per DEER 2013 for appropriate building type

[7] http://www.energydataweb.com/cpucfiles/18/finalupstreamlightingevaluationreport_2.pdf (Table 84, Overall/Overall)

Table 3-15 Gross Impacts for Residential Green Partners CFL Program

Gross Ex Post Annual Energy Impacts [kWh]	*Gross Ex Post Peak Demand Reductions [kW]*
102,972	6.50

3.3.3. **Net Impact Methods and Results**

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Green Partners program was conducted using the methodologies outlined in Section 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratio. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of measures they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided Table 3-15.

Table 3-16 List of Net-To-Gross Factors & Questions: Residential - Green Partners CFL

#	Factor	Description	Question Used in Survey
1	Behavior without Giveaway	If the customer answers "Definitely would", then the customer is considered to have not been planning to purchase any of the measures and is 100% free-rider. If the customer answers "Probably" or "Probably not", then the customer is considered to a partial free-rider. If the customer answers "Definitely not", then the customer is assigned 0% free-rider.	**Q1:** If TDPUD had not given out the CFLs, how likely is it that you would have purchased CFLs anyway?
2	Tendency To Buy Incandescent Bulbs	The answer to this question helps to modify the corrected behavior without the giveaway.	**Q2**: Have you purchased any incandescent light bulbs in the past year?
3	Corrected Behavior w/o giveaway (incorporating incandescent tendency)	If the customer answered Tendency to Buy Incandescent question as "yes", the Behavior Without the Giveaway modified the free-ridership score associated with the customer.	-
4	Prior Experience	Customers were assigned free-ridership scores based on the number of spare CFLs compared to the number of CFLs in their home prior to learning about the program. Depending on their answer, they were assigned 0%, 50%, or 100% free-ridership scores.	**Q3:** Do you currently have any spare CFLs stored in your home that are not in use? **Q4:** Prior to learning of the program, how many CFL bulbs did you have in your home?

Table 3-16 through Table 3-18 summarizes the responses to questions addressing free-ridership for the 2014 Green Partners Program.

Table 3-17 Importance of Program Results: Residential - Green Partners CFL

Factor	*Question*	*Definitely would*	*Probably would*	*Probably would not*	*Definitely would not*
Importance of program	Question 10: Have you purchased any incandescent light bulbs in the past year?	0%	27%	45%	27%

Table 3-18 Tendency To Buy Incandescent Bulbs: Residential - Green Partners CFL

Factor	*Question*	*Yes*	*No*
Tendency To Buy Incandescent Bulbs	Question 11: *Have you purchased any incandescent light bulbs in the past year?*	27%	73%

Table 3-19 Prior Planning Results: Residential - Green Partners CFL

Factor	*Question*	*Yes*	*No*	*Don't know*
Prior Planning	*Question 7: Do you currently have any spare CFLs stored in your home that are not in use?*	73%	9%	18%

Based on survey responses for the 11 participants, ADM estimated a NTGR of 0.65 for the program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-19.

Table 3-20 NTGR and Net Impacts for Green Partners Program: Residential - Green Partners CFL

Free Ridership Estimate	*NTGR Ratio*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
35%	65%	66,932	4.21

3.3.4. **Participant Satisfaction Survey Results**

ADM contacted 74 participants of the Green Partners program from which we received 11 responses (15% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer purchasing and installation habits; and
- Customer satisfaction with the Green Partners Residential program.

3.3.4.1.1. Installation Rates

Respondents were asked questions about the installation of CFLs in their homes and the types of light bulbs that were replaced. Most respondents said they received between six and fourteen CFLs. After receiving various amounts of CFLs from the utility, 70% of respondents had installed all the CFLs they received. Seventy-seven percent of respondents replaced incandescent bulbs with the CFLs, and 15% replaced CFLs. Of those respondents who replaced incandescent bulbs, 69% of them said they replaced

burned out bulbs. Seventy-three percent said that they have spare CFLs stored in their homes that were not currently in use.

3.3.4.1.2. Program Awareness

Respondents were asked several questions regarding their awareness of the program, the likelihood of purchasing more CFLs, and participation in other programs.

They were asked about how they learned about the program. A few recalled learning about the program while paying their utility bill (27%). Figure 3-3 summarizes how respondents learned about the program.

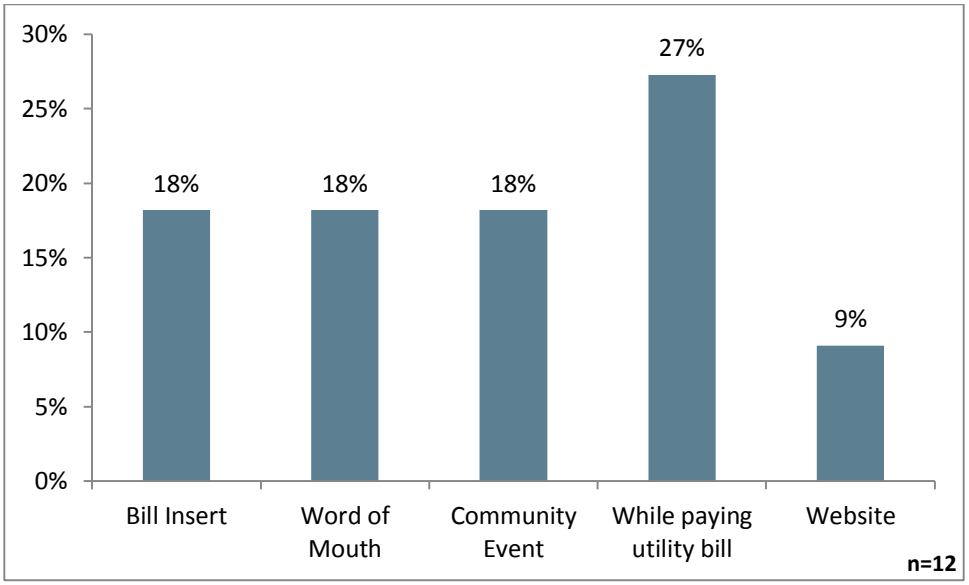


Figure 3-3 Program Awareness

Prior to learning about the Green Partners program, 45% of respondents already had CFL bulbs in their homes. They had as few as two bulbs to as many as 24 bulbs in their homes.

When asked about the likelihood of purchasing CFLs outside of the giveaway, only 27% would have probably purchased CFLs, while 45% probably would not have and 27% definitely would not have purchased other CFLs. Two respondents did purchase more CFLs since receiving the free CFLs, and only one received a lighting rebate for their purchase. However, 27% of respondents purchased incandescent bulbs within the last year.

Respondents were asked if they had participated in any other TDPUD residential programs besides the Green Partners program. Forty-five percent said they had participated in another program; these programs included the Appliance Rebate program, Toilet Rebate program, and the Residential Energy Surveys program.

3.3.4.1.3. Overall Program Satisfaction

Respondents were asked to rate on a scale of 1 to 5, where 1 is "Very Dissatisfied" and 5 is "Very Satisfied", various program elements. Figure 3-4 summarizes these results.

Figure 3-4 Overall Program Satisfaction

Program Element	*Very Satisfied*	*Somewhat Satisfied*	*Neutral*	*Somewhat Dissatisfied*	*Very Dissatisfied*	*Don't Know*
The quality of the CFLs given	45%	36%	9%	0%	9%	0%
Service provided by TDPUD staff	100%	0%	0%	0%	0%	0%
Savings on your electric bill	9%	9%	0%	0%	0%	82%
Information provided by TDPUD on how to save energy in your home	91%	9%	0%	0%	0%	0%
Overall program experience	81%	9%	9%	0%	0%	0%
N = 11						

Overall, respondents were very satisfied with the program. Respondents were also very satisfied with the service provided by utility staff and the information provided by staff on how to save energy in their homes. There was high uncertainty regarding savings on respondents' electric bills. One respondent said they were dissatisfied with the quality of the CFL because it "takes a while for the bulb to be bright."

Respondents expressed appreciation for the available program.

3.3.5. **Evaluation Findings and Program Recommendations**

The following represent ADM's key findings for the CY 2014 evaluation of the Green Partners program:

- **High Program Installation Rates.** The installation rates were found to be generally high for this program (95% on average) and many of the customers are installing received bulbs upon receipt. While the increased efficiency standards have impacted the baseline wattage to which CFL bulbs are compared, 71% of respondents indicated that the CFLs received directly replaced incandescent bulbs – indicating that the market for this technology is not yet saturated in TDPUD service territory.
- **High Ex Ante Assumptions for HOU.** The evaluation used available secondary research to estimate average annual operating hours for CFLS installed in this program. The Ex Post estimate for HOU is 2.5 Hours/Day. The Ex Ante assumption

was 3 Hours/Day based on a handful of surveys from previous TDPUD impact evaluations.

- **High customer satisfaction with the program.** The evaluation found that participants in the Green Partners Program were highly satisfied with the service provided by program staff. However, many respondents were indicated they were unsure of any savings on their utility bill after installing the bulbs.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.
- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known. ADM recommends that the CFL component to the Commercial Green Partners program target these specialty applications.
- **Consider funding a monitoring study for Residential HOU.** The current hours of use estimate (2.5 Hrs/Day) is based on secondary literature. While the study referenced is recent (2010) and pertinent to CA utilities it does not specifically address TDPUD's unique demographic of customers. Surveys from previous TDPUD evaluations indicate that the actual HOU for bulbs installed in TDPUD territory are higher than 2.5 Hrs per day. However; insufficient data is currently available to justify this assumption. Therefore, ADM recommends that TDPUD consider funding a monitoring study for lighting hours of use in their residential sector. This would benefit multiple programs in TDPUD's portfolio.

3.4. Residential - Appliance

Table 3-21 Residential - Residential-Appliance: Summary Table

Final Project Count:	541
Ex Post Net Energy Savings [kWh]:	62,891
Ex Post Net Demand Savings [kWh]:	2.19
Program Contribution to Portfolio:	4%
General EM&V Approach	Deemed
Survey Sample Size	32

The Appliance Rebate Program encourages customers to purchase energy efficient appliances by providing increasing incentives for more efficient appliances as identified by Energy Star and the Consortium of Energy Efficiency (CEE). Energy Star and CEE Tier 1 identify appliances that use less energy than the federal standard. CEE Tiers 2 & 3 identify super-efficient appliances that use significantly less energy than the federal standard and identify the most energy efficient of the Energy Star spectrum.

3.4.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM chose participants with email addresses to conduct an online survey.

3.4.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES_{kWh} * N$$

$$kW_{Sav} = \frac{kWh_{Sav}}{8760}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES_{kWh}	Is the unit energy savings estimate for the measure
N	Is the number of rebated units

UES values for this program were derived from the CMUA TRM. The final values used for this evaluation are listed in Table 3-10.

Table 3-22 List of UES Estimates: Appliance Rebates

Equipment	*UES (kWh/Unit)*
ES/CEE Tier 1 Clothes Washer	209
ES/CEE Tier 2 Clothes Washer	220
ES/CEE Tier 3 Clothes Washer	229
ES/CEE Tier 1 Dishwasher	79
ES/CEE Tier 1 Refrigerator	130
ES/CEE Tier 2 Refrigerator	162
ES/CEE Tier 3 Refrigerator	195

3.4.3. Net Impact Methods and Results

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Appliance Rebate program was conducted using the methodologies outlined in 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratio. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided in Table 3-49.

Table 3-23 List of Net-To-Gross Factors &Questions: Appliance Rebates

#	Factor	Description	Question Used in Survey
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to purchase and install the appliance without the rebate you received through the program?
2	Importance of program assistance in the decision-making process	If the respondent answers "Somewhat unlikely" or "Highly unlikely", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	How likely is it that you would have purchased the appliance if you had not received a rebate through the program?
3	Prior Planning to purchase the measure	Two Questions are considered here. If the respondent answers "*Yes*" to Q1 and indicates they learned of the rebate "*After deciding to replace items with these energy efficiency measures, but before purchasing these measures on their own*", then the respondent is considered to have been planning to purchase the same quantity of measures with or without the rebate and is thus a partial free-rider. If the respondent answers "*Yes*" in Q1 and indicates they learned of the rebate "*After purchasing the energy efficiency measures on their own but before installing them*", or "*After already replacing some items with the energy efficiency measures*", then the respondent is considered to have been planning to purchase the same quantity of measures (or already did) without the rebate and is thus 100% free-rider.	**Q1:** When did you learn of the rebate program? **Q2:** Before learning about the rebates available through the utility, were you already planning to replace the appliance?
4	Demonstrates Behavior In Purchasing Similar Equipment without program assistance	If the respondent indicates "*Yes*" in Q1, and for Q2 chooses an option of "*over 1 year*", then they are considered to have been motivated by the energy efficiency program and are thus 0% free-rider. If respondents who indicated in Q2 "*less than 6 months*" or "*6-12 months*", these respondents are considered partial free-riders. If the respondent indicates "*No*" in Q1, they are considered a free-rider as the program did not affect timing of purchase and installation of measures.	**Q1:** Did you install these energy efficient measures earlier than you otherwise would have without the program? **Q2:** When would you otherwise have installed the appliance?

Table 3-23 through Table 3-27 summarizes the responses to questions addressing free-ridership for the 2014 Appliance Rebate Program.

Table 3-24 Financial Ability Results: Appliance Rebates

Factor	*Question*	*Yes*	*No*	*Don't Know*
Financial Ability	*Question 13: Would you have been financially able to purchase and install the Clothes Washer without the rebate you received through the program?*	79%	21%	0%
	Question 22: Would you have been financially able to purchase and install the Dishwasher without the rebate you received through the program?	100%	0%	0%
	Question 40: Would you have been financially able to purchase and install the Refrigerator without the rebate you received through the program?	100%	0%	0%

Table 3-25 Importance of Program Rebate: Appliance Rebates

Factor	*Question*	*Very Likely*	*Somewhat Likely*	*Neither Likely nor Unlikely*	*Somewhat Unlikely*	*Highly Unlikely*
Importance of program	*Question 10: How likely is it that you would have purchased the Clothes Washer if you had not received a rebate through the program?*	29%	43%	29%	0%	0%
	Question 19: How likely is it that you would have purchased the Dishwasher if you had not received a rebate through the program?	80%	20%	0%	0%	0%
	Question 37: How likely is it that you would have purchased the Refrigerator if you had not received a rebate through the program?	42%	50%	0%	8%	0%

Table 3-26 Prior Planning Results: Appliance Rebates

Factor	*Question*	*Prior to Decision*	*After Decided / Before Purchased*	*After Purchased / Before Installed*	*After Replaced*	*Other / DK*	*Yes*	*No*
Prior Planning	*Question 8: When did you learn of the rebate program?*	57%	21%	7%	7%	7%	-	-
	Question 7: Before learning about the rebates available through the utility, were you already planning to replace the Appliance?	-	-	-	-	-	86%	14%
	Question 17: When did you learn of the rebate program?	60%	20%	0%	20%	0%	-	-
	Question 16: Before learning about the rebates available through the utility, were you already planning to replace the Dishwasher?	-	-	-	-	-	100%	0%
	Question 35: When did you learn of the rebate program?	42%	42%	17%	0%	0%	-	-
	Question 34: Before learning about the rebates available through the utility, were you already planning to replace the Refrigerator?	-	-	-	-	-	83%	17%

Table 3-27 Behavior Without Program Results: Appliance Rebates

Factor	*Question*	*Yes*	*No*	-
Importance of Rebate	*Question 11: Did you install the Clothes Washer earlier that you otherwise would have without the program?*	36%	64%	-
	Question 20: Did you install the Dishwasher earlier that you otherwise would have without the program?	40%	60%	-
	Question 38: Did you install the Refrigerator earlier that you otherwise would have without the program?	42%	58%	-
	Question	*Less than 6 months*	*6-12 months*	*More than 1 year*
	Question 12 When would you have otherwise installed the Clothes Washer?	29%	43%	14%
	Question 21: When would you have otherwise installed the Appliance?	80%	20%	0%
	Question 39: When would you have otherwise installed the Refrigerator?	42%	42%	8%

Based on survey responses for the 32 participants, ADM estimated a NTGR of 0.79 for the clothes washers, 0.75 for dishwashers, and 0.73 for refrigerators within the Appliance Rebate program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-27.

Table 3-28 NTGR and Net Impacts for Appliance Rebate Program

Measure	*Free Ridership Estimate*	*NTGR Estimate (1-FR)*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
Clothes Washer	21%	79%	34,189	0
Dishwasher	25%	75%	9,539	0
Refrigerator	27%	73%	19,193	2.19

3.4.4. **Participant Satisfaction Survey Results**

ADM sent online surveys to 157 participants of the Appliance Rebate program from which we received 32 responses (20.4% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;

- Customer purchasing and installation habits; and
- Customer satisfaction with the Appliance Rebate program.

The Appliance Rebate program covers rebates for refrigerators, dishwashers, clothes washers, and high efficiency clothes washers.

3.4.4.1.1. Participant Decision-Making Processes

Respondents were asked several questions regarding their decision-making processes including prior planning, equipment efficiency, likelihood of purchase, and financial ability. Respondents were first asked if they were already planning on purchasing the energy efficient appliance before they had learned about the program. Eighty-seven percent of respondents said they had prior plans to purchase the energy efficient appliance. Respondents were asked specifically when they had learned about the program. Table 3-28 summarizes their responses to the following question:

> *"During which of the following time periods would you say you learned about TDPUD's Appliance Rebate program?"*

Table 3-29 Summary of Program Awareness Timing: Appliance Rebates

Response	*Clothes Washer*	*Dishwasher*	*Refrigerator*
Prior to deciding to replace the appliance	57%	0%	42%
After deciding, but before purchasing	21%	20%	42%
After purchasing, but before installation	36%	60%	17%
After purchasing and installing appliance	7%	20%	0%
Some other time	7%	0%	0%

Fifty percent of respondents said that the program had an effect on the efficiency of the appliance they purchased.

Respondents were asked about the likelihood of purchasing the appliance without the rebate. If they had not received the rebate, 44% of respondents were very likely to purchase the efficient appliance, 41% were somewhat likely, 13% were neither likely nor unlikely to purchase it, and 3% were unlikely to have made the purchase.

Fifty-nine percent of respondents installed the equipment earlier than they had originally planned because of the program. If the program was not available, 55% percent of respondents would have installed the appliance within six months, 34% would have installed it between six months to a year, and 10% would have installed more than a year later.

Ninety-one percent of respondents would have been financially able to purchase the equipment without the incentive from the utility.

3.4.4.1.2. Equipment Satisfaction and Perceived Benefits

Respondents were asked questions regarding their satisfaction with the installed equipment, perceived benefits after installing the equipment, and participation in other utility programs.

Sixty-nine percent said they were very satisfied with the appliance and 31% were satisfied. Thirty-three percent of respondents also participated in the Refrigerator Recycling program.

Respondents were asked to identify the greatest benefit they had noticed after installing the new fixture in their home. Sixty-six percent indicated the greatest benefit after installing the equipment was saving money on their utility bill. Respondents indicated that there is less noise from the appliances (50%) and the appliances are more reliable (41%).

3.4.4.1.3. Overall Program Satisfaction

Respondents were asked how satisfied they were with the program elements indicating whether they were very satisfied, satisfied, neutral, dissatisfied, or very dissatisfied. Table 3-29 summarizes respondents' satisfaction towards each element.

Table 3-30 Overall Program Satisfaction

Element of Program Experience	*Very satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very dissatisfied*	*Don't know*
Interactions with the utility staff	75%	13%	6%	0%	6%	3%
Application process	59%	28%	0%	3%	9%	3%
Rebate amount	38%	44%	3%	6%	6%	6%
Amount of time it took to receive the rebate	44%	38%	6%	0%	9%	6%
The range of equipment that qualifies for a rebate	31%	44%	13%	3%	9%	3%
Overall program experience	59%	31%	3%	0%	6%	3%

Overall, respondents are satisfied with the program. Respondents had scored interactions with the utility staff with very high satisfaction. Respondents were also satisfied with the application process and the rebate amount. However, some respondents indicated lower satisfaction with all the program elements, but more specifically with the range of equipment that qualified for rebates and the rebate amount.

Lastly, respondents were asked if they had any comments or suggestions regarding the program. Some of these comments suggested that follow-up on rebate application deadlines would be appreciated and the range of appliances that qualify for a rebate should be updated. Other respondents said that they thought the program was great and that they had learned a lot during their energy audit. One respondent says they have spoken to their friends and family members about the available programs.

3.4.5. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Appliance Rebate program:

- **Good customer satisfaction with the program.** The evaluation found that participants in the Appliance Rebate Program were satisfied by the program's application process and their interactions with program staff. Participants were also satisfied with the amount of time it took to receive the rebate. Furthermore, program participants perceived their new appliance as providing additional benefits (e.g. besides energy and water conservation) in the areas of improved health, noise reduction, equipment reliability, and improved home comfort. Note that several customers did indicate that they would like to see a wider range of qualified equipment.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Emphasize application deadline on program materials.** Some respondents were unhappy with the application deadline because the time period was "too short" and would have appreciated a reminder. Emphasizing the deadline on the materials may help encourage more customers to participate in the future.

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for the appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.5. Residential - ESP Residential Survey

Table 3-31 Residential - ESP Residential Survey: Summary Table

Final Project Count:	58
Ex Post Net Energy Savings [kWh]:	48,581
Ex Post Net Demand Savings [kWh]:	2.63
Ex Post Net Water Savings [MG]:	0.21
Program Contribution to Portfolio:	2%
General EM&V Approach	Option A
Survey Sample Size	6

The TDPUD provides residential energy surveys to qualified income-limited customers through the Energy Savings Partners (ESP). All residential energy surveys include a free energy survey and free energy and water-saving measures. The energy survey is a visual inspection only. Income-limited customers are qualified by an intermediary agency who will pre-qualify applicants for this program. Any measures recommended during the survey, which the District is providing for the program, are given to the residents at the time of survey. Customers are responsible for installing these free measures within 10 days of the receipt of these measures. Beginning in 2013 the energy surveyor will install up to 24 compact fluorescent light bulbs (CFL) and 2 low-flow shower heads for the customer with their permission and dependent upon time available within the scheduled survey. Customers are also informed of District programs that they may benefit from and provided with associated literature. ESP program participants are eligible for a one-time credit per service address equal to their highest energy charge in the past 12-months not to exceed $200. If they do not have 12-month of billing history, District may use the prior 12-month energy usage history for the service address. Customers who have received an ESP credit, but have moved to a new service address are eligible for a credit and survey at the new address 2 years after the initial credit. 2009 program participants are eligible for a second credit and survey at the same address as the original survey. ESP qualifications guidelines are consistent with the Nevada County Low-Income criteria, other local low income organization criteria (food stamps, MediCal) or proof of 25% or greater loss of household income due to change in employment status. Second home owners (Non-permanent resident rate) do not qualify.

3.5.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM randomly chose 68 participants out of the total participants of the RES and ESP programs to contact via telephone for the survey.

3.5.2. **Gross Impact Evaluation Methods and Results**

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Is the Unit energy savings estimate for the measure
N	Is the number of measures implemented

Several measures were offered through this program. ADM also observed that various combinations/quantities of each were implemented among program participants. ADM developed UES estimates for each measure as listed in Table 3-31.

Table 3-32 List of UES estimates for Measures offered in ESP Program

Measure	*Savings Per [kWh]*		*Savings Per [kW]*	
	No Hot Water	W/ Hot Water	No Hot Water	W/ Hot Water
DR30 15/65	46	46	2.9E-03	2.9E-03
Globe G25 9/40	29	29	1.8E-03	1.8E-03
PAR 38 120/23	90	90	5.6E-03	5.6E-03
R20 14/50	33	33	2.1E-03	2.1E-03
R30 15/65	46	46	2.9E-03	2.9E-03
Spiral 13/60	43	43	2.7E-03	2.7E-03
Spiral 23/100	71	71	4.5E-03	4.5E-03
Bathroom Aerators	3	44	0.0E+00	0.0E+00
Kitchen Aerators	10	219	0.0E+00	0.0E+00
Showerheads	11	276	0.0E+00	0.0E+00
Spray Nozzle	4	4	0.0E+00	0.0E+00

The assumptions and sources used to develop each of the UES estimates in Table 3-31 can be found in the Excel workbook used to analyze the program's impacts. This workbook can be made available to TDPUD upon request.

3.5.3. **Net Impact Methods and Results**

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Residential Energy Survey program was conducted using the methodologies outlined in 2.1.1.1. The participant survey included several questions designed to elicit

information on free-ridership, which in turn is used to estimate net-to-gross ratios. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase. Rather than apply a binary scoring (0% vs. 100% free-ridership), ADM applied a free-ridership probability to program participants, based upon three factors. These factors, along with the survey questions used to address them are provided in Table 3-32.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate.

Table 3-33 List of Net-To-Gross Factors and Questions: ESP Program

#	*Factor*	*Description*	*Question Used in Survey*
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to make these home improvements without the incentive from the utility?
2	Importance of program assistance in the decision-making process	If the respondent answers "Definitely would", then the respondent would is considered to be 100% free-rider. If the respondent answers "Probably would" or "Probably would not", then the respondent is considered to have been planning to purchase the same measures with or without the rebate, and is thus a partial free-rider. If the respondent answers in Question 17 "Definitely would not", then the respondent is considered to be 0% free-rider.	How likely is it that you would have purchased the same energy efficiency measures if you had not received a rebate through the program?
3	Behavior without the Program Modified by Prior Planning	If the respondent answers "No", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	Did you have plans to make these improvements to your home prior to learning about the program?

Table 3-34 through Table 3-36 summarizes the responses to questions addressing free-ridership for the 2014 Energy Savings Partners Program. Based on survey responses for the 6 ESP participants, ADM estimated a NTGR of 0.72 for the program. This values was

multiplied by gross per-unit kWh to derive program net energy savings (kWh) and net peak demand reduction (kW).

Table 3-34 Financial Ability Results: ESP Program

Factor	*Question*	*Yes*	*No*	*Other / DK*
Financial Ability	*Question 18: Would you have been financially able to purchase and install the toilet without the rebate you received through the program?*	67%	33%	0%

Table 3-35 Behavior without Program Results: ESP Program

Factor	*Question*	*Definitely Would*	*Probably Would*	*Probably Not*	*Definitely Not*
Importance of program	*Question 19: How likely is it that you would have purchased the measures if you had not received a rebate through the program?*	0%	67%	33%	0%

Table 3-36 Behavior w/o Program Modified by Prior Planning Results: ESP Program

Factor	*Question*	*Yes*	*No*	*Other / DK*
Behavior W/O Program Modified by Prior Plan Existence	*Question 17: Before learning about the rebates available through the utility, were you already planning to replace the energy efficiency measures?*	33%	67%	0%

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for all measures based on results from the participant survey. Survey responses were scored based on the answers to the questions above and the type of unit they purchased. These responses fell into one of three categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. Industry best practices state that low-income programs are deemed 100% for NTGR. These values were multiplied by gross per-unit kWh. Net savings values are shown in Table 3-7.

3.5.4. **Participant Satisfaction Survey Results**

ADM contacted 68 participants of the ESP and RES programs from which we received 18 total responses (26.5% response rate); six from ESP participants and twelve responses from RES participants. ADM sampled participants from both programs

because they received the same services. The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer purchasing and installation habits; and
- Customer satisfaction with the Energy Savings Partners program.

The survey results in this chapter will also be used for the Residential Energy Survey report chapter.

3.5.4.1.1. Program Awareness

Respondents were asked how they learned about the program. Figure 3-5 summarizes how respondents learned about the Energy Savings Partners and the Residential Energy Survey program. Many respondents indicated they learned about the program from the utility (30%) and from a flyer (20%).

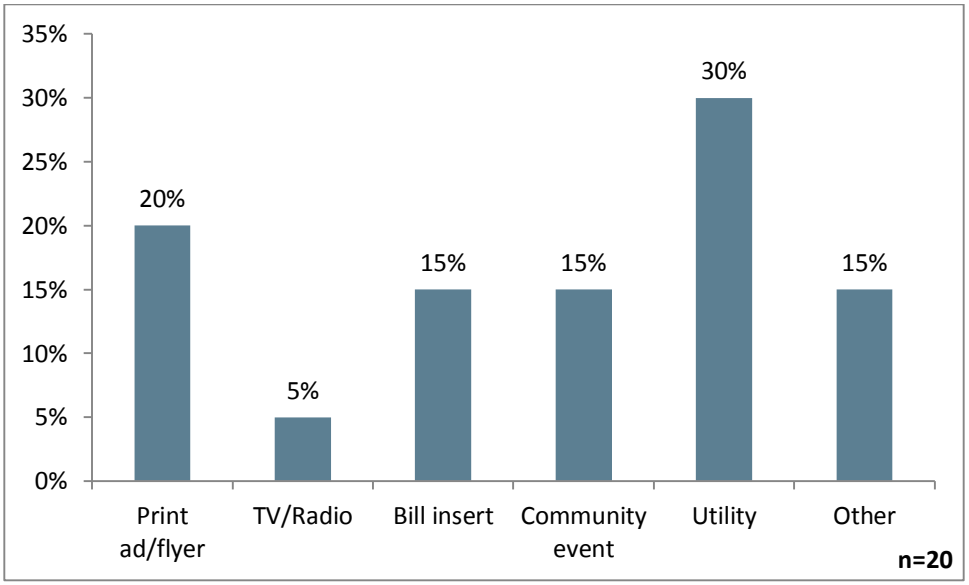


Figure 3-5 Sources of Program Awareness

3.5.4.1.2. Participant Decision-Making Processes

Respondents were asked several questions regarding their decision-making processes including why they chose to participate in the program, prior planning, financial ability, and likelihood to install the free devices without the program. Respondents were asked why those chose to participate in the program. The most frequent answer was to reduce their utility bill (36%) followed closely by wanting to save energy (28%). Figure 3-6 summarizes these results.

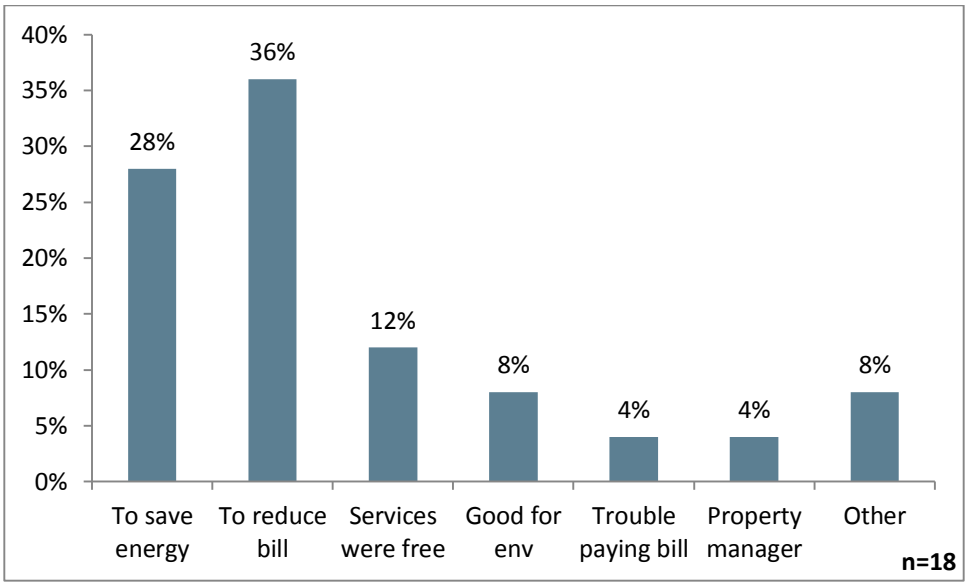


Figure 3-6 Reasons for Participation

Another reason respondents had decided to participate in the program included a credit on their utility bill (ESP only).

Forty-seven percent of respondents did not have existing plans to make improvement on their homes prior to learning about the program. However, 55% of them would have likely installed the same home improvements available in the program. Seventy-eight percent of respondents would have been financially able to make the home improvements without the incentives from the utility.

3.5.4.1.3. Measure Installation Rates and Satisfaction

Respondents were asked several questions regarding the survey and installation work done in their homes by the surveyor. Participants could receive a range of direct install items through the program that included CFLs, low-flow showerheads, and weather stripping. Participants could receive up to 24 CFLs for their home. Respondents said they had installed between 2 to 25 CFLs in their homes. They rated their satisfaction with the CFLs high with a mean score of 8.63. Thirteen of fifteen respondents had CFLs installed by the surveyor and rated the service with very high satisfaction (9.11). Fifty-seven percent of respondents believed that the CFLs were generally higher quality than the bulbs that they had installed while 43% said they were the same quality. Only 2 respondents had removed the CFLs; their reasons included that they did not work with their dimmer fixture, it had broken, and mercury concerns.

Respondents were asked about the low-flow showerheads that were installed in their homes. Thirteen respondents installed the showerheads in their homes; 19% installed one showerhead and 63% installed two showerheads. The respondents were satisfied with the quality of the showerhead (8.89), and for those that had the surveyor install the

showerhead, they rated their satisfaction as moderate (6.57). Two respondents said they that had removed the showerheads because they did not like the spray.

3.5.4.1.4. Overall Program Satisfaction

Respondents were asked to rate several program elements on a scale of 1 to 10, where "10"; is very satisfied and "1" is very dissatisfied. Table 3-36 summarizes respondents' satisfaction towards each element.

Table 3-37 Overall Program Satisfaction

Element of Program Experience	*Score*	*Don't Know*
Information provided by the surveyor	9.59	6%
The quality of installation work by the surveyor	7.91	50%
The savings on your monthly bill	6.43	22%
The service provided by utility staff	8.88	11%
Information provided by TDPUD on how to reduce your utility bill	8.94	0%
Improvement in home comfort after receiving the home improvements	8.25	0%
Overall program experience	9.11	0%

Overall, respondents are highly satisfied with the program. Respondents had scored program elements with highest satisfaction included information provided by the surveyor (9.59), information provided by the utility (8.94), and the service provided by utility staff (8.88). The program element that scored the lowest was the savings on the monthly bill. Many respondents indicated that they were unsure if there was a difference in their bill and said that they had not noticed a difference or were experiencing other problems in their home that increased their bill.

Finally, respondents had comments and suggestions for improvement to the program. Many of the comments were very positive saying that they thought the utility was doing a good job, it was a good program, high praise for the surveyor who performed the work, and the program was a great experience. A few respondents suggested that they wish the program had included LED lights. Some examples or responses provided by program participants include:

- *"It's a great program. It's absolutely fantastic. They do the best to get out the information."*
- *"I was pretty happy with the person that came and they were very knowledgeable."*

- *"It's a great program and incentive to have the audit done to get more information on how to improve the home."*

3.5.5. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Residential Energy Survey program:

- **High customer satisfaction with the program.** The evaluation found that participants in the RES Program were highly satisfied with the program surveyor and their interactions with program staff. Many participants also indicated high satisfaction with an improvement in home comfort after the measures were installed.
- **Participants report high levels of satisfaction with their surveyor.** Many of the participants were greatly appreciative of the information provided by their surveyor.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Additional follow-up with participants regarding measure installations.** For those that choose to self-install rather than have the surveyor install on-site, send a reminder to participants to install the measures. The reminder can be packaged as a thank you card, thanking the customer for their participation and reminding them of the savings they will see with full installation of the kit. This delivery mechanism can provide gentle a reminder to customers to install their equipment.
- **Consider the addition of LEDs to the program.** Participants mentioned they would be interested having LEDs instead of the CFLs as a lighting option. Inclusion of LEDs in the program would be contingent upon due diligence in cost-benefit screening at the measure and program level.
- **Update Ex Ante Estimates for Program (Lighting Measures Specifically).** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-

ridership is expected to be lower in these applications for which CFLs are less well-known.

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.6. Residential - Lighting Rebate

Table 3-38 Residential Lighting Rebate: Summary Table

Final Project Count:	161
Ex Post Net Energy Savings [kWh]:	43,204
Ex Post Net Demand Savings [kWh]:	2.7
Program Contribution to Portfolio:	2%
General EM&V Approach	Deemed
Survey Sample Size	12

The TDPUD Residential Lighting Rebate Program encourages customers to replace incandescent and halogen light bulbs with energy efficient lighting by providing incentives for Compact Fluorescent (CFL) and Light Emitting Diode (LED) screw-in or plug in bulbs.

3.6.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. ADM used a random digit dial of participants based on the total number of participants.

3.6.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = (kW_{Base} - kW_{CFL}) * Hrs * HCIF * ISR$$

$$kW_{Sav} = (kW_{Base} - kW_{CFL}) * CDF * HCIF * ISR$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb[8]
kW_{CFL}	Is the connected load of the installed light bulb[9]
Hrs	Are the annual hours of operation
HCIF	Heating/Cooling Interactive Factor[10]
CDF	Is the Coincident Demand Factor

[8] Assessed using an assumed baseline wattage based on the wattage/type of the installed bulb and further informed through surveys

[9] Based on the records kept in the tracking system and further informed by the surveys

[10] Per DEER 2013 for appropriate building type

ISR Is the *In-Service Rate*

Due to similarities between this program and the Green Partners program, as well as the small size of this program relative to the others, ADM leveraged our findings from the Green Partners program to inform the assumptions used to estimate gross impacts for the Lighting Rebate Program. Annual Hours of use were used per Table 3-12, the CDF and HCIFs were used from DEER, and per bulb energy savings estimates were determined and applied.

3.6.3. **Net Impact Methods and Results**

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Lighting Rebate program was conducted using the methodologies outlined in 2.1.1.1. Determining the net effects of the lighting discounts requires estimating the percentage of energy savings from efficient lighting purchases that would have occurred without program intervention. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided in Table 3-38.

Table 3-39 List of Net-To-Gross Factors and Questions Addressing Them: Lighting Rebate

#	Factor	Description	Question Used in Survey
1	Prior Experience	If the customer answers "LED", they are assigned 100% free-ridership. If the customer answers "Incandescent", "CFL", or "Mix/Other", customers are asked a follow-up question (Q2).	**Q1**: Regarding the light bulbs being replaced, what type of bulbs are they?
2	Behavior without the Discount	If the customer answers "Probably not" or "Definitely not", then the customer is considered to have not been planning to purchase any of the measures and is 0% free-rider.	**Q2:** If the rebate incentives were not available, how likely would you have been to install the CFLs/LEDs bulbs?
3	Importance of Program (Mitigating Factor)	If the customer provided an answer of "Don't know" for their awareness of the discount, they were assigned "No Change." If the customer answers "5", meaning "Very important", they were assigned Full Mitigation; If the customer answers "4", they were assigned Partial Mitigation; anything less than "3" was assigned "No change."	**Q3:** How did you become aware of the TDPUD lighting discounts? **Q4:** On a scale of 1 to 5, where 1 is "not important at all" and 5 is "very important," how important was the TDPUD lighting discount to your decision to purchase those specific light bulbs?

Table 3-39 through Table 3-41 summarizes the responses to questions addressing free-ridership for the 2014 Lighting Rebate Program.

Table 3-40 Prior Experience Results: Lighting Rebate

Factor	Question	Incandescent	CFLs	LEDs	Mix/Other
Prior Experience	*Question 8/9: Regarding the light bulbs being replaced, what type of bulbs are they?*	75%	8%	0%	17%

Table 3-41 Behavior without the Discount Results: Lighting Rebate

Factor	Question	Definitely	Probably	Probably not	Definitely not
Behavior without the Discount	*Question 15:* If the rebate incentives were not available, how likely would you	40%	33%	13%	13%

	have been to install the CFLs or LEDs bulbs?				

Table 3-42 Importance of Program Results: Lighting Rebate

Factor	*Question*	*Provided Answer*	*Don't know*	*5*	*4*	*3*	*2*	*1*
Importance of Program (Mitigating Factor)	Question 12: How did you become aware of the TDPUD lighting discounts?	92%	8%	-	-	-	-	-
	Question 11: On a scale of 1 to 5, where 1 is "not important at all" and 5 is "very important," how important was the TDPUD lighting discount to your decision to purchase those specific light bulbs?	-	-	75%	8%	8%	0%	8%

Based on survey responses for the 12 participants, ADM estimated a NTGR of 0.57 for the program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-42.

Table 3-43 NTGR and Net Impacts for Lighting Rebate Program: Lighting Rebate

Installation Rate	*NTG Ratio*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
92%	57%	43,204	2.7

3.6.4. **Participant Satisfaction Survey Results**

ADM contacted 47 participants of the Lighting Rebate program via telephone from which we completed 12 responses (25.5% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer bulb purchase and installation habits; and
- Customer satisfaction with the Lighting Rebate program.

3.6.4.1.1. Installation Rates

Respondents were asked several questions about the installation of CFLs and/or LEDs in their homes and the types of light bulbs that were replaced. Most respondents had purchased between one and 30 bulbs and one respondent had purchased 80 bulbs. Only one respondent purchased a combination of CFLs and LEDs, and everyone else

purchased only LEDs. ADM calculated the installation rate as 92%. The most common reason respondents purchased the energy efficient bulbs was because they wanted to lower their energy usage (42%). The second most common reason was because they were replacing burned out bulbs (25%). Other reasons included the installation of new fixtures (17%) and needing to replace burnt out, but also replaced working bulbs at the same time (17%). Seventy-five percent of all installations replaced incandescent bulbs; one respondent replaced existing CFLs with new CFLs, and two others said they installed their bulbs into new fixtures.

3.6.4.1.2. Light Bulb Characteristics

Respondents were asked several questions regarding characteristics they consider when purchasing light bulbs. The most important characteristic to respondents when purchasing energy efficient bulbs is brightness (27%). For those respondents that chose more than one characteristic, they were asked to choose the most important characteristic; cost and energy efficiency were both mentioned as the most important characteristic. Table 3-43 shows other important characteristics participants consider when choosing an energy efficient bulb.

Table 3-44 Important Bulb Characteristics: Lighting Rebate

Bulb Characteristic	*% Indicated*	*% Indicated Most Important*
Cost	23%	33%
Energy Efficiency	23%	33%
Color	18%	17%
Brightness	27%	17%
Longevity	9%	0%
	n=22	**n=6**

Seventy-five percent of respondents stated that the energy efficiency of light bulbs they select for purchase is very important to their decision-making process.

3.6.4.1.3. Awareness of the Discounts

Respondents were asked several questions regarding their awareness of the program incentives, and more specifically about how they learned about the program, the ability to recall the discount, financial ability to purchase the bulbs, the likelihood of purchase, and the importance of the program discount.

Respondents were first asked to recall if they saw any discounted products in the last six months. Fifty-eight percent of respondents recalled seeing a discount on the energy efficient bulbs. Next, they were asked about where they learned about the Lighting Rebate program. Respondents said that they learned about the program through several different

sources. Table 3-44 summarizes the potential sources of awareness of the lighting discounts.

Table 3-45 Program Sources of Awareness: Lighting Rebate

Potential Sources of Awareness	*% Indicated*
In-store promotional event representative	8%
Store salesperson	17%
TDPUD website	8%
Word of mouth	17%
Bill Insert	17%
Flyer	17%
Contractor	8%

Eighty-three percent of respondents said they would have been financially able to purchase the energy efficient bulbs, and 67% were likely to install the same CFLs or LEDs without the rebate incentive. Seventy-five percent said that the lighting discount was important in their decision to purchase the specific bulbs.

Respondents expressed great appreciation for the program and hope that the program continues in the future.

3.6.5. **Evaluation Findings and Program Recommendations**

The following represent ADM's key findings for the CY 2014 evaluation of the Lighting Rebate program:

- **Participants want to buy energy efficient light bulbs.** Seventy-five percent of respondents stated that the energy efficiency of light bulbs they select for purchase is very important in their decision-making process. Many stated their reason to purchase energy efficient bulbs was to lower their energy usage.

- **Participants learned about the program word-of-mouth.** Half of the respondents indicated they learned about the program through word-of-mouth sources.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.
- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some

are considered “specialty bulbs” and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.

- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known.

3.7. Residential -Toilet Exchange

Table 3-46 Residential -Toilet Exchange: Summary Table

Final Project Count:	213
Ex Post Net Energy Savings [kWh]:	10,961
Ex Post Net Demand Savings [kWh]:	1.25
Ex Post Net Water Savings [MG]:	2.29
Program Contribution to Portfolio:	1%
General EM&V Approach	Deemed
Survey Sample Size	0

The Water Efficient Toilet Exchange Program encourages customers to replace high-water use toilets (greater than or equal to 3 gallons per flush) to low water use toilets by distributing low-flush toilets (1.28 gallons per flush) through a local vendor store front. The vendor provides, at their store, year-round at least two low-flush toilet options (round and oblong) to qualifying customers to exchange at no cost. The vendor is responsible for collecting and verifying eligibility of the old toilet, properly disposing of the old toilets, and providing monthly program reports documenting the District customers served, quantity of toilets provided and vendor invoice. The District verifies the customer's eligibility to participate in the program and provides them with an approved District Water-Efficient Toilet Exchange Program Customer Information Form.

3.7.1. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES * N$$

$$kW_{Sav} = \frac{kWh_{Sav}}{8760}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Is the per unit energy savings estimate for each measure.
N	Is the number of measures implemented

Three separate UES estimates were derived based on the capacity of the toilet installed and on the toilet it replaced. ADM used engineering calculations to derive the unit energy savings estimates along with secondary literature research to establish appropriate assumptions. The following formula was used to estimate the UES;

$$kWh_{Toilet} = F_{Person-Day} * N_{Persons} * (V_{Base} - V_{Post}) * 365 * \gamma$$

Where:

kWh_{Toilet}	Are the annual energy impacts for the retrofit
$F_{Person-Day}$	Is the number of flushes per person per day
$V_{Base/Post}$	Is the volume of water consumed per flush by baseline and post toilets.[11]
γ	Is the embedded energy content of water flushed

Final values for each of the three toilet volume combinations offered through the program are listed in Table 3-46.

Table 3-47 List of UES estimates for Each Toilet Volume Represented in the Program: Toilet Exchange/Rebate

Measure	*Gross Energy Impacts [kWh/Toilet]*	*Gross Water Impacts [Gal/Toilet]*
Toilet 1.6 GPF to 1.28 GPF/Dual-Flush	7	1,510
Toilet 3 GPF to 1.28 GPF/Dual Flush	39	8,114
Toilet 3 GPF to 1.6 GPF	32	6,605

3.7.2. Net Impact Methods and Results

As this program is implemented by a third party, and is nearly identical to the Toilet Rebate program, the net-to-gross ratio for the rebate program was applied to the Toilet-Exchange program as ADM received a sizable response rate from customers surveyed in the Toilet-Rebate program. The Net-To-Gross rate applied to this program, and final net impacts are shown in Table 3-47.

Table 3-48 Summary of NTG Ratio and Net Impacts: Toiled Exchange Program

NTG Ratio	*Net Energy Impacts [kWh]*	*Net Water Impacts [MGal]*
0.9	10,961	2.29

3.7.3. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Residential Toilet Exchange program:

- **Ex Post Impacts were higher than the Ex Ante estimates.** The Ex Ante per unit savings estimates for this program were slightly lower than the Ex Post per unit estimates. This resulted in a program level realization rate of 112%.

[11] The embedded energy content of water was assumed to be .0047 kWh/Gal based on two years data on TDPUD's water distribution. Note that this is a conservative estimate as it does not include the cost of water conveyance through Truckee Sanitary District or the cost of processing at the Tahoe Truckee Sanitation Agency waste-water treatment plant. A study is currently on-going to establish final values for these additional components.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.8. Residential - Toilet Rebate

Table 3-49 Residential - Toilet Rebate: Summary Table

Final Project Count:	114
Ex Post Net Energy Savings [kWh]:	4,989
Ex Post Net Demand Savings [kWh]:	.57
Ex Post Net Water Savings [MG]:	1.04
Program Contribution to Portfolio:	< 1%
General EM&V Approach	Deemed
Survey Sample Size	19

The Water Efficient Toilet Rebate Program encourages customers to replace high-water use toilets to low water use toilets by providing increasing incentives for more efficient toilets. In 1992 the Federal toilet standards went into effect requiring toilets installed in residential new construction to use 1.6 gallons of water per flush or less. Many “older” homes and businesses still have high-water use toilets that use between 3 and 7 gallons per flush (GPF). Recent advancements have allowed toilets to use 1.28 gallons per flush or less while still providing equal or superior performance.. This is 20 percent less water than the current 1.6 GPF federal standard.

3.8.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM chose participants with email addresses to conduct an online survey.

3.8.2. Gross Impact Evaluation Methods and Results

ADM applied an identical gross impact method to the Toilet Rebate Program as was described in Section 3.7 for the Toilet Exchange Program. The UES estimates were identical as were the measure offerings.

3.8.3. Net Impact Methods and Results

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Toilet Rebate program was conducted using the methodologies outlined in 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratio. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided in Table 3-49.

Table 3-50 List of Net-To-Gross Factors and Questions: Toilet Rebate

#	Factor	Description	Question Used in Survey
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to purchase and install the toilet without the rebate you received through the program?
2	Importance of program assistance in the decision-making process	If the respondent answers "Somewhat unlikely" or "Highly unlikely", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	How likely is it that you would have purchased the toilet if you had not received a rebate through the program?
3	Prior Planning to purchase the measure	Two Questions are considered here. If the respondent answers "*Yes*" to Q1 and indicates they learned of the rebate "*After deciding to replace items with these energy efficiency measures, but before purchasing these measures on their own*", then the respondent is considered to have been planning to purchase the same quantity of measures with or without the rebate and is thus a partial free-rider. If the respondent answers "*Yes*" in Q1 and indicates they learned of the rebate "*After purchasing the energy efficiency measures on their own but before installing them*", or "*After already replacing some items with the energy efficiency measures*", then the respondent is considered to have been planning to purchase the same quantity of measures (or already did) without the rebate and is thus 100% free-rider.	**Q1:** When did you learn of the rebate program? **Q2:** Before learning about the rebates available through the utility, were you already planning to replace the toilet?
4	Demonstrates Behavior In Purchasing Similar Equipment without program assistance	If the respondent indicates "*Yes*" in Q1, and for Q2 chooses an option of "*over 1 year*", then they are considered to have been motivated by the energy efficiency program and are thus 0% free-rider. If respondents who indicated in Q2 "*less than 6 months*" or "*6-12 months*", these respondents are considered partial free-riders. If the respondent indicates "*No*" in Q1, they are considered a free-rider as the program did not affect timing of purchase and installation of measures.	**Q1:** Did you install these energy efficient measures earlier than you otherwise would have without the program? **Q2:** When would you otherwise have installed the measures?

Table 3-50 through Table 3-53 summarizes the responses to questions addressing free-ridership for the 2014 Toilet Rebate Program.

Table 3-51 Financial Ability Results: Toilet Rebate

Factor	*Question*	*Yes*	*No*	*Don't Know*
Financial Ability	*Question 58: Would you have been financially able to purchase and install the toilet without the rebate you received through the program?*	98%	17%	0%

Table 3-52 Importance of Program Rebate: Toilet Rebate

Factor	*Question*	*Very Likely*	*Somewhat Likely*	*Neither Likely nor Unlikely*	*Somewhat Unlikely*	*Highly Unlikely*
Importance of program	*Question 55: How likely is it that you would have purchased the toilet if you had not received a rebate through the program?*	39%	11%	11%	28%	11%

Table 3-53 Prior Planning Results: Toilet Rebate

Factor	*Question*	*Prior to Decision*	*After Decided / Before Purchased*	*After Purchased / Before Installed*	*After Replaced*	*Other / DK*	*Yes*	*No*
Prior Planning	*Question 53: When did you learn of the rebate program?*	72%	22%	0%	0%	6%	-	-
	Question 52: Before learning about the rebates available through the utility, were you already planning to replace the toilet?	-	-	-	-	-	44%	56%

Table 3-54 Behavior Without Program Results: Toilet Rebate

Factor	*Question*	*Yes*	*No*	-
Importance of Rebate	*Question 56: Did you install the toilet earlier that you otherwise would have without the program?*	56%	44%	-
	Question	*Less than 6 months*	*6-12 months*	*More than 1 year*
	Question 57: When would you have otherwise installed the toilet?	39%	17%	44%

Based on survey responses for the 18 participants, ADM estimated a NTGR of 0.90 for the program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-54.

Table 3-55 NTGR and Net Impacts for Toilet Rebate Program

Free Ridership Estimate	*NTG Ratio*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
10%	90%	4,989	0.57

3.8.4. **Participant Satisfaction Survey Results**

ADM sent online surveys to 66 participants of the Toilet Rebate program from which we received 18 responses (27.3% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer decision-making processes; and
- Customer satisfaction with the Toilet Rebate program.

3.8.4.1.1. Participant Decision-Making Processes

Respondents were asked several questions regarding their decision-making processes including prior planning, equipment efficiency, likelihood of purchase, and financial ability to purchase the equipment. Respondents were first asked if they were already planning on purchasing the equipment before they had learned about the program. Forty-four of respondents said they had prior plans to purchase the toilet. Seventy-two percent of respondents learned about the program after deciding to replace their toilet, 22% learned

about the program before deciding to replace the toilet, but before purchasing it, and one respondent specifically said they learned about it during their home remodel.

Seventy-two percent stated that the program had an effect on the efficiency of the toilet they purchased. Respondents were then asked to indicate their likelihood of purchasing a higher efficiency toilet without a program rebate. Fifty percent of respondents indicated that they were somewhat likely or very likely to purchase a higher efficiency toilet, 11% stated that they were neither likely nor unlikely to purchase it, and 39% stated that they were unlikely to have made the purchase.

Fifty-six percent of respondents installed the equipment earlier than they had originally planned because of the program. When asked to provide a timeline for installation of similar equipment without a program rebate, thirty-nine percent of respondents stated that they would have installed a new toilet within six months, 17% between six months to a year, and 44% stated that they would have installed more than a year later.

Eighty-three percent of respondents indicated that they would have been financially able to purchase the equipment without the incentive from the utility.

3.8.4.1.2. Equipment Satisfaction and Perceived Benefits

Respondents were asked questions regarding their satisfaction with the installed equipment, perceived benefits after installing the equipment, and participating in the Toilet Exchange program.

Eighty-three percent said they were very satisfied with the equipment, 11% were satisfied, and 6% were neutral. Fifty-six percent of respondents also participated in the Toilet Exchange program.

Respondents were asked to identify the greatest benefit they had noticed after installing the new fixture in their home. Sixty-seven percent indicated the greatest benefit after installing the equipment was saving money on their utility bill. Respondents also indicated that the appliances are more reliable (28%). Other perceived benefits included a more comfortable home (17%), water savings (17%), less noise from appliances (11%), and health improvements (6%).

3.8.4.1.3. Overall Program Satisfaction

Respondents were asked how satisfied they were with the program elements indicating whether they were very satisfied, satisfied, neutral, dissatisfied, or very dissatisfied. *Table 3-55* summarizes respondents' satisfaction towards each element.

Table 3-56 Summary of Program Experience Satisfaction: Toilet Rebate

Element of Program Experience	*Very satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very dissatisfied*	*Don't know*
Interactions with the utility staff	67%	28%	0%	0%	0%	6%
Application process	67%	28%	0%	0%	6%	0%
Rebate amount	39%	50%	0%	6%	0%	6%
Amount of time it took to receive the rebate	56%	39%	0%	0%	0%	6%
The range of equipment that qualifies for a rebate	45%	33%	22%	0%	0%	0%
Overall program experience	50%	50%	0%	0%	0%	0%

Overall, respondents demonstrated high satisfied with the program. Respondents had scored interactions with the utility staff and the application process with high satisfaction. Some respondents indicated lower satisfaction with the range of equipment that qualified for rebates and the rebate amount, but did not expand or clarify their dissatisfaction.

Lastly, respondents were asked if they had any comments or suggestions regarding the program. One respondent said:

"The energy audit was helpful not only for tips about the condominium receiving the audit, but the advice carried over to our primary residence. We made changes there as well despite not having a rebate program in our primary residence city. TDPUD has a great and meaningful program. We hope everyone takes advantage of it to help our environment."

3.8.5. **Evaluation Findings and Program Recommendations**

The following represent ADM's key findings for the CY 2014 evaluation of the Toilet Rebate program:

- **Ex Post Impacts were higher than the Ex Ante estimates.** The Ex Ante per unit savings estimates for this program were slightly lower than the Ex Post per unit estimates. This resulted in a program level realization rate of 107%.

- **Low Program Free-Ridership.** The evaluation found the Toilet Rebate Program had a high Net-To-Gross Ratio [90%] indicating that the rebate/program is effective in motivating customers to purchase more water (and energy) efficient equipment.

- **Incentive Levels Contribute to Low TRC Test Results.** Currently the incentive levels for this measure are high relative to "typical" energy efficiency measures (which range between $.06 to $0.20 per Gross kWh). A reduction in the incentive

levels would improve the cost effectiveness for this program, though such an action would need to be weighed against the potential impacts on customer participation.

- **High customer satisfaction with the program.** The evaluation found that participants in the Toilet Rebate Program were highly satisfied by the program's application process and their interactions with program staff. Participants were also satisfied with the amount of time it took to receive the rebate. Furthermore, program participants perceived their new toilets as providing additional benefits (e.g. besides energy and water conservation) in the areas of improved health, noise reduction, equipment reliability, and improved home comfort. Note that several customers did indicate that they would like to see a wider range of qualified equipment.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of Toilet Exchange program.** Customers who participate in the Toilet Rebate program should be encouraged to participate in the Toilet Exchange program. Fifty-six of survey respondents indicated that they had participated in the Toilet Exchange program.

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.9. Residential - Building Efficiency

Table 3-57 Residential - Building Efficiency: Summary Table

Final Project Count:	11
Ex Post Net Energy Savings [kWh]:	1,795
Ex Post Net Demand Savings [kWh]:	4.23
Program Contribution to Portfolio:	< 1%
General EM&V Approach	Option A
Survey Sample Size	4

EPA estimates that homeowners can typically save up to 10% of total energy costs by air sealing their homes and adding insulation. Additionally sealing and insulating ducts can save as much as 20% of the energy for heating/cooling. Customers who test and repair their home's envelope or duct system to save energy received rebates through this program.

3.9.1. Sampling Methodology

ADM chose to use a census of participant data for select programs where such review is feasible. There were a total of seven participants for the program and they were all contacted via telephone for the survey.

3.9.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES_{kWh} * N$$

$$kW_{Sav} = UES_{kW} * N$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
$UES_{kWh/kW}$	Is the per unit energy/demand savings estimate for each measure.
N	Is the number of measures implemented

Two separate UES values were determined for this program (one for each measure offered). Based on the information available from each site, the best available source for UES estimates was the CMUA TRM. Table 3-57 summarizes the UES values used for Duct leakage and Table 3-58 provides the same for envelope mitigation.

Table 3-58 UES Values used for Duct Repair Measure

Climate Zone	*kWh*	*KW*
CZ16	118	0.278

Table 3-59 UES Values used for Envelope Mitigation Measure

Climate Zone	*Sngl Story 15 %*	*Sngl Story 30 %*	*2 Story 15 %*	*2 Story 30 %*
CZ16	10.8	20.8	13.6	29.2

3.9.3. **Net Impact Methods and Results**

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for the Building Efficiency Rebate program was conducted using the methodologies outlined in 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratio. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided in Table 3-59.

Table 3-60 List of Net-To-Gross Factors and Questions: Building Efficiency

#	Factor	Description	Question Used in Survey
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to purchase and install the measures without the rebate you received through the program?
2	Importance of program assistance in the decision-making process	If the respondent answers "Somewhat unlikely" or "Highly unlikely", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	How likely is it that you would have purchased the measures if you had not received a rebate through the program?
3	Prior Planning to purchase the measure	Two Questions are considered here. If the respondent answers "*Yes*" to Q1 and indicates they learned of the rebate "*After deciding to replace items with these energy efficiency measures, but before purchasing these measures on their own*", then the respondent is considered to have been planning to purchase the same quantity of measures with or without the rebate and is thus a partial free-rider. If the respondent answers "*Yes*" in Q1 and indicates they learned of the rebate "*After purchasing the energy efficiency measures on their own but before installing them*", or "*After already replacing some items with the energy efficiency measures*", then the respondent is considered to have been planning to purchase the same quantity of measures (or already did) without the rebate and is thus 100% free-rider.	**Q1:** When did you learn of the rebate program? **Q2:** Did you know about the issues with the duct work in your home before contacting a contractor or the utility about the program?
4	Demonstrates Behavior In Purchasing Similar Equipment without program assistance	If the respondent indicates "*Yes*" in Q1, and for Q2 chooses an option of "*over 1 year*", then they are considered to have been motivated by the energy efficiency program and are thus 0% free-rider. If respondents who indicated in Q2 "*less than 6 months*" or "*6-12 months*", these respondents are considered partial free-riders. If the respondent indicates "*No*" in Q1, they are considered a free-rider as the program did not affect timing of purchase and installation of measures.	**Q1:** Did you install these energy efficient measures earlier than you otherwise would have without the program? **Q2:** When would you otherwise have installed the measures?

Table 3-60 *through*

Table 3-63 summarizes the responses to questions addressing free-ridership for the 2014 Building Efficiency Rebate Program.

Table 3-61 Financial Ability Results: Building Efficiency

Factor	*Question*	*Yes*	*No*	*Don't Know*
Financial Ability	*Question 9: Would you have been financially able to purchase and install the toilet without the rebate you received through the program?*	50%	50%	0%

Table 3-62 Importance of Program Rebate: Building Efficiency

Factor	*Question*	*Definitely*	*Probably*	*Probably not*	*Definitely not*
Importance of program	*Question 8: How likely is it that you would have had your duct work repaired anyway?*	50%	25%	0%	25%

Table 3-63 Prior Planning Results: Building Efficiency

Factor	*Question*	*Prior to Decision*	*After Decided / Before Purchased*	*After Purchased / Before Installed*	*After Replaced*	*Other / DK*	*Yes*	*No*
Prior Planning	*Question 7: When did you learn of the rebate program?*	100%	0%	0%	0%	0%	-	-
	Question 6: Did you know about the issues with the duct work in your home before contacting a contractor or the utility about the program?	-	-	-	-	-	0%	100%

Table 3-64 Behavior Without Program Results: Building Efficiency

Factor	*Question*	*Yes*	*No*	*Don't know*
Importance of Rebate	*Question 8A: Did the program rebate allow you to have your duct work repaired earlier than you otherwise would have?*	33%	33%	33%
	Question	*Less than 6 months*	*6-12 months*	*More than 1 year*
	Question 57: When would you have otherwise have had your duct work repaired?	50%	0%	50%

Based on survey responses for the four participants, ADM estimated a NTGR of 1.00 for the program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-64.

Table 3-65 NTGR and Net Impacts for Building Efficiency Rebate Program

Free Ridership Estimate	*NTG Ratio*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
0%	100%	1,795	4.23

3.9.4. **Participant Satisfaction Survey Results**

ADM contacted seven participants of the Building Efficiency program from which we received four responses (57.1% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer decision-making processes; and
- Customer satisfaction with the Building Efficiency program.

3.9.4.1.1. Participant Decision-Making Processes

Respondents were asked several questions regarding their awareness of the program and decision-making processes including prior planning, likelihood of repair work without the incentive, and financial ability to have the repair work done.

Respondents were first asked how they had learned about the program. They had learned about the program in-person at the PUD (40%), a community event (20%), and from a bill insert (20%). A utility staff member had recommended the program to the participant and that recommendation was very important to them.

Ultimately, the respondents participated in the program because it was good for the environment (50%), they wanted to save money (25%), and the program was free (25%).

Half of the respondents were already planning to have the energy efficiency improvements installed in their home. None of the respondents knew that they had issues with their duct work before contacting the utility about the program and they did not learn about the program until after contacting the utility.

If the respondents had not received the incentive from the program, 50% of respondents would have definitely had the duct work repaired anyway, 25% would have somewhat likely had the repair work done, and 25% were very unlikely to have had the repair work done.

The program incentive allowed three out of four respondents to have the duct work repaired earlier than they otherwise would have been able to; two respondents said that without the incentive, the repairs would have been completed within six months or greater than a year.

Seventy-five percent of respondents were able to repair the duct work earlier than they had originally planned because of the program. If the program was not available, one respondent would have repaired the duct work within six months, one would have fixed it more than a year later, and another respondent was unsure when the work could have been done.

Half of the respondents would have been financially able to repair the duct work without the program incentive.

3.9.4.1.2. Repair Work Satisfaction and Program Feedback

Respondents were asked questions regarding their satisfaction with the repair work and feedback on the program.

Fifty percent of respondents have noticed an improvement in air quality inside their homes after the repair work was finished. Half of the respondents have also noticed a decrease in their utility bill.

Lastly, respondents were asked if they had any comments or suggestions regarding the program. These respondents said:

- *"I think it's an excellent program and hope it continues. They did a great job and the people they send out are great and really qualified."*
- *"I think it's fantastic. I really admire our PUD for all the environmental work they are doing."*
- *"I thought it was really good and gave really great info. The people that did the work were great and trustworthy."*

3.9.5. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Toilet Rebate program:

- **Ex Post Impacts were higher than the Ex Ante estimates.** The Ex Ante per unit savings estimates for this program were slightly lower than the Ex Post per unit estimates. This resulted in a program level realization rate of 197%.

- **Low Program Free-Ridership.** The evaluation found the Building Efficiency Program had a high Net-To-Gross Ratio [100%] indicating that the rebate/program is effective in motivating customers to make improvements in their homes.

- **High customer satisfaction with the program.** Participants experience noticeable differences in their homes after the repair work was finished which included decreased utility bills and an improvement in air quality. They held the program in high regard and were very pleased with the quality of work.

- **Word-of-mouth communication to promote program is highly useful.** The survey respondents responded well to communication with utility staff regarding the program and said that the recommendation of the program was very important to them.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

- **Modify Application Process to Track Additional Data.** If additional data is tracked in Energy Orbit (or separate tracking database) regarding rebated customer equipment, a more rigorous engineering approach could be taken to evaluate the program. This would improve the quality of the evaluation results without any added evaluation cost.[12] These data are listed separately for the duct leak repair and envelope improvement measures in Table 3-65 and Table 3-66.

[12] The UPM Protocol specifies a regression with specific variables based on equipment and population characteristics. Ideally monitoring/surveying would be done to establish regression coefficients specific to the program being evaluated. However; "stock" coefficients are provided where resources are not available for primary data collection.

Table 3-66 List of Variables Needed for Envelope Mitigation Measure

Variable	*Description*
Baseline Whole House Infiltration [CFM50]	The baseline measured infiltration for the entire house (includes leakage to unconditioned space, etc.). Measured in CFM at 50 Pascals.
Post Whole House Infiltration [CFM50]	The post measured infiltration for the entire house (includes leakage to unconditioned space, etc.). Measured in CFM at 50 Pascals
Baseline Envelope Only Infiltration [CFM50]	The baseline measured infiltration for the envelope only. This should not include leakage to unconditioned space (e.g. through ductwork, etc.). Measured in CFM at 50 Pascals.
Post Envelope Only Infiltration [CFM50]	The post measured infiltration for the envelope only. This should not include leakage to unconditioned space (e.g. through ductwork, etc.). Measured in CFM at 50 Pascals.
% Supply Leaks	% of Leaks located in supply ducts
% Return Leaks	% of Leaks located in return ducts
Cooling/Heating System Efficiency	The efficiency of the heating and/or cooling equipment that the affected ducts serve. Note that while the actual nameplate efficiency is preferred (SEER and/or AFUE) this can be estimated based on the age and type of unit using the contractors experience.

Table 3-67 List of Variables Needed for Duct Leakage Measure

Variable	*Description*
Baseline Duct leakage (CFM50)	The measured baseline duct leakage in CFM at 50 Pascals
Post Duct leakage (CFM50)	The measured post duct leakage in CFM at 50 Pascals
Cooling/Heating System Efficiency	The efficiency of the heating and/or cooling equipment that the affected ducts serve. Note that while the actual nameplate efficiency is preferred (SEER and/or AFUE) this can be estimated based on the age and type of unit using the contractors experience.

3.10. Residential - Windows

Table 3-68 Residential - Windows: Summary Table

Final Project Count:	2
Ex Post Net Energy Savings [kWh]:	324
Ex Post Net Demand Savings [kWh]:	1.3
Program Contribution to Portfolio:	0%
General EM&V Approach	Deemed
Survey Sample Size	1

TDPUD pays $5 per square foot of window to replace single-pane windows or dual-pane windows over 20 years old with qualifying windows.

3.10.1. Sampling Methodology

For programs with relatively homogenous measures, ADM conducted a simple random sample of participants. Specifically, ADM chose participants with email addresses to conduct an online survey.

3.10.2. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES_{kWh} * N$$

$$kW_{Sav} = UES_{kW} * N$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
$UES_{kWh/kW}$	Is the per unit energy/demand savings estimate for each measure.
N	Is the number of measures implemented

UES estimates were reviewed from various secondary sources including the CMUA TRM, the Pennsylvania TRM, and previous TDPUD evaluation reports. It was evident from literature research that the current claims are of an appropriate magnitude, and possibly even conservative. Given the many uncertainties (discussed in the findings/recommendations) in attempting to apply these numbers to TDPUD, ADM applied the current estimate of 1.6 kWh/Sq. Ft. in the PY14 evaluation.

3.10.3. Net Impact Methods and Results

In addition to gross savings, ADM estimated associated net-to-gross ratios (NTGRs) for this program based on results from a participant survey. The net-to gross analysis for

the Thermally Efficient Windows Rebate program was conducted using the methodologies outlined in 2.1.1.1. The participant survey included several questions designed to elicit information on free-ridership, which in turn is used to estimate net-to-gross ratio. These questions corresponded with financial ability to purchase the equipment, timing of program awareness, likelihood of purchase without the incentive, and timing of the purchase.

For residential programs, free-ridership is calculated as the average score determined for the sample of participants surveyed. Survey responses were scored based on the survey answers and the type of unit they purchased. These responses fell into one of five categories of what the customer would have installed without the availability of the rebate versus what they installed with the rebate. These factors, along with the survey questions used to address them are provided in Table 3-68.

Table 3-69 List of Net-To-Gross Factors and Questions: Thermal Windows

#	Factor	Description	Question Used in Survey
1	Financial Ability to purchase the measure absent program assistance	If the customer answers "No" they are assigned 0% free-ridership. Without financial ability to purchase the measures other factors in the decision making process are not relevant. Note that Having financial ability does not inherently make one a free-rider.	Would you have been financially able to purchase and install the measure without the rebate you received through the program?
2	Importance of program assistance in the decision-making process	If the respondent answers "Somewhat unlikely" or "Highly unlikely", then the respondent is considered to have not been planning to purchase any of the measures and is 0% free-rider.	How likely is it that you would have purchased the measure if you had not received a rebate through the program?
3	Prior Planning to purchase the measure	Two Questions are considered here. If the respondent answers "*Yes*" to Q1 and indicates they learned of the rebate "*After deciding to replace items with these energy efficiency measures, but before purchasing these measures on their own*", then the respondent is considered to have been planning to purchase the same quantity of measures with or without the rebate and is thus a partial free-rider. If the respondent answers "*Yes*" in Q1 and indicates they learned of the rebate "*After purchasing the energy efficiency measures on their own but before installing them*", or "*After already replacing some items with the energy efficiency measures*", then the respondent is considered to have been planning to purchase the	**Q1:** When did you learn of the rebate program? **Q2:** Before learning about the rebates available through the utility, were you already planning to replace the measure?

		same quantity of measures (or already did) without the rebate and is thus 100% free-rider.	
4	Demonstrates Behavior In Purchasing Similar Equipment without program assistance	If the respondent indicates "*Yes*" in Q1, and for Q2 chooses an option of "*over 1 year*", then they are considered to have been motivated by the energy efficiency program and are thus 0% free-rider. If respondents who indicated in Q2 "*less than 6 months*" or "*6-12 months*", these respondents are considered partial free-riders. If the respondent indicates "*No*" in Q1, they are considered a free-rider as the program did not affect timing of purchase and installation of measures.	**Q1:** Did you install these energy efficient measures earlier than you otherwise would have without the program? **Q2:** When would you otherwise have installed the measures?

Table 3-69 through Table 3-72 summarizes the responses to questions addressing free-ridership for the 2014 Window Rebate Program.

Table 3-70 Financial Ability Results: Thermal Windows

Factor	*Question*	*Yes*	*No*	*Don't Know*
Financial Ability	*Question 49: Would you have been financially able to purchase and install the window(s) without the rebate you received through the program?*	0%	100%	0%

Table 3-71 Importance of Program Rebate: Thermal Windows

Factor	*Question*	*Very Likely*	*Somewhat Likely*	*Neither Likely nor Unlikely*	*Somewhat Unlikely*	*Highly Unlikely*
Importance of program	*Question 46: How likely is it that you would have purchased the window(s) if you had not received a rebate through the program?*	0%	100%	0%	0%	0%

Table 3-72 Prior Planning Results: Thermal Windows

Factor	*Question*	*Prior to Decision*	*After Decided / Before Purchased*	*After Purchased / Before Installed*	*After Replaced*	*Other / DK*	*Yes*	*No*

Prior Planning	*Question 44: When did you learn of the rebate program?*	100%	0%	0%	0%	0%	-	-
	Question 43: Before learning about the rebates available through the utility, were you already planning to replace the window(s)?	-	-	-	-	-	100 %	0%

Table 3-73 Behavior Without Program Results: Thermal Windows

Factor	*Question*	*Yes*	*No*	-
Importance of Rebate	*Question 47: Did you install the window(s) earlier that you otherwise would have without the program?*	0%	100%	-
	Question	*Less than 6 months*	*6-12 months*	*More than 1 year*
	Question 48: When would you have otherwise installed the window(s)?	0%	100%	0%

Based on survey responses for the one participant, ADM estimated a NTGR of 100% for the program. This values was multiplied by gross per-unit kWh to derive program net savings [kWh] and net peak demand reduction [kW]. Program NTGR and associated Net savings values are shown in Table 3-73.

Table 3-74 NTGR and Net Impacts for Thermally Efficient Windows Rebate Program

Free Ridership Estimate	*NTGR Estimate (1-FR)*	*Ex Post Net Annual Energy Savings [kWh]*	*Ex Post Net Peak Demand Reductions [kW]*
0%	100%	324	1.30

3.10.4. **Participant Satisfaction Survey Results**

ADM sent online surveys to one participant of the Thermally Efficient Windows Rebate program from which we received one response (100% response rate). The purpose of this survey was focused on collecting data used to determine the net-to-gross ratio; however, additional data was collected to qualify the following:

- Customer awareness of the program;
- Customer decision-making processes; and

- Customer satisfaction with the Window Rebate program.

3.10.4.1.1. Participant Decision-Making Processes

The respondent was asked several questions regarding their decision-making processes including prior planning, equipment efficiency, likelihood of purchase, and financial ability to purchase the equipment. Respondents were first asked if they were already planning on purchasing the equipment before they had learned about the program. The respondent said they had prior plans to purchase the windows and had learned about the program prior to deciding to replace the windows.

The respondent said that the program had an effect on the efficiency of the windows they purchased. If they had not received the rebate, the respondents said they would have been somewhat likely to purchase a higher efficiency window.

The respondent did not install the windows earlier than they had originally planned because of the program. If the program was not available, the respondent would have installed the windows between six months to a year later.

The respondent would not have been financially able to purchase the windows without the incentive from the utility.

3.10.4.1.2. Equipment Satisfaction and Perceived Benefits

The respondent was asked questions on their satisfaction with the installed equipment and perceived benefits after installing the equipment. The respondent was very satisfied with the windows. The participant indicated the greatest benefits to installing the windows was that their home was more comfortable to live in, they were saving money on their utility bill, and decreased noise from outside.

3.10.4.1.3. Overall Program Satisfaction

The respondent was asked how satisfied they were with the program elements indicating whether they were very satisfied, satisfied, neutral, dissatisfied, or very dissatisfied. Table 3-74 summarizes respondents' satisfaction towards each element.

Table 3-75 Overall Program Satisfaction: Thermal Windows

Element of Program Experience	*Very satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very dissatisfied*	*Don't know*
Interactions with the utility staff	0%	100%	0%	0%	0%	0%
Application process	0%	100%	0%	0%	0%	0%
Rebate amount	0%	100%	0%	0%	0%	0%

Element of Program Experience	*Very satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very dissatisfied*	*Don't know*
Amount of time it took to receive the rebate	0%	0%	100%	0%	0%	0%
The range of equipment that qualifies for a rebate	0%	100%	0%	0%	0%	0%
Overall program experience	0%	100%	0%	0%	0%	0%

Overall, respondents are satisfied with the program and with most elements of the Windows Rebate program. No comments were left regarding the amount of time it took receive the rebate. However, the respondent said that they were "*grateful for the rebate.*"

3.10.5. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Thermally Efficient Windows Rebate program:

- **Low Program Free-Ridership.** The evaluation found the Toilet Rebate Program had a high Net-To-Gross Ratio [100%] indicating that the rebate/program is effective in motivating customers to purchase more energy efficient equipment.

- **High customer satisfaction with the program.** The evaluation found that the participant in the Windows Rebate Program was satisfied by the program's application process, their interactions with program staff, the rebate amount, and the range of qualifying equipment. The participant indicated neutral feelings toward the time it took to receive the rebate. Furthermore, program participants perceived their new windows as providing additional benefits noise reduction and improved home comfort.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

- **Review Ex Ante Impact Estimates for this Program.** It is evident from literature research that the current estimates are of an appropriate magnitude, and possibly even conservative. However; the actual savings from any window will be highly dependent on the window's orientation. Also - if the SHGC is too low the heating savings may well be negated. The heating savings are also impacted by the high density of wood heating in Truckee. Given the many uncertainties in attempting to apply these numbers to TDPUD, ADM applied the current estimate in the PY14

evaluation. However; it should be noted that this estimate is likely low and a higher deemed value could be supported with some modeling specific to TDPUD's service territory.

3.11. Residential - Million CFLs

Table 3-76 Million CFLs: Summary Table

Final Project Count:	25,836
Ex Post Net Energy Savings [kWh]:	664,962
Ex Post Net Demand Savings [kWh]:	7.73
Program Contribution to Portfolio:	11%
General EM&V Approach	Desk Review

The Million CFL program provides free CFL 13 Watt CFL spirals at give-away events to persons who come into the utility offices and request them. The goal is to install one million CFLs over 10 years by providing free CFL 12-packs and other high efficiency lights. This includes handing them out at the Truckee Home & Building Show, Chamber Mixers, and other community events. TDPUD also purchases a large selection of efficient lighting to include specialty lighting such as dimmable CFLs, cold-temp CFLs, and a variety of other CFLs replacing less efficient lighting sources.

3.11.1. Gross Impact Evaluation Methodology and Results

ADM conducted a desk review of the program, using program documentation and tracking data to estimate annual impacts. ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Unit Energy Savings estimate
N	Is the number of measures implemented

Program impacts were estimated using the results from the Residential Green Partners CFL program described in Section 3.3. The assumptions are listed in Table 3-76.

Table 3-77 Summary of Savings Estimates: Million CFLs

Parameter	*Value*
Unit Energy Estimate [kWh/Year]	43.5
Unit Demand Savings Estimate [kW]	.05

CFL inventory levels were reviewed and CFLs given away through other programs were cross-checked against the quantities identified for the Million CFL program. In total, 25,836 CFLs were confirmed to have been given away through this program in CY 2014.

3.11.2. Net Impact Methods and Results

ADM applied the Net-To-Gross value derived for the Residential Green Partners CFL program to the Million CFL program given their similarities. Furthermore, ADM compared this against the program's NTG from last year's evaluation and found it to be reasonable. The NTG ratio applied was 0.65.

3.11.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.
- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known.

3.12. Residential - Water Leak Rebate

Table 3-78 Residential - Residential - Water Leak Rebate: Summary Table

Final Project Count:	26
Ex Post Net Energy Savings [kWh]:	33,796
Ex Post Net Demand Savings [kWh]:	3.86
Ex Post Net Water Savings [MG]:	7.2
Program Contribution to Portfolio:	2%
General EM&V Approach	Desk Review

The Truckee Donner PUD began installing meters in the summer of 2009 as required by California State Law. One feature of the water meters is the ability to remotely detect water leaks on the customer-side of the water meter. We have found that over 10% of our customers have leaks on water or irrigation piping and/or fixtures. Water leaks can be very costly if not repaired. The Water Leak Repair Rebate is intended to help customers offset the cost of locating and repairing leaks that require the services of a licensed professional by offering a rebate of up to $100.

3.12.1. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Unit Energy Savings estimate
N	Is the number of measures implemented

The UES estimates were developed by performing regression analysis on billing data from program participants (IPMVP Option C). The regression equation took the following form:

$$Q_{Day} = \beta_1 * SITE * Seas + \beta_2 * SITE * LK + \beta_3 * SITE * TEMP$$

Where:

Q_{Day}	Daily Water Consumption [Gallons]
SITE	Variable indicating difference in usage from one site to the next
Seas	Used to capture differences in usage correlated with seasonality
LK	Dummy variable representing the presence of a leak

TEMP Average ambient temperature for time period

Figure 3-7 illustrates the water savings identified for each site through this regression. What remains unknown is how long these leaks would have persisted in the absence of the program as no non-participant data was reviewed. As such, the regressed average impact of .790 MG (3,686 kWh) per site is expected to be high. When several outlier sites are removed the average savings drops to 1,385 kWh per year which is slightly less than what was verified in the CY 2013 evaluation.

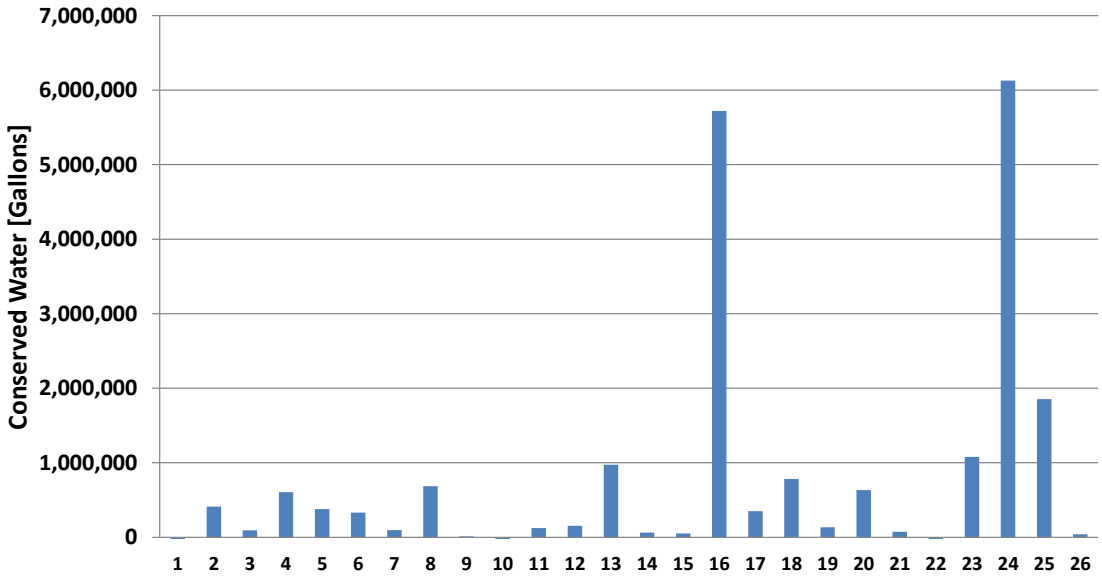


Figure 3-7 Estimated Annual Water Impacts [Gal] per Regression Analysis

Since the current Ex Ante estimate is based on a previous billing analysis (performed during the 2011 EM&V cycle), and since the current analysis would yield 1,688 kWh/Site if the lowest outlier is included in the mean per-site estimate, ADM concluded that an estimate of 361,628 gallons per year (1,688.11 kWh) per site is reasonable.

3.12.2. Net Impact Methods and Results

Net impacts were not reviewed directly for this program. The applied NTG ratio is 0.77 and was derived from the PY 2013 evaluation report for this program.

3.12.3. Evaluation Findings and Program Recommendations

The following represent ADM's key findings for the CY 2014 evaluation of the Toilet Rebate program:

- **High Savings Potential.** Based on the rudimentary billing analysis performed in this evaluation the program appears to have a significant water savings potential, and the highest energy savings potential of the water conservation programs offered by TDPUD.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

- **Consider Focusing Evaluation Resources on this Program to Better Establish its Savings Potential.** Currently the evaluation resources must be spread across many programs in TDPUD's portfolio. One of our general recommendations is to reduce the number of programs evaluated within a particular program year (given certain constraints) so as to better utilize evaluation resources for the *important* programs. ADM recommends that in future evaluation cycles this program receive particular attention in establishing its savings potential through as one of the select programs to be evaluated.

3.13. Residential - Neighborhood Block Party

Table 3-79 Residential – Neighborhood Block Party: Summary Table

Project Count:	756
Ex Post Net Energy Savings [kWh]:	21,186
Ex Post Net Demand Savings [kWh]:	1.33
Program Contribution to Portfolio:	1%
General EM&V Approach	Desk Review

The collaborative neighborhood block party provides immediate benefit to target neighborhoods through distribution of services and information by multiple agencies and stakeholders in a single day. The event has grown from 3 agencies in 2010 to 11 participating local agencies in 2013. Community members love the access to programs, leveraging of resources, and that the local agencies are working together to improve service. Local agency boards and staff are given the opportunity to interact, together in one place, with a large number of their customers/constituents. In addition, customers are informed about the Residential Energy Survey program and survey appointments are booked during the event. Other program information is also provided.

3.13.1. Gross Impact Evaluation Methods and Results

ADM conducted a desk review of the program, using program documentation and tracking data to estimate annual impacts. ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Unit Energy Savings estimate
N	Is the number of measures implemented

Program impacts were estimated using the results from the Residential Green Partners CFL program described in Section 3.3. The assumptions are listed in Table 3-79.

Table 3-80 Summary of Savings Estimates: Neighborhood Block Party

Parameter	*UES kWh [kWh/Year]*	*UES kW [kW/Year]*
Spiral 13W	43	0.0027
Spiral 23W	71	0.0045
Par 20, 11 W	27	0.0017
Globe, 11 W	27	0.0017
BR30, 15 W	46	0.0029
Dim BR30, 15W	46	0.0029
Par 38, 23W	90	0.0056

CFL inventory levels were reviewed and CFLs given away through other programs were cross-checked against the quantities identified for the Neighborhood Block Party program. In total, 756 CFLs of various types were confirmed to have been given away through this program in CY 2014.

3.13.2. Net Impact Methods and Results

ADM applied the Net-To-Gross value derived for the Residential Green Partners CFL program to the Neighborhood Block Party program given their similarities. Furthermore, ADM compared this against the program's NTG from last year's evaluation and found it to be reasonable. The NTG ratio applied was 0.65.

3.13.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.
- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-

ridership is expected to be lower in these applications for which CFLs are less well-known.

3.14. Residential – LED Holiday Swap

Table 3-81 Residential – LED Holiday Swap: Summary Table

Project Count:	1,774
Ex Post Net Energy Savings [kWh]:	17,261
Ex Post Net Demand Savings [kWh]:	0
Program Contribution to Portfolio:	1%
General EM&V Approach	Desk Review

The Holiday Swap program provides customers with energy efficient LED holiday lights. Customers bring in their own, inefficient, lights and TDPUD staff exchange them for more efficient LED variants.

3.14.1. Gross Impact Evaluation Methods and Results

ADM conducted a desk review of the program, using program documentation and tracking data to estimate annual impacts. ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \mathrm{UES} * \mathrm{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
UES	Unit Energy Savings estimate
N	Is the number of measures implemented

The program UES estimate was derived using an engineering equation (IPMVP Option A) for each of the 3 types of non-LED holiday lights replaced through this program. The equation for each light took the following form:

$$\mathrm{UES} = \mathrm{N}_{Bulbs} * \Delta P_{Bulb} * Hrs$$

Where:

UES_{Bulb}	Energy Savings Estimate
N_{Bulbs}	Is the number of bulbs per strand
ΔP_{Bulb}	Is the delta power (kW) between the non-LED and LED bulbs
Hrs	Annual operating hours per strand

The UES determined for this measure was 10.69 kWh/Year-strand. Strands were assumed to operate 10 hours per day for 31 days a year.

3.14.2. Net Impact Methods and Results

Net impacts were not reviewed directly for this program. The applied NTG ratio is 0.91 and was derived from the PY 2013 evaluation report for this program.

3.14.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

3.15. Residential – Green Schools Program

Table 3-82 Residential – Green Schools Program: Summary Table

Project Count:	1,768
Ex Post Net Energy Savings [kWh]:	44,910
Ex Post Net Demand Savings [kWh]:	2.82
Program Contribution to Portfolio:	1%
General EM&V Approach	Desk Review

The Green Schools program promotes energy and water conservation through an innovative series of programs designed to both educate students and deliver, for free, energy and water savings measures. The program is run in collaboration with the Sierra Watershed Education Program (SWEP) Green Teams, the Envirolution Club Trashion Show, and Truckee Tahoe Unified School District. The Green Teams are sustainability clubs at local elementary schools that utilize educational projects to empower students and teacher to be good global citizens, working to ensure adequate resources for a clean and healthy environment. SWEP educators, along with high school mentors, facilitate weekly sustainability club meetings exploring service learning projects including energy and water conservation.

3.15.1. Gross Impact Evaluation Methods and Results

ADM conducted a desk review of the program, using program documentation and tracking data to estimate annual impacts. ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Unit Energy/Demand Savings estimate
N	Is the number of measures implemented

Program impacts were estimated using the results and assumptions from the Residential Green Partners CFL program described in Section 3.3. The assumptions are listed in Table 3-79.

Table 3-83 Summary of Savings Estimates: Green Schools Program

Parameter	*UES kWh [kWh/Year]*	*UES kW [kW/Year]*
LED A19	43	0.0027

In total, 1,768 LEDs were given away through this program in CY 2014.

3.15.2. Net Impact Methods and Results

ADM applied the Net-To-Gross value derived for the Residential Green Partners CFL program to the Green Schools program given their similarities. Furthermore, ADM compared this against the program's NTG from last year's evaluation and found it to be reasonable. The NTG ratio applied was 0.65.

3.15.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.
- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known.

3.16. Residential - High Efficiency Washer Water Rebate

Table 3-84 Residential - High Efficiency Washer Water: Summary Table

Final Project Count:	172
Ex Post Net Energy Savings [kWh]:	690
Ex Post Net Demand Savings [kWh]:	0.08
Ex Post Net Water Savings [MG]:	0.14
Program Contribution to Portfolio:	< 1%
General EM&V Approach	Desk Review

This program provides TDPUD customers incentives for purchasing water efficient clothes washing machines as identified by Energy Star and the Consortium of Energy Efficiency (CEE). Energy Star and CEE Tier 1 identify appliances that use less energy than the federal standard. CEE Tiers 2 & 3 identify super-efficient appliances that use significantly less energy than the federal standard and identify the most efficient of the Energy Star spectrum.

3.16.1. Gross Impact Evaluation Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = UES * N$$

$$kW_{Sav} = \frac{kWh_{Sav}}{8760}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Is the per unit energy savings estimate for each measure.
N	Is the number of measures implemented

UES estimates were derived based on the CEE Tier of the installed unit. ADM used engineering calculations to derive the unit energy savings estimates along with secondary literature research to establish appropriate assumptions. The following formula was used to estimate the UES;

$$kWh_{Washer} = V_{Load} * \Delta WF * Cycles/Year * \gamma$$

Where:

kWh_{Washer}	Are the annual energy impacts for the retrofit
V_{Load}	The volume of water consumed in each load of laundry
ΔWF	The difference in Water Factor rating between the base and efficient unit
Cycles/Year	The number of washing loads run in a year.

γ Is the embedded energy content of water used [13]

Final values for each of the three toilet volume combinations offered through the program are listed in Table 3-85.

Table 3-85 List of UES estimates for Each Clothes Washer Represented in the Program: Clothes Washer Program

Measure	*Gross Energy Impacts [kWh/Washer]*	*Gross Water Impacts [Gal/Washer]*
Efficient Washer	5.9	1,232

3.16.2. Net Impact Methods and Results

Net impacts were not reviewed directly for this program. The applied NTG ratio is 0.68 and was derived from the PY 2013 evaluation report for this program.

3.16.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

[13] The embedded energy content of water was assumed to be .0047 kWh/Gal based on two years data on TDPUD's water distribution. Note that this is a conservative estimate as it does not include the cost of water conveyance through Truckee Sanitary District or the cost of processing at the Tahoe Truckee Sanitation Agency waste-water treatment plant. A study is currently on-going to establish final values for these additional components.

3.17. Residential - Electric Water Heater

Table 3-86 Residential - Electric Water Heater: Summary Table

Final Project Count:	1
Ex Post Net Energy Savings [kWh]:	153
Ex Post Net Demand Savings [kWh]:	0.02
Program Contribution to Portfolio:	< 1%
General EM&V Approach	Desk Review

TDPUD pays $2/gallon for new, qualifying electric water heaters. Maximum rebate $150. Qualifying water heater must have the following Energy Factor:

Water Heater Capacity	*Energy Factor (EF)*
60 gallons or greater	.91 (91%) or Higher
59 gallons or less	.93 (93%) or Higher

3.17.1. Gross Impact Evaluation Methods and Results

ADM conducted a desk review of the program, using program documentation and tracking data to estimate annual impacts. ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = \text{UES} * \text{N}$$

$$kW_{Sav} = \text{UES} * \text{N}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
UES	Unit Energy/Demand Savings estimate
N	Is the number of measures implemented

UES estimates were derived from the most recent information at the Regional Technical Forum on this measure. The RTF provides the following assumptions for energy impacts for this measure:

Size Category	*Gallons*	***RTF Workbook Savings***		
		Savings (Btu/hour)	*Savings (kWh/year)*	*Savings (kWh/year/Gallon)*
'>= 25 gallons, <35 gallons	30	28.51	73.25	2.44
'>= 35 gallons, <45 gallons	40	53.03	136.25	3.41
'>= 45 gallons, <55 gallons	50	72.11	185.28	3.71
'>= 55 gallons, <75 gallons	60	91.77	235.79	3.93
'>= 75 gallons, <100 gallons	70	62.26	159.96	2.29
'>= 100 gallons, <120 gallons	80	57.69	148.22	1.85
			Average:	**2.94**

3.17.2. Net Impact Methods and Results

Net impacts were not reviewed directly for this program. The applied NTG ratio is 0.79 and was derived from the PY 2013 evaluation report for this program.

3.17.3. Evaluation Findings and Program Recommendations

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Increase cross-promotion of other TDPUD residential programs.** Although many customers received rebates for other appliances, they may be unaware of the full portfolio of residential programs TDPUD offers.

4. EM&V Approach: Commercial Programs

In this chapter we discuss the Evaluation results (including findings and recommendations) for each evaluated commercial program. Programs are listed in order of contribution to the overall portfolio.

3.18. Commercial – Refrigeration

Table 4-1 Commercial – Refrigeration: Summary Table

Project Count:	9
Net Ex Post Energy Savings [kWh]:	90,575
Net Ex Post Demand Savings [kWh]:	7.7
Program Contribution to Portfolio:	5%
General EM&V Approach	Site-Specific
Sample Size	3

The Commercial Refrigeration program provides energy-efficient refrigeration controls, motors, case lighting, and infiltration barriers. Customers receive a comprehensive refrigeration energy audit and proposal for energy efficient refrigeration measures from TDPUD's installation contractor.

3.18.1. Sample Design

The evaluation used a stratified random sample design to identify program participants for site inspection. While on-site, evaluation staff collected data regarding measure installation, and surveyed site staff regarding program participation and their decision making processes. Three strata were developed based on ex ante estimates for program participants with the following statistics:

Table 4-2 Population & Sample Summary: Commercial Refrigeration Program

Strata	*Ex Ante Savings [kWh]*	*Population Size*	*Stratum Cv*	*Sample Size*	*Stratum Weight*
1	25,946	6	0.435	1	4.62
2	39,000	2	0.622	1	1.39
3	358,823	1	-	1	1.00

The total sample size for this program was 3 sites. Results from this sample design are representative of the population within a ±8% precision at the 90% confidence level.

3.18.2. Gross Impact Methods and Results

ADM leveraged a *Site-Specific* savings approach to this program in which we identified the most appropriate IPMVP option for each sampled site. Site-specific reports are provided in Section 8 (Appendix D) which provides detail on the M&V methods used for each and the subsequent results/findings. Table 4-3 summarizes the IPMVP Option and savings identified for each site evaluated.

Table 4-3 Summary of Results by Sampled Project (Gross Impacts): Refrigeration

Project #	*IPMVP Option*	*Gross Ex Post Energy Impacts [kWh]*	*Gross Ex Post Peak Reduction [kW]*
1410081450	Option A	1,515	.5
1410081217	Option A	26,582	2.3
1410071048	Option A	69,626	4.8

3.18.3. Net Impact Methods and Results

ADM employed the Net-To-Gross method outlined for programs evaluated with a Site-Specific approach (see Section 2.1.1.2 for details). The resulting estimate for program free-ridership (FR) and the subsequent net-to-gross ratio (NTG) is provided for each strata in Table 4-4. Table 4-4 also presents the factors calculated for each strata used to estimate program free-ridership.

Table 4-4 Summary of Program Free-Ridership Estimates: Refrigeration

Strata	*Had Plans and Intentions to Install Measure without Program? (Definition 1)*	*Had Plans and Intentions to Install Measure without Program? (Definition 2)*	*Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*FR*	*NTG*
1	N	Y	Y	Y	0	1
2	N	N	Y	N	0	1
3	N	N	N	Y	0.33	0.67
Overall	-	-	-	-	**0.2**	**0.8**

3.18.4. Evaluation Findings and Results

The following represent ADM's key findings for the CY 2014 evaluation of the Commercial Green Partners LED program:

- **High Ex Ante Savings Estimates for Strip Curtains and Door Gaskets.** High Ex Ante estimates for door gasket and strip curtain measures were observed in the two sites evaluated with these measures. For one of the projects this was due to clerical errors in the Ex Ante spreadsheet, but for the other project it was due to an optimistic Unit Energy Savings (UES) assumption.
- **LED Case lighting a successful measure.** One site was evaluated at which LED fixtures were installed in refrigerated cases. This site successfully saved the expected energy impacts (a 95% realization rate) and also engendered high

customer satisfaction. While on-site the customer indicated several times that they have noticed the impacts in their energy bills, that the equipment worked well, and that they were very satisfied with the program.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Update Ex Ante Estimates for Strip Curtains and Door Gaskets.** As indicated in the site-specific reports, ADM leveraged UES estimates for strip curtains and door gaskets from the Pennsylvania TRM. These values were provided by ADM to the PA TRM and stem from detailed measurement and verification (IPMVP Option B) we performed during our evaluation activities in the ’06-’08 CPUC evaluation of CA IOU implemented incentive programs. It is our recommendation that these values be used for strip curtain and door gasket measures as they are: 1) empirically based on primary data, and 2) the values listed in the PA TRM provide a more granular set of UES estimates which include building types outside of the two available in the CMUA TRM.
- **Retain and Promote LED Case Lighting.** It is our understanding that TDPUD is contemplating discontinuing the Refrigeration program in light of low participation/uptake. If the program is discontinued we recommend retaining the LED case lighting measure and offer it through the Commercial Lighting Program.

3.19. Commercial - Green Partners LED

Table 4-5 Commercial - Green Partners LED: Summary Table

Project Count:	22
Net Ex Post Annual Energy Savings [kWh]:	73,060
Net Ex Post Peak Demand Savings [kW]:	21
Program Contribution to Portfolio:	4%
General EM&V Approach	Deemed
Sample Size	6

The Commercial – Green Partners LED program provides efficient Light Emitting Diode (LED) bulbs free of charge to commercial customers. Bulbs are intended to replace existing incandescent and halogen bulbs. TDPUD conservation specialists visit businesses to evaluate lighting needs and provide solutions.

3.19.1. Sample Design

The evaluation used a stratified random sample design to survey program participants regarding installation rates and free-ridership. Four strata were developed based on ex ante estimates for program participants with the following statistics:

Table 4-6 Population & Sample Summary: Commercial Green Partners LED Program

Strata	*Ex Ante Savings [kWh]*	*Population Size*	*Stratum Cv*	*Sample Size*	*Stratum Weight*
1	9,962.00	9	0.487	1	7.63
2	33,406.00	8	0.470	2	6.03
3	37,700.00	3	0.104	1	3.33
4	165,214.00	2	0.314	2	1.00

The total sample size for this program was 6 sites. Results from this sample design are representative of the population within a ±8% precision at the 90% confidence level.

3.19.2. Gross Impact Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = (kW_{Base} - kW_{CFL}) * Hrs * HCIF * ISR$$

$$kW_{Sav} = (kW_{Base} - kW_{CFL}) * CDF * HCIF * ISR$$

where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb[14]
kW_{CFL}	Is the connected load of the installed light bulb[15]
Hrs	Are the annual hours of operation[16]
HCIF	Heating/Cooling Interactive Factor[17]
CDF	Is the Coincident Demand Factor
ISR	Is the *In-Service Rate*

The *In-Service Rate* was derived using customer surveys to identify how many of the bulbs received had actually been installed. Additional questions were asked to identify the locations in which the bulbs were installed. Table 4-13 provides a breakdown of the installation rates observed by strata and overall.

Table 4-7 Summary of Installation Rates for Commercial Green Partners LED Program

Strata	*ISR*
1	100%
2	72%
3	26%
4	79%
Overall	**76%**

The population of projects was sufficiently small that DEER building types were ascribed to each via internet research (e.g. using the address and business name). DEER hours of use, Coincident Demand Factor, and interactive factors were then applied based on the project's building type. The Ex Post gross impacts are provided in Table 4-14.

[14] Assessed using an assumed baseline wattage based on the wattage/type of the installed bulb and further informed through surveys

[15] Based on the records kept in the tracking system and further informed by the surveys

[16] Per DEER 2013 for appropriate building type

[17] Per DEER 2013 for appropriate building type

Table 4-8 Gross Impacts for Commercial Green Partners LED Program

Strata	*Gross Ex Post Annual Energy Impacts [kWh]*	*Gross Ex Post Peak Demand Reductions [kW]*
1	8,080	2.4
2	18,719	5.5
3	7,589	1.9
4	54,841	16.1
Overall	**89,229**	**25.9**

3.19.3. Net Impact Methods and Results

ADM employed the Net-To-Gross method outlined for programs evaluated with a Deemed Savings approach (see Section 2.2.1 for details). The resulting estimate for program free-ridership (FR) and the subsequent net-to-gross ratio (NTG) is provided for each strata in Table 4-15. Table 4-15 also presents the factors calculated for each strata used to estimate program free-ridership.

Table 4-9 Summary of Program Free-Ridership Estimates: Commercial Green Partners LED Program

Free-Ridership Factors					*FR*	*NTG*
Strata	*Behavior w/o Giveaway*	*Tendency To Buy Incandescent*	*Behavior incorporating incandescent tendency*	*Prior Experience*		
1	1.00	0.00	1.00	0.00	0.50	0.50
2	0.66	0.20	0.63	0.60	0.61	0.39
3	0.33	1.00	0.17	0.00	0.08	0.92
4	0.00	1.00	0.00	0.00	0.00	1.00
Overall	-	-	-	-	**0.18**	**0.82**

3.19.4. Customer Surveys

The eight sampled customers received telephone surveys regarding their participation in the program. While this survey was focused on collecting data used to determine the net-to-gross ratio and installation rates, additional data was collected to qualify customer:

- Awareness of the program,
- Decision-making processes, and

- Overall satisfaction with the program.

Several avenues through which participants indicated awareness of the program were identified, though the majority of respondents heard of the program through:

- Direct communication with utility staff (38%),
- Participation in other programs (25%)[18],
- Program marketing materials (13%)[19], or
- Word of mouth (25%)

The responses to questions pertaining to program satisfaction are summarized in Table 4-16.

Table 4-10 Customer Satisfaction Responses: Commercial Green Partners LED Program

Question	*Very Satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very Dissatisfied*
Quality of the LEDs	56%	33%	11%	0%	0%
TDPUD staff	44%	22%	33%	0%	0%
Overall experience	67%	33%	0%	0%	0%

Overall, respondents demonstrated high satisfaction with the program. No responses indicated dissatisfaction within the categories surveyed. Respondents were also asked if they had any comments or suggestions regarding the program. All of the comments received indicated high customer satisfaction with the program and its staff.

3.19.5. Evaluation Findings and Results

The following represent ADM's key findings for the CY 2014 evaluation of the Commercial Green Partners LED program:

- **LED Installation Rates Lower than CLFs.** The installation rates were found to be reasonable for this program (76% on average); however the ISR is certainly lower than the 95% observed for the Green Partners CFL program. The survey respondents did not provide sufficient description of installation locations to identify if the un-installed bulbs were being used as "replacement" bulbs or whether they were being installed at an alternate, off-site, location.
- **Wide Range of Savings Potential from LED Bulbs.** Thirty-four different bulb types were incentivized in CY 2014. Within this set of bulbs the evaluation

[18] Including giveaway events

[19] Primarily bill inserts

observed a significant range of savings potential, namely in the connected load reduction. While the average project connected load reduction was 40 Watts, connected load reductions ranged from a low of 21 Watts to a high of 81 Watts.

- **High Levels of Customer Satisfaction**. The evaluation found that customers were generally very satisfied with the program and in their interactions with program staff. No negative responses were indicated through customer surveys regarding either the program's administration or the equipment.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts.
- **Target Higher Connected Load Reducing Bulbs.** The average project connected load reduction was 40 Watts and a significant portion of these projects included bulbs providing only 32-33 watts of connected load reduction. Given the range of bulbs offered ADM recommends that the program target higher connected load applications to improve program impacts. Example "*high saving*" bulbs are the 19 Watt A21, 22 Watt A19, and 12 Watt Par 38.

3.20. Commercial - Green Partners CFL

Table 4-11 Commercial - Green Partners CFL: Summary Table

Project Count:	21
Net Ex Post Annual Energy Savings [kWh]:	24,552
Net Ex Post Peak Demand Savings [kW]:	7.3
Program Contribution to Portfolio:	2%
General EM&V Approach	Deemed
Sample Size	8

The Commercial – Green Partners CFL program provides energy efficient compact fluorescent (CFL) bulbs free of charge to commercial customers. Bulbs are intended to replace existing incandescent and halogen bulbs. TDPUD conservation specialists visit businesses to evaluate lighting needs and provide solutions.

3.20.1. Sample Design

The evaluation used a stratified random sample design to survey program participants regarding installation rates and free-ridership. Four strata were developed based on ex ante estimates for program participants with the following statistics:

Table 4-12 Population & Sample Summary: Commercial Green Partners CFL

Strata	*Ex Ante Savings [kWh]*	*Population Size*	*Stratum Cv*	*Sample Size*	*Stratum Weight*
1	3,826.10	8	0.479	2	4.79
2	6,422.60	6	0.044	2	2.93
3	7,413.80	3	0.195	1	3.87
4	20,079.20	4	0.181	3	1.40

The total sample size for this program was 8 sites. Results from this sample design are representative of the population within a ±9% precision at the 90% confidence level.

3.20.2. Gross Impact Methods and Results

ADM leveraged a *Deemed Savings* approach to this program in which we applied the following formula to estimate gross impacts:

$$kWh_{Sav} = (kW_{Base} - kW_{CFL}) * Hrs * HCIF * ISR$$

$$kW_{Sav} = (kW_{Base} - kW_{CFL}) * CDF * HCIF * ISR$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb[20]
kW_{CFL}	Is the connected load of the installed light bulb[21]
Hrs	Are the annual hours of operation[22]
HCIF	Heating/Cooling Interactive Factor[23]
CDF	Is the Coincident Demand Factor
ISR	Is the *In-Service Rate*

The *In-Service Rate* was derived using customer surveys to identify how many of the bulbs received had actually been installed. Additional questions were asked to identify the locations in which the bulbs were installed. Table 4-13 provides a breakdown of the installation rates observed by strata and overall.

Table 4-13 Summary of Installation Rates for Commercial Green Partners CFL

Strata	*ISR*
1	100%
2	100%
3	91%
4	80%
Overall	**95%**

The population of projects was sufficiently small that DEER building types were ascribed to each via internet research (e.g. using the address and business name). DEER hours of use, Coincident Demand Factor, and interactive factors were then applied based on the project's building type. The Ex Post gross impacts are provided in Table 4-14.

[20] Assessed using an assumed baseline wattage based on the wattage/type of the installed bulb and further informed through surveys

[21] Based on the records kept in the tracking system and further informed by the surveys

[22] Per DEER 2013 for appropriate building type

[23] Per DEER 2013 for appropriate building type

Table 4-14 Gross Impacts for Commercial Green Partners CFL Program

Strata	*Gross Ex Post Annual Energy Impacts [kWh]*	*Gross Ex Post Peak Demand Reductions [kW]*
1	7,963	2.5
2	13,361	4.1
3	6,706	1.6
4	28,441	8.7
Overall	**56,471**	**16.8**

3.20.3. Net Impact Methods and Results

ADM employed the Net-To-Gross method outlined for programs evaluated with a Deemed Savings approach (see Section 2.2.1 for details). The resulting estimate for program free-ridership (FR) and the subsequent net-to-gross ratio (NTG) is provided for each strata in Table 4-15. Table 4-15 also presents the factors calculated for each strata used to estimate program free-ridership.

Table 4-15 Summary of Program Free-Ridership Estimates: Commercial Green Partners CFL

Free-Ridership Factors					*FR*	*NTG*
Strata	*Behavior w/o Giveaway*	*Tendency To Buy Incandescent*	*Behavior incorporating incandescent tendency*	*Prior Experience*		
1	0.83	0.50	0.67	0.75	0.71	0.29
2	0.83	0.00	0.83	0.50	0.67	0.34
3	0.81	0.14	0.76	0.43	0.59	0.41
4	0.78	0.00	0.78	0.17	0.47	0.53
Overall	-	-	-	-	**0.57**	**0.43**

3.20.4. Customer Surveys

The eight sampled customers received telephone surveys regarding their participation in the program. While this survey was focused on collecting data used to determine the net-to-gross ratio and installation rates, additional data was collected to qualify customer:

- Awareness of the program,
- Decision-making processes, and
- Overall satisfaction with the program.

Several avenues through which participants indicated awareness of the program were identified, though the majority of respondents heard of the program through:

- Direct communication with utility staff (14%),
- Participation in other programs (29%)[24],
- Program marketing materials (29%)[25], or
- Word of mouth (29%)

The responses to questions pertaining to program satisfaction are summarized in Table 4-16.

Table 4-16 Customer Satisfaction Responses: Commercial Green Partners CFL

Question	*Very Satisfied*	*Satisfied*	*Neutral*	*Dissatisfied*	*Very Dissatisfied*
Quality of the CFLs	71%	14%	14%	0%	0%
TDPUD staff	71%	0%	29%	0%	0%
Overall experience	71%	14%	14%	0%	0%

Overall, respondents demonstrated high satisfaction with the program. No responses indicated dissatisfaction within the categories surveyed. Respondents were also asked if they had any comments or suggestions regarding the program. All of the comments received indicated high customer satisfaction with the program and its staff.

3.20.5. Evaluation Findings and Results

The following represent ADM's key findings for the CY 2014 evaluation of the Commercial Green Partners: CFL program:

- **High Program Installation Rates.** The installation rates were found to be generally high for this program (95% on average) and many of the customers are installing received bulbs upon receipt. While the increased efficiency standards have impacted the baseline wattage to which CFL bulbs are compared, 71% of respondents indicated that the CFLs received directly replaced incandescent bulbs – indicating that the market for this technology is not yet saturated in TDPUD service territory.
- **High Free-ridership Rates.** The program was found to have 57% free-ridership. While some of this is due to general customer awareness the predominant factor

[24] Including giveaway events

[25] Primarily bill inserts

is respondents who indicated that in the absence of the program they *"probably would have purchased"* or *"definitely would have purchased"* the CFLs anyways.

- **High Levels of Customer Satisfaction**. The evaluation found that customers were generally very satisfied with the program and in their interactions with program staff. No negative responses were indicated through customer surveys regarding either the program's administration or the equipment.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Update Ex Ante Estimates for Program.** ADM recommends that the Ex Ante savings estimates be reviewed for each bulb offered through this program. Some are considered "specialty bulbs" and considered exempt under the recent EISA standards, while others are not – requiring separate baseline treatment when estimating gross impacts. Furthermore, the high free-ridership rate should be considered when modeling program performance in future years.
- **Target Specialty Bulbs.** The EISA standards currently exempt certain specialty lighting applications. For the remaining applications the effective baseline technology is halogen lighting. As such, specialty bulbs have a higher savings potential (particularly in high use applications such as signage). Furthermore, free-ridership is expected to be lower in these applications for which CFLs are less well-known. ADM recommends that the CFL component to the Commercial Green Partners program target these specialty applications.

3.21. Commercial - Custom

Table 4-17 Commercial - Custom: Summary Table

Project Count:	2
Net Ex Post Energy Savings [kWh]:	50,683
Net Ex Post Demand Savings [kW]:	20
Program Contribution to Portfolio:	2%
General EM&V Approach	Site-Specific
Sample Size	2

The Commercial – Custom program offers incentives for non-standard energy efficiency projects implemented by businesses in TDPUD's service territory.

3.21.1. Sample Design

The evaluation identified a census of program participants for site inspection. While on-site, evaluation staff collected data regarding measure installation, and surveyed site staff regarding program participation and their decision making processes. No sampling was done (e.g. we evaluated a census of projects) only two projects participated:

Table 4-18 Population Summary: Commercial Custom Program

Site	*Ex Ante Energy Savings [kWh]*	*Ex Ante Demand Savings [kW]*	*Population Mean [kWh]*	*Population Cv*
TDCUSTOM-504883	3,255	0	14,578	1.1
TDCUSTOM-505660	25,900	0		

The number of evaluated sites for this program was 2 sites which represent a census of the population.

3.21.2. Gross Impact Methods and Results

ADM leveraged a *Site-Specific* savings approach to this program in which we identified the most appropriate IPMVP option for each sampled site. Site-specific reports are provided in Section 8 (Appendix D) which provides detail on the M&V methods used for each and the subsequent results/findings. Table 4-19 summarizes the IPMVP Option and savings identified for each site evaluated.

Table 4-19 Summary of Results by Project (Gross Impacts): Commercial Custom

Project #	*IPMVP Option*	*Gross Ex Post Energy Impacts [kWh]*	*Gross Ex Post Peak Reduction [kW]*
TDCUSTOM-504883	Option A	7,973	20
TDCUSTOM-505660	Option A	42,710	0

3.21.3. Net Impact Methods and Results

ADM employed the Net-To-Gross method outlined for programs evaluated with a Site-Specific approach (see Section 2.1.1.2 for details). The resulting estimate for program free-ridership (FR) and the subsequent net-to-gross ratio (NTG) is provided for each project in Table 4-4. Table 4-4 also presents the factors calculated for each project used to estimate program free-ridership.

Table 4-20. Summary of Program Free-Ridership Estimates: Commercial Custom

Project	*Had Plans and Intentions to Install Measure without Program? (Definition 1)*	*Had Plans and Intentions to Install Measure without Program? (Definition 2)*	*Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*FR*	*NTG*
1	N	N	Y	N	0	1
2	N	N	Y	N	0	1
Overall	-	-	-	-	**0**	**1**

3.21.4. Evaluation Findings and Results

The following represent ADM's key findings for the CY 2014 evaluation of the Commercial Green Partners LED program:

- **Ex Post Verified Impacts were higher than Ex Ante Estimates.** The final Ex Post verified impacts for this program were found to be greater than the Ex Ante estimates with a realization rate of 174%. Much of this can be attributed to a conservative effort by TDPUD to estimate the impacts for project TDCUSTOM-505660 given its behavioral nature
- **Low Program Participation.** Only two customers participated in the custom program in CY2014. While some of this can be attributed to current socio-economic issues, it may be that the "standard" set of energy efficiency measures are reaching a state of saturation in Truckee, requiring deeper and more creative retrofits.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Consider adding a Commercial Audit Component to Proactively Identify Custom Projects.** Much of TDPUD business customers can be classified as small commercial or industrial. These particular customer types can benefit significantly from energy audits of their facilities. Such audits would enable TDPUD to actively identify custom measures (in addition to smaller projects which fit into other existing programs).

3.22. Commercial - Lighting

Table 4-21 Commercial - Lighting: Summary Table

Project Count:	8
Net Ex Post Energy Savings [kWh]:	45,228
Net Ex Post Demand Savings [kW]:	2.8
Program Contribution to Portfolio:	2%
General EM&V Approach	Site-Specific
Sample Size	5

The Commercial – Lighting program provides incentives for businesses to replace old linear fluorescent fixtures with reduced wattage T-8 fluorescent or LED fixtures. Other retrofits may qualify for a rebate equivalent to projected first year energy savings.

3.22.1. Sample Design

The evaluation used a stratified random sample design to identify program participants for site inspection. While on-site, evaluation staff collected data regarding measure installation, and surveyed site staff regarding program participation and their decision making processes. Two strata were developed based on ex ante estimates for program participants with the following statistics:

Table 4-22 Population & Sample Summary: Commercial Lighting

Strata	*Ex Ante Savings [kWh]*	*Population Size*	*Stratum Cv*	*Sample Size*	*Stratum Weight*
1	10,192	7	0.61	4	1.91
2	27,927	1	-	1	1.00

The total sample size for this program was 5sites. Results from this sample design are representative of the population within a ±9% precision at the 90% confidence level.

3.22.2. Gross Impact Methods and Results

ADM leveraged a *Site-Specific* savings approach to this program in which we identified the most appropriate IPMVP option for each sampled site. Site-specific reports are provided in Section 8 (Appendix D) which provides detail on the M&V methods used for each and the subsequent results/findings. Table 4-23 summarizes the IPMVP Option and savings identified for each site evaluated.

Table 4-23 Summary of Results by Sampled Project (Gross Impacts): Refrigeration

Project #	*IPMVP Option*	*Gross Ex Post Energy Impacts [kWh]*	*Gross Ex Post Peak Reduction [kW]*
TDCOMLIGHT-505659	Option A	1,304	0.37
TDCOMLIGHT-504913	Option A	2,172	0.49
TDCOMLIGHT-504250	Option A	2,316	0.69
TDCOMLIGHT-504330	Option A	1,683	0.49
TDCOMLIGHT-504074	Option A	30,921	0

3.22.3. Net Impact Methods and Results

ADM employed the Net-To-Gross method outlined for programs evaluated with a Site-Specific approach (see Section 2.1.1.2 for details). The resulting estimate for program free-ridership (FR) and the subsequent net-to-gross ratio (NTG) is provided for each project in Table 4-24. Table 4-24 also presents the factors calculated for each project used to estimate program free-ridership.

Table 4-24 Summary of Program Free-Ridership Estimates: Commercial Lighting

Project	*Had Plans and Intentions to Install Measure without Program? (Definition 1)*	*Had Plans and Intentions to Install Measure without Program? (Definition 2)*	*Program had influence on Decision to Install Measure?*	*Had Previous Experience with Measure?*	*FR*	*NTG*
1	N	Y	Y	N	0	1
2	N	Y	Y	N	0	1
3	N	N	Y	N	0	1
4	N	N	Y	N	0	1
5	N	N	Y	N	0	1
Overall	-	-	-	-	**0.2**	**0.8**

3.22.4. Evaluation Findings and Results

The following represent ADM's key findings for the CY 2014 evaluation of the Commercial Lighting program:

- **Ex Post Verified Impacts were higher than Ex Ante Estimates.** The final Ex Post verified impacts for this program were found to be greater than the Ex Ante

estimates with a realization rate of 119%. Much of this can be attributed to differences in hours of use estimates for each project.

The evaluation team has the following recommendations to improve program performance in future program cycles:

- **Consider Adding Refrigerated Case Lighting to Program.** Refrigerated case-lighting is an effective and cost effective measure for many businesses – not just chain grocery stores. ADM recommends that this measure be added to the offerings for the commercial lighting program, particularly if the Refrigeration program is discontinued.
- **Create Prescriptive Lighting Measures.** Simple lighting measures in particular lend themselves to a prescriptive application process. In line with the previous recommendation ADM recommends that TDPUD establish a list of prescriptive lighting offerings with incentive levels set between $0.10 and $.20 per kWh saved. Example offerings should include:
    1. Standard T-8 to Super T-8 Fixture Change-outs (Indoor)
    2. T-8 to LED Fixture Change-outs (Indoor)
    3. Fluorescent Fixture De-lamping (Indoor)
    4. Metal Halide to LED Fixture Change-outs (Outdoor)
    5. LED Exit Signs
    6. Screw Based LEDs
    7. Refrigerated Case Lighting
    8. T-12 to LED Fixture Change-outs (Indoor)

5. Appendix A: Customer Survey for Res Green Partners CFL Program

Truckee Donner PUD

Residential Green Partners Program

Participant Survey Questionnaire

Interviewer: _____

Date of Interview: _____/_____/_____

Respondent: _____

Address: _____

Hello. My name is _____, and I am calling on behalf of TDPUD. We are contacting customers that received CFLsthrough the Green Partners program for a brief survey questionnaire.

1. We have it in our records that you received ___ number of bulbs. Of the CFL bulbs you had received, how many have you installed?

2. (If some are left) How many do you plan to install in the next month?

3. Where in your home did you install the bulbs? (Don't read. Prompt only if necessary)

Room	***# Bulbs***
Living room	
Kitchen	
Family Room / Den	
Dining Room	
Entry/Hallway	
Bedroom	
Bathroom	

Garage	
Outdoors	
Closet	
Office	
Other	

AFTER CUSTOMER INDICATES ROOMS, PROMPT ON EACH ROOM: “How many did you install in (room indicated)?

4. Is the residence where the bulbs were installed located in Truckee?

    a. Truckee
    b. Other (specify) _____

5. What type of bulb did the new bulbs replace? (IF NECESSARY: Did they replace incandescent bulbs? Other CFLs? Other LEDs?)

    a. Replaced incandescent lighting
    b. Replaced CFLs
    c. Replaced LEDs
    d. Don’ t Know (Don’t Read)

6. (IF THEY REPLACED INCANDESCENT BULBS): Were the incandescent bulbs still operating when you removed them or were they burnt out?

    a. Yes
    b. No
    c. Don’t Know (Don’t read)

7. Do you currently have any spare CFL’s stored in your home that are not in use?

    a. Yes. How many? ___
    b. No
    c. Don’t Know (Don’t Read)

8. How did you become aware of TDPUD’s Green Partners Program? (Don’t read)

    a. Bill insert
    b. Newspaper ad
    c. Television/radio ad
    d. Friend/relative/word-of-mouth
    e. Flyer

f. At a giveaway event
g. While paying my utility bill
h. Retailer
i. Other (Specify):
j. Don't Know

9. Prior to learning of the program, how many CFL or LED bulbs did you have in your home?

If Answer > 0: 9a. Where were they installed?

Room	***# Bulbs***
Living room	
Kitchen	
Family Room / Den	
Dining Room	
Entry/Hallway	
Bedroom	
Bathroom	
Garage	
Outdoors	
Closet	
Office	
Other	

10. If TDPUD had not given out the CFLs, how likely is it that you would have purchased CFLs anyway?

a. Definitely would have purchased
b. Probably would have purchased
c. Probably would not have purchased
d. Definitely would not have purchased

11. Have you purchased any incandescent light bulbs in the past year?

a. Yes. Why did you purchase incandescent bulbs? ___
b. No
c. Don't Know (Don't Read)

12. After receiving the CFL bulbs, have you since purchased more CFLs/LEDs?

10a. If Yes: How many?
CFLs:
LEDs:

13. Did you receive a rebate for the purchased bulbs?

14. I'm going to list some factors about the Green Partners program, and I would like you to rate them 1-5, where 1 is "Very Dissatisfied" and 5 is "Very Satisfied". How satisfied were you with:

14a. The quality of the CFLs given?
14b. Service provided by TDPUD staff?
14c. Savings on your electric bill?
14d. Information provided by TDPUD on how to save energy in your home?
14e. Overall program experience?

For any answer less than 3:

14F: Why did you rate [factor] at [score]?

15. Have you participated in any other TDPUD residential programs?

15a. IF YES: Which programs?

Thank you very much! Your responses will help TDPUD in improving the program.

6. Appendix B: Customer Survey for Residential Appliance Program

Admin (Questions 1 & 2 pre-populated from database. Hidden from respondent.)

1. *Which of the following energy efficiency measures were installed in your home?*

1. Clothes Washer
2. Dishwasher
3. High Efficiency Water Heater
4. Refrigerator
5. Windows
6. Water Leak Repair
7. Toilet (Rebate)
8. High Efficiency Clothes Washer

Participation Verification

2. *According to our records, you purchased an appliance and received a rebate through the Truckee Donner PUD (TDPUD) Appliance Rebate program and may have also had various energy efficiency measures installed and rebated for your home. Do you recall participating in TDPUD's Appliance Rebate program as described above?*

1. Yes
2. No [THANK AND TERMINATE]

Program Awareness

3. *How did you hear about TDPUD's Appliance Rebate program?*

1. Retail Store
2. Bill Insert
3. Direct Mail from utility company
4. TDPUD website
5. Print Ad
6. Radio/TV/Newspaper
7. Friend/Family/Word-of-Mouth

8. Don’t know

99. Other:

Verify Energy Efficient Measures

4. *Our records show that you had the following energy efficiency measures installed in your home:*

[LIST OF ALL DIRECTLY INSTALLED MEASURES]

Is that correct?

1. Yes
2. No [skip to 8]
98. Don't know

[DISPLAY Q5 IF Q4 = 98]

5. *Is there someone more familiar with the energy efficient measures installed in your home, who might be able to finish this survey?*

1. Yes
2. No [THANK AND TERMINATE]

[DISPLAY IF Q7=1]

Please have the individual who is more familiar with your household’s energy efficiency measures finish this survey.

[DISPLAY IF Q6=2 or Q7=1]

6. *Which of the following energy efficiency measures were installed in your home? (Select all that apply)*

1. Clothes Washer
2. High Efficiency Clothes Washer
3. Dishwasher
4. Refrigerator
5. Windows
6. High Efficiency Water Heater
7. Toilet

8. Water Leaks

9. None of the Above

Clothes Washer (High Efficiency or lower tier)

[DISPLAY QError! Reference source not found. - Q15 lF “Clothes Washer”]

The following questions pertain to the Clothes Washer that was installed and rebated as part of your participation in the Appliance Rebate program.

7. *Before learning about the rebates available through the utility, were you already planning to replace your Clothes Washer?*

1. Yes

2. No

8. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

1. Prior to deciding to replace my Clothes Washer

2. After deciding to replace my Clothes Washer but before I had purchased the new unit on my own

3. After I had purchased a new Clothes Washer on my own but before I had installed the new unit

4. After I had already purchased and installed a new Clothes Washer on my own

96. Some other time (Please describe):

9. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the Clothes Washer you purchased? In other words, do you think you purchased a more efficient Clothes Washer than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

1. Yes

2. No

10. *How likely is it that you would have purchased a new energy efficient Clothes Washer if you had not received a rebate through the TDPUD's Appliance Rebate program?*

1. Very likely

2. Somewhat likely

3. Neither likely nor unlikely
4. Somewhat unlikely
5. Highly unlikely

11. *Did you purchase an energy efficient Clothes Washer earlier than you had originally planned BECAUSE of the program?*

1. Yes
2. No

12. *If you had not received a rebate through the program, when do you think you would have purchased a new energy efficient Clothes Washer?*

1. Within six months
2. Six months to a year
3. Greater than a year

13. *Would you have been financially able to purchase and install the energy efficient Clothes Washer without the rebate you received through the program?*

1. Yes
2. No

14. *Using the satisfaction scale below, please indicate how satisfied you are with your new energy efficient Clothes Washer:*

1. Very satisfied
2. Satisfied
3. Neutral
4. Dissatisfied
5. Very Dissatisfied

[DISPLAY Q15 IF Q14 = 4 OR 5]

15. *Please describe why you are dissatisfied with your new energy efficient Clothes Washer.*

Dishwasher

[DISPLAY QError! Reference source not found. - Q24 lF “Dishwasher”]

The following questions pertain to the Dishwasher that was installed and rebated as part of your participation in the Appliance Rebate program.

16. *Before learning about the rebates available through the utility, were you already planning to install a dishwasher?*

1. Yes
2. No

17. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

1. Prior to deciding to install a dishwasher
2. After deciding to install a dishwasher but before I had purchased the new unit on my own
3. After I had purchased a dishwasher on my own but before I had installed the new unit
4. After I had already purchased and installed a dishwasher on my own
96. Some other time (Please describe):

18. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the dishwasher you installed? In other words, do you think you installed a more efficient dishwasher than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

1. Yes
2. No

19. *How likely is it that you would have installed a dishwasher if you had not received a rebate through the Appliance Rebate program?*

1. Very likely
2. Somewhat likely
3. Neither likely nor unlikely
4. Somewhat unlikely
5. Highly unlikely

20. *Did you install a dishwasher earlier than you had originally planned BECAUSE of the Appliance Rebate program?*

1. Yes
2. No

21. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have installed a dishwasher?*

1. Within six months
2. Six months to a year
3. Greater than a year

22. *Would you have been financially able to purchase and install the dishwasher without the rebate you received through the Appliance Rebate program?*

1. Yes
2. No

23. *Using the satisfaction scale below, please indicate how satisfied you are with your installed dishwasher:*

1. Very satisfied
2. Satisfied
3. Neutral
4. Dissatisfied
5. Very Dissatisfied

[DISPLAY Q24 IF Q23 = 4 OR 5]

24. *Please describe why you are dissatisfied with your installed dishwasher.*

High Efficiency Water Heater Replacement

[DISPLAY QError! Reference source not found. - Q33 IF “High Efficiency Water Heater”]

The following questions pertain to the high efficiency water heater that was installed and rebated as part of your participation in the Appliance Rebate program.

25. *Before learning about the rebates available through the utility, were you already planning to install a high efficiency water heater?*

1. Yes
2. No

26. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

1. Prior to deciding to replace my water heater
2. After deciding to replace my water heater but before I had purchased the new unit on my own
3. After I had purchased a new water heater on my own but before I had installed the new unit
4. After I had already purchased and installed a water heater on my own
96. Some other time (Please describe):

27. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the high efficiency water heater you installed? In other words, do you think you installed a more efficient water heater than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

1. Yes
2. No

28. *How likely is it that you would have purchased a high efficiency water heater if you had not received a rebate through the Appliance Rebate program?*

1. Very likely
2. Somewhat likely
3. Neither likely nor unlikely
4. Somewhat unlikely
5. Highly unlikely

29. *Did you install a high efficiency water heater earlier than you had originally planned BECAUSE of the Appliance Rebate program?*

1. Yes

2. No

30. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have installed a high efficiency water heater?*

1. Within six months
2. Six months to a year
3. Greater than a year

31. *Would you have been financially able to purchase and install the high efficiency water heater without the rebate you received through the Appliance Rebate program?*

1. Yes
2. No

32. *Using the satisfaction scale below, please indicate how satisfied you are with the newly installed high efficiency water heater:*

1. Very satisfied
2. Satisfied
3. Neutral
4. Dissatisfied
5. Very Dissatisfied

[DISPLAY Q33 IF Q32 = 4 OR 5]

33. *Please describe why you are dissatisfied with the newly installed high efficiency water heater.*

Refrigerator

[DISPLAY Q**Error! Reference source not found.** - Q33 IF "Refrigerator"]

The following questions pertain to the refrigerator that was installed and rebated as part of your participation in the Appliance Rebate program.

34. *Before learning about the rebates available through the utility, were you already planning to install a refrigerator?*

3. Yes

4. No

35. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

5. Prior to deciding to replace my refrigerator
6. After deciding to replace my refrigerator but before I had purchased the new unit on my own
7. After I had purchased a refrigerator on my own but before I had installed the new unit
8. After I had already purchased and installed a refrigerator on my own
97. Some other time (Please describe):

36. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the refrigerator you installed? In other words, do you think you installed a more refrigerator than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

3. Yes
4. No

37. *How likely is it that you would have purchased a refrigerator if you had not received a rebate through the Appliance Rebate program?*

6. Very likely
7. Somewhat likely
8. Neither likely nor unlikely
9. Somewhat unlikely
10. Highly unlikely

38. *Did you install a refrigerator earlier than you had originally planned BECAUSE of the Appliance Rebate program?*

3. Yes
4. No

39. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have installed a refrigerator?*

4. Within six months
5. Six months to a year
6. Greater than a year

40. *Would you have been financially able to purchase and install the refrigerator without the rebate you received through the Appliance Rebate program?*

3. Yes
4. No

41. *Using the satisfaction scale below, please indicate how satisfied you are with the newly installed refrigerator:*

6. Very satisfied
7. Satisfied
8. Neutral
9. Dissatisfied
10. Very Dissatisfied

[DISPLAY Q33 IF Q32 = 4 OR 5]

42. *Please describe why you are dissatisfied with the newly installed refrigerator.*

Windows

[DISPLAY Q**Error! Reference source not found.** - Q**Error! Reference source not found.** IF "Windows"]

The following questions pertain to the window(s) that was installed and rebated as part of your participation in the Appliance Rebate program.

43. *Before learning about the rebates available through the utility, were you already planning to install window(s)?*

5. Yes
6. No

44. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

9. Prior to deciding to replace my window(s)
10. After deciding to replace my window(s) but before I had purchased the new unit on my own
11. After I had purchased a window(s) on my own but before I had installed the new unit
12. After I had already purchased and installed a window(s) on my own
98. Some other time (Please describe):

45. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the window(s) you installed? In other words, do you think you installed more window(s) than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

5. Yes
6. No

46. *How likely is it that you would have purchased window(s) if you had not received a rebate through the Appliance Rebate program?*

11. Very likely
12. Somewhat likely
13. Neither likely nor unlikely
14. Somewhat unlikely
15. Highly unlikely

47. *Did you install window(s) earlier than you had originally planned BECAUSE of the Appliance Rebate program?*

5. Yes
6. No

48. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have installed window(s)?*

7. Within six months

8. Six months to a year

9. Greater than a year

49. *Would you have been financially able to purchase and install the window(s) without the rebate you received through the Appliance Rebate program?*

5. Yes

6. No

50. *Using the satisfaction scale below, please indicate how satisfied you are with the newly installed window(s):*

11. Very satisfied

12. Satisfied

13. Neutral

14. Dissatisfied

15. Very Dissatisfied

[DISPLAY Q33 IF Q32 = 4 OR 5]

51. *Please describe why you are dissatisfied with the newly installed window(s).*

Toilet

[DISPLAY Q**Error! Reference source not found.** - Q**Error! Reference source not found.** IF "Toilet"]

The following questions pertain to the toilet that was installed and rebated as part of your participation in the Appliance Rebate program.

52. *Before learning about the rebates available through the utility, were you already planning to install the toilet?*

7. Yes

8. No

53. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

13. Prior to deciding to replace my toilet

14. After deciding to replace my toilet but before I had purchased the new unit on my own

15. After I had purchased a toilet on my own but before I had installed the new unit

16. After I had already purchased and installed a toilet on my own

99. Some other time (Please describe):

54. *Do you think participating in the Appliance Rebate program had an effect on the efficiency of the toilet you installed? In other words, do you think you installed more than you otherwise would have because of the rebate you received through TDPUD's Appliance Rebate program?*

7. Yes

8. No

55. *How likely is it that you would have purchased toilet if you had not received a rebate through the Appliance Rebate program?*

16. Very likely

17. Somewhat likely

18. Neither likely nor unlikely

19. Somewhat unlikely

20. Highly unlikely

56. *Did you install the toilet earlier than you had originally planned BECAUSE of the Appliance Rebate program?*

7. Yes

8. No

57. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have installed the toilet?*

10. Within six months

11. Six months to a year

12. Greater than a year

58. *Would you have been financially able to purchase and install the toilet without the rebate you received through the Appliance Rebate program?*

7. Yes
8. No

59. *Using the satisfaction scale below, please indicate how satisfied you are with the newly installed toilet:*

16. Very satisfied
17. Satisfied
18. Neutral
19. Dissatisfied
20. Very Dissatisfied

[DISPLAY Q33 IF Q32 = 4 OR 5]

60. *Please describe why you are dissatisfied with the newly installed window(s).*

Customer Water Leak Repair

[DISPLAY Q**Error! Reference source not found.** - Q**Error! Reference source not found.** IF "Water Leak Repair"]

The following questions pertain to the water leak repair audit and rebate as part of your participation in the Appliance Rebate program.

61. *Before learning about the rebates available through the utilityCustomer Water Leak Repair, were you already planning on fixing the water leaks at your home?*

9. Yes
10. No

62. *How did you find out about the Water Leak Repair program?*

The utility contacted me

I saw an increase on my water bill

I got a free toilet leak detection kit

I wanted to check on my own

Other

Don't remember

63. *During which of the following time periods would you say learned about TDPUD's Appliance Rebate program?*

17. Before noticing any leaks
18. After noticing a leak
19. After I contacted the utility
20. Some other time (Please describe):

64. *How likely is it that you would have fixed the leaks if you had not received a rebate through the program?*

21. Very likely
22. Somewhat likely
23. Neither likely nor unlikely
24. Somewhat unlikely
25. Highly unlikely

65. *Did you fix the leak(s) earlier than you had originally planned BECAUSE of the program?*

9. Yes
10. No

66. *If you had not received a rebate through the Appliance Rebate program, when do you think you would have fixed the leak(s)?*

13. Within six months
14. Six months to a year
15. Greater than a year

67. *Would you have been financially able to fix the leak without the rebate you received through the program?*

9. Yes
10. No

Program Level Information

68. *Would you say that the energy efficiency improvements made to your home have made it:*

1. More comfortable to live in.
2. Just as comfortable as before the improvements were made
3. Less comfortable to live in
98. Don't know

69. *What are the biggest benefits you have noticed since installing new fixtures in your home? (Please check all that apply)*

1. There have been health improvements
2. Saving money on my utility bill
3. The home is safer
4. The appliances and heating or cooling equipment are more reliable
5. There is less noise from the appliances
6. There is less noise from the outside
7. The home feels more comfortable
8. Other. (Please describe)
9. No benefits
98. Don't know

70. *How would you rate your level of awareness about the advantages of energy and/or water efficiency since the improvements were made to your home?*

1. More aware
2. About the same
3. Less aware

98. Don't know

71. *What temperature do you typically set your thermostat at in the summer for cooling and in the winter for heating?*

1. *Cooling (Summer):_____*

2. *Heating (Winter):_____*

3. *Don't know*

72. *Is there anything that you don't like about the improvements installed in your home as part of the program?*

Program Level Satisfaction

73. *Using the satisfaction scale below, please indicate how satisfied you are with the following aspects of TDPUD's Appliance Rebate program: Very dissatisfied, Dissatisfied, Neutral, Satisfied, or Very satisfied.*

1. Interactions with the utility staff
2. Application process
3. Rebate dollar amount
4. Amount of time it took to receive your rebate
5. The range of equipment that qualifies for a rebate
6. The program overall

Participant Demographics

74. *Which of the following best describes your home?*

1. Single-family home, detached construction
2. Single-family home, factory manufactured/modular
3. Mobile home
4. Duplex
5. Two or Three family attached residence
6. Apartment with 4+ families
7. Condominium

99. Other:

75. *Do you own or rent this residence?*

1. Own
2. Rent

76. *Approximately when was your home built?*

1. Before 1960
2. 1960-1969
3. 1970-1979
4. 1980-1989
5. 1990-1999
6. 2000-2005
7. 2006 or Later

77. *About how much living space do you have in your home?*

1. Less than 1,000 square feet
2. 1000-2000 square feet
3. 2000-3000 square feet
4. 3000-4000 square feet
5. 4000-5000 square feet
6. Greater than 5000 square feet

Program Feedback

78. *Do you have any other comments that you would like to relay to the program staff about energy efficiency in residences or about these programs in general?*

Thank You!

7. Appendix C: Customer Survey for Refrigerator Recycling Program

Truckee Donner PUD

2014 Refrigerator Recycling Program

Residential Participant Survey Questionnaire

ID No. _____

Customer Name: _____

Date of interview: _____

Date data entered _____

Hello. My name is _____ with _____, and I am calling from ___ on behalf of Truckee Donner PUD, your utility service provider. I am conducting a brief survey regarding TDPUD's Refrigerator Recycling Program. Our records show that you recycled a refrigerator or freezer through the program in the past year. We would like to get some feedback from you about the program. May I ask you a few questions?

Q-1 Do you recall having one of your old refrigerators or freezers picked up for recycling by TDPUD?

- ❑ Yes
- ❑ No [IF NO, THANK RESPONDENT AND TERMINATE INTERVIEW]

Q-2 How did you first hear about the Refrigerator Recycling Program? [DO NOT PROMPT, CHECK ALL THAT APPLY]

- ❑ Newspaper magazine or article
- ❑ Newspaper advertisement
- ❑ Friend or relative / Word of mouth
- ❑ TDPUD website
- ❑ Email from TDPUD
- ❑ Other website: specify
- ❑ TV advertisement
- ❑ TDPUD bill insert
- ❑ Radio advertisement
- ❑ Retailer / in-store [MARK IF REPSONDENT INDICATES IN-STORE SIGNAGE OR FROM RETAIL STAFF, OR MENTIONS A SPECIFIC RETAILER BY NAME]

- ❑ Other [SPECIFY] _____

Q-3 When did you learn about the TDPUD's Refrigerator Recycling program and the available rebate? Was it…

- ❑ Before deciding to recycle the refrigerator
- ❑ After deciding to recycle the refrigerator
- ❑ At the same time as deciding to recycle the refrigerator
- ❑ Don't Know [DON'T READ]

Q-4 Was the unit being used as your main refrigerator, or had it been a secondary or spare?

- ❑ Main [ASK Q-4a]
- ❑ Secondary or Spare [ASK Q-4b]
- ❑ Don't Know [DON'T READ. SKIP TO Q-5]

Q-4a Why did you replace your refrigerator? [DON'T READ. MARK ALL INDICATED. PROBE FOR MULTIPLE RESPONSES. SKIP TO Q-5 AFTER THIS QUESTION ANSWERED]

- ❑ Wanted a better working unit
- ❑ Wanted a better looking unit
- ❑ Wanted a newer unit
- ❑ Wanted a more efficient unit
- ❑ Wanted a different size/type
- ❑ Remodeling home
- ❑ Other (Specify) _____

Q-4b Approximately how many months out of the year was the unit in use?

Q-5 What condition was the unit in when it was picked up? Would you say [READ LIST, INDICATE ONE RESPONSE]

- ❑ It worked well and was in good physical condition (normal wear and tear such as scratches, etc.)
- ❑ It worked but needed minor repairs (like a door seal or handle)
- ❑ It worked but had some problems (like it wouldn't defrost)
- ❑ Or it didn't work at all
- ❑ Don't Know [DON'T READ]

- ❑ Don't Know [DON'T READ]

Q-6 Did you attempt to sell or donate your refrigerator prior to participating in the Refrigerator Recycling Program?

- ❑ Yes [ASK Q-6a]
- ❑ No [SKIP TO Q-7]

Q-6a. Why didn't you follow through with selling or donating? [DON'T READ OPTIONS, CHECK ALL THAT APPLY]

- ❑ Couldn't find an interested buyer at the price I wanted
- ❑ Couldn't find an interested buyer because of the unit's condition
- ❑ Decided recycling the unit was more important than selling it
- ❑ Other [SPECIFY] _____
- ❑ Don't Know

Q-7 What factors motivated you to recycle your refrigerator with the program in 2014 (DO NOT READ. CHECK ALL THAT APPLY])?

- ❑ TDPUD rebate
- ❑ Energy cost savings
- ❑ Good for the environment
- ❑ Refrigerator no longer worked properly
- ❑ Purchased new refrigerator or freezer
- ❑ Convenience of free pickup
- ❑ Wanted another TDPUD rebate for an energy efficient appliance purchase
- ❑ Don't Know [DON'T READ]
- ❑ Other [SPECIFY] _____

Q-8 When the refrigerator was in use, where in the house was it set up? [PROMPT ONLY IF NECESSARY]

- ❑ Kitchen
- ❑ Den/Lounge
- ❑ Garage
- ❑ Basement
- ❑ Outdoors
- ❑ Other [SPECIFY]_____

Q-9 Did you have specific plans to dispose of the refrigerator prior to learning of the TDPUD Refrigerator Recycling Program?

- ❑ Yes
- ❑ No

Q-10 When replacing a major appliance, what do you typically do with the old unit? [DO NOT READ. PROMPT ONLY IF NECESSARY]

- ❑ Take for recycling
- ❑ Dispose at a dump
- ❑ Give to friend/family
- ❑ Donate to Charity
- ❑ Have an appliance retailor remove the old unit at time of delivery for a small fee
- ❑ Keep the unit
- ❑ Sell the refrigerator [ASK 11a]
- ❑ Other [SPECIFY]_____

10a Are you more likely to sell the appliance in a private party sale, or to sell or trade it in to a used refrigerator dealer?

- ❑ Private Party
- ❑ Used Refrigerator Dealer
- ❑ Other [SPECIFY]_____
- ❑ Don't Know

Q-11 What would you have done with your old refrigerator if you had not recycled it through TDPUD? [DO NOT PROMPT]

- ❑ Continued to use it
- ❑ Sold it
- ❑ Unplugged and stored it
- ❑ Disposed of it
- ❑ Given it away / Donated to charity
- ❑ Other [SPECIFY]

_____

Q-12 How important was the rebate in your decision to recycle your refrigerator?

- ❑ Very Important
- ❑ Somewhat Important
- ❑ Slightly Important

- ❑ Not at All Important
- ❑ Don't Know [DON'T READ]

Q-13 How important was the free pickup service in your decision to recycle your refrigerator?

- ❑ Very Important
- ❑ Somewhat Important
- ❑ Slightly Important
- ❑ Not at All Important
- ❑ Don't Know [DON'T READ]

Q-14 How long did it take to receive your rebate? [READ IF NECESSARY]

- ❑ 1-2 weeks
- ❑ 3-4 weeks
- ❑ 5-6 weeks
- ❑ 6 or more weeks
- ❑ Don't know

Q-15 Do you think the wait time to receive the rebate was too long?

- ❑ Yes
- ❑ No

Q-16 On a scale of 1 – 10, with "1" meaning "very dissatisfied" and "10" meaning "very satisfied", how satisfied were you with:

[ASK IN RANDOM ORDER, WITH ITEM (F) ALWAYS LAST]

	Score:	*Don't know or no answer*
A. The scheduling process for recycling		❑
B. The service performed by staff that picked up your refrigerator		❑
C. The wait time between scheduling and pick-up of the refrigerator		❑
D. The wait time to receive the rebate		❑
E. The rebate amount		❑
F. Overall program experience		❑

[IF ANY ITEM <5, ASK Q17. OTHERWISE SKIP TO Q-18]

Q-17 Why were you dissatisfied with [COMPONENT SCORED < 5]? [ENTER VERBATIM RESPONSE]

Q-18 What type of cooling system do you have for your home? Do you have a... [READ LIST, ONE ANSWER ONLY]

- ❑ Central air conditioning system
- ❑ Evaporative cooling system or a swamp cooler
- ❑ Window air conditioner
- ❑ No cooling system [DON'T READ]
- ❑ Don't Know [DON'T READ]

Q-19 Do you have any specific comments or suggestions you would like me to relay to TDPUD about the Refrigerator Recycling Program?

- ❑ Yes [RECORD VERBATIM RESPONSE]
- ❑ No

That concludes my questions. Thank you for your help and participation in this survey. Have a great day/evening.

8. Appendix D: Customer Survey for RES Program

ID No. _____

Customer Name: _____

Date of interview: _____

Date data entered _____

.....

Hello. My name is ___ and I'm calling from ADM Associates on behalf of TDPUD. We are conducting a study of the Residential Energy Survey [Energy Savings Partners] Program, though which you've received an audit and direct install measures for energy and water efficiency improvements. TDPUD will use this information to help them improve the program. The interview will take approximately 10 minutes. May I ask you a few questions?

Q-1 Our records indicate that you received a survey and directly installed fixtures from TDPUD to help pay for energy efficiency improvements in your home. Is this correct?

- ❑ Yes *(If checked, go to Q-2)*
- ❑ No *(If checked, thank respondent and terminate interview)*
- ❑ Don't know *(If checked, ask to speak with someone in the home who may know)*

Q-2 How did you first hear about the RES/ESP program?
[DO NOT READ. AFTER INITIAL RESPONSE ASK IF THERE WERE ANY OTHER WAYS. CHECK ALL THAT ARE MENTIONED]

- ❑ Print ad/flyer
- ❑ Word-of-mouth
- ❑ TV/radio ad
- ❑ Bill insert/brochure/message
- ❑ TDPUD website
- ❑ Community/local event
- ❑ Other (*Specify*) _____
- ❑ Don't know (*DO NOT READ)*

Q-3 Why did you participate in the RES/ESP Program?

[DO NOT READ. Check all mentioned. Prompt only if necessary. Probe as needed.]

- ❑ To save energy
- ❑ To reduce our utility bill
- ❑ Because services were free of charge
- ❑ Good for the environment
- ❑ Because you had trouble paying your utility bill
- ❑ Indoor air quality/health issues
- ❑ Property manager wanted you to
- ❑ Recommendation of a friend/relative
- ❑ Other (Describe: _____)
- ❑ Don't know

Q 3-A Of the things you mentioned, which was the most important?

- ❑ To save energy
- ❑ To reduce our gas/electric bill
- ❑ Because services were free of charge
- ❑ Good for the environment
- ❑ Because you had trouble paying your electric or gas bill
- ❑ Indoor air quality/health issues
- ❑ Property manager wanted you to
- ❑ Recommendation of a friend/relative
- ❑ Other (Describe:
- ❑ Don't know

[DIRECT INSTALL COMPONENT]

Q-4 How many CFLs were installed in your home?

- ❑ #____
- ❑ Don't know [DON'T READ]

Q-5 On a scale of 1-10, where 1 means "not at all satisfied" and 10 means "very satisfied", how satisfied were you with the CFLs?

- ❑ #____
- ❑ Don't know [DON'T READ]

[ASK RESPONDENT IF THEY SELF-INSTALLED; IF YES, SKIP TO Q-7]

Q-6 On a scale of 1-10, where 1 means "not at all satisfied" and 10 means "very satisfied", how satisfied were you with the installation of the CFLs?

- ❑ #____
- ❑ Don't know [DON'T READ]

Q-7 Do you think the CFLs are higher quality, the same quality, or lower quality than what you had before?

- ❑ Higher
- ❑ Same
- ❑ Lower - Q7a: “What makes you say that?” [RECORD VERBATIM]
- ❑ Don't know

Q-8 Have you removed any of the CFLs?

- ❑ Yes (ask Q-9)
- ❑ No
- ❑ Don't know

Q-9 Why did you remove them? [DON’T READ. CHECK ALL INDICATED]

- ❑ They were not bright enough
- ❑ I didn’t like the color
- ❑ I didn’t like them
- ❑ Wanted something else
- ❑ Stopped working
- ❑ Other (specify_____)
- ❑ Don’t know/Refused to answer

Q-10 How many low flow showerheads were installed in your home?

- ❑ #____
- ❑ Don't know [DON’T READ]

Q-11 On a scale of 1-10, where 1 means “not at all satisfied” and 10 means “very satisfied”, how satisfied were you with the showerhead(s)?

- ❑ #____
- ❑ Don't know [DON’T READ]

[ASK RESPONDENT IF THEY SELF-INSTALLED; IF YES, SKIP TO Q-13]

Q-12 On a scale of 1-10, where 1 means “not at all satisfied” and 10 means “very satisfied”, how satisfied were you with the installation of the showerhead(s)?

- ❑ #____
- ❑ Don't know [DON’T READ]

Q-13 Have you removed any of them?

- ❑ Yes (Q-14)
- ❑ No
- ❑ Don't know

Q-14 Why did you remove them? [DON’T READ. CHECK ALL INDICATED]

- ❑ Not enough flow
- ❑ Didn’t like the spray
- ❑ Wanted one with a hose

- ❑ Didn't like the looks
- ❑ Stopped working
- ❑ Other (specify_____)
- ❑ Don't know/Refused to answer

[ASK CUSTOMER IF THEY SELF-INSTALLED; IF YES, ASK ABOUT THEIR EXPERIENCE W/ SURVEYOR]

Q-15 Using the 1-10 scale, where 1 means "strongly disagree" and 10 means "strongly agree", please rate your experience with the installation work done on your home (the CFLs and showerheads) by the surveyor. If you don't know or can't answer, then just say "I don't know".

#____

- ❑ Don't know [DON'T READ]

Q-16 Have you noticed a decrease in your utility bill since participating in the program?

- ❑ Yes – electric
- ❑ Yes – water
- ❑ Yes – both
- ❑ No
- ❑ Don't know

Q-17 Did you have plans to make these improvements to your home prior to learning about the program?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-18 Would you have been financially able to make these home improvements without the incentive from the utility?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-19 If the services from the RES/ESP program were not available, how likely would you have been to install the same home improvements? [READ, MARK ONE]

- ❑ Definitely would have installed
- ❑ Probably would have installed
- ❑ Probably would not have installed
- ❑ Definitely would not have installed
- ❑ Don't know (*don't read*)

Q-20 On a scale of 0 to 10, where "10"; is very satisfied, "0" is very dissatisfied, and a "5" is neither satisfied or dissatisfied, how would you rate the following? [RANDOMIZE. ASK "OVERALL PROGRAM EXPERIENCE" LAST]

Element of Program Experience	*Score*	*Don't Know*
A. Information provided by the surveyor		❑
B. The quality of installation work by the surveyor [SKIP IF SELF-INSTALL]		❑
C. The savings on your monthly bill		❑
D. The service provided by utility staff		❑
E. Information provided by TDPUD on how to reduce your utility bill		❑
F. Improvement in home comfort after receiving the home improvements		❑
G. Overall program experience		❑

[FOR ANY PROGRAM ELEMENT SCORED < 5]

Q-20a Why were you dissatisfied with [Program Element]?

Q-21 When was your home built? [IF RESPONDENT DOES NOT GIVE VERBATIM ANSWER, READ OFF YEAR RANGES UNTIL RESPONDENT INDICATES ONE]

- ❑ Verbatim____
- ❑ Before 1970's
- ❑ 1970's
- ❑ 1980's
- ❑ 1990's
- ❑ 2000-present
- ❑ Don't know (*don't read*)
- ❑ Refused

Q-22 Including yourself, how many people currently live in your home year-round?

- ❑ Quantity:____
- ❑ Don't know (*don't read*)
- ❑ Refused

[ASK Q-22a ONLY IF Q27 > 1]

Q-22a How many people under the age of 18 currently live in your home year-round?

- ❑ Quantity:____
- ❑ Don't know (*don't read*)

- ❑ Refused

Q-23 Do you have any comments about the RES/ESP Program, or any suggestions with regard to how it might be improved?

Thank you for your help! TDPUD will use your ideas to improve its programs for its customers.

9. Appendix E: Customer Survey for Residential Lighting Rebate Program

Hello, my name is _____ and I'm calling from ADM Associates on behalf of TDPUD. We are conducting a survey regarding household lighting. I am calling to ask a few brief questions about any light bulbs you've purchased for your home. The survey should only take about ten minutes and your answers will be completely anonymous. May I please speak with an adult in the household who is responsible for purchasing the light bulbs for your home?

- ❑ Yes, I purchase lights [GO TO Q1]
- ❑ Someone else does it [ASK TO SPEAK WITH PERSON, REPEAT INTRODUCTION THEN GO TO Q1]
- ❑ No [TRY TO RESCHEDULE AND THEN TERMINATE]

Recent Light Bulb Purchases

Q1. I'd like to ask you a few questions about your light bulb purchases during the past year. In the last six months, have you purchased any light bulbs?

- ❑ Yes 01
- ❑ No 02 [SKIP TO Q2]
- ❑ Don't know 98 [SKIP TO Q2]
- ❑ Refused 99 [SKIP TO Q2]

Q2. During the past six months, how many light bulbs would you say you have purchased? [If respondent unsure, say "Your best estimate is OK."] Would you say you purchased: [READ ANSWERS]

- ❑ 0-5 01
- ❑ 6-10 02
- ❑ 11-15 03
- ❑ 16-20 04

❑ 21-25 05

❑ 25-30 06

❑ Other (specify) _____ (Record exact respondent estimate)

❑ Don't know 98

❑ Refused 99

Q3. Have you purchased any compact fluorescent light bulbs, also known as CFLs, during the past year?

❑ Yes [ask Q-3a] 01

Q-3a How many? #_____

❑ No 02

❑ Don't know 98

❑ Refused 99

Q4. Have you purchased any light emitting diode bulbs, also known as LEDs, during the past six months?

❑ Yes [ask Q-4a] 01

Q-4a How many? #_____

❑ No 02

❑ Don't know 98

❑ Refused 99

In-Service Rate

Q5. How many of those CFLs or LEDs would you estimate you installed?

❑ _____ [RECORD NUMBER, 0 – 97. IF RESPONDENT SAYS "100%" or "ALL", THEN SKIP TO Q6]

❑ Don't recall 98

❑ Refused 99

Q5B. Are there any CFL or LED bulbs you purchased in the past six months that you have not installed or are saving for a later date?

❑ Yes, have some left	01	[GO TO Q5C]
❑ None	02	[GO TO Q6]
❑ Don't know	98	[GO TO Q6]
❑ Refused	99	[GO TO Q6]

Q5C. Approximately how many do you have left? [If respond is unsure, say "Your best estimate is okay."]

❑ _____ [RECORD NUMBER, 0 – 97.]	
❑ Don't recall	98
❑ Refused	99

Purchase Reasoning

Q6. Why did you purchase the CFLs?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. IF respondent says "I needed bulbs" or similar, PROMPT for more detailed explanation.]

❑ Replaced burned out bulbs	01
❑ Replace working bulbs, wanted to lower energy usage	02
❑ Installed in a new light fixture or lamp socket	03
❑ Improve lighting quality/brighten a room	04
❑ Replaced burned out bulbs & working bulbs at same time	05
❑ Stock up on bulbs	06
❑ Good deal prompted purchase	07
❑ Other (describe)_____	08
❑ Don't recall	98
❑ Refused	99

Q7. Why did you purchase the LEDs?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES. If respondent says "I needed bulbs" or similar, PROMPT for more detailed explanation.]

- ❑ Replaced burned out bulbs 01
- ❑ Replace working bulbs, wanted to lower energy usage 02
- ❑ Installed in a new light fixture or lamp socket 03
- ❑ Improve lighting quality/brighten a room 04
- ❑ Replaced burned out bulbs & working bulbs at same time 05
- ❑ Stock up on bulbs 06
- ❑ Good deal prompted purchase 07
- ❑ Other (describe)_____ 08
- ❑ Don't recall 98
- ❑ Refused 99

Bulb Types Replaced

Q8. Now I would like you to think about the types of bulbs the CFLs replaced. Did they replace typical incandescent light bulbs, old CFL light bulbs, some other type of existing bulb, or a combination of old bulb types?

- ❑ Incandescent 01
- ❑ Existing CFLs 02
- ❑ LEDs 03
- ❑ Other :_____ [VERBATIM] 04
- ❑ Mixture:_____ [VERBATIM] 05
- ❑ Don't know 98
- ❑ Refused 99

Q9. Now I would like you to think about the types of bulbs the LEDs replaced. Did they replace typical incandescent light bulbs, old LED light bulbs, some other type of existing bulb, or a combination of old bulb types?

❑ Incandescent	01
❑ CFLs	02
❑ Existing LEDs	03
❑ Other :_____ [VERBATIM]	04
❑ Mixture:_____ [VERBATIM]	05
❑ Don’t know	98
Refused	99

Q10. When purchasing light bulbs, what is the most important characteristic you consider when selecting a particular style, brand, or package to buy?

[DO NOT READ RESPONSES. RECORD ALL RESPONSES GIVEN. PROMPT IF NECESSARY.]

❑ Cost	01
❑ Energy efficiency	02
❑ Color/style of light	04
❑ Brightness of the bulb	05
❑ Brand	06
❑ How long the bulb lasts before replacement	07
❑ Other (specify)_____	08
❑ Don’t recall	98
❑ Refused	99

Q10A. [If more than one reason listed] Of all the reasons you listed, which is the most important?

❑ Cost	01
❑ Energy efficiency	02
❑ Color/style of light	04
❑ Brightness of the bulb	05
❑ Brand	06
❑ How long the bulb lasts before replacement	07

- ❑ Other (specify)_____ 08
- ❑ Don't recall 98
- ❑ Refused 99

Q11. On a scale of 1 to 5, where 1 is "not important at all" and 5 is "very important," how important is energy efficiency to you when you select light bulbs for purchase?

- ❑ _____ [Record number, 1-10]
- ❑ Don't know 98
- ❑ Refused 99

Awareness of Discounts

Q12. How did you become aware of the TDPUD lighting discounts?

- ❑ In-store promotional event representative 01
- ❑ In-store signage/marketing materials 02
- ❑ Store salesperson 03
- ❑ TDPUD website 04
- ❑ TDPUD program staff 05
- ❑ Word of mouth 06
- ❑ Other:_____ (describe) 07
- ❑ Don't know 98
- ❑ Refused 99

Q13. When purchasing CFL or LED light bulbs in the past six months, do you recall any of the products being discounted from their normal pricing?

- ❑ Yes 01
- ❑ No 02
- ❑ Don't know 98
- ❑ Refused 99

Q14. Would you have been financially able to purchase the bulbs without the incentive from the utility?

- ❑ Yes 01
- ❑ No 02
- ❑ Don't know 98

Q15. If the rebate incentives were not available, how likely would you have been to install the CFLs or LEDs bulbs? [READ, MARK ONE

- ❑ Definitely would have installed 01
- ❑ Probably would have installed 02
- ❑ Probably would not have installed 03
- ❑ Definitely would not have installed 04
- ❑ Don't know (don't read) 98

Q16. On a scale of 1 to 5, where 1 is "not important at all" and 5 is "very important," how important was the TDPUD lighting discount to your decision to purchase those specific light bulbs? [

- ❑ #_____
- ❑ Don't recall 98
- ❑ Refused 99

Household Characteristics / Demographics

Q17. Which of the following best describes your home/residence?

- ❑ Single Family Home, detached construction 01
- ❑ Single Family Home, factory manufactured/modular 02
- ❑ Single family, mobile home 03
- ❑ Condominium 04
- ❑ Apartment 05
- ❑ Other (specify) 06
- ❑ Don't know 98
- ❑ Refused 99

Q18. Do you own or rent this residence?

- ❑ Own 01
- ❑ Rent 02
- ❑ Don’t know 98
- ❑ Refused 99

Q19. Approximately when was your home constructed? [DO NOT READ]

- ❑ Before 1960 01
- ❑ 1960-1969 02
- ❑ 1970-1979 03
- ❑ 1980-1989 04
- ❑ 1990-1999 05
- ❑ 2000-2010 06
- ❑ 2011 or later 07
- ❑ Don’t know 98
- ❑ Refused 99

Q20. Approximately how many square feet is your home?

- ❑ _____ Record Number [100-99999]
- ❑ Don’t know 98
- ❑ Refused 99

Q21. How many individuals currently live in your home?

- ❑ _____ Record Number [1-97]
- ❑ Don’t know 98
- ❑ Refused 99

Q22. Do you have any comments about the Residential Lighting Rebate program, or any suggestions with regard to how it might be improved?

Thank you very much! Your responses will help TDPUD in improving the program.

10. Appendix F: Customer Survey for Building Efficiency Rebate Program

ID No. _____

Customer Name: _____

Date of interview: _____

Date data entered _____

Hello. My name is ____ and I'm calling from ADM Associates on behalf of TDPUD. I am conducting a study of the Building Efficiency Program, through which you've received testing and completed work for energy efficiency improvements in your home. TDPUD will use this information to help them improve the program. The interview will take approximately 10 minutes. May I ask you a few questions?

AA-1 According to our records, you purchased received a rebate through the Truckee Donner PUD (TDPUD) Building Efficiency program and may have testing and work done on the building envelope and/or ducts on your home. Do you recall participating in Building Efficiency program as described above?

- ❑ Yes
- ❑ No [THANK AND TERMINATE]

Verify Energy Efficient Measures

AA-2 Our records show that you had the following energy efficiency measures installed in your home:

Measures:

- Duct Test
- Duct Repair
- Building Envelope Test
- Building Envelope Mitigation

Is that correct?

- ❑ Yes
- ❑ No
- ❑ Don't know

Program Awareness

Q-1 How did you hear about Building Efficiency program?

- ❑ Contractor
- ❑ Bill Insert
- ❑ Mail/Letter from TDPUD
- ❑ In-person - at an event or office
- ❑ Print Ad
- ❑ Radio/TV/Newspaper
- ❑ Friend/Family/Word-of-Mouth
- ❑ Don't know
- ❑ Other: _____

Q-2 Did a utility staff member recommend the program to you?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-3 How important was the recommendation?

- ❑ Very important
- ❑ Somewhat important
- ❑ Slightly important
- ❑ Not important at all
- ❑ Don't know

Q-4 Why did you participate in the Building Efficiency Program?
[DO NOT READ. Check all mentioned. Prompt only if necessary. Probe as needed.]

- ❑ To save energy
- ❑ To reduce our utility bill
- ❑ Because services were free of charge
- ❑ Good for the environment
- ❑ Because you had trouble paying your utility bill
- ❑ Indoor air quality/health issues
- ❑ Property manager wanted you to
- ❑ Recommendation of a friend/relative
- ❑ Other (Describe: _____)

- ❑ Don't know

Q-5 Before learning about the rebates available through the utility, were you already planning to have the energy efficiency improvements done?

- ❑ Yes
- ❑ No
- ❑ Don’t know

Q-6 Did you know about the issues with the duct work in your home before contacting a contractor or the utility about the program?

- ❑ Yes
- ❑ No
- ❑ Don’t know

Q-7 During which of the following time periods would you say learned about TDPUD's Building Efficiency program? Was it…

- ❑ Prior to contacting the utility or contractor
- ❑ After contacting the utility or contractor, but before I had the tests done
- ❑ After contacting the utility or contractor but before I had any work done
- ❑ After I had contacted a contractor and finished the work
- ❑ Some other time (Please describe):

Q-8 If you had not received a financial incentive through the program, how likely is it that you would have had your duct work repaired anyway?

- ❑ Definitely would [ASK Q8A]
- ❑ Probably would [ASK Q8A]
- ❑ Probably would not
- ❑ Definitely would not

Q-8A Did the program’s rebate allow you to have your ductwork repaired earlier than you otherwise would have?

- ❑ Yes [ASK Q8B]
- ❑ No
- ❑ Don’t know

Q-8B When would you have completed these repairs if TDPUD didn't provide you with a rebate to assist with the cost?

- ❑ Within six months
- ❑ Six months to a year
- ❑ Greater than a year

Q-9 Would you have been financially able to test and fix the duct work without the rebate you received through the program?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-10 Have you noticed an improvement in the air quality in your home?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-11 Have you noticed a decrease in your monthly bill?

- ❑ Yes
- ❑ No
- ❑ Don't know

Q-12 What kind of heating system do you have in your home?

- ❑ Electric
- ❑ Gas
- ❑ Both
- ❑ Propane
- ❑ Other:_____
- ❑ Don't know

Q-13 When was your home built? [IF RESPONDENT DOES NOT GIVE VERBATIM ANSWER, READ OFF YEAR RANGES UNTIL RESPONDENT INDICATES ONE]

- ❑ Verbatim____
- ❑ Before 1970's
- ❑ 1970's
- ❑ 1980's
- ❑ 1990's
- ❑ 2000-present
- ❑ Don't know (*don't read*)
- ❑ Refused

Q-14 Including yourself, how many people currently live in your home year-round?

- ❑ Quantity:____
- ❑ Don't know (*don't read*)
- ❑ Refused

[ASK Q-14a ONLY IF Q14 > 1]
Q-14a How many people under the age of 18 currently live in your home year-round?

- ❑ Quantity:____
- ❑ Don't know (*don't read*)
- ❑ Refused

Q-15 Do you have any comments about the Building Efficiency Program, or any suggestions with regard to how it might be improved?

11. Appendix G: Site-Level EM&V Reports

This section provides site-specific M&V reports for all sampled projects for which ADM performed a site-level analysis.

3.23. Save Mart LED Case Lighting (Project 1408121213)

Save Mart is a local supermarket which participated in the Refrigeration program. This rebate includes the retrofit of refrigerated case work with LED case lighting (36 Fixtures). LED lighting fixtures were installed in several refrigerated cases throughout the store. The cases were predominately frozen food, though several cases were identified at "higher" cooler temperatures (mainly dairy cases). The LED fixtures replaced pre-existing T-8 fixtures. The Ex Post gross annual energy savings and peak demand estimates for this project are provided in the table below:

Table 11-1 Site Impact Summary: Project 1408121213

Evaluation Measure	***Energy Savings (kWh/year)***	***Demand Savings (peak kW)***	***% of Total Savings***
LED Case Lighting	26,582	2.3	100%
Total	**26,582**	**2.3**	**100%**

3.23.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = (kW_{Base} - kW_{Meas}) * Hrs * HCIF$$

$$kW_{Sav} = (kW_{Base} - kW_{Meas}) * CDF * HCIF$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb
kW_{Meas}	Is the connected load of the installed light bulb
Hrs	Are the annual hours of operation[26]
HCIF	Heating/Cooling Interactive Factor[27]
CDF	Is the Coincident Demand Factor

ADM leveraged a specially developed spreadsheet calculator for lighting fixture retrofits, developed in-house. The spreadsheet itemizes savings by each retrofitted fixture type and location within the facility.

3.23.2. Findings & Results

ADM field staff visited the facility and identified the fixture counts listed in Table 11-2. The fixture counts and quantities were consistent with the documentation provided for the project. The Ex Post verified annual energy savings were slightly lower than the Ex Ante estimates (with a realization rate of 95%) which is mostly due to differences in the assumed annual hours of operation for the retrofitted fixtures.

Table 11-2 List of Retrofitted Fixtures by Type and Location

Location	***Pre-Existing***			***Installed***		
	Type	***Qty***	***Wattage***	***Type***	***Qty***	***Wattage***
Dairy (L & R)	F51ILL	2	36	GE LED	2	16
Dairy (Center)	F51ILL	8	36	GE LED	8	8
End-Cap 1 (L & R)	F51ILL	2	36	GE LED	2	16
End-Cap 1 (Center)	F51ILL	1	36	GE LED	1	8
End-Cap 2 (L & R)	F51ILL	2	36	GE LED	2	16
End-Cap 2 (Center)	F51ILL	1	36	GE LED	1	8
Frozen Foods 1a (L & R)	F51ILL	2	36	GE LED	2	16
Frozen Foods 1a (Center)	F51ILL	29	36	GE LED	29	8
Frozen Foods 1b (L & R)	F51ILL	2	36	GE LED	2	16
Frozen Foods 1b (Center)	F51ILL	29	36	GE LED	29	8
Frozen Foods 2a (L & R)	F51ILL	2	36	GE LED	2	16
Frozen Foods 2a (Center)	F51ILL	29	36	GE LED	29	16

[26] Per DEER 2013 for appropriate building type

[27] Per DEER 2013 for appropriate building type

3.24. Full Belly Deli Door Gaskets & Strip Curtains (Project 1410081450)

Full Belly Deli is a local deli sandwich shop which participated in the Refrigeration program. This rebate includes two measures: 1) New Door Gaskets (71.16 Linear Ft.), and 2) New Strip Curtains (23.06 Sq. Ft.). The strip curtains were installed in a walk-in cooler and the door gaskets were installed on various coolers and display cases throughout the shop. The Ex Post annual energy savings and peak demand estimates for this project are provided in the table below:

Table 11-3 Site Impact Summary: Project 1410081450)

Evaluation Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
Door Gaskets	1487	0.51	52%
Strip Curtains	28	0.001	48%
Total	**1,515.00**	**0.51**	**100%**

3.24.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = UES_{kWh} * N$$
$$kW_{Sav} = UES_{kW} * N$$

where:

kWh_{Sav}	Are the annual energy impacts for the project
UES	Is the unit energy savings for the installed measure(s)
N	Is the number of units installed

3.24.2. Findings and Results

ADM field staff verified that all measures were installed and operable. No discrepancies were found regarding either the surface area of the strip curtains or length of the installed door gaskets. Unitary energy savings estimates (UES) were leveraged from the CMUA TRM for the strip curtains, but values from the Pennsylvania Technical Resource Manual for were used for the door gaskets because the current measure listing in the CMUA TRM does not include values for this measure. The Ex Post verified annual energy savings estimates were lower than the Ex Ante estimates due to differences in the assumed UES for each measure.

3.25. DBI Beverage Strip Curtains (Project 1410071048)

DBI Beverage is a beverage distribution company with a refrigerated warehouse located in Truckee, Ca. which participated in the Refrigeration program. This rebate was given for new strip curtains (274.12 Sq. Ft.) installed in DBI's refrigerated warehouse. ADM field staff verified the location and operation of the strip curtain installed in this retrofit, the state of the pre-existing strip curtains. The Ex Post gross annual energy savings and peak demand estimates for this project are provided in the table below:

Table 11-4 Site Impact Summary: Project 1410071048

Evaluation Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
Strip Curtains	69,626	4.75	100%
Total	**69,626**	**4.75**	**100%**

3.25.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = UES_{kWh} * N$$

$$kW_{Sav} = UES_{kW} * N$$

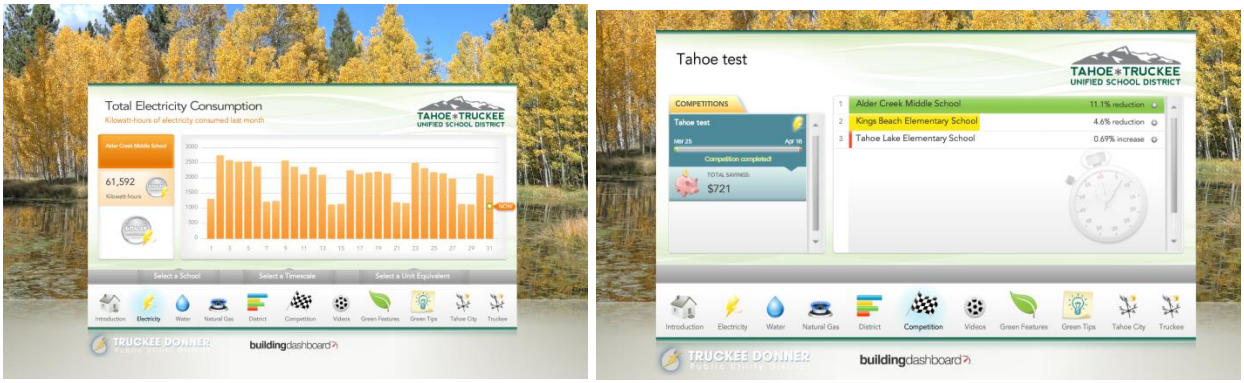
where:

kWh_{Sav}	Are the annual energy impacts for the project
UES	Is the unit energy savings for the installed measure(s)
N	Is the number of units installed

3.25.2. Findings & Results

ADM field staff were able to locate the rebated strip curtains in the facility. No discrepancies were found regarding placement or the approximate surface area. Unitary energy savings estimates (UES) were leveraged from the Pennsylvania Technical Resource Manual for this site because the current measure listing in the CMUA TRM does not include values for refrigerated warehouse (only Restaurant and Grocery). Note that the UES for this measure in the Pennsylvania TRM is significantly higher than either estimate in the CMUA TRM, which is reasonable given the difference in application. While the Ex Ante savings estimates utilized the values listed in the CMUA TRM the Ex Post verified annual energy savings are lower than the Ex Ante estimates due to clerical errors in the Ex Ante calculations.

3.26. Tahoe Truckee Unified School District (Project TDCUSTOM-505660)



Under this rebate Tahoe Truckee Unified School District installed Lucid energy usage dashboard(s) which allow students and staff to monitor the facilities energy use and encourages all persons to participate in reducing facility energy consumption where possible. Savings for this measure are garnered by inducing energy efficiency behavior in participants by making such activities "fun" or "competitive". The Ex Post gross annual energy savings and peak demand estimates for this project are provided in the table below:

Table 11-5 Site Impact Summary: Project TDCUSTOM-505660

Evaluation Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
Lucid Dashboards	42,710	0	100%
Total	**42,710**	**0**	**100%**

3.26.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = kWh_{Base} * f_{Sav}$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kWh_{Base}	Is the baseline facility energy use
f_{Sav}	Is the estimated % energy savings for the installed measure(s)

The baseline annual energy use estimate (kWh_{Base}) was determined using a billing regression analysis. Billing histories for all campuses on which the measure was installed were weather normalized using a regression of the following form:

$$kWh_{Month} = \beta_1 * HDD + \beta_2$$

Once weather normalized the regression equations were used to estimate "typical" annual energy use for each campus applying TMY3 weather data for Truckee, Ca. An estimated savings (f_{Sav}) of 1.9% was then applied to the aggregated, weather normalized, baseline energy use.[28]

3.26.1. Findings & Results

ADM field staff were able to verify that the lucid systems are installed and operating as expected. The Ex Post verified annual energy savings estimates were higher than the Ex Ante estimates due to differences in the value assumed % savings (f_{Sav}). The Ex Ante estimates applied a conservative 1% savings estimate. However; based on recent literature regarding the impacts of behaviorally based programs, ADM leveraged a savings estimate of 1.9%. Similarly, ADM identified secondary literature from a recent impact evaluation of behaviorally based water program implemented by the East Bay Municipal District in which water conservation impacts were found to be 4.6%. Thus, in addition to the energy impacts, this project was found to conserve approximately 12,356 gallons of water annually.

[28] The % Savings assumption is referenced from *Parkinson, et.al, Are Savings from Behavior Programs Ready for TRM Prime Time?. IEPEC Proceedings Chicago, 2013.*

3.27. Kelly Brothers Painting (Project TDCUSTOM-504883)

Under this rebate Kelly Brothers Painting installed above code energy efficiency improvements to their newly constructed building. Above code improvements were found present in the space heating, space cooling, and lighting equipment. Furthermore, the facility installed a 2 kW solar PV system which generated even further savings. The Ex Post gross annual energy savings and peak demand estimates for this project are provided in the table below:

Table 11-6 Site Impact Summary: Project TDCUSTOM-505660

Evaluation Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
Lucid Dashboards	7,973	1.9	100%
Total	**7,973**	**1.9**	**100%**

3.27.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = kWh_{Post} * \left[\frac{1}{f_{Sav}} - 1\right]$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kWh_{Post}	Is the Observed facility energy use
f_{Sav}	Is the estimated % energy savings for the installed measure(s)

The observed annual energy use estimate (kWh_{Post}) was determined by reviewing the available billing history for the facility (10 months). An estimated savings (f_{Sav}) of 6.8% was then applied as shown in the formula above to estimate impacts from the above code improvements. The value used for f_{Sav} was derived using the outputs from a *savings by design* analysis provided in the project documentation. The energy generated by the solar PV system was estimated using a calibrated PV-Watts model (IPMVP Option D). The model was calibrated to net-meter data showing the PV system's monthly outputs for the previous 10 months.

3.27.2. Findings & Results

ADM field staff were able to verify that the facility had been built to standards above Title-24 and was subsequently using less energy than an equivalent, minimally code compliant, building. In addition to the above code improvements ADM found a ~2 kW grid-tied solar PV system installed on-site which contributed to even greater energy impacts through renewable energy generation. Savings for these components are illustrated in Table 11-7.

Table 11-7 Project Impacts by Component: TDCUSTOM-504883

Component	*Gross Ex Post Annual Energy Impacts [kWh]*
Above Code Improvements	4,325
Solar PV System	3,648
Overall	**7,973**

The Ex Post impacts are higher than those estimated in the Ex Ante calculations primarily due to the PV System. In the Ex Ante calculations the PV system impacts were not accounted for.

3.28. Mountain Forge (Projects TDCOMLIGHT-504074 & TDCOMLIGHT-504330)

This project covers two incentives – project 504074 and 504330 in the commercial lighting program. These incentives cover two lighting retrofit projects. The descriptions in the tracking data for these two projects are as follows:

1) 350W HID, 32WT8 to LED (Quantity of 9)
2) 350W HPS to 240 W LED (Quantity of 3)

The first project retrofitted (4) 1-lamp fixtures located in Work bay spaces, and (5) 3-lamp fixtures located in office spaces. Fixtures were replaces 1 for one, though the new office fixtures are now only 2-lamps each. The Ex Post annual energy savings and peak demand savings estimates are provided in the table below:

Table 11-8 Site Impact Summary: projects 504074 and 504330

Evaluation Measure ID	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
504074	2,316	.69	64%
504330	1,304	.37	36%
Total	**3,620**	**1.06**	**100%**

3.28.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and

operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the presence of air conditioning serving the areas in which the retrofit occurred. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = (kW_{Base} - kW_{Meas}) * Hrs * HCIF$$

$$kW_{Sav} = (kW_{Base} - kW_{Meas}) * CDF * HCIF$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb
kW_{Meas}	Is the connected load of the installed light bulb
Hrs	Are the annual hours of operation[29]
HCIF	Heating/Cooling Interactive Factor[30]
CDF	Is the Coincident Demand Factor

ADM leveraged a specially developed spreadsheet calculator for lighting fixture retrofits, developed in-house. The spreadsheet itemizes savings by each retrofitted fixture type and location within the facility.

3.28.2. Findings and Results

ADM field staff visited the facility and identified the fixture counts listed in Table 11-9. The fixture counts and quantities were consistent with the documentation provided for the project. The Ex Post verified annual energy savings were higher than the Ex Ante estimates (with a realization rate of 147%) which is mostly due to differences in the assumed annual hours of operation for the retrofitted fixtures.

Table 11-9 List of Retrofitted Fixtures by Type and Location

Location	***Pre-Existing***			***Installed***		
	Type	***Qty***	***Wattage***	***Type***	***Qty***	***Wattage***
Bay 1	DayBrite	4	375	CXB-23L	4	240
Office	F43ILL	5	89	UR2-48-45L-40K-S-S-FD	5	44
Main Bay	DayBrite	3	375	CXB-23L	3	240

[29] Per DEER 2013 for appropriate building type

[30] Per DEER 2013 for appropriate building type

3.29. Richard Molsby (Project TDCOMLIGHT-504250)

This project covers a lighting retrofit at the Mobo Law Office in Downtown Truckee. In this retrofit pre-existing 4 Lamp 32W T-8 fixtures were replaced with (23) Sorra 4w LED fixtures. The fixtures were located in the reception area, the conference room and the back office area. The Ex Post annual energy savings and peak demand savings estimates are provided in the table below:

Table 11-10 Site Impact Summary: Project TDCOMLIGHT-504250

Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
LED Fixtures/Bulbs	1,683	.49	100%
Total	**1,683**	**.49**	**100%**

3.29.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = (kW_{Base} - kW_{Meas}) * Hrs * HCIF$$

$$kW_{Sav} = (kW_{Base} - kW_{Meas}) * CDF * HCIF$$

Where:

kWh_{Sav}	Are the annual energy impacts for the project
kW_{Sav}	Are the peak demand reductions
kW_{Base}	Is the connected load of the baseline light bulb
kW_{Meas}	Is the connected load of the installed light bulb

Hrs Are the annual hours of operation[31]
HCIF Heating/Cooling Interactive Factor[32]
CDF Is the Coincident Demand Factor

ADM leveraged a specially developed spreadsheet calculator for lighting fixture retrofits, developed in-house. The spreadsheet itemizes savings by each retrofitted fixture type and location within the facility.

3.29.2. Findings & Results

ADM field staff visited the facility and identified the fixture counts listed in Table 11-2. The fixture counts and quantities were consistent with the documentation provided for the project. The Ex Post verified annual energy savings were higher than the Ex Ante estimates (with a realization rate of 105%) which is mostly due to differences in the assumed annual hours of operation for the retrofitted fixtures.

Table 11-11. List of Retrofitted Fixtures by Type and Location

Location	*Pre-Existing*			*Installed*		
	Type	*Qty*	*Wattage*	*Type*	*Qty*	*Wattage*
Reception	Advance/ICN-4P32-SC	4	98	WACO	11	11.5
Conference Room	Sylvania QTP4X32T8-UNV	4	98	WACO	10	11.5
Back Office	Sylvania QTP4X32T8-UNV	1	98	HALO	5	5

[31] Per DEER 2013 for appropriate building type

[32] Per DEER 2013 for appropriate building type

3.30. First Baptist Church Lighting Retrofit (TDCOMLIGHT-504913)

The First Baptist Church retrofitted several 4-lamp 32W T-8 fixtures to LEDs. Fixtures were replaced in multiple spaces: the dining room, kitchen, class rooms, and entry way. In these spaces a total of (24) linear fluorescent fixtures were replaced by (24) LED fixtures. In the entry way (7) 100 W Incandescent bulbs were replaced by (7) LEDs. The Ex Post annual energy savings and peak demand savings estimates are provided in the table below:

Table 11-12 Site Impact Summary: Project TDCOMLIGHT-504913

Measure	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
LED Fixtures/Bulbs	2,172	0.49	100%
Total	**2,172**	**0.49**	**100%**

3.30.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$kWh_{Sav} = (kW_{Base} - kW_{Meas}) * Hrs * HCIF$$

$$kW_{Sav} = (kW_{Base} - kW_{Meas}) * CDF * HCIF$$

Where:

kWh_{Sav} Are the annual energy impacts for the project
kW_{Sav} Are the peak demand reductions

kW_{Base}	Is the connected load of the baseline light bulb
kW_{Meas}	Is the connected load of the installed light bulb
Hrs	Are the annual hours of operation[33]
HCIF	Heating/Cooling Interactive Factor[34]
CDF	Is the Coincident Demand Factor

ADM leveraged a specially developed spreadsheet calculator for lighting fixture retrofits, developed in-house. The spreadsheet itemizes savings by each retrofitted fixture type and location within the facility.

3.30.2. Findings & Results

ADM field staff visited the facility and identified the fixture counts listed in Table 11-2. The fixture counts and quantities were consistent with the documentation provided for the project. The Ex Post verified annual energy savings were higher than the Ex Ante estimates (with a realization rate of 269%) which is mostly due to differences in the assumed annual hours of operation for the retrofitted fixtures.

Table 11-13. List of Retrofitted Fixtures by Type and Location

Location	*Pre-Existing*			*Installed*		
	Type	*Qty*	*Wattage*	*Type*	*Qty*	*Wattage*
Main Room	F42LL	9	60	LED	9	48.6
Kitchen	F42LL	2	60	LED	2	48.6
Back Classroom	F42LL	6	60	LED	6	48.6
Front Classroom	F42LL	3	60	LED	3	48.6
Entry	I100/1	7	100	LED	7	10

[33] Per DEER 2013 for appropriate building type

[34] Per DEER 2013 for appropriate building type

3.31. US Dept. Of Agriculture (TDCOMLIGHT-505659)

The US Department of Agriculture retrofitted their existing metal-halide parking lot fixtures (cobra heads) with LED bulbs. In all, the site replaced 17 fixtures one-for-one throughout the parking lot. All fixtures are pole mounted and operate from dusk to dawn. The Ex Post annual energy savings and peak demand savings estimates are provided in the table below:

Table 11-14 Site Impact Summary: Project TDCOMLIGHT-505659

Evaluation Measure ID	*Energy Savings (kWh/year)*	*Demand Savings (peak kW)*	*% of Total Savings*
504074	30,921	0	100%
Total	**30,921**	**0**	**100%**

3.31.1. M&V Algorithms (IPMVP Option A – Partial Retrofit Isolation)

ADM evaluated the annual energy impacts for this project using IPMVP Option A. Field staff visited the site in order to collect data regarding the location, quantity, type, and operability of the installed measures. Additionally, ADM collected data regarding the facility's hours of operation and the type or refrigeration system serving the affected equipment. Annual impacts were calculated using the following formula:

$$\mathrm{kWh_{Sav}} = (\mathrm{kW_{Base}} - \mathrm{kW_{Meas}}) * \mathrm{Hrs} * \mathrm{HCIF}$$

$$\mathrm{kW_{Sav}} = (\mathrm{kW_{Base}} - \mathrm{kW_{Meas}}) * \mathrm{CDF} * \mathrm{HCIF}$$

Where:

$\mathrm{kWh_{Sav}}$	Are the annual energy impacts for the project
$\mathrm{kW_{Sav}}$	Are the peak demand reductions

kW_{Base}	Is the connected load of the baseline light bulb
kW_{Meas}	Is the connected load of the installed light bulb
Hrs	Are the annual hours of operation[35]
HCIF	Heating/Cooling Interactive Factor[36]
CDF	Is the Coincident Demand Factor

ADM leveraged a specially developed spreadsheet calculator for lighting fixture retrofits, developed in-house. The spreadsheet itemizes savings by each retrofitted fixture type and location within the facility.

3.31.2. Findings & Results

ADM field staff visited the facility and identified the fixture counts listed in Table 11-2. The fixture counts and quantities were consistent with the documentation provided for the project. The Ex Post verified annual energy savings higher than the Ex Ante estimates (with a realization rate of 111%) which is mostly due to differences in the assumed annual hours of operation for the retrofitted fixtures.

Table 11-15. List of Retrofitted Fixtures by Type and Location

Location	*Pre-Existing*			*Installed*		
	Type	*Qty*	*Wattage*	*Type*	*Qty*	*Wattage*
Parking Lot	MH	17	400	LED	17	35

[35] Per DEER 2013 for appropriate building type

[36] Per DEER 2013 for appropriate building type