EVERGREEN ECONOMICS

333 SW Taylor St. Suite 200
Portland OR 97204
Tel 503-894-8676
Fax 503-536-6637
www.evergreenecon.com

MEMORANDUM

December 19, 2014

To: Chris Ann Dickerson, Jim Flanagan

Re: Verification of Hawaii Energy Program Year 2013 Programs

Evergreen Economics is currently under contract with the Hawaii Public Utilities Commission (Commission) to conduct a comprehensive multi-year evaluation of the Hawaii Energy Conservation and Efficiency (Hawaii Energy) Program.[1] The program is implemented by an independent third-party, Leidos,[2] serving as the "Public Benefits Fee Administrator" (PBFA) under contract to the Commission. This memorandum provides the results of validation and verification activities that the Evergreen team conducted as part of the evaluation on energy efficiency programs implemented by Hawaii Energy for Program Year 2013.

The memorandum contains the following sections:

1. Introduction

One component of the Program Year 2013 evaluation was to estimate energy savings (electricity only) by measuring and verifying the program's energy savings claims. Our research to estimate the energy savings included:

- Savings database validation and
- Measure installation verification.

[1] www.hawaiienergy.com

[2] Leidos changed their name from SAIC in September 2013. We elected to use the name Leidos in this verification memo covering Program Year 2013 because the majority of Program Year 2013 was implemented while the firm operated under the name Leidos.

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This memorandum presents the results of these two activities to estimate energy savings, which may be performed as one component of a larger program impact evaluation. They are generally referred to as "verification" activities. They are intended to:

- Validate that the summary of program accomplishments from the Annual Report matches the program tracking database;
- Confirm that the program is claiming savings based on the most recently approved values in the current Program Year 2013 TRM;
- Verify that the program installed the measures for which savings were claimed;
- Determine that the installed measures are program-qualifying; and
- Verify savings for custom measures using engineering analyses.

These verification activities are distinguished from "measurement" activities that are intended to measure the energy savings from the program such as through equipment metering or analysis of changes in electricity bills and from analyzing the savings values approved for use in the TRM. These evaluation efforts are typically conducted on different schedules, apart from the verification activities described herein. For Program Year 2013 we are not conducting any additional measurement activities to determine savings.

The combination of the results from these two verification activities, the **savings database validation** and the **measure verification**, comprises the **overall verification results** that are presented in this memorandum.

1.1 Background

The Hawaii Energy Program is operated by Leidos, the independent third-party contractor serving as the PBFA under contract to the Hawaii Public Utilities Commission. The Program Year 2013 Hawaii Energy portfolio, which ran from July 1, 2013 through June 30, 2014, consisted of eight programs, with four programs targeting the business sector and four targeting the residential sector.[3]

- **Business Energy Efficiency Measures (BEEM)**. Provided prescriptive incentives to business customers who purchased and installed energy efficiency measures. The program paid incentive rebates for lighting, air conditioning, motors, solar water heating, water pumping, condominium submetering, and many other measures.

[3] Hawaii Energy Conservation and Efficiency Programs. *Annual Plan Program Year 2013*. Submitted by Hawaii Energy on June 20, 2013.

- **Custom Business Energy Efficiency Measures (CBEEM).** Provided custom financial incentives based on calculated savings to commercial, institutional, governmental, and industrial sector customers. Some examples of custom technologies include, but are not limited to, energy management systems, exhaust ventilation control systems, high performance lighting, low emissivity glass and heating, ventilation and air conditioning (HVAC) controls.
- **Business Service and Maintenance (BESM).** Provided incentives and direct installation of measures to businesses in addition to business design, audits, and commissioning to underserved sectors. This program also conducted a more aggressive outreach effort to lighting and electrical contractors by offering training, education, promotional materials, and frequent communications on program updates.
- **Business Hard to Reach (BHTR).** Provided equipment grants and direct install lighting measures targeted to traditionally underserved geographies and demographics such as restaurants.
- **Residential Energy Efficiency Measures (REEM).** Provided prescriptive incentives to residential customers who purchased and installed energy efficiency measures. These measures included high efficiency water heating, lighting, air conditioning, appliances, as well as awareness, measurement and control systems.
- **Residential Energy Services and Maintenance (RESM)**. Provided incentives for custom integrated building design and construction standards. Unlike previous years, solar water heating tune-ups were included in REEM instead of RESM.
- **Residential Hard to Reach (RHTR)**. Provided equipment grants with a focus to secure projects within traditionally underserved demographics and geographies. The most notable included bringing the refrigerator exchange program, *Hui Up*, to Molokai and offering direct install solar hot water heaters to families in need.
- **Custom Energy Solutions for the Home (CESH).** Provided incentives for three custom lighting proposals for specialized residential light-emitting diode (LED) applications. CESH is intended to provide incentives with more flexibility within the prescriptive portfolio to accommodate unforeseen market opportunities. This program became available in Program Year 2012, but did not have any activity until Program Year 2013.

Leidos also conducted various market transformation activities in Program Year 2013 focusing on behavior modification, professional development, as well as technical knowledge and training that will lead to energy efficiency and conservation in later years. No direct energy savings are claimed for these activities,

and as such they are not included in the tables showing verified program savings throughout this memo. However, these market transformation activities were reviewed as part of the validation task as discussed in Section 3.1.

1.2 Overall Validation and Verification Results

The overall validation and verification results indicate that the program realized 99.6 percent of the energy savings claimed in the Leidos *Hawaii Energy Annual Report Program Year 2013* (Annual Report).[4] There were cases at the measure level where the program realized less savings than it claimed due to a variety of issues, but there were also cases where the program realized more savings than it claimed. The net effect was that the program realized 99.6 percent of the savings that it claimed in the Annual Report. The results are presented in more detail in Section 3, including explanations for discrepancies between claimed and verified savings. Table 1 presents the overall verification results by program. Percentages have been rounded to the nearest whole number. The values shown in the table by column are:

- **Sector** and **Program**, which indicate the sector (residential or business) and the Hawaii Energy program;
- **Claimed First-Year Net[5] Savings** (kWh), which summarize the first-year energy savings claims from the Annual Report in kilowatt hours by program;
- **Verified First-Year Net Savings** (kWh), which summarize the overall verified energy savings by program, based on the combination of the savings validation and measure installation verification results; and
- **Percent Verified of Claimed kWh Savings**, which presents the overall verified kWh savings ratios by program, also reflecting the combination of the savings validation and measure installation verification results. Percentages are rounded to the nearest percent.

[4] Submitted to Hawaii Public Utilities Commission, November 21, 2014. Net savings is reported at the measure level by program in the body of the Annual Report, starting with BEEM on page 79.
[5] Net savings refer to the program-level savings reported by Leidos in their Annual Report and tracking data. For Program Year 2013 Leidos adopted net-to-gross ratios that vary by program as recommended by Evergreen in the Program Year 2011 Evaluation Report. These program-level net-to-gross ratios range from 0.65 to 1.00, reflecting the impact of differences in program driven savings between the various categories of measures on program free-ridership.

Table 1. Program Year 2013 Claimed and Verified First-Year Energy Savings (kWh), by Sector and Program

Sector	Program	First-Year Net Savings (kWh)		Percent Verified of Claimed Savings
		Claimed*	Verified	
Business				
	Business Energy Efficiency Measures	26,941,496	27,012,860	100%
	Business Services and Maintenance	3,872,686	3,744,695	97%
	Business Hard to Reach	2,412,099	2,303,631	96%
	Custom Business Energy Efficiency Measures	22,539,657	22,516,302	100%
	Business Total	**55,765,938**	**55,577,488**	**100%**
Residential				
	Residential Energy Efficiency Measures	67,307,632	66,977,494	100%
	Residential Energy Services and Maintenance	3,758,500	3,758,500	100%
	Residential Hard to Reach	166,211	162,629	98%
	Custom Energy Solutions for the Home	9,531	9,467	99%
	Residential Total	**71,241,874**	**70,908,090**	**100%**
Program Overall		**127,007,811**	**126,485,578**	**100%**

* Claimed program-level net savings reported by Leidos in *Hawaii Energy Annual Report Program Year 2013*.

2. Research Methods

2.1 Overview

This memorandum presents results from seven research tasks that were intended to evaluate the program's energy savings claims:

1. **Savings database validation.** We obtained a database from Leidos including program participants and energy savings values for Program Year 2013 and summarized the savings claims by program (e.g., REEM) and energy efficiency measure (e.g., ceiling fans) and compared that to Leidos' program and measure-level summary of its savings claims in the Annual Report. We also compared per unit savings values against the approved ("deemed") values in the approved Program Year 2013 TRM.

2. **Measure verification.** We conducted telephone surveys with statistically representative samples of participants by program. For business large projects and custom measures, we conducted documentation reviews to confirm claimed savings.

3. **Upstream Lighting Verification.** Evergreen also conducted a separate verification of the upstream compact fluorescent lamps (CFLs) and LED distributed through the REEM program. A sample of invoices and

distribution documentation was requested from Hawaii Energy and checked against the final tracking database to verify the number of bulbs claimed.

4. **BEEM Condominium Submetering Verification.** Evergreen conducted a calculation review of submetering projects completed in Program Year 2013. Each building's electricity billing data was used to determine the expected savings from submetering, based on the formulas provided in the TRM. The total savings was verified by comparing the expected savings using the TRM formula against the claimed savings in the tracking database.

5. **REEM Peer Group Comparison Verification.** Evergreen conducted a calculation review of all savings claimed for the Opower peer group comparison in Program Year 2013 using the participant database and electricity billing data. Each participating household's billing data was used to determine the expected peer group comparison savings, based on the formulas provided in the TRM. The total savings was verified by comparing the expected savings using the TRM formula against the claimed savings in the tracking database.

6. **RESM Integrated Building Design and Construction Standards Verification.** Evergreen conducted a documentation review of all Integrated Building Design and Construction Standards projects rebated by RESM in Program Year 2013. The documentation for each project was checked against the final tracking database to verify the claimed savings.

7. **BESM and BHTR Small Business Direct Install Lighting Verification.** Evergreen conducted a documentation review of a sample of Small Business Direct Install Lighting (SBDIL) projects that received a post-installation inspection. The findings from each inspection report were compared to the tracking data to verify the quantities claimed.

The combination of the results from these activities comprises the overall verification results that are presented below. The **savings database validation** provides a set of ratios by program and energy efficiency measure category that reflects the proportion of energy savings we validated in the program tracking database relative to the savings reported in Annual Report. The **measure verification** provides a second set of ratios, also by program and measure, that reflect the proportion of measures and their associated savings that we verified to be installed, program qualifying and with appropriate savings claims.

We multiplied the two sets of ratios to yield a final set of **overall verification and validation ratios** that are applied by program and measure to the values found in

the Annual Report. The resulting savings are our independent assessment of the verified energy savings associated with Program Year 2013 operations.

2.2 Savings Database Validation

Leidos provided the evaluation team with the final data from its tracking system for the entire 2013 Program Year. We used the data to generate an independent estimate of claimed savings and compared our estimate to that reported in the Hawaii Energy 2013 Annual Report.

The validation exercise included summarizing the measure installation counts and total kWh and kW savings in the final tracking database and comparing them to the values in the Annual Report.

Similarly, the per unit savings values used in the final tracking data were also checked against the TRM (for those measures included in the TRM) to ensure that the appropriate values from the TRM were being used for each measure and program. Finally, we validated net kW savings, and net Total Resource Benefit (TRB) results from the Annual Report by comparing the tracking data to the claimed values in the Annual Report. We developed validation ratios based on the fraction of the claimed kWh and kW savings from the Annual Report that we validated in the program tracking data.

2.3 Measure Verification

The measure verification research methods included fielding telephone surveys, reviewing program participation records, confirming savings inputs and calculations and conducting engineering desk reviews. Below we provide an overview of the approach to sampling, data collection, and analysis.

2.3.1 Sample Design

We used program tracking data from the first three quarters of the Program Year 2013 as the basis for the first stage of the sample frame, from which we drew samples for the measure verification. We used this subset of the full-year program tracking database because the verification results were due in the fall of 2014, requiring us to pull the majority of our research samples before the close of the program year. Our intent was that the samples drawn from the first three quarters and the subsequent research results would be representative of the full-year program, since the program design did not change in the fourth quarter.

Leidos provided Evergreen an extract of the program tracking database covering the first three quarters (Q1-Q3) on June 5, 2014. We used this dataset to develop samples for phone surveys and desk reviews, which we used to verify the REEM, RHTR, BEEM, BESM, BHTR and CBEEM programs. Additional participant-level data

was downloaded from the Salesforce database on July 28, 2014 to include a sample of quarter four (Q4) large projects and custom measures in our engineering desk reviews.

For the business programs, we supplemented the Q1-Q3 sample frame with large projects in the BEEM program and all large complex measures in the CBEEM program recorded in the tracking database in Q4 of the Program Year 2013. We conducted technical reviews of a selection of those large Q4 projects, to ensure our sample included significant projects not already included in the sample frame based on the first three quarters.

Table 2 below compares the first-year net energy savings covered by the sample to the total savings claimed by the program. The first two columns indicate the sector and program, the third column the first-year net energy savings claims represented by the sample, the fourth column the first-year net energy savings claims represented by the full-year participation database, and the fifth and final column the fraction of full-year energy savings that is represented by the sample.

The sample represents 59 percent of the full-year program savings. Appendix B provides more detail on our sampling approach.

Table 2. Program Year 2013 Net Energy Savings for Measure Verification Sample as a Fraction of the Participant Population, by Sector and Program

		First-Year Net Savings (kWh)		
Sector	**Program**	**Sample**	**Total Program Savings**	**Sample as a % of Total Program Savings**
Business				
	Business Energy Efficiency Measures	7,507,271	26,941,495	28%
	Business Services and Maintenance	434,103	3,872,687	11%
	Business Hard to Reach	595,210	2,412,099	25%
	Custom Business Energy Efficiency Measures	6,055,794	22,539,657	27%
	Business Total	**14,592,378**	**55,765,938**	**26%**
Residential				
	Residential Energy Efficiency Measures	56,971,039	67,307,632	85%
	Residential Energy Services and Maintenance	3,758,500	3,758,500	100%
	Residential Hard to Reach	15,741	166,211	9%
	Custom Energy Solutions for the Home	-	9,531	0%
	Residential Total	**60,745,279**	**71,241,874**	**85%**
Program Overall		**75,337,657**	**127,007,812**	**59%**

2.3.2 Data Collection

The evaluation team implemented a variety of research methods to verify program measure installations and program qualifications. The research approach varied based on the type of customer.

Most of the program participants were "downstream" customers that resided in a residential home or operated a commercial, industrial, or government facility and received a rebate for program-qualifying equipment. Typically they mailed in a rebate application and were later mailed a check. The program also paid rebates directly to lighting manufacturers and distributors ("upstream" or "mid-stream" market actors) for CFLs and LEDs. The manufacturers and distributors then sold discounted product to lighting retailers. The retailers pass on that discount directly to customers who buy CFLs or LEDs and receive their discount via a point-of-sale rebate that is redeemed instantly at the time of purchase.

Research methods used for the downstream customers primarily consisted of telephone surveys to confirm that customers received a rebate, bought program-qualifying equipment, and presently had the equipment installed and operational. For downstream customers with large prescriptive business projects and complex custom measures, we conducted a technical documentation review to verify the accuracy of any original calculations and to determine if the customer's actual operation was consistent with program assumptions. For residential upstream CFLs and LEDs, we performed a verification of invoices and rebate documentation to ensure that the quantities claimed matched the database and the Annual Report and that a sample of measures were found to be program-qualifying. For REEM peer group comparison and BEEM condominium submetering, we performed calculation reviews to verify the claimed savings matched the program documentation according to the formulas provided in the TRM. For RESM building design measures, we conducted a documentation review to ensure that claimed quantities and savings matched what was found in the program documentation. For BESM and BHTR SBDIL measures, we reviewed a sample of inspection reports to ensure that the quantities installed matched the claimed quantities in the database.

The following is a brief description of the methods we used to verify measure installations and program qualifications. More detail is provided on the methods in Sections 2.3.3 through 2.3.7.

- **Telephone surveys.** SMS, a Hawaii-based telephone survey research firm, conducted computer-assisted telephone interview (CATI) surveys for both residential and business customers in Summer 2014. The surveys included questions to verify that the customer had received a rebate for a program measure, installed the measure, and that the measure was still operable.

The telephone surveys were conducted with a sample of participants from REEM and RHTR as well as small and medium projects from BEEM, BESM, BHTR, and CBEEM programs. For residential customers, to determine the allocation, we first constructed a proportional allocation of 350 sample points based on the percentage of energy savings of each measure/island combination. We then adjusted the target sample to ensure a minimum number of sample points by strata (geography and measure category) to arrive at the sample allocation. We increased the sample allocation for certain measure categories and Hawaii and Maui Counties to ensure adequate sample for islands other than Oahu. The residential survey targeted 350 customers, addressing up to two measures per customer.

For business customers, due to the small number of participants across all islands, the sample allocation was not made based on each measure/island combination. Instead, we constructed a proportional allocation of 50 sample points based on the percentage of energy savings of each measure. We then adjusted the target sample to include additional measure categories to arrive at the sample allocation. The sample allocations for some measures were reduced when the total number of non-residential participants that received that measure was too small to realistically achieve the desired number of survey completes. Since the survey addressed up to two measures for participants who installed more than one measure, the number of completed surveys at the measure level was expected to exceed 50.

SMS completed a total of 351 residential surveys covering 370 rebated measures and 53 business surveys covering 67 rebated measures.[6] However, seven of the business measures (from five different respondents) were not found in the final Q1-Q4 tracking data. Hawaii Energy had moved these measures to Program Year 2014 between the time our sample was developed with Q1-Q3 data and when we received the final Q1-Q4 data. We dropped the survey responses for these measures, as they were not measures that were included in the Program Year 2013 claimed savings. An additional five measures (four residential and one business) were dropped because the survey responses were insufficient to determine whether or not the measure had been rebated and was still installed and working. In each of

[6] Note that for Program Year 2009 and Program Year 2010, we conducted a nested sample of on-site verification surveys for residential programs and small/medium projects within the BEEM program. We found very high verification rates from the telephone survey, which were confirmed during the on-sites for these same customers. For Program Year 2011, we conducted only telephone verification surveys for a sample of the participant population, reserving on-site surveys for the custom and large business projects. For Program Year 2012 we returned to our approach from Program Years 2009 and 2010 and conducted nested on-site verification surveys for REEM and small/medium business projects.

these cases, the survey was not terminated because the respondents were able to recall sufficient information about a second measure. After these adjustments, we were left with a total of 351 residential surveys covering 366 measures and 48 business surveys covering 59 measures.

- **Large and custom engineering desk reviews.** In addition to the telephone surveys described above, we also conducted technical engineering reviews on a sample of measures installed in business locations for CBEEM and large business projects (from BEEM, BESM, and BHTR). Michaels Energy based in Wisconsin conducted the engineering reviews to verify the accuracy of any original calculations, and to determine if the customer's actual operation was consistent with program assumptions.

  All of the sampled projects underwent a technical engineering review of the project documentation to ensure consistency, accuracy, and the measure/project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with engineering fundamentals.

  The large business prescriptive (BEEM, BESM, and BHTR) sample was determined by taking a random stratified sample based on energy savings of projects from the 39 projects with the highest savings from Q1-Q4.[7] Five large prescriptive sites were selected for engineering reviews, accounting for 17 percent of total measure savings from BEEM, BESM, and BHTR. We included sites that received SBDIL in our engineering reviews, ultimately reviewing five SBDIL measures from one large project.

  In Program Year 2013, the CBEEM program funded some projects that included prescriptive-type measures. Based on previous evaluations, these projects have been found to be very straightforward and do not warrant additional investigation through engineering review. These prescriptive-type CBEEM projects from the Q1-Q3 data were included in the CATI survey sample frame; similar prescriptive-type CBEEM projects from Q4 were excluded from the sample frame for this engineering review. After excluding these prescriptive-type CBEEM projects from the custom engineering review sample, we were left with a sample frame of 48 CBEEM projects. The sample for the custom projects engineering review was determined using a random stratified sampling approach based on claimed energy savings. Of the 48

[7] The sample frame of the top 39 sites was pulled in two stages. First, the largest sites from the Q1-Q3 program tracking data were pulled, consisting of all projects claiming more than 250,000 kWh savings. After the Q4 data was available, the database was re-examined to determine if any additional large projects were completed in Q4.

CBEEM projects in our sample frame, five were selected for engineering reviews, accounting for 25 percent of total CBEEM measure savings.

- **Upstream CFL and LED verification.** We reviewed a random stratified sample of invoices representing 65 percent of REEM LED bulbs and 60 percent of REEM CFL bulbs included in the program tracking data to ensure that they matched invoice detail from the Salesforce database and the claimed quantities found in the final tracking data. We also reviewed model numbers to ensure that bulbs were program qualifying.
- **BEEM condominium submetering verification**. We reviewed all of the project information and billing data provided for the condominium submetering projects completed in Program Year 2013. Hawaii Energy did not include any billing or project data for one condominium submetering project that was listed in the tracking database, so our verification included 11 of the 12 condominium submetering projects.
- **REEM peer group comparison verification.** We reviewed the entire peer group comparison customer list for Program Year 2013 and each participating household's electricity billing data for a full year before they began participating in the program to verify the savings found in the final tracking data.
- **RESM integrated building design and construction standards verification.** Evergreen conducted a documentation review of all seven Integrated Building Design and Construction Standards projects rebated by RESM in Program Year 2013. The documentation for each project was checked against the final tracking database to verify the claimed savings.
- **BESM and BHTR SBDIL verification.** We reviewed a sample of SBDIL inspection reports for projects rebated by BESM or BHTR in Program Year 2013, which we retrieved from the Salesforce database. A random stratified sample of inspected projects was selected for review, including 21 BESM and 12 BHTR SBDIL projects. The types and quantities of each measure listed in the sampled inspection reports were checked against the claimed measure types and quantities in the tracking data.

2.3.3 Upstream Lighting Verification

Additional verification was conducted for CFLs and LEDs rebated through the upstream portion of the REEM program. Hawaii Energy supplied tracking data and Evergreen developed a stratified random sample to request invoices and rebate forms for CFLs and LEDs rebated through the program.

The CFL and LED verification for Program Year 2013 was conducted in three parts:

1. Checking compliance with the participation requirements set forth by the Memorandum of Understanding that all retailers are required to sign in order to participate in the program;
2. Verifying quantities of equipment between invoice/rebate documentation, final program data, and the Hawaii Energy Program Year 2013 Annual Report; and
3. Reviewing a sample of CFL and LED model numbers to ensure that the rebated measures are program qualifying (e.g., matching the unique retail product number with the ENERGY STAR website.)

To conduct the upstream lighting verification, Hawaii Energy provided us with tracking spreadsheets with purchase and distribution information for both CFLs and LEDs along with invoices and rebate forms in PDF form. Tracking spreadsheets for the full program year were provided, while only a sample of invoices were sent at our request.

The sample of CFL invoices covered 60 percent of all REEM CFLs, while the sample of LED invoices represented 65 percent of all REEM LEDs. The quantities of CFLs and LEDs reflected in the invoices were compared to the final tracking data to verify the number of bulbs claimed. After bulb quantities were verified, we checked model numbers in the tracking data against the current list of ENERGY STAR approved bulbs to ensure that they were program qualifying.

Finally, we reviewed the number of bulbs distributed at each retailer and the size of rebated multi-packs. During last year's CFL and LED documentation review, we learned that although Leidos claims savings for all sizes of multi-packs, they only provide rebates for up to 10 bulbs per multi-pack. This maximum number of rebates is in accordance with the Memorandum of Understanding that each retailer must sign with Hawaii Energy to participate and receive rebates for upstream lighting sold through the program. To best align verified savings with the level of rebates provided, we verified a maximum of 10 bulbs per multi-pack. This meant that multi-packs with more than 10 bulbs were verified at less than 100 percent.

2.3.4 Condominium Submetering Verification

The current savings for Program Year 2013 BEEM Condominium Submetering in the TRM is deemed as a 10 percent reduction in a customer's annual pre-period kWh usage; the pre-period is defined as the 24 months prior to submetering installation. Evergreen conducted an independent calculation replicating the TRM formula to determine the verified savings of this measure. Using site-specific billing data, we calculated savings for each of 11 submetering projects provided to us by Leidos. We then scaled these monthly savings up to an annual value and summed across all projects to yield our total verified kWh savings for Condominium Submetering.

We calculated a verification ratio for the Condominium Submetering measure equivalent to the ratio of the calculated savings to the savings value reported in the final tracking data.

Hawaii Energy also conducted an analysis of savings for Condominium Submetering using a billing regression methodology. The results of their analysis showed average savings of approximately 10 percent, which is in line with the existing deemed value in the Program Year 2013 TRM.

2.3.5 Peer Group Comparison Verification

Evergreen conducted an independent calculation to verify the savings claimed for the REEM Peer Group Comparison measure. The TRM deems the kWh savings of the Peer Group Comparison as 0.89% of a household's average electricity usage in the pre-period for every month that they receive a home energy report. The kW savings are deemed in the TRM as the annual kWh savings divided by 3,000, representing the annual hours of active behavioral usage.

We used customer tracking data provided by Leidos to identify which customers were participants (i.e. which households received the Opower home energy reports) and how long they had been participating. There were two separate participant groups for Program Year 2013: a group of full-year participants that received reports throughout Program Year 2013 and an expansion group of 6-month participants that received their first report in January 2014.

For each participating household we calculated an average monthly kWh usage in the "pre-period", defined as the 12 months prior to the first home energy report received in Program Year 2013. Therefore, the pre-period was defined as July 2012 through June 2013 for the full-year participants, and January 2013 through December 2013 for the 6-month participants. Once we determined the average pre-period usage for each household, we multiplied this by 0.89% to get the kWh savings for each monthly report. The kW savings were calculated by dividing the kWh savings for each household by 3,000, in accordance with the TRM formula. Assuming each full-year participant received 12 reports and the 6-month participants received 6 reports during Program Year 2013, we calculated the Peer Group Comparison savings for each participant in Program Year 2013. We then determined the total verified savings for the Peer Group Comparison by taking a sum of the savings across all participating households.

2.3.6 Residential Building Design Verification

We conducted additional verification analysis on the residential building design projects rebated through the RESM program. For Program Year 2013, this RESM verification was conducted to develop a verification ratio for this measure that was

not included in the CATI surveys due to the fact that these were upstream rebates to builders.

To conduct the RESM verification, Leidos provided us with access to all project documentation available through the Salesforce database. In most cases, the documentation included a project summary, combined submittal workbook, results of any home energy modeling and/or testing performed (e.g. air leakage reports, HERS ratings), certificates of occupancy, floor plans, and incentive applications.

Due to the small number of RESM projects, we reviewed 100 percent of the projects rebated through the program. The design projects were verified by comparing quantities and savings in the project documentation to the values recorded in the final tracking data.

2.3.7 SBDIL Verification

SBDIL measures were included in the samples for telephone surveys, as well as the large project and custom measure technical file reviews. We conducted additional verification specifically for SBDIL measures from BESM and BHTR, using a sample of SBDIL inspection reports.

For each SBDIL project in our sample, we compared the quantities of each SBDIL measure in the tracking data to the quantities of SBDIL measures installed, according to the inspection report. We discussed any discrepancies with Leidos, and determined a verified quantity and associated verification ratio for every measure. The verified savings were calculated by multiplying the claimed net savings for each measure by the verification ratio. Summing up the claimed and verified savings from all of the projects in our sample generated the program-level verification ratios.

The sample of SBDIL inspection reports from BESM covered 12 percent of all BESM SBDIL savings, while the sample of SBDIL inspection reports from BHTR represented 19 percent of all BHTR SBDIL savings.

2.4 Total Resource Benefit Verification

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, we replicated the TRB calculations described in the Annual Report. Most of the verified net TRB values deviate slightly from the reported values due to the fact that their verified net savings were slightly higher or lower than the claimed values. There were multiple cases where Hawaii Energy used EULs that differed significantly from those provided in the TRM, causing the verified TRB to be substantially higher or lower

than what was claimed in the Annual Report. The resulting verified net TRB values are shown in the detailed verification tables in Appendix A.

2.5 Analysis

We used data collected from the phone surveys, project reviews, documentation reviews, independent savings calculations, and invoice audits to develop verification ratios by program and measure category, which are the fraction of energy savings that was verified to be installed and program-qualifying. Where samples were used, we developed sample weights so that results are reflective of the population of participating customers. When a measure was verified by more than one source, a sample-weighted average of the results was used to determine the overall verification ratio for that measure.

For **end-use customers**, a measure was counted as verified if:

- The respondent recalled receiving a rebate or we confirmed the respondent received a rebate check based on Leidos' database check fields;
- The measure was program-qualifying based on confirming the model number against program qualifications;
- The savings inputs and calculations were appropriate and accurate; and
- The equipment was still operable and in use.

For telephone surveys, we relied on customers to provide this information. We developed an initial verification ratio equal to the fraction of measures verified by telephone for each stratum.

For **large and custom business facilities** that were reviewed by engineers based on electronic project files, we attempted to confirm the energy savings claims in the database. We reviewed invoices, equipment specifications, and descriptions from customers, project applications, and any available calculations. We developed verification ratios for each project based on the energy savings that we could confirm from the project documentation. There were no on-site verification surveys this year, and there was no overlap between the engineering review and the telephone surveys.

We applied the verification ratios that we developed (based on the process described above) to the final program tracking database at the program and measure level.

3. Overall Verification Results

This section presents the overall verification results, which is the combined effect of applying the savings database validation research and the installed verification to

the claimed savings numbers. As described previously, the overall verification results reflect our independent assessment of the verified energy savings associated with Hawaii Energy's Program Year 2013.

The results of the two steps of the verification, the savings database validation (step one) and the installation verification (step two), are discussed separately below.

3.1 Savings Database Validation – Step One (of Two)

The savings validation exercise was intended to provide an independent verification of the savings accomplishments from the Annual Report based on the final program tracking database extract provided by Leidos. We compared the results to the Hawaii Energy 2013 Annual Report by program and measure category.

Hawaii Energy reported first-year energy savings of 127,007,811 kWh in the Annual Report and the evaluation team validated 127,005,239 kWh, which translates to 99.998 percent of first-year energy savings from the tracking database. Residential solar water heaters rebated by the RHTR program was the only measure validated at less than 100 percent. This slight difference in validated versus claimed savings is due to changes made to the program tracking database by Leidos after the final tracking data we were provided to us. The program tracking data was delivered to us on September 28, 2014 by Leidos, which we used to perform all validation and verification activities described in this memo. As Leidos produced their Program Year 2013 Annual Report, they made a few minor changes to the data after we had begun our analysis, resulting in the validation ratio for kWh savings of slightly less than 100 percent.

The validation task also included comparing kW savings and quantity values between the program tracking data and the Program Year 2013 Annual Report. All kW and quantity values were reviewed at the program and measure level and were validated at 100 percent of claimed values.

As part of the validation task, we also compared per unit savings (kWh and kW) and measure EULs between the program tracking data and the TRM. Several discrepancies were found for kWh and kW savings, but were clarified and sorted out in discussions with Leidos. Some discrepancies were also found for measure EULs, and it was determined that many EULs in the tracking data were using values from older versions of the TRM. We validated measure EULs using the approved values from the TRM for Program Year 2013. We will include a recommendation to Hawaii Energy in the comprehensive EM&V report to make sure that all values used in the tracking data are up to date with the current year's TRM values.

An additional validation task that we conducted was to review market transformation activities. Leidos provided a description of all market transformation activities in the Program Year 2013 Annual Report. We reviewed this list and conducted research online to independently validate that each of the market transformation activities occurred as described in the Annual Report and occurred during the Program Year 2013 cycle. Table 3 below lists each market transformation activity and shows the outcome of our review. The Energy Education in the Schools activities and the Professional Development activities implemented by Mark Jewell at Energy Efficiency Funding Group (EEFG) were each validated as a set of activities, rather than individual workshops. This is consistent with how Hawaii Energy has reported their Market Transformation activities in the Annual Report. Based on our research we confirmed that Hawaii Energy has accurately claimed their achievements for Market Transformation.

Table 3. Program Year 2013 Market Transformation Activities Validation Summary

Market Transformation Category	Market Transformation Activity		Reviewed Event/Activity Website to Validate	Occurred During Program Year 2013
Behavior Modification	Energy Literacy in Hard-to-Reach Communities: Sharing the Aloha (Helen Wai)		✔	✔
	Energy Efficiency Literacy at Scale – Messaging (Kanu - Messaging)		✔	✔
	Energy Efficiency Literacy at Scale – Devices and Pay-It-Forward (Kanu - Devices)		✔	✔
	2nd Annual Hawaii Sustainability in Higher Education Summit (UH Sustainability Summit)		✔	✔
	Hui Up 3.0 – Energy Literacy in Hard-to-Reach Communities (Hui Up - BPF)		✔	✔
Professional Development*	Energy Education in the Schools - NEED	Basic Energy Workshop Building Science Workshop Teacher Advisory Board	✔	✔
	Kupu – R.I.S.E. (Rewarding Internships for Sustainable Employment)		✔	✔
	Hui Up 3.0 – Green Workforce Development (Hui Up - SMI)		✔	✔
	Energy Efficiency Sales Professional Training (EEFG)	The Efficiency Sales Professional Boot Camp Learning to S.E.E. (Sell Efficiency Effectively) Financial Analysis of Energy Efficiency		
	Using Efficiency to Build Your Business (EEFG)	Finding Your Focus Getting Efficiency Projects Approved	✔	✔
	Boosting Your Competitiveness (EEFG)	Taking Control of Your Energy Use Making Efficiency Happen		
Technical Knowledge and Training	Water and Wastewater Training and Best Practices Handbook (W&WW Training)		✔	✔
	Certified Energy Manager (CEM), Energy Manager in Training (EMIT) (CEM - AEE)		✔	✔
	Building Operator Certification (BOC©) Workshops (BOC - UHMOC & SLIM)		✔	✔

*Hawaii Energy began the Facilities Degree Program at the University of West Oahu under the Professional Development category in Program Year 2013, but will not claim participation for this acitivity until Program Year 2014. Therefore it is not included in this table.

Our final validation task was to determine the appropriate claim for island equity, which is based on the amount of incentives and market transformation funds spent by island. We validated the incentives spent by island using values from the final tracking data, and used market transformation spending as reported in the Annual Report (this is not tracked in the database). We calculated the percentage share of this spending by island to compare to the Hawaii Energy claim and validated the island equity claim at 100 percent.

3.2 Installation Verification – Step Two (of Two)

The verification surveys and engineering analyses resulted in a set of verification ratios that were used to adjust the savings claimed by Leidos in the Annual Report. The verification ratio represents the percentage of savings associated with the measures that we verified to be installed, program qualifying, and operational. Results are shown at the program and measure levels.

We verified a total of 99.5 percent of residential and 99.7 percent of business energy savings to be installed, program qualifying, operational, and with accurate savings claims based on the methods described above. A total of 99.6 percent of the overall program savings were verified (a weighted average of results from the two sectors).

For the business sector, we verified a total of 100.3 percent of BEEM, 96.7 percent of BESM, 95.5 percent of BHTR, and 99.9 percent of CBEEM savings. For each of the business programs we combined the telephone survey results, engineering analyses of selected large projects and custom measures, and any other verification activities (e.g. BEEM submetering verification) to produce a verification ratio at the measure-level by weighting the results against the size of the sample frame from each activity. The samples from all verification activities made up 28 percent of the total claimed BEEM savings, 11 percent of the total claimed BESM savings, 25 percent of the total claimed BHTR savings, and 27 percent of the total claimed CBEEM savings, as shown previously in Table 2.

Measures not included in the telephone surveys or engineering analyses were assigned verification ratios from similar measures or programs that were verified. These measures accounted for a very small portion of overall program savings when we drew the Q1-Q3 sample frame. For example, we assigned the overall BEEM verification ratio (100.3 percent) to the following measures that were rebated by BEEM but were not covered in the telephone surveys or engineering analyses: demand control kitchen ventilation, air conditioning (AC) maintenance, electronically commutated (EC) motors, cool roof technologies, and water cooler timers.

As mentioned above, 99.7 percent of the business program claimed savings were verified. This is a weighted average of project-level results, with a varying range of realization rates. For CBEEM, there were five measures that we sampled for technical reviews (representing 25 percent of the program total). For large prescriptive (BEEM, BESM, and BHTR participants with cumulative savings of greater than 250,000 kWh),[8] we conducted technical reviews for five projects

[8] In PY2012, "large" prescriptive customers were identified as those with cumulative savings of greater than 100,000 kWh. For PY2013, we adjusted this cutoff for the definition of "large" from the

representing 17 percent of the business prescriptive population. Discrepancies between claimed and realized savings found in the phone survey and desk reviews for the business sector programs were due to the following reasons:

- One prescriptive measure asked about in the telephone survey (LED lighting) was not confirmed to be installed and operational.
- One of the custom measures in the desk reviews did not accurately determine the on peak demand savings. The ex ante analysis used peak coincidence factors when determining the baseline demand, but did not when determining the energy efficient case peak demand. Applying the peak coincidence factors based on the hours of operation presented in the project files reduced the energy efficient case demand, therefore increasing the project peak demand savings.
- One adjustment was made to one of the measures from a large prescriptive project that received a desk review. The customer completed 27 different lighting measures totaling nearly 2,400 fixtures or lamps. One of the lighting measures incorrectly accounted for the total number of lamps. The measure claimed that 11 lamps were removed. However, based on the project documentation there were 11 fixtures with two lamps each that were removed, resulting in 22 lamps removed in total. Increasing the quantity for this measure to 22 increased the savings slightly for this customer.

Evaluators typically find and correct a few errors of this type when conducting the kinds of verification activities described in this memorandum. Despite having identified and corrected the discrepancies mentioned above, we find that on the whole, program tracking was done properly and the correct values were applied.

For the residential sector, we verified a total of 99.5 percent of REEM, 100 percent of RESM, 97.8 percent of RHTR, and 99.3 percent of CESH program savings. There were three measures that were found to be not verified based on the telephone surveys (three sampled measures of a total of 351 surveyed customers representing 366 measures); these were either not installed, no longer operational, or had been removed.

- For REEM, we included downstream customer rebate measures in the telephone survey sample. CFLs and LEDs were delivered upstream and were verified by reviewing tracking data and invoice documentation. The REEM Peer Group Comparison was verified by analyzing tracking data and billing data provided by Leidos. We developed measure-level verification ratios for

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PY2012 value of 100,000 kWh to 250,000 kWh because this successfully isolated the 50 largest projects, which accounted for 64 percent of the total Q1-Q3 savings.

the downstream customer rebate measures and for upstream lighting measures using telephone survey results and our separate verification of CFLs and LEDs. In the REEM program, room occupancy sensors, air conditioning maintenance, and home energy metering were not covered by the telephone survey, so we applied the average REEM verification ratio (99.5 percent) to those measures.

- For RESM, residential building design measures were verified by a thorough review of program tracking data and project documentation. A verification ratio was developed based on the results of this review (100 percent).
- For RHTR, we developed measure-level verification ratios for the Hui Up refrigerator exchange and solar water heaters using residential telephone survey results.
- For CESH, we applied the verification ratio from the LEDs covered by the business telephone survey. The LEDs verified by the business telephone survey were funded with downstream rebates and did not include any LEDs from large and/or custom projects. The only residential LEDs we verified were from the REEM program; they were funded with upstream incentives. Due to the difference in incentive mechanisms, we felt that the verification ratio for the LEDs in the business telephone survey was more appropriate to apply to the LEDs from CESH than the verification ratio from the upstream residential LEDs.

3.2.1 Upstream Lighting Verification Results

In our invoice and documentation review of upstream CFLs and LEDs, we were able to verify that all bulbs claimed in the random sample we selected were found on the invoice and rebate forms that Hawaii Energy provided.

A second part of our verification for upstream lighting included counting savings only for bulbs that were rebated by Hawaii Energy. After discovering during the Program Year 2012 verification that Hawaii Energy does not provide rebates for any bulbs over 10 in a single multi-pack, we adjusted our verification to count savings for at most 10 bulbs per multi-pack. Since some CFLs were sold in multi-packs of 12 or 18 bulbs, we verified these large multi-packs at less than 100 percent. After scaling back savings for these multi-packs with greater than 10 bulbs, CFLs were found to be verified at 99 percent. All LEDs distributed through the program were single bulbs or multi-packs of less than 10 bulbs so no correction was needed for LED savings. Thus, the verification ratio for REEM CFLs was determined to be 99 percent and for REEM LEDs it was 100 percent.

Finally, we checked a sample of model numbers for CFLs and LEDs against the ENERGY STAR approved list and found that the models we reviewed were program qualifying.

3.2.2 Condominium Submetering Verification Results

Using billing data provided by Hawaii Energy, we conducted an independent calculation to determine the savings achieved by the condominium submetering measure. Our calculation resulted in verified savings of 1,490,161 kWh, which when compared to the claimed value of 1,407,274 kWh, translates to a verification ratio of 106 percent. One submetering project was also included in the phone survey, which was verified at 100 percent, and submetering was also included in the sample frame for large prescriptive desk reviews. The sample-weighted average of these results translates into an overall verification ratio of 105 percent for this measure.

3.2.3 Peer Group Comparison Verification Results

Using the customer list and billing data provided by Hawaii Energy, we conducted an independent calculation to verify the total savings claimed for this measure. We calculated each participating household's average monthly pre-period electricity usage and, using the TRM savings formula, calculated a total of 4,871,033 kWh and 1,625 kW savings. These values correspond to verification ratios of 101 percent for kWh and 295 percent for kW. The kW verification ratio is so high because Leidos made an error in the calculation of kW savings for this measure in their savings claim.

3.2.4 Residential Building Design Verification Results

Our review of documentation for RESM *Integrated Building Design and Construction Standards* projects found that all savings claimed in the final tracking data and Annual Report were verified in the project documentation. As a result, the verification ratio for this measure was determined to be 100 percent.

3.2.5 Small Business Direct Install Lighting Verification Results

We reviewed a sample of SBDIL inspection reports, including 21 projects rebated by BESM and 12 projects rebated by BHTR in Program Year 2013. During this review, we found discrepancies between the quantities of measures listed in the inspection reports and the quantities listed in the tracking data:

- One BESM project with multiple lighting types was missing two lamps of one type and had two extra lamps of another type according to the inspection report. The quantities of each measure found during the inspection should have been used to update the tracking data, but this was not done. These measures were verified at 96 percent and 104 percent, respectively.
- One of the BESM inspection reports noted that many of the measures were not installed. The incentives for this project were credited back to the program and Leidos expects that the project will be claimed in Program Year 2014. However, the savings for this project still appeared in the final tracking

data so it was verified at 0 percent for Program Year 2013, effectively removing the project from the total savings for SBDIL.

- One BHTR inspection report noted that 2-lamp fixtures were installed instead of 3-lamp fixtures. Leidos confirmed that the contractor went back to the business and installed the remaining lamps. This project was verified at 100 percent because the equipment listed in the tracking data was in fact installed during Program Year 2013, just not before the inspection.
- Five BESM projects and four BHTR inspection reports did not match the tracking data because the information in the report was incorrect (e.g. typographical errors, equipment information from a different project was accidentally included, etc.). Leidos confirmed that the quantities listed in the tracking data were correct and the inspection reports were not, thus all of these projects were verified at 100 percent.

As a result, the verification ratio for SBDIL was determined to be 94 percent based on the inspection report reviews. Leidos assured us that the types of discrepancies described above would be reduced in future years, due to the implementation of a new system for administering the SBDIL program, which uses a more rigorous inspection process. Since SBDIL was verified by the phone survey, desk reviews, and an inspection report review, the weighted average of these verification results yielded an overall verification ratio of 96 for this measure category.

3.3 Overall Verification Results

Table 4 shows the final verification results for the business programs, which are the combination of the savings database validation and the measure installation verification. The first two columns indicate the sector and program, and the third column indicates the name of the measure (as carried over from the Annual Report). The fourth column shows the claimed first-year net energy savings. The fifth column is the energy savings as validated and verified by Evergreen. The sixth column shows the final ratio of verified and validated savings relative to the savings reported by Leidos in the Annual Report (rounded to the nearest percent). To calculate the final ratio, we divided the verified and validated energy savings in this table by the claimed savings in the Annual Report. The last column shows each measure's percent of total validated and verified savings in the business program.

Table 5 presents the verification ratio results for the residential programs. It also shows the overall ratio for both the business and residential programs. The final column shows each measure's percent of total validated and verified savings in the residential program. Overall, the business program accounts for 44 percent and the residential program accounts for 56 percent of total validated and verified savings.

The overall verification results are 99.5 percent of residential and 99.7 percent of business savings were validated and verified based on the combination of research activities described in this document. The overall verification ratios shown here were applied to kW savings by program and measure to arrive at the verified and validated kW values shown in Appendix A. A separate verification of TRB values was conducted and the results of this are also shown in the tables in Appendix A.

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Table 4. Program Year 2013 Overall Verification Results by Program and Measure, Business Programs

Sector	Program	Measure	Claimed First Year Net Energy Savings (kWh)	Verified and Validated Net First-year Savings (kWh)	Verified and Validated % of Claimed Net First Year Savings	Verified Savings as % of Total Sector Savings
Business	Business Energy Efficiency Measures	Accounting Record	-	-	-	-
		Bounty - Refrigerator/Freezer	13,499	13,499	100%	0%
		CEE Tier 1 Listed Premium Efficiency Motors	12,283	12,287	100%	0%
		Ceiling Fans	31,611	31,612	100%	0%
		Chiller	2,916,216	2,920,296	100%	5%
		Clothes Washer	42,171	42,195	100%	0%
		Compact Fluorescent Lighting (CFL)	199,289	199,313	100%	0%
		Condominium Submetering Pilot	1,407,274	1,479,286	105%	3%
		Cool Roof Technologies	56,854	56,731	100%	0%
		Delamping	662,374	663,352	100%	1%
		Delamping with Reflectors	2,108,322	2,111,375	100%	4%
		Demand Control Kitchen Ventilation (DCKV)	518,299	518,338	100%	1%
		Domestic Water Booster Packages	383,440	383,541	100%	1%
		EC Motor - Refrigeration	390,611	390,632	100%	1%
		EC Motors - Fan Coil Units	795,242	796,515	100%	1%
		Heat Pump Water Heaters	569,462	570,037	100%	1%
		HID Pulse Start Metal Halide	77,997	78,038	100%	0%
		LED	6,368,728	6,357,964	100%	11%
		Maintenance - AC	269	268	100%	0%
		Package Unit AC	1,528,287	1,529,643	100%	3%
		Pool VFD Controller Pumps	34,321	34,321	100%	0%
		Recycler Cost	-	-	-	-
		Refrigerator - Trade In (or "w/Recycling") *	491,240	481,480	98%	1%
		Refrigerator - Under $600	11,729	11,729	100%	0%
		Sensors	220,407	220,627	100%	0%
		Solar Water Heater	122,256	121,284	99%	0%
		T12 to T8 with Electronic Ballast	3,988,380	3,993,764	100%	7%
		T8 to T8 Low Wattage	1,059,734	1,061,264	100%	2%
		VFD - AHU	480,154	480,692	100%	1%
		VFD - Chilled Water/Condenser Water	826,293	827,418	100%	1%
		VFD - Exhaust Fan	11,798	11,798	100%	0%
		VFD - Pool Pump Packages	488	488	100%	0%
		VRF AC	1,007,506	1,008,334	100%	2%
		Water Cooler Timer (H2off)	121,733	121,470	100%	0%
		Whole House Fans	2,509	2,509	100%	0%
		Window Tinting	480,719	480,759	100%	1%
		Subtotal	26,941,496	27,012,860	100%	49%
	Business Services and Maintenance	Accounting Record	-	-	-	-
		Central Plant Benchmarking	-	-	-	-
		Central Plant Optimization	991,954	993,504	100%	2%
		Compact Fluorescent Lighting (or "CFL") *	76,140	72,716	96%	0%
		Custom Lighting	127,993	122,237	96%	0%
		Energy Study	-	-	-	-
		Installation Cost - Ladders	-	-	-	-
		LED	786,231	750,875	96%	1%
		LED Refrigerated Case Lighting	6,831	6,524	96%	0%
		T12 to T8 with Electronic Ballast	1,808,447	1,727,124	96%	3%
		T8 to T8 Low Wattage	75,091	71,714	96%	0%
		VRF AC	-	-	-	-
		Subtotal	3,872,686	3,744,695	97%	7%

Table 4 (continued). Program Year 2013 Overall Verification Results by Program and Measure, Business Programs

Sector	Program	Measure	Claimed First Year Net Energy Savings (kWh)	Verified and Validated Net First-year Savings (kWh)	Verified and Validated % of Claimed Net First Year Savings	Verified Savings as % of Total Sector Savings
Business	Business Hard to Reach	Accounting Record	-	-	-	-
		Compact Fluorescent Lighting (CFL)	74,530	71,179	96%	0%
		Custom Lighting	135,618	129,519	96%	0%
		Installation Cost - Ladders	-	-	-	-
		LED	988,288	943,846	96%	2%
		LED Refrigerated Case Lighting	2,590	2,474	96%	0%
		Other	-	-	-	-
		T12 to T8 with Electronic Ballast	850,748	812,491	96%	1%
		T8 to T8 Low Wattage	360,325	344,122	96%	1%
		Subtotal	2,412,099	2,303,631	96%	4%
	Custom Business Energy Efficiency Measures	Air Compressor	111,382	111,208	100%	0%
		CEE Tier 1 Listed Premium Efficiency Motors	496,211	496,211	100%	1%
		Chiller	131,718	131,718	100%	0%
		Commercial Lighting	5,566,295	5,566,295	100%	10%
		Custom Equipment	600,464	600,464	100%	1%
		Custom Lighting	11,949	11,949	100%	0%
		Data Center Technologies	345,108	345,108	100%	1%
		Demand Ventilation Control - AC	795,546	795,247	100%	1%
		Energy Star - TV	34,580	34,505	100%	0%
		Equipment Controls	55,279	55,159	100%	0%
		Equipment Controls - Bi-Level Lighting	213,421	213,421	100%	0%
		Equipment Controls - Building	751,678	751,562	100%	1%
		Equipment Controls - HVAC	542,077	541,907	100%	1%
		Equipment Controls - Lighting	28,575	28,575	100%	0%
		Garage Demand Control Ventilation Control	880,657	880,537	100%	2%
		HVAC	3,029,047	3,029,047	100%	5%
		LED	5,310,645	5,289,562	100%	10%
		Refrigeration	142,201	141,923	100%	0%
		Solar Water Heater	57,885	57,050	99%	0%
		VFD - Cooling Tower Fan	310,939	310,904	100%	1%
		VFD - Fans - Non HVAC	9,295	9,275	100%	0%
		VFD - Pumps Non HVAC	1,245,254	1,245,254	100%	2%
		Water Heating	168,729	168,699	100%	0%
		Windows	1,700,722	1,700,722	100%	3%
		Subtotal	22,539,657	22,516,302	100%	41%
	All Business - Total		55,765,938	55,577,488	100%	100%

* Some measures were rolled up for the verification process. For instance, "Refrigerator - Trade In (or "w/Recycling")" from BEEM includes "Refrigerator - Trade In" and "Refrigerators w/Recycling" measures from the Annual Report. Similarly, "Compact Fluorescent Lighting (or "CFL")" from BESM includes "Compact Fluorescent Lighting (CFL)" and "CFL" measures from the Annual Report.

Table 5. Program Year 2013 Overall Verification Results by Program and Measure, Residential Programs

Sector	Program	Measure	Claimed First Year Net Energy Savings (kWh)	Verified and Validated Net First-year Savings (kWh)	Verified and Validated % of Claimed Net First Year Savings	Verified Savings as % of Total Sector Savings
Residential	Residential Energy Efficiency Measures	Bounty - Refrigerator/Freezer	268,863	268,863	100%	0%
		Ceiling Fans	482,440	482,440	100%	1%
		CFL	47,590,167	47,342,698	99%	67%
		Clothes Washer	738,087	738,087	100%	1%
		Heat Pump	342,559	342,559	100%	0%
		LED	4,167,833	4,167,833	100%	6%
		Maintenance - AC	829	819	99%	0%
		Metering - Home Energy	720	711	99%	0%
		Peer Group Comparison	4,819,509	4,871,033	101%	7%
		Recycler Cost	-	-	-	-
		Refrigerator - Trade In	3,863,029	3,785,576	98%	5%
		Refrigerator - Under $600	24,509	24,509	100%	0%
		Room Occupancy Sensors	3,016	2,978	99%	0%
		Solar Attic Fans	90,392	90,392	100%	0%
		Solar Water Heater	3,912,723	3,856,040	99%	5%
		Solar Water Heating Tune-Up	209,851	209,851	100%	0%
		VFD - Pool Pump Packages	134,637	134,637	100%	0%
		VRF AC	310,447	310,447	100%	0%
		Whole House Fans	348,021	348,021	100%	0%
		Subtotal	67,307,632	66,977,494	100%	94%
	Residential Energy Services and Maintenance	Design	3,758,500	3,758,500	100%	5%
		Subtotal	3,758,500	3,758,500	100%	5%
	Residential Hard to Reach	Refrigerator - Hui Up	74,793	74,793	100%	0%
		Refrigerator - Hui Up (Molokai)	-	-	-	-
		Solar Water Heater	91,418	87,836	96%	0%
		Subtotal	166,211	162,629	98%	0%
	Custom Energy Solutions for the Home	LED	9,531	9,467	99%	0%
		Subtotal	9,531	9,467	99%	0%
	All Residential - Total		71,241,873	70,908,090	100%	100%
Program Overall			127,007,811	126,485,578	100%	

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Appendix A-Detailed Verification Tables

This appendix provides detailed results from Evergreen's savings database validation and verification and calculation of verified net TRB. The overall verification ratio for kWh savings is 99.6 percent, for kW savings is 106.0 percent, and for net TRB is 103.8 percent. Leidos' claims in the Program Year 2013 Annual Report for net kWh, net kW, and net TRB were 127,007,811 kWh, 16,787 kW, and $156,542,771 respectively.

A-1 Business Programs

Table A-1 shows Evergreen's independent estimate of measure installation counts and savings for the business programs. The evaluation team used the final data from Leidos' tracking system for entire Program Year 2013 to generate the data in the table. The table shows the following data:

- The first two columns indicate the program and measure.
- The third column (labeled A) shows the claimed net kWh savings—the subtotal and total lines show the summed total of claimed net kWh savings.
- The fourth column (labeled B) shows the claimed net kW savings—the subtotal and total lines show the summed total of claimed net kW savings.
- The fifth and sixth columns (labeled C and D) show the overall verification ratios for kWh and kW (rounded to the nearest percent), as reported in Table 4 of this memorandum. These represent the portion of savings for each measure that Evergreen verified to be installed and program qualifying.
- The seventh and eighth columns (labeled E and F) show verified and validated net savings, in kWh and kW, respectively. The figures are the product of the net kWh savings (or the net kW savings) and the verification ratio—the subtotal and total lines show the summed number of savings.
- The ninth column (labeled G) shows the effective useful life (EUL) for each measure, as reported in the Annual Report.
- The tenth column (labeled H) shows the verified EUL for each measure, from the Program Year 2013 TRM for prescriptive measures and from the program tracking data for custom measures.
- The final column (labeled I) shows the verified and validated net Total Resource Benefit (TRB), based on the verified and validated net savings (kWh and kW) and the verified EUL.

A-2 Residential Programs

Table A-2 shows Evergreen's independent estimate of measure installation counts and savings for the residential programs. The evaluation team used the final data from Leidos' tracking system for entire Program Year 2013 to generate the data in the table. The table shows the following data:

- The first two columns indicate the program and measure.
- The third column (labeled A) shows the claimed net kWh savings—the subtotal and total lines show the summed total of claimed net kWh savings.
- The fourth column (labeled B) shows the claimed net kW savings—the subtotal and total lines show the summed total of claimed net kW savings.
- The fifth and sixth columns (labeled C and D) shows the overall verification ratios for kWh and kW (rounded to the nearest percent), as reported in Table 5 of this memorandum. These represent the portion of savings for each measure that Evergreen verified to be installed and program qualifying.
- The seventh and eighth columns (labeled E and F) show verified and validated net savings, in kWh and kW, respectively. The figures are the product of the net kWh savings (or the net kW savings) and the verification ratio—the subtotal and total lines show the summed number of savings.
- The ninth column (labeled G) shows the EUL for each measure, as represented in the final tracking data.
- The tenth column (labeled H) shows the verified EUL for each measure, from the Program Year 2013 TRM.
- The final column (labeled I) shows the verified and validated net Total Resource Benefit (TRB), based on the verified and validated net savings (kWh and kW) and the verified EUL.

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Table A-1. Program Year 2013 Validated and Verified Participation and Savings by Program and Measure, Business Program

Program	Measure	Sum Net kWh Savings (A)	Sum Net kW Savings (B)	Overall kWh Verification Ratio (C)	Overall kW Verification Ratio (D)	Verified & Validated Net kWh Savings (E = A x C)	Verified & Validated Net kW Savings (F=B x D)	EUL (G) - Avg of Useful Life	Verified EUL (H) - Useful Life from TRM	Verified & Validated Net TRB (I)
Business Energy Efficiency Measures	Accounting Record	-	-	-	-	-	-	-	-	-
	Bounty - Refrigerator/Freezer	13,499	1	100%	100%	13,499.00	1.00	14.0	14.0	$ 18,926
	CEE Tier 1 Listed Premium Efficiency Motors	12,283	7	100%	100%	12,286.74	7.00	15.0	15.0	$ 42,399
	Ceiling Fans	31,611	4	100%	100%	31,611.90	4.00	5.0	5.0	$ 22,247
	Chiller	2,916,216	464	100%	100%	2,920,296.48	464.65	20.0	20.0	$ 6,348,239
	Clothes Washer	42,171	6	100%	100%	42,195.05	6.00	12.0	11.0	$ 58,997
	Compact Fluorescent Lighting (CFL)	199,289.00	23	100%	100%	199,313.04	23.00	3.00	3.00	85,064.46
	Condominium Submetering Pilot	1,407,274	181	105%	105%	1,479,285.80	190.26	8.0	8.0	$ 1,562,862
	Cool Roof Technologies	56,854	23	100%	100%	56,731.20	22.95	10.0	15.0	$ 158,288
	Delamping	662,374	95	100%	100%	663,351.95	95.14	14.0	14.0	$ 1,105,377
	Delamping with Reflectors	2,108,322	295	100%	100%	2,111,374.80	295.43	14.0	14.0	$ 3,490,108
	Demand Control Kitchen Ventilation (DCKV)	518,299	89	100%	100%	518,338.05	89.01	15.0	15.0	$ 964,013
	Domestic Water Booster Packages	383,440	41	100%	100%	383,540.69	41.01	15.0	15.0	$ 614,024
	EC Motor - Refrigeration	390,611	42	100%	100%	390,632.35	42.00	15.0	15.0	$ 626,309
	EC Motors - Fan Coil Units	795,242	91	100%	100%	796,514.53	91.15	15.0	15.0	$ 1,299,051
	Heat Pump Water Heaters	569,462	18	100%	100%	570,037.29	18.02	10.0	10.0	$ 553,562
	HID Pulse Start Metal Halide	77,997	10	100%	100%	78,038.11	10.01	14.0	14.0	$ 125,513
	LED	6,368,728	885	100%	100%	6,357,964.24	883.50	14.5	14.7	$ 10,486,430
	Maintenance - AC	269	-	100%	100%	268.42	-	1.0	1.0	$ 28
	Package Unit AC	1,528,287	192	100%	100%	1,529,642.55	192.17	15.0	15.0	$ 2,563,180
	Pool VFD Controller Pumps	34,321	3	100%	100%	34,321.00	3.00	15.0	15.0	52,269.24
	Recycler Cost	-	-	-	-	-	-	-	-	-
	Refrigerator - Trade In (or "w/Recycling") *	491,240	20	98%	98%	481,479.71	19.60	14.0	14.0	$ 613,810
	Refrigerator - Under $600	11,729	2	100%	100%	11,729.14	2.00	14.0	14.0	$ 20,756
	Sensors	220,407	17	100%	100%	220,626.76	17.02	7.9	7.9	$ 183,415
	Solar Water Heater	122,256	65	99%	99%	121,284.25	64.48	15.0	15.0	$ 400,008
	T12 to T8 with Electronic Ballast	3,988,380	532	100%	100%	3,993,764.33	532.72	14.0	14.0	$ 6,502,230
	T8 to T8 Low Wattage	1,059,734	116	100%	100%	1,061,263.53	116.17	14.0	14.0	$ 1,631,050
	VFD - AHU	480,154	170	100%	100%	480,692.49	170.19	15.0	15.0	$ 1,244,218
	VFD - Chilled Water/Condenser Water	826,293	224	100%	100%	827,417.95	224.30	10.0	15.0	$ 1,867,391
	VFD - Exhaust Fan	11,798	5	100%	100%	11,798.00	5.00	15.0	15.0	$ 33,826
	VFD - Pool Pump Packages	488	-	100%	100%	488.00	-	10.0	10.0	$ 428
	VRF AC	1,007,506	108	100%	100%	1,008,334.42	108.09	15.0	15.0	$ 1,615,361
	Water Cooler Timer (H2off)	121,733	11	100%	100%	121,470.07	10.98	5.0	5.0	$ 78,128
	Whole House Fans	2,509	1	100%	100%	2,509.00	1.00	20.0	5.0	$ 2,909
	Window Tinting	480,719	128	100%	100%	480,759.35	128.01	10.0	10.0	$ 803,604
	Subtotal	26,941,496	3,868	100%	100%	27,012,860.18	3,878.86			$ 45,174,021

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Table A-1 (continued). Program Year 2013 Validated and Verified Participation and Savings by Program and Measure, Business Programs

Program	Measure	Sum Net kWh Savings (A)	Sum Net kW Savings (B)	Overall kWh Verification Ratio (C)	Overall kW Verification Ratio (D)	Verified & Validated Net kWh Savings (E = A x C)	Verified & Validated Net kW Savings (F=B x D)	EUL (G) - Avg of Useful Life	Verified EUL (H) - Useful Life from TRM	Verified & Validated Net TRB (I)
	Accounting Record	-	-	-	-	-	-	-	-	-
	Central Plant Benchmarking	-	-	-	-	-	-	-	-	-
	Central Plant Optimization	991,954	119	100%	100%	993,503.58	119.19	17.5	17.5	$ 1,784,294
	Compact Fluorescent Lighting (or "CFL") *	76,140	5	96%	96%	72,716.11	4.78	14.0	3.0	$ 27,261
	Custom Lighting	127,993	-	96%	96%	122,237.36	-	14.0	14.0	$ 136,863
Business Services and Maintenance	Energy Study	-	-	-	-	-	-	-	-	-
	Installation Cost - Ladders	-	-	-	-	-	-	-	-	-
	LED	786,231	73	96%	96%	750,875.48	69.72	14.0	14.0	$ 1,106,466
	LED Refrigerated Case Lighting	6,831	1	96%	96%	6,523.82	0.96	14.0	8.0	$ 7,182
	T12 to T8 with Electronic Ballast	1,808,447	88	96%	96%	1,727,124.10	84.04	14.0	14.0	$ 2,254,129
	T8 to T8 Low Wattage	75,091	2	96%	96%	71,714.28	1.91	14.00	14.00	87,575.69
	VRF AC	-	-	-	-	-	-	-	-	-
	Subtotal	3,872,686	287	97%	97%	3,744,694.73	280.59			$ 5,403,771
	Accounting Record	-	-	-	-	-	-	-	-	-
	Compact Fluorescent Lighting (CFL)	74,530	11	96%	96%	71,178.51	10.51	14.0	3.0	$ 32,768
	Custom Lighting	135,618	9	96%	96%	129,519.48	8.60	14.0	14.0	$ 177,780
	Installation Cost - Ladders	-	-	-	-	-	-	-	-	-
Business Hard to Reach	LED	988,288	163	96%	96%	943,846.31	155.67	14.0	14.0	$ 1,650,160
	LED Refrigerated Case Lighting	2,590	-	96%	96%	2,473.53	-	14.0	8.0	$ 1,817
	Other	-	-	-	-	-	-	-	-	-
	T12 to T8 with Electronic Ballast	850,748	100	96%	96%	812,491.25	95.50	14.0	14.0	$ 1,273,744
	T8 to T8 Low Wattage	360,325	57	96%	96%	344,121.77	54.44	14.0	14.0	$ 592,798
	Subtotal	2,412,099	340	96%	96%	2,303,630.86	324.71			$ 3,729,067

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Table A-1 (continued). Program Year 2013 Validated and Verified Participation and Savings by Program and Measure, Business Programs

Program	Measure	Sum Net kWh Savings (A)	Sum Net kW Savings (B)	Overall kWh Verification Ratio (C)	Overall kW Verification Ratio (D)	Verified & Validated Net kWh Savings (E = A x C)	Verified & Validated Net kW Savings (F=B x D)	EUL (G) - Avg of Useful Life	Verified EUL (H) - Useful Life from TRM	Verified & Validated Net TRB (I)
Custom Business Energy Efficiency Measures	Commercial Lighting	5,566,295	648	100%	100%	5,566,295.00	648.00	13.2	13.2	$ 8,264,246
	Custom Lighting	11,949	2	100%	100%	11,949.00	2.00	12.0	11.4	$ 17,669
	LED	5,310,645	799	100%	100%	5,289,562.44	795.83	12.7	12.7	$ 8,031,380
	Chiller	131,718	26	100%	100%	131,718.00	26.00	15.6	15.6	$ 258,485
	Demand Ventilation Control - AC	795,546	124	100%	100%	795,246.71	123.95	15.0	15.0	$ 1,428,654
	Garage Demand Control Ventilation Control	880,657	84	100%	100%	880,537.34	83.99	11.6	11.6	$ 1,098,750
	HVAC	3,029,047	299	100%	100%	3,029,047.00	299.00	15.2	15.2	$ 4,749,871
	VFD - Cooling Tower Fan	310,939	37	100%	100%	310,904.04	37.00	15.5	15.5	$ 512,729
	Equipment Controls	55,279	-	100%	100%	55,158.83	-	10.0	10.0	$ 48,360
	Equipment Controls - Bi-Level Lighting	213,421	24	100%	100%	213,421.00	24.00	9.6	9.4	$ 238,314
	Equipment Controls - Building	751,678	77	100%	100%	751,561.86	76.99	13.7	13.7	$ 1,077,813
	Equipment Controls - HVAC	542,077	67	100%	100%	541,907.06	66.98	14.8	14.8	$ 862,056
	Equipment Controls - Lighting	28,575	5	100%	100%	28,575.00	5.00	10.0	10.0	$ 39,978
	Solar Water Heater	57,885	11	99%	99%	57,050.44	10.84	17.6	17.6	$ 119,814
	Water Heating	168,729	68	100%	100%	168,698.67	67.99	10.0	10.0	$ 350,843
	Air Compressor	111,382	6	100%	100%	111,207.75	5.99	20.8	20.8	$ 185,565
	CEE Tier 1 Listed Premium Efficiency Motors	496,211	97	100%	100%	496,211.00	97.00	18.2	18.2	$ 1,093,189
	Custom Equipment	600,464	19	100%	100%	600,464.00	19.00	19.0	19.0	$ 909,709
	Energy Star - TV	34,580	7	100%	100%	34,504.83	6.98	15.0	15.0	$ 68,407
	Refrigeration	142,201	3	100%	100%	141,923.35	2.99	14.3	14.3	$ 170,318
	VFD - Fans - Non HVAC	9,295	-	100%	100%	9,274.79	-	10.0	10.0	$ 8,132
	VFD - Pumps Non HVAC	1,245,254	137	100%	100%	1,245,254.00	137.00	13.8	13.8	$ 1,819,984
	Windows	1,700,722	218	100%	100%	1,700,722.00	218.00	30.0	30.0	$ 4,206,312
	Data Center Technologies	345,108	39	100%	100%	345,108.00	39.00	12.0	12.0	$ 479,821
	Subtotal	22,539,657	2,799	100%	100%	22,516,302.11	2,793.53			$ 36,040,398
All Business - Total		55,765,938	7,294	100%	100%	55,577,487.88	7,277.70			$ 90,347,256

* Some measures were rolled up for the verification process. For instance, "Refrigerator - Trade In (or "w/Recycling")" from BEEM includes "Refrigerator - Trade In" and "Refrigerators w/Recycling" measures from the Annual Report. Similarly, "Compact Fluorescent Lighting (or "CFL")" from BESM includes "Compact Fluorescent Lighting (CFL)" and "CFL" measures from the Annual Report.

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Table A-2. Program Year 2013 Validated and Verified Participation and Savings by Program and Measure, Residential Programs

Program	Measure	Sum Net kWh Savings (A)	Sum Net kW Savings (B)	Overall kWh Verification Ratio (C)	Overall kW Verification Ratio (D)	Verified & Validated Net kWh Savings (E = A x C)	Verified & Validated Net kW Savings (F=B x D)	EUL (G) - Avg of Useful Life	Verified EUL (H) - Useful Life from TRM	Verified & Validated Net TRB (I)
Residential Energy Efficiency Measures	Bounty - Refrigerator/Freezer	268,863	11	100%	100%	268,863.00	11.00	14.0	14.0	$ 342,962
	Ceiling Fans	482,440	55	100%	100%	482,440.00	55.00	5.0	5.0	$ 329,399
	CFL	47,590,167	6,555	99%	99%	47,342,698.13	6,520.91	6.0	6.0	$ 40,146,151
	Clothes Washer	738,087	100	100%	100%	738,087.00	100.00	12.0	11.0	$ 1,015,916
	Heat Pump	342,559	48	100%	100%	342,559.00	48.00	10.0	10.0	$ 443,613
	LED	4,167,833	753	100%	100%	4,167,833.00	753.00	15.0	15.0	$ 7,900,510
	Maintenance - AC	829	-	99%	99%	818.65	-	1.0	1.0	$ 85
	Metering - Home Energy	720	-	99%	99%	711.01	-	4.0	4.0	$ 286
	Peer Group Comparison	4,819,509	551	101%	295%	4,871,032.53	1,625.13	1.0	1.0	$ 1,079,037
	Recycler Cost	-	-	-	-	-	-	-	-	-
	Refrigerator - Trade In	3,863,029	160	98%	98%	3,785,576.10	156.79	14.0	14.0	$ 4,836,181
	Refrigerator - Under $600	24,509	4	100%	100%	24,509.00	4.00	14.0	14.0	$ 42,689
	Room Occupancy Sensors	3,016	1	99%	99%	2,978.36	0.99	8.0	8.0	$ 4,659
	Solar Attic Fans	90,392	3	100%	100%	90,392.00	3.00	5.0	5.0	$ 49,484
	Solar Water Heater	3,912,723	872	99%	99%	3,856,040.36	859.43	15.0	20.0	$ 9,562,765
	Solar Water Heating Tune-Up	209,851	24	100%	100%	209,851.00	24.00	5.0	5.0	$ 143,409
	VFD - Pool Pump Packages	134,637	10	100%	100%	134,637.00	10.00	10.0	10.0	$ 147,892
	VRF AC	310,447	143	100%	100%	310,447.00	143.00	14.9	15.0	$ 935,757
	Whole House Fans	348,021	173	100%	100%	348,021.00	173.00	19.8	5.0	$ 460,891
	Subtotal	67,307,632	9,463	100%	111%	66,977,494.15	10,487.25			$ 67,441,686
Residential Energy Services and Maintenance	Design	3,758,500	-	100%	100%	3,758,499.82	-	14.5	15.0	$ 4,411,293
	Subtotal	3,758,500	-	100%	100%	3,758,499.82	-			4,411,293
Residential Hard to Reach	Refrigerator - Hui Up	74,793	3	100%	100%	74,793.00	3.00	14.0	14.0	$ 95,177
	Refrigerator - Hui Up (Molokai)	-	-	-	-	-	-	-	-	-
	Solar Water Heater	91,418	20	96%	99%	87,836.10	19.71	15.0	20.0	$ 218,476
	Subtotal	166,211	23	98%	99%	162,629.10	22.71			$ 313,654
Custom Energy Solutions for the Home	LED	9,531	7	99%	99%	9,467.38	6.95	15.0	15.0	$ 38,895
	Subtotal	9,531	7	99%	99%	9,467.38	6.95			$ 38,895
All Residential - Total		71,241,873	9,493	100%	111%	70,908,090.44	10,516.92			$ 72,205,528
Program Overall		127,007,811	16,787	100%	106%	126,485,578.32	17,794.62			$ 162,552,785

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Appendix B-Sample Design

This appendix provides detailed data regarding Evergreen's sample design for the measure verification research.

Evergreen developed sample frames by customer category, based on our research approach. For the business sector, we developed three customer strata:[9]

- Small and Medium Business End-Use Customers – small and medium business customers who installed prescriptive measures based on the Q1-Q3 data extract;
- Large Business End-Use Customers – business customers who completed projects in the business programs with large savings in Q1-Q4; and
- Custom Projects – business customers who completed custom projects through CBEEM in Q1-Q4.

For the residential sector, we developed four customer strata:

- Residential End-Use Customers – residential customers who pay their own utility bill based on the Q1-Q3 data extract and participate through the REEM and RHTR programs. Upstream lighting measures and Opower peer group comparisons from the REEM program are separated into other customer segments described below;
- Residential Energy Services and Maintenance – building design measures funded through the RESM program in Q1-Q4;
- Opower Peer Group Comparison – participants receiving Opower home energy reports from the REEM program in Q1-Q4; and
- Upstream CFLs and LEDs – CFL and LED sales through the REEM program in Q1-Q4.

Each sample frame was developed based on the most current data available to the team at the time that the sample frame was created.

The following sample strata used data from Q1-Q3 to form the sample frame:

- Small and Medium Business End-Use Customers
- Residential End-Use Customers

[9] BEEM condominium submetering, BESM SBDIL, and BHTR SBDIL were not excluded from the business customer strata. Hence, some were verified with the telephone surveys and desk reviews. However, these measures were also verified by various technical review activities.

The following sample strata used data from Q1-Q4 to form the sample frame:[10]

- Residential Energy Services and Maintenance
- Opower Peer Group Comparison
- Upstream CFLs and LEDs
- Large Business End-Use Customers
- Custom Projects

[10] The samples for the BEEM condominium submetering, BESM SBDIL, and BHTR SBDIL technical reviews used data from Q1-Q4.

Tables B-1 and B-2 below present a summary of the savings each sample category represents, compared to the total claimed program savings. The first row shows the verification method used and the second row shows the sample category. (The table is continued on the next page, with additional columns of data).

Table B-1. Program Savings Represented by Verification Samples (First-Year Net Energy kWh Savings Claimed by the Program)

		Telephone Survey		Desk Reviews	
Sector	Program	Residential End-Use Customers	Small and Medium Business End-Use Customers	Large Business End-Use Customers	Custom Business Energy Efficiency Measures
Business					
	Business Energy Efficiency Measures	-	752,843	5,373,027	-
	Business Services and Maintenance	-	96,325	-	-
	Business Hard to Reach	-	6,692	131,738	-
	Custom Business Energy Efficiency Measures	-	497,173	-	5,558,621
	Business Total	**-**	**1,353,032**	**5,504,765**	**5,558,621**
Residential					
	Residential Energy Efficiency Measures	393,530	-	-	-
	Residential Energy Services and Maintenance	-	-	-	-
	Residential Hard to Reach	15,741	-	-	-
	Custom Energy Solutions for the Home	-	-	-	-
	Residential Total	**409,271**	**-**	**-**	**-**
Program Overall		**409,271**	**1,353,032**	**5,504,765**	**5,558,621**

Table B-1 (continued). Program Savings Represented by Verification Samples (First-Year Net Energy kWh Savings Claimed by the Program)

		Technical Review						
Sector	**Program**	**Business SBDIL**	**Business Energy Efficiency Measures Submetering**	**Residential Energy Services and Maintenance Design**	**Residential Energy Effiencieny Measures Opower**	**Residential Energy Effiencieny Measures CFLs**	**Residential Energy Efficeincy Measures LEDs**	**Total**
Business								
	Business Energy Efficiency Measures	-	1,381,401	-	-	-	-	7,507,271
	Business Services and Maintenance	337,778	-	-	-	-	-	434,103
	Business Hard to Reach	456,779	-	-	-	-	-	595,210
	Custom Business Energy Efficiency Measures	-	-	-	-	-	-	6,055,794
	Business Total	**794,557**	**1,381,401**	**-**	**-**	**-**	**-**	**14,592,378**
Residential								
	Residential Energy Efficiency Measures	-	-	-	4,819,509	47,590,167	4,167,833	56,971,039
	Residential Energy Services and Maintenance	-	-	3,758,500	-	-	-	3,758,500
	Residential Hard to Reach	-	-	-	-	-	-	15,741
	Custom Energy Solutions for the Home	-	-	-	-	-	-	-
	Residential Total	**-**	**-**	**3,758,500**	**4,819,509**	**47,590,167**	**4,167,833**	**60,745,279**
Program Overall		**794,557**	**1,381,401**	**3,758,500**	**4,819,509**	**47,590,167**	**4,167,833**	**75,337,657**

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Table B-2. Verification Samples as a Percent of Program kWh Savings (First-Year Net Energy Savings Claimed by the Program)

		Telephone Survey		Desk Reviews		Technical Review						
Sector	Program	Residential End-Use Customers	Small and Medium Business End-Use Customers	Large Business End-Use Customers	Custom Business Energy Efficiency Measures	Business SBDIL	Business Energy Efficiency Measures Submetering	Residential Energy Services and Maintenance Design	Residential Energy Effienciey Measures Opower	Residential Energy Effienciey Measures CFLs	Residential Energy Efficeincy Measures LEDs	Total
Business												
	Business Energy Efficiency Measures	-	3%	20%	-	-	5%	-	-	-	-	28%
	Business Services and Maintenance	-	2%	-	-	9%	-	-	-	-	-	11%
	Business Hard to Reach	-	0%	5%	-	19%	-	-	-	-	-	25%
	Custom Business Energy Efficiency Measures	-	2%	-	25%	-	-	-	-	-	-	27%
	Business Total	**0%**	**2%**	**10%**	**10%**	**1%**	**2%**	**0%**	**0%**	**0%**	**0%**	**26%**
Residential												
	Residential Energy Efficiency Measures	1%	-	-	-	-	-	-	7%	71%	6%	85%
	Residential Energy Services and Maintenance	0%	-	-	-	-	-	100%	-	-	-	100%
	Residential Hard to Reach	9%	-	-	-	-	-	-	-	-	-	9%
	Custom Energy Solutions for the Home	0%	-	-	-	-	-	-	-	-	-	0%
	Residential Total	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**	**5%**	**7%**	**67%**	**6%**	**85%**
Program Overall		**0%**	**1%**	**4%**	**4%**	**1%**	**1%**	**3%**	**4%**	**37%**	**3%**	**59%**

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Appendix C – Verified Performance Award Claim

After finalizing our verification analysis, we applied our results to Hawaii Energy's performance award claim presented in the Program Year 2013 Annual Report. We used our verified net kWh, net kW, and net TRB to calculate a verified performance award. Market transformation activities were confirmed as part of our validation task discussed in the body of this memo. Island equity claims were not adjusted using verification ratios, however we did validate incentive claims at 100 percent as part of our validation activities. Hawaii Energy set targets for island equity of 73.8 percent, 12.9 percent, and 13.4 percent for Honolulu, Hawaii, and Maui Counties, respectively. They came within 2 percent of each of these targets and were able to claim the full award for island equity. The results of our calculations on the performance award are shown below in Table C-1, with a total of $627,564 total performance award verified.

Table C-1. Summary of Verified Performance Award Claim

			Claimed			Verified		
Performance Indicator		**Target**	**Results**	**% of Target**	**Award Claim**	**Results**	**% of Target**	**Award Claim**
First Year Energy Reduction (kWh)		141,616,143	127,007,811	90%	$219,727	126,485,578	89%	$218,824
Peak Demand Reduction (kW)		17,821	16,787	94%	$32,969	17,795	100%	$34,948
Utility Cost Avoidance (TRB)		$177,013,974	$156,542,771	88%	$247,619	$162,552,785	92%	$257,125
Market Transformation	Behavior Modification	18,000	23,297	129%	$23,334	23,297	129%	$23,334
	Professional Development	1,000	1,336	134%	$23,333	1,336	134%	$23,333
	Technical 'Know-How'	2,000	223	11%	$0	223	11%	$0
Island Equity	Honolulu County	73.8%	71.7%	97%		71.7%	97%	
	Hawaii County	12.9%	13.2%	103%	$70,000	13.2%	103%	$70,000
	Maui County	13.4%	15.1%	113%		15.1%	113%	
Total Performance Award					**$616,982**			**$627,564**