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Hawaii Energy: History of Annual EM&V- Related Research (PY2009-2016)

Impact, cost-effectiveness, market, potential, process
and related evaluations

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1. Introduction

Within this report, we provide a summary-level description of all Evaluation, Measurement and Verification (EM&V) research completed in each program year (PY) from the inception of Hawaii Energy in PY2009 through PY2015, including approved PY2016 plans. We carefully reviewed each of the past seven Annual EM&V Reports¹ to identify both ongoing and unique research efforts. We also reviewed related reports including, but not limited to, the most recent potential and market characterization studies (both included in 2013) and customer research and satisfaction studies. The outcome of the review, synthesis, and analysis documented in this report includes:

- Tables that summarize each research activity for each PY by sector (e.g. Residential, Business).
- A brief description of each research activity for each PY identified in the summary tables. This will allow the reader to not only see when a given research activity was executed (in what PYs) but also easily review the associated description for each PY.

2. EM&V Research Activity by Program Year

The table below provides a summary of the EM&V research activities completed for each PY. Appendix A provides a high-level definition of each research activity presented in the table. The subsequent sections include a brief description of all EM&V-related research for each PY, including a table that illustrates whether the research was completed for the residential sector, business sector, or both.

¹ Reports referenced within this document are available at www.hawaiienergy.com/about/information-reports

Table 1. EM&V Research Activities - Residential and Business

			All Program Years	PY2009	PY2010	PY2011	PY2012	PY2013	PY2014	PY2015	PY2016	
Impact	TRM Review	TRM Review		✓	✓	✓	✓					
		TRM Recommendations Review				✓	✓		✓	✓	✓	
	Verification	Database Review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Application of TRM Values	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Application and Invoice Review			✓	✓	✓		✓	✓	✓	✓
		Engineering Desk Review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		On-Site Verification		✓	✓	✓	✓		✓	✓		
		Upstream Lighting Review	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		PEER Comparison Billing Data Review						✓	✓	✓	✓	✓
		Market Transformation Verification					✓	✓	✓	✓		
		Total Resource Benefits (TRB) Calculations	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Verification of Award Claim, Island Equity Calculations		✓	✓	✓			✓	✓	✓	✓
	Other	NTG Assessment				✓						
		Integrated Building Design and Construction Standards Verification						✓				
		Small Business Direct Install Lighting (SDBIL) Verification						✓				
		PEER Group Comparison Control Group Analysis				✓						
		Solar Water Heating Billing Analysis			✓							
Condominium Sub-metering Analysis						✓	✓					
Process	Participant Surveys		✓	✓	✓	✓	✓					
	Non-participant Surveys		✓									
	Trade Ally Interviews		✓	✓		✓						
	Focus Group Data Collection			✓								
Market Assessment	Market Assessment Evaluation		✓	✓								
	Baseline Study							✓				
	Potential Study		✓	✓				✓				
	Food Service Sector Market Assessment					✓						
	Upstream Lighting Program Analysis				✓	✓	✓					
Other Studies	Non-Energy Benefits Literature Review				✓							
	Economic Impact Analysis			✓								
	Energy Efficiency Study		✓	✓								
	New Initiatives and Pilot Program Analysis			✓								
	Hours of Use Inputs for Key C&I Programs										✓	
	Potential Overlap Between Key C&I Programs										✓	
	Comprehensive Longitudinal Effects (CLE) Study										✓	
	History of Hawaii Building Energy Codes							✓				
	Hawaii Energy Awareness Study									✓		
	Historic Participation Analysis									✓		
History of Annual EM&V-Related Research		✓	✓							✓		

3. EM&V Research by Program Year and Sector

Below we provide a brief description of each EM&V research activity for each program year.

3.1 PY2009 EM&V Research

Table 2 presents the residential and business research activities completed in PY2009.²

Table 2. EM&V Research Activities – PY2009

			PY2009	
			Residential	Business
Impact	TRM Review	TRM Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review		✓
		Engineering Desk Review		✓
		On-Site Verification	✓	✓
		Upstream Lighting Review	✓	
		Total Resource Benefits (TRB) Calculations	✓	✓
		Verification of Award Claim, Island Equity Calculations	✓	✓
	Process	Participant Surveys		✓
Non-participant Surveys			✓	✓
Trade Ally Interviews			✓	✓
Market Assessment	Market Assessment Evaluation		✓	✓
	Potential Study		✓	✓
Other Studies	Energy Efficiency Study		✓	✓
	History of Annual EM&V-Related Research		✓	✓

3.1.1 TRM Review

TRM Review

The Evaluation team reviewed the TRM and compared the savings values against other sources such as those 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. The Evaluation Team examined not only the derived deemed savings values, but also assumptions regarding operating conditions and baseline equipment, and 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.

The Evaluation Team did not make any recommendations for changes for Program Year 2009 but recommended changes for Program Year 2010.

² PY2009 EM&V research activities compiled using information from:
 Program Year 2009 EM&V Verification Report. "Evaluation of the Hawaii Energy Conservation and Efficiency Programs. Program Year 2009". Volume 1 of 2: Main Report. March. 2011.
https://hawaiienergy.com/images/resources/EMV_ProgramYear2009_VerificationReport.pdf

3.1.2 Verification

Database Review

The Evaluation Team confirmed that the claimed savings and measure installation counts in the PY2009 Hawaii Energy Annual Report matched the total savings and measure counts in the PY2009 program-tracking database.

Application of TRM Values

The Evaluation Team confirmed that the per-unit savings values for each measure in the program-tracking database mirror the approved (deemed) values in the PY2009 TRM.

Application and Invoice Review

The Evaluation Team reviewed business project files associated with claimed measures to verify measure counts and program eligibility. The Evaluation Team checked data in the program-tracking database against participants' rebate applications, purchase invoices and post-inspection forms.

Engineering Desk Reviews

The Evaluation Team conducted technical engineering desk reviews based on electronic project files such as vendor records and equipment invoices. The engineering desk reviews verified the accuracy of original calculations and determined if the customer's actual operation was consistent with program assumptions. Additionally, the review ensured consistency, accuracy, and whether the measure or project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with program-tracking data.

On-Site Verification

The Evaluation Team conducted on-site verification visits for a sample of residential and non-residential facilities to confirm that the measures were installed, that they qualified for the Program, and were operational. During the on-site visits, the Evaluation Team recorded the quantity of installed equipment verified by inspection and equipment specifications. These two pieces of information were used to ensure that the installed equipment was consistent with the information presented in the application and the program-tracking database, and met Program requirements.

Upstream Lighting Review

For the upstream lighting measures in REEM, the Evaluation Team 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. The research focused on participating manufacturers, distributors and retailers.

- **Lighting retailer site visits.** The Evaluation Team visited 14 retail stores across Oahu, Maui, and Hawaii for a sample of participating lighting retailers to verify that the stores met the requirements of the Memorandum of Understanding (MOU).

- **CFL retailer invoice audit.** The Evaluation Team reviewed a sample of invoices from lighting retailers to ensure that the information in the database matched the invoices and to verify that the stores met the requirements of the Program participation agreement. Store name, stock-keeping unit (SKU) number, and number of packages from the program-tracking database were compared to the information on the invoices. The Evaluation Team then compared the SKU numbers with a list of ENERGY STAR certified CFLs, as reported on the ENERGY STAR website.

Total Resource Benefits (TRB) Calculations

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the PY2009 Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, the Evaluation Team replicated the TRB calculations described in the PY2009 Annual Report.

Verification of Award Claim, Island Equity Calculations

The Hawaii Public Utilities Commission (PUC) sets performance goals and incentives for Hawaii Energy to achieve. Verified savings were used to evaluate how well the Program is meeting its goals to distribute benefits across islands in a manner deemed equitable by the PUC.

3.1.3 Process

Participant Surveys

The Evaluation Team completed participant surveys for both residential and non-residential customers to verify that the customer received a rebate for a program measure, had installed the measure, and that the measure was still operable. The surveys 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).

Non-participant Surveys

The Evaluation team completed general population surveys using random digit dialing (including cell phones) for all residential type customers (e.g., renters, owners, individually metered, master-metered, military, and civilian). The residential survey included the following survey batteries:

- Home and household characteristics for demographics and market potential
- General energy efficiency awareness, attitudes, behaviors, and awareness of other Hawaii Energy programs/campaigns
- CFL awareness, purchases, satisfaction, saturation, storage, and installations

Additionally, the Evaluation Team completed non-residential, non-participant surveys to provide a snapshot of market conditions. The business survey included the following survey batteries:

- Account characteristics
- Participation in Hawaii Energy and earlier programs
- Barriers to participation

- General and energy saving investment activity in last two years
- Plans for future investment
- Detailed invest in shell, cooling, motors and drives, lighting, air compressors, commercial cooking, pools, clothes washers, controls, process and other measures
- Investment criteria

Trade Ally Interviews

The Evaluation Team completed in-depth interviews with participating and non-participating contractors across a variety of industries including lighting, HVAC, and solar water heating. The in-depth interviews provided data that supported the impact evaluation, process evaluation, and market assessment. Feedback from the in-depth interviews provided insight into how the programs had been perceived by retailers. Additionally, the interviews revealed how utility customers think about investment in efficient equipment and how trade allies can be engaged to expand the market.

3.1.4 Market Assessment

Market Assessment Evaluation

The Evaluation Team completed the following research activities to support the market assessment evaluation:

- General population surveys
- Non-residential non-participant surveys
- Contractor interviews
- Lighting and appliance retailer interviews
- Comprehensive review of energy efficiency potential studies and other secondary research

Potential Study

The Evaluation Team 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, including:

- A 2004 study by Global Energy Partners (GEP) that estimated maximum achievable potential by 2019 by sector and end-use (the Evaluation Team scaled these results to actual 2009 usage for comparison purposes)
- A 2010 study by Booz Allen Hamilton (BAH) that updated and expanded upon the study listed above, focusing on six sectors that account for 62% of Hawaii Energy's usage

3.1.5 Other Studies

Energy Efficiency Study

The Evaluation Team reviewed several studies that were conducted at the national, state, or regional level on initiatives outside of Hawaii to update their understanding of national energy efficiency market conditions, including:

- Energy Star appliance sales figures by state from the U.S. Environmental Protection Agency (EPA)
- National CFL market profiles. Annual D&R International profile of the CFL market, including sales and market share estimates
- Various CFL industry papers and studies. Key papers and studies on CFLs from the International Energy Program Evaluation Conference (IEPEC) and American Council for an Energy Efficient Economy (ACEEE) conferences, as well as recent evaluations conducted in California and the Northwest
- Rankings of state energy efficiency activities. Annual state "scorecards" prepared for ACEEE
- Program evaluation reports posted at calmac.org, energytrust.org, nwalliance.org, and neep.org
- Rebate levels from other regions from the Database of State Incentives for Renewables and Efficiency (DSIRE).

History of Annual EM&V-Related Research

The Evaluation Team reviewed information regarding HECO utility programs operating in Hawaii prior to PY2009, including:

- **2001-2007 HECO Utilities Evaluations.** Impact evaluations conducted every three years that provided independent estimates of program savings
- **2008 Hawaii Integrated Resource Planning Document.** Contains energy savings and energy efficiency equipment saturation estimates

3.2 PY2010 EM&V Research

Table 3 presents the residential and business research activities completed in PY2010.³

Table 3. EM&V Research Activities – PY2010

			PY2010	
			Residential	Business
Impact	TRM Review	TRM Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review	✓	✓
		Engineering Desk Review		✓
		On-Site Verification	✓	✓
		Upstream Lighting Review	✓	
		Total Resource Benefits (TRB) Calculations	✓	✓
		Verification of Award Claim, Island Equity Calculations	✓	✓
	Other	Solar Water Heating Billing Analysis	✓	
Process	Participant Surveys		✓	✓
	Trade Ally Interviews		✓	✓
	Focus Group Data Collection		✓	✓
Market Assessment	Market Assessment Evaluation		✓	✓
	Potential Study		✓	✓
Other Studies	Economic Impact Analysis		✓	✓
	Energy Efficiency Study		✓	✓
	New Initiatives and Pilot Program Analysis		✓	✓
	History of Annual EM&V-Related Research		✓	✓

3.2.1 TRM Review

TRM Review

The Evaluation team reviewed the TRM and compared the savings values against other sources such as those 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. The Evaluation Team examined not only the derived deemed savings values, but also assumptions regarding operating conditions and baseline equipment, and 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.

Additionally, the Evaluation Team offered recommendations for a small number of TRM values and suggested conducting further research for a few TRM values to improve accuracy and reliability.

³ PY2010 EM&V research activities compiled using information from: Program Year 2010 EM&V Evaluation Report. "Evaluation of the Hawaii Energy Conservation and Efficiency Programs". Program Year 2010. Volume 1 of 2: Main Report. April. 2012. https://hawaiienergy.com/images/resources/EMV_ProgramYear2010_EvaluationReport.pdf

3.2.2 Verification

Database Review

The Evaluation Team confirmed the claimed savings and measure installation counts in the PY2010 Hawaii Energy Annual Report matched the total savings and measure counts in the PY2010 program-tracking database.

Application of TRM Values

The Evaluation Team confirmed that the per-unit savings values for each measure in the program-tracking database mirror the approved (deemed) values in the PY2010 TRM.

Application and Invoice Review

The Evaluation Team reviewed invoices and related community-based organizations (CBO) paperwork for the Residential Low-Income (RLI) Program to verify that CFLs, showerheads, and smart strips were distributed appropriately to low-income customers. Because the documentation was incomplete, the Evaluation Team developed recommendations for RLI CFL tracking for PY2011.

Engineering Desk Reviews

The Evaluation Team conducted technical engineering desk reviews for large, custom, and non-residential military facility projects based on electronic project files such as vendor records and equipment invoices. The engineering desk reviews verified the accuracy of original calculations and determined if the customer's actual operation was consistent with program assumptions. Additionally, the review ensured consistency, accuracy, and whether the measure or project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with program-tracking data.

On-Site Verification

The Evaluation Team conducted on-site verification of participating business and residences to verify that the measures were installed, that they qualified for the Program, and were operational. During the on-site visits, the Evaluation Team 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 the information presented in the application, and was Program qualifying. Additionally, the Evaluation Team collected operational characteristics such as temperature set points, operating schedules, typical loading characteristics, baseline system equipment and baseline system operational details. This information was used to verify the accuracy of any original calculations and to determine if customer's actual operation was consistent with Program assumptions.

Upstream Lighting Review

For the upstream lighting measures in REEM, the Evaluation Team 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. This research focused on participating manufacturers, distributors and retailers.

- **Lighting retailer site visits.** The Evaluation Team visited five retail stores in early 2011 to confirm that the Program-qualifying CFLs were being sold by participating retailers

- **CFL retailer invoice audit.** The Evaluation Team reviewed a sample of invoices from lighting retailers to ensure that the information in the program-tracking database matched the invoices and to verify that the stores met the requirements of the Program participation agreement. Store name, stock-keeping unit (SKU) number, and number of packages from the program-tracking database were compared to the information on the invoices. They then compared the SKU numbers with a list of ENERGY STAR certified CFLs, as reported on the ENERGY STAR website.

Total Resource Benefits (TRB) Calculations

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the PY2010 Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, we replicated the TRB calculations described in the PY2010 Annual Report.

Verification of Award Claim, Island Equity Calculations

The Hawaii Public Utilities Commission (PUC) sets performance goals and incentives for Hawaii Energy to achieve. Verified savings were used to evaluate how well the Program is meeting its goals to distribute benefits across islands in a manner deemed equitable by the PUC.

Solar Water Heating Billing Analysis

The Solar Water Heating (SWH) billing analysis focused on the installation of residential SWH systems for PY2009 and PY2010. The final model used PY2010 as a control group to determine the savings realized by PY2009 participants. The Evaluation Team 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.

3.2.3 Process

Participant Surveys

The Evaluation Team conducted surveys with residential and business Program participants to verify that customers received the rebate for a program measure, installed the measure, and that the measure was still operable. The survey also included questions related to process evaluation (e.g., customer satisfaction and program awareness) and market assessment (e.g., energy efficiency equipment saturation, energy efficiency awareness, behaviors, and attitudes).

Additionally, the Evaluation Team conducted surveys to collect data on customer experiences with the Program including both residential and business Program participants, each of whom received Program rebates. The purpose of the surveys was to understand customer perspectives on key Program attributes. The surveys examined 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

The Evaluation Team compared year-over-year results to identify any differences. When possible, comparative results were visually displayed for both PY2009 and PY2010.

Trade Ally Interviews

The Evaluation Team conducted in-depth interviews with trade allies across a variety of industries. The interviews included HVAC, SWH, and electric/lighting contractors along with representatives from manufacturers, distributors, builders, developers, and businesses involved in the industries. The 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)
- Extent of spillover effects
- Program awareness
- Perception of program effectiveness
- Potential recommendations for program design improvements

The Evaluation Team reviewed and summarized comments from the in-depth interviews. The assessment included a summary of trends found in the responses, with a review of how contractors perceive Hawaii Energy and their preferences for changes to Program offerings and design in the future. Findings from in-depth interviews informed all aspects of the evaluation. Interviews with trade allies, contractors, and businesses provided insight into how the programs have been perceived and 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 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. The sessions were flexible to adapt to the dynamics presented by the group-setting format. This allowed for unanticipated topics of discussion, while retaining a focus on the following session objectives:

- **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.

The Evaluation Team reviewed and summarized comments from the focus group. The assessment included a summary of trends found in the responses, with a review of how contractors perceive Hawaii Energy and their preferences for changes to Program offerings and design in the future. Findings from the focus groups informed all aspects of the evaluation. 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.

3.2.4 Market Assessment

Market Assessment Evaluation

The Evaluation Team reviewed internal data and documentation and obtained feedback from Hawaii Energy staff, Program participants, and other stakeholders. In particular, the Evaluation Team completed the following research activities to support the market assessment 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
- Geographic information system (GIS) analysis of program participation

Potential Study

The Evaluation Team 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. The Evaluation Team added the savings for PY2009 to those for the current year and estimated the cumulative percentage of first year savings to the potential that existed in PY2009 to better demonstrate the cumulative effect of two years of savings. This approach provides a rough measure of market penetration useful for indicating whether the Program allocated its resources effectively or whether it needed to shift its focus or assign more support for some markets and/or measures.

3.2.5 Other Studies

Economic Impact Analysis

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. Using data from Hawaii Energy's Program tracking system, economic impacts were estimated for PY2010 for each county that had active Program participants. The Evaluation Team measured the economic impacts using an input-output modeling framework and the Impact Analysis for Planning (IMPLAN) modeling software. This analysis measures Program impacts that accrue to each county as well as secondary spending impacts that spill over to other islands. Measured impacts include changes in output, wages, business income, employment, and indirect business taxes.

Energy Efficiency Study

The Evaluation Team reviewed several studies that were conducted at the national, state, or regional level on initiatives outside of Hawaii to update their 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
- 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
- Rankings of state energy efficiency activities. Annual state "scorecards" prepared for ACEEE
- Program evaluation reports. Reports on programs across the nation
- 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
- Individual utility websites. For information on similar programs and initiatives.

New Initiatives and Pilot Program Analysis

The Evaluation Team analyzed Hawaii Energy's new initiatives and pilot programs by focusing on two initiatives that were most like traditional pilot programs: Central Plant Optimization and Condo Sub-metering. To evaluate these two initiatives the Evaluation Team 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
- Conducted interviews with pilot participants

History of Annual EM&V-Related Research

The Evaluation Team reviewed information regarding HECO utility programs operating in Hawaii prior to PY2009, including:

- **2001-2007 HECO Utilities Evaluations.** Impact evaluations conducted every three years that provided independent estimates of program savings
- **2008 Hawaii Integrated Resource Planning Document.** Contains energy savings and energy efficiency equipment saturation estimates

3.3 PY2011 EM&V Research

Table 4 presents the residential and business research activities completed in PY2011.⁴

Table 4. EM&V Research Activities – PY2011

			PY2011	
			Residential	Business
Impact	TRM Review	TRM Review	✓	✓
		TRM Recommendations Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review	✓	✓
		Engineering Desk Review		✓
		On-Site Verification		✓
		Upstream Lighting Review	✓	
		Total Resource Benefits (TRB) Calculations	✓	✓
		Verification of Award Claim, Island Equity Calculations	✓	✓
		Other	NTG Assessment	✓
		PEER Group Comparison Control Group Analysis	✓	
	Process	Participant Surveys	✓	✓
	Market Assessment	Upstream Lighting Program Analysis	✓	
Other Studies	Non-Energy Benefits Literature Review	✓	✓	

3.3.1 TRM Review

TRM Review

The Evaluation team conducted an independent review of the TRM. This review aided in developing an in-depth understanding of how the measure savings values were derived and in assessing the reasonableness of these values. The PY2011 TRM values were compared to a wide variety of industry sources such as program evaluations and market studies from across the nation. The Evaluation Team provided recommendations and suggested conducting further research for a few PY2011 TRM values to improve accuracy and reliability. Recommendations included integrating the recommended changes from the prior TRM review conducted in PY2010, and increasing the effective useful life (EUL) for business LEDs.

TRM Recommendation Review

Several recommendations were provided as part of the PY2010 evaluation in the initial review of the PY2011 TRM. The Evaluation Team reviewed the PY2011 TRM to verify whether these recommendations were updated in the latest version of the TRM. There appeared to be a few recommendations made during the PY2010 evaluation that had not yet been incorporated in the TRM document. The Evaluation Team noted that most of these recommendations pertain to measure eligibility or quantities, and not the algorithms.

⁴ PY2011 EM&V research activities compiled using information from: Program Year 2011 EM&V Evaluation Report. "Evaluation of the Hawaii Energy Conservation and Efficiency Programs". Program Year 2011. Volume 1 of 2: Main Report. June, 2013. https://hawaiienergy.com/images/resources/EMV_ProgramYear2011_EvaluationReport.pdf

3.3.2 Verification

Database Review

The Evaluation Team confirmed the claimed savings and measure installation counts in the PY2011 Hawaii Energy Annual Report matches the total savings and measure counts in the PY2011 program-tracking database.

Application of TRM Values

The Evaluation Team confirmed that the per-unit savings values for each measure in the program-tracking database mirror the approved (deemed) values in the PY2011 TRM.

Application and Invoice Review

The Evaluation Team conducted additional verification for CFLs distributed through the Residential Hard-to-Reach (RHTR) program and advanced power strips (APS) distributed through BEEM, REEM and RHTR programs. For PY2011, the verification included a thorough review of program documentation and verification of the number of measures claimed versus those listed in the hard copy documentation.

The CFL and APS verification for PY2011 was conducted in three parts:

- Checking compliance with the documentation requirements set forth by the Contract Manager in a memorandum dated October 5, 2011
- Verifying quantities of equipment between tracking spreadsheets, final program data, and the Annual Report
- Reviewing a sample of distribution logs from giveaway and exchange events, and comparing related quantities to the tracking spreadsheets

To check compliance with the documentation requirements, the Evaluation Team reviewed the tracking spreadsheets and distribution logs for information such as receipts for equipment purchases, number and description of units given to third parties, number and description of units distributed to end users, and dates and nature of distribution events. After the review of documentation, they compared the quantities shown in the CFL and APS tracking spreadsheets to the quantities reflected in the Annual Report and the final Program data. Finally, the Evaluation Team reviewed the sample of distribution logs from community events and compared the quantities logged on paper to the quantities reflected in the tracking spreadsheets.

Engineering Desk Reviews

The Evaluation Team conducted technical engineering desk reviews for a sample of measures installed in business locations for CBEEM and large (> 100,000 kWh claimed savings) business projects from BEEM. The engineering desk reviews verified the accuracy of original calculations and determined if the customer's actual operation was consistent with program assumptions. Additionally, the review ensured consistency, accuracy, and whether the measure or project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with program tracking data.

On-Site Verification

The Evaluation Team conducted on-site verification for measures installed in business locations for CBEEM and large BEEM projects to verify that the measures were installed, that they qualified for the Program, and were operational.

The business on-site surveys also supported the engineering analyses performed on all custom measures. During the on-site visits, the quantity of installed equipment was verified by inspection, and equipment nameplate information was recorded. These two pieces of information were used to ensure the installed equipment was consistent with the information presented in the application, and was Program qualifying. Additionally, we collected operational characteristics such as temperature set points, operating schedules, typical loading characteristics, baseline system equipment and baseline system operational details. This information was used to verify the accuracy of any original calculations and to determine if customer's actual operation was consistent with Program assumptions.

Upstream Lighting Review

For the upstream lighting measures in REEM, the Evaluation Team reviewed a sample of invoices to ensure that measure descriptions, savings, and quantities claimed matched the program-tracking database and the Annual Report. Additionally, they confirmed that the products are Program qualifying (e.g., matching the unique retail product number with the ENERGY STAR website).

Total Resource Benefits (TRB) Calculations

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the PY2011 Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, the Evaluation Team replicated the TRB calculations described in the PY2011 Annual Report.

Verification of Award Claim, Island Equity Calculations

The Hawaii Public Utilities Commission (PUC) sets performance goals and incentives for Hawaii Energy to achieve. 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.

Net-to-Gross (NTG) Assessment

The NTG assessment was intended to help frame on-going discussions related to attribution (or NTG measurement) for demand-side management programs in Hawaii. Research activities included the following:

- An examination of secondary research and survey data from the first two years of Program evaluation
- Recommendations for revisions to NTG ratios as needed for the next program cycle

As part of PY2011 evaluation tasks, the Evaluation Team developed a NTG Assessment Memo which provides an overview of why NTG is relevant, highlights how the regulatory treatment of NTG can impact the success of energy efficiency goals, and provides both near and long-term recommendations.

PEER Group Comparison Control Group Analysis

The Evaluation Team conducted a review of the 2011 Peer Group Comparison (PGC) Program. The research methods consisted of two complementary analysis activities:

- A phone survey of 300 PGC participants and a control group (n=300) that solicited information on how the Home Energy Reports (HER) influenced energy usage; and
- A billing regression on a sample of participants and a control group to develop an independent estimate of energy savings.

3.3.3 Process

Participant Surveys

The Evaluation Team conducted surveys with residential and business Program participants to understand overall customer satisfaction as well as verify measure installation. They then compared this feedback to that received over the past two evaluation cycles to identify trends that warranted additional study. The surveys included questions to verify that the customer had received a rebate for a Program measure, installed the measure, and that the measure was still operable. Additionally, the customers provided insight into trends in Program-participant perspectives over time.

3.3.4 Market Assessment

Upstream Lighting Program Analysis

The Evaluation Team conducted an annual analysis of the Upstream Lighting Program, offered as a component of the REEM program. This analysis provided insight into how the program adapted to the changing residential lighting market as LEDs gain market acceptance and make up an increasing share of rebated bulbs sold in Hawaii. The Evaluation Team reviewed sales records for qualifying lighting measures (CFLs and LEDs) at participating retailers for the past three program years (PY2009-PY2011) to determine the number of qualifying measures sold through the program each year by lamp type and store type, as well as the relative distribution of rebate dollars.

3.3.5 Other Studies

Non-Energy Benefits Literature Review

The Evaluation Team conducted a review of literature on non-energy benefits of energy efficiency programs. To narrow the focus of the review, the Evaluation Team selected non-energy benefits based on the following criteria:

- **Benefit is commonly found in the literature.** The non-energy benefits selected were those that are most commonly considered in other jurisdictions and therefore most commonly addressed in the literature. This typically enabled them to find benefit estimates for both the residential and non-residential sectors, as well as for a range of different program types.
- **Study included primary data collection.** Studies that involved only a review of existing literature without conducting any additional primary data collection on non-energy benefits are not included in this

review. These literature reviews tend to cite existing studies without conducting any analysis on the quality of studies being reviewed. In this manner, sub-standard studies can get cited repeatedly and eventually obtain an appearance of legitimacy that is not merited.

- **Applicability to Hawaii.** The non-energy benefits needed to be relevant for Hawaii to be included in the review. As a result, benefits relating to heating (e.g., reduced fire hazards) and similar impacts associated with cold weather were excluded from the final review.
- **Estimates based on credible analysis methods.** The review focused on studies that used the more commonly accepted approaches, as discussed below. However, while these approaches have seen widespread use, it is not necessarily true that researchers used them appropriately to produce credible estimates. The Evaluation Team excluded those studies in which the analysis did not appear credible.

Based on the above criteria, the review focused on a subset of non-energy benefits that were among the most common studied in the literature and are applicable to Hawaii, including:

- Greenhouse gas (GHG) emissions reductions
- Improved occupant comfort
- Improved health and safety
- Reduced operation and maintenance costs
- Increased productivity

3.4 PY2012 EM&V Research

Table 5 presents the residential and business research activities completed in PY2012.⁵

Table 5. EM&V Research Activities – PY2012

			PY2012	
			Residential	Business
Impact	TRM Review	TRM Review	✓	✓
		TRM Recommendations Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review	✓	
		Engineering Desk Review		✓
		On-Site Verification		✓
		Upstream Lighting Review	✓	
		Market Transformation Verification	✓	✓
		Total Resource Benefits (TRB) Calculations	✓	✓
	Other	Condominium Sub-metering Analysis	✓	
	Process	Participant Surveys	✓	✓
Trade Ally Interviews			✓	
Market Assessment	Food Service Sector Market Assessment		✓	
	Upstream Lighting Program Analysis	✓		

3.4.1 TRM Review

TRM Review

The Evaluation team conducted an independent review of the TRM. This review aided in developing an in-depth understanding of how the measure savings values were derived and in assessing the reasonableness of these values. The PY2012 TRM values were compared to a wide variety of industry sources such as program evaluations and market studies from across the nation. The Evaluation Team provided recommendations and suggested conducting further research for a few PY2012 TRM values to improve accuracy and reliability. Recommendations included integrating the recommended changes from the prior TRM review conducted in PY2011, updating parameters to include Hawaii specific data, and adjusting savings for faucet aerators to be consistent with the literature.

TRM Recommendation Review

Several recommendations were provided as part of the PY2011 evaluation in the initial review of the PY2012 TRM. The Evaluation Team reviewed the PY2012 TRM to verify whether these recommendations were updated in the latest version of the TRM. There appeared to be several recommendations made during the PY2011 evaluation that had not yet been incorporated in the TRM document. It should be noted that most of these recommendations pertain to measure eligibility or quantities, and not the algorithms. The Evaluation Team developed a recommendation checklist to help clarify, expedite, and track any recommended changes to new measures and past recommendations that had not been implemented in the TRM.

⁵ PY2012 EM&V research activities compiled using information from: Program Year 2012 EM&V Evaluation Report. "Evaluation of the Hawaii Energy Conservation and Efficiency Programs". Program Year 2012. Volume 1 of 2: Main Report. June, 2014. https://hawaiienergy.com/images/resources/EMV_ProgramYear2012_EvaluationReport.pdf

3.4.2 Verification

Database Review

The Evaluation Team confirmed that the claimed savings in the PY2012 Hawaii Energy Annual Report matches the total savings in the PY2012 program-tracking database.

Application of TRM Values

The Evaluation Team reviewed the savings calculations confirmed that the per-unit savings values for each measure in the program-tracking database mirror the approved (deemed) values in the PY2012 TRM.

Application and Invoice Review

The Evaluation Team conducted additional verification for refrigerator trade-ins and advanced power strips (APS) distributed through the Residential Hard-to-Reach (RHTR) program. For PY2012, this RHTR verification included a thorough review of program documentation and verification of the number of measures claimed versus those listed in the hard copy documentation.

Engineering Desk Reviews

The Evaluation Team conducted technical engineering desk reviews for a sample of measures installed in business locations for CBEEM and large (> 100,000 kWh claimed savings) business projects from BEEM. The engineering desk reviews verified the accuracy of original calculations and determined if the customer's actual operation was consistent with program assumptions. Additionally, the review ensured consistency, accuracy, and whether the measure or project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with program-tracking data.

On-Site Verification

The Evaluation Team conducted on-site verification for small and medium business projects completed through the BEEM, BESM and CBEEM) programs. They also conducted a sample of on-site surveys of measures installed in business locations for CBEEM and large (> 100,000 kWh claimed savings) BEEM projects. On-site verification confirmed that measures were installed, qualified for the Program, and were operational.

The on-site verification for business Programs also supported the engineering analyses performed on all custom measures. During the on-site visits, the quantity of installed equipment was verified by inspection, and equipment nameplate information was recorded. These two pieces of information were used to ensure the installed equipment was consistent with the information presented in the application, and to determine if it was Program qualifying. Additionally, the Evaluation Team 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 a customer's actual operation was consistent with Program assumptions.

Upstream Lighting Review

The Evaluation Team conducted a separate verification of the CFLs and LEDs rebated through the upstream portion of the REEM Program. The CFL and LED verification for PY2012 was conducted in three parts:

- Checked compliance with participation requirements set forth by the Memorandum of Understanding (MOU) that all retailers are required to sign to participate in the program
- Verified quantities of equipment between invoice/rebate documentation, final program data, and the Hawaii Energy PY2012 Annual Report
- Reviewed sample of CFL and LED model numbers to ensure that the rebated measures are program qualifying (e.g., matching the unique retail product numbers with the ENERGY STAR website).

Market Transformation Verification

The Evaluation Team reviewed the Transformational Program Portfolio by completing the following four research activities:

- Reviewed existing literature on market transformation and gathered information about peer programs run by other organizations
- Conducted a review of the Transformational Program Portfolio, including a series of in-depth interviews with key program staff to better understand program objectives
- Completed an in-depth study of four specific Transformational Programs selected by the Evaluation Team and approved by Hawaii Energy
- Developed rough estimates of saving magnitudes for the programs

Total Resource Benefits (TRB) Calculations

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the PY2012 Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, we replicated the TRB calculations described in the PY2012 Annual Report.

Condominium Sub-Metering Analysis

In PY2010, Hawaii Energy began a Condominium Sub-Metering Pilot Program to offer rebates for the installation of sub-meters at previously master metered multifamily buildings. The Evaluation Team conducted a billing analysis of the Condominium Sub-metering program. The research objectives included the following:

- Estimate savings associated with sub-metering projects completed in PY2011 and PY2012
- Determine whether an update to the TRM for this measure is necessary

The research methods consisted of two complementary analysis activities:

- A fixed effects billing regression on a sample of sub-metering projects to develop an independent estimate of energy savings
- A review of sub-metering savings found in other jurisdictions across the US and Canada.

For purposes of the PY2012 cycle, condominium sub-metering was treated as a custom measure rather than a deemed savings measure. The billing analysis was used to verify savings (resulting in savings of 22.7 percent) rather than the TRM value of 10 percent.

3.4.3 Process

Participant Surveys

The Evaluation Team conducted telephone surveys with residential and business Program participants to understand overall customer satisfaction as well as verify measure installation. Survey results were compared to that received over the past three evaluation cycles to identify related trends. In both residential and business participant surveys, respondents rated on a scale from 1 to 5 their overall satisfaction with the Program, where 1 is not at all satisfied and 5 is extremely satisfied. Measure verification questions confirmed that the participants received rebates for program measures, installed the measures, and that the measures were still operable.

Trade Ally Interviews

The Evaluation Team conducted eight in-depth interviews with participating SBDIL contractors from six different companies, including those who work on projects in the food service sector, with the purpose of gaining insight into program operation and processes. Of these eight interviews, four were with owners (one was the lighting corporation owner, and three were owners/contractors), two lighting and electrical contractors (non-owners/employees), one rebate specialist and one sales rep (office employee).

3.4.4 Market Assessment

Food Service Sector Market Assessment

The Evaluation Team conducted research on Hawaii's food service sector (including restaurants, retail food stores and groceries) to assess the potential for increasing energy efficiency efforts in this market, leveraging the baseline data collected (as part of the 2013 Baseline Study) and addressing recommendations made in the PY2011 evaluation report. The research activities included the following:

- In-depth interviews with program staff, trade allies in Hawaii and administrators of other successful food service programs outside of Hawaii
- Analysis of baseline energy savings data from the 2013 Baseline Study and the State of Hawaii Energy Efficiency Potential Study published in 2013 (2013 Potential Study) to identify potential for energy savings among Hawaii's food service businesses.
- Review of the literature on food service energy efficiency programs

Upstream Lighting Program Analysis

The Evaluation Team conducted an annual analysis of the Upstream Lighting Program, offered as a component of the REEM program. This analysis provided insight into how the program is adapting to the changing residential lighting market as LEDs gain market acceptance and make up an increasing share of rebated bulbs sold in Hawaii. The Evaluation Team reviewed sales records for qualifying lighting measures (CFLs and LEDs) at participating retailers for the past four program years (PY2009-PY2012) to determine the number of qualifying measures sold through the program each year by lamp type and store type, as well as the relative distribution of rebate dollars.

3.5 PY2013 EM&V Research

Table 6 presents the residential and business research activities completed in PY2013.⁶

Table 6. EM&V Research Activities – PY2013

			PY2013	
			Residential	Business
Impact	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Engineering Desk Review		✓
		Upstream Lighting Review	✓	
		PEER Comparison Billing Data Review	✓	
		Market Transformation Verification	✓	✓
		Total Resource Benefits (TRB) Calculations	✓	✓
	Other	Condominium Sub-metering Analysis	✓	
		Integrated Building Design and Construction Standards Verification		✓
		Small Business Direct Install Lighting (SDBIL) Verification		✓
Process	Participant Surveys	✓	✓	
Market Assessment	Baseline Study	✓	✓	
	Potential Study	✓	✓	
	Upstream Lighting Program Analysis	✓		

3.5.1 Verification

Database Review

The Evaluation Team confirmed that the total savings and measure installation counts in the PY2013 program-tracking database matched the claimed savings in the PY2013 Hawaii Energy Annual Report.

Application of TRM Values

The Evaluation Team confirmed that the per-unit savings values for each measure in the program-tracking database mirror the approved (deemed) values in the PY2013 TRM.

Engineering Desk Reviews

The Evaluation Team conducted technical engineering desk reviews for a sample of measures installed in business locations for CBEEM and large business projects (from BEEM, BESM, and BHTR). The engineering desk reviews verified the accuracy of original calculations and determined if the customer's actual operation was consistent with program assumptions. Additionally, the review ensured consistency, accuracy, and whether the measure or project met program requirements. Key pieces of information such as invoices, equipment specifications, descriptions from customers, project applications, and any calculations were reviewed to ensure that the savings were accurate and consistent with engineering fundamentals.

⁶ PY2013 EM&V research activities compiled using information from: Program Year 2013 EM&V Verification Report. "Verification of Hawaii Energy Program Year 2013 Programs". Memorandum. December. 2014. https://hawaiienergy.com/files/resources/PY13_HawaiiEnergyVerificationReport.pdf

Upstream Lighting Review

The Evaluation Team conducted a separate verification of the CFLs and LEDs rebated through the upstream portion of the REEM Program. The CFL and LED verification for PY2013 was conducted in three parts:

- Checked compliance with the participation requirements set forth by the MOU that all retailers are required to sign to participate in the program
- Verified quantities of equipment between invoice/rebate documentation, final program data, and the Hawaii Energy PY2013 Annual Report
- Reviewed sample of CFL and LED model numbers to ensure that the rebated measures are program qualifying (e.g., matching the unique retail product numbers with the ENERGY STAR website).

PEER Comparison Billing Data Review

The Evaluation Team conducted an independent calculation to verify savings claimed for the REEM Peer Group Comparison. The Evaluation Team reviewed the entire peer group comparison customer list for PY2013 and each participating household's electricity billing data for a full year before they began participating in the program to verify the savings found in the final program-tracking database, using the formula provided in the PY2013 TRM.

Market Transformation Verification

The Evaluation Team reviewed market transformation program activities. The activities were grouped into the categories of Behavior Modification, Professional Development, and Technical Knowledge and Training. This research included a review of the activities in each category and online research to verify that each of the market transformation activities occurred as described in the Annual Report and during the PY2013 cycle.

Total Resource Benefit Calculations

A separate verification was conducted for the net Total Resource Benefit (TRB) presented in the Annual Report. Using verified net savings (kW and kWh) and approved measure effective useful lives (EULs) given in the TRM, we replicated the TRB calculations described in the PY2013 Annual Report.

Condominium Sub-Metering Analysis

In PY2010, Hawaii Energy began a Condominium Sub-Metering Pilot Program to offer rebates for the installation of sub-meters at previously master metered multifamily buildings. In addition to the verification activities, which determined the verified savings for Condominium sub-metering, the Evaluation Team also conducted a billing analysis of 11 condominium sub-metering projects. The objective of this analysis was to estimate average kWh savings for PY2013 sub-metering projects and compare the savings estimate to the previously approved value in the TRM to inform prospective (i.e., PY2014 and forward) assessments of the savings associated with this measure.

Integrated Building Design and Construction Standards Verification

The Evaluation Team conducted documentation review of all seven Integrated Building Design and Construction Standards projects rebated by RESM in PY2013. Due to the small number of RESM projects, 100% of the rebated projects were reviewed. The design projects were verified by comparing quantities and savings in the project documentation to the values recorded in the final tracking data. The documentation

included a project summary, combined submittal workbook, results of any home energy modeling and/or testing performed (e.g. air leakage reports, HERS ratings), certificates of occupancy, floor plans, and incentive applications.

Small Business Direct Install Lighting (SBDIL) Verification

The Evaluation Team reviewed a sample of SBDIL inspection reports for projects rebated by BESM or BHTR in PY2013, including 21 BESM and 12 BHTR projects. For each SBDIL project in the sample, the Evaluation Team compared the types and quantities of each measure in the program-tracking database to the types and quantities of SBDIL measures installed, per the inspection reports. The Evaluation Team identified any discrepancies during and determined a verified measure quantity.

3.5.2 Process

Participants Surveys

The Evaluation Team conducted telephone surveys with residential and business Program participants to understand overall customer satisfaction as well as verify measure installation. They then compared this feedback to that received over the past four evaluation cycles to identify related trends. In both residential and business participant surveys, respondents rated on a scale from 1 to 5 their overall satisfaction with the Program, where 1 is not at all satisfied and 5 is extremely satisfied. Measure verification questions confirmed that the participants received rebates for program measures, installed the measures, and that the measure were still operable.

3.5.3 Market Assessment

Baseline Study

This study presents the results of research conducted on behalf of the State of Hawaii PUC to assess key characteristics of buildings, appliances and equipment that use electricity in the Hawaiian Electric Companies' service territories providing a "baseline" from which to assess changes in the buildings, equipment, appliance, and use patterns over time. Study results informed the planning of future energy efficiency programs and supported a statewide energy efficiency potential study via the PUC. The baseline data was used to enhance or update PBFA-funded energy efficiency programs and for planning other energy-related programs and policies in the state. These baseline data served as a reference point to monitor the effectiveness of program efforts or track progress toward energy efficiency and related goals. Finally, these baseline data were used by the Hawaiian Electric Companies for electricity load planning.

Potential Study

The study objectives address energy efficiency potential and inform the program design process in the following ways:

- Developed a thorough and independent assessment of the energy efficiency resources available to the State through the actions of entities that contributed savings toward EEPS goals using allowable measures and activities per the EEPS Framework.
- Developed technical and economic potential estimates for 2013–2030 for benchmarking and future analyses by island.

- Annual kWh savings and peak savings (net and gross).
- Reporting tables that convey the potential that was captured from 2009 through present, in addition to savings available in 2013 and beyond.
- Provided guidance and insight regarding attainment of the EEPS goals based on the energy savings opportunities identified in the potential study and relative to the EEPS base year of 2008.
- Provided estimates of available energy efficiency potential that can be used as a resource and included in IRP filings by the Hawaii electric utilities [Hawaiian Electric Company (HECO), Hawaii Electric Light Company (HELCO), Maui Electric Company (MECO) and Kauai Island Utility Cooperative (KIUC)].

Upstream Lighting Program Analysis

The Evaluation Team conducted an annual analysis of the Upstream Lighting Program, offered as a component of the REEM program. This analysis provided insight into how the program is adapting to the changing residential lighting market as LEDs gain market acceptance and make up an increasing share of rebated bulbs sold in Hawaii. The Evaluation Team reviewed sales records for qualifying lighting measures (CFLs and LEDs) at participating retailers for the past five program years (PY2009-PY2013) to determine the number of qualifying measures sold through the program each year by lamp type and store type, as well as the relative distribution of rebate dollars.

3.6 PY2014 EM&V Research

Table 7 presents the residential and business research activities completed in PY2014.⁷

Table 7. EM&V Research Activities – PY2014

			PY2014	
			Residential	Business
Impact	TRM Review	TRM Recommendations Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review	✓	✓
		Engineering Desk Review		✓
		On-Site Verification		✓
		Upstream Lighting Review	✓	
		PEER Comparison Billing Data Review	✓	
		Market Transformation Verification	✓	✓
		Total Resource Benefits (TRB) Calculations	✓	✓
		Verification of Award Claim, Island Equity Calculations	✓	✓
	Other Studies	History of Hawaii Building Energy Codes	✓	✓

3.6.1 TRM Review

TRM Recommendations Review

The Hawaii Energy Program implementation team reviewed the PY2012 TRM and recommended 44 updates to be included in the PY2014 TRM. The Evaluation Team reviewed the PY2014 TRM to identify whether the 44 recommendations were integrated within the PY2014 TRM. This review recognized that of the 44 recommendations, 24 were fully integrated in the PY2014 TRM, 15 were not addressed, 1 was partially updated, and 4 require updates in future TRM versions.

3.6.2 Verification

Database Review

For all programs except for CBEEM, the Evaluation Team verified that the information in the program-tracking database was correct and free of errors. This process began with cleaning the program-tracking database, which consisted of removing negative quantities, checking duplicates, removing measures with no savings (e.g., payment tracking, etc.), and confirming that the tracked savings in the database matched the claimed savings in the PY2014 Hawaii Energy Annual Report.

Application of TRM Values

The Evaluation Team performed a database and TRM review for all residential and non-CBEEM business sector programs (BEEM, BHTR, and BESM). For each measure in the program-tracking database, they confirmed that

⁷ PY2014 EM&V research activities compiled using information from: Program Year 2014 EM&V Verification Report. "Verification of Hawaii Energy Program Year 2014 Programs". Memorandum. March. 2016. https://hawaiienergy.com/files/resources/PY14_HawaiiEnergyVerificationReport.pdf

the per-unit savings (kW and kWh), Net-To-Gross Ratios (NTGR), and Effective Useful Life (EUL) values mirrored the stipulated values documented in the PY2014 TRM. This consisted of three areas:

- **Savings Estimates (kW, kWh).** The Evaluation Team referred to the PY2014 TRM for the correct savings estimates for all non-custom measures. Additionally, they checked for any possible duplicates within the program-tracking database.
- **Net-to-Gross.** The Evaluation Team compared program-tracking database NTGR values to those stipulated in the PY2014 TRM.
- **Effective Useful Life.** The PY2014 TRM includes EULs for all measures. The Evaluation Team compared these values to values used in the program-tracking database.

Application and Invoice Review

For REEM, BEEM, and BHTR Programs, the Evaluation Team reviewed a sample of applications and invoices to confirm the accuracy of the quantities listed in the program-tracking database. This review included 99 REEM measures (49 solar water heaters; 50 refrigerator/freezers), 89 BEEM measures (44 HVAC; 45 Lighting), and 45 BHTR applications.

Engineering Desk Review

The Evaluation Team completed desk reviews for a sample of 40 custom projects representing a high proportion of CBEEM savings. They developed a stratified random sample of projects based on net-tracked energy savings to ensure that the largest projects from the database were included in the sample. The desk reviews consisted of reviewing all project documentation including applications, specification sheets, test reports, rebate checks, program savings calculations, post-inspection pictures and invoices as available. A reviewed of the project documentation was completed to ensure consistency with the program-tracking database for all measure-specific variables and to identify parameters for onsite verification (e.g., measure counts, efficiencies, horsepower, capacities, etc.).

Desk reviews included the following:

- **Project Documentation Review.** Identify the types of installed measures, quantity of installed measures, and other measure specific characteristics (i.e. wattage, installed location, horse power, etc.).
- **Claimed Savings Calculations.** Calculate claimed savings using information found in project documentation. This step helps identify variables that require on site verification to provide more accurate savings estimates in ex post impacts.
- **Project Magnitude** Define project size to estimate time needed to perform site visit.
- **Sampling Strategy.** Determine whether sampling within the sample is required to gather adequate data that does not compromise or skew the verification results. If sampling was required, engineers developed an appropriate sampling strategy prior to the site visit. Thirteen sites required sampling designs.

On-Site Verification

The Evaluation Team conducted 40 site visits for the CBEEM Program for measures representing a high proportion of CBEEM savings to verify that measures remained in place and are operating, verify the appropriateness of Hawaii Energy's savings calculations, and gather specific savings parameters needed to calculate ex post savings. In addition to verifying measures are in place and operating, six sites required short-term metering. The Evaluation Team generated Measurement and Verification (M&V) plans for these six sites as described below:

- Measure description
- Summary of claimed savings calculations
- Ex post savings methodology
 - Determine what data to use as baseline and how it will be used
 - Determine what data is needed to record while on site and how it will be used
 - Identify algorithms for ex post savings calculations
- Specific activities to perform while on site (i.e. record nameplate information, interview building operator, discuss hours of operation and plant shutdowns, etc.)
- Detailed description of monitoring equipment and its purpose

The Evaluation Team independently calculated savings based on data gathered onsite and site-specific information. Each site received a verification rate that was the comparison of the program-tracking savings value to the value calculated by the Evaluation Team. After completing verification of all sites, the Evaluation Team provided draft verification rates for each site and met to discuss them.

Following the site visits, the Evaluation Team calculated ex post savings for each project based on data gathered onsite and applied any applicable adjustments to measure-specific variables. For the six sites that received short-term metering, the metering data was used to adjust equipment assumptions for run-time and other operating characteristics.

Upstream Lighting Review

The Evaluation Team reviewed REEM upstream lighting measures for 50 records. The verification included the following steps:

- Checked compliance with the participation requirements set forth by the MOU documents submitted by each of the manufacturers
- Verified quantities of equipment between invoice/rebate documentation, final program data, and Hawaii Energy PY2014 Hawaii Energy Annual Report

PEER Comparison Billing Data Review

The Evaluation Team conducted an independent calculation, based on billing data, to verify savings claimed for the REEM Peer Group Comparison. For the Peer Group Comparison, the data provided by Hawaii Energy was used to identify participating customers (i.e., which households received program home energy reports) in PY2014. The Evaluation Team chose to use PY2014 usage as its base year (instead of PY2013) and not to

apply the algorithm from the TRM. Instead the Evaluation Team followed the fundamental principal for calculation of this type of program that has a random control trial design and use the energy use of the year under construction (PY2014).

Market Transformation Verification

The Evaluation Team validated the achievements of the nine Transformational Programs to ensure they matched Hawaii Energy's performance indicators. Hawaii Energy provided documents used to verify that each of the nine Transformational Programs targeted for evaluation occurred during the PY2014 cycle. The verification included the following tasks:

- **Data Gathering.** Submission of two data requests for Transformational Programs, two meetings with Hawaii Energy, and multiple email communications to assure understanding of the data.
- **Document Review.** Review of event or workshop attendance spreadsheets/signup sheets, presentation slides, and logic models.
- **Activity Information Review.** Review of detailed information, specifically:
 - **Participation Counts.** For the Behavior Modification, Professional Development, Clean Energy Ally, and Technical Know How Programs, the Evaluation Team determined program participation counts. This included social media engagements, participation in the Professional Development internship program, and several buildings or sites evaluated within the Energy Systems Integration Pilot's Benchmarking activities.
 - **Study Review.** For the Energy Systems Integration Pilots on Codes & Standards, Demand Response, Smart Grid, and Electric Vehicle, the Evaluation Team reviewed and counted the number of studies conducted and any other actions/activities performed that aligned with these pilots.

Total Resource Benefits (TRB) Calculations

The Evaluation Team used verified savings (kWh and KW) to estimate TRB for residential and business Programs. They then compared the verified TRB value to the claimed TRB value presented in the Hawaii Energy PY2014 Annual Report.

Verification of Aware Claim, Island Equity Calculations

The Hawaii Public Utilities Commission sets performance goals and incentives for Hawaii Energy to achieve. The Evaluation Team reviewed the established goals, claimed results and award, and separately calculated a verified award based on PY2014 verification results. In addition, a verification of the distribution of incentives across Honolulu County, Hawaii County, and Maui County (i.e., Island Equity calculations) was completed.

3.6.3 Other Studies

History of Hawaii Building Energy Codes

The Evaluation Team performed an assessment of the history of Hawaii building energy codes and potential implications for energy savings stemming from future code enforcement and adoption activities.

3.7 PY2015 EM&V Research

Table 8 presents the residential and business research activities completed in PY2015.⁸

Table 8. EM&V Research Activities – PY2015

		PY2015			
		Residential	Business		
Impact	TRM Review	TRM Recommendations Review	✓	✓	
	Verification	Database Review	✓	✓	
		Application of TRM Values	✓	✓	
		Application and Invoice Review	✓	✓	
		Engineering Desk Review		✓	
		On-Site Verification		✓	
		Upstream Lighting Review	✓		
		PEER Comparison Billing Data Review	✓		
		Market Transformation Verification	✓	✓	
		Total Resource Benefits (TRB) Calculations	✓	✓	
		Verification of Award Claim, Island Equity Calculations	✓	✓	
		Other Studies	Hawaii Energy Awareness Study	✓	✓
			Historic Participation Analysis	✓	✓

3.7.1 TRM Review

TRM Recommendations Review

The Hawaii Energy Program implementation team recommended 22 updates to the PY2014 Hawaii Energy TRM. The Evaluation Team reviewed each of the 22 recommendations to assess the merit of each recommendation and indicated whether they agree with and accept the recommendations or if additional supporting documentation is required. This review included a comparison between the recommended values and similar measures or values used in other jurisdictions. When assessing the merit of the recommended changes, the following steps were performed:

- Reviewed each recommended change to assess, at a high level, whether the change is warranted (e.g., if a recommendation is to remove a measure and the Evaluation Team agreed, they performed no additional research)
- For all recommended additions or changes to existing measures, the Evaluation Team reviewed:
 - Publicly available TRMs used throughout North America as a comparison to the recommended change. While individual measure inputs and savings will vary by jurisdiction depending on many factors, leveraging other TRMs allows for a useful comparison to determine the reasonableness of the recommended changes. The TRMs used for these purposes included: the Illinois TRM, Indiana TRM, Pennsylvania TRM, and the California Database for Energy Efficient Resources (DEER), among others
 - Previous Hawaii Energy evaluation reports and memorandums and previous versions of the Hawaii Energy TRMs for additional context around existing TRM methodologies

⁸ PY2015 EM&V research activities compiled using information from: Program Year 2015 Verification Report. “Verification of Hawaii Energy Program Year 2015 Programs”. Memorandum. November. 2016. https://hawaiienergy.com/files/resources/PY15_HawaiiEnergyVerificationMemo.pdf

- Other relevant secondary sources to assess the reasonableness of the recommendations such as ASHRAE Fundamentals for heating and cooling degree day requirements for Hawaii

3.7.2 Verification

Database Review

For all programs except CBEEM and CESH, the Evaluation Team performed a database review. This process began with cleaning the program-tracking database, which consisted of removing negative quantities, checking duplicates, removing measures with no savings (e.g., payment tracking, etc.), and confirming through discussions with PBFA that the tracked savings in the database matched claimed savings for PY2015.

Application of TRM Values

The Evaluation Team performed a database and TRM review for residential and non-CBEEM business sector programs (BEEM, BHTR and BESM). For each measure type in the program-tracking database, they confirmed that the per-unit savings (kW and kWh), NTGR, and EUL values mirrored the stipulated values documented in the TRM. This consisted of three areas:

- **Savings Estimates.** The Evaluation Team referred to the PY2015 TRM for the correct savings estimates for all non-CESH and non-CBEEM measures. Additionally, they checked for any possible duplicates within the program-tracking database.
- **Net-To-Gross.** The Evaluation Tea applied the program specific NTG values found in the PY2015 TRM.
- **Effective Useful Life.** The Evaluation Team applied the measure specific EUL values found in the PY2015 TRM.

Application and Invoice Review

For REEM, BEEM, and BHTR, the Evaluation Team performed an additional step of reviewing a sample of applications and invoices to confirm the accuracy of the quantities listed in the program-tracking database. The Evaluation Team limited this step to these three programs as they contributed more than 96% of the non-CBEEM tracked savings in the PY2015 portfolio.

Engineering Desk Review

The Evaluation Team performed detailed desk reviews for a sample of 25 CBEEM projects. Desk reviews included a complete review of the provided documentation (e.g., incentive applications, equipment invoices, and any other related project information included in the project database) to help outline the methodology behind calculating project energy savings and ensure site visits focused on the parameters needed to execute energy savings calculations.

Desk reviews included the following:

- **Project Documentation Review.** Identify the types of installed measures, quantity of installed measures, and other measure specific characteristics (i.e. wattage, installed location, horsepower, etc.).
- **Claimed Savings Calculations.** Calculate claimed savings using information found in project documentation. This step helps identify variables that require on site verification to provide more accurate savings estimates in ex post impacts.

- **Project Magnitude.** Define project size to estimate time needed to perform site visit.
- **Sampling Strategy.** Determine whether sampling within the sample is required to gather adequate data that does not compromise or skew the verification results. For example, a site with more than 1,000 lighting fixtures would require site-specific sampling. If sampling is required, engineers developed an appropriate sampling strategy prior to the site visit.

On-Site Verification

The Evaluation Team facilitated on-site verification for a sample of 25 CBEEM projects. Data collection activities for these 25 sites ranged from simple in-place and operation verification (n=22) to short-term metering (n=3).

Upstream Lighting Review

For the upstream lighting measures in REEM, the verification included the following steps:

- Checked compliance with the participation requirements set forth by the MOU documents submitted by each of the ten manufacturers.
- Verified quantities of equipment between invoice/rebate documentation, final program data, and Hawaii Energy PY2015 Hawaii Energy Annual Report.

PEER Comparison Billing Data Review

For the PEER Comparison component of REEM, the Evaluation Team verified savings by leveraging program participation and customer billing data consistent with the TRM savings algorithm. This effort required additional data requests (beyond the typical program-tracking database data requests) for the list of all residential customers within the PEER Comparison program by treatment cohort (i.e., which year they were added to the program and their associated monthly electric usage for PY2015). This data allowed us to perform a calculation based on the TRM savings algorithm to estimate the savings from the PEER Comparison component of REEM.

Market Transformation Verification

The Evaluation Team verified achievements resulting from the nine market transformation programs offered by Hawaii Energy. These programs seek to determine and overcome market barriers that prevent residential and business customers from becoming energy-efficient in terms of energy savings actions or the equipment they use. Market transformation Programs include Behavior Modification, Professional Development, and Technical Knowledge and Training Programs. The Evaluation Team verified that each of the nine market transformation programs occurred in the PY2015 cycle. Specifically, the Evaluation Team verified accomplishments through the following tasks:

- Submission of a data request for the market transformation programs, two meetings with the PBFA, and email communications to confirm our understanding of the data.
- Review of event, presentation, or workshop attendance spreadsheets/signup sheets, presentation slides, and reports.
- Review of detailed information, specifically:

- For the Behavior Modification, Professional Development, and Technical Knowledge and Training programs, the Evaluation Team determined program participation counts.
- For the Hawaii Energy Ally program, the Evaluation Team determined the number of Clean Energy Allies, while for the Benchmarking pilot we determined the number of buildings or sites evaluated.
- For the Codes & Standards, Shift for Savings Plan (Demand Response), Smart Grid, and Electric Vehicle Support pilots, the Evaluation Team reviewed and counted the number of studies conducted and any other actions performed that aligned with these pilots.

Total Resource Benefits (TRB) Calculations

The Evaluation Team used program-level net verified savings (kWh and kW) to calculate the TRB for Residential and Business Programs. We then compared the verified program-level TRB values to the claimed ones presented in the PY2015 Annual Report.

Verification of Award Claim, Island Equity Calculations

The Hawaii Public Utilities Commission sets performance goals and incentives for Hawaii Energy to achieve. The Evaluation Team reviewed the established goals, claimed results and award, and separately calculated a verified award based on our PY2015 verification results. They found several errors in the claimed savings and award calculations and corrected these errors as part of the verification effort. In addition, the Evaluation Team verified the distribution of incentives across Honolulu County, Hawaii County, and Maui County (i.e., Island Equity calculations).

3.7.3 Other Research

Hawaii Energy Awareness Study

The primary objective of this research was to measure changes in Hawaii Energy awareness since the inception of Hawaii Energy in 2009. In addition, The Evaluation Team measured changes in awareness and knowledge related to actions that customers can take to save energy in their homes or businesses since the launch of Hawaii Energy. The ability to compare and contrast current findings to past survey results is highly dependent upon comparable survey designs across studies (and the specific questions asked). In order to enable valid comparisons the following research was performed:

- Incorporated survey questions from prior Hawaii surveys (both residential and business) that measure changes in awareness
- Incorporated survey questions, to the extent feasible and applicable, from similar survey efforts in other jurisdictions for the purposes of benchmarking
- Included demographic/firmographic questions

The findings are based upon two customer surveys—one residential and one business—which, together, capture data from over 1,700 Hawaii residential and business customers in the target counties of Honolulu, Hawaii, and Maui. The residential survey effort included telephone fielding, and a parallel web survey. Business survey efforts included telephone fielding.

Historic Participation Analysis

To understand program participation patterns, energy savings achievements, and changes in customer energy purchases since the inception of Hawaii Energy, the Evaluation Team conducted a historic participation analysis in both the residential and business sectors. The analysis synthesized data from various sources of historical information, including:

- PY2009-PY2014 Hawaii Energy program-tracking databases
- PY2009-PY2014 Hawaiian Electric Company (HECO) customer billing data
- U.S. Census Bureau data
- Energy consumption data from the U.S. Energy Information Administration (EIA)

3.8 Planned PY2016 EM&V Research

Table 9 presents the residential and business research activities planned for PY2016.⁹

Table 9. EM&V Research Activities – PY2016

			PY2016	
			Residential	Business
Impact	TRM Review	TRM Recommendations Review	✓	✓
	Verification	Database Review	✓	✓
		Application of TRM Values	✓	✓
		Application and Invoice Review	✓	✓
		Engineering Desk Review		✓
		Upstream Lighting Review	✓	
		PEER Comparison Billing Data Review	✓	
		Total Resource Benefits (TRB) Calculations	✓	✓
		Verification of Award Claim, Island Equity Calculations	✓	✓
		Other Studies	Hours of Use Inputs for Key C&I Programs	
Potential Overlap Between Key C&I Programs			✓	
Comprehensive Longitudinal Effects (CLE) Study	✓		✓	
History of Annual EM&V-Related Research	✓		✓	

3.8.1 TRM Review

TRM Recommendations Review

The Hawaii Energy Program implementation team recommended 25 updates to the PY2016 Hawaii Energy TRM. The Evaluation Team plans to review each of the 25 recommendations to assess the merit of each recommendation and indicate whether they agree with and accept the recommendations or if additional supporting documentation is required. When assessing the merit of the recommended changes, the Evaluation Team plans to perform the following steps:

- Review each recommended change to assess, at a high level, whether the change is warranted (e.g., if a recommendation is to remove a measure and the Evaluation Team agreed, they perform no additional research)
- For all recommended additions or changes to existing measures, the Evaluation Team will review:
 - Publicly available TRMs used throughout North America as a comparison to the recommended change. While individual measure inputs and savings will vary by jurisdiction depending on many factors, leveraging other TRMs allows for a useful comparison to determine the reasonableness of the recommended changes. The TRMs used for these purposes included: the Illinois TRM, Indiana TRM, Pennsylvania TRM, and the California Database for Energy Efficient Resources (DEER), among others
 - Previous Hawaii Energy evaluation reports and memorandums and previous versions of the Hawaii Energy TRMs for additional context around existing TRM methodologies
 - Other relevant secondary sources to assess the reasonableness of the recommendations such as ASHRAE Fundamentals for heating and cooling degree day requirements for Hawaii

⁹ PY2016 planned EM&V research activities compiled using information from: Program Year 2016 Evaluation Plan. "Hawaii Energy Program Year 2016 Plan". Memorandum. August. 2017.

3.8.2 Verification

Database Review

The Evaluation Team will conduct a thorough review of all records in the Hawaii Energy program tracking database to check for duplicates, verify incented measures meet program requirements (e.g., minimum efficiencies), and identify any parameters that are outside of expected ranges (e.g., efficiencies, horsepower, etc). Additionally, they will verify the accuracy and appropriateness of savings and incentive calculations (i.e., check per-unit savings across similar measure types and multiply by quantities to ensure they match total project savings). The Evaluation Team will perform this task for all records in the Hawaii Energy program-tracking database, however review will be limited to information contained within the database (i.e., will not verify the correct application of assumptions).

Application of TRM

The Evaluation Team will conduct a thorough review of all measure-specific savings calculations for REEM and BEEM Programs included in the program-tracking database to verify that the database incorporates the stipulated values from the Hawaii TRM correctly. Together, these programs account for more than 90% of the non-custom claimed energy savings for PY2016. This includes verifying deemed savings values (kW and kWh), NTG values, and other parameters (wattages, hours of use, horsepower, etc) as applicable. This review will consist of two elements:

- **Savings Estimates:** The Evaluation Team will refer to the Hawaii TRM for the correct savings estimates and use of appropriate savings algorithms and assumptions.
- **Net-To-Gross:** In 2013, evaluators revised and stakeholders vetted Hawaii Energy's NTG estimates in the TRM. For PY2016, we will apply these estimates.

The Evaluation Team will not review the application of TRM values for the BHTR, RHTR, and RESM programs, which accounted for less than 10% of the claimed non-custom program energy savings in PY2016.

Application and Invoice Review

The Evaluation Team will review a sample of project applications (i.e. desk reviews) for REEM and BEEM including all associated documentation and invoices to ensure verification of measures or programs.

Engineering Desk Review

The Evaluation Team will conduct up to 25 desk reviews of CBEEM projects. The desk reviews will consist of a rigorous review of project files and attempt to recreate the claimed savings for each project. They will not perform any site visit verification of the projects.

Upstream Lighting Review

For the upstream lighting measures in REEM, the verification will include a review of a sample of program MOUs with participating retailers, invoices and distribution data, as well as verification that program qualifying models appear on the ENERGY STAR website.

PEER Comparison Billing Data Review

For the PEER Comparison component of REEM, the Evaluation Team will verify savings by leveraging program participation and customer billing data consistent with the TRM savings algorithm. This effort requires additional data requests (beyond the typical program-tracking database data requests) for the list of all residential customers within the PEER Comparison program by treatment cohort (i.e., which year they were added to the program and their associated monthly electric usage for PY2016). This data allows the Evaluation Team to perform calculations based on TRM savings algorithms to estimate the savings from the PEER Comparison component of REEM.

Total Resource Benefits (TRB) Calculations

The Evaluation Team will use program-level net verified savings (kWh and kW) to calculate the TRB for Residential and Business Programs. They will then compare the verified program-level TRB values to the claimed ones presented in the PY2015 Annual Report.

Verification of Award Claim, Island Equity Calculations

The Hawaii Public Utilities Commission sets performance goals and incentives for Hawaii Energy to achieve. The Evaluation Team will review the established goals, claimed results and award, and separately calculate a verified award based on our PY2016 verification results. In PY2015, the Evaluation Team found several errors¹⁰ in the claimed savings and award calculations and corrected these errors as part of our verification effort. They will again check for these types of discrepancies in PY2016. In addition, the Evaluation Team will verify the distribution of incentives across Honolulu County, Hawaii County, and Maui County (i.e., Island Equity calculations).

3.8.3 Other Studies

Hours of Use Inputs for Key C&I Programs

The Evaluation Team will validate contractor-based hours of use inputs for the SBDIL and Custom Lighting Program. Direct Entry of Facility Operating Hours (for establishing incentive amounts) by Participating Contractors. This investigation will begin with a conversation/meeting with Hawaii Energy toward the goal of understanding how each program operates and the controls/checks that are in place to ensure that contractors are entering accurate operating hours estimates. Questions will center around:

- The checks and balances currently in place by Hawaii Energy
- The extent to which relevant issues have arisen historically
- As part of this effort, requesting data (as available) will allow the Evaluation Team to compare entered hours estimates (for the population of projects) to TRM default values—allowing us to understand the extent to which default (TRM) values are being used as well as the range of hours estimates included in the database (including outliers). The Evaluation Team envisions key metrics will include:
 - The percentage of time set at TRM default levels
 - The percentage of time set above and below default levels

¹⁰ The most substantial errors involved 1) the Island Equity calculation; and 2) the PEER comparison savings calculation. Based on our feedback, Hawaii Energy has indicated that they will make corrections going forward.

- The percentage of projects under vs. over \$3,000 (as under \$3,000 does not trigger a Hawaii Energy review).

Potential Overlap Between Key C&I Programs

The Evaluation Team will investigate the potential overlap—and double counting of savings—for measures and associated incentives across C&I Prescriptive, SBDIL, and Midstream efforts. This investigation will begin with a conversation/meeting with Hawaii Energy toward the goal of understanding how each program operates and what measures (if any) overlap with one another. Questions will center around:

- Potential for overlap and mechanisms that are in place to prevent the double counting (or double paying) of incentives
- Information that is collected at relevant steps in the delivery process (e.g., from distributors, contractors, or customers) and how it might (or might not) inform the degree to which such overlap is occurring.

Comprehensive Longitudinal Effects (CLE) Study

The goal of the comprehensive longitudinal effects (CLE) study is to quantify and describe the opportunities that remain for the Hawaii Energy programs to achieve long-term energy savings. Toward this goal, the study focuses on the savings realized through Hawaii Energy programs to date as well as the potential for those programs to claim additional energy savings through 2030. To understand cumulative program (i.e., inception-to-date) accomplishments overall, by sector and end use, the Evaluation Team first compared cumulative Hawaii Energy (Public Benefit Fund Administrator or PBFA) savings generated by Program Year (PY) 2009 through PY2015 program interventions to economic potential savings estimates in order to understand cumulative program (i.e., inception-to-date) accomplishments, both overall and by sector and end use.¹¹ To understand future savings opportunities, the Evaluation Team estimated the savings potential available to be captured by program interventions (Available Economic Potential) and the remaining savings potential after current and anticipated program interventions (Remaining Economic Potential), for Hawaii Energy overall and by end use.

History of Annual EM&V-Related Research

The Evaluation Team provided a summary-level description of all research completed in each PY (from the inception of Hawaii Energy in PY2009 through PY2015, including approved PY2016 plans). As part of this task, they carefully reviewed each of the past seven Annual EM&V Reports to identify both consistent and unique research efforts. The Evaluation Team also reviewed related reports including, but not limited to, the most recent potential and market characterization studies (both included in 2013) and customer research and satisfaction studies. The outcome of the review, synthesis, and analysis is documented in this report and includes:

- Catalogue of research activities, identifying both the timing (when) and the extent of repetitiveness (how often) a given research activity has been executed.
- Tables that summarizes each research activity by sector (e.g. Residential, Business).

¹¹ To accurately compare program savings to potential savings, all savings are at the meter and do not include line losses. We used Customer Tracked Savings for PY2009 through PY2012. For PY2013 through PY2015, we used Net Tracked Savings from which savings associated with line losses were removed. Estimates of economic potential were derived from the 2014 Potential Study (*State of Hawaii Energy Efficiency Potential Study Final*. EnerNOC Utility Solutions Consulting. January 15, 2014).

- A brief description of each research activity for each PY identified in the summary tables. This will allow the reader to not only see when a given research activity was executed (in what PYs) but also easily review the associated description for each PY.

Appendix A. EM&V Research Category Definitions

The Evaluation activities for PY2009 through PY2016 consist of 36 research categories across residential and business sectors. Table 10 provides a high-level definition for each EM&V research category, however the specific steps for each category (i.e. TRM Review) may vary from year-to-year.

Table 10. EM&V Research Category Definitions

EM&V Research Category	Definition
TRM Review	Review of the TRM content (assumptions and resources) while providing recommendations for improvement
TRM Recommendations Review	Review of recommendation provided as part of a previous TRM review to ensure most current version of the TRM incorporated these changes
Database Review	Review Hawaii Energy program-tracking database by checking for duplicates and comparing to claimed savings in Annual Report
Application of TRM Values	Verify that the Hawaii Energy program-tracking database applied the appropriate per-measure TRM values
Application and Invoice Review	Review of project applications and documentation to ensure consistency with the Hawaii Energy program-tracking database
Engineering Desk Review	Detailed review of project files used to prepare for site visit verification
On-Site Verification	Site visits to verify measures in-place and operating, measure quantity, and measure type. Data collected on site used to calculate ex post savings
Upstream Lighting Review	Invoice review comparing measure quantity and type to the data in the Hawaii Energy program-tracking database
PEER Comparison Billing Data Review	Ex post calculations using billing data for Peer Comparison Group
Market Transformation Verification	Validation of achievements for Transformational Programs
Total Resource Benefits (TRB) Calculations	Total Resource Benefit calculations using verified savings and comparing to claimed values in the Annual Report
Verification of Award Claim, Island Equity Calculations	Award calculations using verified results. Verification of incentive distribution across islands
NTG Assessment	Assessment intended to frame on-going research related to attribution for demand-side management programs
PEER Group Comparison Control Group Analysis	Analysis using phone surveys and billing data to develop independent energy savings estimates
Solar Water Heating Billing Analysis	Separate analysis targeting solar water heating measures
Condominium Sub-Metering Analysis	Billing analysis to estimate average savings and compare to the TRM value
Integrated Building Design and Construction Standards Verification	Documentation review to verify quantities and savings in the project documentation to the values recorded in the program-tracking database

EM&V Research Category	Definition
Small Business Direct Install Lighting (SDBIL) Verification	Separate verification for SBDIL measures that required a review of inspection reports to ensure consistency within the program-tracking database
Participant Surveys	Surveys with customers who received rebates through the residential or business programs to gather information for measure verification and customer satisfaction
Non-participant Surveys	Surveys with the general population to gather information related to household characteristics, demographics, market potential, and awareness
Trade Ally Interviews	In-depth interviews with contractors to gain insight into program operation and processes
Focus Group Data Collection	Group sessions with participation from contractors to gather information related to changes in program offerings and design that could encourage future participation
Market Assessment Evaluation	Review of internal data, documentation, and feedback from Hawaii Energy staff, program participants, and stakeholders to evaluate the market
Baseline Study	Assessment of key building characteristics, equipment, appliances, and use patterns within Hawaii Energy service territories used to establish a baseline for future planning, program effectiveness, and energy efficiency progress toward achieving related goals
Potential Study	Comparison of program savings by sector and end-use to the achievable savings potential estimated by various studies conducted in Hawaii
Food Service Sector Market Assessment	Food service research used to assess the potential for increasing energy efficiency efforts in the market
Upstream Lighting Program Analysis	Annual analysis to provide insight into how the program adapted to the changing residential lighting market by reviewing sales records for qualifying measures sold through the program each year
Non-Energy Benefits Literature Review	Review of literature on non-energy benefits of energy efficiency programs
Economic Impact Analysis	Analysis used to measure program impacts including changes in output, wages, business income, employment, and indirect business taxes
Energy Efficiency Study	Review of studies to understand national energy efficiency market conditions
Hours of Use Inputs for Key C&I Programs	Validation of contractor-based hours of use inputs for SBDIL and Custom Lighting Programs
Potential Overlap Between Key C&I Programs	Investigation of potential overlap for measures associated with C&I Prescriptive, SBDIL, and Midstream efforts
New Initiatives and Pilot Program Analysis	Analysis of new initiative and pilot programs using program staff and pilot participant survey data, initiative participation, and additional research
Comprehensive Longitudinal Effects (CLE) Study	A study that quantifies and describes opportunities that remain for Hawaii Energy programs to achieve long-term energy savings

EM&V Research Category	Definition
History of Hawaii Building Energy Codes	Assessment of past and present Hawaii building energy codes
Hawaii Energy Awareness Study	Study that measures awareness and knowledge related to actions that customers take to save energy since the inception of Hawaii Energy in 2009
Historic Participation Analysis	Assessment of past program accomplishments in Program participation and savings impacts
History of Annual EM&V-Related Research	Assessment of past EM&V related research

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