EVERGREEN ECONOMICS

Evaluation of the *Hawaii Energy* Conservation and Efficiency Programs

Program Year 2010

Volume 1 of 2: Main Report

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1 Executive Summary

This report presents the findings of the comprehensive evaluation of the Hawaii Energy Conservation and Efficiency Programs (Hawaii Energy or Program) for Program Year 2010 (PY2010), from July 1, 2010 through June 30, 2011.[1] The individual Hawaii Energy programs addressed by this evaluation are:

- **Residential Energy Efficiency Measures (REEM)**. This program provides customer rebates for energy efficient water heating (solar and high efficiency), lighting, air conditioning and appliances measures, and includes an upstream CFL component;

- **New Residential Programs Incubator (NEW)**. This umbrella program includes energy services and maintenance (air conditioning and solar water heating (SWH) tune-ups), as well as residential design and audit assistance for new homes;

- **Residential Low Income (RLI)**. This program includes SWH inspections (that are a companion to the state Weatherization Assistance Program, which provides SWH systems), gift packs (compact fluorescent lamps (CFLs), showerheads and smart strips), CFL exchange and energy audits for low-income customers;

- **Business Energy Efficiency Measures (BEEM).** This program provides rebates to business[2] customers for energy efficient lighting, air conditioning, water heating, water pumping, motors, building envelope, business equipment and measurement and control systems, and includes a direct installation lighting component and a condominium sub-metering component;

- **Custom Business Energy Efficiency Measures (CBEEM).** This program provides rebates to business customers for custom projects, and was formerly known as the Commercial Industrial Customized Rebate program; and

- **New Business Programs Incubator (NEW)**. This umbrella program targets new non-residential construction projects and includes service and maintenance (central plant optimization and air conditioning tune-up), direct installation of measures for small businesses, and design and audit assistance.

[1] Hawaii Energy is a ratepayer-funded conservation and efficiency program administered by Science Applications International Corporation (SAIC) under contract with the Hawaii Public Utilities Commission as the Public Benefits Fee Administrator (PBFA) serving the islands of Hawaii, Lanai, Maui, Molokai, and Oahu. On July 1, 2009, Hawaii Energy took over management of the demand side management programs from Hawaiian Electric Company (HECO) and its subsidiaries, Maui Electric Company (MECO) and Hawaii Electric Light Company (HELCO), referred to as the HECO utilities. Note that throughout this report "Hawaii Energy" is used to refer to both the suite of programs offered through this initiative, as well as the organization that implements it.

[2] The term "business" includes all non-residential customer categories (commercial, industrial and agricultural).

Major conclusions from the impact evaluation, market assessment and process evaluation are summarized below.

1.1 Impact Evaluation

The goal of the impact evaluation was to develop an independent estimate of energy savings achieved by Hawaii Energy in PY2010.

Impact evaluation activities included:

- Review of the Hawaii Energy's energy savings assumptions documented in its Technical Reference Manual (TRM);
- Validation of tracking database and savings calculations;
- Participant phone and on-site verification inspections;
- Engineering desk review of large and custom project applications;
- Invoice audit for participating CFL retailers;
- RLI program hard copy record audit;
- SWH billing analysis; and
- Analysis of Hawaii Energy's economic impacts.

Below we discuss the key findings and conclusions of the impact evaluation.

1.1.1 Technical Reference Manual Review

An independent review of the TRM, which describes the methodology and the background assumptions used to calculate Program savings was a key task for the PY2010 impact evaluation.[3] This review aided in developing an in-depth understanding of how the measure savings values were derived and making an assessment of the reasonableness of these values.

We compared TRM values to those in a wide variety of industry sources such as program evaluations and market studies from across the nation. Our independent review found that measures were well researched and adequately documented, typically with savings values derived from data collected from previous program evaluations.

1.1.1.1 TRM Review Recommendations

We offered recommendations to modify a small number of TRM values and suggested conducting further research on a few categories of TRM values to improve their accuracy

[3] Energy and demand savings estimates for Program measures and activities are approved on an *ex ante* basis and must be documented in a TRM prepared by PBFA and reviewed by the EM&V contractor. The TRM must include estimates for all prescriptive measures, and descriptions of calculation methodologies for custom measures. The information in the TRM must be consistent with the information in any database or other tool used to calculate savings resulting from the Program. The PY2009 TRM was approved for use by Hawaii Energy for the PY2010 year. Therefore, the EM&V review conducted during this program cycle will be used in the PY2011 and PY2012 cycles.

and reliability. The most significant recommendations were to develop savings values specifically for new construction that take into account the relevant baseline and to claim cooling and lighting operating hours by building type instead of using the building average.

1.1.2 Verification of Savings

The second major impact evaluation task was to verify Hawaii Energy's savings claims. The two major components of the independent savings verification were validation of the Hawaii Energy tracking database and verification of measure installations.

We validated the savings claims by analyzing an extract of the Program tracking database and comparing it to the claimed savings documented in the *Hawaii Energy Conservation and Efficiency Programs Annual Report, Program Year 2010* (Annual Report).[4]

We reviewed the savings calculations and other inputs and checked for consistency with the TRM. We verified Program measure installations based on telephone and on-site surveys with participating residents and businesses. We also conducted engineering analyses of custom measure savings claims.

1.1.2.1 Verification Findings

As a result of these verification activities, we were able to verify 93 percent of the savings claimed, or 107 GWh/year in first-year net electricity savings. These savings translate to net Total Resource Benefits (TRB)[5] of $35,229,956 for the residential sector and $53,855,455 for the business sector.

Table 1 shows the targets, claims and verified amounts for PY2010 net electricity savings and TRB, and the Program budget. Table 2 lists PY2010 claimed and verified first–year savings by individual program.

[4]SAIC Energy, Environment & Infrastructure, LLC. *Efficiency Programs Annual Report, Program Year 2010.* (Honolulu, HI: Hawaii Public Utilities Commission, November 22, 2011). http://www.hawaiienergy.com/75/hawaii-energy-reports

[5] The TRB is the estimated total net present value (NPV) of the avoided cost for the utility from the reduced lifetime demand (kW) and energy (kWh) from the energy efficiency projects and measure. The utility costs were determined using average avoided coast data for installed capacity to meet demand and cost to produce energy that was provide by HECO IRP4 an adjusted under the advice of the PBFA Contract Manager. Average annual avoided cost for capacity and energy for calendar year 2010 escalated for a 20-year period was the basis for the analysis. The TRB has incorporated avoided transmission and distribution costs into the avoided energy and capacity costs. The time value of money is represented by a discount rate of six percent. The discount rate is used to convert all costs and benefits to a "present value" for comparing alternative costs and benefits in the same year's dollars.

Table 1: Hawaii Energy Net Electricity Savings, TRB and Budget, PY2010

	Residential	Business	Total
Target kW	N/A	N/A	23,126
Claimed kW	8,894	8,116	17,011
Verified kW	6,224	5,164	11,388
Target kWh	71,245,000	61,370,000	132,615,000
Claimed kWh	56,908,379	58,065,632	114,974,011
Verified kWh	55,729,024	50,841,633	106,570,657
Target TRB	N/A	N/A	$148,596,954
Claimed TRB	$50,329,878	$84,380,931	$134,710,809
Verified TRB	$35,229,956	$53,855,455	$89,085,411
Budget	$8,581,755	$8,767,250	$18,554,134

Table 2: Hawaii Energy Verification Results PY2010

	First-Year Net Savings (kWh)		Percent of Verified 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%
Non-Residential Total	*58,065,632*	*50,841,633*	88%
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%
Residential Total	*56,908,380*	*55,729,024*	98%
Total	**114,974,012**	**106,570,657**	**93%**

1.1.3 Economic Impact Analysis

A separate analysis component of the evaluation was to estimate the economic impacts associated with Hawaii Energy program activities in PY2010.[6] Using data from Hawaii Energy's Program tracking system, economic impacts were estimated for PY2010 for each county that had active Program participants. The Evergreen team measured the economic

[6] The analysis methods and results are discussed in much greater detail in a separate 2012 report on Hawaii Energy Efficiency Program economic impacts developed by the Evergreen Economics evaluation team. Evergreen Economics. *Hawaii Energy Efficiency Program Economic Impacts.* (Honolulu, HI: Hawaii Public Utilities Commission, March 2012).

impacts using an input-output modeling framework and the IMPLAN (for Impact Analysis for Planning)[7] impact modeling software. This analysis takes advantage of IMPLAN's Multi-Region Input-Output ("MRIO") component to measure Program impacts that accrue to each county as well as secondary spending impacts that spill over to other islands. Impacts measured include changes in output, wages, business income, and employment.

The IMPLAN model tracks dollars as they move through an economy from one sector to the next. Expenditures on Program implementation initiate changes that directly affect the Hawaiian economy. This spending then generates indirect impacts among businesses that supply the directly affected businesses. In addition, the direct and indirect impacts enhance overall economy purchasing power and generate induced or consumption-driven impacts. The sum of these direct, indirect, and induced impacts makes up the total economic impacts.

Our analysis measured the short-term economic impacts associated with changes in business activity as a direct result of changes in spending (or final demand) by Hawaii Energy, Program participants; and ratepayers who provide Program funding via the PBF. These impacts are driven by changes (both positive and negative) in final demand, and are measured within a static input-output modeling framework that relies on data for an economy at a point in time and assumes that Program spending does not affect the evolution of the state economy. Energy efficiency programs may have longer lasting effects, and this is clearly the case for continued out-year energy savings. However, these long-term, dynamic effects are not measured in this analysis.

1.1.3.1 Economic Analysis Findings

The spending and energy savings attributed to PY2010 Hawaii Energy programs increased economic output in Hawaii by $28.1 million, including increases of $9.9 million in wages and $3.1 million in business income. This activity also created 316 jobs in Hawaii. This reflects economic activity over and above what would have been created in the Base Case scenario. Table 3 shows the total gross and net economic impacts[8], by county and for the state of Hawaii as a whole, for Hawaii Energy programs in PY2010.

[7] IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. Applications of IMPLAN by the US Government, public agencies and private firms span a wide range of projects, from broad, resource management strategies to individual projects, such as proposals for developing ski areas, coal mines, and transportation facilities, and harvesting timber or other resources.

[8] The term "net impacts" is here used to refer to economic impacts that occur over and above the Base Case scenario, and should not to be confused with net energy impacts discussed elsewhere in this report.

Table 3: PY2010 Total Gross and Net Economic Impacts, by County[9]

Program / County	Gross Impacts	Net Impacts
Oahu		
Output	$41,725,500	$23,890,900
Wages	$13,330,300	$8,254,900
Business Income	$3,084,600	$2,465,100
Jobs (person-years)	385	246
Hawaii		
Output	$4,269,800	$3,008,600
Wages	$1,449,800	$1,128,600
Business Income	$460,900	$397,700
Jobs (person-years)	57	47
Maui		
Output	$2,518,400	$1,112,700
Wages	$934,500	$524,200
Business Income	$286,300	$239,800
Jobs (person-years)	35	23
Total Statewide		
Output	$48,653,300	$28,101,300
Wages	$15,745,400	$9,928,400
Business Income	$3,837,000	$3,106,400
Jobs (person-years)	478	316

Note: Total state impacts are slightly larger than the sum of the three county impacts due to modest spillover impacts for Kauai.

Table 4 shows how the net economic impacts of Program activities are distributed across industries. Although total net economic impacts are positive in PY2010, changes in final demand and the associated income and job effects can be either positive or negative across industries. This can occur for two reasons: 1) energy efficiency programs save energy that - as we have assumed in this analysis - can reduce utility revenues, and 2) energy efficiency program funding redistributes spending between program participants and ratepayers. In

[9] In this and the following table, the impact on "Wages" reflects the increase in wage income for all workers as a result of activities funded through the Hawaii Energy Program. "Business Income" is the increase in income to local businesses as a result of spending associated with Hawaii Energy Program spending. "Jobs" reflects the number of full- and part-time jobs that result directly from Hawaii Energy Program activities and from the increase in spending in other sectors of the economy.

this analysis, the negative net impacts in the Transportation, Information, and Utility sector is due to lost utility revenue due to increased energy efficiency (and therefore less money spent on electricity by households and businesses).

Table 4: Total Net Economic Impacts by Aggregate Industry Sector – PY2010

Aggregate Industry Sector	Output	Wages	Business Income	Jobs (person-years)
Agriculture	$48,700	$9,300	$300	1
Mining	$100,800	$27,900	$9,100	0
Construction	$12,055,300	$3,748,400	$1,252,500	94
Manufacturing	$2,587,800	$372,300	$99,100	9
Transportation, Information, Utilities	-$14,088,500	-$2,915,800	-$9,200	-18
Trade	$9,854,800	$4,175,900	$385,200	102
Service	$17,068,800	$4,215,800	$1,369,400	124
Government	$473,600	$294,600	$0	3
Total	**$28,101,300**	**$9,928,400**	**$3,106,400**	**316**

1.2 Market Assessment and Process Evaluation

In addition to the impact evaluation, we conducted both a market assessment and process evaluation of Hawaii Energy's programs for PY2010. The goals of the market assessment and process evaluation were to:

- Research the markets that the programs targeted and provide suggestions for aligning programs more closely to these markets; and
- Provide feedback from participants, non-participants, contractors, and other market actors on how well the programs are being implemented.

We conducted the following research activities to support both the market assessment and process evaluation:

- Participant phone surveys;
- In-depth interviews with program staff and market actors;
- Contractor focus groups;
- Comprehensive review of energy efficiency potential studies and other secondary research;
- Development of program theory and logic models;
- Review of last year's general population and non-participant business customer surveys; and

- Geographic information system (GIS) analysis of program participation.

1.2.1 Market Assessment and Process Evaluation Findings and Recommendations

The conclusions and recommendations from the market assessment and process evaluation are summarized below. Note that some of the findings may have been superseded due to actions taken by Hawaii Energy in response to interim findings and real-time feedback. Where such corrective actions were taken they are briefly noted in this summary. The findings in the body of the report reflect the status of the Program at the time the evaluation research was conducted (i.e., calendar year 2011).

1.2.1.1 High Customer and Contractor Satisfaction with Program

In its second year, the Program again scored highly among its participating customers and contractors. There is stability in how the Program is being delivered and how it is perceived by the market. Hawaii Energy is implemented by a dedicated and knowledgeable staff, maintaining some key continuity from the prior programs. The flexible policy environment and lack of onerous reporting requirements have likely contributed to its success in meeting goals and achieving high satisfaction.

Although the high satisfaction scores are encouraging, as noted below we are concerned that the Program continues to rely on a few key personnel for its success. We recommend that Hawaii Energy develop ways to rely on a broader pool of staff and cultivate a model that lends itself to scalability. This will become more critical in future years as tapping into available savings potential becomes progressively more difficult. Recent personnel promotions and additions by Hawaii Energy may help address this concern.

1.2.1.2 Innovative, Creative Program

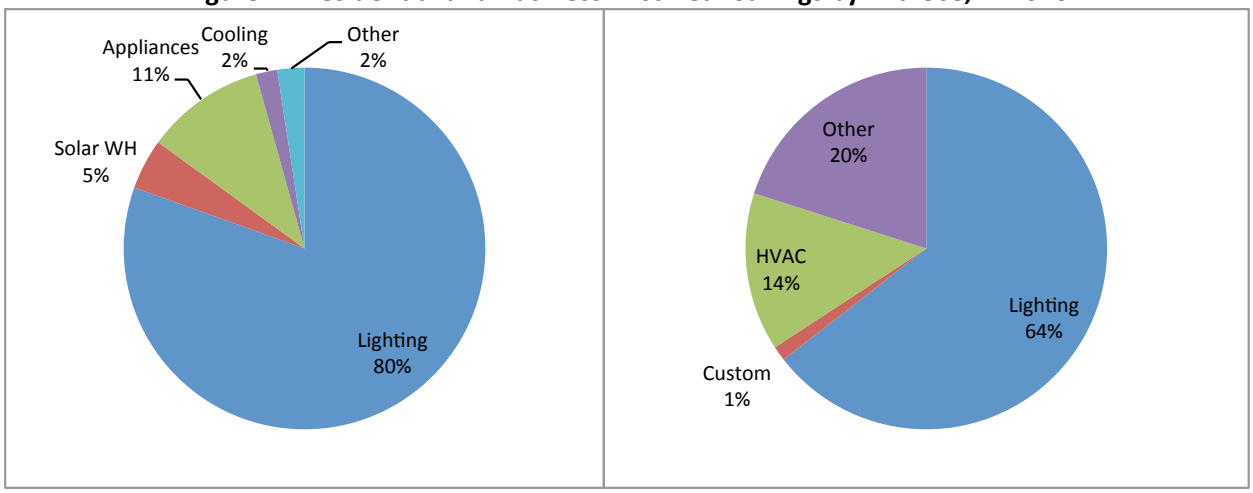
The continuous conception of new strategies and measures to offer the market is a strength of Hawaii Energy's staff and implementation approach. Many of the senior staff are very knowledgeable of the market and are experienced, creative implementers. However, the Program has a relatively small staff compared to programs with similarly sized budgets elsewhere and tends to rely on few key personnel to design and manage the individual programs. Given staffing constraints, Hawaii Energy is not always able to dedicate enough resources to ensure that a new strategy or measure can be successfully deployed full-scale. We recommend that the Program streamline its plans to launch new or pilot program strategies and measures to improve internal monitoring and suitability for independent evaluation. The Program may also be constrained by its determination to keep administrative (and staffing) costs down, and the merit of that approach should be considered during the next Program planning cycle.

1.2.1.3 Focus on Short-Term Energy Savings

Despite goals and incentives that explicitly encourage achieving long-term savings, Hawaii Energy is a very streamlined, efficient program that, to date, has been most successful in maximizing short-term energy savings. In its second year, the Program continued to deliver on its energy savings goals. The Program diversified the sectors it served compared to its

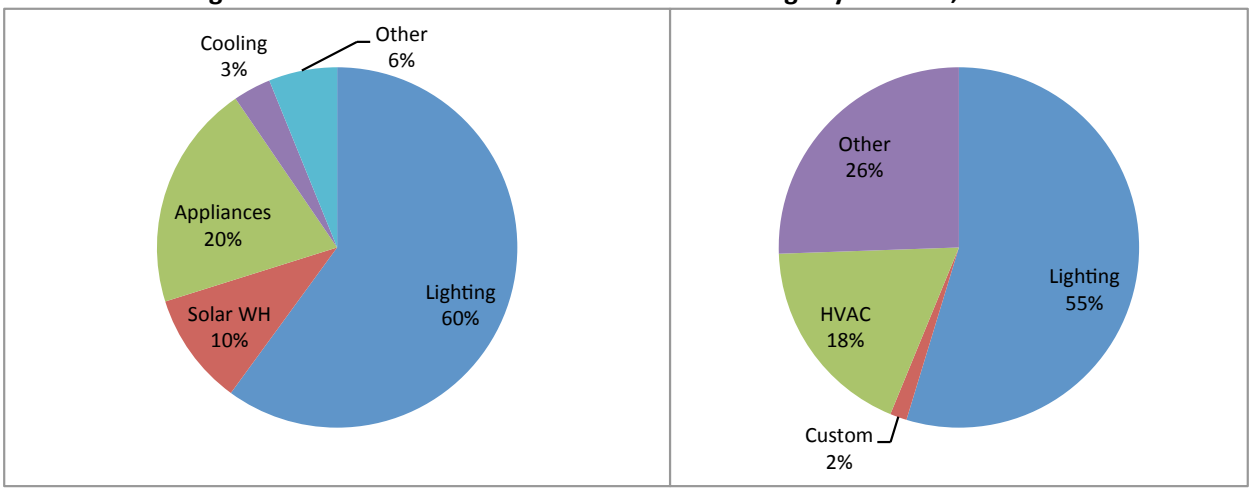
first year as a result of one-time additional rebates funded by American Recovery and Reinvestment Act (ARRA) funds administered by the state. Lighting measures (primarily compact and T8 fluorescent lamps) still dominated the Program portfolio. Figure 1 shows the first-year savings by end use for the residential and non-residential sectors for PY2010. The figure shows that lighting makes up the vast majority of savings in both sectors: 80 percent of residential savings and 64 percent of business savings. For the residential sector, appliances are a distant second (11 percent), followed by SWH and cooling which make up seven percent of total residential savings. For the business sector, custom projects, which include all types of Program measures, make up only one percent of savings (a significant drop from its 16 percent in PY2009), with HVAC and other projects making up 34 percent of all business savings. Savings allocation by end use changes when we consider lifetime savings. In this case, while lighting remains the "biggest piece of the pie" for both sectors, HVAC (non-residential), and appliances and SWH (residential) represent a larger portion of savings than they did for first-year savings, as seen in Figure 2.

Figure 1: Residential and Business First-Year Savings by End Use, PY2010



Source: Evergreen analysis of PY2010 Program tracking database (system-level savings)

Figure 2: Residential and Business Lifetime Savings by End Use, PY2010



Source: Evergreen analysis of PY2010 Program tracking database (system-level savings)

Striking a balance between lower cost short-term measures and higher cost long-term measures is an integral part of the Program portfolio contract negotiations between the PUC and Hawaii Energy as the Public Benefits Fee Administrator (PBFA). In light of this, Hawaii Energy has launched a new set of transformational programs for PY2011, offering an opportunity to break with the short-term energy savings focus. The most recent plan for transformational programs in 2012 more explicitly addresses training for contractors, building operators and other market actors. These skill sets need to be developed to transition the market into embracing more complex and expensive measures that garner long-term energy savings.

Even though the Program was successful in meeting its stated goals, there are concerns about the long-term sustainability of the Program approach and of its alignment with the state's long-term clean energy goals. There remains untapped potential among sectors and measures that will require more Program resources and consequently will be associated with lower cost-effectiveness. Rather than face that issue abruptly several years down the road when all the short-term savings opportunities have been seized, we believe it is better to begin that transition now while there still exists highly cost-effective energy savings potential that can be achieved in combination with savings from harder to reach sectors. Hawaii Energy has begun to address this issue in the current program year with several programs promoting LED lighting, retro-commissioning, chiller optimization, and energy manager training.

We also have concerns about the ability of the Program to make this transition, since during its first two years it has relied on a small staff compared to other similarly funded programs. The current model is not easily scalable, and it will require time to add staff, expand outreach to a broader pool of contractors and customers, and make progress selling measures beyond compact and T8 fluorescent lamps. Both Program goals and staffing changes appear to incorporate recognition of the need to expand both the measures covered by the Program and the staffing levels required to attain the new goals.

We recommend that policymakers set Program goals consistent with an objective of transitioning the Program to a sustainable model that engages the broader customer and contractor market to pave the way to achieve the state's long-term energy goals. While some of these goals appear to have been incorporated into the 2011 contract between the state and Hawaii Energy, there remains room for improvement. Additionally, we believe that longer-term contracts between the state and Hawaii Energy will help ensure that these loftier goals are met by allowing for the development of long lead time capital projects

1.2.1.4 Program Tracking System and Timely Reporting

There continue to be difficulties with the Program tracking system used to collect Program data critical to impact evaluation processes. For PY2010, this resulted in delayed delivery of the verification results. The delays may have been due in part to the inclusion of overlapping measures delivered through ARRA-funded programs with unique federal reporting constraints, which will not be an issue in future program years. Additionally, the

schedule of the program and evaluation cycles contributes to the challenges in delivering timely verification results, as the main impact evaluation results are due within a few months of the close of the program year. There is also room to improve the communication process among the implementers, contract managers and evaluators.

We recommend that Hawaii Energy place a higher priority on Program data tracking and reporting as is done in similar jurisdictions nationwide, given the complexity and regulatory oversight of administration of the Public Benefits Fee (PBF). Opportunities to modify the program or evaluation cycle should be explored, as this will significantly improve the efficiency of the savings verification process.

1.2.1.5 Sector-Specific Results

Because of their importance to achieving Program and state goals, several market sectors served by the Program were researched as a key component of the market assessment. Additional findings and recommendations for these market sectors, which include military, residential low-income and small business, are summarized below.

In general, we recommend developing a broader set of metrics that provide information to the Program and policymakers on the distribution of rebates by sector and across islands, the comprehensiveness of measures delivered and the remaining energy efficiency opportunities. These metrics should also include awareness of the Program among contractors and customers, and behaviors related to energy efficiency. Annual tracking of such metrics could help guide the Program over the long-term as it transitions to a more sustainable model with greater customer and contractor engagement. Behavioral and market metrics could also support evaluation of the behavioral and market-based strategies that are being increasingly embraced by the Program.

Military

Our independent interviews with high-level decisions-makers in the state's military sector indicated that many energy efficiency projects are likely to happen in absence of Hawaii Energy support. Our market analysis also showed that the military sector is receiving a much greater share of incentives than it is contributing to the PBF. There also exist military directives to achieve energy savings, and consequently energy efficiency projects for the military need less support than in other market sectors.

We recommend that policymakers develop a policy specifically for the military sector that resolves the discrepancy between its PBF contribution and its current share of incentives, while still enabling it to deliver energy efficiency savings in a manner consistent with the state's broader desires to support this sector. In keeping with the need to transform markets, the program should work with the military to design projects that develop new concepts, help commercialize products, and/or help develop a foothold for efficient products that are not yet readily available in Hawaii. Recent conversations with Hawaii Energy indicate that it is starting to work directly with the military to promote these technologies and concepts. If these efforts generate additional spillover effects, Hawaii Energy would be justified in distributing a larger share of the PBF dollars to the military sector than the military currently contributes.

Net to Gross Ratio

In calculating energy savings attributable to its programs, Hawaii Energy is required to use a combined NTG ratio of 0.73 that reflects an average across all individual programs. Due to issues in accurately assigning net Program impact issues, some individual programs, such as those targeting the military sector, may be decreasing to a smaller NTG ratio in future program years, as more Program impact data become available. Other programs such as RLI, New Chiller Optimization, and those aimed at creating behavioral change may move to a higher NTG ratio closer to 1.0. Revising this NTG ratio is a complex and time-consuming process that may be worth revisiting in future program years.

Residential Low Income and Small Business

Hawaii Energy has specific program offerings to address the residential low-income sector and small businesses. The program is constrained in how much it can support the residential sector overall as total incentives available are limited to the amount that the residential sector contributes to the public benefits fund.

During PY 2010, Hawaii Energy successfully engaged many low-income service agencies across the state to deliver CFLs, smart strips and low-flow showerheads to its low-income residents. However it is difficult for the program to scale up these initiatives due to the isolation of some of the communities and the lack of infrastructure to serve this sector on a larger scale. Currently, the Program is offered incentives to achieve equity by island, and it has made significant efforts to serve some of the most isolated residents on Molokai and in Hana, areas of Maui County. There exists additional energy savings potential across all islands, particularly the island of Hawaii. One potential strategy Hawaii Energy is using in PY2011 to address the need and help meet the island equity goal is to scale up the Program's refrigerator replacement program component for low-income residents.

Hawaii Energy had less success in PY2010 with its newly introduced small business direct install program, engaging only one contractor with very limited customer participation. The program was not a true direct install program, since it required customers to cover some of the up-front costs of the installed equipment. It also suffered from lack of broad marketing to contractors. We found very low awareness of, yet broad contractor interest in, the Program offering among a sample of lighting and HVAC contractors. For PY2011, the program is ramping up by offering a true direct install (no cost) program, relying on a small pool of select contractors who have a backlog of projects that could easily use up the budget set aside for this program component.

2 Introduction

This report presents the results of a comprehensive evaluation conducted of the Hawaii Energy Conservation and Efficiency Programs (Hawaii Energy or Program) during the second year of operations, Program Year 2010 (PY2010), from July 1, 2010 through June 30, 2011. The evaluation verified Program impacts, and assessed Program processes and markets.

2.1 Background

The Program is administered by Science Applications International Corporation (SAIC), as selected by the Hawaii Public Utilities Commission (PUC) in 2009, at which time Hawaii Energy took over management of the state's demand side management programs from Hawaiian Electric Company (HECO) and its subsidiaries, Maui Electric Company (MECO) and Hawaii Electric Light Company (HELCO), The Program is funded by Hawaii electric and gas utility rate-payers via a Public Benefits Fee (PBF) that is intended to promote the development of programs and services that increase energy efficiency, reduce electricity consumption and demand, and ultimately decrease Hawaii's dependence on imported fossil fuels. [10] In its role with Hawaii Energy, SAIC serves as the state's Public Benefits Fee Administrator (PBFA).[11]

Hawaii Energy uses several subcontractors to implement its portfolio of programs, including Honeywell (residential program administration support), Wall-to-Wall Studios (marketing and creative design services) and the Bennet Group (public relations).

Hawaii Energy also has an implementation and oversight organization, the Technical Advisory Group (consisting of the PUC, the PBF administration contract manager, fiscal agent and contract evaluator, and local energy stakeholders), to provide expertise and technical guidance.

To boost energy conservation and efficiency measures in the state, Hawaii Energy began implementing federal stimulus grants (associated with the American Recovery and Reinvestment Act (ARRA) of 2009) in the second half of PY2009 on behalf of the State Energy Office and the Department of Business, Economic Development and Tourism, and has assumed a leadership role in the Hawaii Clean Energy Initiative (HCEI), a collaborative effort between the State of Hawaii and the U.S. Department of Energy focusing on transforming the energy sector of Hawaii to a clean energy economy based on 70 percent clean sources by 2030. The Program is also participating in the Integrated Resource Planning (IRP) Framework and Energy Efficiency Portfolio Standards (EEPS) open dockets.

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[10] For further detail on the origination of the PBF, refer to Evergreen Economics. *Evaluation of the Hawaii Energy Conservation and Efficiency Programs Program Year 2009*. (Honolulu, HI: Hawaii Public Utilities Commission, March 2011). http://www.hawaiienergy.com/125/evaluation-measurement-verification-em-v.

[11] For more detail on the PBFA role, the related contract between the PUC and SAIC may be downloaded from the Hawaii Energy site at http://www.hawaiienergy.com/75/hawaii-energy-reports

2.2 Program Overview

Hawaii Energy modified its legacy programs before launching in PY2010. The residential programs saw the following changes for PY2010:

- The former Residential Efficient Water Heating (REWH), Residential New Construction (RNC) and Energy Solutions for the Home (ESH) programs merged into one of three major residential program components known as Residential Energy Efficiency Measures or REEM, which provides customer rebates for energy efficient water heating (solar and high efficiency), lighting, air conditioning and appliances measures, and includes an upstream CFL component;
- A second residential program component known as New Residential Programs Incubator or NEW was established. This umbrella program includes energy services and maintenance (air conditioning and SWH tune-ups) and residential design and audit assistance for new homes; and
- The Residential Low Income or RLI was also a PY2010 residential program offering SWH inspections (that are a companion to the state Weatherization Assistance Program, which provides SWH systems), gift packs (compact fluorescent lamps (CFLs), showerheads and smart strips), CFL exchange and energy audits for low-income customers.

Hawaii Energy business programs were also redesigned to more accurately describe the programs and avoid customer confusion:

- The former Commercial industrial Energy Efficiency (CIEE), Commercial Industrial New Construction (CINC) and Commercial Industrial Customized Rebate (CICR) programs merged into one of four major business program components known as Business Energy Efficiency Measures or BEEM, which provides rebates to business customers for energy efficient lighting, air conditioning, water heating, water pumping, motors, building envelope, business equipment and measurement and control systems;
- The program formerly known as the Commercial Industrial Customized Rebate program became the Custom Business Energy Efficiency Measures program or CBEEM, providing rebates to business customers for custom projects; and
- The New Business Programs Incubator or NEW which targets new non-residential construction projects and includes service and maintenance (central plant optimization competition and air conditioning tune-up), direct installation of measures for small businesses, and design and audit assistance was established as a new program.

Table 5 summarizes Hawaii Energy's residential and business program offerings for PY2010.

Table 5: Hawaii Energy Residential and Business Programs - PY2010

Program	Measures/Services
Residential Programs	
REEM	***Residential Energy Efficiency Measures***
	CFLs
	High Efficiency & Solar Water Heating
	High Efficiency Lighting
	High Efficiency Air Conditioning
	High Efficiency Appliances
	Energy Awareness, Measurement and Control Systems
NEW	***New Residential Programs Incubator***
	Residential Energy Services & Maintenance
	Residential Design and Audits
RLI	***Residential Low Income***
	CFLs
	Low Flow Showerheads
	Smart Strips
	SWH Inspections
Business Programs	
BEEM	***Business Energy Efficiency Measures***
	High Efficiency Lighting
	High Efficiency HVAC
	High Efficiency Water Heating
	High Efficiency Water Pumping
	High Efficiency Motors
	Building Envelope Improvements
	Energy Star Business Equipment
	Energy Awareness, Measurement and Control Systems
	Business Direct Installation (Lighting)
CBEEM	***Custom Business Energy Efficiency Measures***
	Customized Project Measures
NEW	***New Business Programs Incubator***
	Business Service and Maintenance
	Business Direct Installation
	Business Design and Audits

Additional PY2010 enhancements include a greater focus on market evaluation and outreach activities across sectors and a greater emphasis on individual personal behavior awareness. A new and expanded Hawaii Energy website[12] was developed and the Program increased outreach to trade allies. An OPOWER peer comparison initiative was tested on 15,000 households.[13]

[12] http://www.hawaiienergy.com/

[13] Conducted on behalf of the State Energy Office using ARRA funds. Opower is a new customer engagement platform for the utility industry. Opower's software creates individualized Home Energy Reports for utility customers that analyze

As part of its planning process, Hawaii Energy must receive PUC approval of goals for annual energy savings and TRB, and a budget to provide Program services to achieve these. Table 6 shows PY2010 targets for Program electricity savings and TRB, and the Program budget.

Table 6: Hawaii Energy Electricity Savings and TRB Targets and Budget- PY2010

Sector	kW	kWh	TRB	Total Budget
Residential	N/A	71,245,000	N/A	$8,581,755
Business	N/A	61,370,000	N/A	$8,767,250
Total	23,126	132,615,000	$148,596,954	$18,554,134

2.3 State of Hawaii Context

This section provides context on the state of Hawaii in order to provide background on how its energy efficiency program portfolio is unique when compared to other states. It is important to consider economic, geographic, and climate differences when reviewing the Program, as these variants each influence the decisions surrounding resource allocation and influence Program performance. Key elements include:

- Tourism and agriculture compose a large portion of economic activity;
- A temperate climate minimizes energy needs tied to heating and air conditioning; and
- A high dependence on petroleum for energy needs heightens vulnerability to price fluctuations.

2.3.1 Climate

The most obvious difference between Hawaii and much of the rest of the nation is its climate. Most of the islands do not require heating in the winter months – except for some of the upcountry regions at higher elevations. In 2006, Hawaii rated 51st among all states in average heating degree-days. Comparing efficiency program portfolios across the U.S. reflects varied demand for heating among both residential and business consumers. Cooling is also only required on a year-round basis by only parts of Hawaii, although when compared to other states it has a much higher ranking for cooling degree-days.[14]

2.3.2 Economy

Hawaii's business sector is composed primarily of small businesses and tourism is a major economic driver. Tourists outnumber the Hawaiian population by a five to one ratio each

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their energy usage and offer recommendations on how to save energy and money by making small changes to their energy consumption It is intended to improve the overall customer experience by making energy use personally relevant. http://opower.com/

[14] U.S. Department of Energy, Energy Efficiency and Renewable Energy, State Information: http://apps1.eere.energy.gov/states/residential.cfm/state=HI

year.[15] With the high flow of temporary visitors, condominiums are often not at their maximum occupancy. Diversification of business and revenue sources has been an ongoing goal of the state, as it would lower their vulnerability to a significant decline due to trouble in any one of their major industries. There is a significant military presence and agriculture, once a primary source of income, remains significant with major crops being sugar, pineapple, flowers, nuts and seeds, coffee, cattle and milk. The U.S. Pacific Command (one of six) is based in Hawaii, with 325,000 military and civilian personnel (one-fifth of total U.S. military strength).

The recent recession has significantly impacted Hawaii, reducing tourism and building construction. However, the unemployment rate (which peaked at nine percent in early 2009) is lower than the national rate. The neighboring islands lag Oahu, with unemployment rates of over 10 percent for Maui and the island of Hawaii.

Private construction has declined since the onset of the recession, but state government construction has filled some of the gap. At the end of 2010, the job market showed signs of recovering with increases through 2011 mirroring growth in the tourism sector. The state's economic recovery is expected to continue, though the March 2011 Japanese earthquake and tsunami led to reductions in the economic growth forecast for the state in 2012.

2.3.3 Energy

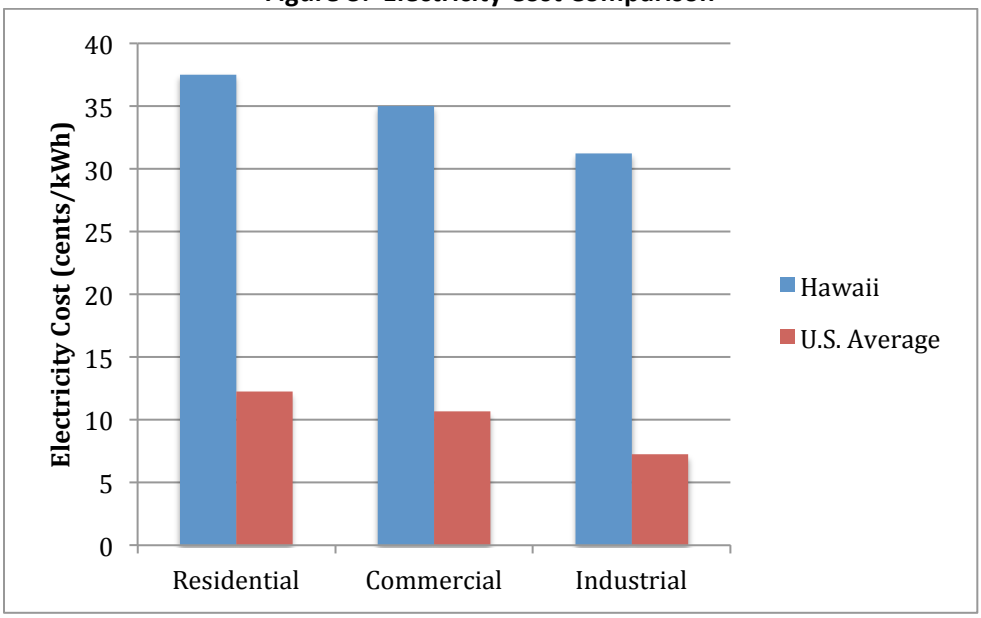
Due to its isolation and lack of fossil fuel reserves, the state relies predominantly on imported petroleum, which supplies 85 percent of its energy. From September 2010 to September 2011 alone, demand for petroleum going to electric generation in the state represented 59 percent of all U.S. petroleum usage for the same purpose.[16] Solar, geothermal, biomass, wind, water and coal are used for the rest of Hawaii's energy needs, but the still high level of dependence on imported petroleum, makes the state vulnerable to fluctuations in price.

When compared to the rest of the nation, Hawaii's population has a much higher cost of electricity (Figure 3). High dependence on one source of energy and the inability to connect to a national grid are a few of the contributing factors to the higher than average cost per kWh. The relatively high cost of electricity likely encourages consumers to conserve energy in order to lower their utility bills.

[15] Hawaii Department of Business, Economic Development & Tourism. *Outlook for the Economy, First Quarter 2012*. http://hawaii.gov/dbedt/info/economic/data_reports/qser/outlook-economy

[16] U.S. Energy Information Administration, Electricity: http://205.254.135.7/electricity/monthly/index.cfm

Figure 3: Electricity Cost Comparison



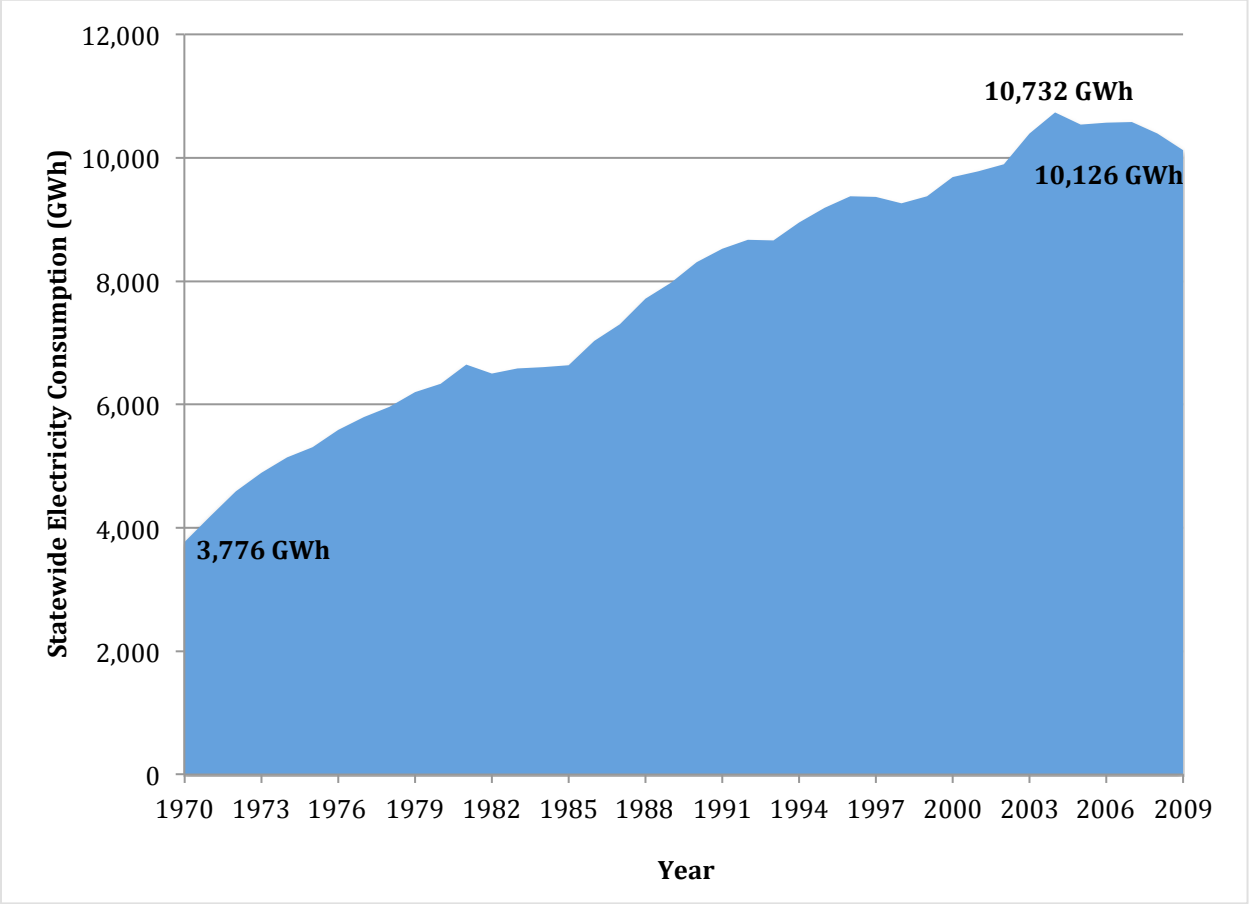
Sources: U.S. Energy Information Administration: http://www.eia.gov/state/state-energy-profiles-data.cfm?sid=HI#Prices
http://www.eia.gov/state/state-energy-rankings.cfm?keyid=18&orderid=1

Higher energy costs and lower heating needs (due to its climate) likely contribute to Hawaii's residential per capita average kWh consumption being about two-thirds of the national average for the residential and commercial sectors.[17]

Recently, both Hawaii's electricity consumption and its expenditures on fossil fuel have been on the decline (Figure 4 and Figure 5). Electricity sales in 2010 totaled 10 billion kWh, supplied by Hawaii Electric Light Company (Hawaii), Hawaiian Electric Co. (Oahu), Kauai Island Utility Cooperative (Kauai) and Maui Electric Co. (Maui, Molokai and Lanai). The Gas Company provided 32.3 million therms of gas (synthetic natural gas and liquefied petroleum gas (propane) from byproducts of imported petroleum) to about 70,000 business and residential customers across the state.

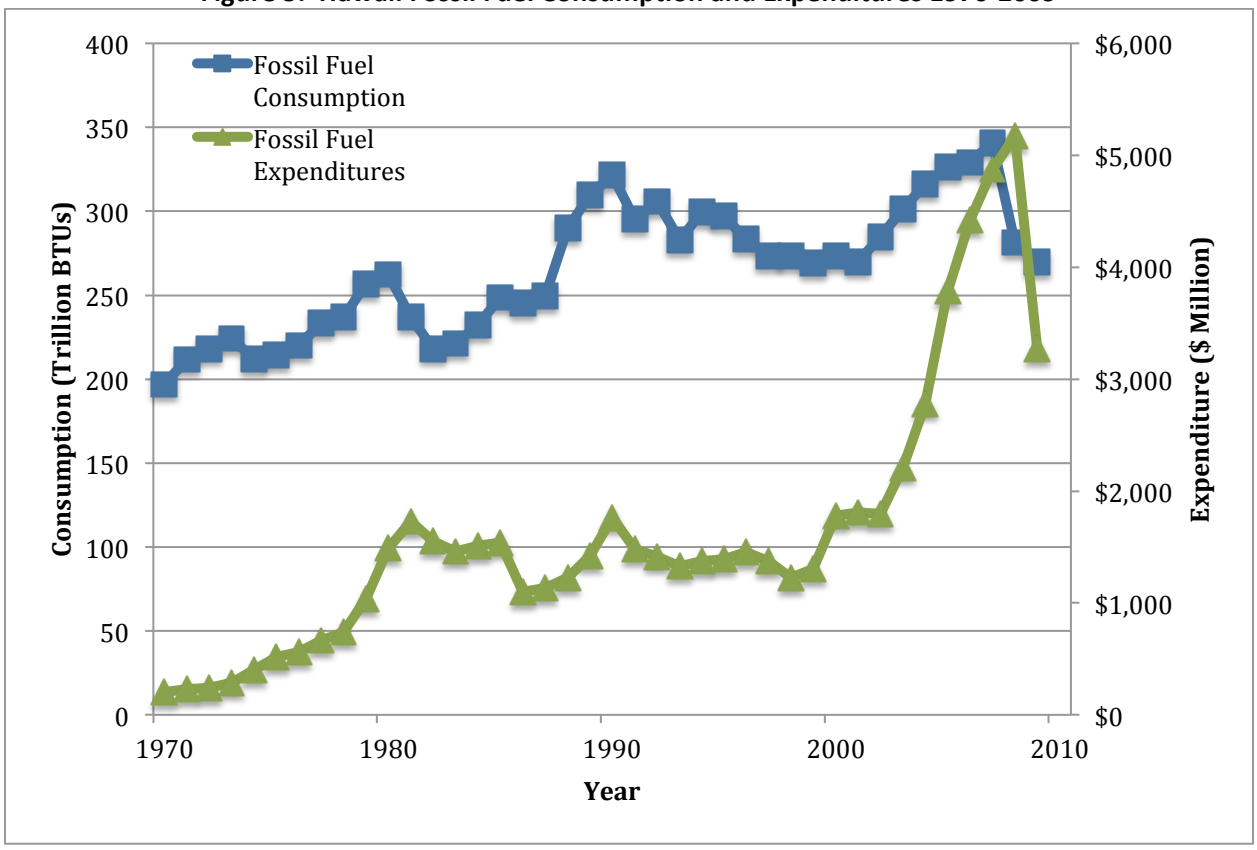
[17]U.S. Energy Information Administration Consumer Consumption:
http://www.eia.gov/electricity/sales_revenue_price/pdf/table5_a.pdf

Figure 4: Hawaii Electricity Consumption 1970-2010



Source: *State Energy Data System: Hawaii,* August 2011 (Energy Information Administration)

Figure 5: Hawaii Fossil Fuel Consumption and Expenditures 1970-2009



Source: *State Energy Data System: Hawaii Primary Energy Use,* June 2011 (Energy Information Administration)

2.3.4 History of Conservation and Efficiency

The state has a history of conserving energy, beginning in 1996 with formal energy efficiency programs offered by the public electric utility companies in response to an integrated resources energy planning process initiated by the Hawaii Public Utilities Commission. According to Hawaiian Electric Company (HECO), it and its subsidiaries, Maui Electric Company and Hawaii Electric Light Company, its efficiency programs reduced demand for electricity by 169 MW (equivalent to a large power plant), saved 1.6 million barrels of oil and 864,000 carbon dioxide emissions annually[18].

The HECO utilities' energy efficiency programs were similar to programs in other states and regions of the country, but with a focus on SWH due to the state's climate and lack of heating load. The programs continued for 13 years through 2008 until they were transferred to SAIC and became the Hawaii Energy portfolio of programs.

[18] Hawaiian Electric Company press release June 25, 2009: http://hecoirp.com/portal/site/heco/menuitem.508576f78baa14340b4c0610c510b1ca/?vgnextoid=5294bf099e812210VgnVCM1000005c011bacRCRD&vgnextfmt=default&cpsextcurrchannel=1

The extensive SWH program efforts paved the way for legislation requiring SWH systems to be installed in all single-family new home construction, which went into effect on January 1, 2010.

2.3.5 Future of Clean Energy

Hawaii is the most oil dependent state in the nation, vulnerable to fluctuations in oil prices. The state recently set goals and a road map to achieve 70 percent clean energy by 2030, with 30 percent from energy efficiency and 40 percent from renewable energy. As mentioned above, the HCEI seeks to reduce reliance on foreign oil reserves, increase economic stability and security and to create a green economy sector to balance reliance on tourism and the military (which together make up half the economy).[19] Hawaii's EEPS has a goal of achieving 4,300 GWH of energy savings by 2030 and its RPS requires that 20 percent of net electricity sales come from renewable energy by 2020. Both the EEPS and the RPS are important components of the HCEI.

Several working groups have been created, consisting of community members and national experts, to make progress towards the initiative's goals. The end-use efficiency working group is focused on energy efficiency, complemented by transportation (alternative fuels), electricity (renewable energy) and fuels (biomass) working groups.

The American Council for a Clean Energy Economy's (ACEEE) 2011 state scorecard report ranks Hawaii 12th among U.S. states based on its use of best practices and leadership in energy efficiency policy and program implementation.[20] The report cites the state's efforts to set policy and implement programs such as Hawaii Energy to advance its Clean Energy Initiative. Like many states, Hawaii is taking a leadership role in energy policy to promote its economic future, in lieu of comprehensive federal energy legislation.

Hawaii Energy, as the state's energy efficiency program, supports the initiative by achieving energy efficiency savings across the islands in both the residential and business sectors. The State Energy Office also contributes to energy efficiency through policy, and codes and standards development. The legislation that established Hawaii Energy as PBFA, also specified that the Program must be evaluated by an independent auditor to verify energy savings claims and other mandated deliverables. The results of the subject evaluations of this report serve to meet requirements of SB 3001 (2008), Hawaii Revised Statutes §269-124.[21]

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[19] Hawaii Clean Energy Initiative: http://www.hawaiicleanenergyinitiative.org/

[20] American Council for an Energy Efficient Economy, *2011 State Energy Efficiency Scorecard*. http://aceee.org/research-report/e115

[21] "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 deliver energy-efficiency and demand-side management programs under section 269-121." http://www.capitol.hawaii.gov/session2008/bills/SB3001_HD1_.pdf

2.4 Evaluation Overview

Evergreen Economics has contracted with the Hawaii PUC to conduct a comprehensive multi-year evaluation of Hawaii Energy. The PY2010 evaluation team consisted of the following firms and expert associates:

- **Evergreen Economics** managed the overall evaluation and led the impact evaluation work.
- **EMI** led the process evaluation and assisted with the market effects and market baseline work.
- **Michaels Engineering** managed all on-site metering and verification work and conducted fieldwork. They also led the review of *ex ante* savings values.
- **ECONorthwest** conducted the economic (input/output) analysis.
- **InSynergy Engineering** conducted on-site verification work.
- **SMS** fielded all of the phone surveys in this evaluation.
- **Robert Wirtshafter** was involved with the process evaluation and market studies and the low-income program evaluation.
- **Phil Willems** assisted with all the process evaluation, market effects, and market baseline work.
- **John Stevenson** supported the development of the phone survey instruments.

During the 2011 calendar year, we conducted extensive research on Hawaii's residential and non-residential sectors to evaluate the effectiveness of the Program, assess the state's energy efficiency markets, and estimate energy savings. The Program evaluation objectives were to:

- Review the Program's savings estimates and ensure that sound values and methodologies were used to estimate energy savings in the Hawaii Energy TRM;
- Verify and validate the Program's reported energy savings, including site inspections and "desk" reviews of Hawaii Energy project reports;
- Conduct *ex post* impact evaluations of all Hawaii Energy programs, with an emphasis on measures and sites with high impact (and/or relatively high savings uncertainty) and those measures that received less attention in PY2009, while allowing for expenditures on other useful evaluation activities;
- Calculate *ex post* cost-effectiveness individual program and Hawaii Energy portfolio analyses using the Total Resource Cost (TRC) Test;[22]

[22] The TRC is the customer project or incremental cost to purchase and install or implement the energy efficient measure above what would have been done anyway. The TRC Test is a benefit over cost test that compares the ratio of the TRB to the TRC. The test of cost effectiveness is if the benefit exceeds the cost.

- Conduct process evaluations of the individual programs, Hawaii Energy portfolio benchmarking (with an emphasis on new activities), and establishment of market penetration tracking priorities;
- Conduct an economic impact analysis; and
- Coordinate with Hawaii Energy market research.

The evaluation approach consisted of the following key activities:

- **Impact Evaluation** to provide an independent assessment of the Program's energy savings accomplishments, including:
    - **TRM Review** – an engineering review of the Program's deemed savings values;
    - **Verification Research** – savings validation and measure installation verification, including participant telephone and on-site surveys and project file review;
    - **SWH Savings Analysis** – billing analysis of participating SWH customers; and
    - **Economic Impact Analysis** –assessment of the broader economic impacts of Hawaii Energy on the state.
- **Process Evaluation** to determine the effectiveness of Program processes, based on Program staff interviews, Program data and materials review, participant surveys, and trade ally interviews; and
- **Market Assessment** to characterize the supplier and customer markets in Hawaii, using participant surveys, trade ally interviews, and secondary research.

3 Evaluation Approach

This section provides an overview of the evaluation methods used to conduct the TRM review, verification research, and primary and secondary research. We provide additional detail in Appendix E on sample design. The reader is also referred to Appendix A, Verification Results Memorandum and Appendix B, Technical Reference Manual Review Results Memorandum, for the comprehensive methods and results for these two research tasks.

3.1 Technical Reference Manual Review

A key impact evaluation task is the review of energy savings assumptions are used by Hawaii Energy and documented in its TRM. Savings claims for the PBFA are based on a regulatory approach that focuses on approving *ex ante* per unit savings, which are "trued up" with measure installation verification at the close of each program year. Energy and demand savings estimates for Program measures and activities are approved on an *ex ante* basis and must be documented in a TRM prepared by the PBFA and reviewed by the EM&V contractor. The TRM must include estimates for all prescriptive measures, and descriptions of calculation methodologies for custom measures. The information in the TRM must be consistent with the information in any database or other tool used to calculate savings resulting from the Program. The TRM must be updated each year to reflect the best available information unless a two-year cycle has been permitted by the PUC.

The approved estimates are "deemed" for the applicable program year. That is, savings from energy efficiency measures are evaluated using the following formula:

> *Measures installed X TRM estimate X Verification Rate*
>
> *Where:*
>
> Measures installed = Program-qualifying measures properly installed and operating and recorded correctly in the program database
>
> TRM estimate = The approved TRM value for energy and demand savings
>
> Verification rate = The percent of measures found to be installed and operating per EM&V verification processes using appropriately designed sampling techniques.

Ex post EM&V to develop and/or update unit savings estimates is conducted for selected measures and programs, but the results are applied prospectively rather than retrospectively (with some exceptions, e.g., custom sites). That is, the results are used to update estimates for the subsequent version of the TRM. This approach enables the EM&V team to have confidence in the savings estimates that are being used for the Program, while allowing the PBFA a measure of security for program planning. The implementer can be

confident in the savings they will be credited, providing that the measures are in place, operational and Program qualifying based on the EM&V contractor's verification work.

For the PY2010 evaluation we reviewed the TRM itself, as well as cited documentation to ensure consistency. In addition, we compared the claimed savings against other sources, such as savings values used in other jurisdictions and research documentation from KEMA (the EM&V contractor that evaluated the HECO utilities' prior energy efficiency programs), the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), the National Renewable Energy Laboratory (NREL), and other organizations. We examined not only the derived deemed savings values, but also assumptions regarding operating conditions and baseline equipment. Additionally, we evaluated the reasonableness of the supporting documentation (e.g., expected useful life and system loss factor) when compared to available sources and findings from other utility programs.[23] Refer to Appendix B, Technical Reference Manual Review Results Memorandum, for more detail on the research approach.

3.2 Verification Research

We conducted two major research tasks to verify the Program's energy savings claims: savings database validation and measure verification. The overall verification results comprise the combination of the results of these two activities. The savings database validation provided a set of ratios by Program and energy efficiency measure category that reflect the proportion of energy savings we verified in the Program tracking database relative to the savings reported in the Annual Report.[24] The measure verification provided a second set of ratios that reflect the proportion of measures and their associated savings that we verified to be installed and Program qualifying.

We multiplied the two sets of ratios to yield a final set of overall verification and validation ratios that we applied by Program and measure to the Annual Report values. The resulting savings are our independent assessment of the verified energy savings associated with Hawaii Energy's PY2010. Below we provide a summary of the results. Refer to Appendix A, Verification Results Memorandum, for more detail on the evaluation methods.

3.2.1 Savings Database Validation

We obtained a database from SAIC that included Program participants and energy savings values for PY2010. We summarized the savings claims by individual program (e.g., REEM) and energy efficiency measure (e.g., water heaters and fluorescent lamps) and compared that summary to SAIC's program and measure-level summary of its savings claims in Attachment A of the Annual Report.

[23] Refer to Appendix B for a full list of references

[24] Gross and net savings are reported at the measure level in Section VII (Business) and Section VIII (Residential) of the Annual Report.

The validation exercise required that we replicate the measure installation counts included in the Annual Report in our independent review of the tracking database. Similarly, we checked the per unit savings values used in the Annual Report in the tracking data (for those measures included in the TRM) to ensure that we were using the appropriate values from the TRM for each measure and program. Finally, we replicated the gross savings, net savings and TRB results from the Annual Report by performing our own calculations for these parameters using the final tracking system data.

3.2.2 Measure Verification

In order to verify that measures in the Program tracking database were actually installed, operable and Program qualifying, we conducted telephone and site surveys with statistically representative samples of participants by individual program, reviewed Program participation records and conducted an engineering review of large customer projects. Telephone survey verification was based on customer response when asked if the Program measure was still installed and operating. During customer site surveys we inspected a sample of households and non-residential facilities to confirm measure qualification, installation and operation.

We verified that CFLs delivered upstream through manufacturer and distributor rebates via the REEM program, were Program-qualifying and were being sold in retail stores with the proper rebate amount applied, and that the respective invoices submitted by retailers matched the measure counts claimed by Hawaii Energy.

For the RLI program, which uses community-based organizations (CBOs) to distribute CFLs, we verified that the CFLs were purchased in bulk by Hawaii Energy and distributed to the appropriate CBOs, and we audited the invoices using similar methods as for the upstream CFL program. We also reviewed related CBO paperwork to verify that the CFLs they received from Hawaii Energy were distributed appropriately to low-income customers. However, the documentation necessary for such verification was incomplete. Consequently, we developed recommendations for RLI CFL tracking which were used by to develop Program tracking requirements for PY2011.

We used the data collected from the surveys, project reviews, and invoice audits to develop verification ratios by individual program and measure category. These ratios are the fraction of claimed energy savings from measures that were verified as installed and Program qualifying. Where samples were used, we developed sample weights so that results would reflect the population of participating customers. We developed an initial verification ratio equal to the fraction of measures verified by telephone.

A correction factor was used for the nested sample of customers who had both a telephone and site survey, whereby the site survey was assumed to be correct if there was a discrepancy between the two. 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 percent was applied to the telephone survey verification ratio to produce a final verification ratio.

We attempted to confirm the energy savings claims in the database for large, custom, and military non-residential facility projects using engineering reviews based on electronic project files and customer site surveys. We reviewed vendor records, observed equipment size and specifications on-site, and interviewed customers, and developed verification ratios for each project based on the energy savings we could confirm. When we could not confirm the full amount of energy savings as claimed in the tracking database, we relied on at least two sources of information (e.g., a site survey combined with a project file review) to determine the appropriate verification ratio.

We applied these verification ratios by individual program and measure to the final Program tracking database, which covered all of PY2010. A more detailed discussion of our primary research tasks, such as the telephone and site surveys used for measure verification, is found in the following section.

3.3 Primary Research

To support the impact evaluation, and process and market assessments, we conducted primary data collection during the summer of 2011, including nearly 700 telephone surveys, 51 in-depth interviews, and more than 120 on-site surveys, as Table 7shows.

The table depicts the type and number of surveys and interviews done for each customer group. For the residential sector, we used participant phone surveys and site surveys. We used similar surveys for the business sector as well as in-depth interviews and file reviews. We also used the in-depth interview format for trade allies in order to facilitate a deeper discussion, and conducted focus groups with contractors. Lighting retailers were studied through store visits and invoice audits. We also reviewed all invoices and distributor-level transactions for the RLI program.

Table 7: Primary Data Collection Summary

Customer Group	Participant Phone Survey	Participant Site Survey	Contractor Forum	In-Depth Interview	Invoice Audit	File Review
Residential	606	51		0		1
Business	80	76		28		51
Lighting retailer		5		0	20	
Trade allies			16	23		
Totals	**686**	**132**	**16**	**51**	**20**	**52**

3.3.1 Participant Survey Sample Design

We used Program tracking data from the first three quarters of PY2010 as the basis for the participant sample frame, from which we drew samples for the participant telephone and on-site surveys to verify REEM and BEEM measure installations and associated savings. The determination to use this subset of the full-year Program tracking database (provided by Hawaii Energy in May 2011) was made 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 in June. As the Program design did not change in the fourth quarter of PY2010, our assumption was that the samples drawn from the first three quarters and the subsequent research results would be representative of the full program year.

However, due to the number of large non-residential projects due to be completed and recorded in Q4 of PY2010, in order to ensure the sample frame was representative of the full-year savings for this sector's programs, we supplemented the partial PY2010 dataset with large projects in the BEEM program and all projects in the CBEEM program added to the tracking database in Q4 of PY2010. We worked closely with Hawaii Energy 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 PY2010 tracking data available at the time.

For the RLI program, we reviewed invoices for all measures distributed throughout the entire program year.

The Program claimed 65 percent of its PY2010 savings during the first three quarters of that program year, and the remaining 35 percent in the final quarter. Our sample frame, however, represented 90 percent of the full-year program savings. For the BEEM program, claimed savings in the sample frame represented just over 100 percent of the full-year savings. Adjustments to the tracking database caused claimed savings to decline. The sample frame savings for the CBEEM program represented 100 percent of the full program year, and the REEM program sample frame represented 81 percent of the full-year savings.

Refer to Appendix E, Sample Design Detail, for additional information about the sample design.

3.3.2 Participant Survey Data Collection

The evaluation team conducted a variety of research activities involving Program participants to verify Program measure installations and support the process evaluation and market assessment, with the research approach varying based on customer type.

The majority of Program participants were *downstream* residential or business/government agency customers who received a rebate for Program-qualifying equipment. Typically they mailed in a rebate application and later received a check. The Program also paid rebates directly to lighting manufacturers and distributors (*upstream* or *mid-stream* market actors) for CFLs as part of the REEM program. The manufacturers and distributors then sold discounted products to lighting retailers. The retailers passed that discount directly on to customers who bought CFLs and received a discount via a point-of-sale rebate that was redeemed instantly.

Research methods used for downstream customers included telephone and site surveys, and an engineering review to confirm savings for large and custom business projects. For upstream market actors, we visited a sample of stores selling Program-discounted products to confirm that the products were Program qualifying and being sold at the correct discounted price. We also 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.

3.3.2.1 Downstream Participant 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, and to support the process evaluation and market assessment for downstream customers.

- **Telephone surveys.** SMS, a Hawaii-based telephone survey research firm, conducted computer-assisted telephone interview (CATI) surveys for both residential and business customers in July 2011. The surveys included questions to verify that the customer had received a rebate for a Program measure, had installed the measure, and that the measure was still operable. The survey also included batteries on process evaluation (e.g., customer satisfaction and program awareness) and market assessment (e.g., energy efficiency equipment saturation, and energy efficiency awareness, behaviors, and attitudes). The survey 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 island. The survey targeted 600 customers, addressing up to two measures per customer. Because the population of small and medium business customers was so small (419), we did not draw a sample, but rather called all participants. SMS completed 606 residential surveys and 80 business surveys.

- **Customer site surveys.** Michaels Engineering and InSynergy Engineering, Inc. conducted on-site surveys of participating businesses and residences to verify that measures were installed, qualified for the program, and were operational. Residential participants were recruited through the CATI survey, yielding 79 completed on-site surveys of measures at 76 sites.

  Business customers were also recruited during the CATI survey, yielding 43 completed on-site surveys of measures in the BEEM program at 21 sites. Additionally, we inspected 154 measures at 30 business locations of customers excluded from the telephone survey, including those who completed large projects in the fourth quarter (101 measures at 16 businesses), those who completed custom projects through the CBEEM program (15 measures at 13 businesses), and military personnel (38 measures at commercial and residential facilities of the U.S. Navy, U.S. Marine Corps, and the U.S. Army).

  The business on-site surveys also supported the engineering analyses performed of all custom measures. During the on-site visits, we recorded the quantity of installed equipment verified by inspection and equipment nameplate information. 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 the customer's actual operation was consistent with Program assumptions.

3.3.3 Upstream and Residential Low Income CFL Research

We conducted site visits and invoice audits to verify that CFLs sold through the upstream REEM program component were Program qualifying, and to collect pricing information on bulbs. Because the program does not collect end-user customer data (i.e., information about who buys the CFLs and where the CFLs are ultimately installed), our research focused on the participating manufacturers, distributors, and retailers.

- **Lighting retailer site visits.** The evaluation team visited five 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-site surveys 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 REEM CFL rebate program. We reviewed a random stratified sample of invoices from participating retailers to ensure that the information in Program databases matched the invoices and to verify that the stores met the requirements of the Program participation agreement 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.[25] The invoice audit represented 20 percent 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 invoice audit approach described above for upstream CFL retailers to verify RLI CFLs (and a small number of showerheads and smart strips distributed through the RLI program). We verified 100 percent of the RLI invoices.

3.3.4 Quantitative Survey Data Analysis

The two CATI surveys yielded data used by the evaluation team for the impact evaluation, process evaluation and market assessment. Appendix I, Quantitative Survey Results, shows the CATI survey results in banner table format. The tables present data for every variable in the survey, cross-tabbed against key variables, such as island, measure type (for

[25] http://www.energystar.gov/

residential participants), and firm size (for businesses). Residential survey data was weighted by measure and island prior to generating the banner tables. The business survey data did not require weighting, as all participating business customers were surveyed.

In addition to relying on the banner tables for the analysis, the evaluation team conducted its own *ad hoc* analysis of the survey data. We used SPSS software[26] to generate cross-tabbed data as we conducted the evaluation. All calculations using the survey data were reviewed by at least one other staff member to determine that results could be recreated. This quality control exercise ensured that results were consistent and accurate.

3.3.5 Solar Water Heating Billing Analysis

Because of the importance of the SWH market in Hawaii and the energy-saving potential of this measure, considerable emphasis was placed on evaluating it and the program offering it. The SWH billing analysis focused on the installation of residential SWH systems for PY2009 and PY2010. In our final model, participants from PY2010 were used as a control group to determine the savings realized by PY2009 participants, as the PY2010 participants had not yet installed the SWH system in the year used for the billing analysis, calendar year 2009. Including the PY2010 customers in the sample provided an additional control for external influences that may impact energy use (e.g., economic conditions, household and structural changes).

We developed a fixed effects billing regression model using monthly panel data to estimate changes in household electricity consumption between the baseline (pre-measure-installation) and post-measure-installation periods. The billing regression model relates normalized monthly electricity consumption by household by month:

1. An indicator variable for the months in which the SWH system was installed
2. Monthly dummy variables to control for external factors
3. Interaction terms between the indicator for SWH installation and monthly dummy variables

Interactions between the first two independent variables were examined and ultimately included in the model. The final model was estimated using the linear values of the dependent and independent variables.

Hawaii Energy provided monthly electricity billing data and information related to the timing of SWH installation for participants in PY2009 and PY2010. Utility billing data were provided from April 2008 to July 2011.

Weather or temperature data were not included in this analysis since water heater use is not greatly affected by outdoor temperature and temperatures are relatively constant

[26] SPSS (Statistical Package for the Social Sciences) is used for survey authoring and deployment, data mining, text analytics, statistical analysis, and collaboration and deployment (batch and automated scoring services).

throughout the year in Hawaii. However, monthly indicator variables were included in the final model specification to capture any seasonal or monthly effects that may exist.

Data screens were employed to ensure that only participants within a reasonable consumption range were included in the analysis. This data screen was based on monthly kWh usage and participants were selected for analysis if their monthly usage fell between 50 and 3,000 kWh. More details are provided in Appendix C, Solar Water Heating Billing Analysis.

3.3.6 Qualitative Research

To complement its quantitative research efforts in order to assess a broad sample of Hawaii Energy programs, the evaluation team engaged in the following qualitative research activities:

- In-depth interviews with contractors, business and industry representatives, and trade ally professionals across a variety of industries.
- Focus groups with contractors not participating in the direct install lighting component of the BEEM program.

3.3.6.1 In-Depth Interview Data Collection

The evaluation team conducted 51 in-depth interviews with trade allies across a variety of industries. The overarching objective of the in-depth interviews was to assess market perspectives on a set of specific research areas that included:

- Standard process evaluation issues (e.g. feedback on programs, satisfaction and suggestions for improvement);
- Changes in incentive levels;
- Financing issues;
- Bonus and stimulus offers;
- Barriers to participation;
- Outreach to targeted communities;
- Prospects for new technologies and program ideas;
- Feedback on new program offerings (e.g., awareness, participation, barriers, potential for savings and suggestions for improvement); and
- Extent of spillover effects.

The 51 interviews included HVAC, SWH, and electrical/lighting contractors along with representatives from manufacturers, distributors and businesses involved in the industries. The evaluation team's final sample of completed in-depth interviews consisted of 20 contractors, 28 business representatives, and three other industry professionals representing six Hawaii Energy program components. The complete breakdown of in-depth interviews by program is detailed below in Table 8.

Table 8: In-Depth Interview (IDI) Sample Characteristics

Program Type	# IDI's Completed	Targeted Populations
Business Direct Installation/Small Business	16	*Contractors*: (10 completed) *Businesses*: (5 completed) *Hawaii Energy outreach staff*
High Efficiency Water Heaters	17	*Contractors*: (10 completed) *Lenders*: (5 completed) *Honeywell Representative* *Hawaii Energy Representative*
New Construction	4	*Participating Builders* *Non-participant builders*
High Efficiency Air-Conditioning	5	*HVAC Contractors & Industry Professionals*
Central Plant Optimization	2	*Participating Businesses*
Multi-Family	2	*Participating Businesses*
Residential Low-Income	5	*Trade Allies*
Total	**51**	

The sample for the in-depth interviews with trade allies was designed to gather information primarily from the contractor groups most closely allied with measures targeted by the Hawaii Energy programs. In addition, in-depth interviews included both participating and non-participating businesses, builders, lenders, and other industry professionals. Potential interview respondents were primarily sourced through the following:

- Trade ally names from the participant database provided by Hawaii Energy; and
- SWH contractors listed on the Hawaii Energy website as Program qualified.

Interviews were conducted by telephone and results were stored on a secure server. This enabled the evaluation team to track the number of completed interviews by type and also facilitated the analysis of results. In addition, calls were recorded (with respondent permission), thereby allowing review of information when needed. The final interview results are included in Appendix G, Interview Summary Results, and significant findings and implications are summarized and discussed in Section Six, Process Evaluation.

3.3.6.2 Focus Group Data Collection

The evaluation team conducted two 90-minute focus group sessions that were structured as a seminar style discussion with conversations lead by a moderator. Participants (shown in Table 9) were identified through a contact list supplied by Hawaii Energy and supplemented by contacts from the Hawaii Better Business Bureau (BBB). The recruitment goal for the focus groups was to have eight contractors participate in each of the sessions, the first on Oahu and the second on Maui. The sessions were flexible enough to adapt to the dynamics presented by the group-setting format. This allowed for unanticipated topics of discussion, while retaining a focus on the session objectives that are provided below:

- **Contractor Background** - obtain an overview of how these businesses operate, assess how familiar these contractors are with energy efficient lighting options, and assess the relative frequency with which energy efficiency is recommended to customers.

- **Hawaii Energy Lighting Program Component** - describe program component options to these contractors, solicit their feedback on specific elements of the program, assess current awareness levels and reasons for non-participation, identify what works well for their business model and what does not work as well.

- **Program Design Options** - build upon what does, and does not, work with the current program design, and explore alternative program designs.

Table 9: Focus Group Sample Characteristics

# of employees	% of commercial work	# of years in Industry	Participation with Hawaii Energy Rebates
Oahu Contractors			
Under 3	20-40 %	20	No
Under 3	20-40 %	3	No
3 to 20	40-60 %	4	No
3 to 20	60-80 %	54	No
3 to 20	60-80 %	25	No
3 to 20	60-80 %	10	No
3 to 20	80-100 %	20	No
More than 100	40-60 %	28	Yes
Maui Contractors			
Under 3	0-20 %	15	No
Under 3	20-40 %	15	No
3 to 20	0-20 %	25	No
3 to 20	20-40%	25	No
3 to 20	40-60 %	35	No
3 to 20	40-60 %	41	Yes
3 to 20	60-80 %	2	No
3 to 20	80-100%	35	No

3.3.6.3 Qualitative Data Assessment

The evaluation team reviewed and summarized the comments from the in-depth interviews and focus groups for each category. The qualitative assessment includes a summary of trends found in the responses, with a review of how contractors, Program participants, and other businesses perceive Hawaii Energy and their preferences for

changes to Program offerings and design in the future. Findings from the in-depth interviews and focus groups informed all aspects of the evaluation. Interviews with trade allies, contractors, and businesses provided insight into how the programs have been perceived that was useful for the process evaluation. The interviews also aided the assessment of the market, as they revealed how various stakeholders view incentives offered through each of the programs and think about investment in efficient equipment, as well as how trade allies can be engaged to expand the market. Focus group discussions helped the evaluation team better understand the limited involvement of contractors in the direct install lighting program component and identify program design changes that may encourage future participation. Appendix G, Interview Summary Results and Appendix H, Contractor Forum Results, include more detailed findings.

3.3.7 Economic Impact Analysis

To estimate the Program's economic impacts on the state of Hawaii, an input/output analysis was conducted. Spending related to Program implementation, participation, and the reduction in spending due to reduced energy costs were used as inputs to a model that shows how these changes in spending affect the local economy. These types of spending impact the economy *directly*, through the purchases of goods and services locally, and *indirectly*, as those purchases, in turn, generate purchases of intermediate goods and services from other related sectors of the economy. In addition, the direct and indirect increases in employment and income enhance overall economy purchasing power, thereby *inducing* further spending on goods and services. This cycle continues until the spending eventually leaks out of the local economy as a result of taxes, savings, or purchases of non-locally produced goods and services.

We used an input-output modeling framework and the IMPLAN (for Impact Analysis for Planning)[27] impact modeling software to develop the economic impact estimates presented and discussed in more detail later in this report. This analysis takes advantage of IMPLAN's Multi-Region Input-Output ("MRIO") component to measure Program impacts that accrue to each county as well as secondary spending impacts that spill over to other islands. IMPLAN contains information on industry sectors within Hawaii and provides very detailed information on the distribution of spending impacts across various industries.

The IMPLAN model tracks dollars as they move through an economy from one sector to the next. Expenditures on Program implementation initiate changes that directly affect the Hawaiian economy. This spending then generates indirect impacts among businesses that supply the directly affected businesses. In addition, the direct and indirect impacts enhance overall economy purchasing power and generate induced or consumption-driven impacts.

[27] IMPLAN was developed by the Forest Service of the US Department of Agriculture in cooperation with the Federal Emergency Management Agency and the Bureau of Land Management of the US Department of the Interior to assist federal agencies in their land and resource management planning. Applications of IMPLAN by the US Government, public agencies and private firms span a wide range of projects, from broad, resource management strategies to individual projects, such as proposals for developing ski areas, coal mines, and transportation facilities, and harvesting timber or other resources.

The sum of these direct, indirect, and induced impacts makes up the total economic impacts.

The IMPLAN model reports the following economic impacts:

- **Total Industrial Output (Output)** - the value of production by industries for a specified period of time. Output can be also thought of as the value of sales including reductions or increases in business inventories;
- **Employee Compensation (Wages) -** includes workers' wages and salaries, as well as other benefits such as health and life insurance, and retirement payments;
- **Proprietary Income (Business Income)** - represents the payments received by small business owners or self-employed workers;
- **Employment (Jobs)** - impacts include both full-time and part-time employment; and
- **Indirect business taxes** - taxes paid by businesses to local, state, and federal taxing jurisdiction.

Our analysis measured the short-term economic impacts associated with changes in business activity as a direct result of changes in spending (or final demand) by Hawaii Energy, Program participants; and ratepayers who provide Program funding via the PBF. These impacts are driven by changes (both positive and negative) in final demand, and are measured within a static input-output modeling framework that relies on data for an economy at a point in time and assumes that Program spending does not affect the evolution of the state economy.
Because the IMPLAN model is a static one, more complex market relationships (such as the entry of new businesses and exit of existing businesses) are not accounted for in this analysis. Nonetheless, running the IMPLAN model does provide useful information on the general economic impacts that result from Hawaii Energy activities.

3.4 Secondary Research

We reviewed a number of secondary sources to support our evaluation, including prior Hawaii energy efficiency program evaluations and regulatory filings, energy efficiency studies from other states and regions, Census and geographic data, Hawaii potential studies, Hawaii population energy consumption data, and Hawaii Energy program materials and documents.

3.4.1 Prior Hawaii Energy Efficiency Program Evaluations and Regulatory Documents

To inform our evaluation we obtained and reviewed information about the HECO utilities programs that were operating in Hawaii prior to PY2009:

- **2001-07 HECO Utilities Evaluations** – impact evaluations conducted every three years that provided independent estimates of program savings;[28] and
- **2008 Hawaii Integrated Resource Planning Document** – contains energy savings and energy efficiency equipment saturation estimates.[29]

3.4.2 Census and Geographic Data

To prepare the maps in the market characterization, we used U.S. Census data and other geographic information system (GIS) data resources:

- **U.S. Census** – the American Community Survey 2006-08 for data on household characteristics and poverty levels;[30]
- **GIS data** – locations of each household using ESRI's ArcInfo geocoding software;[31] and
- **Electric account data from Hawaii Energy data files** – include annual use, annual bill, rate class, and customer type.

3.4.3 Hawaii Potential Studies

As in the PY2009 evaluation, we compared Program savings – both by sector and by end-use – to the achievable savings potential estimated by various studies conducted in Hawaii in the past several years.[32] In making these comparisons, we considered two alternatives:

- Reduce the potential estimated for the PY2009 evaluation by the savings achieved for that year and calculate the PY2010 savings as a percentage of that remaining potential; and
- Add the savings for PY2009 to those for the current year and estimate the cumulative percentage of first year savings to the potential that existed in PY2009.

While the results using either approach provide only a rough measure of market penetration, they are useful for indicating whether the Program is allocating its resources

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[28] KEMA-XENERGY, Inc. 2004. *Energy and Peak Demand Impact Evaluation Report of the 2001-2003 Demand Side Management Programs*. Oakland, CA.

KEMA. *Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Side Management Programs*. (Honolulu, HI: Hawaiian Electric Company, Maui Electric Company, and Hawaii Electric Light Company, December 2008).

[29] Hawaiian Electric Company, Inc.., *Integrated Resource Plan 2009 – 2028*, Docket No. 2007-0084. 2008. http://www.heco.com/vcmcontent/IntegratedResource/IRP/PDF/HECO_IRP4_Plan2009_2028_Final_Report.pdf

[30] http://www.census.gov/acs/www/data_documentation/data_main/

[31] ArcView Street Map Extensions and Data. USA: ESRI, 2009. http://www.esri.com/

[32] Global Energy Partners. *2004 HECO Demand-Side Management Report* (IRP-3), (Honolulu, HI: Hawaii Public Utilities Commission, 2004_. http://heco.com/vcmcontent/FileScan/PDFConvert/HECO_IRP3_App_L_Ph1_Final.pdf and http://heco.com/vcmcontent/FileScan/PDFConvert/HECO_IRP3_App_L_Ph2_Final.pdf

Booz Allen Hamilton, *Hawaii Clean Energy Initiative Existing Building Energy Efficiency Analysis*, *November 17, 2009 to June 30, 2010,* (Honolulu, HI: NREL, June 2010). http://www1.eere.energy.gov/deployment/pdfs/48318.pdf

effectively or whether it may need to shift its focus or assign more support for some markets and/or measures. We chose the latter approach to better demonstrate the cumulative effect of two years of savings.

3.4.4 Hawaii Population Energy Consumption Data

We analyzed Hawaii population energy consumption data provided by the HECO utilities, via Hawaii Energy, on April 15, 2011. The dataset contained customer information and billing data for all customers between December 2006 and March 2011. On August 27, 2011 we received additional billing data for the months of April through July of 2011 to supplement our analysis. We used these data to inform our non-participant sample designs, to update the energy efficiency potential study estimates, and to conduct a SWH billing analysis.

We used rate schedule and business structure code information received from the HECO utilities to separate customers into residential and non-residential sectors. We were able to further use the rate schedule and the business structure code to group non-residential customers by use level and to group customers by building type.

Although Hawaii Energy does not store the rate schedule or business structure code in its customer information database, we were able to join the two databases using customer utility account numbers. This allowed us to accurately identify customers in the population data who had participated in the Program, as well as to maintain a common customer classification by sector, use level and building type.

We were then able to obtain summary information, including customer counts and average energy use (kWh) by sector, use level, and building type, as well as by whether or not the customer had participated in an energy efficiency program.

3.4.5 Hawaii Energy Program Information

We reviewed the Hawaii Energy PY2010 plan, and annual and monthly reports to gain an understanding of Program design and operations. We also periodically visited the Hawaii Energy website and joined its mailing list, and Twitter and Facebook accounts. We reviewed information from Hawaii Energy about the Hawaii Clean Energy road map and the program's administration of federal stimulus funds. We supplemented this information with interviews with key Hawaii Energy Program staff and sub-contractors (Honeywell).

3.4.6 State of Hawaii Context

We relied on many online information sources to inform the summary of the state of Hawaii context, including the state's Department of Business Economic Development and Tourism, the U.S. Census Bureau, U.S. Bureau of Economic Analysis, the National Oceanic and Atmospheric Administration, and the U.S. Energy Information Administration. We also

reviewed non-government reports including the Yale School of Forestry report on low-income communities.[33]

In addition, we conducted a review of online policy statements, directives and conference presentations regarding the effect of Department of Defense and individual service branch energy efficiency initiatives.[34]

3.4.7 Outside Hawaii Energy Efficiency Studies

We reviewed a number of studies that were conducted at the national, state or regional level on initiatives outside of Hawaii to update our understanding of national energy efficiency market conditions, including:

- **National CFL market profiles** – annual D&R International profile of the CFL market, including sales and market share estimates;[35]
- **Various CFL industry papers and studies** – key papers and studies on CFLs from the International Energy Program Evaluation Conference (IEPEC) and ACEEE conferences, as well as recent evaluations conducted in California and the Northwest; and
- **Rankings of state energy efficiency activities** – annual state "scorecards" prepared by ACEEE;[36]
- **Program evaluation reports** – reports on programs across the nation;[37]
- **Database of State Incentives for Renewables and Efficiency (DSIRE)** – program descriptions, implementation plans and evaluation results for programs and pilots similar to those pilots fielded by Hawaii Energy in the current program year;[38] and
- **Individual utility websites** – for information on similar programs and initiatives.

[33] Simon De Stercke, Jake Segelman, et al., *Energy Efficiency in Low-Income Communities on Hawai'i Island*. (New Haven, CT: Center of Industrial Ecology at the Yale School of Forestry and Environmental Studies, 2011). http://www.kohalacenter.org/pdf/EnergyEfficiencyinLowincomeCommunitiesonHawaiiIslandYaleCenterforIndustrialEcologyV3.pdf

[34] http://www.eesi.org/dod_eere_factsheet_072711

[35] D&R International, Ltd. 2010. *ENERGY STAR CFL Market Profile, Data Trends and Market Insights*. Prepared for the U.S. Department of Energy, Washington DC.

[36] American Council for an Energy Efficient Economy, *2011 State Energy Efficiency Scorecard*. http://aceee.org/research-report/e115

[37] Sources include report postings on calmac.org, energytrust.org, nwalliance.org, and neep.org.

[38] www.dsireusa.org/

4 Energy Impact Evaluation

The impact evaluation included the TRM review, savings validation, measure installation verification, SWH billing analysis, residential low-income documentation review, and an input/output economic analysis. The reader is also referred to Appendix A, Verification Results Memorandum, Appendix B, Technical Reference Manual Review Results Memorandum, Appendix C, Solar Water Heating Billing Analysis, and Appendix D, Input Output Analysis for the comprehensive methods and results for these research tasks.

4.1 Technical Reference Manual Review

Objectives of the TRM review include:

- Ensure savings values were calculated correctly and include PY2010 Program;
- Identify any significant issues regarding calculated savings that may affect savings that can be claimed for PY2010 and PY2011; and
- Develop recommendations for addressing any significant issues identified, including:
    - Alternative values for immediate use based on secondary sources;
    - Research that should be conducted by the Program administrator to improve savings values and/or underlying parameters; and
    - Fieldwork or other research the evaluation team should undertake to improve savings values.

For the majority of measures included in the TRM, savings values were derived from earlier estimates in KEMA's 2008 *Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Side Management Programs.*[39] In many cases, savings calculations shown in the TRM are manually adjusted to match the savings values in the 2008 KEMA study. The review encompasses the measures presented in the *Program Year Three July 2010 through June 2011 No. 2011* of the TRM supplied to the evaluation team in October 2011,[40] which is included in Appendix B, Technical Reference Manual Review Results Memorandum.

4.1.1 Summary of Findings

In general, the level of documentation associated with many of the measures continues to improve on that in earlier versions of the TRM. The measures appear to be well researched and documented accordingly. Also, many of the savings values appear to be based on data collected from evaluations of previous programs. Therefore, the majority of the recommendations related to the TRM offered in this report are minor. Most of the recommendations from the PY2009 review appear to have been implemented, and done so

[39] KEMA. *Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Side Management Programs*. (Honolulu, HI: Hawaiian Electric Company, Maui Electric Company, and Hawaii Electric Light Company, December 2008).

[40] Hawaii Energy Technical Reference Manual document dated October 10, 2011.

correctly. Many of the measures that were included in the PY2009 TRM review also contain significantly more detailed information. Current recommendations include:

- Savings for the specified measure IDs (e.g., L011 Pulse St MH <100 W) should be included with the savings. There are several measures that have multiple measure IDs (e.g., L011, L012, and L013 for Pulse Start Metal Halides) and different savings levels for each. However, the current version of the TRM does not designate which measure ID applies to which savings value or group of values. Including this information will improve the TRM's usefulness as a resource for both Hawaii Energy staff and other stakeholders.
- Qualifications and exceptions for each measure should be included in the description section. For example, only certain sized HVAC motors with VFDs installed are qualified for incentives. Many of these qualifications are present in the application. Since the TRM is the summary resource for all measures, any qualifications should be included with the measure details in the TRM as well.
- Sources should be included for each measure with any assumptions. Hawaii Energy has made significant improvements to the level of documentation provided in the recent versions of the TRM. Continued effort to improve citation allows for a quick concise evaluation, and provides staff detailed measure information.
- Any measures that are applied to new construction projects should be specified in the TRM. The current TRM savings values do not take into account new construction baseline characteristics. New construction measures should either have different baselines or be processed through the custom program. Baseline for new construction should be the required code minimum for each measure. For example, new construction lighting should not have the same baseline as retrofit lighting in an existing building. The new construction lighting savings should be based on industry standard watts per square foot instead of comparing installed lighting to an average baseline for that measure.

Refer to Appendix B, Technical Reference Manual Review Results Memorandum, for more detail on the review results.

4.2 Verification of Savings

This section presents the results of the savings database validation and the measure verification conducted for PY2010. These two activities are typically performed as one component of a larger program impact evaluation. They are intended to:

- Verify that measures for which savings were claimed were installed;
- Determine that measures are Program qualifying; and
- Validate that the summary of Program accomplishments matches those in the Program tracking database.

These verification activities are distinguished from measurement activities that are intended to measure energy savings from Program measures through activities such as equipment metering or analysis of changes in electricity bills. The results of these two

verification activities (the savings database validation and the measure verification) combine to form the overall verification results that are presented in this section.

4.2.1 Summary of Findings

4.2.1.1 Overall Verification Results

Measures associated with 93 percent of energy savings claimed in the Annual Report[41] were verified to be installed, Program qualifying, and validated in the Program tracking database, including 88 percent of business and 98 percent of residential sector savings. Table 10 presents the overall verification results by individual program. The values shown in the table by column are:

- **Sector** and **Program** - indicating the individual program by sector;
- **Claimed First-Year Net Savings (kWh)** - summarizing the first-year energy savings claims from the Annual Report in kWh by program;
- **Verified First-Year Net Savings (kWh)** - summarizing the overall verified energy savings by program, based on the combination of the savings validation and measure verification results; and
- **Percent Verified of Claimed Savings** - presenting the overall verified savings ratios by program, also reflecting the combination of the savings validation and measure verification results.

Please see Appendix A, Verification Results Memorandum, for the full text of the verification memorandum.

Table 10: Verification Results - PY2010

Sector & Program	First-Year Net Savings (kWh)		Percent of Verified 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%
Non-Residential Total	*58,065,632*	*50,841,633*	88%
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%
Residential Total	*56,908,380*	*55,729,024*	98%
Total	**114,974,012**	**106,570,657**	**93%**

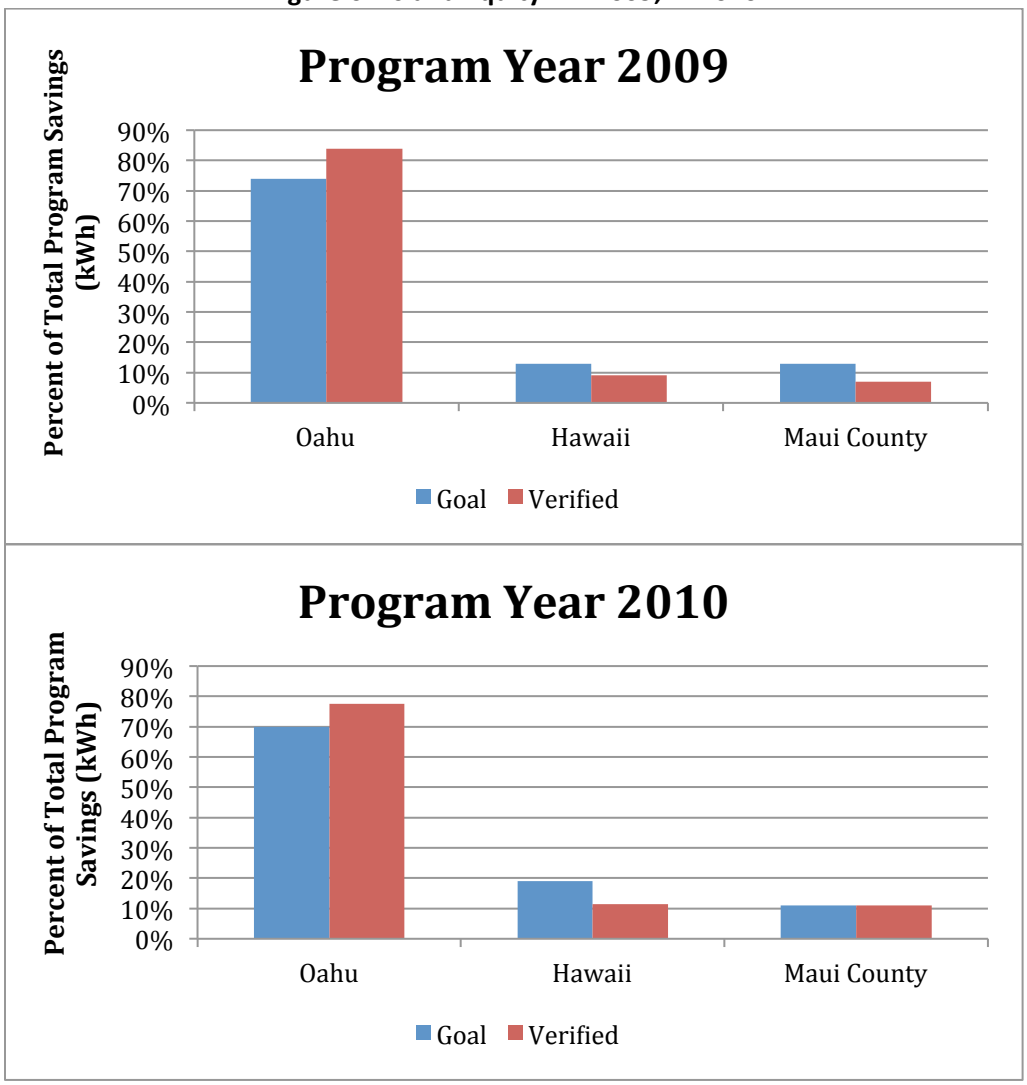
Source: Evergreen PY2010 Verification Memo

[41] Net savings reported at the measure level in Section VII (Business) and Section VIII (Residential) of the Annual Report.

4.2.1.2 Island Equity Achievements

Verified savings were also used to evaluate how well the Program is meeting its goals to distribute benefits across islands in a manner deemed equitable by the PUC. Figure 6 shows island equity achievements for PY2009 and PY2010, where the equity is shown in terms of the distribution of kWh savings across islands. Equity goals were not achieved in PY2009, but were achieved in PY2010. In PY2009 and from PY2011 on, the goal is to provide benefits (rebate dollars) within plus or minus 20 percent of PBF contribution dollars, while in PY2010 the goal was based on kWh savings. As Figure 6 shows, the program increased its kWh savings contributions to Maui and Hawaii from PY2009 to PY2010, with much of the Hawaii goal met through a CFL give-away in the fourth quarter of PY2010.

Figure 6: Island Equity - PY2009, PY2010



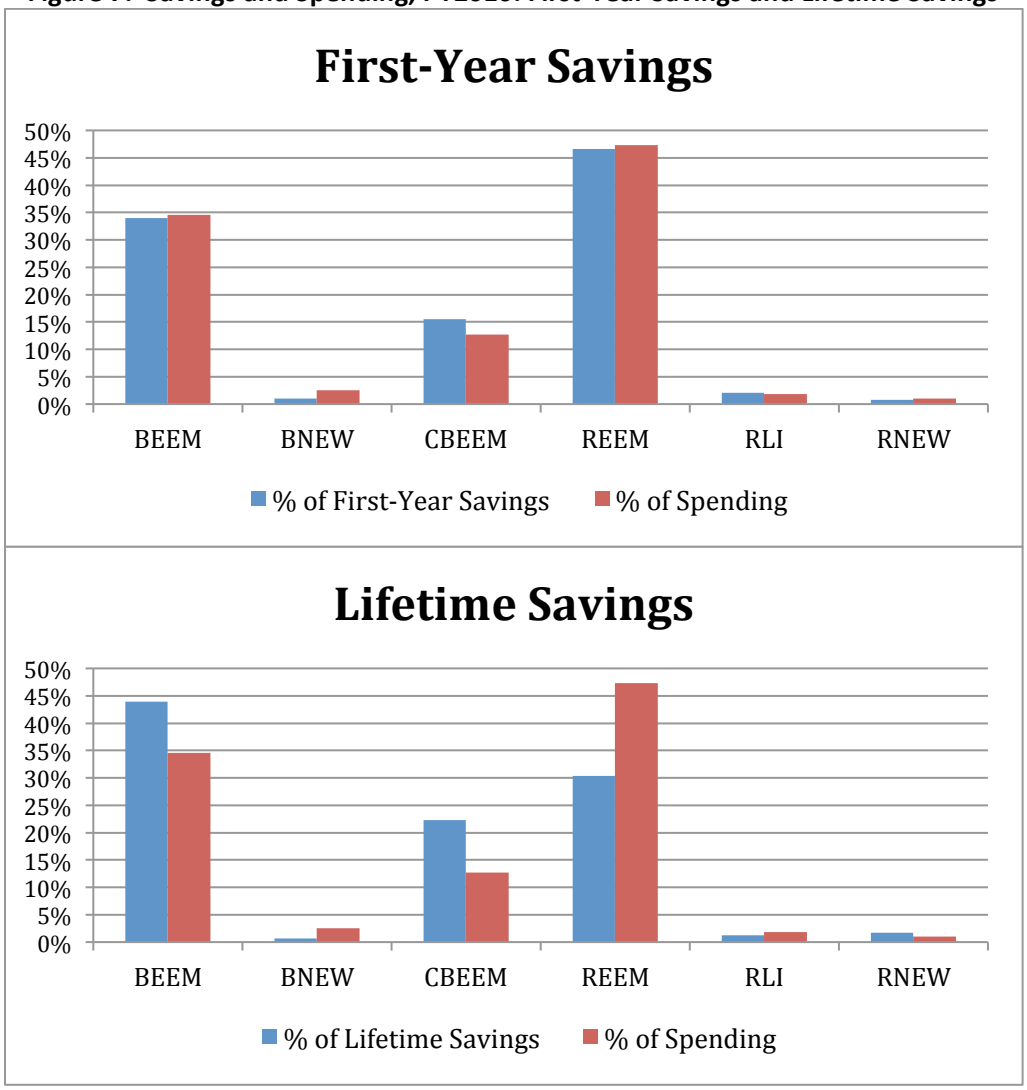
Source: Evergreen analysis of PY2010 Program tracking database

4.2.1.3 Energy Savings Analysis - Cost of Savings

Verifying measures and savings allows us to accurately analyze and compare first-year and lifetime savings and the associated costs across programs and measures. Such analysis aids in determining both resource costs and benefits.

Figure 7 compares the portion of total savings attributable to each program and the portion of total spending for each program calculated across both the first year and the measure lifetime. This comparison shows that there is greater variance between the percent of savings and the percent of spending per program over the course of measure lifetime than in its first year of savings. For example, when we consider lifetime savings, REEM accounts for 30 percent of total Hawaii Energy savings and 47 percent of total spending, but if we consider first-year savings, the same program accounts for 46 percent of total savings and 47 percent of spending. This variance is due to the mix of measures – and each measure's respective effective useful life – offered in each program.

Figure 7: Savings and Spending, PY2010: First-Year Savings and Lifetime Savings



Source: Evergreen analysis of PY2010 Program tracking database (system-level savings, first-year savings, and lifetime savings)

Figure 8 shows the cost of savings from a different perspective, illustrating the cost per kWh of lifetime savings by sector for PY2009, PY2010 and both program years combined. Residential cost of savings increased from PY2009 to PY2010 because lighting measures became more expensive on a per kWh basis due to a decline in the per unit savings. This decline was based on evaluation findings that impacted PY2010 savings claims.[42]

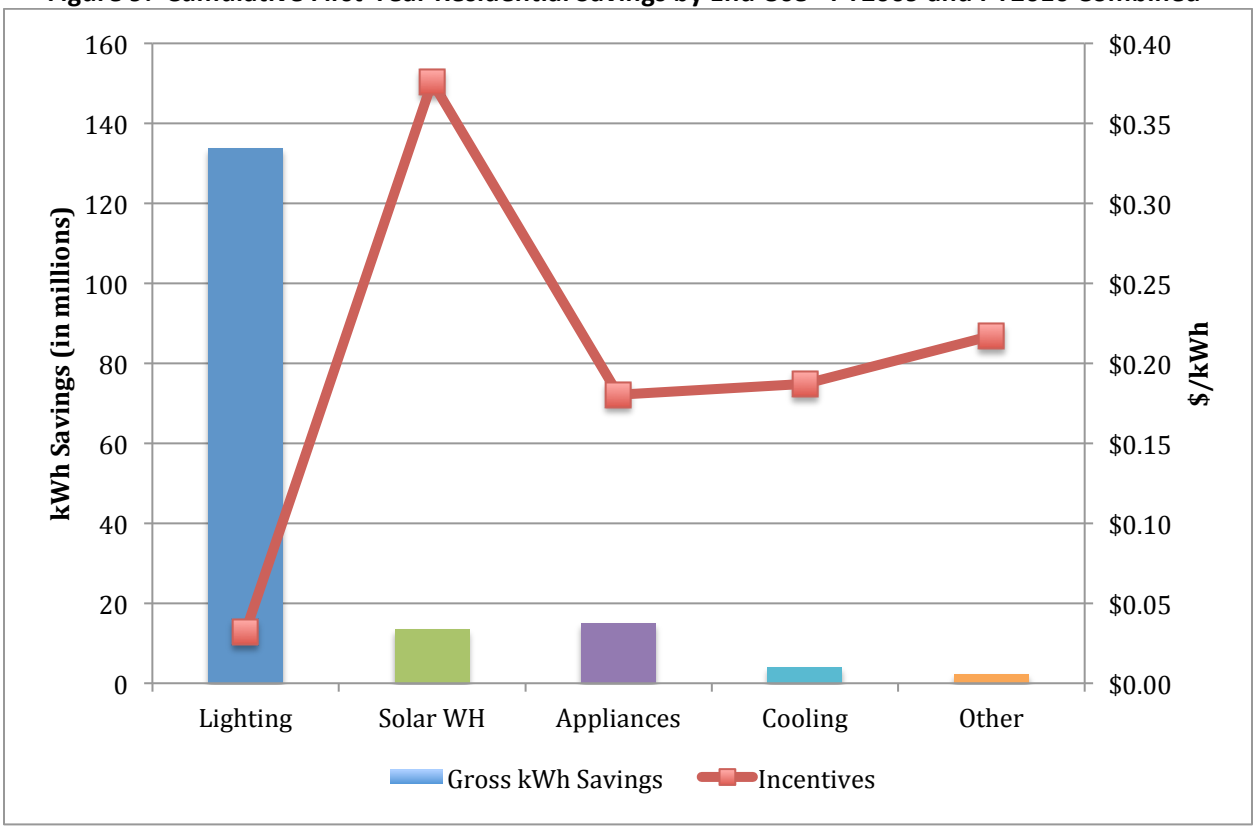
[42] These costs are consistent with those found in other studies of other programs and regions. For example, the Northwest Power & Conservation Council's Fifth Plan found that non-residential measures cost about $0.02 per kWh and a Pacific Northwest National Laboratory study found that common non-residential measures ranged in cost from $0.02 to $0.05 per kWh. Since electricity costs in the Northwest are much lower than in Hawaii, energy efficiency measures provide Hawaii residents and businesses more value.

Figure 8: Cost of Lifetime Savings - PY2009, PY2010, and Combined

Source: Evergreen analysis of PY 2010 program tracking database (system-level savings, life cycle)

Figure 9 compares the cost of incentives to the cumulative gross kWh first-year savings in the residential sector by end use for PY2009 and PY2010. The chart shows that lighting measures provide the most savings for the lowest cost. Savings attributable to lighting are substantially larger than for any other measure type and the cost of the incentive is lower on a per kWh basis.

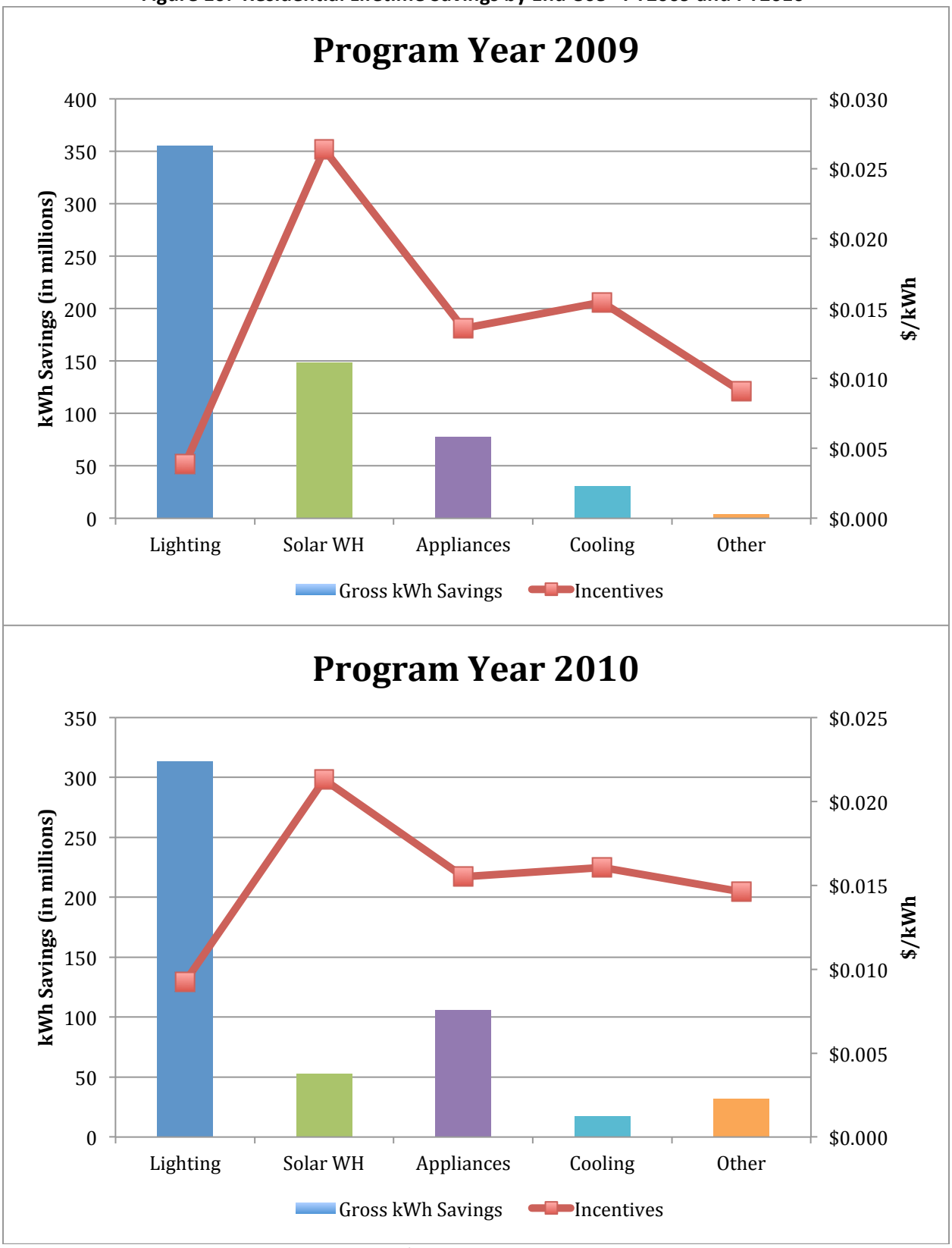
Figure 9: Cumulative First-Year Residential Savings by End Use - PY2009 and PY2010 Combined



Source: Evergreen analysis of PY2009/PY2010 Program tracking database (system-level savings)

Figure 10 compares lifetime savings calculations of various residential measures for both PY2009 and PY2010. While lighting provides significantly more savings than any other measure in each program year, appliances and SWH have now reversed positions, with the former outranking SWH in gross kWh savings in PY2010. This is reasonable given the comparatively lower incentive dollar spent per kWh for appliances.

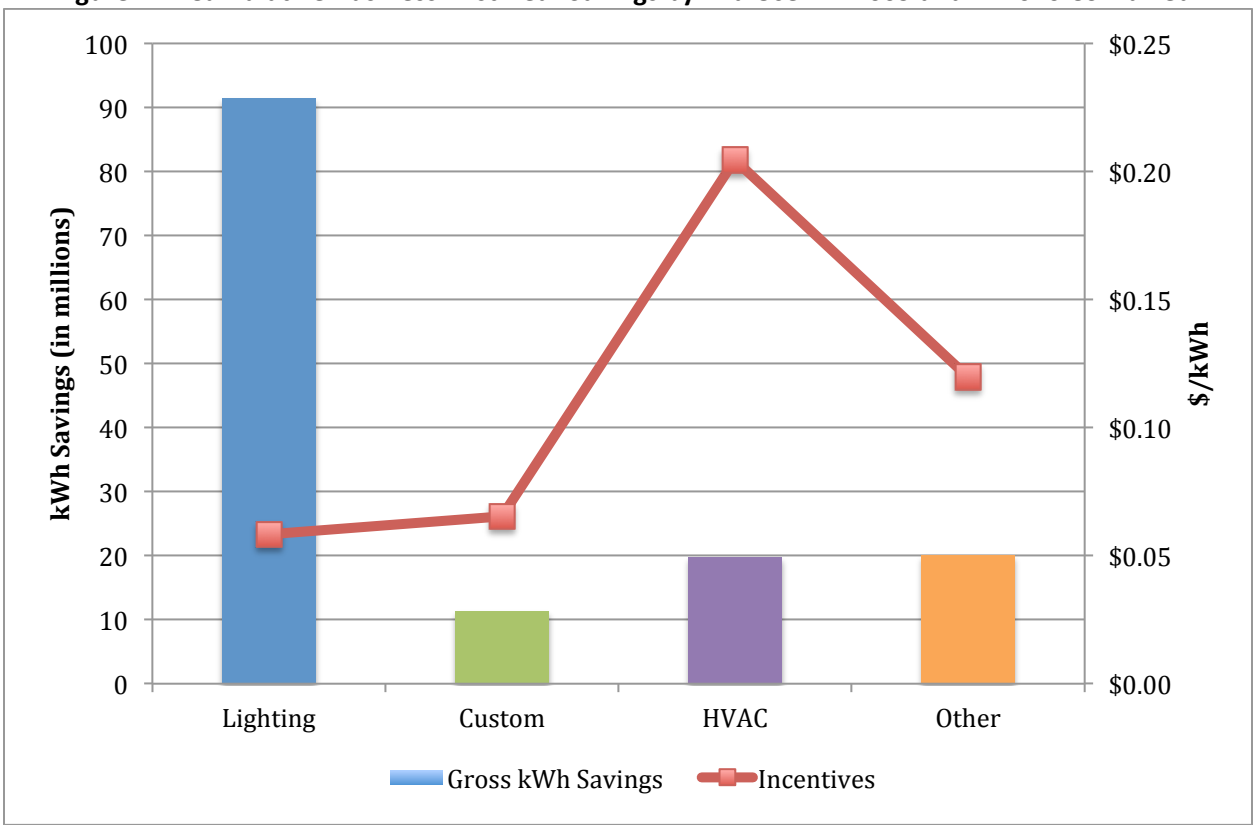
Figure 10: Residential Lifetime Savings by End Use - PY2009 and PY2010



Source: Evergreen analysis of PY2009/PY2010 Program tracking database (system-level savings)

Figure 11 presents the cost of incentives to cumulative gross kWh savings for PY2009 and PY2010 for the non-residential sector by end use. The figure shows that lighting measures provide the most savings at the lowest cost of savings per kWh for the non-residential sector, too. Custom measures, the smallest source of savings, also have a low cost.

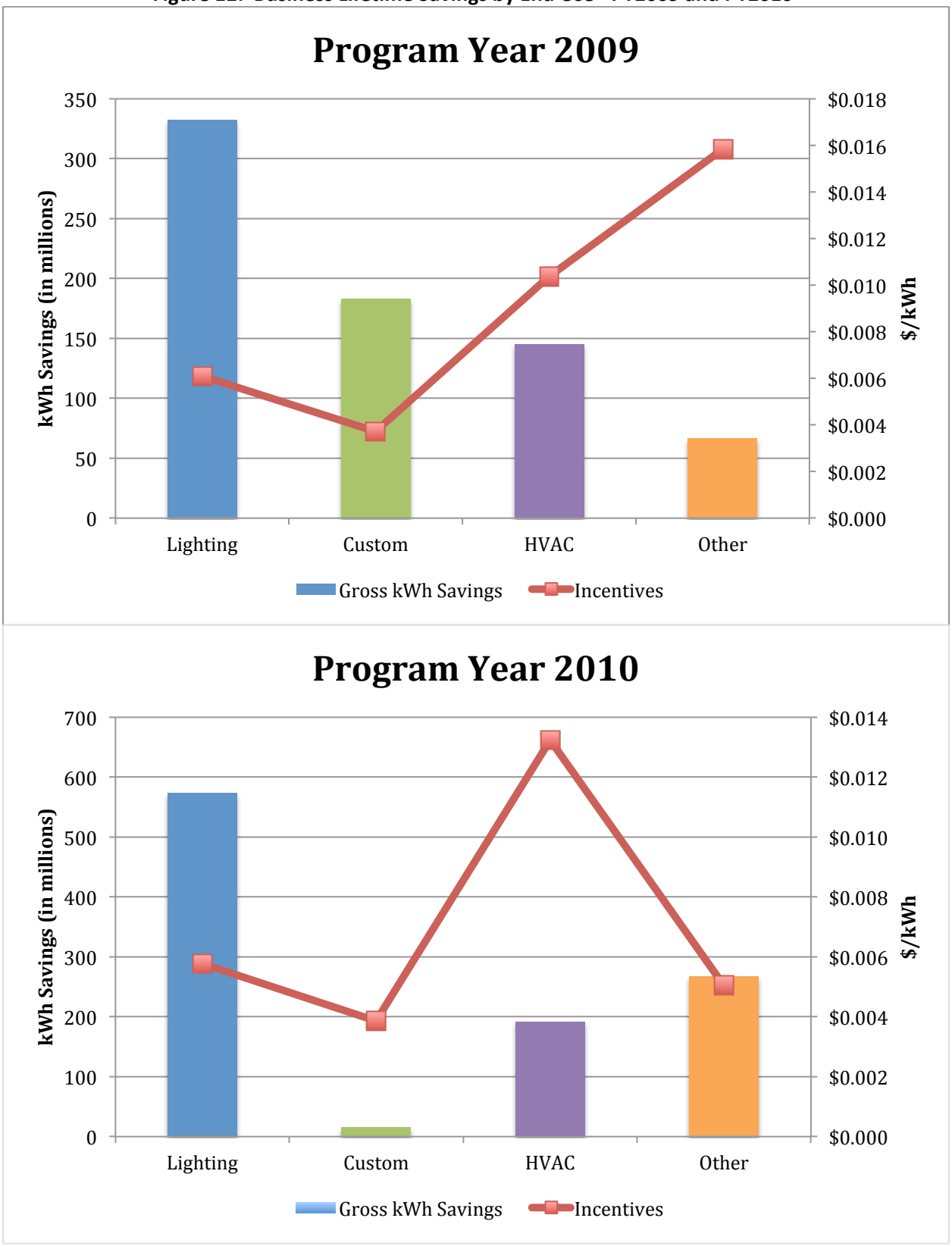
Figure 11: Cumulative Business First-Year Savings by End Use - PY2009 and PY2010 Combined



Source: Evergreen analysis of PY2009 program tracking database (system-level savings)

PY2010 programs have a much lower incentive per kWh for "Other" measures, and a greater increase in incentive costs per kWh for HVAC measures across lifetime savings. The lifetime figures in Figure 12 also show that PY2010 saw a substantial decrease in lifetime kWh savings from custom projects.

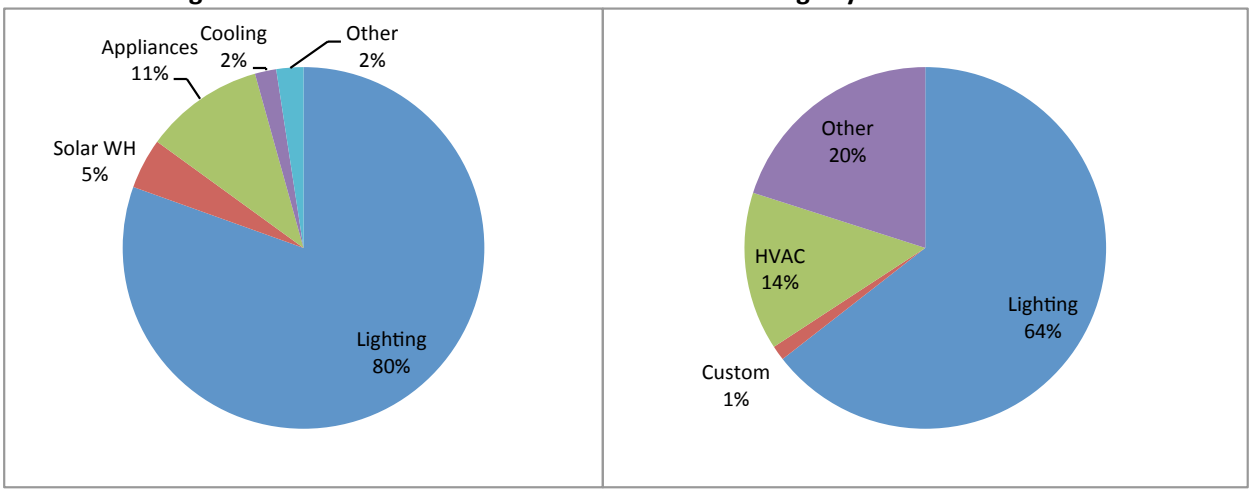
Figure 12: Business Lifetime Savings by End Use - PY2009 and PY2010



Source: Evergreen analysis of PY2009/PY2010 Program tracking database

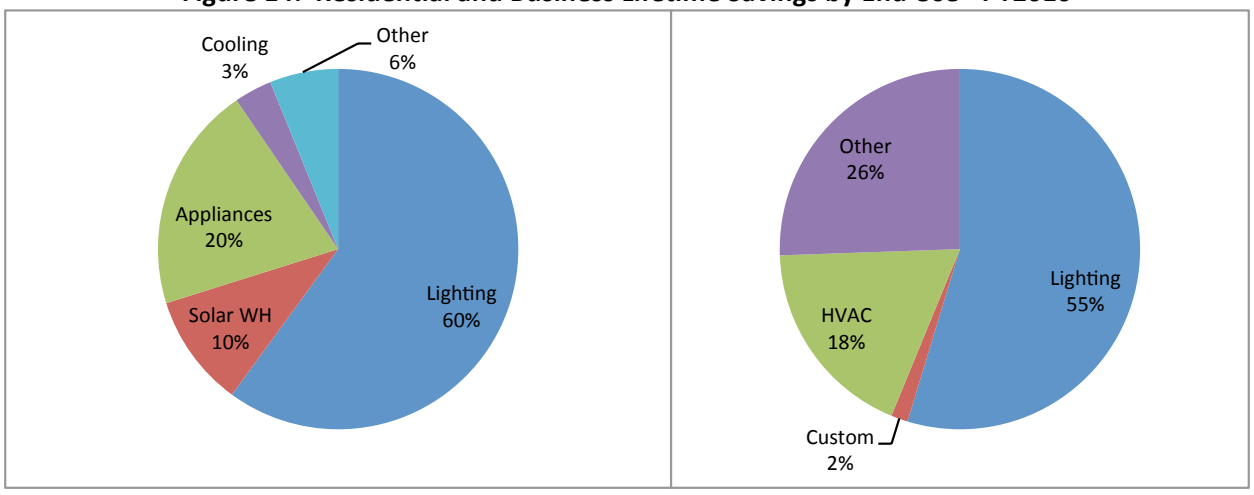
Figure 13 shows PY2010 first-year savings by end use for the residential and business sectors. The figure shows that lighting makes up the vast majority of savings in both sectors: 80 percent of residential savings and 64 percent of business savings. For the residential sector, appliances are a distant second (11 percent), with SWH and cooling making up seven percent of total residential savings. For the business sector, custom projects, which include all types of Program measures, make up only one percent of savings (a significant drop from its 16 percent in PY2009), with HVAC and other projects making up 34 percent of all non-residential savings. Savings allocation by end use changes when we consider lifetime savings. In this case, while lighting remains the "biggest piece of the pie" for both sectors, HVAC (business), and appliances and SWH (residential) represent a larger portion of savings than they did for first-year savings, as seen in Figure 14.

Figure 13: Residential and Business First-Year Savings by End Use - PY2010



Source: Evergreen analysis of PY2009/PY2010 Program tracking database (system-level savings)

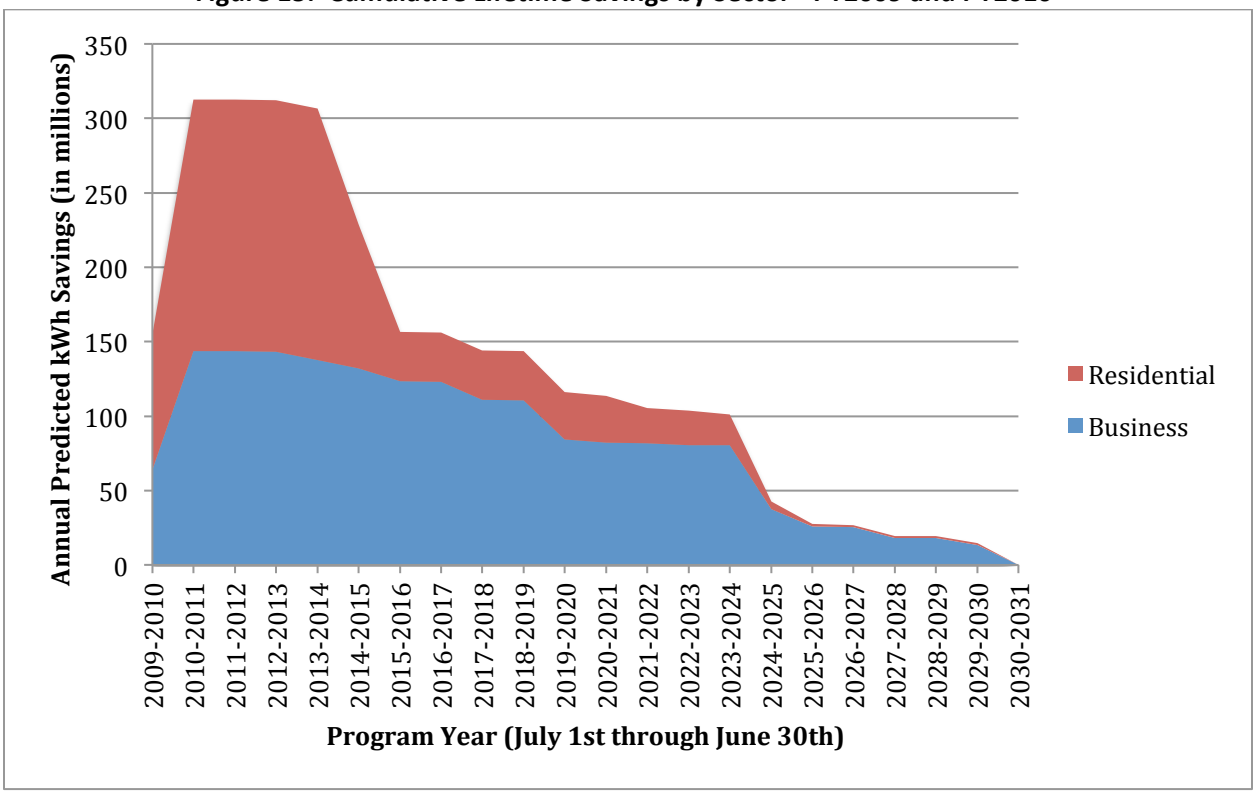
Figure 14: Residential and Business Lifetime Savings by End Use - PY2010



Source: Evergreen analysis of PY2010 Program tracking database (system-level savings)

Figure 15 shows cumulative lifetime savings for PY2009 and PY2010 measures for the residential and business sectors, incorporating the first-year savings with each measure's effective useful life.

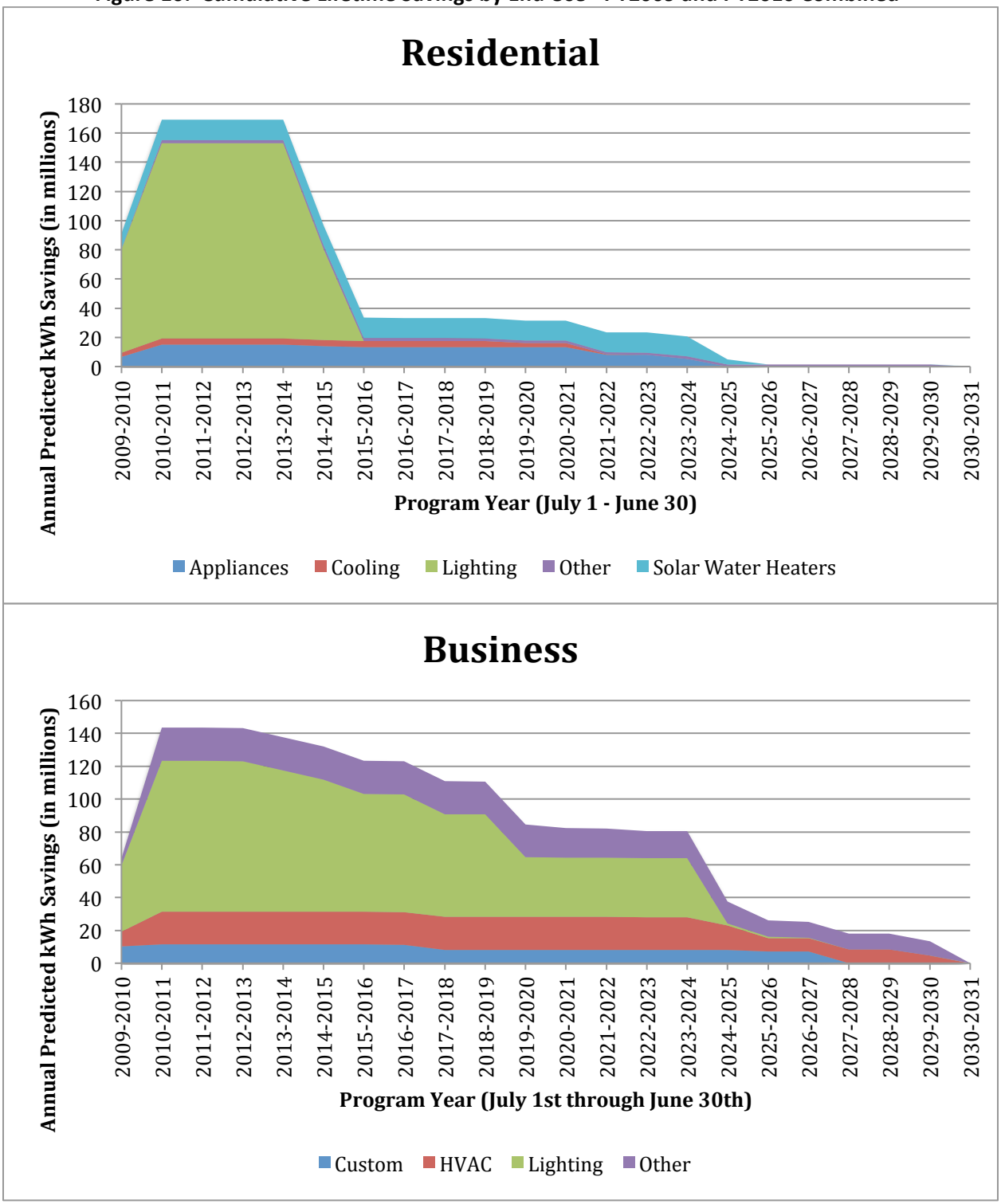
Figure 15: Cumulative Lifetime Savings by Sector - PY2009 and PY2010



Source: Evergreen analysis of PY2009/PY 2010 Program tracking database (system-level savings)

Figure 16 breaks out cumulative lifetime savings for each measure by sector. Lighting provides a large portion of savings over time in both sectors, although residential SWH and business "Other" measures offer even more. Savings in the business sector are generally sustained over a longer period than those in the residential sector, due to the difference in lifetime of equipment in these sectors. Figure 16 shows that savings from PY2010 activities in both sectors persist well beyond the first year and continue to help Hawaii achieve its energy goals in the coming years.

Figure 16: Cumulative Lifetime Savings by End Use - PY2009 and PY2010 Combined



Source: Evergreen analysis of PY 2010 Program tracking database (system-level savings)

Understanding which measures provide cost-effective savings over both the short- and long-term is critical to the ongoing development of the Program as it works to help Hawaii meet its aggressive energy reduction goals. One of the key takeaways from this section is

that in both the residential and business sectors, lighting equipment provides the greatest amount of savings for the least amount of money (incentive dollars). This value benefit is worth noting, considering that lighting makes up the majority of first-year and lifetime kWh savings for both sectors. Savings resulting from lighting are sustained for many years in the business sector, while savings from lighting in the residential sector (from CFLs) are sustained for just a few years. On the other hand, SWH is the most expensive residential equipment type, and makes up a relatively small portion of savings. HVAC equipment was the most expensive measure type for the business sector in PY2010 but still made up a significant portion of savings.

4.3 Measurement of Savings – Refinement of Savings Values

In addition to conducting research to independently verify the program's savings claims for PY2010 as presented above, some of our impact evaluation research supports refinement of savings values going forward. Much as the above-described impact evaluation findings help meet the state's long-term clean energy goals, this type of analysis informs and enhances the ability of both program administrator and policy-maker to effectively build on Hawaii Energy's successes. Following is a discussion of two measure areas for which such refinements should be applied: SWH and ceiling fans. We report on an analysis of SWH savings and anomalies found in a small sample of ceiling fan installations.

4.3.1 Solar Water Heating Billing Analysis

Due to the measure's importance to Hawaii's energy future, we conducted a billing analysis of customers who installed SWH through the PY2010 REEM program in order to obtain current estimates of associated savings. Previously, the Program relied on robust analysis of savings for this measure from prior evaluations of the HECO programs. This subject analysis was intended as a first of possible additional phases of research to update those prior estimates. As described below, the billing analysis results were very similar to the prior savings estimates, which were based on on-site metering and billing analysis. Therefore at present there are no plans to use additional evaluation resources to investigate the savings claims associated with SWH.

The number of customers receiving Program rebates for installing SWH by year is shown in Table 11. In our final model, participants from PY2010 were used as a control group to determine the savings realized by PY2009 participants, as the PY2010 participants had not yet installed the SWH system in 2009 (the calendar year used for the billing analysis). Including the PY2010 customers in the sample provides an additional control for external influences (e.g., economic conditions, household and structural changes) that may impact energy use.

Table 11: SWH Participants

Program Year	Number of Participants
2009	3,607
2010	2,695
Total	6,302

The annual savings estimate for SWH derived from this analysis is shown in Table 12, with a 95 percent confidence interval. Our impact estimate of 1,912 kWh is close to the current *ex ante* savings value of 2,066 kWh included in the TRM. Given that the savings estimates are so close, we do not recommend any change to the TRM value currently used by the Program.

Table 12: Savings Estimate and 95 percent Confidence Interval

Annual Savings (kWh)	95 %Conf. Interval LOWER BOUND	95 %Conf. Interval UPPER BOUND	Current TRM Value
1,912	1,714	2,111	2,066

Source: Analysis by Evergreen Economics of data provided by Hawaii Energy

Details on the billing analysis steps and results are provided in the memo in Appendix C, Solar Water Heating Billing Analysis.

4.3.2 Ceiling Fan CFLs

The PY2010 Program offered rebates for ceiling fans, which provide savings primarily from the integrated CFLs. The fan motor contributes relatively little savings. Our on-site inspections included a small number of homes whose owners had received ceiling fan rebates. A quarter of those homes had removed the CFLs and replaced them with incandescent bulbs. We recommend that the Hawaii Energy consider rebating only fans with pin-based CFLs that are harder to remove. Some programs in other states/regions have eliminated this measure altogether due to this issue.

5 Economic Impact Analysis

A separate analysis component of the evaluation was to estimate the economic impacts associated with Hawaii Energy program activities in PY2010. The analysis methods and results are discussed in much greater detail in a separate 2012 report on Hawaii Energy Efficiency Program economic impacts developed by the Evergreen Economics evaluation team.[43] A summary of these methods and results are presented below.

Using data from Hawaii Energy's Program tracking system, economic impacts were estimated for PY2010 for each county that had active Program participants. The Evergreen team measured the economic impacts using an input-output modeling framework and the IMPLAN impact modeling software. This analysis takes advantage of IMPLAN's Multi-Region Input-Output ("MRIO") component to measure Program impacts that accrue to each county as well as secondary spending impacts that spill over to other islands. Impacts measured include changes in output, wages, business income, and employment.

The IMPLAN model tracks dollars as they move through an economy from one sector to the next. Expenditures on Program implementation initiate changes that directly affect the Hawaiian economy. This spending then generates indirect impacts among businesses that supply the directly affected businesses. In addition, the direct and indirect impacts enhance overall economy purchasing power and generate induced or consumption-driven impacts. The sum of these direct, indirect, and induced impacts makes up the total economic impacts. Using the model, we determined the number of jobs, amount of income, and dollars of economic output that can be traced to the initial program.

Measuring the economic impacts attributable to individual Hawaii Energy programs is a complex process, as spending by Hawaii Energy—and subsequent changes in spending by Program participants—unfold over a lengthy period of time. From this perspective, therefore, the most appropriate analytical framework for estimating the economic impacts is to classify them into the following categories:

- **Short-term impacts** - associated with changes in business activity as a direct result of changes in spending (or final demand) by Hawaii Energy; Program participants; and ratepayers who provide Program funding via the PBF; and
- **Long-term impacts** - associated with the potential changes in relative prices, factor costs, and the optimal use of resources among Program participants, as well as industries and households linked by competitive, supply-chain, or other factors.

This analysis measures the short-term economic impacts associated with Hawaii Energy programs. These impacts are driven by changes (both positive and negative) in final demand, and are measured within a static input-output modeling framework that relies on data for an economy at a point in time and assumes that Program spending does not affect

[43] Evergreen Economics. *Hawaii Energy Efficiency Program Economic Impacts* (Honolulu, HI: Hawaii Public Utilities Commission, March 2012).

the evolution of the state economy. Energy efficiency programs may have longer lasting effects, and this is clearly the case for continued out-year energy savings. However, these long-term, dynamic effects are not measured in this analysis.

In addition to the short-term and long-term dimensions, expenditures resulting from the Hawaii Energy programs affect the Hawaii economy directly, through the purchases of goods and services in this state, and indirectly, as those purchases in turn generate purchases of intermediate goods and services from related sectors of the economy. In addition, the direct and indirect increases in employment and income enhance overall economy purchasing power, thereby inducing further consumption- and investment-driven stimulus. This cycle continues until the spending eventually leaks out of the local economy as a result of taxes, savings, or purchases of non-locally produced goods and services or "imports."

The economic modeling framework that best captures these direct, indirect, and induced effects is called input-output modeling. Input-output models provide an empirical representation of the economy and its inter-sectoral relationships, enabling the user to trace out the effects (economic impacts) of a change in the demand for commodities (goods and services). We use the IMPLAN input-output modeling software for this analysis, which utilizes Hawaii-specific multipliers to estimate spending impacts at the 4-digit SIC code level.
For this analysis, economic impacts are reported as different types of income effects. In the following tables, the impact on Wages reflects the increase in wage income for all workers as a result of activities funded through the Hawaii Energy Program. Similarly, Business Income is the increase in income to local businesses as a result of spending associated with Hawaii Energy Program spending. Finally, Jobs reflects the number of full- and part-time jobs that result directly from Hawaii Energy Program activities and from the increase in spending in other sectors of the economy.

Business and residential customers who invest in energy efficient measures have an additional impact on the economy due to lower production costs resulting from lower energy costs. This is particularly true for the commercial and industrial sectors, as costs of production decrease and overall output will increase due to more efficient production processes relative to the Base Case where these investments in efficiency do not occur. In the discussion below (and only in this section), the term "net impacts" is used to refer to economic impacts that occur over and above the Base Case scenario, and should not to be confused with net energy impacts discussed elsewhere in this report.

5.1 Economic Impact Analysis Inputs

5.1.1 PY2010 Expenditures

For this analysis, Program budget information provided by Hawaii Energy was aggregated into several general categories to facilitate economic impact modeling for similar areas of spending. Table 13 shows the general areas of spending for that resulted from the PY2010 programs. As shown at the bottom of the table, total spending due to the Hawaii Energy

programs in PY2010 was just over $17 million. Note that here and elsewhere the economic impacts are divided into Oahu, Hawaii and Maui Counties as these are the only counties that had Program participation in PY2010 (i.e., they had specific projects with paid rebates in PY2010 recorded in Hawaii Energy's participant tracking database).

As a general rule, spending on Program incentives goes directly to equipment purchases and labor for installation. In PY2010, Program incentives totaled $13.5 million (79 percent of total Program spending) and Program administration costs are estimated to be $3.6 million.

Table 13: PY2010 Hawaii Energy Program Spending (2010 dollars)

Program / County	Program Incentives	Program Administration	Total Program
Residential			
Oahu	$4,685,744	$1,944,731	$6,630,475
Hawaii	$814,488	–	$814,488
Maui	$647,795	–	$647,795
Total Residential	**$6,148,028**	**$1,944,731**	**$8,092,759**
Business			
Oahu	$5,918,341	$1,635,284	$7,553,625
Hawaii	$393,894	–	$393,894
Maui	$999,190	–	$999,190
Total Business	**$7,311,425**	**$1,635,284**	**$8,946,710**
All Programs			
Oahu	$10,604,085	$3,580,015	$14,184,100
Hawaii	$1,208,382	–	$1,208,382
Maui	$1,646,986	–	$1,646,986
Total All Programs	**$13,459,453**	**$3,580,015**	**$17,039,468**

Source: Hawaii Energy Program tracking system

5.1.2 Measure Spending

Table 14 summarizes participants' incremental measure spending by individual program and county in PY2010 based on information from the Hawaii Energy participant database. Common measures that received incentives include CFLs, ENERGY STAR refrigerators, dishwashers, clothes dryers, ceiling fans, air conditioners, HVAC systems, high efficiency water heaters and heat pumps. In total, 72 different types of energy efficiency measures were installed as part of Hawaii Energy programs in PY2010.

Table 14: PY2010 Incremental Measure Spending (2010 dollars)

Program / County	Incremental Measures Spending
Residential	
Oahu	$31,486,726
Hawaii	$5,588,716
Maui	$3,644,491
Total Residential	**$40,719,933**
Business	
Oahu	$2,648,909
Hawaii	$303,892
Maui	$264,719
Total Business	**$3,217,521**
All Programs	
Oahu	$34,135,635
Hawaii	$5,892,608
Maui	$3,909,211
Total All Programs	**$43,937,454**

Source: Hawaii Energy Program tracking database

5.1.3 Energy Savings

Table 15 shows the estimated total net annual energy saved by Hawaii Energy programs in PY2010. On an annualized basis, a total of 16 MW were saved as a direct result of Hawaii Energy Program activities in PY2010. This includes energy savings for both residential and business customers.

Table 15: PY2010 Net Annual Energy Savings

Program / County	Net Annual Energy Savings (MWh)	Net Annual MW Saved
Residential		
Oahu	38,294	5.7
Hawaii	7,682	1.1
Maui	5,339	0.8
Total Residential	**51,315**	**7.6**
Business		
Oahu	47,004	6.9
Hawaii	3,305	0.5
Maui	6,543	1.0
Total Business	**56,852**	**8.4**
All Programs		
Oahu	85,298	12.6
Hawaii	10,987	1.6
Maui	11,883	1.8
Total All Programs	**108,168**	**16.0**

Source: Hawaii Energy Program tracking database

5.2 Economic Impact Results

Table 16 shows the total gross and net economic impacts, by county and for the state of Hawaii as a whole, for Hawaii Energy programs in PY2010.

Table 16: PY2010 Total Gross and Net Economic Impacts, by County

Program / County	Gross Impacts	Net Impacts
Oahu		
Output	$41,725,500	$23,890,900
Wages	$13,330,300	$8,254,900
Business Income	$3,084,600	$2,465,100
Jobs (person-years)	385	246
Hawaii		
Output	$4,269,800	$3,008,600
Wages	$1,449,800	$1,128,600
Business Income	$460,900	$397,700
Jobs (person-years)	57	47
Maui		
Output	$2,518,400	$1,112,700
Wages	$934,500	$524,200
Business Income	$286,300	$239,800
Jobs (person-years)	35	23
Total Statewide		
Output	$48,653,300	$28,101,300
Wages	$15,745,400	$9,928,400
Business Income	$3,837,000	$3,106,400
Jobs (person-years)	478	316

Note: Total state impacts are slightly larger than the sum of the three county impacts due to modest spillover impacts for Kauai.

The spending and energy savings attributed to PY 2010 Hawaii Energy programs increased economic output in Hawaii by $28.1 million, including increases of $9.9 million in wages and $3.1 million in business income. This activity also created 316 jobs in Hawaii. This reflects economic activity over and above what would have been created in the Base Case scenario.

Table 17 shows how the net economic impacts of Program activities are distributed across industries. Although total net economic impacts are positive in PY2010, changes in final demand and the associated income and job effects can be either positive or negative across industries. This can occur for two reasons: 1) energy efficiency programs save energy that- as we have assumed in this analysis - can reduce utility revenues, and 2) energy efficiency program funding redistributes spending between program participants and ratepayers. In this analysis, the negative net impacts in the Transportation, Information, and Utility sector

is due to lost utility revenue due to increased energy efficiency (and therefore less money spent on electricity by households and businesses).

Table 17: Total Net Economic Impacts by Aggregate Industry Sector (PY2010)

Aggregate Industry Sector	Output	Wages	Business Income	Jobs (person-years)
Agriculture	$48,700	$9,300	$300	1
Mining	$100,800	$27,900	$9,100	0
Construction	$12,055,300	$3,748,400	$1,252,500	94
Manufacturing	$2,587,800	$372,300	$99,100	9
Transportation, Information, Utilities	-$14,088,500	-$2,915,800	-$9,200	-18
Trade	$9,854,800	$4,175,900	$385,200	102
Service	$17,068,800	$4,215,800	$1,369,400	124
Government	$473,600	$294,600	$0	3
Total	**$28,101,300**	**$9,928,400**	**$3,106,400**	**316**

6 Market Assessment and Process Evaluation

This section summarizes the results of the process evaluation and market assessment for Hawaii Energy. In conducting this research, the evaluation team reviewed internal data and documentation and obtained feedback from Hawaii Energy staff, Program participants, and other stakeholders. In particular, we completed the following research activities to examine Hawaii Energy processes:

- Review of Program planning and implementation documentation;
- Review of Program data and tracking systems;
- Interviews with Hawaii Energy staff and stakeholders;
- Interviews and surveys with Program participants;
- Two 90-minute focus group sessions (contractor forums);
- In-depth interviews with contractors, retailers, distributors, and manufacturers of energy efficient equipment; and
- Review of a 2004 Global Energy Partners study[44] that estimated maximum achievable potential for 2019 by sector and end use, and a 2010 Booz Allen Hamilton study[45] that focused on the six sectors that account for the majority of Hawaii's energy usage.

We also relied on a variety of existing studies and data sources to inform the market characterization, including those from ACEEE, U.S. Environmental Protection Agency (EPA), D&R International, DSIRE, the American Community Survey 2006-2008 from the U.S. Census, the 2011 Yale School of Forestry report on Energy Efficiency in Low-Income Communities on Hawaii Island, and Geographical Information Systems (GIS) data using ESRI's ArcInfo geocoding software. We reviewed key papers and studies on CFLs from the IEPEC and ACEEE conferences as well as recent evaluations conducted in California and the U.S. Northwest.[46] For two of the pilot initiatives – Central Plant Optimization and Condo Sub-metering – we conducted a literature review of similar programs, including program plans and evaluation results, to determine if any lessons learned would be applicable to Hawaii Energy initiatives.

Key topics addressed through this research include:

- Success of the pilot initiatives;
- SWH market penetration and participation levels;

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[44] Global Energy Partners. *2004 HECO Demand-Side Management Report* (IRP-3), (Honolulu, HI: Hawaii Public Utilities Commission, 2004_. http://heco.com/vcmcontent/FileScan/PDFConvert/HECO_IRP3_App_L_Ph1_Final.pdf and http://heco.com/vcmcontent/FileScan/PDFConvert/HECO_IRP3_App_L_Ph2_Final.pdf

[45] Booz Allen Hamilton, *Hawaii Clean Energy Initiative Existing Building Energy Efficiency Analysis*, *November 17, 2009 to June 30, 2010,* (Honolulu, HI: NREL, June 2010). http://www1.eere.energy.gov/deployment/pdfs/48318.pdf

[46] Please see Section 3.4, Secondary Research, for a description of specific data sources.

- Low-income sector's needs and initiatives;
- Impact of the program's new construction programs on the market;
- The Program's appropriate role in achieving energy savings in the military sector;
- Effectiveness of the program's leveraging of ARRA funding;
- Impact of inconsistency in rebate levels on the Program and the market;
- Development of the state's energy efficiency infrastructure to achieve long-term energy policy goals; and
- Assessment of Program effectiveness, including its processes, marketing, and customer and market actor awareness of and satisfaction with the Program.

6.1 Major Program Updates for PY2010

PY2010 was marked with several key Program changes:

- **Changes in Rebate Levels and Impacts Due to ARRA Funding**. The Program continued administering ARRA funds on behalf of the State Energy Office and Department of Business Economic Development and Transportation, primarily to augment PBFA funds for SWH, refrigerator purchase and large commercial non-profit projects. This additional funding allowed for the temporary doubling of the rebate available to customers for SWH. While the boost in rebate offerings increased Program participation, its temporary nature led to confusion among lending institution and contractors who perceived a related negative impact on their credibility with customers. Most ARRA funds were distributed by the end of PY2010.
- **Addition of new Hawaii Energy Staff.** Hawaii Energy added new staff to meet the needs of its programs. The increased levels of outreach supported by these staff additions, especially the on-island representatives, were much appreciated by businesses and contractors. The impact of the additional staff was mentioned positively during in-depth interviews conducted with HVAC and lighting contractors, and by the trade allies working with the RLI program.
- **Opower Residential Behavior Program Launch**. The Program, using ARRA funding it distributed on behalf of the State Energy Office and Department of Business Economic Development and Transportation, piloted the Opower social marketing program with 15,000 Hawaii residents. Due to the pilot's success, the Program launched a full-scale Opower program early 2011.
- **Expanded Role in HCEI, IRP and EEPS**. The Program increased its active involvement in the IRP and EEPS proceeding related to meeting the long-term goals of the HCEI. Hawaii Energy is a key vehicle for helping the state achieve its aggressive energy goals.
- **Planning for Launch of Market Transformation Programs in PY2011.** Hawaii Energy hired staff and developed plans for market transformation programs that will be launched in PY2011, with a focus on education, behavior and contractor training. These programs include metrics for tracking program success.

6.2 Market Potential Assessment Update

For the PY2010 evaluation, we again analyzed the results of the Hawaii Energy programs in the context of the broader residential and non-residential markets. We leveraged secondary sources, previous research and our own evaluation interviews with Program staff, trade allies and a limited number of customers to gain insights into the success of both full-scale programs and pilot initiatives.

As in the PY2009 evaluation, the purpose of the market assessment was to determine the relative effectiveness of the Program in achieving savings in specific residential and non-residential markets, and with specific measures. The PY2009 evaluation confirmed that Hawaii Energy had focused on lighting as an end use, and concluded that greater diversification to non-lighting measures could help achieve the savings potential offered by others measures.

6.2.1 Savings by Market Sector

Similarly the PY2009 evaluation found that two sectors, residential and military, accounted for more than 75 percent of total Program savings, and recommended that outreach to other sectors could help tap the potential available there. As shown in Table 18, Hawaii Energy has made significant strides in diversifying the sectors that participate in its programs. The share of savings accounted for by military and residential combined has declined to about 60 percent even as overall savings increased by more than six percent, with significant gains in Program savings in the "other commercial," office, education and health sectors.

Note that several of these sectors have a high proportion of government and non-profit customers who would have been eligible for the ARRA "kicker" that enabled Hawaii Energy to pay up to 25 percent of the cost of qualifying energy efficiency projects. While the ARRA funding appears to have helped attain the goal of reducing concentration of savings in a few sectors, it is not clear whether activity by some of the sectors participating in PY2010 can be sustained in the coming year.

Table 18: First-Year Savings by Sector - PY2010 vs. PY2009

Sector	PY2009 share	PY2010 share	Change
Residential	58.96%	46.75%	-12.2%
Other Commercial	8.07%	15.76%	7.69%
Military	19.15%	14.63%	-4.52%
Office	5.12%	8.50%	3.38%
Education	2.77%	6.27%	3.50%
Health	0.25%	3.60%	3.35%
Retail	2.05%	2.45%	0.40%
Hotel	3.47%	2.00%	-1.47%
Restaurant	0.15%	0.04%	-0.12%

Source: Evergreen Economics team analysis of PY2009 and PY 2010 Program tracking databases

6.2.2 Savings by Measure

In analyzing savings by measure across both residential and business participants, we found that lighting (including CFLs and "other lighting") accounted for 72 percent of total PY2010 savings, up from 67 percent in PY2009, as shown in Table 19. As in PY2009, CFLs alone represented 44 percent of total PY2010 savings, highlighting the pivotal role continuing to be played by this technology in both the residential and business programs. RLI program measures, which accounted for two percent of total savings, also included CFLs, although their number was not specified in the tracking data. HVAC and HVAC-related measures such as ceiling fans, heat pumps and window AC units together accounted for about nine percent of savings, while custom measures represented just over seven percent.

Table 19: First-Year Savings by Measure - PY2010 vs. PY2009

Measure	2009 share	2010 share	Change
CFLs (non-RLI)	43.60%	44.23%	0.63%
Other Lighting	22.56%	27.50%	4.94%
HVAC	7.11%	8.93%	1.83%
Hot Water Heating*	8.22%	3.83%	-4.40%
Residential Low Income	6.29%	2.03%	-4.26%
Custom	6.73%	7.19%	0.46%
Appliances	3.73%	4.93%	1.19%
Other	1.77%	1.37%	-0.39%

*** solar only in PY2009, solar plus HE in PY2010**

Source: Evergreen Economics team analysis of PY2009 and PY2010 Program tracking databases

While Hawaii Energy was able to drive broader Program participation across a range of market sectors, Program savings continue to be attributable to a relatively small set of measures. Lighting has become more dominant, and while there was also a small increase in the percentage of savings attributable to HVAC, custom measures and appliances, there was a significant drop in the share of savings from hot water heating, even though the PY2010 total include both solar and other high efficiency hot water heaters, while only solar installations were counted in PY2009. RLI measure savings continue to lag.

6.2.3 Potential (vs.) Achieved Savings

As in the PY2009 evaluation, we compared Program savings, both by sector and by measure, to the achievable savings potential estimated by various studies conducted in Hawaii in the past several years. In making these comparisons, we considered two alternatives:

- Reduce the potential estimated for the PY2009 evaluation by the savings achieved for that year and calculate the PY2010 savings as a percentage of that remaining potential; and
- Add the PY2009 to the PY2010 savings and estimate the cumulative percentage of first-year savings to the potential that existed for PY2009.

While the results using either approach provide only a rough measure of market penetration, they are useful for indicating whether the Program is allocating its resources effectively, or whether it may need to shift its focus or assign more support for some markets and/or measures. We chose the latter approach to better demonstrate the cumulative effect of two years of savings.

Using that second approach, and as shown in Table 20, the comparison of savings to potential found that PY2010 residential savings were about 7.7 percent of the PY2009/PY2010 potential, for a cumulative total of about 17 percent of potential achieved. Among non-residential sectors, cumulative savings as a percentage of potential ranged from less than one percent for restaurants to almost 80 percent for the military. As discussed elsewhere, the high percentage of potential achieved by the military sector reflects a number of ongoing, aggressive initiatives to reduce energy usage at both the Department of Defense and individual service branch levels which are helping to drive Program participation.

Table 20: PY2009, PY2010 and Cumulative Savings as Percent of Potential by Sector

Sector	PY2009	PY2010	Cumulative
Military	43.8%	35.6%	79.3%
Education	9.0%	22.1%	31.2%
Office	7.2%	12.9%	20.1%
Residential	9.2%	7.7%	16.9%
Other Commercial	3.3%	6.6%	9.9%
Hotels	3.8%	2.4%	6.1%
Retail	1.2%	1.5%	2.7%
Restaurant	0.5%	0.1%	0.6%

Source: Evergreen Economics analysis of potential study data and PY2009/2010 Program tracking databases

Savings as a percentage of potential were also analyzed by measure. Results, shown Table 21, confirm the Program's overall success with lighting as well as the significant gains in PY2010 with appliances, but also illustrate the limited extent to which potential has been realized for HVAC. Achieved potential could only be broken down by measure for the residential, office, hotel, and retail sectors.

Table 21: PY2009, PY2010 and Cumulative Savings as Percent of Potential by Measure*

End Use	PY2009	PY2010	Cumulative
Lighting	20.8%	18.9%	39.7%
HVAC	1.8%	1.8%	3.6%
Appliances	2.5%	3.4%	6.0%
Other	2.1%	1.5%	3.6%

* Residential, office, hotel and retail sectors only. Source: Evergreen Economics analysis of potential study data and PY2009/2010 Program tracking databases

As presented Table 22, when considered by business sector, cumulative lighting savings for PY2009 and PY2010 ranged from just a few percent of the estimated potential for retail to 30 percent more than the estimated potential (i.e., almost 130 percent of potential) for the

military. Again, as discussed elsewhere, the military has been pursuing lighting retrofit projects aggressively, and appears to have gone well beyond traditional T12 to T8 conversions. In addition, the fact that savings exceed the estimated potential may be explained in part by changes in technology. In calculating lighting potential, the 2010 Booz Allen Hamilton report prepared for NREL[47] considered only the commercial sector's mix of T12 and T8 linear fluorescent lighting and the relative shares of incandescent and CFL bulbs when comparing the current "base" case with the achievable efficiency case, which assumed all T12s would be replaced with T8s and incandescent bulbs with CFLs.[48]

This appears to have already occurred across much of the military sector. According to a Navy energy manager interviewed for this evaluation, there are unlikely to be any opportunities for T12-T8 conversions left, and remaining lighting projects would be more likely to address high-bay fixtures or the installation of LED bulbs – the latter being a technology that was not readily available when the Booz Allen potential studies were conducted.

Given the military's aggressive energy savings campaign, we recommend that Hawaii Energy be more discriminating in the types of lighting retrofits it approves for this sector. For example, we believe that the Program should not provide incentives for any retrofit of T12 fixtures or standard incandescent bulbs, since those would be almost certain to be replaced even without the Program.

Table 22: Lighting Savings as Percent of Potential by Business Sector - PY2009 and PY2010

Sector	2009	2010	Cumulative
Military	70.5%	57.3%	127.8%
Education	11.6%	36.6%	48.2%
Office	15.5%	30.7%	46.1%
Health	1.6%	41.6%	43.2%
Hotels & Resorts	11.4%	5.8%	17.2%
Commercial other	2.3%	11.9%	14.2%
Retail	5.8%	6.8%	12.6%
Restaurant	1.2%	0.9%	2.1%

Source: Evergreen Economics team analysis of potential study data and PY2009/PY2010 Program tracking databases

A similar analysis comparing HVAC savings to the potential by non-residential sector found that cumulative savings were more than five percent of potential for HVAC for each hotels, the military and offices. However, while hotels topped the cumulative list at over 22 percent, it, like the military sector, exhibited a decrease as compared to PY2009. Results of this analysis are found in Table 23. The retail, education, health and restaurant sectors all showed increases for PY2010, indicating that Hawaii Energy has been successful in its efforts to promote this category of non-lighting measures for a broad range of users.

[47] Booz Allen Hamilton, 2010.

[48] Ibid., p. 24

Table 23: HVAC Savings as Percent of Potential by Business Sector - PY2009 and PY2010

Sector	2009	2010	Cumulative
Hotels & Resorts	11.7%	10.8%	22.5%
Military	6.5%	4.6%	11.1%
Office	0.3%	5.0%	5.3%
Retail	1.6%	2.7%	4.3%
Education	1.6%	1.9%	3.5%
Health	0.5%	2.1%	2.5%
Restaurant	0.8%	1.3%	2.0%
Commercial other	0.7%	0.1%	0.7%

Source: Evergreen Economics team analysis of secondary potential study data and PY2009/PY2010 Program tracking databases

For all calculations of potential, it should be noted that these are strictly estimates of efficiency potential; that is, savings that can be attained by installing more efficient equipment. The estimates do not include conservation potential for savings that could be achieved by changing individual or business behavior. Examples of measures impacting conservation potential would include audits, sub-metering of condos, apartments, and military residential units, and initiatives such as implementing Opower software that rely on individuals to reduce their electricity usage based on information only.

6.3 Distribution of Rebates

One of the performance goals for Hawaii Energy is to achieve "Island Equity," as defined by the PUC. This goal was established to encourage Hawaii Energy to ensure that all of islands are fairly served. All three Hawaiian counties contribute funds to the PBF and it is an important consideration to see that all three share appropriately in the benefits that the PBF generates.

The establishment of an equity metric is a novel policy initiative not practiced in other states. The metric recognizes that without some intervention by the Program, a disproportionate share of Program participants may be from Oahu. Oahu's proximity to Hawaii Energy offices and access to a more developed infrastructure make it is easier for residences and businesses there to participate.

It is important to recognize that Hawaii Energy has not created an imbalance in Program distribution. In fact, unequal distribution of benefits tends to be an issue for energy efficiency programs generally speaking. Those customers with more access to money, information, expertise, and program infrastructure are more apt to know of the program's existence, understand the benefits of the technologies and services offered, and have the capability and financing to act on the incentive offers. It is also natural for efficiency programs to target the most cost-effective savings, and for Hawaii Energy these are currently located in Oahu. What makes Hawaii unique is that the PUC has decided to address equity as a policy goal.

There are several important reasons why public utilities commissions should be concerned about how public benefit program incentives are distributed. One of the most important is fairness. Fairness and equity of the distribution of public program benefits is an issue that has gained some traction in Hawaii. The 2011 Yale School of Forestry report on energy efficiency in low-income communities on Hawaii Island documents the unequal distribution of Hawaii Energy Program funds to Hawaii Island and to low-income households.[49] This study recommends changes in the current Island Equity indicator and establishment of a parallel indicator that tracks the distribution of Program dollars to low-income households.

Fairness is not the only reason for addressing an unequal distribution of public benefit program resources. This issue also concerns questions about program effectiveness and longer-term development goals. Let us introduce these ideas by stating that fairness alone is not a compelling reason for guiding how public benefit energy efficiency program dollars are distributed. It is important to remember that the reduction in the use of electricity often has benefits that extend beyond the specific energy saver. For this reason, it is not essential that rebate levels perfectly track public benefit fee contributions. For measures that are not yet commercialized, those investing in the early stages are benefiting non-participants, who will see improved and cheaper products when they are ready to purchase. In the long-run such rebates, even though they are unequally distributed, encourage market transformation and therefore generate large overall benefits for the respective jurisdiction and its inhabitants. In Hawaii, achieving these types of market transformation changes is critical to achieving the state's its long-term energy reduction changes.

For fully commercialized measures, the opposite distribution of program dollars is ideal because of free-ridership concerns and long-term energy-sustainability goals. In Hawaii, the current distribution of PBF dollars through the Program includes some rebates given to establishments that are free-riders, which tend to be customers with the fewest barriers to Program participation. When a measure is already commercialized, such as T8 lighting, programs that rely on rebates given on a first-come-first-served basis are likely to have high free ridership. To reduce free-ridership, programs must go out of their way and expend more resources to attract those customers less advantaged and less likely to participate.

Most importantly, the aggressive long-term energy efficiency goals that Hawaii has established can **only** be achieved if energy efficiency eventually reaches such underserved Hawaii business and residential sectors. These sectors may not be participating because market barriers are be limiting their awareness of opportunities, restricting their access to easily implemented solutions, and/or hampering their ability to pay for efficiency measures. Reaching these sectors means developing strategies that can overcome these market barriers. To do so successfully will require that Hawaii Energy devote additional resources to develop trade ally infrastructure and to raise awareness to non-participant

[49] De Stercke, et al., 2011, 16.

households and businesses. Because these efforts cost money, reaching such new markets will be more expensive.

The Island Equity metric gave impetus to the Program to establish a stronger presence on islands that have been less well served. As a result, Hawaii Energy added staff and brought more activities to these islands. That additional investment worked to allow Hawaii Energy to meet the Island Equity metric in PY2010.

The successful demonstration of the Island Equity metric should encourage the PUC to develop other metrics based on Program benefit distribution. In the following section, we explore the distribution of rebates from a number of perspectives, including business size and type, and residential characteristics. In considering these perspectives, the analysis suggests areas where opportunities for the Program to develop untapped energy savings potential in the next round of contract negotiations.

6.3.1 Overall Island Equity

The Annual Report calculates island equity by comparing by island the PBF contribution amounts to the kWh savings achieved through the Hawaii Energy programs. While this is the formula used to determine whether or not Hawaii Energy receives a bonus payment for achieving island equity, it is not the most useful measure of it.

Equity can also be measured more directly by comparing dollars contributed to the PBF versus Program dollars distributed to each island. This is the formula that will be used to measure equity beginning in PY2011. Table 24 shows PY2010 island equity using this method.

Table 24: PBF Contributions to Rebate Distribution – PY2010

	Total	Oahu	Maui	Hawaii
Program Rebates	$13,439,870	$10,598,096	$1,639,341	$1,202,433
PBF Contributions	$31,402,123	$23,465,012	$4,075,372	$3,861,739
Ratio of PBF Contributions to Rebate Distributions	0.428	0.452	0.402	0.311

6.3.2 Residential Equity

Table 25 shows the distribution of PY2010 rebates across the three island counties by residential program, with a breakout of CFLs versus other program measures. Oahu received the vast majority of Program dollars for each of the residential programs offered.

Table 25: Distribution of Residential Program Rebates – PY2010

	Total	Oahu	Maui	Hawaii
CFL REEM	$2,619,334	$2,002,354	$287,898	$329,082
CFL RLI	$198,419	$151,811	$41,280	$5,328
CFL Res New Cons	$76,839	$0.00	$0	$76,839
Res NEW	$124,450	$124,300	$150	
All Other Res Rebates	$3,109,398	$2,401,283	$310,825	$397,290
Total Residential	$6,128,439	$4,679,748	$640,153	$808,538
Percent of Total		76%	10%	13%

Using the data shown in the tables above, alternative ways for comparing the distribution of Program rebates were developed by the evaluation team in order to shed some light on untapped energy savings potential that Hawaii Energy will need to focus on in future program years. To accomplish this, GIS was used to geolocate every electric account across the study area. For each account, the annual kWh consumed was then attached, and totaled by county. The current PBF surcharge rate of $0.005944/kWh is used to calculate PBF contribution. Table 26 adds that information to calculate the ratio of rebates to funds contributed. Because Oahu consumes 70 percent of Hawaii's residential electricity, it also pays 70 percent of the PBF contribution of this sector. Not surprisingly, Oahu has the highest residential PBF-to-Rebate ratio, followed by Hawaii and Maui.

Table 26: Distribution of Residential Program Rebates and PBF Contributions – PY2010

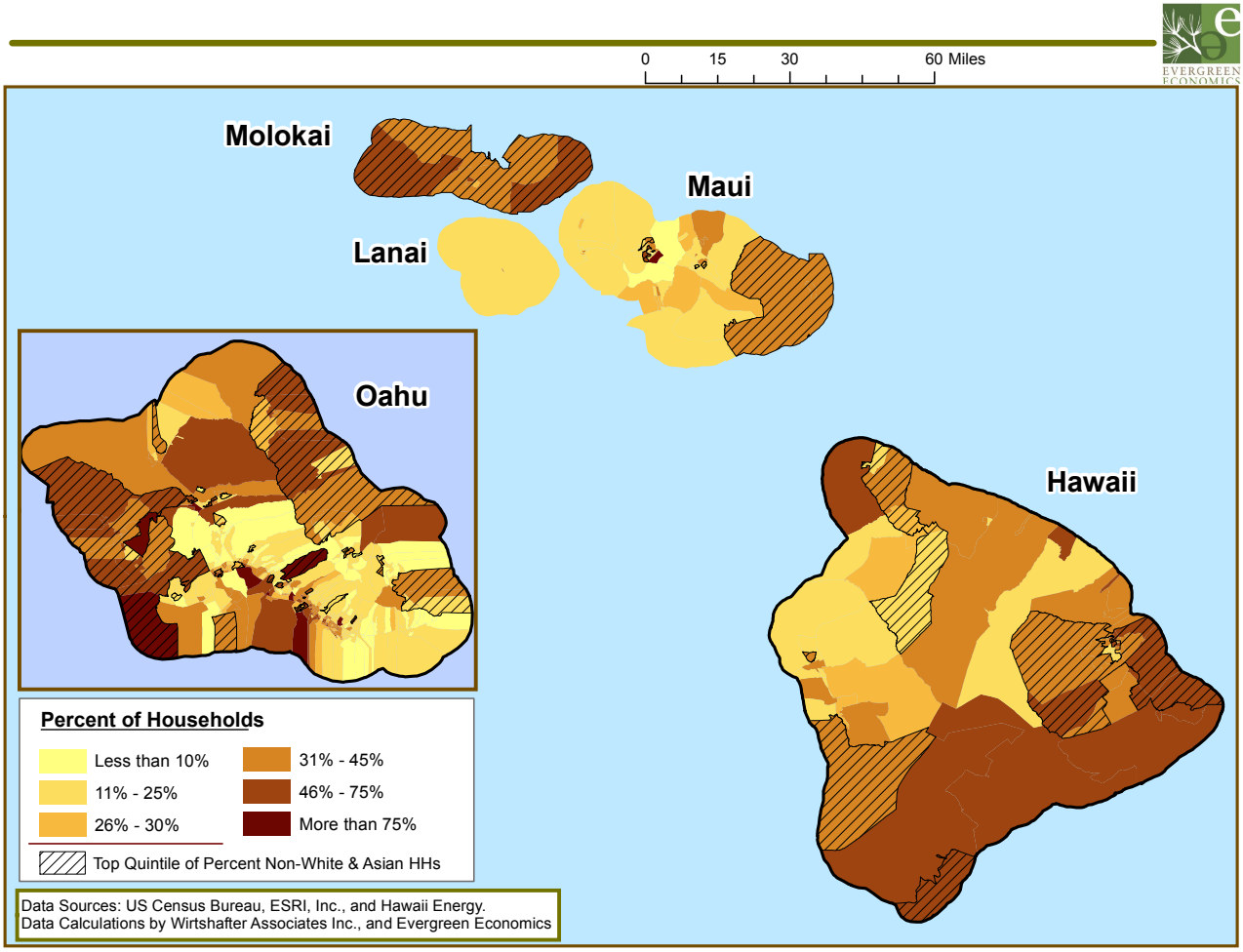
	Total	Oahu	Maui	Hawaii
Total Residential Program Rebates	$6,128,439	$4,679,748	$640,153	$808,538
KWh Consumed	2,828,255,100	1,976,909,899	422,436,177	428,909,024
Percent of Residential Electricity Consumed	100%	70%	15%	15%
PBF (kWh *$0.005944/kWh)	$16,811,148	$11,750,752	$2,510,961	$2,549,435
Ratio PBF Contributions to Rebate Distributions	0.365	0.398	0.255	0.317

An additional component to consider is how the distribution of rebates compares with the distribution of income. This is an important factor, as low-income households often have significant energy efficiency savings potential, but the savings are more expensive and more difficult to achieve as the Program typically must pay the full cost of the equipment installation (as opposed to paying only part of the equipment cost, as is done in typical efficiency program offerings). Examining how well the current programs are serving low-income households will help determine whether more programs are needed in the future that are tailored specifically to them.

Figure 17 shows the distribution of households at or below the 200 percent poverty level by block group. The United States block-groups are chosen to represent a homogeneous

grouping of households and contain between 600 and 3,000 people. The block group is the smallest census designation where income and poverty status is provided. As these maps show, income is not evenly distributed across islands or within each island.

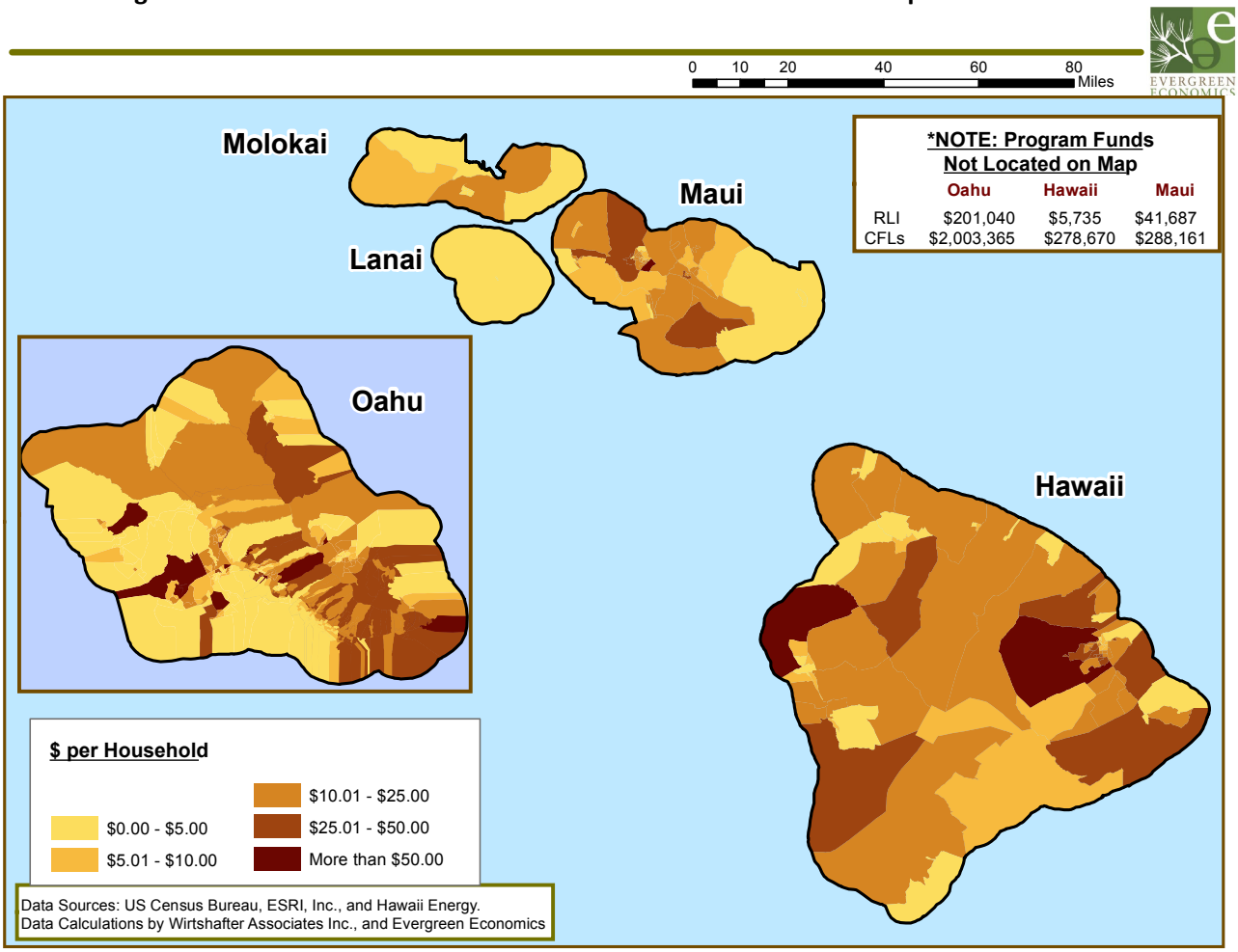
Figure 17: Percentage of Households Below 200 percent of Poverty



Using geocoding software that locates the precise longitude and latitude of each Program participant, we are able to place each participant into a U.S. 2000 Census Block Group. Once the participant is assigned a block group, the activity within each block group is totaled and then divided by the number of households. This assigns a rebate-dollar –per-household value for each block group. The analysis can only locate those Program measures and incentives where an exact address is known. The addresses of those receiving SWH and appliance rebates are known and are locatable. Expenditures for other residential program measures, particularly the REEM upstream CFL incentives and most of the RLI CFL distributions are not locatable. This analysis was done for purely PBF-funded Program rebates and those supported by ARRA funds.

In PY2010, Hawaii Energy distributed $3,118,747 of PBF-funded Program rebates and $3,403,915 ARRA funds (on behalf of the State Office of Energy) to households identified in the 2000 Census data.[50] Together this means that a total of $6,522,662 rebates were distributed to 383,239 households for an average of $17.14 per household. As Figure 18illustrates, the distribution of funds varies significantly across the state's block groups. Many of the block groups received less than $5/per household of PY2010 rebates, while others averaged more than two times the overall state average.

Figure 18: Total PY2010 Residential PBF-funded and ARRA Rebates per Household



The percent of households that are at or below the 150 percent of poverty level is used to assign each block group to one of five quintiles. The 20 percent of the block groups with the lowest percent of low-income households (the wealthiest block groups) is quintile number one. The 20 percent of the block groups with the highest percent of low-income

[50] Note that this excludes upstream lighting (which were around $2.8 million) and RLI funds (which were around $250,000) where a specific location was not identifiable from the Hawaii Energy participant data. Measures represented are primarily SWH and appliances.

households (the poorest block-groups) is quintile number five. Table 27 shows the distribution of residential rebate dollars across the five block-group quintiles.

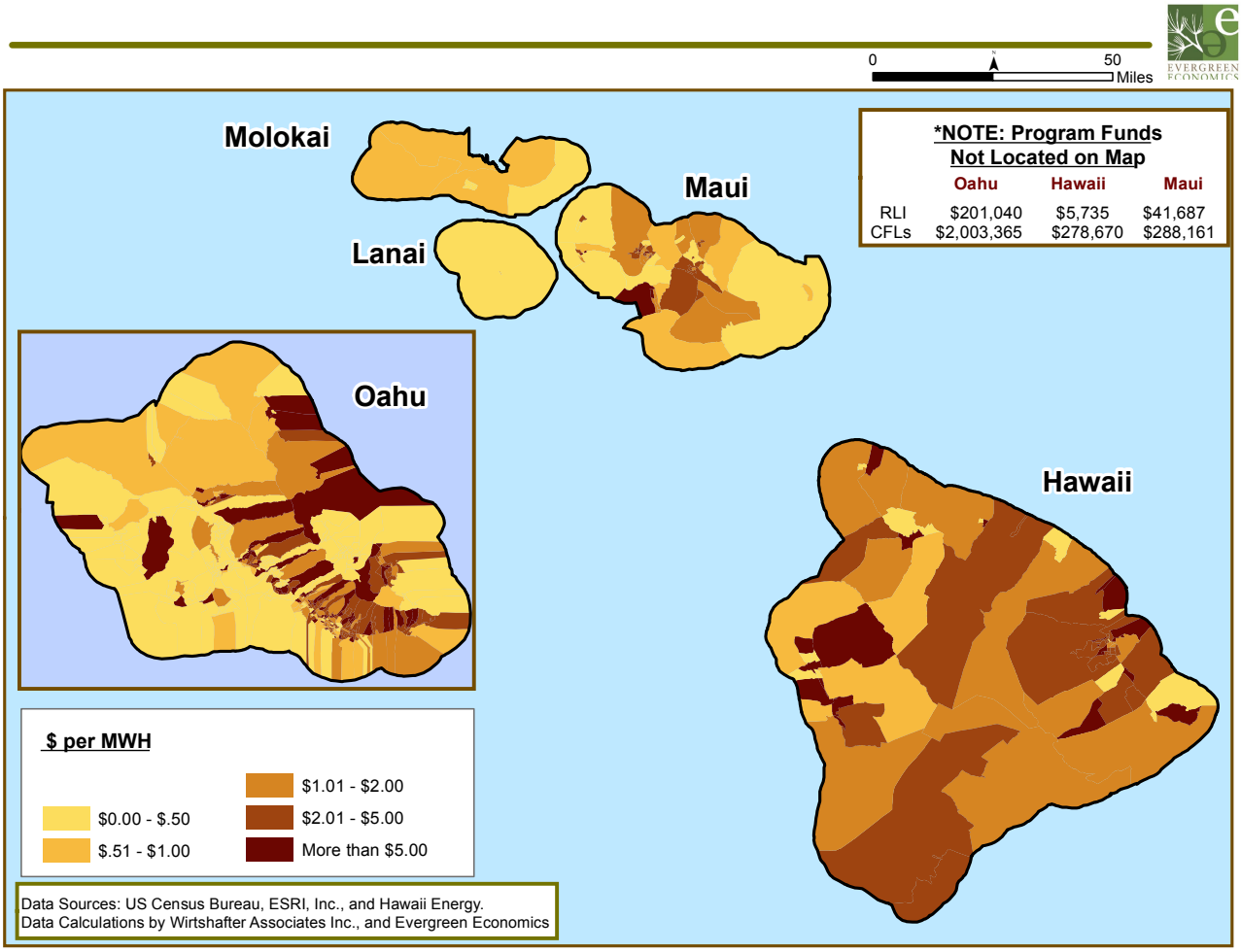
Table 27: Distribution of PY2010 Residential Rebate Dollars by Percentage Below 150% Poverty Quintile

	Residential $/HH		
Block-Group Quintiles	**$Program Rebate/HH**	**$ARRA Rebate/HH**	**$Program and ARRA rebate/HH**
Wealthiest (less than 7% below 150% poverty)	$22.71	$13.92	$36.62
Next Wealthiest (7% to 28% below 150% poverty)	$9.64	$10.07	$19.71
Middle (28 to 35% below 150% poverty)	$5.22	$7.74	$12.96
Next Poorest (35 to 46% below 150% poverty)	$2.71	$3.90	$6.61
Poorest (more than 46% below 150% poverty)	$6.97	$4.46	$11.43
Average	$9.21	$7.93	$17.14

The results show that rebate dollars are not distributed equally across household income levels, although it is important to remember that higher income households also spend more on efficiency measures and therefore are able to claim larger rebates. Households in the wealthiest block groups (with the lowest percentages of low-income households) received almost four times the rebate amounts of those in the poorest (with the highest percentage of low-income households).

Wealthier block groups do consume more electricity and do contribute more to the PBF. And, as mentioned above, they are also more likely to purchase higher cost measures, which will require a higher rebate. However, when rebates are normalized based on energy consumption (i.e., divided by kWh consumed), the wealthier block-groups still receive twice the rebate levels of block groups in the poorest quintile. Figure 19 shows the distribution of residential rebates as a factor of MWh consumed. This measure takes into consideration both contribution and distribution of PBF funds. Block groups that received on average more than $2.32 MWh are taking a bigger share of the PBF funds than they contributed. Given this threshold, it is apparent from the map that Hawaii is performing relatively well (as shown by the amount of darker shaded areas in the map) with the rebate per MWh metric compared with the other metrics examined.

Figure 19: Total PY2010 Residential Rebates per MWh Consumed



6.3.3 Business Equity

The distribution of business rebates is also worth examining. As Table 28 and Figure 20 show, 81 percent of all PY2010 Program business rebates were distributed to Oahu business locations.

Table 28: Distribution of Business Program Rebates by County – PY2010

	Total	Oahu	Maui	Hawaii
BEEM	$5,104,616	$4,397,474	$397,982	$309,160
NEW	$444,645	$154,133	$278,087	$12,425
CBEEM	$1,762,170	$1,366,741	$323,119	$72,310
Total Business Programs	$7,311,431	$5,918,348	$999,188	$393,895
Percent of Total	100%	81%	14%	5%

Figure 20: Total PY2010 Business Rebates per MWH Consumed

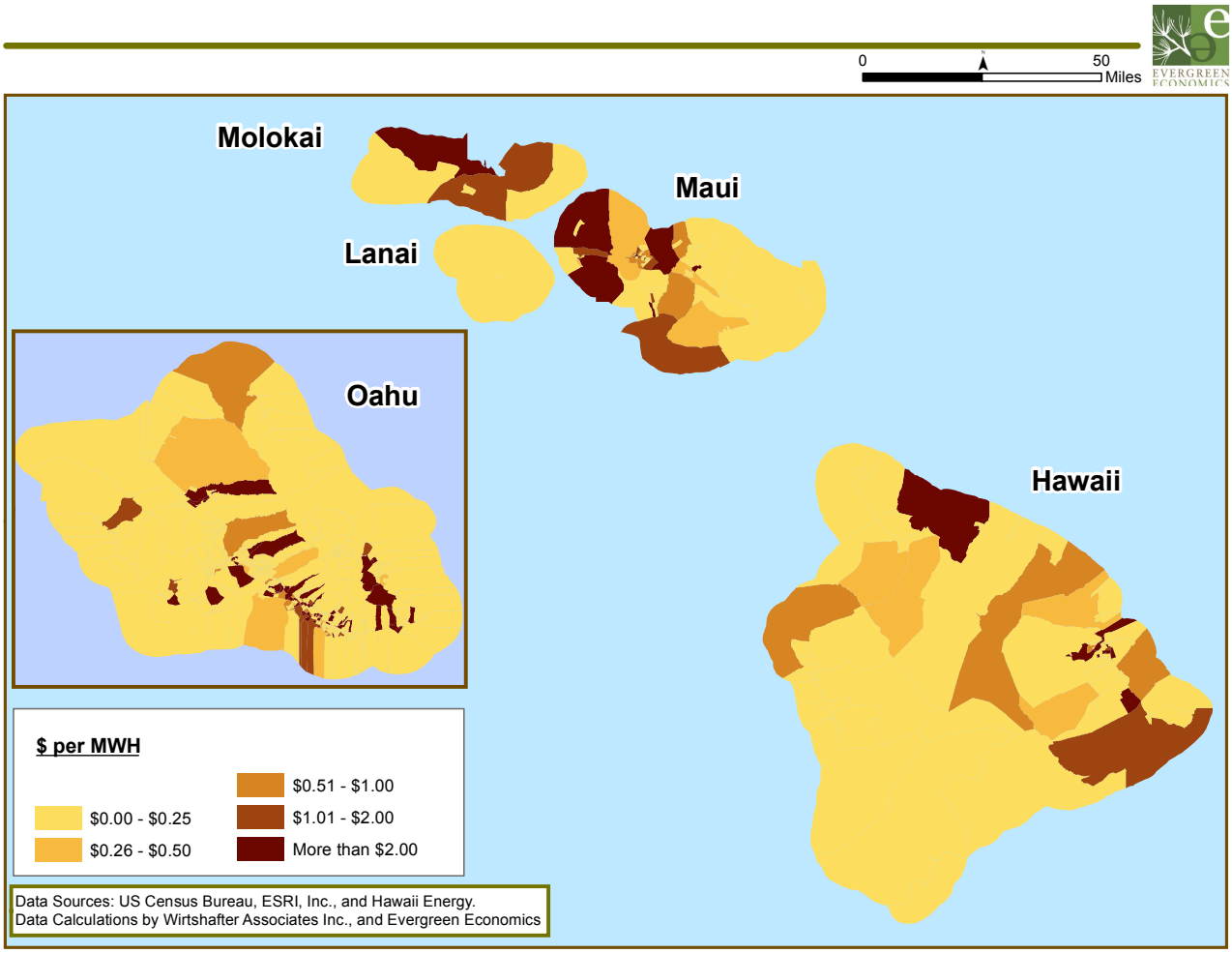


Table 29 indicates that Oahu accounts for 75 percent of the electricity consumed by state businesses, and receives 81 percent of business program rebates. At the other end of the spectrum, the Island of Hawaii consumes 11 percent of the business electricity and receives five percent of the rebates. As shown at the bottom of the table, Oahu and Maui are at similar PBF-to-Rebate ratio levels (near the average of 0.509), while Hawaii lags at 0.238

Table 29: Comparison of Business Rebates to PBF Contributions – PY2010

	Total	Oahu	Maui	Hawaii
Program Rebates	$7,311,431	$5,918,348	$999,188	$393,895
Percent of Total Rebates	100%	81%	14%	5%
KWh Used	4,594,089,657	3,431,256,635	632,345,721	530,487,301
Percent of Electricity Consumed	100%	75%	14%	11%
PBF (kWh *$0.003125/kWh)	$14,356,530	$10,722,677	$1,976,080	$1,657,773
Ratio PBF Contributions to Rebate Distributions	0.509	0.552	0.506	0.238

6.3.4 Rebate Distribution Analysis Conclusions

The Island Equity metric has proven to be a successful means of shifting the distribution of Program activity so that it more closely matches PBF contributions. In the next round of contract negotiations with the PBFA, the PUC should consider adding additional metrics to both maintain fairness and to help the Program reach its long-term development goals. In developing these metrics, the PUC must recognize that reaching new participants (particularly low-income households) is necessarily harder and more costly than is merely offering rebates on a first-come-first-served basis. Such a strategy, if successful, will result in lower free-ridership and the development of infrastructure essential to meeting the state's stringent long-term energy reduction goals. In particular, the PUC should consider new metrics that reward Hawaii Energy for increasing Program participation among low-income households and other harder to reach segments frequently under-served by efficiency programs.

6.4 2010 Participant Feedback

In order to collect data on customer experiences with the Program, the evaluation team fielded a survey with 1,037 participating customers, each of whom received Program rebates. For residential customers, a proportional sample allocation was used, based on measure category and island, which ensured that at least 50 sample points were obtained per island. Because the population of business customers was limited to only 228 customers all of them were contacted. The final number of surveys completed by customer type included:

- 893 residential customers
- 144 business customers

The overall purpose of the surveys was to understand customer perspectives on key Program attributes. In doing our analysis, we compared year-over-year results to identify any differences. When possible, comparative results were visually displayed for both PY2009 and PY2010.

6.4.1 Residential Participant Survey Results

Surveys were conducted with 893 participating residential customers to examine a variety of topics, including:

- Initial Program awareness
- Rebate satisfaction
- Motivation for reducing energy usage
- Reasons for installing SWH
- Effects of rebates on purchase cost
- Importance of rebate
- Knowledge of rebate
- Rebate impact on timing of purchases
- Influence of rebate on purchase of specific technologies

6.4.1.1 Initial Program Awareness

Residential customers became aware of the Program through a variety of methods. As found during the PY2009 evaluation, more than half of the PY2010 respondents (54 percent) learned of the Program at a retail store where rebates were offered on qualifying products. In addition, the second most reported source (16.5 percent) for initially learning about the Program across both years was from a television, radio or newspaper advertisement. Survey respondents mentioned many other sources of initial information, including, but not limited to, friends and family members, utility representatives, the Program website and contractors. A comparison of the frequencies of these various sources of initial contact with the Program is shown in Table 30. The data confirms that direct marketing to customers, both in stores and through traditional media, is as effective in PY2010 as it was in PY2009.

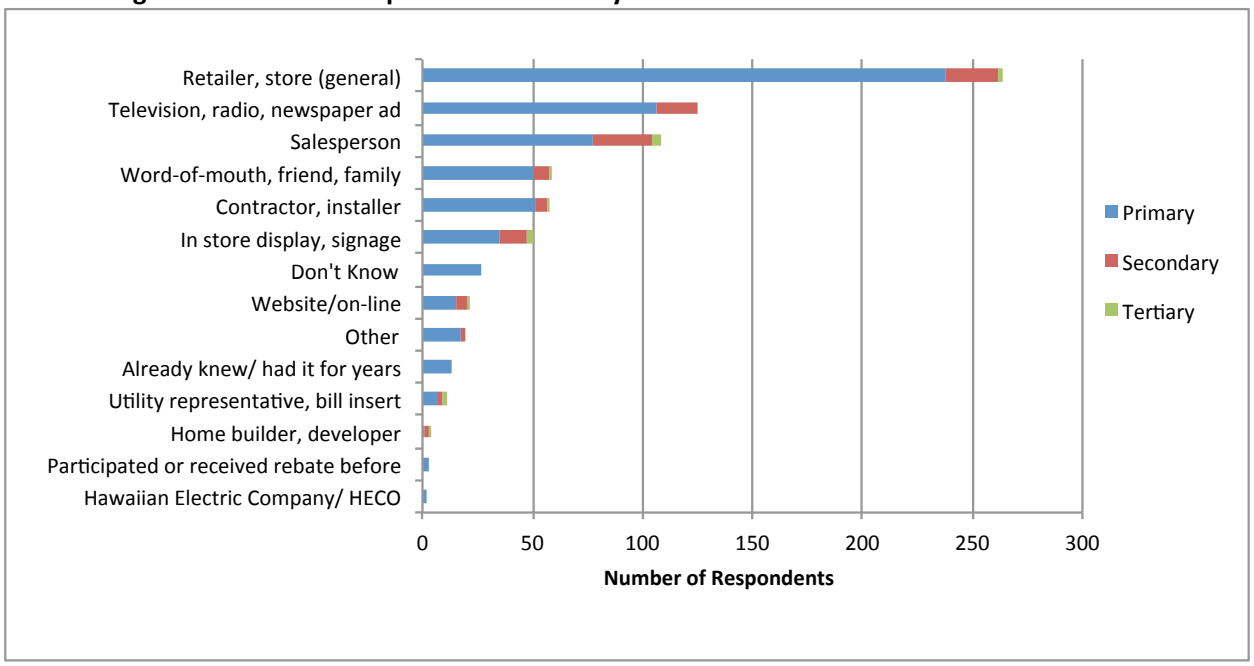
Table 30: Comparison of How Participants Were Initially Informed of Rebates –PY2010

How Participants Were Initially Informed (Primary Response)	PY2010 Program Participants		Percent change from PY2009
	Frequency	Percent	
In store (all)	**350**	**54.3%**	**-4.7%**
Retailer, store (general)	238	37.0%	-
Salesperson	77	12.0%	-
In store display, signage	35	5.4%	-
Television, radio, newspaper ad	**106**	**16.5%**	**-4.5%**
Contractor, installer	**52**	**8.1%**	**+5.1%**
Word-of-mouth, friend, family	**51**	**7.9%**	**+1.9%**
Utility information source (all)	**27**	**4.2%**	**-2.8%**
Website/on-line	15	2.3%	-
Utility representative, bill insert	7	1.1%	-
Participated or received rebate before	3	0.5%	-
Hawaiian Electric Company/HECO	2	0.3%	-
Already knew/ had it for years	**13**	**2.0%**	**-**
Other [Specify]	**18**	**2.8%**	**-**
Don't Know	**27**	**4.2%**	**+1.2%**
Total	**644**	**100.0%**	-

Source: Participating residential customer telephone surveys (2010 & 2011)

As with the prior year survey findings, alternatives such as marketing through the website or contractors appear to be less effective than in-store methods for the residential sector. However, it bears noting that in-store channels decreased by almost five percent and contractors increased by over five percent as sources of initial information in PY2010 as compared to PY2009. Figure 21 illustrates that efforts to continue assisting stores by providing marketing materials about the Program and qualifying measures are very important. Additionally, for residential customers, relying on traditional sources of information such as newspapers remains a stronger option overall than relying on the website or contractors, although this traditional channel also decreased in frequency as compared to PY2009. Respondents were allowed to give up to three answers as to how they initially heard about the rebates, all of which are reflected in Figure 21. Primary indicates that this was their first response, secondary their second, and tertiary their third. Not all respondents provided three answers.

Figure 21: How Participants Were Initially Informed of Rebates – PY2010 Residential



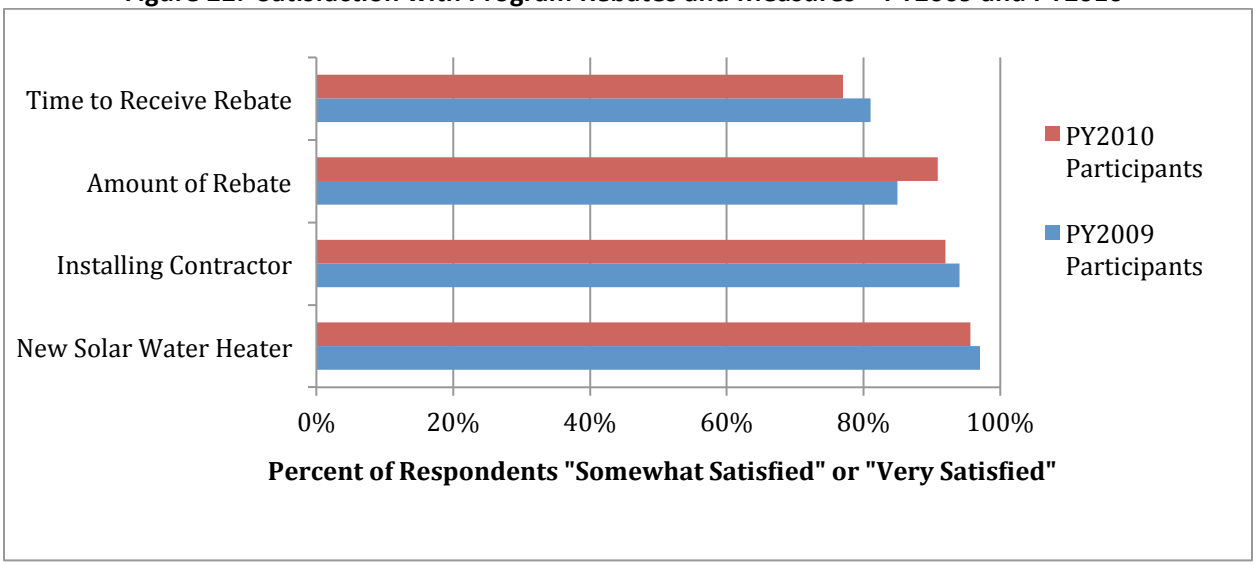
Source: Participating residential customer telephone surveys (2011)

6.4.1.2 Rebate and Measure Satisfaction

A comparison of responses from participating residential customers on various aspects of satisfaction with Program rebates and rebated equipment and installation, reveals that the vast majority (more than 75 percent) are *somewhat satisfied* or *very satisfied,* as shown in Figure 22. Nearly all (97 percent in PY2009 and 96 percent in PY2010) of those who purchased SWH systems were satisfied with their rebated purchase.[51] Similarly, residential customers who hired contractors to install their rebated products were nearly all satisfied with the contractors (94 percent in PY2009 and 92 percent in PY2010). The level of satisfaction with the amount of the rebate available for residential customers increased to by six percent to 91 percent in PY2010. Finally, more than three quarters of customers (81 percent in PY2009 and 77 percent in PY2010) across both program years reported being satisfied with the time it took to receive the rebate.

[51] Solar water heater customers are used as a representative group here, to reflect the general level of satisfaction of participants with purchased equipment.

Figure 22: Satisfaction with Program Rebates and Measures – PY2009 and PY2010

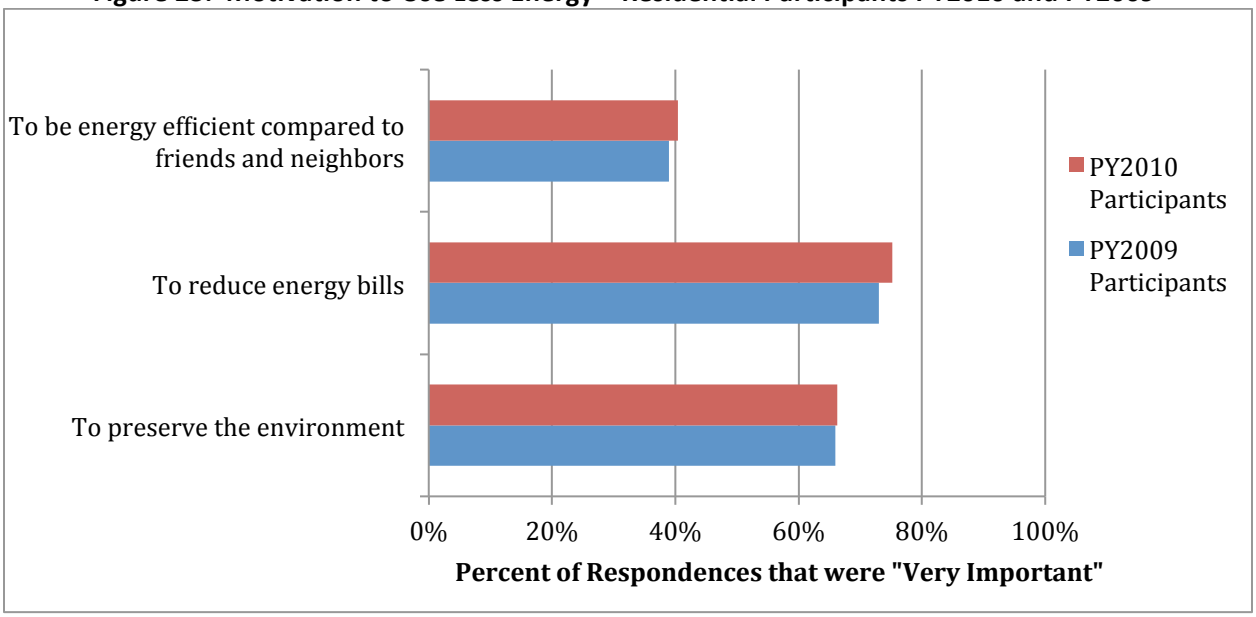


Source: Participating residential customer telephone surveys (2010 & 2011)

6.4.1.3 Motivation for Reducing Energy Usage

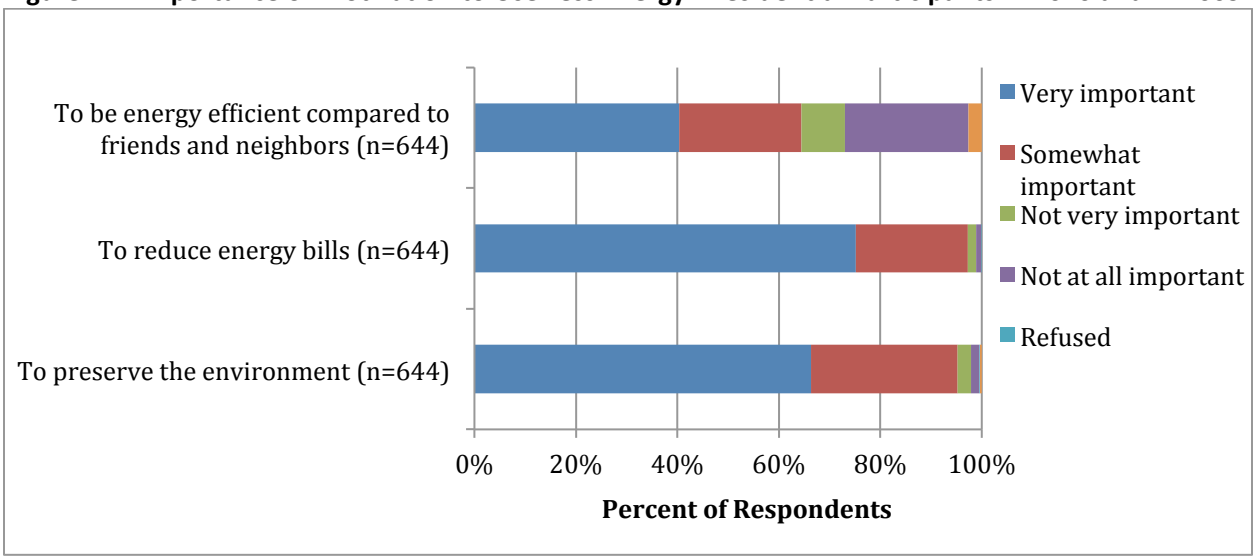
Motivations for participating residential customers to reduce energy use are similar in PY2010 as those found in the PY2009 survey (shown in Figure 23). The motivation most strongly mentioned by participants was to reduce energy bills, with 75 percent in PY2010 and 73 percent in PY2009 reporting this motivation as *very important*. In reviewing findings for PY2010, specifically (shown in Figure 24), nearly all of surveyed participating residential customers (97 percent) reported that it is *somewhat* or *very important* to use less energy to reduce energy bills. In addition, nearly the same percentage (95 percent) said that it is *somewhat* or *very important* to use less energy to help preserve the environment. Although nearly two-thirds of residential participants (64 percent) responded that it is *somewhat* or *very important* to be energy efficient as compared to their neighbors, most of the remaining residential respondents (33 percent) reported that being energy efficient compared to their neighbors is *not very* or *not at all important*. This finding illustrates that peer comparisons among customers may not be as strong of a motivating factor as saving money or preserving environmental quality.

Figure 23: Motivation to Use Less Energy – Residential Participants PY2010 and PY2009



Source: Participating residential customer telephone surveys (2010 & 2011)

Figure 24: Importance of Motivation to Use Less Energy - Residential Participants PY2010 and PY2009



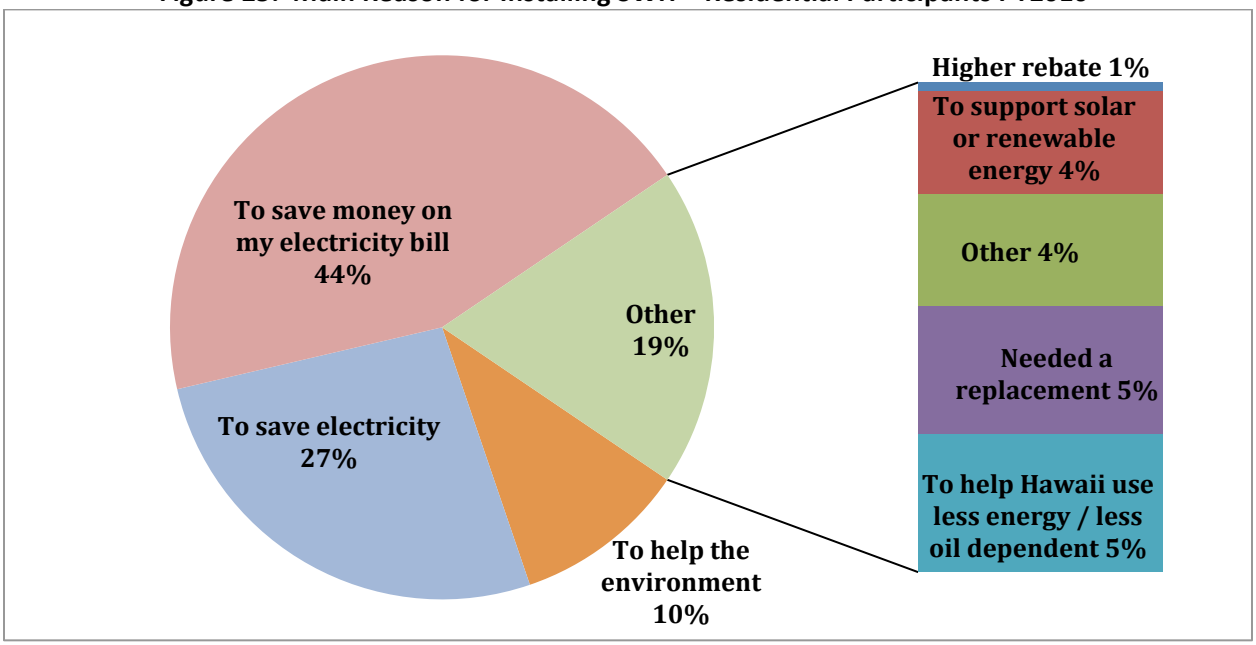
Source: Participating residential customer telephone surveys (2010 & 2011)

6.4.1.4 Reasons for Installing SWH

Due to the importance of SWH to the Hawaiian market, in addition to addressing broad motivating factors, participating residential customers were also asked about their motivations for installing SWH. As illustrated in Figure 25, roughly half (44 percent) of residential customers who received PY2010 rebates for SWH reported that the main reason for installing a SWH system was to save money on their electricity bill.

Approximately one-third (27 percent) reported the desire to save electricity as the primary reason. Together, 71 percent of customers surveyed reported installing a SWH system in order to help reduce energy usage and costs. The remaining 29 percent of motivating reasons include to help the environment (10 percent), needed a replacement (five percent), reduce Hawaii's oil dependence (five percent), to support solar or renewable energy (four percent), and other (four percent).

Figure 25: Main Reason for Installing SWH – Residential Participants PY2010



Source: Participating residential customer telephone surveys (2011)

6.4.1.5 Effects of Rebates on Purchase Cost Perceptions

Residential PY2010 participants are fairly split in the degree to which they perceive the cost of energy efficient products as a barrier to purchase. The survey results, shown in Table 31, illustrate that over half (56 percent) of respondents view the cost of energy efficient products as a large (20 percent) or medium-sized (35 percent) barrier to purchasing – an increase of over 10 percent from PY2009.

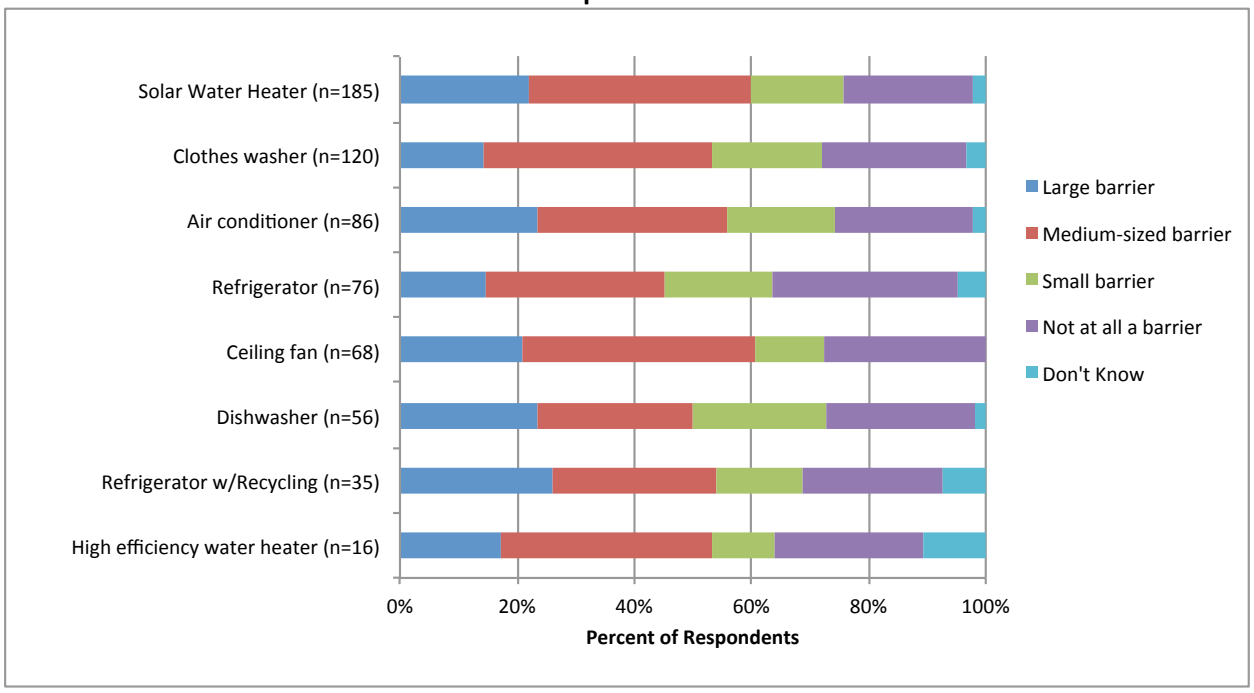
Table 31: Comparison of Barrier to Purchase of Measure Cost – Residential Participants PY2010

Perceived Size of Barrier to the Purchase Cost of Energy-Saving Products and Equipment	Frequency	Percent	Change from PY2009
Large barrier	131	20.3%	+4.3%
Medium-sized barrier	228	35.4%	+5.4%
Small barrier	107	16.6%	-2.4%
Not at all a barrier	160	24.8%	-7.2%
Don't Know	18	2.8%	-0.2%
Total	**644**	**100.0%**	-

Source: Participating residential customer telephone surveys (2010 & 2011)

Among PY2010 participating residential customers surveyed, the perceived barrier of the purchase cost was fairly consistent across a variety of measure technologies as depicted in Figure 26.

Figure 26: Perceived Size of Barrier of Purchase Cost by Measure Technology – Residential Participants PY2010

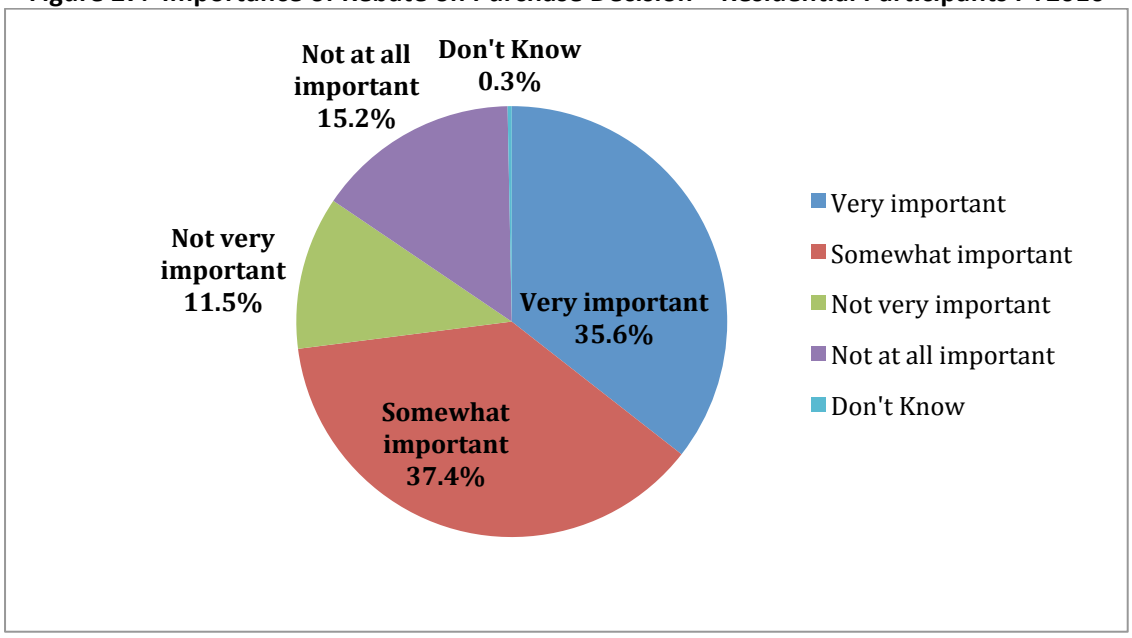


Source: Participating residential customer telephone surveys (2011)

6.4.1.6 Importance of Rebate

Analyses of survey data found that 73 percent of PY2010 participating residential customers reported that the rebate was *somewhat important* or *very important* to the purchase decision. Surprisingly though, nearly one-third (27 percent) of respondents reported that the rebate was either *not at all important* or *not very important* to the purchase decision. This latter finding suggests that it is possible some customers would have purchased the product even if the rebate were not available, as illustrated further in Figure 27. However, it is important to note here that customers who report the rebate was not important in their decision may not be aware of the other ways in which the program is influencing their decision to purchase equipment. For example, the program works to affect the cost, availability, and marketing of the equipment, which are likely to affect the purchase decision in ways that the participant is not aware of. These responses also conflict with earlier responses (see Table 31) indicating that equipment cost is a significant barrier to adoption for over half of respondents. Taken together, these questions highlight the complexity of the purchase decision process and the challenges in identifying free riders using self-report survey questions.

Figure 27: Importance of Rebate on Purchase Decision – Residential Participants PY2010

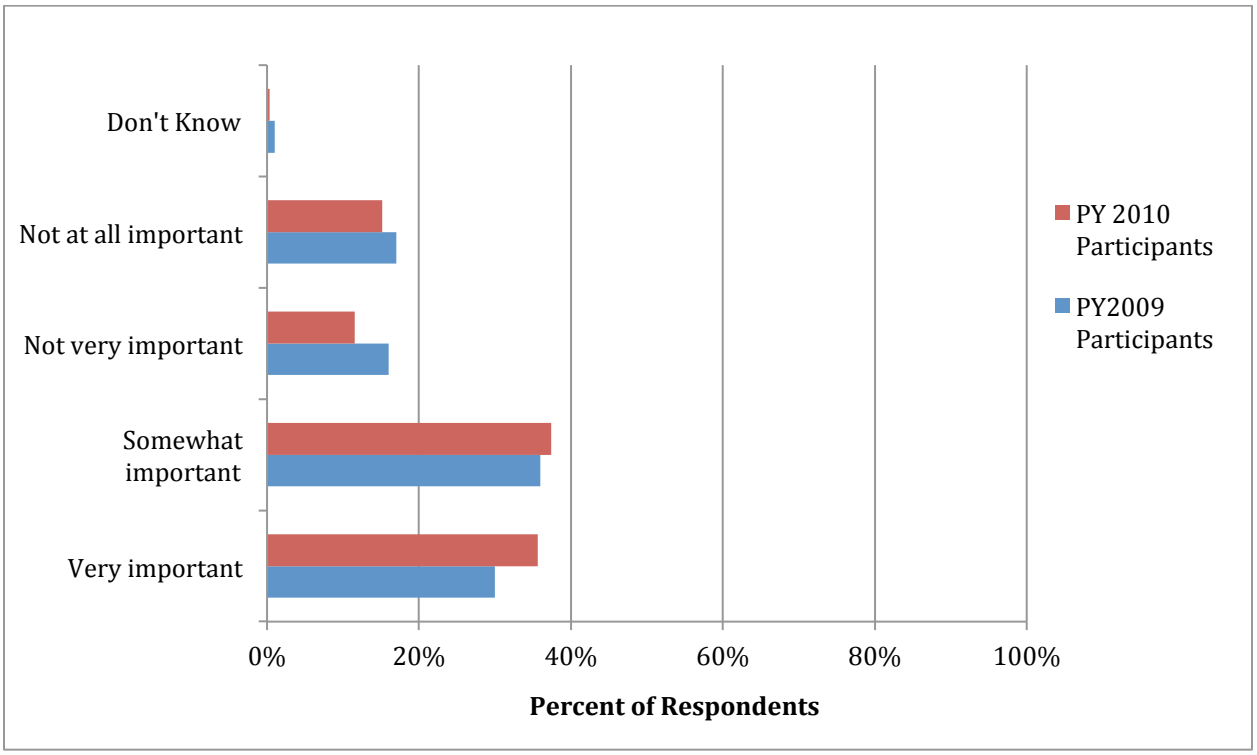


Source: Participating residential customer telephone surveys (2011)

As illustrated in Figure 28, distribution of responses on the importance of rebates on purchase decisions is fairly similar across PY2009 and PY2010 surveys. In PY2010, seven percent more residential participants responded that the rebates were *somewhat important* or *very important* to the purchase decision, which aligns with our findings on purchase cost as a perceived barrier across program years. However, the same caveat mentioned in the previous paragraph applies here as well, that the customer's decision to purchase rebated equipment is likely affected by other program activities that are not as

obvious as a cash rebate. The equipment may not be as widely available without the program rebates increasing demand, for example.

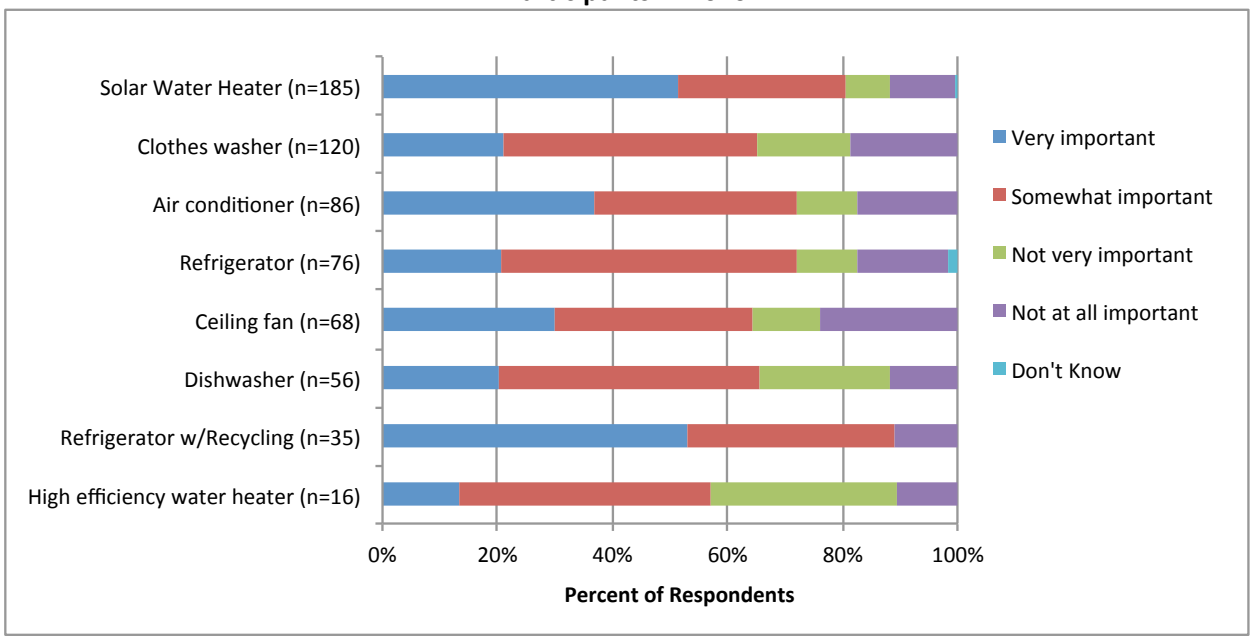
Figure 28: Comparison of Importance of Rebate on Purchase Decision – Residential Participants PY2009 and PY2010



Source: Participating residential customer telephone surveys (2010 & 2011)

For PY2010 specifically, participating residential customer responses on the importance of rebates on the purchase decision did vary a considerable amount by measure technology as shown in Figure 29. The rebate was reported as *very important* by more than half of the respondents for two of the technologies, SWH (51 percent) and refrigerators with recycling (53 percent). Not surprisingly, this finding demonstrates that the importance of rebates tends to be greatest for the most expensive products. It is interesting to note that this doesn't completely align with the self-reported perceived barriers to purchase, which were roughly consistent across measure technologies.

Figure 29: Importance of Rebate for Purchase Decision by Measure Technology – Residential Participants PY2010



Source: Participating residential customer telephone surveys (2011)

6.4.1.7 Knowledge of Rebates

When asked about knowledge of rebates, 62 percent of residential survey respondents reported that they were aware of the rebate before they bought the rebated product (see Table 32). As with findings from PY2009 survey, this suggests the possibility that rebates partially influenced the decision to purchase an energy efficient measure for this portion of those surveyed.

Table 32: Prior Knowledge of Rebate – Residential Participants PY2010

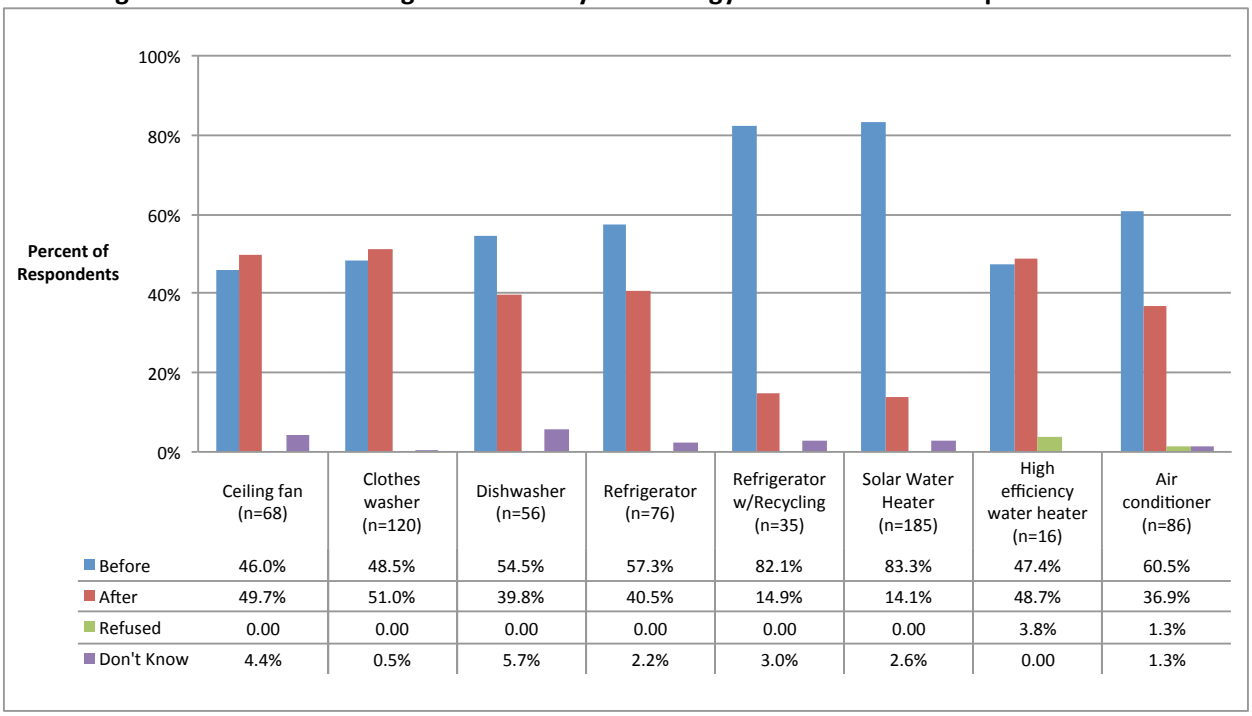
Did you become aware of the rebate before or after you decided to buy a new energy efficient item?	PY2010 Participants		Percent change from PY2009
	Frequency	Percent	
Before	402	62.4%	+1.4%
After	224	34.8%	-0.2%
Refused	2	0.3%	-0.7%
Don't know	16	2.5%	-0.5%
Total	**644**	**100.0%**	-

Source: Participating residential customer telephone surveys (2010 & 2011)

Survey data of rebate awareness by technology (illustrated in Figure 30) shows that rebates likely had the greatest influence for SWH and refrigerators with recycling. For both of these technologies, more than 80 percent of customers reported having prior knowledge of the available rebate, whereas, for all the remaining technologies, on average less than 61

percent of the participating customers responded that they were aware of the rebate before making the decision to purchase the new measure. These findings are similar to the results of the PY2009 survey.

Figure 30: Prior Knowledge of Rebate by Technology – Residential Participants PY2010



	Ceiling fan (n=68)	Clothes washer (n=120)	Dishwasher (n=56)	Refrigerator (n=76)	Refrigerator w/Recycling (n=35)	Solar Water Heater (n=185)	High efficiency water heater (n=16)	Air conditioner (n=86)
Before	46.0%	48.5%	54.5%	57.3%	82.1%	83.3%	47.4%	60.5%
After	49.7%	51.0%	39.8%	40.5%	14.9%	14.1%	48.7%	36.9%
Refused	0.00	0.00	0.00	0.00	0.00	0.00	3.8%	1.3%
Don't Know	4.4%	0.5%	5.7%	2.2%	3.0%	2.6%	0.00	1.3%

Source: Participating residential customer telephone surveys (2011)

6.4.1.8 Rebate Impact on Timing of Purchases

Analysis of survey data revealed that even though rebates are influential on residential customer purchase decisions, they are not the only factor driving the timing of purchases. The survey results, shown in Table 33, illustrate a comparison of the influence rebates have on residential measure purchases. More than three quarters (77 percent in PY2010) reported that they would not have waited to buy the product if the rebate was not available, even though more than 60 percent of respondents were aware of the rebate prior to purchase. As with findings from the PY2009 survey (in which 83 percent reported they would not have waited), this suggests that rebates are not the only factor involved in purchasing decision-making.

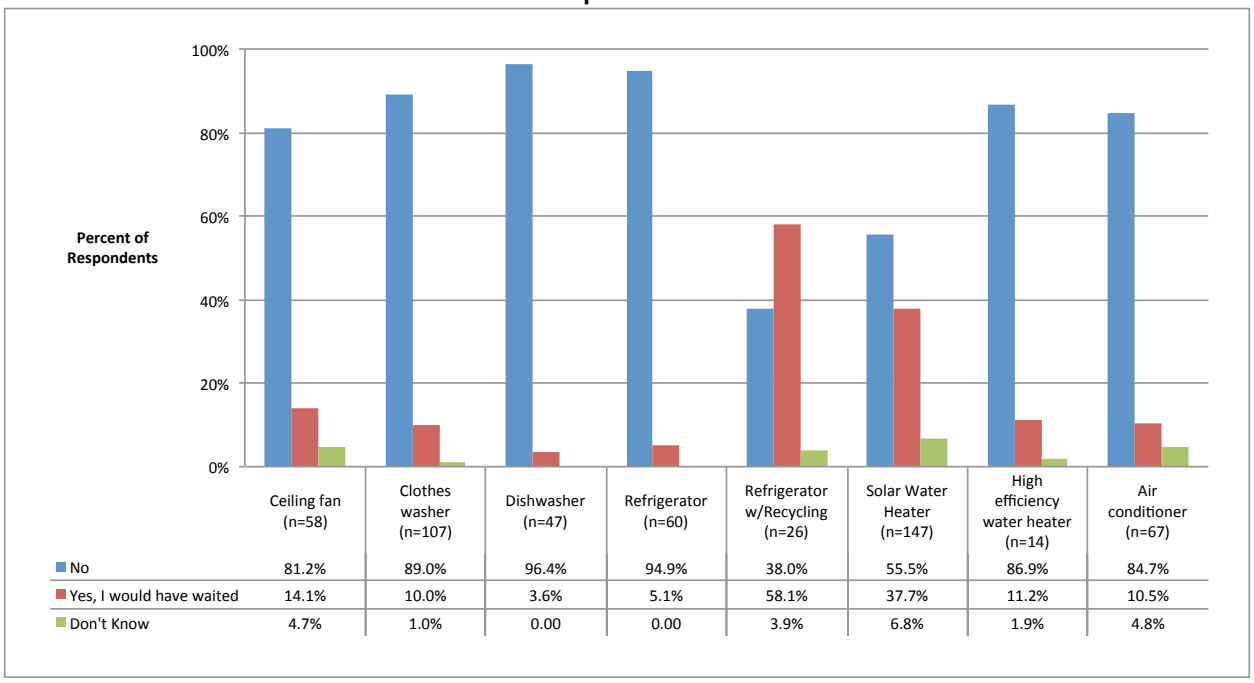
Table 33: Comparison of Rebate Availability on Timing of Purchase – Residential Participants PY2010

If the rebate were not available, would you have waited to buy the item?	PY2010 Participants		Percent change from PY2009
	Frequency	Percent	
No	406	77.0%	-6.0%
Yes, I would have waited	102	19.4%	+6.4%
Don't know	19	3.6%	-0.4%
Total	**527**	**100.0%**	-

Source: Participating residential customer telephone surveys (2010 & 2011)

Data from the PY2010 survey indicate that the availability of the rebate had a considerable impact on participating customers' decision not to wait to purchase a SWH system and refrigerator with recycling. For the other technologies however, more than 80 percent of survey respondents reported that they would have purchased the product even if the rebate were not offered (shown in Figure 31). These respondents are likely under-reporting the extent to which the rebate and other program activities affected the timing of their purchase. They may view the rebate as the only factor affecting their decision, however the program is also affecting their purchase decision through marketing efforts and increased availability of equipment in the market. As noted earlier, responses can be inconsistent across questions, as over 50 percent of respondents also indicated that equipment cost is a significant barrier to purchase energy efficient equipment (see Table 31), therefore implying that rebates are important. As a consequence, the reported statistic of 80 percent of respondents who did not require the rebate should be interpreted within this larger context of program activities.

Figure 31: Rebate Availability on Timing of Purchase by Measure Technology – Residential Participants PY2010



Source: Participating residential customer telephone surveys (2011)

6.4.1.9 Influence of Rebate on Purchase of Specific Technologies

Analysis of survey data show that rebates did not strongly influence the purchase decision of the majority of PY2010 residential participants. Sixty-one percent of respondents said they would have bought the same item even if the rebate had not been available. As shown in Table 34, this is an eight-point reduction from the PY2009 survey findings of 69 percent.

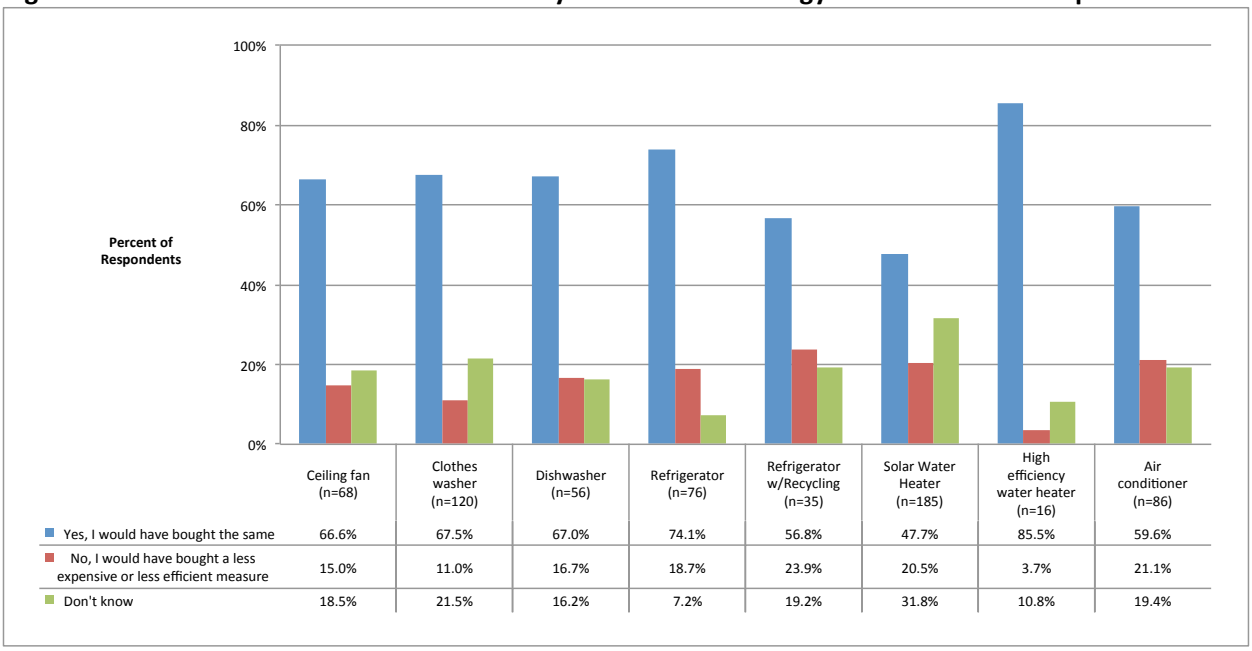
Table 34: Comparison of Rebate Influence on Purchase of a Specific Product – Residential Participants PY2010

If the rebate were not available, would you have bought the same item or would you have bought a less expensive or less efficient measure?	PY2010 Participants		Percent change from PY2009
	Frequency	Percent	
Yes, I would have bought the same	392	60.9%	-8.1%
No, I would have bought a less expensive or less efficient measure	117	18.2%	+2.2%
Don't know	135	21.0%	+7%
Total	**644**	**100.0%**	-

Source: Participating residential customer telephone surveys (2010 & 2011)

The survey data was also analyzed to understand how the impact of rebates differs by technology (shown in Figure 32). Interestingly, SWH and refrigerators with recycling are the only technologies that less than 60 percent of customers reported they would have purchased the same type as without the rebate.

Figure 32: Influence of Rebate on Purchase by Measure Technology – Residential Participants PY2010



	Ceiling fan (n=68)	Clothes washer (n=120)	Dishwasher (n=56)	Refrigerator (n=76)	Refrigerator w/Recycling (n=35)	Solar Water Heater (n=185)	High efficiency water heater (n=16)	Air conditioner (n=86)
Yes, I would have bought the same	66.6%	67.5%	67.0%	74.1%	56.8%	47.7%	85.5%	59.6%
No, I would have bought a less expensive or less efficient measure	15.0%	11.0%	16.7%	18.7%	23.9%	20.5%	3.7%	21.1%
Don't know	18.5%	21.5%	16.2%	7.2%	19.2%	31.8%	10.8%	19.4%

Source: Participating residential customer telephone surveys (2011)

6.4.2 Business Participant Survey Results

The evaluation team conducted telephone surveys with 144 participating business customers and analyzed survey responses to compare PY2010 results with findings from our survey of PY2009 participants relative to a number of important program elements including:

- Initial awareness of Program;
- Knowledge of ways to save energy;
- Rebate timing; and
- Satisfaction with Program elements.

6.4.2.1 Initial Awareness of Program

Participants in Hawaii Energy business programs first learned about the Program in a variety of ways (see Table 35). Nearly half (41 percent) of the survey respondents heard about the Program and obtained an application from contractors or distributors, which is consistent with the current industry view that these vendors are an effective means of marketing energy efficiency programs to business customers. "Word of mouth" was the second most reported source of initial Program information for business customers, up four percent in PY2010 to represent 19 percent of total responses. It is interesting to note that for this participant group, the top three sources were person-to-person channels rather than print or electronic media. There were no discernible differences to initial awareness when analyzing by measure technology purchased.

Table 35: Comparison of How Participants Were Initially Informed of Program - PY2010 Business

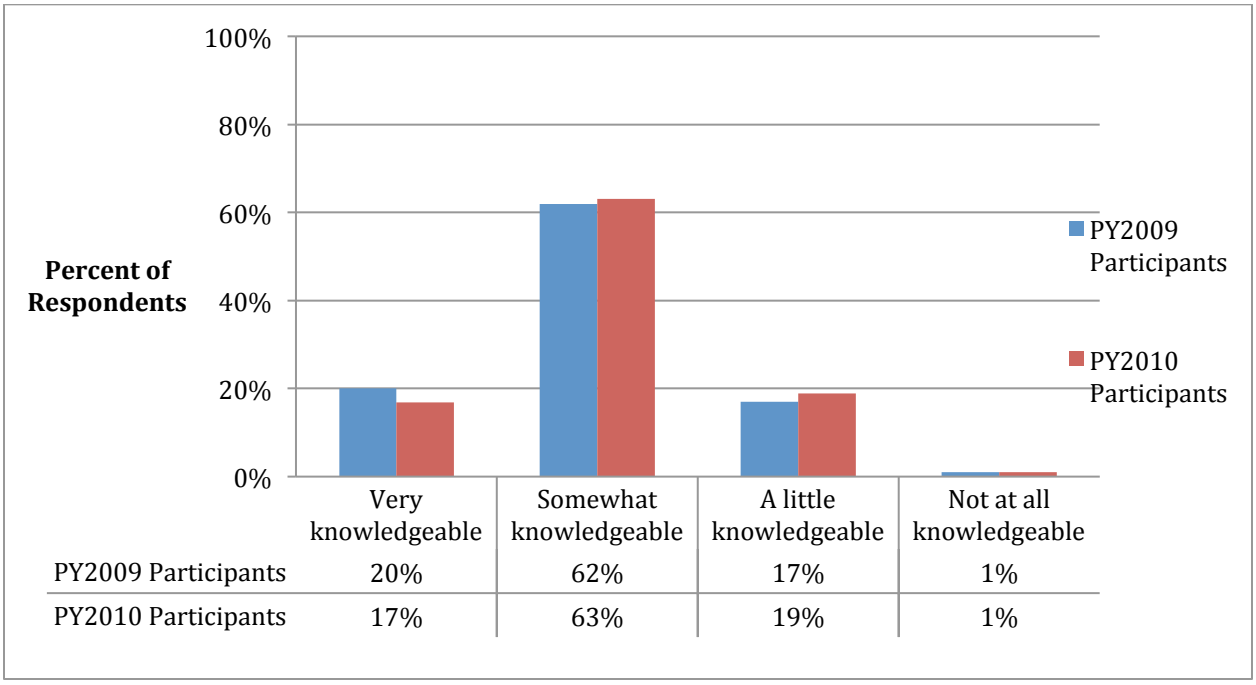
How Customer Was Initially Informed	Frequency	PY2010 Percent	Percent change from PY2009
Word of mouth (business associate, co-worker)	18	18.9%	+3.9%
Contractor/distributor	39	41.1%	-3.9%
Utility or Program website	7	7.4%	-3.6%
Utility bill insert	3	3.2%	N/A*
Utility representative	10	10.5%	+2.5%
Utility advertising	7	7.4%	-2.6%
Other mass media (sign, billboard, newspaper/magazine ad)	3	3.2%	N/A*
Event (conference, seminar, workshop	4	4.2%	+0.2%
Other	4	4.2%	+0.2%
Total	**95**	**100.0%**	**-**

*N/A reflects options not available for 2009 survey
Source: Participating non-residential customer telephone surveys (2010 & 2011)

6.4.2.2 Knowledge of Ways to Save Energy

A comparison of survey results from PY2009 and PY2010 shows only a slight decrease in the percent of business participants who claimed to be *somewhat* or *very knowledgeable* of ways to save energy, although the number remains high in PY2010 at 80 percent (see Figure 33). As with findings from last year's survey, only one percent of all respondents said that they are *not at all knowledgeable*. This finding suggests that the participating non-residential market in Hawaii may be technically savvy and ready to adopt complex energy efficiency measures, which may require more advanced guidance.

Figure 33: Comparison of Level of Knowledge of Ways to Save Energy – Business Participants PY2010 and PY2009



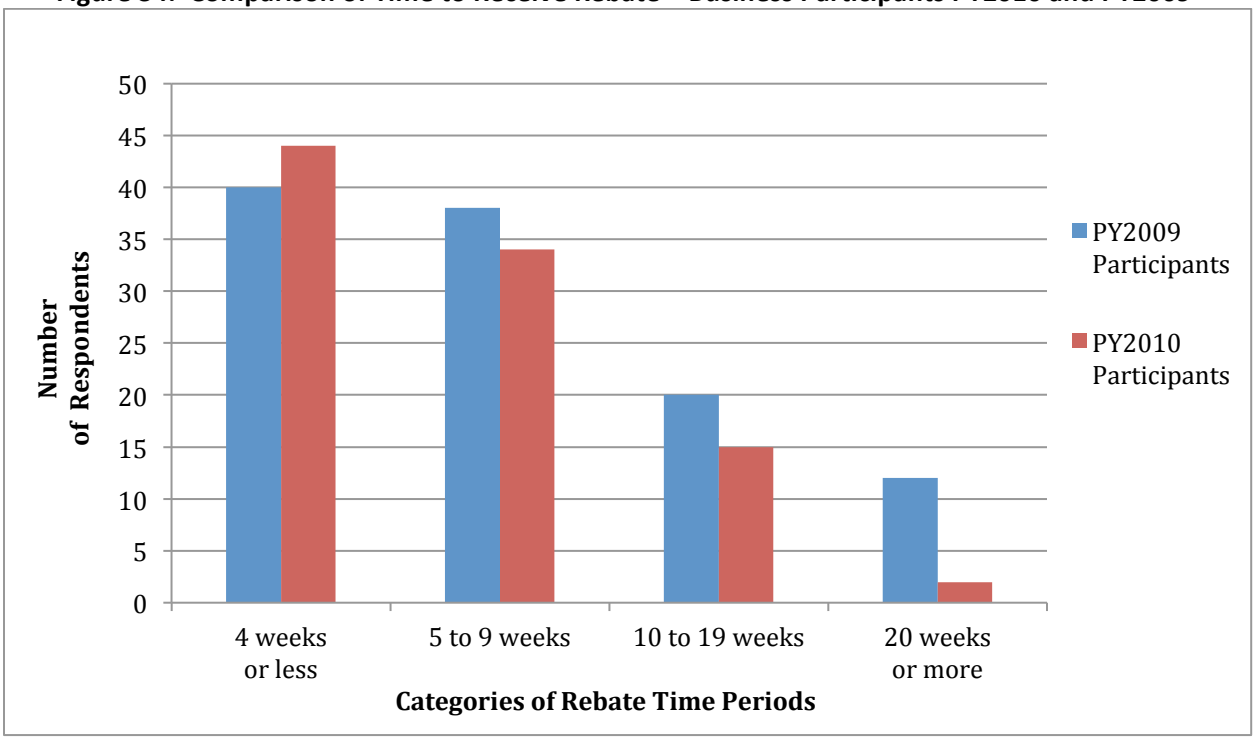
	Very knowledgeable	Somewhat knowledgeable	A little knowledgeable	Not at all knowledgeable
PY2009 Participants	20%	62%	17%	1%
PY2010 Participants	17%	63%	19%	1%

Source: Participating business customer telephone surveys (2010 &2011)

6.4.2.3 Rebate Timing

Survey data from PY2009 and PY2010 (as shown in Figure 34) illustrates a significant improvement in the number of business customers surveyed who reported receiving the rebate after 10 weeks or more, which dropped from 32 to 17 participants. While this improvement is commendable, there may still be potential to lessen the time of rebate processing.

Figure 34: Comparison of Time to Receive Rebate – Business Participants PY2010 and PY2009

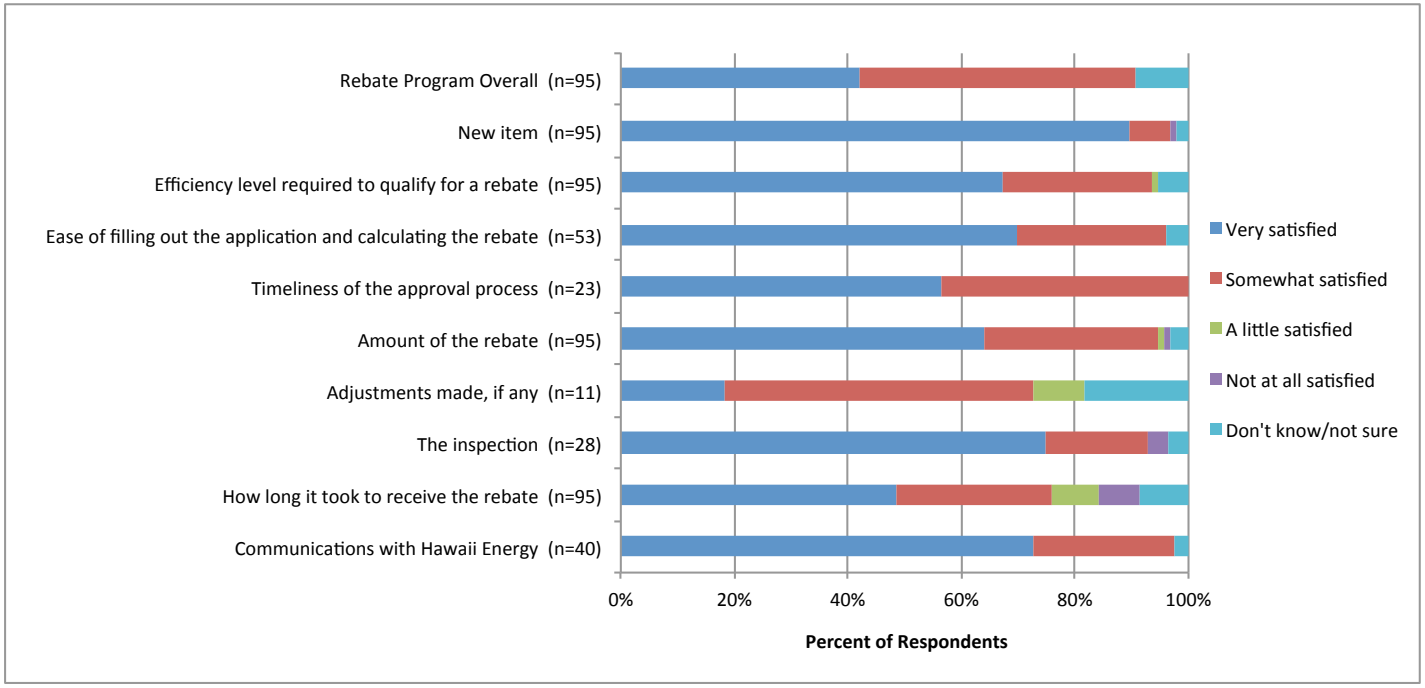


Source: Participating business customer telephone surveys (2010 & 2011)

6.4.2.4 Satisfaction with Program Elements

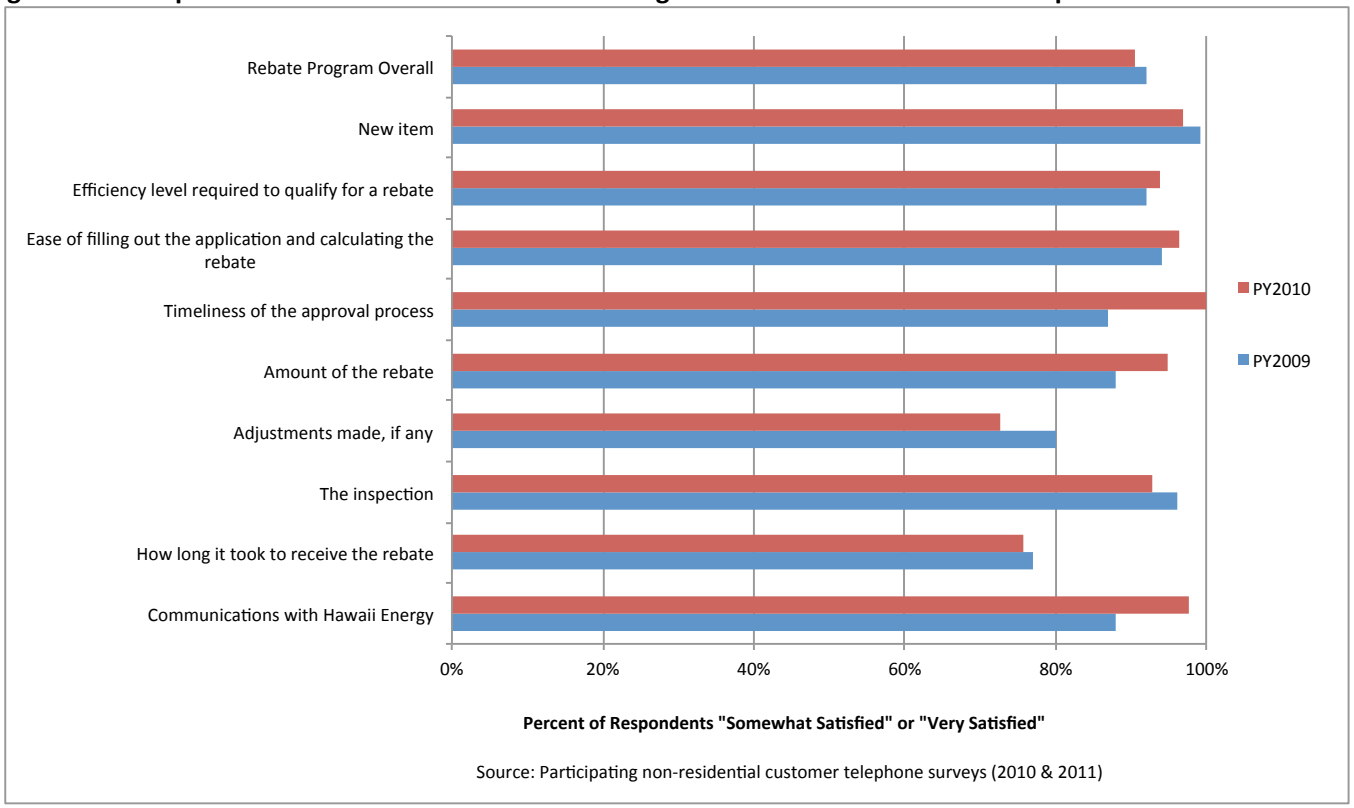
PY2010 business participants reported general satisfaction with most attributes of the Program. Figure 35 illustrates detailed satisfaction levels for each of the various Program elements. Results from both the PY2009 and PY2010 survey of business participants on the satisfaction with various program elements are quite positive. For eight of the 10 measures on satisfaction, as shown in Figure 36, more than 80 percent of respondents reported that they were *somewhat satisfied* or *very satisfied*. The remaining two measures addressing satisfaction with adjustments made to Program elements and satisfaction with the time it took to receive Program rebates still represented fairly consistent results across both program years with more than two-thirds of respondents reporting satisfaction.

Figure 35: Satisfaction with Various Program Elements – Business Participants PY2010



Source: Participating business customer telephone surveys (2011)

Figure 36: Comparison of Satisfaction with Various Program Elements – Business Participants PY2009 and PY2010



Source: Participating business telephone surveys (2010 & 2011)

6.5 Target Market Research

In this section, we present results from research efforts intended to focus on several discrete markets and programs, including:

- Military sector
- SWH program component
- Contractor involvement in small-medium business markets
- Residential low income program
- New construction (residential and business) program components
- Pilot programs

These specific markets and programs were selected for research based on the fact that they were not covered extensively in the PY2009 evaluation. Focusing additional research in these areas allowed us to evaluate Program success and remaining potential in these markets.

6.5.1 Military Participation

As mentioned earlier, a number of military directives to achieve energy savings, both at the Department of Defense level and that of individual service branches, seem to be driving this sector's Program participation. Although its contributions to Program impacts appear to have diminished somewhat in PY2010, the military sector remained a significant factor, accounting for almost 15 percent of total Program savings.

Relatively few decision-makers (from one to six per service branch) appear to drive efficiency project implementation, equipment selection, and Program participation decisions. In the Navy, for example, projects are screened by the Energy Efficiency office and presented to the Admiral in charge of facilities, who makes the decision to approve or reject the project. The military works with a limited number of established vendors, who typically have experience with Hawaii Energy and predecessor efficiency programs. However, military energy managers themselves say they have little or no input on the selection of contractors, which is handled exclusively by the contracting office for each service branch.

In the military residential sector, a pattern of planned demolition and new construction ensures that efficient technologies are implemented, regardless of Hawaii Energy involvement. However, the Program appears to facilitate incremental improvements in efficiency. In addition, the military residential sector has been ramping up sub-metering of its housing facilities, with residents having been gradually introduced to individual usage information with the eventual transformation to payment based on individual usage. It should be noted that such behavioural (i.e., conservation) initiatives are not included in calculation of potential, which may, therefore, be higher than estimated in previous studies.

Department of Defense commitments to energy efficiency and subsequent energy efficiency regulations mean that few non-residential military buildings still have standard efficiency lighting and HVAC. New projects focus on attaining the next highest level of efficiency,

which complicates assessments of the amount of remaining potential. In Hawaii project and equipment selection decisions related to military non-residential facilities are strongly influenced by a variety of initiatives. For example:

- **Energy Independence and Security Act of 2007** –calls for a 30 percent reduction in energy use by 2015.
- **Pacific Command (PACOM) Strategic Goal** - Overall, the PACOM strategic goal is to match or exceed the state of Hawaii's goals. Specifically, PACOM's goal is to reduce power consumption by at least 3 percent per year and by 30 percent by 2015. To do so, it will:
    - Design new buildings to use 30 percent less energy;
    - Design new buildings so that fossil fuel generated energy use is reduced 55 percent in 2010, 65 percent in 2015, 80 percent in 2020, 90 percent in 2025 and 100 percent in 2030 relative to a 2003 baseline;
    - Design new buildings 30 percent better than ASHRAE specifications;
    - Design renovations to use 20 percent less energy; and
    - All new construction/major renovations to be LEED Silver[52]
- **Navy Directive (OPNAV INSTR 4100.5E – draft)** - The Navy is subject to this directive, which requires a 50 percent reduction in land-based energy usage by 2020. The Navy expects to reduce its electricity consumption in Hawaii from more than 200,000 MWh in FY2009 to less than 160,000 MWH in FY2015, while its use of renewable energy to meet that consumption is expected to climb from zero to more than 25 percent over the same period. To achieve these goals, the Navy Facilities Engineering Command Hawaii (NAVFAC Hawaii) has an Energy Office, the sole purpose of which is to pursue energy efficiency, including the following activities:
    - Build Energy Awareness – Create a Conservation Culture:
        - Top-level Leadership - Monthly Energy Conservation Board and Accountability;
        - Good Data & Monitoring ($11 million Advanced Metering Initiative); and
        - Pervasive Training – 4,200 Audits, 1,000 Building Monitor, news articles, training.
    - Pursue Energy Efficiency – Leverage Technology:
        - Currently 40 plus projects valued at $60 million plus; and
        - Innovative Financing – EUL, ESPC, UESC, PPA, Local, Other.
    - Operational Efficiency – Maintain Mission Readiness[53]
- **Marines LEED New Construction** - the Marines are building two new bachelor enlisted quarters and a youth center to LEED Silver or LEED Gold standards and making those buildings 30 percent more energy efficient than required by code.[54]

[52] Ka'iliwai, George and Ross Roley. *PACOM Energy Security Initiatives*. Presented at Energy Expo 2010, September 28, 2010.

[53] *SECNAV Energy Ashore Goals And NAVFAC HI Energy Initiatives*. Presented at Department of the Navy – USDA Energy Meeting, April 2010.

Clearly this level of commitment to energy efficiency and reducing energy use suggests that most, if not all, of the projects for which military facilities received Hawaii Energy incentives may have been implemented even if those incentives were not available. This indicates that the overall net to gross ratio (NTGR) assumed for other Hawaii Energy projects and measures may be too high for the military.

On the other hand, military energy managers say that these are "unfunded mandates," which forces them to pursue non-DOD sources of funding, including USDA, DOE, state, county, utility and industry partnerships, other third party financing 'vehicles' such as Power Purchase Agreements, Energy Savings Performance Contracts, Utilities Energy Service Contracts and Enhanced Use Leases. A Navy energy manager also reports that individual projects must be submitted to the Admiral in charge of facilities, and that the availability of Hawaii Energy rebates improves payback and thereby helps projects get funded.

There appears to be limited remaining potential for non-residential military lighting savings. Two military personnel interviewed said they believe that all the standard T12-T8 lighting retrofits had been done. However, some additional lighting potential may exist in high-bay projects or retrofit of first generation T8s with newer equipment. Program savings for the military sector that appear to exceed the potential reported may be explained by the extent to which the original estimates of lighting potential by sector considered only the replacement of T12 fixtures and incandescent bulbs.

6.5.2 Solar Water Heating Market

Because of the importance of the SWH market in Hawaii, the evaluation team placed considerable emphasis on studying it and the Hawaii Energy programs intended to stimulate it. SWH provides significant opportunity for energy savings in the state. Installed residential solar water heaters can save the average household 30 to 40 percent on its annual electric bill. These savings have been significant enough that the Hawaii State Senate passed SB644,[55] requiring all new single-family residences constructed after January 1, 2010 to include a SWH system. Additionally, there is still a large market for SWH installations in existing homes. It is currently estimated that roughly 75 percent of homes in Hawaii do not have a SWH system.

During the course of this evaluation the team examined the following:

- History of the SWH program component;
- SWH program component activity;
- Contractor involvement within the SWH program component;
- Experiences with the SWH program component; and
- Experiences with the SWH Interest Buy-Down option.

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[54] *Marine Corps Base Hawaii, Renewable Energy Initiatives*. Presented at Energy Expo 2010, September 28, 2010.

[55] SB644 (June 26, 2008). http://www.capitol.hawaii.gov/session2008/bills/SB644_cd1_.htm

6.5.2.1 History of the SWH Program Component

Interest in SWH and renewable energy as a whole has a long history in Hawaii. In 1976, Hawaii established energy tax credits for residents and businesses that purchased and installed renewable energy systems, including SWH. In 1996 rebates for SWH systems were made available to residents on Oahu, Maui, Lanai, and Molokai through the PBF-funded efficiency program administered by HECO and MECO. In 2009 Hawaii Energy assumed the role of PBFA and took over implementation of the state's SWH incentives.

6.5.2.2 SWH Program Component Activity

The current Hawaii Energy SHW program component, which provides rebates for SWH systems, transitioned its focus to SWH system retrofits on existing homes as SB644's mandate rendered rebates for new construction installations unnecessary. In PY2010 Hawaii Energy provided incentives for the installation of SWH through two approaches, the Cash Purchase Program and the Interest Buy-Down Program. The Cash Purchase Program provides rebates for SWH systems purchased and installed outright. The Interest Buy-Down Program, which began in November 2010, offers an interest-free loan option for qualified loans for SWH systems and provided an incentive of up to $1,000 to participating lenders who offered these loans to qualified customers. Figure 37 provides a timeline of rebate levels for SWH installations since Hawaii Energy's inception (July 1, 2009), with the starting point of the original funding levels of the HECO and MECO programs. Figure 38 provides a timeline of the Interest Buy-Down Program.

In Figure 37 the incentive amount offered is identified with a column chart. Funding sources are identified by color, and the number of SWH systems installed is presented using a linear graph. The information is organized by program year, and reflects the following key points:

- **Program Prior to Hawaii Energy:**
  - At one point MECO offered a $750 rebate while HECO offered a $1000 rebate.
  - The rebate level was then adjusted to a consistent $1,000 from both utilities.
- **PY2009:**
  - Due to SB644, effective January 1, 2010 the SWH rebate was limited to SWH retrofits.
  - A significant spike in new construction SWH system installations occurred at the end of the 2009 calendar year as participants rushed to beat the expiration of rebates for this type of measure.
- **PY2010:**
  - Boost in installation rates at the start of PY2010 (July 2010) and at the end of the 2010 calendar year.
  - In March 2011 Hawaii Energy began distributing ARRA funding on behalf of the State Energy Office and Department of Economic Development and Tourism, allowing the Program to double the SWH rebate. Over 800 SWH systems were sold within one month, completely exhausting additional funds.
  - The SWH rebate increased from $750 to $1,000 and was fully funded with ARRA funds through the remainder of PY2010.

- **PY2011:**
    - Rebate adjusted back and held constant at $750 per system.
    - 100 percent of funding for SWH is sourced from PBF.

Figure 38 illustrates Interest Buy-Down Program activity since its inception and includes the following key points:

- **PY2010:**
    - Interest Buy-Down incentive option first made available November 1, 2010.
    - The $1000 made available to lending institutions to cover SWH loan interest was funded using $250 PBF funds and $750 ARRA funds.
    - In March 2011 the ”doubled” rebate made possible by ARRA funds leads to 800 SWH systems being sold within one month, completely exhausting additional approved funds.
    - The SWH rebate increased from $750 to $1,000 and was fully funded with ARRA funds through the remainder of PY2010.
- **PY2011**
    - Interest Buy-Down Program incentive held constant at $1000 per system, and funded 100 percent with the Public Benefits Fee.

Figure 37: Timeline of SWH Incentive Level and Related Activity

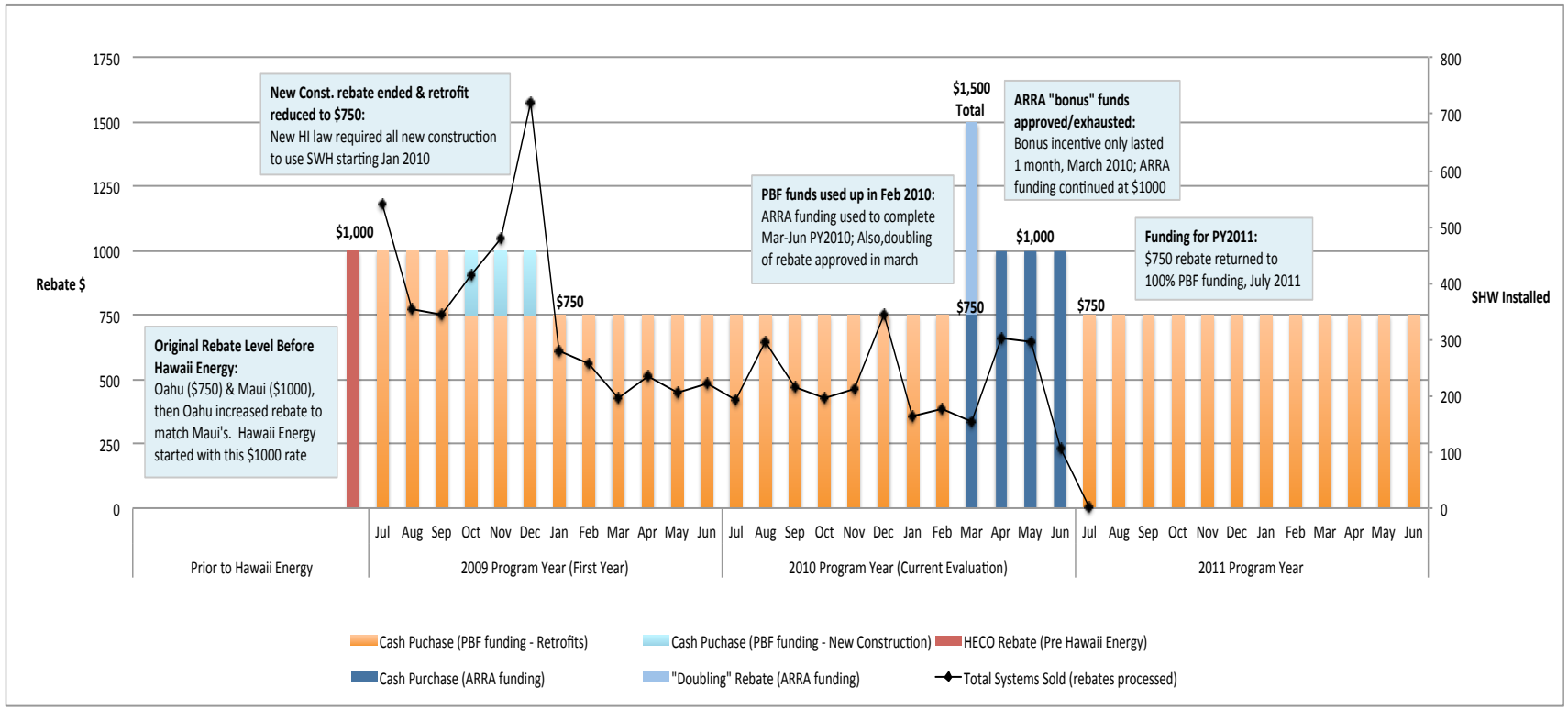
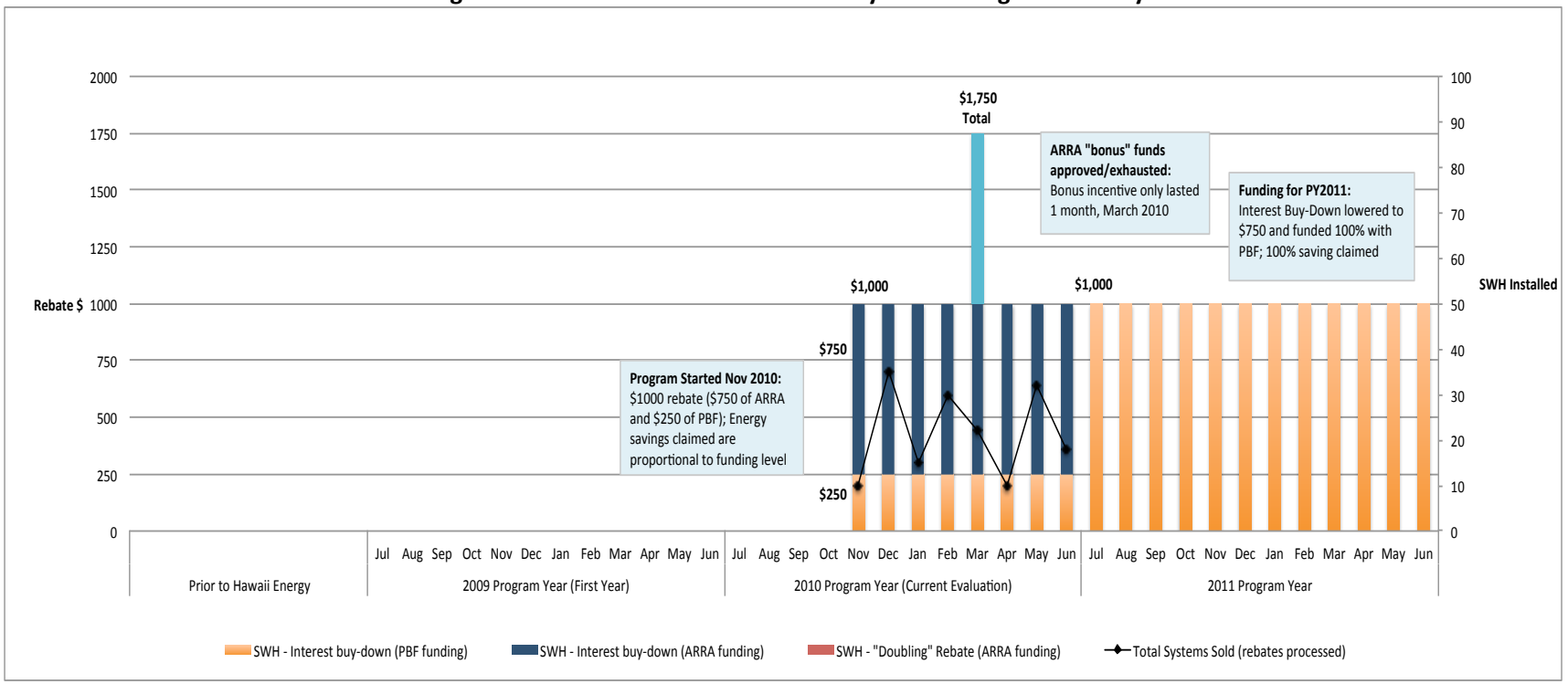


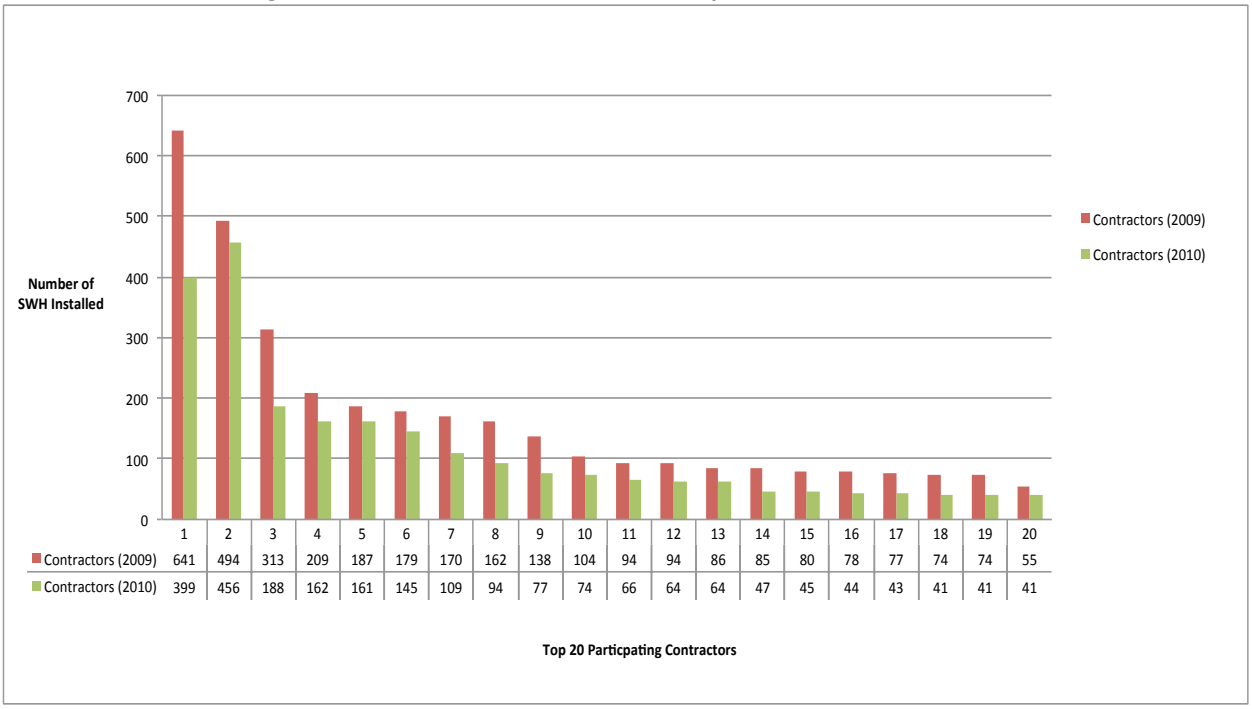
Figure 38: Timeline of SWH Interest Buy-Down Program Activity



6.5.2.3 Contractor Involvement within the SWH Program Component

Contractor participation data provided by Hawaii Energy was examined in detail and in-depth interviews were conducted with participating contractors. Figure 39 provides a comparison between PY2009 and PY2010 SWH installation rates by the top 20 individual contractors. Seventy-nine contractors participated in PY2009 and 62 in PY2010. A figure representing all participating contractors is available in Appendix H, Contractor Forum Results.

Figure 39: Number of Installed SWH by Individual Contractors



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Contractors (2009)	641	494	313	209	187	179	170	162	138	104	94	94	86	85	80	78	77	74	74	55
Contractors (2010)	399	456	188	162	161	145	109	94	77	74	66	64	64	47	45	44	43	41	41	41

Figure 39 highlights the fact that SWH installations are heavily concentrated among a few contractors. The top five contractors alone accounted for 45 percent of installations over a two-year period and the top 10 accounted for 63 percent. The remaining one-third of SWH installations was spread across more than 50 contractors.

In-depth interviews with SWH contractors provided insight into the large difference in installation rates between the top-producing contractors and the remaining two-thirds participating in the Program. Challenges to Program participation are detailed as follows:

- **30-day installation window**. Participation in the SWH program requires that the installation and inspection of the SWH system take place within 30 days of application approval. For smaller contractors who may only have one or two employees and several other jobs, meeting this 30-day deadline can be very onerous.

- **Competition with PV Systems**. According to contractors interviewed, there is a much stronger interest in installing PV systems than SWH systems, since the former offers a considerably higher profit margin.
- **Waiting period for payment**. On average, the contractors interviewed reported that reimbursements for SWH installations could take some time resulting from the variability in the lending institutions' processes for disbursing funds to contractors. In addition, there also can be some time lag in those instances where Hawaii Energy submits check reimbursements. This waiting period ties up capital available for other projects, which can greatly impact smaller firms.
- **Efficiency in quantity.** Contractors also commented that larger contracting firms who install several SWH systems a week could more efficiently install given their team structure and increased quantity of jobs.

6.5.2.4 Experiences with the SWH Program Component

Through interviews with Program participating contractors and lenders, the evaluation team collected information on the experience with the SWH Program, as discussed below.

Communication with Hawaii Energy

Overall, both lenders and contractors reported timely and effective communication with Hawaii Energy, and that Program representatives always seemed to be available and easy to contact. When questioned about ways communication could be improved, several commented that more updates on the application progress and rebate status would be beneficial. A four to six week time lag exists between SWH installations completion and contractor receipt of final rebate checks. This process time lag was greatly decreased for those contractors who participated in the "fast track" payment program with Hawaii Energy. This direct deposit option was reported by participating contractors as extremely easy, time saving and convenient.

Impacts of ARRA Funding Levels

As discussed above, the additional ARRA funds that supplemented incentives for the PY2010 SWH program allowed Hawaii Energy to double rebates available for SWH installations. This increase greatly increased customer demand for SWH – so much so that funds were exhausted after only one month of rebate availability. One credit union representative reported a large increase in interested customers during that month, a claim that was echoed by another credit union representative who mentioned that before the doubling, many customers did not really find the financing option alone a benefit. As expected, once the doubling of the rebate ended, there was a considerable slowdown in interested customers for SWH loans.

Despite the best of intentions in providing additional incentive funding to increase demand for SWH installations, the changing rebate levels did create some confusion among customers, contractors and lending institutions. Contractors and lenders reported that they were not always apprised of the most recent changes to available incentives. As a result, there were instances when customers received mixed messages about the availability of funds for SWH projects. According to contractors and lenders interviewed, changes to the availability of Program funds seemed to happen quickly and without

sufficient notice to allow them to make the necessary adjustments in their business advertising. This created a concern among contractors and lenders about their credibility with customers.

Competition with PV Systems & Size Matters

Another common theme mentioned by the SWH contractors interviewed was that installations of PV systems often are the primary business focus and that SWH systems represent a second line of business. One reason mentioned for the focus on PV systems is that the jobs are larger, and often offer more work and increased profit margins. In addition, some contractors commented that SWH installations are better handled by the larger companies that can install several systems per day. These firms tend to focus on system installations for both new construction and existing homes. This perspective aligns well with the installation rates per contractor shown in Figure 39, where the top five contractors accounted for 45 percent of SWH installations.

Possibility of SWH Tune-up Offering

Hawaii Energy is considering offering tune-ups for SWH that are more than six years old. When Contractors were asked about this, they reported that SWH system technology is quite reliable, requiring nothing more than standard maintenance, making the market potential for such an offering limited.

While a 2008 KEMA study[56] reported that approximately seven percent of SWH systems were not operating properly, this number is relatively small. Additionally, it is not clear whether that seven percent may be reduced by routine maintenance rather than a tune-up measure.

6.5.2.5 Experiences with the Interest Buy-Down Rebate Program

Lending institutions and contractors interviewed were specifically questioned about their perspectives on the effectiveness of the SWH Interest Buy-Down program. This new SWH program option was widely reported by both lenders and contractors as providing significant value to customers. Several topics were described in detail including program marketing, customer participants, and the process for distributing funds.

Marketing

Marketing efforts for the Interest Buy-Down option included messaging on Hawaii Energy's website along with efforts by lending institutions themselves. Representatives from lending institutions interviewed commented on a variety of techniques used to advertise the offering to customers, including:

- Announcements on their bank or credit union website;
- Newspaper advertisements;
- Commercial radio ads; and

[56] KEMA, Inc. *Energy and Peak Demand Impact Evaluation Report of the 2005-2007 Demand Side Management Programs.* (Honolulu, HI: Hawaiian Electric Company, Maui Electric Company, and Hawaii Electric Light Company, December 2008).

- Posters at local bank or credit union branch locations.

The extent of advertising for the program option varied widely among lending institutions, with some very actively involved while others participated very little. Some banks even actively promoted the option to new customers that opened an account. Most institutions agreed that the primary source of customers who applied for SWH loans is through recommendations from contractors working directly with customers. One representative mentioned having a great working relationship with those contractors that helped to promote "their" branch as a lending institution for the SWH interest buy-down loan.

Program Participants

The Interest Buy-Down program primarily attracts homeowners wanting to convert to a SWH system but lacking the necessary capital. For credit unions, the minimum qualifications included that applicants were members, homeowners and have approved credit. The reported approval rating was extremely high. For one credit union, eight out of ten applicants were approved, while another stated they were not aware of a single time when someone was not approved. At some of the banks, qualifying customers could either be homeowners or renting occupants. In one instance, a homeowner with five rentals applied for SWH loans at each of the separate residences.

Process for distributing funds

In-depth interviews with representatives from lending institutions revealed that policies related to the Interest Buy-Down program varied widely. The largest such variance among institutions was the process for distribution of funds. While most lenders distributed funds after completion of the SWH installation, some required only a contractor invoice and completed application form for Hawaii Energy, while others required final inspection paperwork from Hawaii Energy. Lending institutions required some form of installation proof to limit the risk of contractors not completing projects for which funds were provided. Having to carry the cost of the full installations until funds are distributed can prove challenging for smaller contractors. In addition, rebate payments to contractors from Hawaii Energy can take four to six weeks. For smaller contractors, having to float these constructions expenses can be extremely challenging and may even limit which contractors are able to participate in the interest buy-down program.

6.5.3 Residential Low-Income Program

In order to assess if Hawaii's residential low-income and hard-to-reach population is being served appropriately, in-depth interviews were conducted about the RLI program that focuses on this sector and offers energy efficiency educational outreach, training and measures.

In efforts to expand the reach of the program in PY2010, the Program used community-based outreach and marketing allies to deliver measures. In-depth interviews conducted with these allies revealed that there were a variety of services made available to low-income customers, and that there was no consistent method for delivering those services. The four community-based organizations (CBOs) interviewed include:

- Hawaii County Economic Opportunity Council;

- Hana Build;
- Blue Planet Foundation; and
- Independent consultant, Helen N. Wai.

These interviews highlight the need for a clear strategy and process for serving low-income residents as part of the RLI program. In addition, they also help to document program successes and explore its challenges.

Program Successes

CBO representatives consistently reported that program services were extremely well received by low-income communities. While the most common service was the distribution and exchange of CFLs, representatives all noted an overwhelming demand for services of all kinds, and that the response from the community was always greater than resources available.

Program Infrastructure

Interviews revealed the following issues related to RLI program infrastructure:

- **Lack of clear RLI goals**. Despite the considerable progress that the RLI program has made, there is still room for improvement on the clarity of goals regarding resource and service availability and delivery.
- **Reliance on only a few organizations**. For PY2010 there were only six firms identified as actively participating in the RLI program. Of these, only two are large multi-island organizations. The over-reliance on a select few organizations could be a limiting factor to further program growth and involvement.
- **Need for consistent processes**. Inconsistency in program offerings and processes proved problematic for CBOs involved with the program. While CFLs are widely offered, the delivery method depended on the organization and situation. In some instances, CFLs were exchanged for incandescent bulbs on a 1-for-1 basis, while in other cases they CFLs were just distributed among the RLI community.
- **Limited program tracking measures**. As made evident during PY2010, verification of savings from the RLI program is difficult due to the limited amount of data collected for services rendered. In order to accurately account for savings, encouraging or offering incentives for the identification of individual recipients is crucial.

Island Equity

Community organizations serving the residential low-income population face the significant challenge of contacting rural and hard-to-reach residents, and struggle with the lack of a centralized concerted effort to identify and serve low-income residents. The 2011 Yale report claims that, "[t]here is an absence of a strong, coordinated effort to increase

penetration of energy efficiency and conservation measures."[57] Currently, most of the efforts of the RLI Program are focused on the island of Oahu.

A significant barrier to island equity issues is one of geography. Given the difficult terrain and limited transportation access, RLI communities are widely dispersed, making it expensive and time consuming to serve them, particularly for those CBOs with multi-island service areas. As a result of this challenge, many service providers tend to focus on RLI customers on one island or on certain areas on a specific island. Hana Build, located in Hana, Maui, is an example of an organization that serves only one specific community. As a result, they are able to have an impact on the RLI customers within Hana but nowhere else. Such a business model enhances localized success, but severely limits overall program participation.

6.5.4 Residential HVAC Market

Based on the potential for energy savings of high efficiency air conditioning, this REEM program component (and the residential HVAC market more generally) was selected as a topic for in-depth interviews. The evaluation team attempted to contact 62 HVAC contractors and professionals in the state, and completed in-depth interviews with five of them. The purpose of the interviews was to better understand program awareness and perceptions of program effectiveness, and to document recommendations for program design improvements.

Program Awareness

Awareness of the new HVAC program component offered by Hawaii Energy appears to be fairly limited. One of the contractors interviewed was very familiar with the old programs that offered incentives to tune-up and maintain existing systems, but was unaware that program offerings had changed. Another contractor, who had attended several HVAC presentations held by Hawaii Energy, commented that contractors in general only appear to be somewhat aware of the HVAC program component and that he sees it as being under-utilized.

When questioned about how Hawaii Energy could increase the awareness of the HVAC offerings, several specific recommendations were provided, including:

- Increase the number of presentations offered by Hawaii Energy, such as an annual trade shows for contractors;
- Offer educational opportunities for HVAC contractors on properly sizing systems;
- Send targeted emails to contractors that specifically address available HVAC incentives;
- Ensure promotional and outreach activities include all islands; and
- Have a full-time program representative on each of the islands that can be more actively involved in the local community and industry.

[57] DeStercke, et al., p. 5

The interviewees commented that the recent addition of representatives on some of the islands has been invaluable to increasing the awareness and communication of Hawaii Energy and the Program.

Barriers to Program Effectiveness

Potential barriers to program growth and success identified during the interviews included:

- **Lack of presence on outer islands** – As mentioned previously, the contractors reported the need for an increased presence of Hawaii Energy on islands other than Oahu.
- **Struggle to stay current** – Contractors find it is difficult to keep apprised of Program changes and suggest increased communications, particularly those offering sufficient notice in advance of changes..
- **Long response times** – Contractors also reported that response time from Hawaii Energy on applications submitted and corresponding project status was initially rather slow. It was noted, however,, that response times have decreased on Maui where a Hawaii Energy representative is now available.
- **Resistance from multi-family board associations** – A common barrier identified by contractors are Association of Apartment Owners (AOAO) boards that tend to be apathetic about energy efficiency measures, including sub-metering. They mentioned that condominium complexes offer a great potential market for growth in energy efficient HVAC systems, but convincing AOAO boards of the benefits is often difficult.

Despite the current barriers identified by contractors, they also pointed out the significant improvements that have been made over the previous year in addressing them. Improved communication between Hawaii Energy and contractors with the addition of on-island representation was given as an example. Building on successes like this could help increase awareness and participation among contractors in the HVAC program.

6.5.5 New Residential Construction Market

Although construction activity is limited by the recession, the new residential construction market does present an opportunity to increase the breadth of energy efficiency in homes while they are in the process of being built. For this reason, in-depth interviews were conducted about the NEW residential construction program. This program is designed to promote the inclusion of energy efficient measures by offering $0.08/kWh for the expected annual energy saved and $125/kW for the demand reduction between 5:00 PM and 9:00 PM on weekdays for designs as compared in an acceptable energy model software to a code-designed home.

The evaluation team contacted 25 industry professionals (including builders, developers and industry consultants), four of whom agreed to participate in interviews. The interviews focused on program awareness, perceptions of program effectiveness, and potential recommendations for program design improvements.

Program Awareness

All of the in-depth interviewees reported they were aware of both Hawaii Energy as an organization and the incentives available for energy efficient measures offered for residential new construction. The general consensus, however, was that Hawaii Energy is not widely known among most builders and developers. One builder noted that his firm actively seeks out incentives and new energy efficiency opportunities and commented that, "If one is not actively seeking out energy efficiency or well connected into the industry then Hawaii Energy and the incentives offered are hard to find."

Barriers to Program Effectiveness

Interviews with industry professionals also highlighted aspects of the NEW Residential program that may serve as a barrier to program growth and success:

- **Housing market still languishing** – The housing market in Hawaii is still struggling, which makes energy efficiency additions to new homes a more difficult sell to consumers.
- **Builders may have limited incentive to participate** — Builders report that there are few incentives for them to offer a variety of energy efficient measures in new homes as they often do not increase the marketability or attractiveness of the home. Several interviewees reported that it is difficult to recoup money invested in energy efficiency when the new home is sold.
- **Consumers may have limited willingness to pay for energy efficiency** – Beyond the demand for ENERGY STAR appliances, builders perceive that average consumers are often not willing to pay a premium for energy efficient upgrades making it difficult for builders to recoup investments in energy efficiency measures. The exception to this is the custom home market.

Program Design Improvements

In-depth interviews with industry professionals also revealed several practical recommendations that may help to increase program involvement:

- **Market directly to early adopters** – Builders recommended that one way to increase consumer demand for energy efficiency in new homes is to directly market the residential new construction program to the first-tier builders that are already beginning to offer some energy efficient measures, including Gentry, D.R. Horton, and Haseko. As acceptance builds among these early adopters and the demand from consumers' increases, other builders will likely become involved.
- **Provide incentives directly to builders** –Builders interviewed also suggested providing incentives to the builder for new residential homes that include more energy efficiency measures. Although not specific to energy efficiency measures, one example given was to offer incentives for making homes "PV ready" with electrical panels and having wires pre-run. This would drastically reduce the capital costs required for consumers to convert over to PV at a later time.

6.5.6 Small Commercial Lighting Market

The current BEEM program direct install lighting component targets large lighting contractors. This approach is a sound strategy for initial entry into the market as these contractors specialize in lighting installations and account for a significant portion of the lighting retrofit market. However, in order to reach deeper into this market and achieve longer-term market transformation across the entire network of trade allies providing lighting retrofit services, the program may need to tap into the broader electrical contracting market that also installs lighting measures. This research focused on understanding awareness, potential interest, and longer-term needs of those electrical contracting firms that are not currently participating in the direct install program. In order to assess this potential, the evaluation team completed in-depth interviews with non-participating contractors and representatives from participating businesses, and then conducted focus groups with non-participating contractors. Key inquiries of this research are presented below and include:

- Awareness of Hawaii Energy and the direct install lighting program;
- Interest in current program offerings; and
- Feedback on program design.

Awareness of Hawaii Energy and Lighting Program

The evaluation team closely reviewed the focus group and in-depth interview findings to better understand and document contractor awareness of Hawaii Energy and the lighting program. Some of the key themes discovered include:

- **There is a moderate level of awareness of Hawaii Energy, but limited knowledge of the direct install program component** - Four of the five small businesses interviewed that had participated in lighting rebates reported that they only had slight awareness of Hawaii Energy as an organization, with only one claiming broad awareness of it. Among contractors interviewed that install lighting, only half (5 of 10) had heard of Hawaii Energy. In addition, one business owner expressed a limited understanding of the distinction between HECO and Hawaii Energy. These findings were echoed in the two focus group sessions where awareness of Hawaii Energy was moderately strong, and almost no contractors reported knowledge of the direct install program.
- **Knowledge of energy efficient products and services is widespread** - Despite the overall limited awareness of the direct install program, findings from the interviews and across both focus groups concluded there is a fairly broad general level of awareness in Hawaii of the available energy efficient products and services. It was also reported that adoption of energy efficient technologies partially depends on the cost effectiveness of the measures over time.
- **Having communication with a personal feel to it was reported as the most effective outreach strategy** - In order to increase awareness of specific Program offerings, findings from the interviews emphasized the importance that communications from Hawaii Energy have a personal feel to them. One example provided was targeted emails to builders, architects, and contractors that

specifically address the Program offerings and incentives available to them. Those interviewed that had participated in Hawaii Energy rebate programs had positive comments about Program communication efforts. For example, one stated that, "communication with Hawaii Energy was smooth, and was assisted by the contractor's involvement in helping complete paperwork."

- **Recommendations for marketing to small businesses** - Small business representatives interviewed reported that there are a variety of effective strategies for marketing energy efficient programs to businesses. Specific recommendations on the best methods to market programs include:
    - Provide educational seminars and topic-specific forums for small businesses;
    - Work with vendors to promote available rebates/incentives;
    - Add a personal touch in communication to businesses and contractors, which is important in getting the message across. Businesses interviewed specifically mentioned a preference for direct and specific emails in place of marketing flyers. Contractors tended to agree with the preference for direct emails, however they reported that clear marketing flyers also work.

Interest in Current Program Offerings

Overall interest and potential acceptance of the direct install lighting program varied greatly between the contractors from Oahu and those from Maui. The contractors on Oahu were very skeptical of the value offered by the program and were concerned about the amount of labor that would be required for them to actively participate. This is especially so in the current economy because customers are very focused on cost savings. On Maui however, the response from contractors was completely the opposite. Not only were they very interested in the potential value this could provide to Maui businesses, they seemed excited to actively market this to their own customers. Key insights from the focus groups with contractors about current program offerings include:

- **Interest on Oahu is dependent on perceived cost savings resulting from the installation of efficient lighting** - One contractor summed up the importance customers on Oahu place on cost savings as a motivating factor for pursuing energy efficient lighting upgrades, stating that "[t]he biggest driver is the economics on the island."
- **Contractors on Maui are enthusiastic about program potential** - Contractors attending the Maui focus group session commented that they were extremely likely to promote the program to their clients and optimistic about the programs potential stating "I think there's a lot of opportunity, I mean especially with your repeat customers."
- **Contractors expressed concerns over costs that may be incurred marketing the program to customers** - The lack of broad awareness among contractors and customers raised concerns with contractors about the potential labor costs necessary to promote the program and educate customers. Of primary concern was the "return on investment" of their marketing efforts. "It doesn't make sense for me

to spend one hour driving, half hour explaining something, and not end up with anything."

- **Contractors attending the focus group sessions had considerable questions about program details** - Among the many contractor questions were "Do you have a rep you could send … if we needed to call on somebody" and "Is there any incentive there for us besides keeping our customer happy?"

Feedback on Program Design

Focus group sessions with contractors helped provide a better understanding of how the Hawaii Energy direct install lighting program is perceived within the industry. Additionally, discussions with contractors revealed perspectives on market potential for the program, suggestions on how to increase the program's market effectiveness, and identification of possible limitations.

- **There is a strong market potential for energy efficient lighting** - In-depth interviews with contractors and business representatives found that business customers value the long-term energy savings of lighting systems, lighting incentives and vendors that are knowledgeable about energy efficient products. This potential is useful in the short term as the program moves to reach the remaining lighting potential. However, as discussed previously, in the longer term the programs need to shift toward other sectors and end uses.
- **Increase marketing efforts to contractors and customers** - Awareness of Hawaii Energy across both focus group sessions was extremely limited. In addition, awareness among business customers and contractors interviewed was fairly limited. However, with greater investment in marketing through channels reaching both contractors and customers, there is a strong potential for increased participation in the direct install lighting program through customer demand as awareness increases.
- **Contractors are unlikely to carry the burden of marketing the program for Hawaii Energy** - Contracting firms have been hit hard by the recession and are very reluctant to undertake speculative marketing. One contractor interviewed reported that he "would not solicit customers for the program, regardless of the structure." Another contractor shared a similar perspective stating that he "had no extra time to *sell* the program to customers."
- **Contractors' influence on lighting decisions is generally limited to small businesses** - In-depth interviews with contractors revealed that for large lighting projects, contractors have minimal impact on lighting choices, including energy efficient options. Two contractors specifically mentioned that on typical large lighting projects the selection of lighting is predetermined by the builder and general contractor plans drafted by engineers before the subcontractor is even hired. As a result, there is little room for suggestions for energy efficient lighting options that are not already included in the job spec.
- **Broad market transformation to energy efficient lighting among businesses may be limited by building constraints** - Many businesses operating in small towns are located in older buildings that often have historical significance. This is

especially the case for businesses located in federally registered historic towns. As a result, program effectiveness and broad conversion to energy efficient lighting will be limited in these locations due to historic nature of buildings and the structural updates that would be required to meet code.

6.6 New Initiatives and Pilot Programs

The approach to analyzing Hawaii Energy's new initiatives and pilot programs was complicated by the fact that there were several such initiatives that never got past the planning and discussion phase in PY2010 (e.g., solar hot water tune-up), and others that were never formally launched as pilot programs, but merely introduced as mid-course modifications to an existing program (e.g., SWH interest buy-down). The BEEM direct install lighting component, which was in some ways treated as a pilot, never made significant headway, and is discussed above in the context of contractor perceptions and feedback. Several SWH-related pilots and new initiatives are discussed in the SHW section above.

The evaluation team therefore focused on two initiatives that were most like traditional pilot programs: Central Plant Optimization and Condo Sub-metering. To evaluate these two initiatives we did the following:

- Reviewed similar pilots and programs elsewhere;
- Prepared a generic pilot/new initiative Program Theory Logic Model (PTLM) as well as several program-specific models;
- Reviewed initiative participation;
- Conducted interviews with Program staff; and
- Conducted interviews with pilot participants.

6.6.1 Overall Findings

One of the fundamental issues of our review and assessment of the various new program initiatives was simply determining what defines a pilot versus a new program rollout. In theory, the pilots would be designed more as "proof of concept" initiatives that are undertaken on a smaller scale and often with a more narrowly defined target market. Also, they would be expected to have fairly specific definition of what would be considered a successful pilot and warrant a full-scale rollout.

The fact that the pilot initiatives analyzed generally did not have such clearly defined criteria would not likely be a concern for participants or trade allies, and it might provide Hawaii Energy with greater flexibility in fine-tuning program offerings to adapt to the targeted market or to take advantage of emerging or newly perceive opportunities. However, it does make assessing whether a specific pilot has broader potential more difficult.

Overall, it seems that Hawaii Energy employs something of an *ad hoc* process to design and introduce new programs with regard to such pilot characteristics as:

- Selection of markets and measures;

- Identification of barriers and how to address them; and
- Determination of scope, baseline and savings assumptions.

The lack of a clear design and selection process also makes it more difficult to develop metrics that can be used to judge the success of the pilots. While there were no participants in the sub-metering pilot and only a single participant in the central plant optimization pilot, we believe that both offer significant potential, and are worth pursuing using slightly modified approaches, as described below.

6.6.2 Central Plant Optimization Program

While in its pilot year the Central Plant Optimization program had only one participant, there is significant market potential for a program of this type. Based on the number of customer accounts in various business sectors and size categories, there are roughly 100 large offices, hotels, hospitals and school buildings on Oahu and 70-80 on the other islands as well as several dozen military facilities that use central plants. All of these facilities likely have central cooling plants and are candidates for an optimization program.

One of the engineering firms working with Hawaii Energy claims that efficiency can be improved from roughly 1.4 kW/ton for an older system to about 0.65 kW/ton for a thoroughly modern system. However, optimizing that new system can improve efficiency to 0.43 kW/ton, for an overall savings of nearly one kW ton.[58] Better management of schedules can also reduce run times, further increasing the savings potential for central plants. Central-plant focused programs have been successfully implemented in other markets. A program manager in the Pacific Northwest states that an optimization program of this type "produces more savings for less money and less time than other programs."

Barriers to optimization programs include a market "learning curve" for this type of program, which could be overcome by such educational tools as case studies. In addition, the participation cycle can be relatively long and complex, and may require customers to launch a project without certainty that it will result in savings. Costs associated with optimization can also be significant. Metering and controls needed to assess and fine-tune system operations can be expensive. Hawaii Energy's willingness to share the cost of metering as part of program incentives helps mitigate this barrier, but it can be difficult to determine up front how much metering is needed and whether energy savings from optimization will justify the added cost.

One of the initially proposed facets of the Central Plant Optimization pilot was a "competition" among participating buildings to reward the greatest reduction in energy use as tracked by participants. Given the complexity this would add to an already complex participation process, it is not clear that the competition model would add significant value. On the other hand, some form of recognition for achieving a given level of savings could provide an effective non-financial incentive for following through on optimization initiatives.

[58] Benda, George. *High Performance Central Cooling Systems*, Presented at Energy Expo 2010. September 28, 2010.

Thus far, there has been very limited marketing or outreach to end-users for this pilot. Individual contacts by Hawaii Energy staff and word-of-mouth have been the primary method of disseminating information about it. Moreover, the single participating project in PY2010 was driven by an engineering firm rather than by the end user.

Because there was only a single participant in this pilot, it is difficult to generalize about customer perceptions. The single participant learned about the program through a recommendation from an engineering firm retained to conduct a chilled water capacity study as part of a hospital's expansion. Because this project was already underway, it was relatively easy to incorporate aspects of the Central Plant Optimization program, but this might prove more difficult for other projects. The participant regarded Hawaii Energy as a trustworthy local partner, even though over-committed Hawaii Energy staff were sometimes hard to reach. Finally, the participant pointed out that central plant optimization projects could be large and complex, which may require a fairly lengthy approval process for the project to proceed. It should be noted, however, that the availability of the Hawaii Energy incentive helped tip the scales for this project to obtain approval.

6.6.3 Condo Sub-metering Program

The condo sub-metering pilot was designed to assist AOAO's in converting from a single central meter to separate sub-meters for each individual unit so that residents can be billed only for the electricity they use. As metering hardware and software costs associated with sub-metering are significant, Hawaii Energy's pilot was designed to help offset those costs by offering rebates for the installation of sub-meters.

$150/unit metered program rebate is distributed to condominium owners based on a percentage of ownership in order to comply with condo regulations. Once sub-meters are installed, energy audits are required to verify savings. Program participation requires that the AOAO work with Hawaii Energy to offer energy efficiency education, and that sub-metering system equipment remains installed for at least five years. If the sub-meters are removed during that time period, Hawaii Energy will recover a pro-rated portion of the incentive.

Sub-metering programs are based on the theory that people will use less energy when they control and pay for their own consumption. Tests conducted by NYSERDA demonstrate that average reductions in overall usage in the 15- 20 percent range could be expected.[59]

As with the Central Plant Optimization pilot, there was little opportunity to test the validity of the underlying program theory for the condo sub-metering pilot, as the single potential project failed to move forward when the respective Condo Board opposed the effort. The reasons for that failure illustrate the barriers to sub-metering, which have been well documented and generally focus on political rather than technical or economic issues.

[59] Herbert E. Hirschfield, *Integration of Energy Management, Electrical Submetering and Time Sensitive Pricing in a Large Residential Community Utilizing Wireless Communications: Phase 3*, (Asilomar, CA: ACEEE Summer Study, 2010).

According to energy consultant Herbert E. Hirschfeld, "in residential buildings the top 10 percent user apartments consume approximately 25 percent of the total electricity consumed by the apartments."[60] At the individual condo/ apartment owner board level, those most active typically spend the most time at home and use the most energy, so they would pay more under sub-metering. In addition, paid managers may consider the potential for extra paperwork a concern and may oppose sub-metering on that basis.

On a somewhat larger scale, at least based on experiences in New York and New Jersey,[61] residents and politicians often misunderstand sub-metering, feel threatened by it, and oppose it. Sub-metering efforts must be supported by an intensive education and information effort. Since this becomes very costly to do at the individual AOAO level, it may be more appropriate to conduct a broader based marketing and information effort to build support for sub-metering by Hawaii condo owners.

The savings from a broad-based sub-metering effort could be significant. Of the more than 3,200 accounts in the billing data that have AOAO in their name, about 360 have only a single account number, indicating that they are master metered. And while many of these are small condos with just a few units, the largest 90 or so AOAOs average more than 236 MWH a year or roughly 20 GWH total, so that a 20 percent reduction in consumption could be significant.

6.7 Other Process-Related Topics

6.7.1 Energy Efficiency Infrastructure

Hawaii Energy has made significant progress on building initial relationships and creating programs that successfully meet their energy efficiency savings goals. In addition, new pilot programs have offered the potential for considerable energy savings growth. However, limited staffing and lack of clearly designed implementation processes have greatly reduced the effectiveness of these new programs. To increase new program effectiveness, planners should develop a clear process for implementing and tracking programs, increase the rigor and scope of marketing activities, and devote more resources to training key stakeholders.

Process for Implementing and Tracking Savings

- **Set specific program goals and metrics** - All current and future programs should have specific objectives and a defined method for measuring progress towards these objectives.
- **Create a consistent process for implementing each program** - Creating and adhering to a reliable process for implementing new programs or changing existing

[60] Herbert E. Hirschfield, *Integration of Energy Management, Electrical Submetering and Time Sensitive Pricing in a Large Residential Community Utilizing Wireless Communications: Phase 3*, (Asilomar, CA: ACEEE Summer Study, 2010).

[61] Ibid.

programs could help to decrease communication issues and increase programmatic success.

- **Improve tracking of program data** - As found in the prior evaluation, Program tracking issues still hinder Hawaii Energy in reporting savings. Development of a consistent system for tracking progress across all programs will help to increase accuracy in savings claimed and reduce analysis time for assessing savings.

Marketing of Hawaii Energy and Its Programs

- **Identify a clear marketing plan and budget for each program** - As found in the PY2009 evaluation, there is a continued need for a clear marketing plan. Among trade allies, awareness of and participation in Hawaii Energy programs remains minimal. Budget for a statewide marketing plan could go a long way in expanding awareness of Hawaii Energy and the programs offered. Current Program participation has been concentrated among a select few contractors and organizations. Long-term Program viability depends upon the ability of Hawaii Energy to market to and attract new program interest and participation.
- **Expand on-island representation to all islands** - In PY2010, efforts by Hawaii Energy to provide on-island representation on Hawaii and Maui were well received by contractors and trade allies. Expanding staffing presence to all islands may be a valuable next-step in Hawaii Energy's marketing and community impact efforts.

Program Implementation and Process Training

- **Increase training for key Program stakeholders** - Training key stakeholders is a key element to successful Program implementation, but the existing Program does not provide for proper training. Specific Program training initiatives should address implementation processes and how incentives are measured and assessed.

6.7.2 Timing of EM&V Process

The timing of the evaluation cycle for Hawaii Energy creates a significant barrier to robust EM&V activities. Successful process evaluations are heavily dependent upon the availability of timely and accurate databases on which in-depth analysis can be based. The short turn-around time between the end of the fiscal year for Hawaii Energy and the deadline for the evaluation report required by the PUC greatly contributes to difficulties for both the evaluation team and Hawaii Energy in completing effective analyses. Adjusting the evaluation cycle back by six months to allow time for all Hawaii tracking datasets to be finalized before any program evaluation begins would increase the value of future evaluations.

7 Conclusions and Recommendations

Below we present conclusions and recommendations from the impact evaluation, process evaluation and market assessment of the Hawaii Energy PY2010 Program.

7.1 Impact Evaluation

7.1.1 Technical Reference Manual Review

Our independent review found that measures were well researched and adequately documented, typically with savings values derived from data collected from previous program evaluations. Most of the recommendations from the PY2009 review were implemented, and done so correctly.

7.1.1.1 TRM Review Recommendations

We offered recommendations to modify a small number of TRM values and suggested conducting further research on a few categories of TRM values to improve their accuracy and reliability. The most significant recommendations were to develop savings values specifically for new construction (including the relevant new building baseline) that take into account the relevant baseline and to claim cooling and lighting operating hours by building type instead of using the building average.

7.1.2 Verification of Savings

We validated the savings claims by analyzing an extract of the program tracking database and comparing it to the claimed savings documented in the Annual Report. The results of the validation exercise showed that all measures and savings matched at 100 percent between the Program tracking database and the Annual Report.

We reviewed the savings calculations and other inputs and checked for consistency with the TRM. We verified program measure installations based on telephone and on-site surveys with participating residents and businesses. We also conducted engineering analyses of custom measure savings claims.

7.1.2.1 Verification Findings

As a result of these verification activities, we were able to verify 93 percent of the savings claimed, or 107GWh/year in first-year net electricity savings. These savings translate to TRB of $35,229,956 for the residential sector and $53,855,455 for the business sector.

7.1.3 Measurement of Savings

Our impact evaluation included two savings measurement findings on SWH systems and ceiling fan CFLs that were not part of the verification memo.

The SWH billing analysis found an impact estimate of 1,912 kWh first-year savings. The current *ex ante* savings value of 2,066 kWh included in the TRM falls within a 95 percent confidence interval of our estimate. Based on the results of the SWH billing analysis, the

savings estimate is sufficiently close to the current TRM value that we are not recommending any change to the TRM value currently used by the program.

The PY2010 Program offered rebates for ceiling fans, which provide savings primarily from the integrated CFLs. The fan motor contributes relatively little savings. Our on-site inspections included a small number of homes whose owners had received ceiling fan rebates. A quarter of those homes had removed the CFLs and replaced them with incandescent bulbs. We recommend that the Hawaii Energy consider rebating only fans with pin-based CFLs that are harder to remove. Some programs in other states/regions have eliminated this measure altogether due to this issue.

7.1.4 Net to Gross Ratio

In calculating energy savings attributable to its programs, Hawaii Energy is required to use a combined NTG ratio of 0.73 that reflects an average across all individual programs. Due to issues in accurately assigning net Program impact issues, some individual programs, such as those targeting the military sector, may be decreasing to a smaller NTG ratio in future program years, as more Program impact data become available. Other programs such as RLI, New Chiller Optimization, and those aimed at creating behavioral change may move to a higher NTG ratio closer to 1.0. Revising this NTG ratio is a complex and time-consuming process that may be worth revisiting in future program years.

7.1.5 Economic Impact Analysis

Results of the economic impact analysis showed that PY2010 Program activities yielded positive net economic benefits to the state of Hawaii in the form of output, wages, business income and jobs. The changes in spending and energy savings associated with the Program resulted in a net increase of $28.1 million in economic output, $9.9 million in wages, $3.1 million in income to small business owners and 316 full and part-time jobs to the economy in PY2010. Additional economic benefits will be realized in future years as energy cost savings are sustained and continue to benefit the Hawaiian economy as households have additional purchasing power and businesses are able to produce goods and services more efficiently.

7.2 Market Assessment and Process Evaluation

The conclusions and recommendations from the market assessment and process evaluation are summarized below. Note that some of the findings may have been superseded due to actions taken by Hawaii Energy in response to interim findings and real-time feedback. Where such corrective actions were taken they are briefly noted in this summary. The findings in the body of the report reflect the status of the Program at the time the evaluation research was conducted (i.e., calendar year 2011).

7.2.1 High Customer and Contractor Satisfaction with Program

In its second year, the Program again scored highly among its participating customers and contractors. There is stability in how the Program is being delivered and how it is perceived by the market. Hawaii Energy is implemented by a dedicated and knowledgeable

staff, maintaining some key continuity from the prior programs. The flexible policy environment and lack of onerous reporting requirements have likely contributed to its success in meeting goals and achieving high satisfaction. We recommend that the Program continue to emphasize customer and contractor satisfaction in its delivery.

Although the high satisfaction scores are encouraging, as noted below we are concerned that the Program continues to rely on a few key personnel for its success. We recommend that Hawaii Energy develop ways to rely on a broader pool of staff and cultivate a model that lends itself to scalability. This will become more critical in future years as tapping into available savings potential becomes progressively more difficult. Recent personnel promotions and additions by Hawaii Energy may help address this concern.

7.2.2 Agile, Innovative, Creative Program

The Program's agility in addressing market concerns is a key feature of its success, but we learned from our market research that efforts by the Program to fine-tune its rebate levels cause confusion among both customers and contractors. Any necessary changes to rebate levels should be minimized in the future. The Program plans to keep its SWH rebate levels consistent in PY2011, which will go a long way to returning stability to the market.

The continuous conception of new strategies and measures to offer the market is a strength of Hawaii Energy's staff and implementation approach. Many of the senior staff are very knowledgeable of the market and are experienced, creative implementers. However, the Program has a relatively small staff compared to programs with similarly sized budgets elsewhere and tends to rely on few key personnel to design and manage the individual programs. Given staffing constraints, Hawaii Energy is not always able to dedicate enough resources to ensure that a new strategy or measure can be successfully deployed full-scale. The Program may also be constrained by its determination to keep administrative (and staffing) costs down, and the merit of that approach should be considered during the next program planning cycle.

We recommend that the Program:

- Streamline its plans to launch new or pilot program strategies and measures to improve internal monitoring and suitability for independent evaluation:
    - Given the current staffing constraints, consider limiting new pilots to only the most promising strategies;
    - Indicate the expected timeline for launching new efforts in the Annual Plan, based on program year/quarter they are likely to be launched to facilitate monitoring and evaluation by the contract manager and the evaluation team; and
    - Distinguish between targeted program offerings that are not intended to save significant amounts of energy and pilot programs that have significant savings potential and could be scaled up if successful.
- Create more concrete goals (e.g., near-term, mid-term and long-term) and theory related to new programs/pilots to ground programs in the market reality, to set expectations and create common understanding of success;

- Specifically with respect to the Central Plant Optimization pilot program:
    - Roll out Central Plant Optimization on a larger scale but structured so that consulting engineers or implementation contractors can handle the task of guiding participants through the program:
        - Consider creating some form of recognition for successful reduction of energy use for central plants; and
        - Structure the program so that Hawaii Energy can recapture metering cost over time as the customer reaps energy savings from participation.
- Specifically with respect to the sub-metering pilot program:
    - Because the same barriers are likely to arise at each AOAO, any sub-metering initiative should address political barriers on a larger scale rather than AOAO by AOAO. Through media or other marketing, a campaign should be initiated to explain the benefits and costs of sub-metering; and
    - Utilize successful sub-metering participants as case studies to educate and market to other AOAOs.

7.2.3 Focus on Short-Term Energy Savings

Despite goals and incentives that explicitly encourage achieving long-term savings, Hawaii Energy is a very streamlined, efficient program that, to date, has been most successful in maximizing short-term energy savings. In its second year, the Program continued to deliver on its energy savings goals. The Program diversified the sectors it served compared to its first year as a result of one-time additional rebates funded by ARRA funds administered by the state. Lighting measures (primarily compact and T8 fluorescent lamps) still dominated the Program portfolio.

Striking a balance between lower cost short-term measures and higher cost long-term measures is an integral part of the Program portfolio contract negotiations between the PUC and Hawaii Energy as the PBFA. In light of this, Hawaii Energy has launched a new set of transformational programs for PY2011, offering an opportunity to break with the short-term energy savings focus. The most recent plan for transformational programs in 2012 more explicitly addresses training for contractors, building operators and other market actors. These skill sets need to be developed to transition the market into embracing more complex and expensive measures that garner long-term energy savings.

Even though the Program was successful in meeting its stated goals, there are concerns about the long-term sustainability of the Program approach and of its alignment with the state's long-term clean energy goals. There remains untapped potential among sectors and measures that will require more Program resources and consequently will be associated with lower cost-effectiveness. Rather than face that issue abruptly several years down the road when all the short-term savings opportunities have been seized, we believe it is better to begin that transition now while there still exists highly cost-effective energy savings potential that can be achieved in combination with savings from harder to reach sectors. Hawaii Energy has begun to address this issue in the current program year with several programs promoting LED lighting, retro-commissioning, chiller optimization, and energy manager training.

We also have concerns about the ability of the Program to make this transition, since during its first two years it has relied on a small staff compared to other similarly funded programs. The current model is not easily scalable, and it will require time to add staff, expand outreach to a broader pool of contractors and customers, and make progress selling measures beyond compact and T8 fluorescent lamps. Both Program goals and staffing changes appear to incorporate recognition of the need to expand both the measures covered by the Program and the staffing levels required to attain the new goals.

We recommend that policymakers set program goals consistent with an objective of transitioning the Program to a sustainable model that engages the broader customer and contractor market to pave the way to achieve the state's long-term energy goals. While some of these goals appear to have been incorporated into the 2011 contract between the state and Hawaii Energy, there remains room for improvement. We also recommend linking metrics and contractual goals to mid-term goals that may be set by EEPS or related efforts at tracking progress towards the HCEI., and leveraging other state resources to contribute towards a broad-based marketing campaign that highlights HCEI to create a call to action and that Hawaii Energy is the resource to go to once ready to act. Additionally, we believe that longer-term contracts between the state and Hawaii Energy will help ensure that these loftier goals are met by allowing for the development of long lead time capital projects.

We also recommend that policymakers establish metrics and develop baseline measurements of market progress towards these goals and measure them periodically, the basis of which could be used in subsequent contractual goals, such as:

- Number of participating nonresidential customers and contractors;
- Awareness of the program and its offerings among customers and contractors;
- Program participation by measure category, nonresidential sector and size;
- Percentage of CFLs and T8s as a fraction of the portfolio;
- Number of Program-rebated SWH systems installed in renter-occupied homes; and
- Number of new entrants both customers and contractors.

We recommend that the Program:

- To the extent possible while still meeting its energy savings and equity goals, attempt to engage a broader pool of customers and contractors:
    - Create broader awareness of the Program's offerings – e.g., among lighting and HVAC contractors currently not engaged with the program; and
    - Take advantage of opportunities to reinforce the Hawaii Energy brand whenever possible – even when partners deliver Program components.
- Identify possible approaches to serving a broader set of customer segments with more comprehensive measures:
    - Explore strategies for reaching renter-occupied households with SWH;
    - Explore the needs of restaurants and retail;
    - Ramp up low-income programs, especially on the island of Hawaii, and move from CFLs to appliances such as refrigerator replacement; and
    - Explore the feasibility of offering financing for measures beyond SWH.

7.2.4 Program Tracking System and Timely Reporting

There continue to be difficulties with the Program tracking system used to collect Program data critical to impact evaluation processes. For PY2010, this resulted in delayed delivery of the verification results. The delays may have been due in part to the inclusion of overlapping measures delivered through ARRA-funded programs with unique federal reporting constraints, which will not be an issue in future program years. Additionally, the schedule of the Program and evaluation cycles contributes to the challenges in delivering timely verification results, as the main impact evaluation results are due within a few months of the close of the program year. There is also room to improve the communication process among the implementers, contract managers and evaluators. Opportunities to modify the Program or evaluation cycle should be explored, as this will significantly improve the efficiency of the savings verification process.

We recommend that policymakers:

- Weigh the tradeoffs associated with synchronizing the implementation contractual cycle with the calendar year to improve efficiency of evaluation and the timeliness of the verification memo;
- Work with the implementer and evaluator to clarify the role of evaluation and reinforce the separation between the two with regards to estimating Program impacts; and
- Acknowledge that the Program data are not frozen until the Annual Report has been finalized and build that order of events into the schedule.

We recommend that the Program:

- Place a higher priority on Program data tracking and reporting as is done in similar jurisdictions nationwide, given the complexity and regulatory oversight of administration of PBF;
- Deliver data and reports in a timely fashion, and ensure accuracy to reduce iterations; and
- Create more consistency in the Program tracking data.

7.2.5 Sector-Specific Results

Because of their importance to achieving Program and state goals, several market sectors served by the Program were researched as a key component of the market assessment. Additional findings and recommendations for these market sectors, which include military, residential low-income and small business, are summarized below.

In general, we recommend developing a broader set of metrics that provide information to the Program and policymakers on the distribution of rebates by sector and across islands, the comprehensiveness of measures delivered and the remaining energy efficiency opportunities. These metrics should also include awareness of the Program among contractors and customers, and behaviors related to energy efficiency. Annual tracking of such metrics could help guide the Program over the long-term as it transitions to a more sustainable model with greater customer and contractor engagement. Behavioral and

market metrics could also support evaluation of the behavioral and market-based strategies that are being increasingly embraced by the Program.

7.2.5.1 Military

Our independent interviews with high-level decisions-makers in the state's military sector indicated that many energy efficiency projects are likely to happen in absence of Hawaii Energy support. Our market analysis also showed that the military sector is receiving a much greater share of incentives than it is contributing in PBF surcharges. There also exist military directives to achieve energy savings, and consequently energy efficiency projects for the military need less support than in other market sectors.

We recommend that policymakers develop a policy specifically for the military sector that resolves the discrepancy between its PBF contribution and its current share of incentives, while still enabling it to deliver energy efficiency savings in a manner consistent with the state's broader desires to support this sector. In keeping with the need to transform markets, the program should work with the military to design projects that develop new concepts, help commercialize products, and/or help develop a foothold for efficient products that are not yet readily available in Hawaii. Recent conversations with Hawaii Energy indicate that it is starting to work directly with the military to promote these technologies and concepts. If these efforts generate additional spillover effects, Hawaii Energy would be justified in distributing a larger share of the PBF dollars to the military sector than the military currently contributes.

7.2.5.2 Residential Low Income and Small Business

Hawaii Energy has specific Program offerings to address the residential low-income sector and small businesses. The program is constrained in how much it can support the residential sector overall as total incentives available are limited to the amount that the residential sector contributes to the public benefits fund.

During PY2010, Hawaii Energy successfully engaged many low-income service agencies across the state to deliver CFLs, smart strips and low-flow showerheads to its low-income residents. However it is difficult for the Program to scale up these initiatives due to the isolation of some of the communities and the lack of infrastructure to serve this sector on a larger scale. Currently, the Program is incentivized to achieve equity by island, and it has made significant efforts to serve some of the most isolated residents on Molokai and in Hana, areas of Maui County. There exists additional energy savings potential across all islands, particularly the island of Hawaii. One potential strategy Hawaii Energy is using in PY2011 to address the need and help meet the island equity goal is to scale up the Program's refrigerator replacement program component for low-income residents.

Hawaii Energy had less success in PY2010 with its newly introduced small business direct install program, engaging only one contractor with very limited customer participation. The program was not a true direct install program, since it required customers to cover some of the up-front costs of the installed equipment. It also suffered from lack of broad marketing to contractors. We found very low awareness of, yet broad contractor interest in, the program offering among a sample of lighting and HVAC contractors. For PY2011, the

Program is ramping up by offering a true direct install (no cost) program, relying on a small pool of select contractors who have a backlog of projects that could easily use up the budget set aside for this program component. To help ensure success in the area, we recommend that the Program:

- Track participation among small businesses by sector and island to ensure some measure of equity in light of indications that the outer islands as well as the retail and restaurant sectors are underserved;
- Consider broader outreach to contractors, if Hawaii Energy finds it has additional budget for small business direct install;
- Encourage follow-up by contractors with participants to encourage them to install additional measures beyond lighting (not necessarily direct install);
- Attempt to engage a broader pool of contractors and make them aware of all the program offerings rather than relying on a few select firms that already have the capability to perform the services.

8 Appendices

Appendix A: Verification Memo

Appendix B: Technical Reference Manual Review

Appendix C: Solar Water Heating Billing Analysis

Appendix D: Economic Impact Analysis

Appendix E: Sample Design Detail

Appendix F: Research Instruments

Appendix G: Interview Summary Results

Appendix H: Contractor Forum Results

Appendix I: Quantitative Survey Results- Banner Tables

Appendix J: Glossary of Acronyms

Appendix K: References