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Evaluation of the Hawai‘i Energy Conservation and Efficiency Programs

Calendar Year 2021

Prepared for: Hawaii Public Utilities Commission

By: Applied Energy Group, Inc.

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EXECUTIVE SUMMARY

This report presents the results of all *substantially* completed[1] Evaluation, Measurement, and Verification (EM&V) related activities associated with the Hawai'i Energy Conservation and Efficiency Programs (Hawai'i Energy programs) in the calendar year 2021 (CY21).[2] Further, it summarizes the most critical findings from the completed CY21 EM&V activities, focusing on implications for the Hawai'i Energy programs.

The EM&V work conducted for CY21 contributes to three overarching research objectives:

- **Verification of accomplishments:** Verifying Hawai'i Energy's PY20 achievements.
- **Robustness of savings approaches:** Updating and improving approaches used to estimate savings for Hawai'i Energy's programs and measures.
- **Program planning:** Using results to inform future program planning.

Approach

The EM&V-related research activities for CY21 were determined in consultation with the Hawaii Public Utilities Commission (HPUC) and the Energy Efficiency Manager (EEM).

The EM&V Contractor completed (or substantially completed) three research activities in CY21:

- Reviewing and updating the PY21 TRM
- Verifying Hawai'i Energy's PY20 program portfolio
- Developing the Custom Project Guidance Document

The EM&V Contractor also initiated one activity in CY21:

- Reviewing and updating the PY22 TRM.

The EM&V Contractor used various research and analysis methods. Table ES 1-1 summarizes the primary methods employed for each completed and initiated EM&V research activity.

Table ES 1-1 Summary of EM&V Research Activities and Methods for Work Completed in CY21

EM&V Research Activity	Status at the end of CY21	Research and Analysis Methods	
PY21 TRM Major Update	Completed	• TRM updates review and approval	
PY20 Verification	Substantially Completed	• Documentation reviews • Program tracking system review and analyses • Sample design, selection, and extrapolation	• Engineering desk reviews • Total resource benefit (TRB) analysis • Low-to-Moderate Income Performance Incentives Mechanisms analysis
Custom Project Guidance Document	Substantially Completed	• Document best practices for documentation and savings	

[1] From this point forward, "completed" work refers to work that was *substantially* completed during CY21, meaning that the EM&V Contractor completed the research and began drafting final deliverables during CY21. However, final approval of these "completed" activities may have occurred in CY22.

[2] Earlier versions of this report covered only activities completed during the prior program year (PY), July–June, and prior calendar year (CY). Starting with the CY20 version, the reports cover all CY activities initiated and substantially completed.

		during implementation and verification of custom projects	
PY22 TRM Major Update	Initiated	• Best practices research and benchmarking	• Measure and update prioritization

Key Findings and Implications

The EM&V Contractor completed two EM&V activities in CY21, the PY21 TRM Major Update and the PY20 verification of awards. The key findings and implications of these findings for the Hawai'i Energy programs follow.

PY21 TRM Major Update

Ongoing TRM updates have focused on improving the accuracy of deemed savings estimates and expanding the use of semi-prescriptive calculators to better customize savings for a given measure based on the specific installation characteristics (e.g., program delivery approach, equipment capacity, efficiency, building segment).

In CY21, the EM&V Contractor completed updates to the PY21 TRM.

PY20 Verification

PY20 proved a challenging year, and while Hawai'i Energy took action to mitigate issues associated with the COVID-19 pandemic in residential and commercial programs, they fell short of some energy-related goals with a subsequent reduction in potential awards. In total, the PBFA programs achieved 72% of awards.

- Hawai'i Energy **met all targets** for **Residential Hard-to-Reach, Residential Incentives, and Business Prescriptive** program categories.
- They **fell short of targets** for the **Business Custom** program category (driven by adjustments to the claimed savings made during the verification) and for the **Business Hard-to-Reach** (BHTR) program category (likely driven by the COVID-19 pandemic).
- Hawai'i Energy **met most of its PY20 performance targets for Accessibility & Affordability (A&A)**. Those it missed were associated with direct install portions of the BHTR and Residential Hard-to-Reach (RHTR) programs.
- The Hawai'i Energy PBFA programs **met or exceeded targets for all Market Transformation & Economic Development (MTED)** performance metrics except the Innovation and Emerging Technologies key focus area, and exceeded customer satisfaction targets.

Table ES 1-2 provides the key research findings from the PY20 verification and their implications for claimed values, which impacted Hawai'i Energy's awards. The most impactful findings came from the verification of claimed savings and TRBs. Common adjustments included: incorrect application of the dual-baseline approaches as required in the TRM and documentation or methodological issues that the EM&V Contractor identified through engineering desk reviews for Custom Business Energy Efficiency Management (CBEEM) projects.

Table ES 1-2 Key Research Findings and Their Implications/Outcomes: PY20 Verification

Key Result/Finding	Outcome
25% of BHTR lighting projects installed through Energy Advantage (small business direct install) incorrectly used single baselines when replacing halogen, incandescent, and pre-existing fluorescent equipment.	AEG verified lifetime savings for these projects using the dual-baseline approach outlined in the PY20 TRM for direct-install commercial lighting, which led to a TRM adjustment factor of 0.94 for BHTR verified customer-level lifetime savings.

Key Result/Finding	Outcome
Half of the residential program claimed savings came from REEM upstream lighting projects. The savings replication found a TRM adjustment factor of 1.0 for these projects.	REEM upstream lighting, BEEM lighting, and HVAC projects heavily contributed to the near-1.0 TRM adjustment factor for the residential programs overall.
Based on the program tracking data from the HER vendor, nearly 250,000 customers received at least two HERs in PY20, making them eligible for 50% of the annual savings deemed in the PY20 TRM. Hawai'i Energy claimed 50% of the deemed savings for only 207,500 customers.[1,2]	AEG ensured that the re-delivered reports were excluded from its verification. After prorating savings for the number of months each customer remained active during PY20, AEG verified a TRM adjustment of 111% for HERs, which were 12% of the REEM claimed savings.
A handful of CBEEM projects (5/21) incorrectly used a single baseline to calculate lifetime savings when replacing halogen, incandescent, or fluorescent lamps or fixtures.	AEG used the dual baseline approach, which reduced lifetime savings for these measures by about 30%.
The Hawai'i Energy regression models for two sampled CBEEM projects included too few observations for a valid model and used actual weather instead of from a typical meteorological year to estimate savings.	The AEG models included more observations by using both pre- and post-installation data and estimated savings for a typical year, leading to lower savings for both projects.
Hawai'i Energy used incorrect EULs for most of the sampled CBEEM HVAC projects and one general CBEEM project.	Correcting the EULs led to lower lifetime savings for custom HVAC measures.
Two of the CBEEM lighting projects sampled for desk reviews included prescriptive measures. In each case, the prescriptive portion of savings comprised the majority (93% and 99%) of project savings, all of which contributed to Business Custom targets.	AEG did not reallocate these prescriptive savings for the PY20 Verification but recommended that Hawai'i Energy ensure that projects are allocated appropriately to performance targets going forward.
Only three of the seven non-lighting projects sampled under CBEEM and neither of the two sampled CREEM new construction projects included sufficient documentation to confirm that all the rebated equipment was installed as scoped.	Going forward, the EM&V Contractor will verify zero savings for projects/measures lacking sufficient documentation, including an invoice or (in limited cases) installation verification form.
Hawai'i Energy consistently overstated TRBs from measures that required a dual baseline approach, which had the largest impact on lighting measures in BHTR Energy Advantage lighting, REEM, and BEEM programs.	AEG verified lower TRBs for these programs.

[1] The Peer Program was discontinued mid-PY20 based on a variety of factors, including reduced funding due to the COVID 19 pandemic.

[2] During PY20, the HER vendor, found an issue with the first batch of reports delivered to customers in the fall. They amended the issue and re-delivered the reports at the start of the calendar year 2021. However, these were not part of the additional HERs that AEG found in the tracking database.

Custom Project Guidance Document

In CY21, the EM&V Contractor drafted the Custom Project Guidance Document in a collaborative effort with Hawai'i Energy and the EEM. This document, which will go into effect for PY22, clearly articulates expectations related to the EM&V of custom projects. At the end of CY21, the document was largely completed and awaiting approval from the HPUC and Hawai'i Energy.

PY22 Major TRM Update

In CY21, the EM&V Contractor initiated the review and prioritization process to gather and determine updates necessary for the PY22 TRM.

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INTRODUCTION

This report presents the results of all Evaluation, Measurement and Verification (EM&V) related activities associated with the Hawai'i Energy Conservation and Efficiency Programs (Hawai'i Energy programs) initiated or completed during the prior calendar year (CY), 2021 (referred to as CY21).[3] This report also summarizes the most important findings from the completed CY21 EM&V activities, with a focus on implications for the Hawai'i Energy programs.

Research Objectives

The EM&V work conducted for CY21 contributes to three overarching research objectives:

- **Verification of accomplishments:** Verifying Hawai'i Energy's PY20 achievements.
- **Robustness of savings approaches:** Updating and improving approaches used to estimate savings for Hawai'i Energy's programs and measures.
- **Program planning:** Using results to inform future program planning.

EM&V Research Activities

The EM&V-related research activities for CY21 were determined in consultation with the Hawaii Public Utilities Commission (HPUC) and the Energy Efficiency Manager (EEM).

The EM&V Contractor completed (or substantially completed) three research activities in CY21:

- Reviewing and updating the PY21 TRM
- Verifying Hawai'i Energy's PY20 program portfolio
- Developing the Custom Project Guidance Document

One activity was initiated in CY21:

- Reviewing and updating the PY22 TRM.

The remainder of the report first presents an overview of the PY20 Verification of Hawai'i Energy's portfolio. Subsequently, we offer a summary of the two TRM tasks that were completed and initiated.

[3] Earlier versions of this report covered activities completed during the prior program year (PY), July–June, and prior calendar year. Starting with the CY19 version, the reports cover only prior CY activities, both initiated and completed, as opposed to whole program years

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PY20 VERIFICATION

The Hawaii Public Utilities Commission (the Commission) contracted the EM&V Contractor (Applied Energy Group [AEG]) to verify the savings and performance of Hawai'i Energy's Public Benefits Fee Administrator (PBFA) programs in the program year 2020 (PY20, July 1, 2020, to June 30, 2021). PY20 marked Hawai'i Energy's second year in the Triennial Plan for program years 2019 to 2021 (PY19-21) and its 11th year implementing energy efficiency programs as a Public Benefits Fee Administrator (PBFA). The EM&V Contractor verified whether Hawai'i Energy met the targets for the performance indicators and key focus areas (listed in Table 2-3), which determined the performance awards that Hawai'i Energy was eligible to receive in PY20.

This chapter summarizes the PY20 verification approach, results, and recommendations. More detailed information on the verification can be found in the Hawai'i Energy PY20 Verification Report[4] located on the Hawai'i Energy website (https://hawaiienergy.com/about/information-reports).

Approach to Verification

Verification activities included a tracking database review, savings replication for deemed and semi-deemed measures, and engineering desk reviews to ensure that Technical Reference Manual (TRM) gross savings values and related adjustments were correctly applied, as well as documentation reviews to verify program funding equity, engagement with hard-to-reach communities, and customer satisfaction. The EM&V Contractor used the methods shown in Table 2-1 PY20 CET and Table 2-2 to verify PY20 performance in the Clean Energy Technologies (CET) and non-CET key performance areas, respectively. Non-CET performance areas include Accessibility & Affordability (A&A), Market Transformation & Economic Development (MTED), and Customer Satisfaction.

The EM&V Contractor did not design PY20 verification activities to review the validity of the TRM's stipulated savings or adjustment factors, only to assess whether Hawai'i Energy applied them appropriately when calculating claimed values for the PY20 programs. Therefore, our verification does not scrutinize measure-level gross savings values or associated adjustments beyond ensuring the correct application of TRM-stipulated savings and factors and documentation of incented measures through desk reviews.[5]

PY20 methods mostly aligned with those used during the PY19 verification. Key differences in methods from PY19 included:

- All activities performed by AEG, the sole Contractor[6]
- Added program manager interviews, including a focus on how the pandemic affected programs[7]
- Explored the impact of more stringent requirements around required documentation based on previous recommendations
- Added a small effort to show that the data is available for use by Hawaii Electric Companies in their low-to-moderate income performance indicator metric.

[4] Hawai'i Energy PY2020 Verification Report, Prepared by Applied Energy Group, Prepared for Hawaii Public Utilities Commission, May 20, 2022.

[5] AEG compared Hawai'i Energy database information to the PY20 TRM V2.0 information.

[6] AEG previously subcontracted out many of the verification activities.

[7] Program manager interviews last took place in PY18.

Table 2-1 PY20 CET Verification Methods

Performance Metric	Description of Metric	Verification Activities and Adjustments
Energy and Demand Savings[8] First-Year Energy Savings Lifetime Energy Savings Peak Demand Reductions	**Customer-Level Savings** Gross savings for each customer before accounting for line losses or what the customer would have done absent the program (i.e., no application of a net-to-gross ratio at this step)	**TRM Adjustment** through a savings replication for all deemed and semi-prescriptive measures in the tracking database **Desk Review Adjustment** through engineering desk reviews on a sample of custom and non-custom projects
	System-Level Savings Savings reflected at the generator incorporating line losses	**System-Loss Adjustment** through a review of the system loss factors (in PY20 TRM V2.0) applied to the customer-level savings
	Program-Level Savings Net savings that account for free-ridership and spillover (system-level savings multiplied by the net-to-gross ratio)	**Net-to-Gross (NTG) Adjustment** through a review of the NTG ratios (in PY20 TRM V2.0) applied to the system-level savings
Total Resource Benefits	The estimated total net present value (NPV) of the avoided cost for the utility from the reduced lifetime demand (kW) and energy (kWh) from energy efficiency projects and measures	**TRB Adjustment** using customer-level verified savings and NTGRs to calculate TRBs for each program and measure (avoided costs already include line losses so are not included in savings at this step)
Grid Services Products	The total number of projects completed or products installed that qualify as Grid Service Ready (e.g., grid-connected water heaters)	**Product Adjustment** using the count of Grid Services Products included in the reconciled tracking database.
GHG Emissions	The avoided emissions and equivalent avoided barrels of oil due to program-level annual energy savings	**GHG Avoided Emissions Adjustments** using the program-level verified savings and metric tons-per-kWh and barrels of oil-to-metric tons conversion factors provided in the PY21 TRM.[9]

[8] Performance targets for energy and demand savings metrics are based on program-level savings, which are built up from customer- and system-level savings

[9] As specified in the PY20 Verification Workplan, AEG used the PY21 Hawai'i Energy TRM to estimate GHG avoided emissions because these metrics were not included in the PY20 TRM.

Table 2-2 PY20 Non-CET Verification Methods[10]

Performance Area	*Metric*	*Verification Approach*
Affordability & Accessibility		
	Economically Disadvantaged Requires serving a minimum number of customers (who save a minimum amount on their energy bills) through the Energy Advantage and single- and multifamily direct install programs, distinct communities through the Community-Based Energy Efficiency program, and nonprofits through the EmPOWER Hawaii Project.	**Energy Advantage**. Confirmed customer counts in the tracking database **Single Family/Multifamily Direct Install.** Confirmed customer counts in the tracking database and calculated customer bill savings using average Hawaiian Electric rates and 2019 customer billing data **Community-Based Energy Efficiency.** Confirmed community counts through project documentation review **EmPOWER Hawaii Project.** Confirmed number of projects by reviewing contractor invoices
	Island Equity Requires that a minimum 13 percent of program spending occurs in each of the Hawaii and Maui counties.	Reviewed program spending by island (program tracking database includes a variable that states the island for each rebate).
Market Transformation & Economic Development	**Behavior Change** **Professional Development & Technical Training** **Energy in Decision Making** **Codes & Standards** **Clean Energy Innovation Hub**	Reviewed contractor invoices, attendance records, participant agreements, and other backup documents
Customer Satisfaction	**Residential Customer Satisfaction** **Business Customer Satisfaction**	Reviewed survey results from Medallia and in-house survey tools.

Verification Results

Through the verification activities, the EM&V Contractor identified the following important achievements by Hawai'i Energy during PY20:

- Hawai'i Energy delivered 90.8 million kWh in first-year savings and 16.4 MW in peak demand reductions through rebated energy efficient products installed in homes and businesses throughout the state.
    - Through the two residential initiatives (Residential Incentives and Residential Hard-to-Reach), Hawai'i Energy achieved 40.9 million kWh in first-year savings and 8.2 MW in peak demand reductions.
    - Hawai'i Energy achieved the other 49.8 million kWh in first-year savings and 8.2 MW in peak demand reductions through the three business initiatives (Business Prescriptive, Business Hard-to-Reach, and Business Custom).
- The Hawai'i Energy programs saved hard-to-reach, economically disadvantaged residential and small business customers nearly $3 million on their utility bills through direct-install initiatives.
- Savings from Hawai'i Energy's programs offset the use of more than 140,000 barrels of oil and avoided over 61,000 metric tons of GHG emissions.

[10] There are two separate verification efforts under the A&A award: economically disadvantaged and island equity.

Table 2-3 summarizes the PY20 performance targets compared with Hawai'i Energy's claimed results and the verified results derived by the EM&V Contractor. Hawai'i Energy took action to mitigate issues associated with the COVID-19 pandemic in residential and commercial programs. However, they fell short of some energy-related goals with a subsequent reduction in potential awards.

Table 2-3 PY20 Claimed and Verified Performance Award by Performance Indicator

Performance Indicator	Performance Target	Metric	Fraction of Award	Target Award	Claimed Results			Verified Results		
					Performance	Percentage of Performance Target	Award	Performance	Percentage of Performance Target	Award
Clean Energy Technologies - Key Focus Areas			**73.53%**	**$625,000**			**$559,169**			**$427,864**
First Year Energy Reduction	92,734,781	kWh	15.95%	$135,577	91,555,092	98.7%	$103,130	90,768,272	97.9%	$88,086
Lifetime Energy Reduction	1,166,174,708	kWh	15.95%	$135,577	1,161,894,529	99.6%	$111,591	1,068,096,834	91.6%	$72,649
Peak Demand Reduction	14,405	kW	15.95%	$135,577	16,685	115.8%	$137,315	16,411	113.9%	$120,504
Total Resource Benefit	$149,667,430	$	21.27%	$180,769	$165,977,342	110.9%	$169,633	$145,833,272	97.4%	$109,125
Grid Services Ready (new)	700	projects/ demand management products installed or customers served	4.41%	$37,500	2,108	301.1%	$37,500	2,203	314.7%	$37,500
Greenhouse Gas Emissions/ Barrel of Oil (new)	65,733 / 151,874	tons / barrels	0.00%	$0	63,187 / 147,004	96.1% / 96.9%	$0	61,053 / 140,875	92.9% / 92.9%	$0
Accessibility & Affordability - Key Focus Areas			**17.65%**	**$150,000**			**$105,000**			**$105,000**
Economically Disadvantaged										
Energy Advantage										
Customers Served	650	Customers served	1.76%	$15,000	576	88.6%	$0	576	88.6%	$0
Bill Savings	$1,750,000	Customer bill savings	1.76%	$15,000	$1,928,209	110.2%	$15,000	$1,928,209	110.2%	$15,000
Single & Multifamily Direct Install										
Customers Served	1,365	Customers served	1.76%	$15,000	663	48.6%	$0	663	48.6%	$0
Bill Savings	$3,773,374	Customer bill savings	1.76%	$15,000	$1,256,082	33.3%	$0	$1,065,618	28.2%	$0
Community Based Energy Efficiency (new)	3	Communities served	0.88%	$7,500	3	100.0%	$7,500	3	100.0%	$7,500
EmPower Hawai'i Project (new)	7	Participating non-profits	0.88%	$7,500	8	114.3%	$7,500	8	114.3%	$7,500
Island Equity										
County of Hawaii	13%	Target spend must be met in Hawaii & Maui Counties for Milestone & Target Award	8.82%	$75,000	15%	115.4%	$75,000	15%	115.4%	$75,000
County of Maui	13%				14%	107.7%		14%	107.7%	
City & County of Honolulu	74%				71%	95.9%		71%	95.9%	
Economic Development & Market Transformation - Key Focus Areas			**7.06%**	**$60,000**			**$60,000**			**$60,000**
Behavior Change										
Workshop and Presentations										
STEM based student workshop	1,200	Number of participant-hours of Training	0.88%	$7,500	1,518	126.5%	$7,500	1,519	126.6%	$7,500
Adult learning	2,500	Number of participant-hours of Training	0.88%	$7,500	3,926	157.0%	$7,500	3,949	157.9%	$7,500
Gamification Campaigns and Competitions	450	Number of participants	0.00%	$0	1,870	415.6%	$0	1,870	415.6%	$0
Exhibit Educational Resources	0	Number of Stakeholder Collaboration Events	0.00%	$0	0	N/A	$0	0	N/A	$0
Sustained Outreach	1	Participation Agreements	0.00%	$0	1	100.0%	$0	1	100.0%	$0
Behavioral Insights	0	Number of Program Interventions	0.00%	$0	0	N/A	$0	0	N/A	$0
Professional Development & Technical Training										
Clean Energy Ally Support										
Targeted Ally Training Opportunities										
Targeted Participant Training Opportunities	6,500	Number of participant-hours of Training	3.53%	$30,000	6,882	105.9%	$30,000	6,907	106.3%	$30,000
Educator Training and Grants										
Degree Program Support										
Vocational Training										
Energy in Decision Making										
Strategic Energy Management (SEM)	4	Number of new participating institutions	0.88%	$7,500	9	225.0%	$7,500	9	225.0%	$7,500
Codes and Standards										
Appliance Standards Advocacy (new)	1	Advocacy Events	0.88%	$7,500	7	700.0%	$7,500	7	700.0%	$7,500
Improve Code Compliance	0	Establishing compliance roadmap and tracking savings			0	N/A		0	N/A	
Code-Related Training	50	Number of participant-hours of Training			50	100.0%		50	100.0%	
Leading edge technologies and strategies	2	Meeting and one final report			2	100.0%		2	100.0%	
Clean Energy Innovation Hub										
Innovation and Emerging Technologies	2	Companies supported	0.00%	$0	0			0	0.00%	
Customer Satisfaction - Key Focus Areas			**1.76%**	**$15,000**			**$15,000**			**$15,000**
Application Processing Customer Experience - Commercial	>9	Overall customer satisfaction score	0.88%	$7,500	9.6	106.7%	$7,500	9.6	106.7%	$7,500
Application Processing Customer Experience - Residential	>9	Overall customer satisfaction score	0.88%	$7,500	9.4	104.4%	$7,500	9.4	104.4%	$7,500
Total Performance Award			**100%**	**$850,000**			**$739,169**			**$607,864**

In total, Hawai'i Energy achieved $607,864.17 (72%) of the potential awards. Most shortfalls came from not meeting CET targets set for first-year and lifetime energy savings, peak demand reductions, and total resource benefits (TRBs) (see Figure 2-1). Hawai'i Energy met all the non-CET performance metrics except for the A&A targets (see Figure 2-2) set for residential customers served and bill savings from hard-to-reach direct-install initiatives and the Innovation and Emerging Technologies target set under the MTED performance area (see Figure 2-3). Since Hawai'i Energy did not meet certain targets, they did not receive full awards in these areas.

The remainder of this section of the report details the key findings from the CET and non-CET verification activities. The following bullets call attention to several key findings for the CET Performance:

- AEG found **that Hawai'i Energy's implementation of the TRM algorithms for prescriptive programs was near perfect**. We made few impactful TRM adjustments to the claimed savings, leading to TRM adjustment factors close to 1.0 for all programs.
- Hawai'i Energy met the four CET targets (first-year and lifetime energy savings, demand savings, and TRBs) for **Residential Hard-to-Reach**, **Residential Incentives**, and **Business Prescriptive** program categories.
- **Business Custom** (CBEEM) fell short of all but one of the targets because of adjustments made during the verification process.
    - The most impactful performance adjustments made by AEG resulted from updates to regression models that impacted CBEEM HVAC and general custom projects, updates to project Effective Useful Lives (EULs), and updates to lifetime savings that incorporated dual baselines for sampled CBEEM projects.
    - Another impactful adjustment occurred in CBEEM lighting. Two opportunities included custom and prescriptive lighting projects that all received rebates under the CBEEM program. For one of these projects, Hawai'i Energy applied TRM-deemed per-unit savings meant for linear LEDs to nonlinear bulb installations, which increased the verified savings by 1.5 to nearly 3.0 times the claimed savings for this project overall. Hawai'i Energy also did not incorporate the dual-baseline when calculating LED lifetime savings or TRBs for either project. We also removed a small portion of savings (~6% of claimed first-year kWh for the custom lighting sample) that had been double-counted between custom and prescriptive projects across both these opportunities.
- **Business Hard-to-Reach** also fell short of targets, which appeared to be because of the COVID-19 pandemic (and not because of any verification adjustments). Hawai'i Energy and its customers faced numerous challenges with supply chains and direct installation of measures because of the economic uncertainty and health concerns related to the pandemic.
- Hawai'i Energy exceeded targets for installing Grid Services Ready products, which seek to introduce technologies such as grid-integrated water heaters to customers' homes to prepare them for any future participation in demand response programs.
- The programs fell just short of performance targets for GHG reductions, but these targets were not associated with any monetary awards.

Figure 2-1 Achievement of Performance Targets for Clean Energy Technologies for PY20

[1] The gray bars show the savings and TRBs that Hawaii Energy would have lost had AEG used a stricter approach to verify custom project savings. The stricter approach requires invoices or at least purchase orders for every measure rebated through CBEEM or CREEM.

AEG verified 100% of the claimed performance for nearly all the non-CET performance metrics, and Hawai'i Energy also met or exceeded most of the performance targets.

- As shown in Figure 2-2, Hawai'i Energy met most **A&A** performance targets. They fell short on the number of customers served and customer bill savings from single-family and multifamily direct-install projects, initiatives under the RHTR and BHTR programs, and the number of customers served through the Energy Advantage channel of the BHTR program. This shortfall was not due to verification adjustments but was believed to be a result of the COVID-19 pandemic, which discouraged customers from participating in direct-install programs and investing in energy efficiency in general.
- As shown in Figure 2-3, Hawai'i Energy met or exceeded targets for all **Market Transformation and Economic Development** performance metrics except the Innovation and Emerging Technologies key focus area. The shortfall in the Innovation area came about as Hawai'i Energy directed funds to other areas to accommodate the pandemic.
- Hawai'i Energy exceeded the **customer satisfaction** target of 9.0 with values of 9.6 and 9.4 for business and residential participant satisfaction, respectively.

Figure 2-2 Achievement of Performance Targets for Accessibility & Affordability for PY20

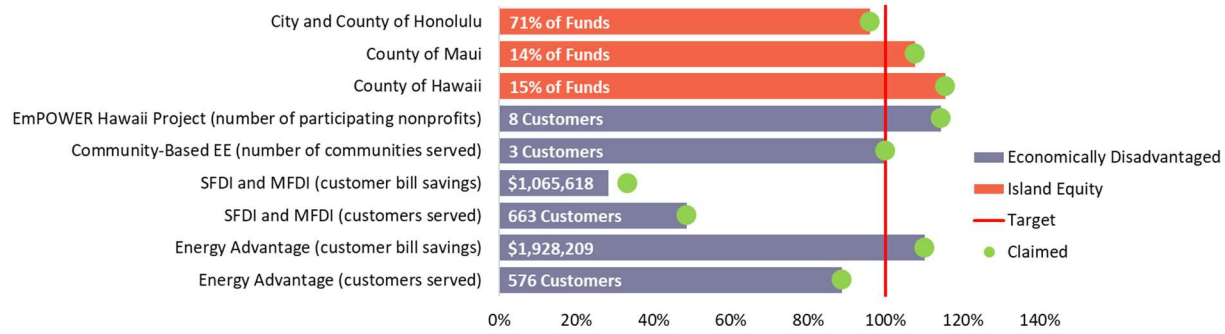
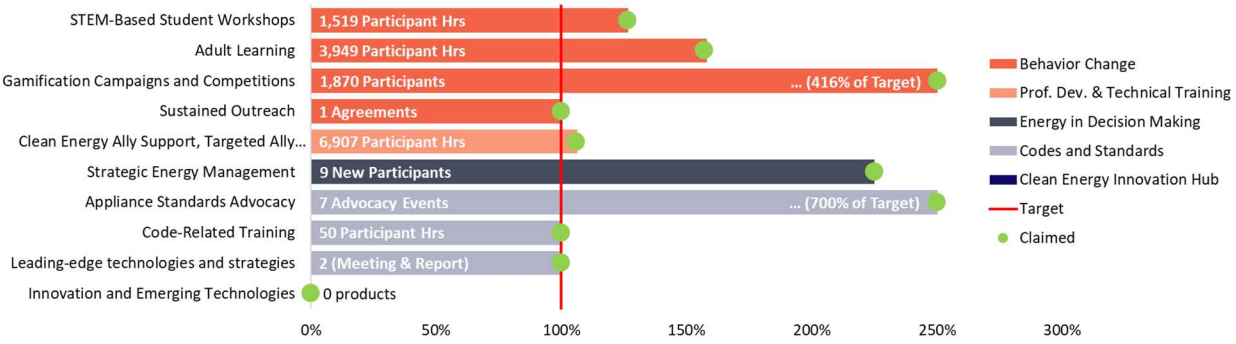


Figure 2-3 Market Transformation & Economic Development Verified Performance



Recommendations

Based on the verification activities, the EM&V Contractor developed a set of recommendations for Hawai'i Energy to consider. Table 2-4 documents the recommendations made by the AEG team beginning in PY17 that remain relevant, with new recommendations detailed in Table 2-5. Additional recommendations may have been made over the past four evaluations; however, either they were implemented by Hawai'i Energy, or they are no longer relevant for another reason, i.e., change in awards, targets, or focus.

Table 2-4 Historical Verification Recommendations

Recommendation	*PY17*	*PY18*	*PY19*	*PY20*	*Comments*
Continuing Recommendations					
Account for dual baselines when calculating Lifetime Energy savings and TRBs.			**X**	**X**	While there was some improvement over PY18, dual baselines still caused reductions in awards under BHTR, REEM, and BEEM.
Collect Invoices (or an equivalent form of documentation) for all measures and projects prior to paying out incentives.		**X**	**X**	**X**	There were several recommendations focused on documentation in PY18 and PY19. PY20's recommendation focuses on documentation for custom projects since they were disproportionately affected.
When using regression models to estimate annual savings for custom projects, ensure that models incorporate sufficient data from both the pre- and post-implementation period to cover the range of operating conditions experienced in a typical year and produce accurate and precise savings estimates.		**X**	N/A	**X**	While the team did not review any regression-based projects in PY19, this recommendation has been ongoing with little improvement since PY18. Adjustments related to this recommendation resulted in a significant loss of savings in CBEEM.
Ensure all data is collected and tracked so that semi-prescriptive savings can be replicated.			**X**	**X**	Similar recommendations were made in PY19 and PY20 to collect and track semi-prescriptive inputs. Without these inputs, the team is unable to replicate savings.
Ensure site inspections are sufficiently rigorous to verify measure type and quantity.		**X**	**X**	**X**	Post-installation site inspections often do not collect sufficient data to verify the type and quantity of all measures. This issue has been significant and ongoing for custom and new construction projects.
Collect and use custom inputs, when possible, especially for CBEEM and CREEM projects, to improve the accuracy of savings estimates and mitigate against large differences between claimed and verified savings.		**X**	**X**	**X**	Basing reported savings on deemed values from the TRM when project documentation includes detailed information can lead to much lower or higher realization rates.
Hawai'i Energy should continue updating its tracking database to include custom inputs for measures that are semi-prescribed in the TRM, enabling the verification contractor to include these measures in the savings replication.			**X**	**X**	Basing reported savings on deemed values from the TRM when project documentation includes detailed information can lead to much lower or higher realization rates.
Correct rounding issues within the tracking database that lead to minor inconsistencies in savings.	**X**	**X**	**X**	**NR**	AEG chose not to continue this recommendation as the implications of rounding errors are truly minor.

Table 2-5 New Verification Recommendations for PY20

Recommendation	*PY20*	*Comments*
New Recommendations in PY20		
Consider using typical meteorological year (TMY) weather data when using regression analysis to estimate lifetime savings for custom projects.	X	Additional new recommendations were focused on enhancing the accuracy of energy and demand reduction estimates; however, they were not linked to issues that directly impacted the verified CET metrics in a meaningful way.
Collect supplemental project documentation before paying out incentives for projects.	X	
Beginning in PY21, use the updated baseline to calculate savings for residential faucet aerators and showerheads.	X	
Include project descriptions for custom projects.	X	
Consider collecting DLC screenshots consistently for all custom lighting projects.	X	

3

TRM UPDATES AND RELATED RESEARCH

This chapter summarizes CY21 activities related to the review and update of Hawai'i Energy's TRM.

PY21 TRM Update

The EM&V Contractor completed the planning, receiving input, and prioritizing updates steps for the PY21 major review and update in CY2020. The updates were based on findings from the TRM Review and Recommendations Review and completed the draft update, review and feedback, additional adjustments, and then received final approval from the HPUC in early CY2021.

Custom Project Guidance Document

In CY21, the EM&V Contractor drafted the Custom Project Guidance Document in a collaborative effort with Hawai'i Energy and the EEM. This document, which will go into effect for PY22, clearly articulates expectations related to the documentation and savings during the implementation and verification of custom projects. Specifically, it defines custom projects, describes program rules, and provides guidance on the following:

- Project documentation and data collection
- Energy savings estimation approach
- Impact evaluation of custom programs

The document includes both minimum requirements and optional best practices. Findings from verification and TRM review efforts informed many of the topics in the Custom Project Guidance Document. At the end of CY21, the document was largely completed and awaiting approval from the HPUC and Hawai'i Energy.

Mid-Year PY21 TRM Update

Since there were no requests for mid-year updates to the PY21 TRM, AEG did not perform this activity in CY21 and made all updates to the PY22 TRM.

PY22 TRM Update (Initiated)

The Hawai'i Energy TRM Framework calls for an annual review and update of TRM content. The workflow includes seven steps, three of which were completed in CY21:

- Completed in CY21
    - Annual TRM update planning
    - Input on updates
    - Prioritization
- To complete in CY22
    - Draft TRM updates
    - Review and feedback
    - TRM adjustments
    - Final TRM presented for HPUC approval

During CY2021, the EM&V Contractor completed the first three steps (planning, receiving input, and prioritizing updates) for the PY22 TRM review and update.

After first developing a plan for the PY2022 TRM updates, the EM&V Contractor compiled a preliminary list of measures and content to consider in the review and update process. The EM&V Contractor identified these items during the PY21 TRM update and PY20 Verification and through correspondence with Hawai'i Energy, the EEM, and the HPUC. The EM&V Contractor next requested additional input on the preliminary list of update ideas from the Technical Advisory Group (TAG) and then compiled all suggested updates into a comprehensive list for prioritization. This process resulted in a list of 87 potential items to review and update. Using four criteria to score each suggested update and considering the level of effort and time required for each update, the EM&V Contractor recommended a "short list" of ten standard updates and two new measures for the PY22 TRM update.[11] The EM&V Contractor began the update process for the PY22 TRM in December of CY21.

[11] Prioritization of Program Year 2022 (PY22) Technical Reference Manual Updates: Approved Plan, Memorandum, Prepared by Applied Energy Group, Prepared for Energy Efficiency Manager (EEM), Hawaii Public Utilities Commission (HPUC), and Hawai'i Energy, December 2, 2021.

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