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January 13, 2012

The Honorable Chair and Members of  
the Hawaii Public Utilities Commission  
465 S. King St., 1<sup>st</sup> Floor  
Honolulu, HI 96813

Dear Commissioners:

Please find attached a memorandum describing the results of Evergreen Economics' verification of Hawaii Energy's Program Year 2010 energy savings claim. This memorandum is submitted in accordance with S.B. 3001 (July 1, 2008) and Hawaii Revised Statutes 269 Part VII:

§269-124(7) Before January 2, 2008, and every three years thereafter, require verification by an independent auditor of the reported energy and capacity savings and incremental renewable energy production savings associated with the programs delivered by the public benefits fee administrator contracted by the public utilities commission to delivery energy-efficiency and demand-side management programs under section 269-121.

The Evaluation, Measurement and Verification (EM&V) team lead by Evergreen Economics was able to verify 93 percent of the energy savings claimed by Hawaii Energy for Program Year 2010 (see Table 1).

**Table 1. Program Year 2010 Claimed and Verified First-Year Energy Savings**

Sector	Program	First-Year Gross Savings (kWh)		Percent Verified of Claimed Savings
		Claimed	Verified	
Non-Residential				
	Business Energy Efficiency Measures	39,007,627	35,507,189	91%
	New Business Programs Incubator	1,210,086	1,101,681	80%
	Custom Business Energy Efficiency Measures	17,847,919	14,232,764	91%
	<b>Non-Residential Total</b>	<b>58,065,632</b>	<b>50,841,633</b>	<b>88%</b>
Residential				
	Residential Energy Efficiency Measures	53,643,302	52,484,471	98%
	Residential Low Income	2,314,972	2,314,972	100%
	New Incubator	950,106	929,581	98%
	<b>Residential Total</b>	<b>56,908,380</b>	<b>55,729,024</b>	<b>98%</b>
<b>Program Overall</b>		<b>114,974,012</b>	<b>106,570,657</b>	<b>93%</b>



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In addition, the EM&V team was also able to confirm that the island equity goals were met (see Table 2), as energy savings achieved in each county was within 20 percent of the proportion of each county's total contribution to the Public Benefit Fee (PBF) in the 2010 Program Year.

**Table 2. Program Year 2010 Island Equity Verification**

		Verified					
County	PBF Contribution    % PBF		Equity Targeted Program	Achieved Program	+/-%		
			Level Savings (kWh)	Level Savings (kWh)	% Savings	of Target	Target Met
Oahu	23,465,012	75%	79,634,162	82,709,396	72%	4%	Yes
Hawaii	3,861,739	12%	13,105,740	12,249,771	11%	-7%	Yes
Maui	4,075,372	13%	13,830,755	11,611,490	10%	-16%	Yes
<b>Total</b>	<b>31,402,123</b>	<b>100%</b>	<b>106,570,657</b>	<b>106,570,657</b>	<b>93%</b>		

Note: PBF contribution reported by SAIC in *Hawaii Energy Annual Report Program Year 2010*. Verified savings were calculated by Evergreen Economics with data from SAIC's tracking system for Program Year 2010.

If you have any questions on this matter, please call me at (503) 894-8676.

Sincerely,

Stephen Grover, PhD  
President

Attachment

cc: Contract Manager  
Technical Advisory Group  
Hawaii Energy

## **MEMORANDUM**

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January 13, 2012

**To:** Chris Ann Dickerson, Jim Flanagan

**Re:** Verification of Hawaii Energy 2010 Programs

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Evergreen Economics is currently under contract with the Hawaii Public Utilities Commission to conduct a comprehensive multi-year evaluation of the Hawaii Energy Conservation and Efficiency (Hawaii Energy) Program. This memorandum provides the results of validation and verification activities that the Evergreen team conducted as part of the comprehensive evaluation on energy efficiency programs implemented by Hawaii Energy for Program Year 2010.

### **1. Introduction**

One component of the Program Year 2010 evaluation was to estimate energy savings by measuring and verifying the program's energy savings claims. Our research to estimate the energy savings included:

- Technical Reference Manual review;<sup>1</sup>
- Savings database validation; and
- Measure installation verification.

This memorandum presents the results of the last two activities to estimate energy savings: the savings database validation and the measure verification. These two activities are typically 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 matches the program tracking database;
- Verify that the program installed the measures it claimed savings for;
- Determine that the measures are program-qualifying; and
- Verify savings for custom measures using engineering analyses.

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<sup>1</sup> The TRM review consisted of an engineering review of all the deemed savings values and underlying assumptions used to calculate the measure-level savings for Program Year 2010. Please see the Evergreen Economics report *Analysis of the Hawaii Energy Efficiency Program Technical Reference Manual, Program Year 2011, July 2010 through June 2011*, revised draft dated November 18, 2011 for the recommended changes to the savings values for 2010. The review will be finalized in January 2012.



These verification activities are distinguished from “measurement” activities that are intended to measure the energy savings from program measures such as through equipment metering or analysis of changes in electricity bills.

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.

We will deliver a comprehensive evaluation report in early 2012 that will include detailed results for all of the energy savings evaluation activities we have conducted on Program Year 2010. The report will also document the methods and results from the process evaluation and market assessment conducted throughout 2011 to support the Hawaii Energy programs.

## Background

The Hawaii Energy Conservation and Efficiency (Hawaii Energy) Program is operated by SAIC under contract to the Hawaii Public Utilities Commission. The Program Year 2010 Hawaii Energy portfolio, which ran from July 1, 2010 through June 30, 2011, consisted of six programs, with three programs targeting the residential sector and three targeting the business sector.<sup>2</sup>

- **Residential Energy Efficiency Measures (REEM).** The program provided prescriptive incentives to residential customers who purchased and installed energy efficiency measures. The program merged legacy residential programs taken by Hawaii Energy and implemented through Program Year 2009. The program paid incentive rebates for prescriptive measures, including solar water heaters, high efficiency electric water heaters, heat pumps, low flow showerheads, CFL bulbs, window ACs, ductless split systems, solar attic fans, whole house fans, ceiling fans, clothes washers, dishwashers, refrigerators, refrigerators with recycling, refrigerator/freezer bounties, smart strips, and AC maintenance.
- **New Residential Programs Incubator (NEW).** The incubator program provided a measure called ‘new home energy modeling’. Hawaii Energy did not implement all planned incubator measures in this program.
- **Residential Low Income (RLI).** Enabled qualified low-income homeowners and renters to receive installation of CFLs, low-flow showerheads, and smart strips, as well as solar inspections. The program was delivered through a network of community action allies.

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<sup>2</sup> Hawaii Energy Conservation and Efficiency Programs. *Annual Plan Program Year 2010*. Submitted to Hawaii Public Utilities Commission, by RW Beck (an SAIC company). June 16, 2010.



- **Business Energy Efficiency Measures (BEEM).** Provided prescriptive incentives to business customers who purchased and installed energy efficiency measures. The program merged legacy commercial and industrial programs taken by Hawaii Energy and implemented through Program Year 2009. The program paid incentive rebates for lighting, air conditioning, water heating, water pumping, motors, building envelope improvements, and business equipment.
- **Custom Business Efficiency Measures (CBEEM).** Provided custom financial incentives based on calculated savings to commercial, institutional, governmental, and industrial sector customers.
- **New Business Programs Incubator (NEW).** The Annual Plan described three categories of services in this program. Business Service & Maintenance provided tune-ups and a competition to optimize complete plant efficiency. The Business Direct Install category targeted customers within the small business market to replace older lighting technologies and obtain financing to implement the lighting projects. The Business Design, Audits, and Commissioning category provided energy study assistance. Hawaii Energy did not implement all planned measures in this program.

## Overall Validation and Verification Results

The overall validation and verification results indicate that 93 percent of the energy savings claimed in the SAIC *Hawaii Energy Annual Report Program Year 2010* (Annual Report)<sup>3</sup> were found to be installed, program-qualifying and validated in the program tracking database. Table 1 presents the overall verification results by program. The values shown in the table by column are:

- **Sector and Program**, which indicate the sector (residential or non-residential) and the Hawaii Energy program;
- **Claimed First-Year Gross Savings** (kWh), which summarize the first-year energy savings claims from the Annual Report in kilowatt hours by program;
- **Verified First-Year Gross 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 Savings**, which presents the overall verified savings ratios by program, also reflecting the combination of the savings validation and measure installation verification results.

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<sup>3</sup> Submitted to Hawaii Public Utilities Commission, November 1, 2011. Gross savings reported at the measure level in Attachment B of the Annual Report.



**Table 1. Program Year 2010 Claimed and Verified First-Year Energy Savings, by Sector and Program**

		First-Year Gross Savings (kWh)		Percent Verified of Claimed Savings
Sector	Program	Claimed	Verified	
Non-Residential				
	Business Energy Efficiency Measures	39,007,627	35,507,189	91%
	New Business Programs Incubator	1,210,086	1,101,681	80%
	Custom Business Energy Efficiency Measures	17,847,919	14,232,764	91%
	<b>Non-Residential Total</b>	<b>58,065,632</b>	<b>50,841,633</b>	<b>88%</b>
Residential				
	Residential Energy Efficiency Measures	53,643,302	52,484,471	98%
	Residential Low Income	2,314,972	2,314,972	100%
	New Incubator	950,106	929,581	98%
	<b>Residential Total</b>	<b>56,908,380</b>	<b>55,729,024</b>	<b>98%</b>
<b>Program Overall</b>		<b>114,974,012</b>	<b>106,570,657</b>	<b>93%</b>

Note: Claimed program-level gross savings reported by SAIC in *Hawaii Energy Annual Report Program Year 2010*.

## 2. Research Methods

### Overview

As described above, this memorandum presents results from three research tasks that were intended to evaluate the program's energy savings claims:

1. **Savings database validation.** We obtained a database from SAIC including program participants and energy savings values for Program Year 2010 and summarized the savings claims by program (e.g., REEM) and energy efficiency measure (e.g., ceiling fans) and compared that to SAIC's program and measure-level summary of its savings claims in the Annual Report.
2. **Measure verification.** We conducted telephone and site surveys with statistically representative samples of participants by program. We also conducted site surveys of large customer projects to verify that measures contained in the program tracking database were actually installed, program-qualifying and the correct savings inputs and calculations were being used. For custom measures, we conducted engineering analyses based on on-site surveys to confirm claimed savings. For compact fluorescent lamps, which were delivered upstream, we verified that the measures were program qualifying, and that the invoices submitted by retailers matched the measure counts claimed by the program.
3. **Residential Low Income verification.** We verified program activity at each distribution stage to verify that the reported activity occurred and to account for the measures claimed by the RLI program. Specific verification activities included a review of the program database for line-item entries, a review of the records of the



distribution of measures to low-income agencies (when paperwork was available), and phone interviews with each low-income agency to confirm that they received the reported number of measures. We also reviewed invoices and confirmed that the measures were program-qualifying and matched the measure counts claimed by the program.

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 verified 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 2010 operations.

### **Savings Database Validation**

SAIC provided the evaluation team the final data from its tracking system for the entire Program Year 2010. We used the data to generate an independent estimate of claimed savings and compared our estimate to that reported in the Hawaii Energy 2010 Annual Report.

The validation exercise required that the measure installation counts and total savings included in the Annual Report be replicated in our independent review of the tracking database. The final database was expected by the end of July but Evergreen did not receive it until November 21. There were multiple iterations of the database through late November. Evergreen's audits of the tracking database showed discrepancies that were subsequently corrected by Hawaii Energy. The corrections to multiple versions of the database in response to question from the Evergreen team confounded our analysis and results. Ultimately, the final version equaled the values reported in the Annual Report. Evergreen rounded the values in the tracking database to the nearest single digit, yielding an exact match for all measures to values reported in the Annual Plan.

Similarly, the per unit savings values used in the Annual Report were also checked in the tracking data (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 replicated the gross savings, net savings, and Total Resource Benefit (TRB) Ratio results from the Annual Report by conducting our own calculations for these parameters using the final tracking system data.





## Measure Verification

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

## Sample Design

We used program tracking data from the first three quarters of the 2010 program year as the basis for 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 2011, requiring us to pull 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.

SAIC provided Evergreen an extract of the program tracking database covering the first three quarters on May 3, 2011. We used this dataset to develop samples for phone and on-site surveys, which we used to verify the REEM and BEEM programs.

For the non-residential program, we supplemented the Q1-Q3 dataset with large projects in the BEEM program and all projects in the CBEEM program recorded in the tracking database in Q4 of the Program Year 2010. We worked closely with SAIC over the summer to collect additional detailed information to support the sampling approach. We conducted on-site surveys of those projects, to ensure our sample included significant projects not included in the sample frame based on the first three quarters.

For the Residential Low Income program, we reviewed invoices for all distributed measures throughout the entire program year.

Table 2 below compares the first-year gross energy savings covered by the sample frame (based on the first three quarters of participation records supplemented with large non-residential projects) to the final program tracking database. The first two columns indicate the sector and program, the third column the first-year gross energy savings claims represented by the sample frame, the fourth column the first-year gross energy savings claims represented by the full-year participation database, and the fifth and final column the fraction full-year energy savings that is represented by the sample frame.





**Table 2. Program Year 2010 Gross Energy Savings for Sample Frame and Full-Program Year, by Sector and Program**

		First-Year Gross Savings (kWh)		Sample Frame as a % of Full-Year Energy Savings
Sector	Program	Sample Frame <sup>1</sup>	Full Year <sup>2</sup>	
Non-Residential				
	Business Energy Efficiency Measures	39,206,697	39,007,627	101%
	New Business Programs Incubator	0	1,210,086	0%
	Custom Business Energy Efficiency Measures	17,847,919	17,847,919	100%
	<b>Non-Residential Total</b>	<b>57,054,616</b>	<b>58,065,632</b>	<b>98%</b>
Residential				
	Residential Energy Efficiency Measures	43,575,054	53,643,302	81%
	Residential Low Income	2,314,972	2,314,972	100%
	New Incubator	0	950,106	0%
	<b>Residential Total</b>	<b>45,890,026</b>	<b>56,908,379</b>	<b>81%</b>
<b>Total</b>		<b>102,944,642</b>	<b>114,974,011</b>	<b>90%</b>

**Notes:**

1. Sample frame for residential programs based on Q1-Q3 extract from the program tracking database. For non-residential programs, the sample frame is based on the Q1-Q3 extract supplemented by large and customer projects recorded in the program tracking database in Q4. The sample frame for the CBEEM program included all projects implemented in Program Year 2010.
2. Full-year program-level savings based on the final Q1-Q4 program tracking database.

The sample frame represents 90% of the full-year program savings. For the BEEM program, claimed savings in the sample frame represented 101% of the full-year savings – a non-intuitive result, due to adjustments to the tracking database that occurred in the fourth quarter that resulted in a decline of total program-year claimed savings. For the CBEEM program, the sample frame savings represented 100% of the full year. During our verification work, Evergreen worked closely with Hawaii Energy to include large BEEM and all CBEEM projects in the verification process. Because many large programs were completed and recorded in Q4, if we had relied solely on the Q1-Q3 data extract, the sample frame would have not been representative of the full-year savings in the non-residential sector. For the REEM program, the Q1-Q3 sample frame represented 81% of the full-year savings.

Appendix B provides more detail on our sampling approach.

## **Data Collection**

The evaluation team conducted 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 worked in 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 compact fluorescent lamps (CFLs). The manufacturers and distributors then sold discounted product to lighting retailers. The retailers pass on that discount directly to customers who buy CFLs and receive their discount via a point-of-sale rebate that is redeemed instantly.

Research methods used for the downstream customers included telephone and site surveys to confirm that customers received a rebate, bought program-qualifying equipment, and presently had the equipment still installed and operating. Evergreen also conducted site surveys and reviewed project files to confirm savings for large and custom commercial and industrial projects. For upstream CFLs, we audited a sample of retailer invoices to verify that the invoice totals matched the program tracking database and that the CFL model numbers were program-qualifying. For the RLI program, we conducted a detailed review of all invoices to verify that the number of measures distributed by cooperating community organizations matched the numbers reported in the program tracking database.

Table 3 below provides an overview of the sample sizes drawn for the various types of research—telephone surveys, site surveys, retailer invoice audits, and project file reviews. A total of 686 telephone and 127 site surveys were conducted across the residential and non-residential sectors and 20 lighting retailer invoices and 51 custom and large business projects files were reviewed. We also reviewed all invoices and distributor-level transactions for the RLI program, provided in a single 644-page file from Hawaii Energy. The samples collectively represent 40% of the sample frame savings from which they were drawn.

**Table 3. Overview of Measure Verification Sample Sizes**

Participant Type	Research Mode				Energy Savings Represented by the Sample as % of Total Sample Frame
	Telephone Survey	Site Survey	Retailer Invoice Audit	Project File Review	
Non-Residential downstream customers	80	51		51	58%
Residential downstream customers	606	76			7%
Residential Low Income				1	100%
Upstream light market actors		5	20		16%
<b>Total</b>	<b>686</b>	<b>132</b>	<b>20</b>	<b>52</b>	<b>40%</b>

### ***Downstream Research***

The following is a brief description of the telephone surveys, on-site surveys, and engineering reviews that were used to verify measure installations and program qualifications for downstream customers.

- **Telephone surveys.** SMS, a Hawaii-based telephone survey research firm, conducted computer-assisted telephone interview (CATI) surveys for both



residential and non-residential customers in July 2011. 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 survey also asked respondents if they would be willing to participate in an on-site verification survey that would follow for a sample of telephone survey respondents.

The telephone surveys were conducted with a sample of participants from the REEM and BEEM programs. For residential customers, we used a modified proportional sample allocation based on measure category and island, ensuring at least 70 sample points per county. The survey targeted 600 customers, addressing up to two measures per customer. For non-residential customers we did not draw a sample of customers; because the population was so small (419 individual customers) we dialed all participants. SMS completed 606 residential surveys and 80 non-residential surveys.

- **Customer on-site surveys.** We conducted on-site visual inspections of measures installed in residences and non-residential locations. Michaels Energy based in Wisconsin and InSynergy Engineering, Inc. based in Honolulu conducted the on-site surveys to verify that the measures were installed, that they qualified for the program, and were operating. For the residential program, SMS recruited willing participants for the residential on-site survey through the CATI survey, yielding 79 completed residential on-site surveys of measures at 76 sites.

The non-residential on-site sample was generated in two ways: SMS recruited willing participants through the CATI survey, yielding completed non-residential on-site surveys of 43 measures in the BEEM program at 21 sites; we inspected an additional 154 measures at 30 businesses who were excluded from the telephone survey. The customers who were excluded were those who completed large projects in the fourth quarter, those that completed custom projects through the CBEEM program, and the military. There were a total of 101 measures at 16 business inspected from the group of customers who completed large energy saving (kWh) projects in the fourth quarter; 15 measures at 13 business who completed projects through the CBEEM program; finally, 38 measures at commercial and residential facilities of the U.S. Navy, U.S. Marine Corps, and the U.S. Army.

The commercial on-site surveys also supported the engineering analyses performed on all custom measures. During the on-site visits, the quantity of installed equipment was verified by inspection, and equipment nameplate information was recorded. These two pieces of information were used to ensure the installed equipment was consistent with what was presented on the application, and to determine if it was program qualifying. Additionally, we collected operational characteristics such as temperature set points, operating schedules, typical loading characteristics, baseline system equipment, and baseline system operational details.



This information was used to verify the accuracy of any original calculations, and to determine if customer's actual operation was consistent with program assumptions.

### ***Upstream and Residential Low Income CFL Research***

We conducted site visits and invoice audits to verify the CFLs sold through the upstream program and to collect pricing information on bulbs. Because the program does not collect end-user customer data (i.e., the residents and businesses where the CFLs are ultimately installed), our research focused on the participating manufacturers, distributors, and retailers. We confirmed that measures are being sold in participating retail stores and reviewed retailer invoices, as described below.

- **Lighting retailer site visits.** The evaluation team visited 5 retail stores in early 2011 to confirm that program-qualifying CFLs were being sold by participating retailers. This was a follow-up to more extensive on-sites that were conducted the prior year.
- **CFL retailer invoice audit.** The evaluation team also reviewed a sample of invoices from lighting retailers participating in the CFL rebate program. We reviewed a random stratified sample of invoices from participating retailers to ensure that the information in Hawaii Energy's databases matched the invoices and to verify that the stores met the requirements of the MOU that the program issued to each store. We compared the fields for store name, stock-keeping unit (SKU) number, and number of packages to those values on the invoices. We then compared the SKU numbers from the invoices with a list of Energy Star-certified CFLs, as reported on the Energy Star website.<sup>4</sup> The invoice audit represented 20% of energy savings associated with CFL sales, based on the extract of the first three quarters of PY2010 data.
- **RLI invoice and documentation review.** We used the same approach as was used for upstream CFLs to verify RLI CFLs (and a small number of showerheads and smart strips). We reviewed 100% of all the RLI invoices.

## **Analysis**

We used the data collected from the surveys, project reviews, 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.

For **upstream and RLI CFLs**, we used the results from the invoice audit to develop a verification ratio. A CFL was counted as verified if:

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<sup>4</sup> <http://www.energystar.gov>.



- Its model number was confirmed to be program-qualifying;
- The total of the CFLs on a particular retailer invoice matched the database;
- They were sold within the 2010 Program Year;
- For RLI CFLs, they were distributed to a low-income service provider.

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 SAIC's database check fields;
- The measure was program-qualifying based on confirming the model number against program qualifications;
- The savings inputs and calculations are appropriate and accurate; and
- The equipment was still operable and in use.

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

We augmented the telephone surveys with customer site surveys to inspect a sample of households and commercial facilities to confirm the measure was still installed, operable, and program qualifying. We developed a correction factor for the nested sample of customers who had both a telephone and site survey, where the customer site survey was assumed to be correct if there was a discrepancy. For example, if two of 10 measures were self-reported as verified by telephone but were not installed or not program-qualifying based on the site survey (and the remaining eight matched between telephone and site), a correction factor of 20% was applied to the telephone survey verification ratio to yield a final verification ratio.

For **large and custom commercial facilities (including military)** that were reviewed by engineers based on electronic project files and customer site surveys, we attempted to confirm the energy savings claims in the database. We reviewed vendor records, observed equipment size and specifications on-site and interviewed customers. We developed verification ratios for each project based on the energy savings that we could confirm. Where we could not confirm the energy savings, we relied on at least two sources of information (e.g., a site survey combined with a project file review).

We applied the verification ratios by program and measure that we developed based on the process described above to the final program tracking database, which covered the entire year.

There were a few cases where we did not have verification ratios for measure categories within a program—either because the program was not offered in the first three quarters (upon which the sample was based) or because the program measures accounted for a small fraction of program savings and were not included in the sample. In the residential sector, these cases were:



- In the REEM program, the measure 'LED Introduction – Residential' was not included in the Q1-Q3 data extract. We applied an average of the verification ratios for all other measures in the REEM program. The measure accounted for less than 1% of total residential savings.
- In the REEM program, the measure 'Whole House Metering' was not included in the Q1-Q3 data extract. We applied an average of the verification ratios for all other measures in the REEM program. The measure accounted for less than 1% of total residential savings.
- In the New Residential Programs, the measure 'New Home – Energy Modeling' was not included in the Q1-Q3 data extract. We applied the overall verification ratio for the REEM program to this measure. The measure accounted for 2% of total residential savings.

In the non-residential sector, these cases were:

- In the BEEM program, we applied a single verification ratio for lighting to all measures associated with lighting (except lighting sensors). Individual lighting measures are implemented in similar ways, with individual measures applied to specific uses.
- In the BEEM program, the measures 'ENERGY STAR – Ceiling Fan', 'ENERGY STAR – Clothes Washer', 'ENERGY STAR – Window AC', 'ENERGY STAR – Window AC – Master Metered', 'Heat Pumps – Residential', 'High Efficiency Water Heater', 'HVAC – Ductless Split – Residential', and the Solar Water Heating measures were not included in the sample frame and/or none of these measures were captured in the phone survey. We applied the verification ratios for these measures from the REEM program. Each of these measures individually account for less than 1% of non-residential savings.
- In the BEEM program, the measure 'Split System AC' was not included in the Q1-Q3 data extract. We applied the verification ratio for HVAC-packaged split. The measure accounted for less than 1% of total non-residential savings.
- In the BEEM program, we applied a single verification ratio for HVAC – Fan Variable Frequency Drive to the measures 'VFD – AHU' and 'VFD – Chilled Water'. We had combined the variable frequency drives to develop our sample frame.
- In the BEEM program, the measure 'VFD Domestic Water Pumps' was not captured in the survey. We applied the verification ratio for motors. The measure accounted for less than 1% of total non-residential savings.



- In the New Business Programs, the measures ‘LED Introduction – Small Business’ and ‘Small Business Direct Lighting Retrofits’ were not included in the Q1-Q3 data extract. We applied the verification ratio for BEEM lighting measures to this measure. These measures combined account for 2% of non-residential savings.

### **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 2010.

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.

#### **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 SAIC. We compared the results to the Hawaii Energy 2010 Annual Report by program and measure category. The results of the savings validation are shown below in Table 4 and Table 5 for first-year gross energy savings.

Table 4 shows the validated savings by measure for the non-residential programs. The first two columns indicate the sector and program, the third column the name of the measure as reported in the program tracking database. The fourth and fifth columns restate first-year gross energy savings as claimed by SAIC in the Annual Report.

The right half of the table (the sixth and seventh columns) shows the first-year gross energy savings as calculated by Evergreen based on the final program tracking database extract. The final column shows the ratio of the energy savings as calculated by Evergreen divided by the energy savings reported by SAIC.

Table 5 shows the validated savings by measure for the residential programs. It also shows the overall total for both residential and business programs. Hawaii Energy reported first-year energy savings of 114,974,011 kWh in the Annual Report and the evaluation team validated 100% of first-year energy savings from the tracking database.





**Table 4. Program Year 2010 Validated Database Savings by Program and Measure – Step One (of Two), Non-Residential Programs**

Sector	Program	Measure	Reported Savings (Hawaii Energy PY2010 Annual Report)		Validated Savings (Q1-Q4 Dataset sent 11/23/11)		Validated kWh Savings as % of Reported
			Number of Measures	First-Year Gross Energy Savings (kWh)	Number of Measures	First-Year Gross Energy Savings (kWh)	
Non-Residential (continued on next page)	Business Energy Efficiency Measures	Accounting Record	-	-	0	0.00	NA
		CFL - Business	60,079	4,983,310	60,079	4,983,310	100%
		Delamping - T8/T12	20,557	1,790,631	20,557	1,790,631	100%
		Delamping with Reflectors - T8/T12	14,999	1,701,894	14,999	1,701,894	100%
		ENERGY STAR - Ceiling Fan	163	21,968	163	21,968	100%
		ENERGY STAR - Clothes Washer	462	77,069	462	77,069	100%
		ENERGY STAR - Dishwasher	611	33,174	611	33,174	100%
		ENERGY STAR - Refrigerator	642	54,525	642	54,525	100%
		ENERGY STAR - Refrigerator - ARRA/SEP	142	94,582	142	94,582	100%
		ENERGY STAR - Refrigerator with Recycling	58	38,629	58	38,629	100%
		ENERGY STAR - Window AC	640	193,652	640	193,652	100%
		ENERGY STAR - Window AC - Master Metered	47	14,227	47	14,227	100%
		Heat Pumps - Residential	1	1,220	1	1,220	100%
		HID - Metal Halide	222	440,145	222	440,145	100%
		HID - Pulse Start Metal Halide	513	153,851	513	153,851	100%
		High Efficiency Water Heater	2	257	2	257	100%
		HVAC - Chiller	34	2,047,717	34	2,047,717	100%
		HVAC - Ductless Split - Residential	1	303	1	303	100%
		HVAC - Package & Split Units	2,110	3,438,256	2,110	3,438,256	100%
		HVAC - Window AC	185	153,214	185	153,214	100%
		Induction Lighting	280	49,598	280	49,598	100%
		LED Exit Sign	1,960	487,886	1,960	487,886	100%
		Lighting Sensors	4,627	93,293	4,627	93,293	100%
		NEMA Premium Efficiency Motors	255	153,345	255	153,345	100%
		Solar Water Heating - Contractor - PBFA \$1,000	2	3,353	2	3,353	100%
		Solar Water Heating - Contractor - PBFA \$750	63	105,465	63	105,465	100%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	2	822	2	822	100%
		Split System AC	90	50,706	90	50,706	100%
		T5 / T5HO	5,863	6,212,285	5,863	6,212,285	100%
		T8	297,088	14,445,561	297,088	14,445,561	100%
		VFD - AHU	118	621,626	118	621,626	100%
		VFD - Chilled Water	68	1,039,875	68	1,039,875	100%
		VFD Domestic Water Pumps	7	208,267	7	208,267	100%
		Window Tinting	59,388	296,923	59,388	296,923	100%
		Subtotal	471,279	39,007,627	471,279	39,007,627	100%

Sector	Program	Measure	Reported Savings (Hawaii Energy PY2010 Annual Report)		Validated Savings (Q1-Q4 Dataset sent 11/23/11)		Validated kWh Savings as % of Reported
			Number of Measures	First-Year Gross Energy Savings (kWh)	Number of Measures	First-Year Gross Energy Savings (kWh)	
Non-Residential (continued)	New	Energy Study Assistance	8	-	8	0	NA
	Business	LED Introduction - Small Business	7,212	995,710	7,212	995,710	100%
	Programs	Small Business Direct Lighting Retrofits	2	214,375	2	214,375	100%
	Incubator	Subtotal	7,222	1,210,086	7,222	1,210,086	100%
	Custom Business Energy Efficiency Measures	Building Envelope Improvements	10	4,424,902	10	4,424,902	100%
		Building Controls	2	1,664,489	2	1,664,489	100%
		Ceramic Metal Halide	1	208,766	1	208,766	100%
		CFL - Business	1	1,908	1	1,908	100%
		CO Demand Control Ventilation - Parking Garage	1	767,847	1	767,847	100%
		Dimming Ballast & Occupancy Sensors	1	19,939	1	19,939	100%
		HID - Metal Halide	2	226,450	2	226,450	100%
		High Bay - T8HO / T8 / T5	7	158,014	7	158,014	100%
		High Efficiency Water Heating - Heat Pumps	1	1,864,449	1	1,864,449	100%
		HPS to CFL PL Exterior	1	71,830	1	71,830	100%
		HPS to CFL PL Walkway Lighting	1	6,216	1	6,216	100%
		HVAC - AHU Controls	1	20,418	1	20,418	100%
		HVAC - Chiller	3	1,394,693	3	1,394,693	100%
		HVAC - Chiller - Retrofit VFD	1	54,954	1	54,954	100%
		HVAC - Cooling Tower VFD	12	934,847	12	934,847	100%
		HVAC Controls	1	117,727	1	117,727	100%
		Indirect T5HO	1	123,208	1	123,208	100%
		Induction Lighting	3	251,824	3	251,824	100%
		LED	54	3,924,237	54	3,924,237	100%
		LED Exterior	1	17,645	1	17,645	100%
		Lighting - Bi-Level Lighting / Control	2	53,423	2	53,423	100%
		Lighting - High Bay MH to T8	114	482,623	114	482,623	100%
		Lighting - T8 to LW T8	1	29,936	1	29,936	100%
		Motors - ECM	3	33,794	3	33,794	100%
		Pulse Start MH	1	119,053	1	119,053	100%
		Pump VFD non HVAC	1	224,883	1	224,883	100%
		retro w/4'T8	1	169,382	1	169,382	100%
		Solar Water Heating - Commercial	9	117,533	9	117,533	100%
		VFD - Water Pumping - Irrigation	2	362,926	2	362,926	100%
		Subtotal	239	17,847,919	239	17,847,919	100%
	All Non-Residential - Total		478,740	58,065,632	478,740	58,065,632	100%

Note: Reported savings from Annual Report. Validated program-level savings calculated by Evergreen with data from SAIC's tracking system for Program Year 2010. Program and measure names are based on terms used in the tracking database. The names differ slightly from those presented in the Annual Report.

**Table 5. Program Year 2010 Validated Database Savings by Program and Measure – Step One (of Two), Residential Programs**

			Reported Savings (Hawaii Energy)		Validated Savings (Q1-Q4 Dataset)		
			Number of	First-Year Gross	Number of	First-Year Gross	Validated kWh
Sector	Program	Measure	Measures	Energy Savings (kWh)	Measures	Energy Savings (kWh)	Savings as % of Reported
Residential	Residential Energy Efficiency Measures	AC Annual Tune Up - Residential	17	11,140	17	11,140	100%
		Accounting Record	-	-	0	0	NA
		CFL - Residential	1,661,081	43,753,804	1,661,081	43,753,804	100%
		ENERGY STAR - Ceiling Fan	3,398	458,699	3,398	458,699	100%
		ENERGY STAR - Clothes Washer	9,255	1,541,628	9,255	1,541,628	100%
		ENERGY STAR - Dishwasher	3,676	199,038	3,676	199,038	100%
		ENERGY STAR - Refrigerator	10,654	903,510	10,654	903,510	100%
		ENERGY STAR - Refrigerator - ARRA/SEP	3,078	2,047,368	3,078	2,047,368	100%
		ENERGY STAR - Refrigerator with Recycling	1,394	927,115	1,394	927,115	100%
		ENERGY STAR - Window AC	2,973	898,966	2,973	898,966	100%
		Heat Pumps - Residential	168	204,334	168	204,334	100%
		High Efficiency Water Heater	533	68,898	533	68,898	100%
		HVAC - Ductless Split - Residential	581	175,800	581	175,800	100%
		HVAC - Package & Split Units	1	1,113	1	1,113	100%
		LED Introduction - Residential	100	15,338	100	15,338	100%
		Solar Attic Fan	14	6,135	14	6,135	100%
		Solar Water Heating - Contractor - PBFA \$1,000	13	21,764	13	21,764	100%
		Solar Water Heating - Contractor - PBFA \$750	1,376	2,297,448	1,376	2,297,448	100%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	182	75,744	182	75,744	100%
		Solar Water Heating - \$1,750 - PBFA \$250/ARRA \$1,5C	80	19,069	80	19,069	100%
		Whole House Energy Metering	4	10,693	4	10,693	100%
		Whole House Fan	13	5,697	13	5,697	100%
		Subtotal	1,698,591	53,643,302	1,698,591	53,643,302	100%
	Residential Low Income	CFL - Residential	77,472	2,026,053	77,472	2,026,053	100%
		Energy Hero Gift Packs - Low Flow Showerheads	500	80,298	500	80,298	100%
		RLI Energy Hero Gift Packs - Smart Strips	942	50,897	942	50,897	100%
		Solar Water Heating - RLI Solar Inspections ARRA WAF	379	157,724	379	157,724	100%
		Subtotal	79,293	2,314,972	79,293	2,314,972	100%
	New	New Home - Energy Modeling	3	950,106	3	950,106	100%
	Incubator	Subtotal	3	950,106	3	950,106	100%
	All Residential - Total			1,777,887	56,908,379	1,777,887	56,908,379
Program Overall			2,256,627	114,974,011	2,256,627	114,974,011	100%

Note: Reported savings from Annual Report. Validated program-level savings calculated by Evergreen with data from SAIC's tracking system for Program Year 2010. Program and measure names are based on terms used in the tracking database. The names differ slightly from those presented in the Annual Report.

## Installation Verification – Step Two (of Two)

The installation verification effort produced a measure-level verification ratio that was then used to adjust the original savings amounts claimed by SAIC. The verification ratio represents the savings associated with the measures that we verified to be installed and program qualifying.

Table 6 presents the verification ratio results for the non-residential programs. The first two columns indicate the sector and program the third column the name of the measure as reported in the tracking database and the final column show the verification ratio for each measure.

Table 7 presents the verification ratio results for the residential programs and shows the overall ratio for both residential and business programs. We verified a total of 98% of residential and 88% of non-residential energy savings to be installed, program qualifying and with accurate savings claims based on the methods described above. A total of 93% of the overall program savings were verified.

The following non-residential measures had verification rates lower than 95%:

- **Lighting** – the program used the average operating hours across all buildings, instead of using specific operating hours for each building type. Additionally, during the on-site visits, we could not find some of the claimed fixtures, or the total quantity of installed lamps was different than what was originally claimed. For lighting measures installed in residences on military bases, we found that Hawaii Energy had used the incorrect building type, overstating savings. Hawaii Energy adjusted the claimed savings, and we adjusted the verification ratio to take the change into account.
- **ENERGY STAR – Ceiling Fan** and **ENERGY STAR – Window AC**- we applied the verification ratio for residential measures. Please refer to the text below describing residential measures.
- **HVAC – Package & Split Units** and **Split System AC** - in the on-site survey, some projects had claimed equipment sizes that did not match what was actually installed. Additionally, some projects claimed the “average” building type instead of the actual building type for cooling operating hours (consistent with the lighting operating hours issue described above).
- **CBEEM-we applied a single ratio to all CBEEM measures** – we sampled 15 CBEEM projects, which represented 36% of all CBEEM kWh savings. Due to these projects being custom, there was a wide range of reasons why the savings were adjusted. The most significant were an EMS project that had the savings reduced based on our own independent whole-building analysis<sup>5</sup> that showed the savings

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<sup>5</sup> Option C of the International Performance Measurement & Verification Protocols.



were less than claimed; adjustments to baseline and system operating conditions for all cooling tower projects; and lighting hours of operation that were different from what was assumed in the original calculations. We applied the total verification ratio for the sample of 15 projects across all CBEEM measures.

The following residential measures had verification rates lower than 95%:

- **ENERGY STAR – Ceiling Fan**-in the site surveys, one respondent of 12 surveyed reported that no ceiling fan was installed at that location.
- **ENERGY STAR – Dishwasher**-in the phone survey, one respondent of 56 reported that the dishwasher was not installed; in the site survey, two of 11 measures were found to be not Energy Star.
- **ENERGY STAR – Refrigerator** and **ENERGY STAR – Refrigerator ARRA/SEP**- in the phone survey, one respondent of 76 reported that the refrigerator was no longer installed; in the site survey, one of eight measures was found to be not Energy Star.
- **ENERGY – Window AC**- in the phone survey, one respondent of 69 reported that the window AC was not installed; in the site survey, six of 10 measures were found to not meet Energy Star minimum standards.
- **Solar Water Heating** (four measure categories)- in the phone survey, one respondent of 185 reported that the solar water heater was not installed; in the site survey, one measure of 28 was not program qualifying

**Table 6. Program Year 2010 Installation Verification Ratios by Program and Measure – Step One (of Two), Non-Residential Programs**

Sector	Program	Measure	Verification Ratio
Non-Residential	Business Energy Efficiency Measures	Accounting Record	NA
		CFL - Business	91%
		Delamping - T8/T12	91%
		Delamping with Reflectors - T8/T12	91%
		ENERGY STAR - Ceiling Fan	92%
		ENERGY STAR - Clothes Washer	99%
		ENERGY STAR - Dishwasher	100%
		ENERGY STAR - Refrigerator	100%
		ENERGY STAR - Refrigerator - ARRA/SEP	100%
		ENERGY STAR - Refrigerator with Recycling	100%
		ENERGY STAR - Window AC	39%
		ENERGY STAR - Window AC - Master Metered	39%
		Heat Pumps - Residential	100%
		HID - Metal Halide	91%
		HID - Pulse Start Metal Halide	91%
		High Efficiency Water Heater	100%
		HVAC - Chiller	95%
		HVAC - Ductless Split - Residential	100%
		HVAC - Package & Split Units	83%
		HVAC - Window AC	100%
		Induction Lighting	91%
		LED Exit Sign	91%
		Lighting Sensors	106%
		NEMA Premium Efficiency Motors	101%
		Solar Water Heating - Contractor - PBFA \$1000	96%
		Solar Water Heating - Contractor - PBFA \$750	96%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	96%
		Split System AC	83%
		T5 / T5HO	91%
		T8	91%
		VFD - AHU	101%
		VFD - Chilled Water	101%
		VFD Domestic Water Pumps	101%
		Window Tinting	100%
		Subtotal	91%

Sector	Program	Measure	Verification Ratio
Non-Residential	New	Energy Study Assistance	NA
	Business Programs	LED Introduction - Small Business	91%
	Incubator	Small Business Direct Lighting Retrofits	91%
		Subtotal	91%
	Custom Business Energy Efficiency Measures	Building Envelope Improvements	80%
		Building Controls	80%
		Ceramic Metal Halide	80%
		CFL - Business	80%
		CO Demand Control Ventilation - Parking Garage	80%
		Dimming Ballast & Occupancy Sensors	80%
		HID - Metal Halide	80%
		High Bay - T8HO / T8 / T5	80%
		High Efficiency Water Heating - Heat Pumps	80%
		HPS to CFL PL Exterior	80%
		HPS to CFL PL Walkway Lighting	80%
		HVAC - AHU Controls	80%
		HVAC - Chiller	80%
		HVAC - Chiller - Retrofit VFD	80%
		HVAC - Cooling Tower VFD	80%
		HVAC Controls	80%
		Indirect T5HO	80%
		Induction Lighting	80%
		LED	80%
		LED Exterior	80%
		Lighting - Bi-Level Lighting / Control	80%
		Lighting - High Bay MH to T8	80%
		Lighting - T8 to LW T8	80%
		Motors - ECM	80%
		Pulse Start MH	80%
		Pump VFD non HVAC	80%
		retro w/4'T8	80%
		Solar Water Heating - Commercial	80%
		VFD - Water Pumping - Irrigation	80%
		Subtotal	80%
	Non-Residential Total		88%

**Table 7. Program Year 2010 Installation Verification Ratios by Program and Measure – Step Two (of Two), Residential Programs**

			Verification
Sector	Program	Measure	Ratio
Residential	Residential Energy Efficiency Measures	AC Annual Tune Up - Residential	100%
		Accounting Record	NA
		CFL - Residential	100%
		ENERGY STAR - Ceiling Fan	92%
		ENERGY STAR - Clothes Washer	99%
		ENERGY STAR - Dishwasher	80%
		ENERGY STAR - Refrigerator	86%
		ENERGY STAR - Refrigerator - ARRA/SEP	86%
		ENERGY STAR - Refrigerator with Recycling	100%
		ENERGY STAR - Window AC	39%
		Heat Pumps - Residential	100%
		High Efficiency Water Heater	100%
		HVAC - Ductless Split - Residential	100%
		HVAC - Package & Split Units	100%
		LED Introduction - Residential	98%
		Solar Attic Fan	100%
		Solar Water Heating - Contractor - PBFA \$1,000	96%
		Solar Water Heating - Contractor - PBFA \$750	96%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	96%
		Solar Water Heating - \$1,750 - PBFA \$250/ARRA \$1,500	96%
		Whole House Energy Metering	98%
		Whole House Fan	100%
		Subtotal	98%
	Residential Low Income	CFL - Residential	100%
		Energy Hero Gift Packs - Low Flow Showerheads	100%
		RLI Energy Hero Gift Packs - Smart Strips	100%
		Solar Water Heating - RLI Solar Inspections ARRA WAP	100%
		Subtotal	100%
	New	New Home - Energy Modeling	98%
	Residential	Subtotal	98%
	Residential - Total		
Program Overall			93%

## Overall Verification Results

Table 8 shows the final verification results for the non-residential program, 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 the name of





the measure (as reported in the tracking database). The fourth column shows the claimed first-year gross energy savings (from Table 5). The fifth column is the energy savings as validated and verified by Evergreen, which was calculated by multiplying the validated savings (fourth column) by the verification ratio (fifth column). The sixth column shows the final ratio of verified and validated savings relative to the savings reported by SAIC in the Annual Report. To calculate the final ratio, we divided the verified and validated energy savings in this table by the reported savings in Table 5. The last column shows each measure's percent of total validated and verified savings in the non-residential program.

Table 9 presents the verification ratio results for the residential programs. It also shows the overall ratio for both the non-residential and residential programs. The final column shows each measure's percent of total validated and verified savings in the residential program. Overall, the non-residential program accounts for 48% and the residential program accounts for 52% of total validated and verified savings.

The overall verification results are 98% percent of residential and 88% percent of non-residential savings were validated and verified based on the combination of research activities described in this document.

Hawaii Energy has explicit targets for Island Equity that are intended to promote equitable participation in the program across the islands. The Annual Report states that the Island Equity targets for Program Year 2010 were to create energy savings within 20% of the proportion of each county's total contribution to the Public Benefit Fee in the Program Year. The evaluation team verified that the Hawaii Energy program met the requirements for Island Equity.

Table 10 shows the verified Island Equity calculation. In the second and third columns, the table shows the Public Benefit Fee contribution by each county and their calculated proportions. The fourth column shows the equity targets based on verified savings, calculated by multiplying the Public Benefit Fee portion by total verified savings. The fifth column shows the verified achieved savings for each county. The sixth column calculates the portion of savings attributed to each county, and the seventh column calculates the percentage difference between the targeted and achieved savings. The final column states if the equity target was met for that county.



**Table 8. Program Year 2010 Overall Verification Results by Program and Measure, Non-Residential Programs**

Sector	Program	Measure	Claimed First-Year Gross Energy Savings (kWh)	Verified and Validated Gross First- Year Savings (kWh)	Verified and Validate % of Claimed Gross First-Year Savings	Verified Savings as % of Total Non- Residential Savings
Non-Residential (continued on next page)	Business Energy Efficiency Measures	Accounting Record	-	0	NA	
		CFL - Business	4,983,310	4,536,885	91%	9%
		Delamping - T8/T12	1,790,631	1,630,219	91%	3%
		Delamping with Reflectors - T8/T12	1,701,894	1,549,432	91%	3%
		ENERGY STAR - Ceiling Fan	21,968	20,137	92%	0%
		ENERGY STAR - Clothes Washer	77,069	76,427	99%	0%
		ENERGY STAR - Dishwasher	33,174	33,174	100%	0%
		ENERGY STAR - Refrigerator	54,525	54,525	100%	0%
		ENERGY STAR - Refrigerator - ARRA/SEP	94,582	94,582	100%	0%
		ENERGY STAR - Refrigerator with Recycling	38,629	38,629	100%	0%
		ENERGY STAR - Window AC	193,652	76,338	39%	0%
		ENERGY STAR - Window AC - Master Metered	14,227	5,608	39%	0%
		Heat Pumps - Residential	1,220	1,220	100%	0%
		HID - Metal Halide	440,145	400,715	91%	1%
		HID - Pulse Start Metal Halide	153,851	140,068	91%	0%
		High Efficiency Water Heater	257	257	100%	0%
		HVAC - Chiller	2,047,717	1,935,995	95%	4%
		HVAC - Ductless Split - Residential	303	303	100%	0%
		HVAC - Package & Split Units	3,438,256	2,869,393	83%	6%
		HVAC - Window AC	153,214	153,301	100%	0%
		Induction Lighting	49,598	45,155	91%	0%
		LED Exit Sign	487,886	444,179	91%	1%
		Lighting Sensors	93,293	98,666	106%	0%
		NEMA Premium Efficiency Motors	153,345	155,353	101%	0%
		Solar Water Heating - Contractor - PBFA \$1000	3,353	3,213	96%	0%
		Solar Water Heating - Contractor - PBFA \$750	105,465	101,071	96%	0%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	822	788	96%	0%
		Split System AC	50,706	42,317	83%	0%
		T5 / T5HO	6,212,285	5,655,763	91%	11%
		T8	14,445,561	13,151,469	91%	26%
		VFD - AHU	621,626	630,078	101%	1%
		VFD - Chilled Water	1,039,875	1,054,013	101%	2%
		VFD Domestic Water Pumps	208,267	210,994	101%	0%
		Window Tinting	296,923	296,923	100%	1%
		Subtotal	39,007,627	35,507,189	91%	70%

Sector	Program	Measure	Claimed First-Year Gross Energy Savings (kWh)	Verified and Validated Gross First- Year Savings (kWh)	Verified and Validate % of Claimed Gross First-Year Savings	Verified Savings as % of Total Non- Residential Savings
Non-Residential (continued)	New	Energy Study Assistance	-	0	NA	0%
	Business	LED Introduction - Small Business	995,710	906,510	91%	2%
	Programs	Small Business Direct Lighting Retrofits	214,375	195,170	91%	0%
	Incubator	Subtotal	1,210,086	1,101,681	91%	2%
	Custom Business Energy Efficiency Measures	Building Envelope Improvements	4,424,902	3,528,624	80%	7%
		Building Controls	1,664,489	1,327,341	80%	3%
		Ceramic Metal Halide	208,766	166,480	80%	0%
		CFL - Business	1,908	1,522	80%	0%
		CO Demand Control Ventilation - Parking Garage	767,847	612,317	80%	1%
		Dimming Ballast & Occupancy Sensors	19,939	15,900	80%	0%
		HID - Metal Halide	226,450	180,582	80%	0%
		High Bay - T8HO / T8 / T5	158,014	126,008	80%	0%
		High Efficiency Water Heating - Heat Pumps	1,864,449	1,486,799	80%	3%
		HPS to CFL PL Exterior	71,830	57,281	80%	0%
		HPS to CFL PL Walkway Lighting	6,216	4,957	80%	0%
		HVAC - AHU Controls	20,418	16,282	80%	0%
		HVAC - Chiller	1,394,693	1,112,193	80%	2%
		HVAC - Chiller - Retrofit VFD	54,954	43,823	80%	0%
		HVAC - Cooling Tower VFD	934,847	745,491	80%	1%
		HVAC Controls	117,727	93,881	80%	0%
		Indirect T5HO	123,208	98,252	80%	0%
		Induction Lighting	251,824	200,816	80%	0%
		LED	3,924,237	3,129,370	80%	6%
		LED Exterior	17,645	14,071	80%	0%
		Lighting - Bi-Level Lighting / Control	53,423	42,602	80%	0%
		Lighting - High Bay MH to T8	482,623	384,866	80%	1%
		Lighting - T8 to LW T8	29,936	23,872	80%	0%
		Motors - ECM	33,794	26,949	80%	0%
		Pulse Start MH	119,053	94,938	80%	0%
		Pump VFD non HVAC	224,883	179,332	80%	0%
		retro w/4'T8	169,382	135,073	80%	0%
		Solar Water Heating - Commercial	117,533	93,726	80%	0%
		VFD - Water Pumping - Irrigation	362,926	289,414	80%	1%
		Subtotal	17,847,919	14,232,764	80%	28%
	<b>Non-Residential Total</b>		<b>58,065,632</b>	<b>50,841,633</b>	<b>88%</b>	<b>100%</b>



**Table 9. Program Year 2010 Overall Verification Results by Program and Measure, Residential Programs**

			Claimed First-Year Gross Energy Savings (kWh)	Verified and Validated Gross First-Year Savings (kWh)	Verified and Validate % of Claimed Gross First-Year	Verified Savings as % of Total Residential
Sector	Program	Measure				
Residential	Residential Energy Efficiency Measures	AC Annual Tune Up - Residential	11,140	11,140	100%	0%
		Accounting Record	-	0	NA	0%
		CFL - Residential	43,753,804	43,731,927	100%	78%
		ENERGY STAR - Ceiling Fan	458,699	420,474	92%	1%
		ENERGY STAR - Clothes Washer	1,541,628	1,528,781	99%	3%
		ENERGY STAR - Dishwasher	199,038	159,941	80%	0%
		ENERGY STAR - Refrigerator	903,510	780,169	86%	1%
		ENERGY STAR - Refrigerator - ARRA/SEP	2,047,368	1,767,875	86%	3%
		ENERGY STAR - Refrigerator with Recycling	927,115	927,115	100%	2%
		ENERGY STAR - Window AC	898,966	354,375	39%	1%
		Heat Pumps - Residential	204,334	204,334	100%	0%
		High Efficiency Water Heater	68,898	68,898	100%	0%
		HVAC - Ductless Split - Residential	175,800	175,800	100%	0%
		HVAC - Package & Split Units	1,113	1,113	100%	0%
		LED Introduction - Residential	15,338	15,007	98%	0%
		Solar Attic Fan	6,135	6,135	100%	0%
		Solar Water Heating - Contractor - PBFA \$1,000	21,764	20,873	96%	0%
		Solar Water Heating - Contractor - PBFA \$750	2,297,448	2,203,421	96%	4%
		Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	75,744	72,644	96%	0%
		Solar Water Heating - \$1,750 - PBFA \$250/ARRA \$1,500	19,069	18,289	96%	0%
	Whole House Energy Metering	10,693	10,462	98%	0%	
	Whole House Fan	5,697	5,697	100%	0%	
	Subtotal	53,643,301.00	52,484,471	98%	94%	
	Residential Low Income	CFL - Residential	2,026,053	2,026,053	100%	4%
		Energy Hero Gift Packs - Low Flow Showerheads	80,298	80,298	100%	0%
		RLI Energy Hero Gift Packs - Smart Strips	50,897	50,897	100%	0%
		Solar Water Heating - RLI Solar Inspections ARRA WAP	157,724	157,724	100%	0%
		Subtotal	2,314,972.00	2,314,972	100%	4%
	New Residential	New Home - Energy Modeling	950,106	929,581	98%	2%
	Subtotal	950,106.00	929,581	98%	2%	
	Residential - Total		56,908,379.00	55,729,024	98%	100%
Program Overall			114,974,011.00	106,570,656.70	93%	



**Table 10. Program Year 2010 Island Equity Verification**

County	PBF Contribution	% PBF	Verified				
			Equity Targeted Program Level Savings (kWh)	Achieved Program Level Savings (kWh)	% Savings	+/-% of Target	Target Met
Oahu	23,465,012	75%	79,634,162	82,709,396	72%	4%	Yes
Hawaii	3,861,739	12%	13,105,740	12,249,771	11%	-7%	Yes
Maui	4,075,372	13%	13,830,755	11,611,490	10%	-16%	Yes
<b>Total</b>	<b>31,402,123</b>	<b>100%</b>	<b>106,570,657</b>	<b>106,570,657</b>	<b>93%</b>		

Note: PBF contribution reported by SAIC in *Hawaii Energy Annual Report Program Year 2010*. Verified savings were calculated by Evergreen with data from SAIC's tracking system for Program Year 2010.



## Appendix A-Detailed Validation Tables

This appendix provides detailed data of Evergreen’s savings database validation and calculation of Net TRB.

### Non-Residential Programs

Table A-1 shows Evergreen’s independent estimate of measure installation counts and savings for the non-residential programs. The evaluation team used the final data from SAIC’s tracking system for entire Program Year 2010 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 number of measures installed—the subtotal and total lines show the summed number of measures.
- The fourth column (labeled B) shows the number of participants, in this case, the number of businesses that received rebates—the subtotal and total lines show the summed number of measures.
- The fifth and sixth columns (labeled C and D) show the gross kWh savings per unit and gross kW savings per unit, respectively.
- The seventh column (labeled E) shows the verification ratio, as reported in Table 6 of this memorandum. It represents the portion of savings for each measure that Evergreen verified to be installed and program qualifying.
- The eighth and ninth columns (labeled F and G) show verified and validated gross savings, in kWh and kW, respectively. The figures are the product of the number of measures and the gross kWh per-unit savings (or the gross kW per-unit savings) and the verification ratio—the subtotal and total lines show the summed number of savings.
- The tenth column (labeled H) shows the net-to-gross ratio, 0.73 for all measures across all programs as specified in the TRM.
- The eleventh and twelfth columns (labeled I and J) show the product of the net-to-gross ratio and the verified and validated gross kWh savings and the gross kW savings—the subtotal and total lines show the summed number of savings.
- The thirteenth column (labeled K) shows the effective useful life (EUL) for each measure, as specified in the TRM—the subtotal and total rows show the EUL for that category.
- The final column (labeled L) shows the verified and validated net Total Resource Benefit (TRB).

### 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 SAIC’s tracking system for entire Program Year 2010 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 number of measures installed—the subtotal and total lines show the summed number of measures.
- The fourth column (labeled B) shows the number of participants, in this case, the number of households that received rebates—the subtotal and total lines show the summed number of measures.
- The fifth and sixth columns (labeled C and D) show the gross kWh savings per unit and gross kW savings per unit, respectively.
- The seventh column (labeled E) shows the verification ratio, as reported in Table 7 of this memorandum. It represents the portion of savings for each measure that Evergreen verified to be installed and program qualifying.
- The eighth and ninth columns (labeled F and G) show verified and validated gross savings, in kWh and kW, respectively. The figures are the product of the number of measures and the gross kWh per-unit savings (or the gross kW per-unit savings) and the verification ratio—the subtotal and total lines show the summed number of savings.
- The tenth column (labeled H) shows the net-to-gross ratio, 0.73 for all measures across all programs as specified in the TRM.
- The eleventh and twelfth columns (labeled I and J) show the product of the net-to-gross ratio and the verified and validated gross kWh savings and the gross kW savings—the subtotal and total lines show the summed number of savings.
- The thirteenth column (labeled K) shows the effective useful life (EUL) for each measure, as specified in the TRM—the subtotal and total rows show the EUL for that category.
- The final column (labeled L) shows the verified and validated net Total Resource Benefit (TRB).





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**Table A-1. Program Year 2010 Validated and Verified Participation and Savings by Program and Measure, Non-Residential Programs**

Program	Measure	Number of Measures Installed (A)	Number of Participants (B)	Gross kWh Savings Per Unit (C)	Gross kW Savings Per Unit (D)	Verification Ratio (E)	Verified & Validated Gross kWh Savings (F = A x C x E)	Verified & Validated Gross kW Savings (G = A x D x E)	NTG Ratio (H)	Verified & Validated Net kWh Savings (I = F x H)	Verified & Validated Net kW Savings (J = G x H)	EUL (K)	Verified & Validated Net TRB (L)	Verified & Validated Gross TRB (M=L / H)
Business Energy Efficiency Measures	Accounting Record	0	NA	NA	NA	NA	NA	NA	0.73	NA	NA	NA	NA	NA
	CFL - Business	60,079	144	83	0.01	91%	4,536,885	565	0.73	3,311,926	412	3.2	\$1,484,198	\$2,033,147.82
	Delamping - T8/T12	20,557	48	87	0.01	91%	1,630,219	248	0.73	1,190,060	181	14.0	\$1,926,604	\$2,639,183.77
	Delamping with Reflectors - T8/T12	14,999	87	113	0.01	91%	1,549,432	138	0.73	1,131,085	101	14.0	\$1,578,068	\$2,161,737.65
	ENERGY STAR - Ceiling Fan	163	128	135	0.01	92%	20,137	2	0.73	14,700	2	5.0	\$8,317	\$11,392.61
	ENERGY STAR - Clothes Washer	462	462	167	0.02	99%	76,427	10	0.73	55,791	7	11.0	\$120,099	\$164,519.34
	ENERGY STAR - Dishwasher	611	611	54	0.01	100%	33,174	4	0.73	24,217	3	11.0	\$141,099	\$193,286.96
	ENERGY STAR - Refrigerator	642	642	85	0.01	100%	54,525	9	0.73	39,803	6	14.0	\$65,826	\$90,172.99
	ENERGY STAR - Refrigerator - ARRA/SEP	142	142	666	0.09	100%	94,582	12	0.73	69,045	9	14.0	\$107,281	\$146,959.72
	ENERGY STAR - Refrigerator with Recycling	58	58	666	0.03	100%	38,629	2	0.73	28,199	1	14.0	\$34,457	\$47,201.65
	ENERGY STAR - Window AC	640	639	303	0.15	39%	76,338	39	0.73	55,727	28	9.0	\$89,075	\$122,019.89
	ENERGY STAR - Window AC - Master Metered	47	47	303	0.15	39%	5,608	3	0.73	4,094	2	9.0	\$5,710	\$7,821.74
	Heat Pumps - Residential	1	1	1,220	0.23	100%	1,220	0	0.73	890	0	9.0	\$1,104	\$1,512.88
	HID - Metal Halide	222	7	1,983	0.03	91%	400,715	6	0.73	292,522	4	14.0	\$330,154	\$452,265.26
	HID - Pulse Start Metal Halide	513	20	300	0.03	91%	140,068	14	0.73	102,250	11	14.0	\$147,822	\$202,495.76
	High Efficiency Water Heater	2	2	129	0.02	100%	257	0	0.73	188	0	10.0	\$858	\$1,174.67
	HVAC - Chiller	34	24	60,227	10.00	95%	1,935,995	321	0.73	1,413,276	235	20.0	\$2,977,208	\$4,078,367.37
	HVAC - Ductless Split - Residential	1	1	303	0.15	100%	303	0	0.73	221	0	12.0	\$571	\$781.85
	HVAC - Package & Split Units	2,110	287	1,630	0.37	83%	2,869,392	660	0.73	2,094,656	482	15.0	\$4,167,182	\$5,708,468.04
	HVAC - Window AC	185	42	828	0.16	100%	153,301	30	0.73	111,910	22	12.0	\$178,236	\$244,159.36
	Induction Lighting	280	15	177	0.02	91%	45,154	4	0.73	32,963	3	2.0	\$8,187	\$11,214.49
	LED Exit Sign	1,960	79	249	0.03	91%	444,179	58	0.73	324,251	42	16.0	\$547,424	\$749,895.71
	Lighting Sensors	4,627	86	20	0.00	106%	98,665	21	0.73	72,026	15	8.0	\$85,016	\$116,460.72
	NEMA Premium Efficiency Motors	255	98	601	0.10	101%	155,352	27	0.73	113,407	20	15.0	\$201,742	\$276,359.00
	Solar Water Heating - Contractor - PBFA \$1,000	2	2	1,677	0.37	96%	3,214	1	0.73	2,346	1	15.0	\$4,602	\$6,304.60
	Solar Water Heating - Contractor - PBFA \$750	63	63	1,674	0.37	96%	101,070	22	0.73	73,781	16	15.0	\$144,750	\$198,287.37
	Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	2	2	411	0.09	96%	788	0	0.73	575	0	15.0	\$1,128	\$1,545.39
	Split System AC	90	28	563	0.06	83%	42,317	5	0.73	30,891	4	15.0	\$47,974	\$65,717.24
	T5 / T5HO	5,863	22	1,060	0.12	91%	5,655,763	630	0.73	4,128,707	460	14.0	\$6,085,135	\$8,335,801.75
	T8	297,088	411	49	0.01	91%	13,151,469	1,522	0.73	9,600,572	1,111	14.0	\$14,297,551	\$19,585,685.88
	VFD - AHU	118	40	5,268	1.76	101%	630,078	211	0.73	459,957	154	15.0	\$1,095,401	\$1,500,549.36
	VFD - Chilled Water	68	31	15,292	4.15	101%	1,054,013	286	0.73	769,430	209	10.0	\$1,220,131	\$1,671,412.29
	VFD Domestic Water Pumps	7	7	29,752	3.18	101%	210,993	23	0.73	154,025	16	15.0	\$235,452	\$322,536.83
	Window Tinting	59,388	29	5	0.00	100%	296,923	73	0.73	216,754	53	10.0	\$327,560	\$448,713.00
	Subtotal	471,279	4,305			91%	35,507,187	4,946	0.73	25,920,246	3,610		37,665,922	51,597,153



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**Table A-1 (continued). Program Year 2010 Validated and Verified Participation and Savings by Program and Measure, Non-Residential Programs**

Program	Measure	Number of Measures Installed (A)	Number of Participants (B)	Gross kWh Savings Per Unit (C)	Gross kW Savings Per Unit (D)	Verification Ratio (E)	Verified & Validated Gross kWh Savings (F = A x C x E)	Verified & Validated Gross kW Savings (G = A x D x E)	NTG Ratio (H)	Verified & Validated Net kWh Savings (I = F x H)	Verified & Validated Net kW Savings (J = G x H)	EUL (K)	Verified & Validated Net TRB (L)	Verified & Validated Gross TRB (M=L / H)
New	Energy Study Assistance	8	8	NA	NA	NA	NA	NA	0.73	NA	NA	NA	NA	NA
Business	LED Introduction - Small Business	7,212	3	138	0.02	91%	906,511	105	0.73	661,753	77	5	\$415,744	\$569,512.92
Programs	Small Business Direct Lighting Retrofits	2	2	107,188	7.91	91%	195,171	14	0.73	142,475	11	10	\$148,463	\$203,374.57
Incubator	Subtotal	7,222	13			91%	1,101,681	119	0.73	804,227	87		\$64,208	772,887
Custom Business Energy Efficiency Measures	Building Envelope Improvements	10	10	442,490	56.82	80%	3,528,624	453	0.73	2,575,896	331	20.0	\$4,988,532	\$6,833,605.72
	Building Controls	2	2	832,245	105.70	80%	1,327,342	169	0.73	968,959	123	13.5	\$1,441,828	\$1,975,106.83
	Ceramic Metal Halide	1	1	208,766	23.13	80%	166,480	18	0.73	121,531	13	2.0	\$31,181	\$42,713.10
	CFL - Business	1	1	1,908	0.40	80%	1,521	0	0.73	1,111	0	5.0	\$855	\$1,171.43
	CO Demand Control Ventilation - Parking Garage	1	1	767,847	87.64	80%	612,317	70	0.73	446,991	51	15.0	\$695,564	\$952,827.88
	Dimming Ballast & Occupancy Sensors	1	1	19,939	1.21	80%	15,900	1	0.73	11,607	1	14.0	\$15,026	\$20,583.69
	HID - Metal Halide	2	2	113,225	19.37	80%	180,582	31	0.73	131,825	23	14.0	\$222,330	\$304,561.27
	High Bay - T8HO / T8 / T5	7	7	22,573	4.67	80%	126,007	26	0.73	91,985	19	10.9	\$132,905	\$182,061.08
	High Efficiency Water Heating - Heat Pumps	1	1	1,864,449	231.90	80%	1,486,799	185	0.73	1,085,363	135	20.0	\$2,082,153	\$2,852,263.71
	HPS to CFL PL Exterior	1	1	71,830	16.39	80%	57,281	13	0.73	41,815	10	5.0	\$33,143	\$45,401.77
	HPS to CFL PL Walkway Lighting	1	1	6,216	1.44	80%	4,957	1	0.73	3,619	1	6.0	\$3,435	\$4,705.13
	HVAC - AHU Controls	1	1	20,418	3.24	80%	16,282	3	0.73	11,886	2	20.0	\$24,659	\$33,778.92
	HVAC - Chiller	3	3	464,898	63.24	80%	1,112,194	151	0.73	811,901	110	18.3	\$1,575,166	\$2,157,761.01
	HVAC - Chiller - Retrofit VFD	1	1	54,954	10.89	80%	43,823	9	0.73	31,991	6	15.0	\$59,834	\$81,964.94
	HVAC - Cooling Tower VFD	12	12	77,904	6.47	80%	745,491	62	0.73	544,208	45	15.0	\$783,743	\$1,073,620.24
	HVAC Controls	1	1	117,727	13.79	80%	93,881	11	0.73	68,533	8	15.0	\$107,424	\$147,156.57
	Indirect T5HO	1	1	123,208	35.95	80%	98,252	29	0.73	71,724	21	14.0	\$151,801	\$207,947.03
	Induction Lighting	3	3	83,941	10.49	80%	200,816	25	0.73	146,596	18	14.0	\$241,407	\$330,693.86
	LED	54	54	72,671	11.87	80%	3,129,371	511	0.73	2,284,441	373	5.3	\$1,643,355	\$2,251,170.64
	LED Exterior	1	1	17,645	4.05	80%	14,071	3	0.73	10,272	2	5.0	\$8,168	\$11,188.50
	Lighting - Bi-Level Lighting / Control	2	2	26,711	2.92	80%	42,602	5	0.73	31,099	3	12.5	\$44,300	\$60,684.25
	Lighting - High Bay MH to T8	114	3	4,234	0.54	80%	384,867	49	0.73	280,953	36	8.3	\$269,908	\$369,736.57
	Lighting - T8 to LW T8	1	1	29,936	3.40	80%	23,872	3	0.73	17,427	2	14.0	\$25,838	\$35,394.72
	Motors - ECM	3	3	11,265	1.09	80%	26,949	3	0.73	19,673	2	15.0	\$29,317	\$40,160.87
	Pulse Start MH	1	1	119,053	20.37	80%	94,939	16	0.73	69,305	12	14.0	\$116,887	\$160,119.21
	Pump VFD non HVAC	1	1	224,883	30.82	80%	179,333	25	0.73	130,913	18	15.0	\$214,935	\$294,431.16
	retro w/4'T8	1	1	169,382	42.52	80%	135,073	34	0.73	98,604	25	5.0	\$81,442	\$111,563.99
	Solar Water Heating - Commercial	9	9	13,059	8.08	80%	93,726	58	0.73	68,420	42	14.7	\$234,918	\$321,806.11
	VFD - Water Pumping - Irrigation	2	2	181,463	29.09	80%	289,414	46	0.73	211,273	34	15.0	\$365,274	\$500,374.86
	Subtotal	239	128			80%	14,232,766	2,009	0.73	10,389,919	1,467		\$15,625,325	\$21,404,555
All Non-Residential - Total		478,740	4,446			88%	0	0	0.73	0	0		\$3,855,455	73,774,595



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**Table A-2. Program Year 2010 Validated and Verified Participation and Savings by Program and Measure, Residential Programs**

Program	Measure	Number of Measures Installed (A)	Number of Participants (B)	Gross kWh Savings Per Unit (C)	Gross kW Savings Per Unit (D)	Verification Ratio (E)	Verified & Validated Gross kWh Savings (F = A x C x E)	Verified & Validated Gross kW Savings (G = A x D x E)	NTG Ratio (H)	Verified & Validated Net kWh Savings (I = F x H)	Verified & Validated Net kW Savings (J = G x H)	EUL (K)	Verified & Validated Net TRB (L)	Verified & Validated Gross TRB (M=L / H)
Residential Energy Efficiency Measures	AC Annual Tune Up - Residential	17	17	655	0.11	100%	11,140	2	0.73	8,132	1	1.0	\$1,170	\$1,602.52
	Accounting Record	0	NA	NA	NA	NA	NA	NA	0.73	NA	NA	NA	NA	NA
	CFL - Residential	1,661,081	16,843	26	0.00	100%	43,731,927	6,656	0.73	31,924,307	4,859	5.0	\$21,803,729	\$29,868,121.29
	ENERGY STAR - Ceiling Fan	3,398	2,379	135	0.01	92%	420,474	45	0.73	306,946	33	5.0	\$175,908	\$240,970.22
	ENERGY STAR - Clothes Washer	9,255	9,253	167	0.02	99%	1,528,781	201	0.73	1,116,010	147	11.0	\$2,029,794	\$2,780,540.15
	ENERGY STAR - Dishwasher	3,676	3,675	54	0.01	80%	159,941	22	0.73	116,757	16	11.0	\$622,793	\$853,140.52
	ENERGY STAR - Refrigerator	10,654	10,646	85	0.01	86%	780,169	126	0.73	569,524	92	14.0	\$941,879	\$1,290,245.81
	ENERGY STAR - Refrigerator - ARRA/SEP	3,078	3,078	665	0.09	86%	1,767,875	233	0.73	1,290,549	170	14.0	\$2,005,221	\$2,746,878.54
	ENERGY STAR - Refrigerator with Recycling	1,394	1,394	665	0.03	100%	927,115	38	0.73	676,794	27	14.0	\$826,715	\$1,132,486.37
	ENERGY STAR - Window AC	2,973	2,934	302	0.15	39%	354,375	179	0.73	258,694	131	9.0	\$446,831	\$612,096.67
	Heat Pumps - Residential	168	168	1,216	0.23	100%	204,334	38	0.73	149,164	28	9.0	\$185,012	\$253,441.29
	High Efficiency Water Heater	533	532	129	0.02	100%	68,898	12	0.73	50,296	9	10.0	\$195,592	\$267,934.44
	HVAC - Ductless Split - Residential	581	573	303	0.15	100%	175,800	89	0.73	128,334	65	12.0	\$331,475	\$454,075.77
	HVAC - Package & Split Units	1	1	1,113	0.11	100%	1,113	0	0.73	813	0	15.0	\$1,206	\$1,651.68
	LED Introduction - Residential	100	1	153	0.02	98%	15,007	2	0.73	10,955	1	5.0	\$6,980	\$9,561.27
	Solar Attic Fan	14	11	438	0.01	100%	6,135	0	0.73	4,479	0	5.0	\$2,300	\$3,150.85
	Solar Water Heating - Contractor - PBFA \$1,000	13	13	1,674	0.37	96%	20,873	5	0.73	15,237	3	15.0	\$29,893	\$40,949.99
	Solar Water Heating - Contractor - PBFA \$750	1,376	1,376	1,670	0.37	96%	2,203,422	489	0.73	1,608,498	357	15.0	\$3,155,668	\$4,322,832.60
	Solar Water Heating - \$1,000 - PBFA \$250/ARRA\$750	182	182	416	0.09	96%	72,644	16	0.73	53,030	12	15.0	\$104,028	\$142,503.44
	Solar Water Heating - \$1,750 - PBFA \$250/ARRA \$1,500	80	80	238	0.05	96%	18,289	4	0.73	13,351	3	15.0	\$26,192	\$35,879.89
	Whole House Energy Metering	4	4	2,673	0.09	98%	10,462	0	0.73	7,637	0	5.0	\$3,862	\$5,290.57
	Whole House Fan	13	13	438	0.01	100%	5,697	0	0.73	4,159	0	5.0	\$2,136	\$2,925.79
	Subtotal	1,698,591	53,173			0%	52,484,472	8,156	0.73	38,313,665	5,954		32,898,384	45,066,280
Residential Low Income	CFL - Residential	77,472	3	26	0.00	100%	2,026,053	311	0.73	1,479,019	227	5	\$1,010,728	\$1,384,559.13
	Energy Hero Gift Packs - Low Flow Showerheads	500	3	161	0.04	100%	80,298	20	0.73	58,617	15	20	\$145,992	\$199,989.15
	RLI Energy Hero Gift Packs - Smart Strips	942	3	54	0.01	100%	50,897	6	0.73	37,155	4	5	\$32,296	\$44,240.66
	Solar Water Heating - RLI Solar Inspections ARRA WAP	379	380	416	0.09	100%	157,724	33	0.73	115,138	24	15	\$221,788	\$303,818.60
	Subtotal	79,293	389			0%	2,314,972	370	0.73	1,689,929	270		1,410,804	1,932,608
New Incubator	New Home - Energy Modeling	3	3	316,702	0.00	98%	929,581	0	0.73	678,594	0	20	\$920,768	\$1,261,326.43
	Subtotal	3	3			0%	929,581	0	0.73	678,594	0		920,768	1,261,326
<b>All Residential - Total</b>		<b>1,777,887</b>	<b>53,565</b>	<b>0</b>	<b>0</b>	<b>98%</b>	<b>55,729,025</b>	<b>8,526</b>		<b>40,682,188</b>	<b>6,224</b>		<b>35,229,956</b>	<b>48,260,214</b>
<b>Program Overall</b>		<b>2,256,627</b>	<b>58,011</b>	<b>0</b>	<b>0</b>	<b>93%</b>	<b>55,729,025</b>	<b>8,526</b>		<b>40,682,188</b>	<b>6,224</b>		<b>89,085,411</b>	<b>122,034,809</b>



## **Appendix B-Sample Design**

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

Evergreen developed samples by customer segment, grouping participants into categories based on how we could conduct research with them. For the non-residential sector, we developed four customer segments:

- End-use customers – non-residential customers who pay their own utility bill based on the Q1-Q3 data extract.
- Large Business Energy Efficiency Measures (BEEM) projects – non-residential customers who completed projects in the BEEM program with large savings in the fourth quarter of PY2010.
- Custom Business Efficiency Measures (CBEEM) projects – non-residential customers who completed custom projects.
- Military– the program tracks the military contact who manages the electricity bill for all military housing or facility, not the individual tenants.

For the residential sector, we developed three categories of customer segments:

- End-use customers – residential customers who pay their own utility bill based on the Q1-Q3 data extract.
- Upstream CFLs – the recipients of the rebates were the manufacturers and distributors, and the program does not track the customer who eventually purchases discount CFLs. The sample frame was based on invoices processed during Q1-Q3.
- Residential Low Income – the measures distributed through the RLI program from the full program year.

Tables B-1 and B-2 below present the sample frame Evergreen developed based on the first three quarters of program participation data. We sampled by customer segment, grouping participants into categories based on how we could conduct research with them:

As shown, upstream CFLs (30%), end-use customers (24%), and large Q4 projects (13%) account for the majority of the program's energy savings based on the sample frame.



**Table B-1. Sample Frame—First-Year Gross Energy Savings by Program and Segment**

Sector	Program	Segment						Total
		End-Use Customers <sup>1</sup>	Large Q4	Custom Projects	Military	Upstream CFLs <sup>1</sup>	Low Income	
Non-Residential								
	Business Energy Efficiency Measures	19,064,522	16,316,143		3,826,032			39,206,697
	New Business Programs Incubator	0						0
	Custom Business Energy Efficiency Measures			15,055,037	2,792,882			17,847,919
	Non-Residential Total	19,064,522	16,316,143	15,055,037	6,618,914	0	0	57,054,616
Residential								
	Residential Energy Efficiency Measures	8,713,657				34,861,397		43,575,054
	Residential Low Income	0					2,314,972	2,314,972
	New Incubator	0						0
	Residential Total	8,713,657	0	0	0	34,861,397	2,314,972	45,890,026
Total		27,778,179	16,316,143	15,055,037	6,618,914	34,861,397	2,314,972	102,944,642

1. Sample frame based on Q1-Q3 extract from the program tracking database.

**Table B-2. Sample Frame as a Percent of First-Year Gross Energy Savings by Program and Segment**

Sector	Program	Segment						Sample Frame as % of Full- Year Savings
		End-Use Customers <sup>1</sup>	Large Q4	Custom Projects	Military	Upstream CFLs <sup>1</sup>	Low Income	
Non-Residential								
	Business Energy Efficiency Measures	17%	14%	0%	3%	0%	0%	34%
	New Business Programs Incubator	0%	0%	0%	0%	0%	0%	0%
	Custom Business Energy Efficiency Measures	0%	0%	13%	2%	0%	0%	16%
	Non-Residential Total	17%	14%	13%	6%	0%	0%	50%
Residential								
	Residential Energy Efficiency Measures	8%	0%	0%	0%	30%	0%	38%
	Residential Low Income	0%	0%	0%	0%	0%	2%	2%
	New Incubator	0%	0%	0%	0%	0%	0%	0%
	Residential Total	8%	0%	0%	0%	30%	2%	40%
Total		24%	14%	13%	6%	30%	2%	90%

1. Sample frame based on Q1-Q3 extract from the program tracking database.

Table B-3 below shows the sample size and Table B-4 the percentage of the sample frame energy savings that is represented by the sample. This information is provided by program, segment (e.g., upstream CFLs, end-use customers, military, etc.) and research mode. As described in the main body of the memorandum, we used a combination of telephone surveys, site surveys, retailer invoice audits, and project file reviews.



We conducted a total of 686 telephone surveys, 127 site surveys, reviewed 20 retailer invoices and 52 project files. These samples 40% of the total energy savings included in the sample frame.

**Table B-3 – Sample Size by Program and Segment**

		Research Mode			
Sector	Segment	Telephone Survey	Site Survey	Retailer Invoice Audit	Project File Review
Non-Residential					
	End-Use Customers	80	21		21
	Large Q4		16		16
	Custom Projects		13		13
	Military		1		1
	Upstream CFLs				
	Low Income				
	Non-Residential Total	80	51	0	51
Residential					
	End-Use Customers	606	76		
	Large Q4				
	Custom Projects				
	Military				
	Upstream CFLs		5	20	
	Low Income				1
	Residential Total	606	81	20	1
Total		686	132	20	52



**Table B-4. Sample Size as a Fraction of the Sample Frame by Program and Segment**

Sector	Segment	Research Mode				Total
		Telephone Survey	Site Survey	Retailer Invoice Audit	Project File Review	
Non-Residential						
	End-Use Customers	4%	3%		3%	6%
	Large Q4		16%		16%	16%
	Custom Projects		3%		3%	3%
	Military		6%		6%	6%
	Upstream CFLs					0%
	Low Income					0%
	Non-Residential Total	4%	28%	0%	28%	32%
Residential						
	End-Use Customers	1%	<1%			1%
	Large Q4					0%
	Custom Projects					0%
	Military					0%
	Upstream CFLs			5%		5%
	Low Income				2%	2%
	Residential Total	1%	0%	5%	2%	8%
Total		4%	28%	5%	31%	40%