

AEG

PY2021 Verification Report Final

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Commission

By: Applied Energy Group, Inc.

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AEG Key Contact: Kelly Marrin



This work was performed by

Applied Energy Group, Inc.
2300 Clayton Road., Suite 1370
Concord, CA 94520

Project Director: Kelly Marrin

Project Manager: Maggie Buffum

Project Team: Austin Alcott
Alex Chamberlain
Nate Perkins

EXECUTIVE SUMMARY

This report presents the verified savings and performance results of program year 2021¹ (PY21) for Hawai'i Energy. The verification's chief purpose was to provide an independent review of Hawai'i Energy's performance relative to the contractually agreed-upon performance targets. The targets span a range of performance indicators, including energy and demand savings for **Clean Energy Technologies (CET)**, **Accessibility & Affordability (A&A)**, **Market Transformation & Economic Development (MTED)**, and **Customer Satisfaction**. Successfully meeting the performance targets related to these indicators can lead to a financial award of up to \$750,000 for Hawai'i Energy's implementer (Leidos).

AEG completed the verification using methods and activities consistent with past years, including savings replication, documentation and desk reviews, and program manager interviews. We worked with Hawai'i Energy to collect the data necessary for the verification and the Energy Efficiency Manager (EEM) and Commission to agree on the appropriate methods and activities. Appendix D and Appendix E present detailed descriptions of the methods employed and the sample design and expansion.

Summary of Findings

In PY21, Hawai'i Energy saw stabilization as concerns around COVID-19 receded while looking toward new measures and initiatives. However, they fell short of some energy-related goals with a subsequent reduction in potential awards.

Program Year Summary

Whereas PY20 was affected deeply by COVID-19, PY21 marked a year of stabilization. More businesses reopened and employees returned to their offices to work in person. Hawai'i Energy attempted to increase in-person engagement with customers, from free site visits to low- and no-cost trainings and workshops. Hawai'i Energy had adapted well to virtual engagement, however, and retained many of its offerings in virtual form. Its virtual reach allowed Hawai'i Energy staff, based on Oahu, to connect with hard-to-reach (HTR) customers such as the low-to-moderate income (LMI) customer segment, kūpuna (elderly) customers, and customers in remote areas of Oahu and on neighbor islands. There was a "mixed response" to in-person workshops; Hawai'i Energy staff acknowledged they may have tried to revive in-person offerings too soon. Similarly, limitations with in-person interaction inhibited the engineering team's ability to conduct site visits and collect data to calculate energy savings for projects.

Despite a "return to normal," Hawai'i Energy still faced several obstacles:

- COVID-19 forced many businesses to focus on staying afloat and making it to the next month rather than looking ahead to the next year or farther out. As such, they don't have substantial (or sometimes any) budget to invest in capital improvement projects such as energy efficiency upgrades. Hawai'i Energy staff perceives this to be more than a temporary, short-term issue.
- COVID-19 also shook up the labor force, resulting in a combination of businesses being understaffed and/or having different points of contact that lack the institutional knowledge of previous "energy champions" at those businesses. For example, many customers in the hospitality sector experienced churn with respect to facilities directors. Hawai'i Energy devoted time and resources toward establishing, repairing, and bolstering connections with commercial customers in PY21.
- Supply chain delays massively hindered the timeliness with which energy efficiency projects could be completed, and inflation, while bringing much-needed attention and awareness to the benefits of energy efficiency, weakened the lubricating effects that rebates have on facilitating new projects.

¹ Program Year 2020 began on July 1, 2020, and ended June 30, 2021.

In addition to COVID-related complications, Hawai'i Energy is facing constraints on achievable energy savings. Changing standards per the Energy Independence and Security Act of 2007 (EISA) will eliminate energy savings for most forms of LED lighting, the biggest contributor to portfolio energy savings annually in both the residential and business portfolios (51% and 30%, respectively). Note however, that most commercial lighting and nearly all custom commercial lighting remains unaffected by the EISA standards which have the highest impact in residential as all general service lighting (GSL) moves to an LED baseline.

Hawai'i Energy launched two initiatives in PY21: the Commercial Kitchen Equipment (CKE) Midstream Program and a Refrigeration Training Effort. The CKE Midstream program packages commercial kitchen rebates offered through other BEEM programs and models delivery after the BEEM midstream commercial lighting program. The Refrigeration Training Effort is a market transformation initiative designed to increase interest in, awareness of, and knowledge about refrigeration efficiency and rebates. Hawai'i Energy staff leveraged the initiative to train CEAs and educate customers about the availability of refrigeration retrofit rebates and the benefits of energy-efficient refrigeration equipment.

Verified Savings and Awards

PY21 proved a challenging year, and in total, Hawai'i Energy achieved \$476,112 (63%) of the potential awards. Most shortfalls came from not meeting CET targets, specifically targets set for lifetime energy savings and total resource benefits (TRBs). Hawai'i Energy met all the non-CET performance metrics except the A&A targets set for residential customer bill savings from hard-to-reach direct-install initiative and Island Equity. Since Hawai'i Energy did not meet certain targets, they did not receive full awards in these areas.

Table ES-1 Verified Performance Award – Summary

	Performance Indicator	Fraction of Award	Target Award	Verified Award	Percent Verified
CET Awards	Clean Energy Technologies	70%	\$525,000.00	\$341,111.66	65%
	<i>First-Year Energy</i>	15%	\$112,500.00	\$106,449.26	95%
	<i>Lifetime Energy</i>	15%	\$112,500.00	\$37,938.84	34%
	<i>Peak Demand Reductions</i>	15%	\$112,500.00	\$112,729.00	100%
	<i>Total Resource Benefits</i>	20%	\$150,000.00	\$46,494.57	31%
	<i>Grid Service Ready</i>	5%	\$37,500.00	\$37,500.00	100%
	<i>Barrels of Oil / GHG</i>	0%	\$0.00	\$0.00	n/a
Non-CET Awards	Accessibility & Affordability	20%	\$150,000.00	\$60,000.00	40%
	<i>Economically Disadvantaged</i>	10%	\$75,000.00	\$60,000.00	80%
	<i>Island Equity</i>	10%	\$75,000.00	\$0.00	0%
	Market Transformation & Economic Development	8%	\$60,000.00	\$60,000.00	100%
	Customer Satisfaction	2%	\$15,000.00	\$15,000.00	100%
Total		100%	\$750,000.00	\$476,111.66	63%

Key Takeaways

The following bullets call attention to several key successes in the CET and non-CET performance areas.

CET Performance

- **Hawai'i Energy exceeded the target for installing Grid Service Ready measures** which are a critical component of Hawaii's clean energy transition. AEG verified nearly 200% of the target, aligning with Hawai'i Energy's claimed amount. The measures included not only grid-interactive water heaters but also smart devices, smart thermostats, and general demand response equipment.

- **AEG found that Hawai'i Energy's implementation of the TRM algorithms for prescriptive programs was nearly perfect.** We made minimal impactful TRM adjustments to the claimed savings, leading to TRM adjustment factors close to 1.0 for all programs.
- **Hawai'i Energy appears to be making incremental improvements to some of its calculators and tools based on past recommendations.** For example, the PY21 custom lighting calculator directly calculated lifetime kWh savings, which are missing from the PY20 and previous calculators. That said, most of the sampled custom lighting projects still used the PY20 calculator, but AEG assumes it will be phased out over time.

Non-CET Performance Key Takeaways

- **Hawai'i Energy met all A&A performance targets except for residential bill savings and program spending in the County of Maui.** While Hawai'i Energy continued to face challenges related to the COVID-19 pandemic, they exceeded targets for residential and business A&A customers served. Even so, the residential A&A target for customer bill savings was missed by a wide margin, consistent with PY20, which suggests misalignment between the targets for customers served and the resulting savings on energy bills. Unlike PY20, the programs missed equity targets, falling short of the 13% target set for spending in the County of Maui (at 12%). In response to the HPUC's call for emergency demand response on Oahu, Hawai'i Energy prioritized projects in Honolulu County, which made achieving island equity in other counties more difficult.
- **Similarly, Hawai'i Energy PBFA programs met or exceeded targets for all MTED performance metrics except for the Sustained Outreach portion of Behavior Change and companies supported through Innovation and Emerging Technologies.** Further, they far exceeded targets in most other MTED focus areas.
- **AEG verified 100% of the claimed customer satisfaction scores of 9.6 and 9.4 for business and residential participant satisfaction, respectively.** Each metric exceeded the 9.0 target by over 104%.

Recommendations

Below we include recommendations that have the largest impact on verified CET metrics, including energy and demand reductions and TRBs. Each of the items below is critical to correctly calculating CET metrics or the ability of an evaluation team to confirm the type or quantity of rebated measures or projects purchased.

1. **Adhere to the documentation requirements outlined in the Custom Project Guidance document to avoid penalties that could hurt the future of the PFBA programs.** The evaluability of program performance and achievements remains a critical verification component that gives stakeholders, including the customers who benefit from these programs, confidence in the process. The AEG Team has seen some incremental improvement over time in the documentation collected for custom projects. However, our review found that hardly any of the savings calculation workbooks included lifetime savings calculations. There were also several cases where equipment specifications, project equipment and labor costs, or some proof of installation were not documented or aligned with how savings were claimed. (Details of issues are included in Appendix F.) Note that if Hawai'i Energy cannot provide appropriate proof of project pre-approval, completion, installation, and cost for PY22 custom projects, AEG proposes to apply zero savings in next year's verification. These fundamental elements of documentation are critical to providing basic assurance that the rebated projects are completed, and that the measures were purchased and installed. Timing of the rebates and pre inspections helps to ensure that the program has a chance of influencing customer behavior, and that rebates are not paid for projects that are already installed.
2. **Document the pre-approval process with customers seeking custom project rebates to mitigate the appearance of free-ridership and ensure all projects conform with Hawai'i Energy's established program rules.** AEG identified several CBEEM projects with unclear timelines that would have benefitted from clearer documentation showing that Hawai'i Energy pre-approved the project before it was underway. Email communications, pre-site inspections, consistent use of the project summary form, or another form

preceding the application rebate submission would provide proof of Hawai'i Energy's intervention. Pre-approval is best practice considering the significant incentives associated with many of these projects.

3. **Update solar water heater replacement calculations in the TRM.** Based on the household data being collected, it appears that many of the solar water heater replacements do not qualify for a deemed savings value because the assumed baseline would exceed a storage volume of 55 gallons for an electric resistance. Further, Hawai'i Energy is not consistently calculating the baseline conditions for solar water heater replacements (see additional recommendation #1). The TRM should be updated with guidance that clarifies how to calculate the baseline electric storage tank size using an occupancy rule-of-thumb of 10 gallons per occupant for low-to-normal hot water usage and 15 gallons per occupant for high hot water usage. This additional information would make it easier for Hawai'i Energy to determine which replacements do not qualify for the deemed savings. In addition, AEG and Hawai'i Energy should work together with the EEM and HPUC to expand the measure to include deemed savings for larger capacity equipment replacements in residential homes. For larger capacity equipment, the appropriate baseline would be a heat pump water heater that meets current federal standards for tank sizes greater than 55 gallons.
4. **Account for dual baselines when calculating TRBs.** Consistent with the PY20 Verification, AEG found that Hawai'i Energy did not consistently implement dual-baselines for lighting projects under BHTR Energy Advantage (small-business direct-install), CBEEM, or BEEM lighting. For BHTR and CBEEM lighting, dual-baseline corrections affected both lifetime energy savings and TRBs. However, for BEEM, corrections only affected TRBs, which probably stems from the fact that the PY21 TRM included per-unit lifetime savings that Hawai'i Energy apply directly in the tracking database using a deemed approach. The TRM did not provide deemed per-unit TRBs for any measures. Hawai'i Energy should use the dual-baseline approach to calculate TRBs for BHTR Energy Advantage and prescriptive lighting measures (including prescriptive lighting implemented under the CBEEM program) to avoid overestimating TRBs in the tracking database.
5. **Account for dual baselines for custom lighting projects.** Consistent with the PY20 Verification, AEG found that when custom lighting projects replaced incandescent lamps, Hawai'i Energy used the first-year energy savings for the duration of the measure life. Adjusting lifetime savings for dual baselines lowered verified lifetime savings by more than 50% for those projects.
6. **Clearly investigate, document, and remove savings from previously-rebated projects when using metered or utility billing data as needed to estimate custom project savings.** Customers may engage with Hawai'i Energy over the course of many program years through multiple program channels. Certain estimation methods, such as IPMVP Option C, will attribute any energy reductions to the project under review, including reductions driven by previously-rebated projects. This will lead to double-counting savings and paying incentives for the same projects multiple times unless all previously-rebated projects are appropriately accounted for, i.e., by adding prorated project savings to the metered consumption before modeling. Similarly, other non-routine events (e.g., facility expansions) that will change load on the meter(s) need to be properly identified, defined in both magnitude and timing, and removed from the meter data before modeling.

Figure ES-1-1 shows the final performance awards claimed by Hawai'i Energy and verified by AEG for each key focus area and performance metric. Note that to achieve CET awards for first-year and lifetime energy savings, peak demand reductions, and total resource benefits, Hawai'i Energy must meet performance thresholds in specific program categories. Therefore, even though Hawai'i Energy exceeded first-year energy and peak demand savings targets overall, they missed performance targets in some program categories and did not achieve 100% of these awards. See Appendix A: Detailed Performance and Awards Tables

for details on performance and awards targets.

Executive Summary

Figure ES-1-1 Performance and Award Results (Claimed and Verified)

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 Areas¹					70.00%	\$525,000		65.9%	\$345,983		65.0%	\$341,112
First Year Energy Reduction	104,531,117	kWh	15.00%	\$112,500	107,475,477	102.8%	\$106,192	107,456,165	102.8%	\$106,449		\$106,449
Lifetime Energy Reduction	1,358,488,174	kWh	15.00%	\$112,500	1,269,465,046	93.4%	\$57,412	1,169,658,362	86.1%	\$37,939		\$37,939
Peak Demand Reduction	16,125	kW	15.00%	\$112,500	17,001	105.4%	\$98,523	17,621	109.3%	\$112,729		\$112,729
Total Resource Benefit	\$185,408,727	\$	20.00%	\$150,000	\$171,869,271	92.7%	\$46,355	\$160,730,405	86.7%	\$46,495		\$46,495
Grid Services Ready (new)	1,000	projects/ demand management products installed or customers served	5.00%	\$37,500	1,896	189.6%	\$37,500	1,892	189.2%	\$37,500		\$37,500
Greenhouse Gas Emissions/ Barrel of Oil	74,095 / 170,968	tons / barrels	0.00%	\$0	74,168 / 172,569	100.1% / 100.9%	\$0	76,168 / 177,135	102.8% / 103.6%	\$0		\$0
Accessibility & Affordability - Key Focus Areas					20.00%	\$150,000		40.0%	\$60,000		40.0%	\$60,000
Economically Disadvantaged												
Business A&A (Energy Advantage, Energy Relief Grant)												
Customers Served	550	Customers served	2.00%	\$15,000	619	113%	\$15,000	617	112%	\$15,000		\$15,000
Bill Savings	\$1,100,000	Customer bill savings (annual)	2.00%	\$15,000	\$2,067,829	188%	\$15,000	\$2,310,136	210%	\$15,000		\$15,000
Residential A&A (Single & Multifamily Direct Install, Water Heating Direct Install, Bulk Appliances)												
Customers Served	2,000	Customers served	2.00%	\$15,000	2,193	110%	\$15,000	2,193	110%	\$15,000		\$15,000
Bill Savings	\$5,400,000	Customer bill savings (lifetime)	2.00%	\$15,000	\$3,152,818	58%	\$0	\$2,793,390	52%	\$0		\$0
Community Based Energy Efficiency (new)	4	Communities served	1.00%	\$7,500	5	125%	\$7,500	5	125%	\$7,500		\$7,500
EmPower Hawai'i Project (new)	7	Participating non-profits	1.00%	\$7,500	8	114%	\$7,500	8	114%	\$7,500		\$7,500
Island Equity												
County of Hawaii	13%	Target spend must be met in Hawaii & Maui Counties for Milestone & Target Award	10.00%	\$75,000	13.2%	102%	\$0	13.2%	102%	\$0		0%
County of Maui	13%				12.4%	95%		12.4%	95%			
City & County of Honolulu	74%				74.4%	101%		74.4%	101%			
Economic Development & Market Transformation - Key Focus Areas					8.00%	\$60,000		100.0%	\$60,000		100.0%	\$60,000
Behavior Change												
Workshop and Presentations												
STEM based student workshop	1,200	Number of participant-hours of Training	1.00%	\$7,500	1,406	117%	\$7,500	1,376	115%	\$7,500		\$7,500
Adult Learning	2,500	Number of participant-hours of Training	1.00%	\$7,500	3,051	122%	\$7,500	3,027	121%	\$7,500		\$7,500
Gamification Campaigns and Competitions	700	Number of participants	0.00%	\$0	1,300	186%	\$0	1,300	186%	\$0		\$0
Exhibit Educational Resources	0	Number of Stakeholder Collaboration Events	0.00%	\$0	0	n/a	\$0	0	n/a	\$0		\$0
Sustained Outreach	2	Participation Agreements	0.00%	\$0	0	0%	\$0	0	0%	\$0		\$0
Behavioral Insights	0	Number of Program Interventions	0.00%	\$0	0	n/a	\$0	0	n/a	\$0		\$0
Professional Development & Technical Training												
Clean Energy Ally Support												
Targeted Ally Training Opportunities												
Targeted Participant Training Opportunities												
Educator Training and Grants	7,000	Number of participant-hours of Training	4.00%	\$30,000	7,313	104.5%	\$30,000	7,298	102.8%	\$30,000		\$30,000
Degree Program Support												
Vocational Training												
Energy in Decision Making												
Strategic Energy Management (SEM)	4	Number of new participating institutions	1.00%	\$7,500	4	100.0%	\$7,500	4	100.0%	\$7,500		\$7,500
Codes and Standards												
Appliance Standards Advocacy (new)	3	Advocacy Events			6			6				
Improve Code Compliance	1	Establishing compliance roadmap and tracking savings			1			1				
Code-Related Training	50	Number of participant-hours of Training	1.00%	\$7,500	50	200.0%	\$7,500	50	102.8%	\$7,500		\$7,500
Leading edge technologies and strategies	2	Meeting and one final report			2			2				
Clean Energy Innovation Hub												
Innovation and Emerging Technologies	1	Companies supported	0.00%	\$0	1	100.0%	\$0	1	100.0%	\$0		\$0
Customer Satisfaction - Key Focus Areas					2.00%	\$15,000		100.0%	\$15,000		100.0%	\$15,000
Application Processing Customer Experience - Commercial	>9	Overall customer satisfaction score	1.00%	\$7,500	9.6	106.7%	\$7,500	9.6	106.7%	\$7,500		\$7,500
Application Processing Customer Experience - Residential	>9	Overall customer satisfaction score	1.00%	\$7,500	9.4	104.4%	\$7,500	9.4	104.4%	\$7,500		\$7,500
Total Performance Award					100%	\$750,000		64%	\$480,983		63%	\$476,112

¹Note that to achieve CET awards for first-year and lifetime energy savings, peak demand reductions, and total resource benefits, Hawai'i Energy must meet performance thresholds in specific program categories. Therefore, even though Hawai'i Energy exceeded first-year energy and peak demand savings targets overall, they missed performance targets in some program categories and did not achieve 100% of these awards. See Appendix A: Detailed Performance and Awards Tables for details on performance and awards targets.



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INTRODUCTION

The Hawaii Public Utilities Commission (the Commission) contracted the 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 2021 (PY21, July 1, 2021, to June 30, 2022). This report summarizes AEG's verification results, which build upon verification efforts and protocols established during the PY17 through PY20 verifications.

This report presents the results of AEG's fifth verification of Hawai'i Energy's programs. The PY21 verification is similar to past efforts but has a few key differences, as explained in the following table.

Table 1-1 Key Similarities and Differences between the past Verification Efforts (PY17-PY20) and the PY21 Verification

<i>Key Similarities</i>	<i>Key Differences</i>
<ul style="list-style-type: none"> • Verification of all performance metrics • Excel-based database replication to verify the population of measures that used information from the Technical Reference Manual (TRM) to estimate savings • Desk reviews to dig deeper into a sample of projects to verify data entry (for TRM-related projects) and savings (for custom projects) • Program manager interviews, including a focus on how the pandemic affected programs • Verification of the low-to-moderate income (LMI) performance indicator metric (PIM) 	<ul style="list-style-type: none"> • AEG worked with RHA Energy as a subcontractor to perform 30 on-site verifications for the CBEEM program. • Added a qualitative review of Hawai'i Energy's compliance with the Custom Project Guidance Document and directly tied non-compliance with key data element to explicit repercussions when verifying savings.

Metrics and Verification Objectives

PY21 marked Hawai'i Energy's third year in the Triennial Plan for program years 2019 to 2021 (PY19-21) and its 12th year implementing energy efficiency programs as a PBFA. AEG verified whether Hawai'i Energy met the targets for the performance indicators and key focus areas listed in Table 1-2, which determines the performance awards that Hawai'i Energy is eligible to receive in PY21. The awards for residential and business clean energy technologies (CET) targets are assessed by program category, including prescriptive, hard-to-reach (HTR), and custom programs.

Table 1-2 PBFA Performance Indicators and Metrics for Performance Awards

Performance Indicator/Key Focus Area		Metric
Clean Energy Technologies (70% of Award)		
First-Year Energy Reduction		kWh
Lifetime Energy Reduction		kWh
Peak Demand Reduction		kW
Total Resource Benefit		\$
Grid Services Ready ²		projects/products
Greenhouse Gas Reductions/ Barrel of Oil		tons/barrels
Accessibility & Affordability (20% of Award)		
Economically Disadvantaged	Business - Energy Advantage and Energy Relief Grant	Customers served, customer bill savings
	Residential - Single & Multifamily Direct Install, Water Heating Direct Install, Bulk Appliance	Customers served, customer bill savings
	Community-Based Energy Efficiency	Communities served
	EmPower Hawai'i Project	Participating non-profits
Island Equity	County of Hawai'i, County of Maui, City & County of Honolulu	Target spend must be met in Hawai'i & Maui Counties for Milestone & Target Award
Economic Development & Market Transformation (8% of Award)		
Behavior Change	Adult learning	Number of participant-hours of training
	STEM-based student workshops	Number of participant-hours of training
	Gamification Campaigns and Competitions	Number of participants
	Sustained Outreach	Participation Agreements
Professional Development & Technical Training	Clean Energy Ally Support	Number of participant-hours of training
	Targeted Ally Training Opportunities	
	Targeted Participant Training Opportunities	
	Educator Training and Grants	
	Degree Program Support	
Vocational Training		
Energy in Decision Making	Strategic Energy Management (SEM)	Number of new participating institutions
Codes and Standards	Appliance Standards Advocacy	Advocacy Events
	Code-Related Training	Number of participant-hours of training
	Improving Code Compliance	Establishing compliance roadmap and tracking savings
	Leading-edge technologies and strategies	Meeting and one final report
Clean Energy Innovation Hub	Innovation and Emerging Technologies	Companies supported
Customer Satisfaction (2% of Award)		
Application Processing Customer Experience	Commercial, Residential	Overall customer satisfaction score

² Sometimes referred to as Energy Optimization or EO

In conjunction with Hawai'i Energy and the Commission, AEG identified the following critical objectives for the PY21 verification:

- Determine how Hawai'i Energy performed against its performance targets by independently verifying the performance indicator metrics above. (See results throughout Chapters 2 and 3).
- Calculate realization rates of AEG verified to Hawai'i Energy claimed first-year and lifetime energy savings based on tracking database and verification activities. (See Table 2-8 in Chapter 2).
- Investigate and report on the program design and delivery, quality assurance/quality control (QA/QC) procedures, effects of the COVID-19 pandemic, and successes and challenges using program manager interviews. (See *Program Year 2021 Summary* below).
- Provide recommendations for program improvements based on findings from the verification activities. (See *CET Highlights and Recommendations* in Chapter 2 and *Non-CET Highlights and Recommendations* in Chapter 3).
- Identify cases where future verification efforts should consider updates to the technical reference manual (TRM) or alternative verification approaches. (See *CET Highlights and Recommendations* in Chapter 2).
- Determine whether Hawai'i Energy implemented the recommendations from the PY20 verification as relevant to PY21 (See Appendix B).
- Determine the extent to which Hawai'i Energy served low-to-moderate income (LMI) customers and the savings associated with the LMI population using definitions included in the Hawaii Commission Decision & Order 37787.³ (See *Low-to-Moderate Income (LMI) Performance Incentive Mechanisms (PIM)* in Chapter 3).
- Determine the level to which Hawai'i Energy's project documentation and savings estimation methodologies aligned with the Custom Project Guidance Document.

AEG did not design PY21 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 savings for the PY21 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.⁴

Hawai'i Energy Programs

In the sections below, we first present descriptions of the residential and commercial programs that are offered by Hawai'i Energy. In addition, we present a summary of the program year's successes and challenges based on the program manager interviews conducted by AEG staff.⁵

Residential Programs

In PY21, Hawai'i Energy implemented four residential sector programs, summarized below. These programs aim to reduce barriers, including up-front costs and access to measures that help customers save energy and lower utility bills. The residential programs have a network of Clean Energy Allies (CEAs) that help deliver the programs, and Hawai'i Energy works closely with CEAs to provide training and shared advertising opportunities.

³ This verification includes only the Hawai'i Energy portion of the LMI performance incentive mechanism and consists of three metrics. The first two are the verified kWh and kW from RHTR. The third is the number of customers in the single-family and multifamily direct install, water heating direct install, and bulk appliances. (D&O 37787, pages 29-31.)

⁴ AEG compared Hawai'i Energy database information to the PY21 TRM V1.0 information.

⁵ As part of the PY21 verification effort, AEG interviewed five Hawai'i Energy program managers covering all programs in the residential and commercial sectors and the A&A and MTED key focus areas. The interviews focused on the effects of COVID-19, marketing and awareness, and the future of the programs.

The four residential programs offered by Hawai'i Energy in PY21 are described in more detail below.

- The **Residential Energy Efficiency Measures (REEM)** is designed to provide comprehensive energy services through three initiatives:
 - An upstream initiative that provides rebates to retailers, which were passed to residential customers as lower-cost, energy-efficient equipment;
 - A traditional downstream initiative that delivers measures through retail and trade-ally channels;
 - And an online marketplace that allows customers to directly purchase certain measures and measure bundles, including energy efficiency kits.
- The **Residential Hard-to-Reach (RHTR)** program delivers measures to single-family and multifamily households that can be hard to reach using traditional mechanisms. Major initiatives in the RHTR program include:
 - A single and multi-family direct installation service package that targets hard-to-reach communities and publicly funded housing such as rural communities, underserved and vulnerable populations, and Section 8 housing;
 - An appliance trade-up and retrofit program that includes water heating, replacement of window AC units, smart appliances, EV charging, and other upgrades;
 - And a heat pump water heater heating initiative that assesses opportunities for centralized and in-unit heat pump water heaters within multi-family residences.
- The **Residential Energy Services and Maintenance (RESM)** program incentivizes tune-ups, by a participating contractor, for existing air conditioners or solar water heaters. According to the program managers interviewed, the tune-ups provide good business for their contractor base.
- The **Custom Residential Energy Efficiency Measures (CREEM)** program enables Hawai'i Energy to incentivize energy efficiency projects for measures not included in the TRM.

Residential Energy Efficiency Measures (REEM)

Comprehensive prescriptive rebate program including upstream and downstream mechanisms.

Residential Hard-to-Reach (RHTR)

Prescriptive rebates targeting underserved customers through direct install and downstream mechanisms.

Residential Energy Services and Maintenance (RESM)

Incentivizes tune-ups for air conditioners or solar water heaters.

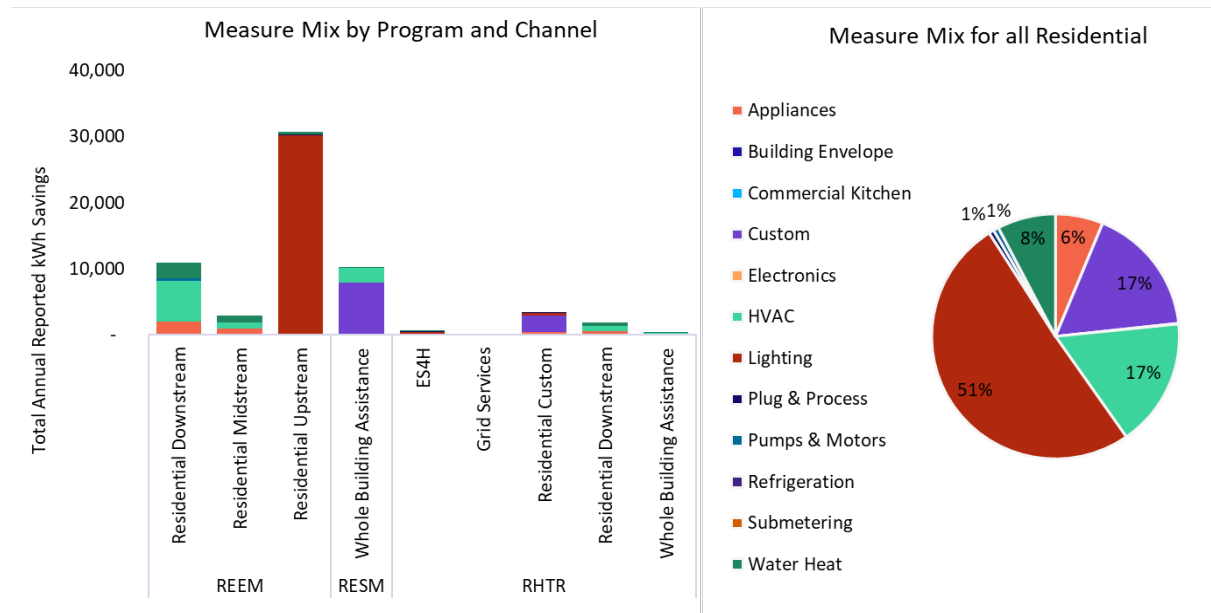
Residential Custom Energy Efficiency Measures (CREEM)

Incentivizes rebates for non-prescriptive projects.

Figure 1-1 illustrates the distribution of reported savings across the residential programs. Verified savings are presented in Chapters 2 and 3. The figure presents the mix of measures in each PY21 residential program and delivery channel and in total across all residential programs. While only the Residential Upstream channel of REEM (dark red) focuses heavily on lighting, lighting measures still account for about 50% of residential reported savings. Second-most prevalent include HVAC measures and custom projects. The remainder of the portfolio includes water heating and appliance measures, which Hawai'i Energy delivers through several program channels.

As the EISA lighting standard takes full effect (expected mid-2023), we expect the lighting savings to drop dramatically and for savings from other measures, particularly HVAC, appliances, and water heating, to increase as a proportion of all savings.

Figure 1-1 PY21 Claimed Savings in Residential Programs Measure Mix



Business (Commercial) Programs

In PY21, Hawai'i Energy implemented four business sector programs, summarized to the right. These programs focused on aligning program offerings with customer needs and helping local businesses access projects. According to program managers, the main drivers of program participation include reducing upfront costs, savings on energy bills, corporate goals, and a preference for taking care of the environment.

The four business programs offered by Hawai'i Energy in PY21 are described in more detail below:

- Business Energy Efficiency Measures (BEEM)** program provides prescriptive incentives for standard energy efficiency technologies and utilizes the TRM to determine savings for each project.

Comprehensive prescriptive rebate program leveraging TRM-based savings.
- The Business Hard to Reach (BHTR)** program provides the installation of energy-efficient measures by program-qualified trade allies and rebates for downstream purchases of energy-efficient commercial kitchen equipment by participants. The program is designed to reach historically underserved markets based on geography and demographics. These include small businesses, restaurants, and lower-income multifamily properties on commercial-rate meters.

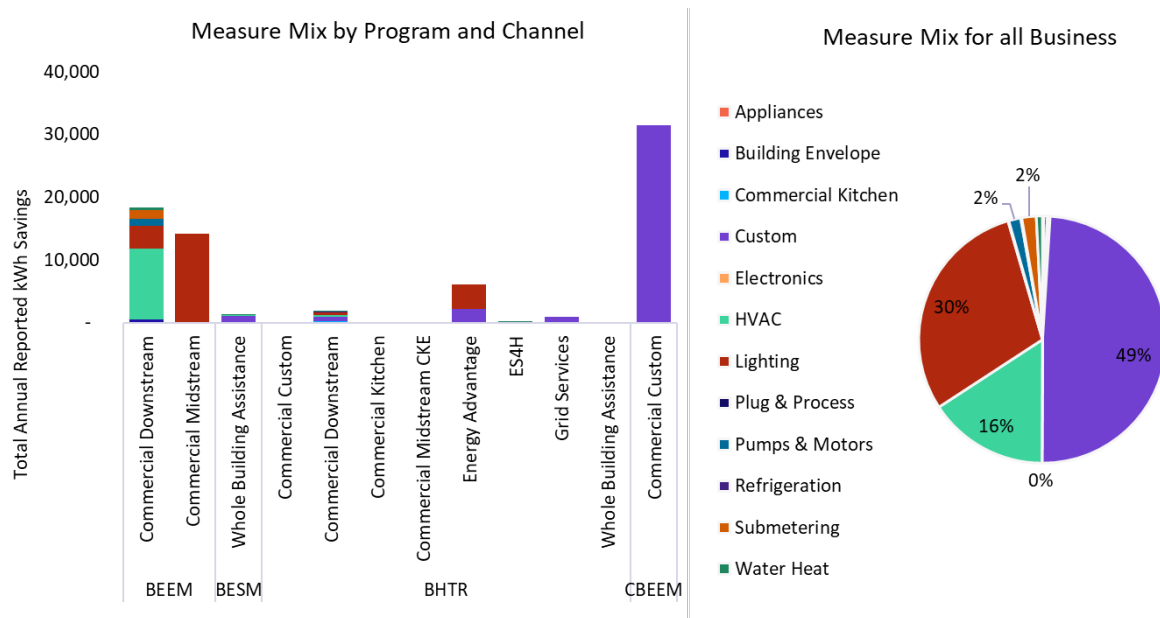
Prescriptive rebates targeting underserved customers through direct install.
- Business Energy Services and Maintenance (BESM)** program provides business customers with retro-commissioning, strategic energy management, submetering, and energy audits.

Incentivizes retrocommissioning, strategic energy management, submetering, and audits.
- Custom Business Energy Efficiency Measures (CBEEM)** program provides incentives for energy-saving measures not covered by prescriptive incentives. Project-specific calculations estimate the energy savings and determine the incentive offered to the customer.

Incentivizes rebates for non-prescriptive projects.

Figure 1-2 illustrates the distribution of reported savings across the commercial programs. Verified savings are presented in Chapters 2 and 3. The figure presents the PY21 measure mix for the business programs by program and delivery channel and in total across the business portfolio. Custom projects accounted for nearly 50% of the reported business portfolio first-year energy savings in PY21. Roughly two-thirds of the projects completed through CBEEM were custom lighting, suggesting that, like the residential portfolio, the business portfolio relied heavily on lighting to reach performance targets. After CBEEM, prescriptive lighting contributed another 30% to savings, nearly all of which came from the midstream channel of BEEM. Another 16% came from HVAC measures installed through the BEEM program’s downstream channel.

Figure 1-2 PY21 Business Program Measure Mix



Program Year 2021 Summary

Below we summarized the information gathered during the program manager interviews into three subsections: COVID-19 Recovery, Effects of EISA Standards, and New Initiatives.

COVID-19 Recovery

Whereas PY20 was affected deeply by COVID-19, PY21 marked a year of stabilization. More businesses reopened and employees returned to their offices to work in person. Hawai’i Energy attempted to increase in-person engagement with customers, from free site visits to low- and no-cost trainings and workshops. Hawai’i Energy had adapted well to virtual engagement, however, and retained many of its offerings in virtual form. Its virtual reach allowed Hawai’i Energy staff, based on Oahu, to connect with hard-to-reach (HTR) customers such as the low-to-moderate income (LMI) customer segment, kūpuna (elderly) customers, and customers in remote areas of Oahu and on neighbor islands. There was a “mixed response” to in-person workshops; Hawai’i Energy staff acknowledged they may have tried to revive in-person offerings too soon. Similarly, limitations with in-person interaction inhibited the engineering team’s ability to conduct site visits and collect data to calculate energy savings for projects.

Despite a “return to normal,” Hawai’i Energy still faced several obstacles:

- COVID-19 forced many businesses to focus on staying afloat and making it to the next month rather than looking ahead to the next year or farther out. As such, they don’t have substantial (or sometimes any) budget to invest in capital improvement projects such as energy efficiency upgrades. Hawai’i Energy staff perceives this to be more than a temporary, short-term issue.

- COVID-19 also shook up the labor force, resulting in a combination of businesses being understaffed and/or having different points of contact that lack the institutional knowledge of previous “energy champions” at those businesses. For example, many customers in the hospitality sector experienced churn with respect to facilities directors. Hawai‘i Energy devoted time and resources toward establishing, repairing, and bolstering connections with commercial customers in PY21.
- Supply chain delays massively hindered the timeliness with which energy efficiency projects could be completed, and inflation, while bringing much-needed attention and awareness to the benefits of energy efficiency, weakened the lubricating effects that rebates have on facilitating new projects.

Furthermore, the closure of the AES Hawai‘i Power Plant, Hawai‘i’s last coal-fired power plant, caused an increase in energy rates that applied additional pressure on residential customers already deeply affected by high costs of living. Their increased need for energy efficiency is undercut by an increased inability to afford it.

Hawai‘i Energy tried to combat these obstacles by strengthening its relationships with its Clean Energy Ally (CEA) network. In addition to hosting its annual CEA kickoff in person for the first time since before the COVID-19 pandemic, Hawai‘i Energy proactively solicited feedback from CEAs regarding customer feedback and needs. Hawai‘i Energy wants to empower smaller contractors to make community connections, which helps them act as a “force multiplier” on Hawai‘i Energy’s behalf. Hawai‘i Energy also revamped its online portal to improve the CEA experience. There were growing pains, but the portal is more efficient now, and program staff reported that Energy Advisors and CEAs preferred Salesforce over the previous platform. Persistent incremental gains from managing CEA relationships will help alleviate, but not necessarily overcome, the economic and market-based issues impacting project viability.

Effects of EISA Standards

In addition to COVID-related complications, Hawai‘i Energy is facing constraints on achievable energy savings. Changing standards per the Energy Independence and Security Act of 2007 (EISA) will eliminate energy savings for most forms of LED lighting, the biggest contributor to portfolio energy savings annually in both the residential and business portfolios (51% and 30%, respectively). Note however, that some commercial lighting and nearly all custom commercial lighting remains unaffected by the EISA standards which have the highest impact in residential as all general service lighting (GSL) moves to an LED baseline.

New Initiatives for PY21

Hawai‘i Energy launched a new program, Power Move, in advance of the AES Hawai‘i Power Plant closure. According to the Hawai‘i Energy annual report, the Power Move program includes two forms of rebates:

- The first awards customers a with a demand savings bonus for energy efficiency projects that reduce consumption between the hours of 5-9 pm on weekdays.
- The second aims to support enrollment in Hawaiian Electric Company’s (HECO) Battery Bonus program through the Commercial Energy Storage offering, which incentivizes commercial battery storage installations (used with existing solar PV systems) to reduce demand during peak load times on Oahu and Maui.

Additionally, in light of legislative focus on demand response as part of the state’s Energy Efficiency Portfolio Standards (EEPS), Hawai‘i Energy provided bonuses for hotel energy management systems, such as smart thermostat occupancy sensors for air conditioners in guest rooms. This effort intends to incorporate “demand response readiness” into the grid.

Other market transformation efforts include green real estate. Hawai‘i Energy sought to inform Realtors and real estate agents about the importance of energy efficiency in new and existing homes. Response to in-person green real estate workshops organized by Hawai‘i Energy was tepid. Because the housing market peaked in PY21, it was unclear to Hawai‘i Energy staff if low attendance was a byproduct of a lack of interest or a lack of time to devote to continuing education.

Hawai'i Energy launched two initiatives in PY21 that directly impacted their progress toward PBFA CET business targets, even though they were not tracked as formal performance categories: the Commercial Kitchen Equipment (CKE) Midstream Program and a Refrigeration Training Effort. The following sections describe the design, delivery, performance, and future of these initiatives.

Commercial Kitchen Equipment (CKE) Midstream Program

During PY21, Hawai'i Energy launched the CKE program, a midstream program that repackaged commercial kitchen rebates from other programs and models the program's delivery on the BEEM midstream lighting program. The goal of the program was to create engagement with end-use customers, primarily restaurants that don't participate in downstream rebate programs and have small capital improvement budgets by offering rebates at point-of-sale to better target customers for this specific equipment. Hawaii only has two commercial kitchen equipment distributors, so Hawai'i Energy staff devoted a significant portion of PY21 to making connections with them, communicating to them the purpose, mechanics, and benefits of the program, and understanding the distributors' processes to make the program successful upon launch.

Table 1-3 describes the three targets Hawai'i Energy created to measure the performance of the CKE program and shows their results against those targets. Hawai'i Energy achieved its goal for distributor engagement and learned that its target for increasing the program's number of participating distributors is incompatible with the commercial kitchen equipment landscape in Hawaii; Hawai'i Energy staff told AEG almost all distribution is handled by these two companies.

Table 1-3 CKE Program Targets, Metrics, and Performance

Target and Metric	Performance
Increase number of suppliers/distributors	Did not meet: +0 suppliers/distributors*
Increase percentage of sold inventory by 5%	N/A: insufficient data
Engage directly with participating distributors a minimum of 7 times each	Met/exceeded: 7 or 8 engagements with two distributors

* Through its engagement with distributors in PY21, Hawai'i Energy determined that a distributor engagement target did not align well with the realities of Hawaii's limited commercial equipment landscape.

In addition to the interviews conducted with AEG, Hawai'i Energy staff documented internal discussions and lessons learned and shared them with AEG:

- Hawai'i Energy surveyed the two distributors to collect information about prior-year sales in order to characterize the market share of electric energy-efficient commercial kitchen equipment. Because of instances of unclear instructions, the survey was administered twice, both times resulting in responses that Hawai'i Energy staff could not use reliably to further its market characterization efforts.⁶ Hawai'i Energy plans to simplify the survey moving forward.
- Hawai'i Energy is considering using increases in incentive dollars paid as a performance metric in place of increases in the percentage of energy-efficient inventory sold.
- Hawai'i Energy is considering using the number of sales members from distributors actively providing instant rebates to customers, which is tracked through the distributor rebate submission process, as a performance metric in place of direct engagement with distributors.
- Hawai'i Energy may revise the definition of refrigeration equipment to exclude standard refrigerators and freezers that do not conform with the initiative's intended equipment types (primarily walk-in coolers/freezers and industrial refrigeration).

⁶ In the first survey, distributors may have included natural gas measures in their record of "percent efficient models." In the second survey, distributors may have included non-ENERGY STAR® models in their record of "percent efficient models."

- Revising this definition may shrink the number of eligible contractors that Hawai'i Energy could otherwise recruit to participate in the initiative under the current definition.
- Hawai'i Energy may consider using increases in peak demand reduction as a performance metric to complement the target for increases in energy savings.

Refrigeration Training Effort

The Refrigeration Training Effort is a market transformation initiative designed to increase interest in, awareness of, and knowledge about refrigeration efficiency and rebates. Hawai'i Energy staff leveraged the initiative to train CEAs and educate customers about the availability of refrigeration retrofit rebates and the benefits of energy-efficient refrigeration equipment.

Staff conducted training with CEAs to better engage contractors in the refrigeration market about energy efficiency opportunities and how they can help encourage businesses to incorporate energy efficiency into future projects. The program's target customer segment (primarily grocery stores and some hotels with walk-in coolers) has been challenging for Hawai'i Energy to penetrate historically. Staff conducted audits with local grocery chains to facilitate interest and adoption, but the widespread reluctance to invest in capital improvement projects, including among grocery stores, impedes progress. Hawai'i Energy plans to conduct market research, such as benchmarking rebate levels and incremental costs, to better position the program for uptake in PY22 and beyond.

Table 1-4 describes the three targets created to measure the performance of the Refrigeration Training Effort as well as Hawai'i Energy's results against those targets. While Hawai'i Energy exceeded the initiative's goal for increasing first-year energy savings relative to PY20, it failed to meet targets for increased numbers of projects, CEAs, unique participants, and unique customer facility types. Staff hypothesized that the number of projects and unique participants did not increase year over year because of supply chain delays and the program-wide slowdown in custom projects (although custom projects drove the year-over-year increase in energy savings compared to PY20).

Table 1-4 Refrigeration Training Effort Targets, Metrics, and Performance

Target and Metric	Performance
Increase number of projects and energy savings by 5% relative to PY20	Partly met: +0% projects, +58% energy savings
Increase number of CEAs that supply refrigeration equipment	Did not meet: +0 CEAs
Increase number of unique participants and customer facility types	Did not meet: -13% unique participants, -11% unique facility types

In addition to the interviews conducted with AEG, Hawai'i Energy staff documented internal discussions and lessons learned and shared them with AEG:

- Although the number of committed CEAs did not increase, more CEAs and non-CEA contractors attended refrigeration training opportunities than in previous program years. Per Hawai'i Energy, "by reaching out to a broader contractor pool, it allows more customer[s] and customer types to be impacted by the program."
- To increase engagement among refrigeration vendors/contractors, Hawai'i Energy will consider tracking the number of unique refrigeration vendors/contractors listed on refrigeration projects.

Organization of the Report

We organized the remainder of the report into two chapters:

- Chapter 2: CET Verification Findings
- Chapter 3: Non-CET Verification Findings

Each chapter presents an overview of Hawai'i Energy's performance relative to targets, discusses any adjustments made through verification activities, and finally provides recommendations ranked in priority order.

Detailed information is presented in appendices, including program-level results for performance awards and verification findings. Appendices include:

- Appendix A: Detailed Performance and Awards Tables
- Appendix B: Historical Verification Recommendations
- Appendix C: Low-to-Moderate Income Performance Incentive Mechanisms
- Appendix D: Detailed Methodologies
- Appendix E: Sample Design and Extrapolation

Additionally, AEG provided a companion Excel file that details verification findings for specific measure categories and projects by verification task.

2

CLEAN ENERGY TECHNOLOGY VERIFICATION FINDINGS

This chapter summarizes the results and findings for residential and business Clean Energy Technology (CET) programs and presents the detailed results. We first give an overview of Hawai'i Energy's performance against the five CET targets with respect to claimed and verified savings. Next, we present an overview of the methods we used during the verification. Then, we review the various adjustments to the claimed savings resulting from each verification activity. And finally, we present some highlights and our recommendations.

Verification activities informed the extent to which Hawai'i Energy:

- Correctly followed the PY21 V2.0 TRM to report impacts for deemed and semi-prescriptive measures.
- Applied the appropriate energy savings calculations for custom measures.
- Accurately recorded measure characteristics in the tracking system based on documentation.
- Accurately claimed total resource benefits (TRB) and avoided GHG emissions.
- Accurately claimed project counts associated with Grid Services Ready products.
- Aligned with the Custom Project Guidance Document.

Overview of CET Performance

The PBFA Awards for CET energy and demand savings and total resource benefits are assessed at the program category level and mapped to individual programs, as shown in Table 2-1.

Table 2-1 Programs Mapped to Program Categories

Program Category	Program
Business Custom	CBEEM
Business Hard-to-Reach	BHTR
Business Prescriptive	BEEM, BESM
Residential Hard-to-Reach	RHTR
Residential Incentives	REEM, CREEM, RESM

Program categories must meet a target threshold of 95% of **first-year (annual) and lifetime energy savings (kWh), peak demand reductions (kW), and total resource benefits (TRB)** targets to earn awards for these performance indicators. This can cause the realization rates between verified and reported savings to appear at odds with changes to the claimed awards.⁷ Grid Services Ready and GHG avoided emissions target thresholds are set at 100% for awards, and the targets are not set for individual program categories.

Figure 2-1 shows Hawai'i Energy PBFA program verified performance against CET performance indicator targets for first-year and lifetime energy savings, peak demand reductions, and total resource benefits (\$). The verification findings show the following with respect to the CET targets:

- Hawai'i Energy met the CET first-year and lifetime energy savings, demand savings, and TRBs targets for **Residential Hard-to-Reach** and **Residential Incentives** program categories.

⁷ For example, an annual energy savings realization of 105% could be driven by one program category, but if that program category still fell short of its annual energy savings performance target, the verified awards could fall below the claimed awards despite the >100% realization rate.

- **Business Custom** fell short of lifetime and TRB targets. Adjustments made during the verification contributed to the shortfall in lifetime energy savings, which accounted for nearly all the differences in claimed and verified awards. The TRBs reported by Hawai'i Energy fell short of the threshold before the verification made adjustments.
- **Business Hard-to-Reach** also fell short of all but the peak demand reductions target. Hawai'i Energy and its customers continue to face challenges with supply chains and direct installation of measures because of the economic uncertainty and health concerns related to the pandemic.
- **Business Prescriptive** exceeded targets for first-year energy and peak demand savings but fell short of lifetime energy savings and TRB targets. The verification did not impact these shortfalls.

Figure 2-1 PBFA Performance Against CET Targets—Energy and Demand Savings, TRBs

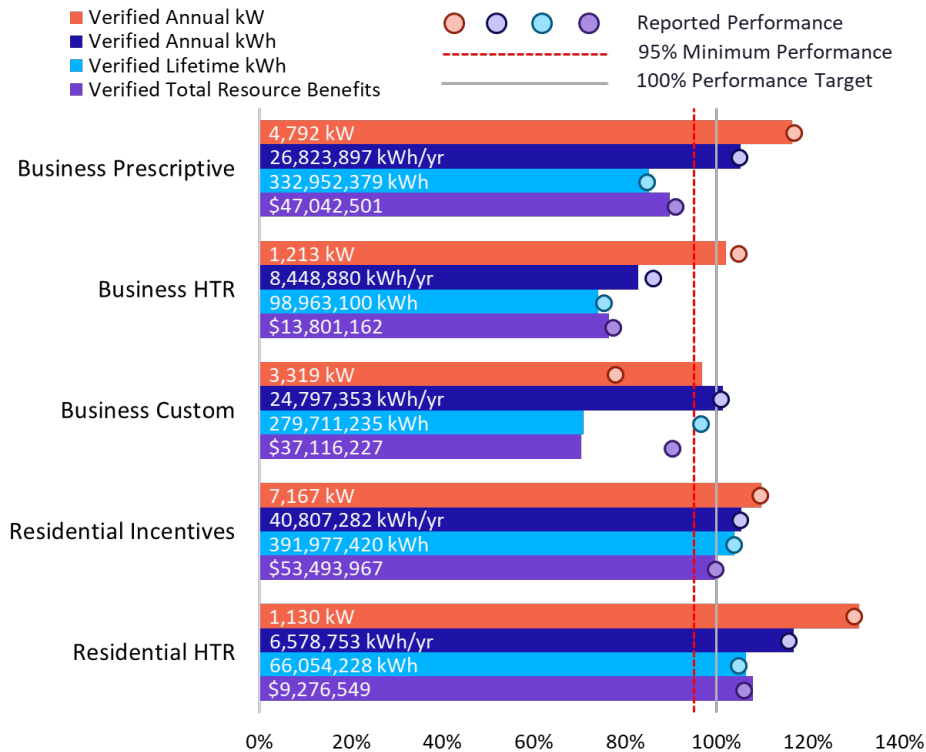
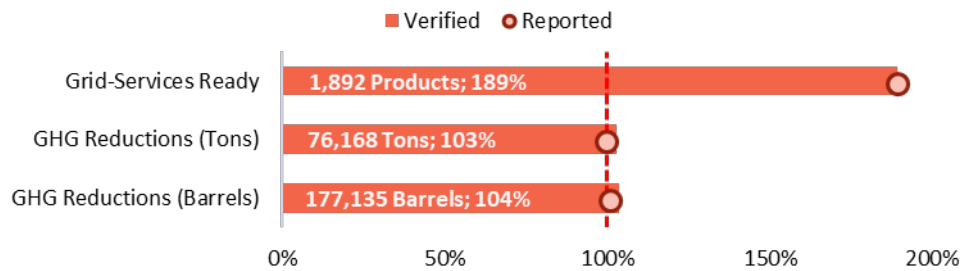


Figure 2-2 shows that, overall, the PBFA programs exceeded Grid Services Ready targets and reached both GHG avoided emissions targets for tons and barrels. While changes from reported GHG emissions were small, AEG was unable to exactly replicate the reported GHG emissions reductions using Hawai'i Energy's reported energy savings, suggesting that some of the discrepancies results from inaccurate applications of GHG conversion factors.

Figure 2-2 PBFA Performance Against CET Targets—Grid Services Ready, GHG Reductions



CET Performance Adjustments (below) provides details on all performance adjustments, and Appendix A provides the final performance towards targets thresholds and achieved awards for each program category.

Summary of CET Verification Methods

Table 2-2 shows how AEG verified each performance metric. As described, we made several adjustments to the performance claimed by Hawai'i Energy through the verification activities. Details on methods, including the detailed Sample Plan for desk reviews and onsite visits, can be found in Appendix D.

Table 2-2 Clean Energy Technology Summary of Verification Methods

Performance Metric	Description of Metric	Verification Activities and Adjustments
Energy and Demand Savings* 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 Onsite Adjustment through in-person site visits to spot check key savings estimation parameters and confirm the installation and operation of rebated equipment.
	System-Level Savings Savings reflected at the generator incorporating line losses	System-Loss Adjustment through a review of the system loss factors (in PY21 TRM V1.0) 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 PY21 TRM V1.0) 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 NTG ratios to calculate TRBs for each program and measure (avoided costs already include line losses so are not included in savings at this step). Avoided costs as stipulated in PY21 TRM V1.0.
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 Reductions	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.

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

CET Performance Adjustments

As described in Table 2-2, AEG determined the PBFA programs' performance towards targets through multiple incremental adjustments to the savings claimed by Hawai'i Energy. This section provides key findings for:

- **Energy and Demand Savings** Adjustments to first-year energy savings, lifetime energy savings, and peak demand reductions at each of the three levels of savings (customer, system, and program-level)
- **Total Resource Benefits** Adjustments
- **Grid Services Ready** Adjustments
- **GHG Reductions** Adjustments

Energy and Demand Savings Adjustments

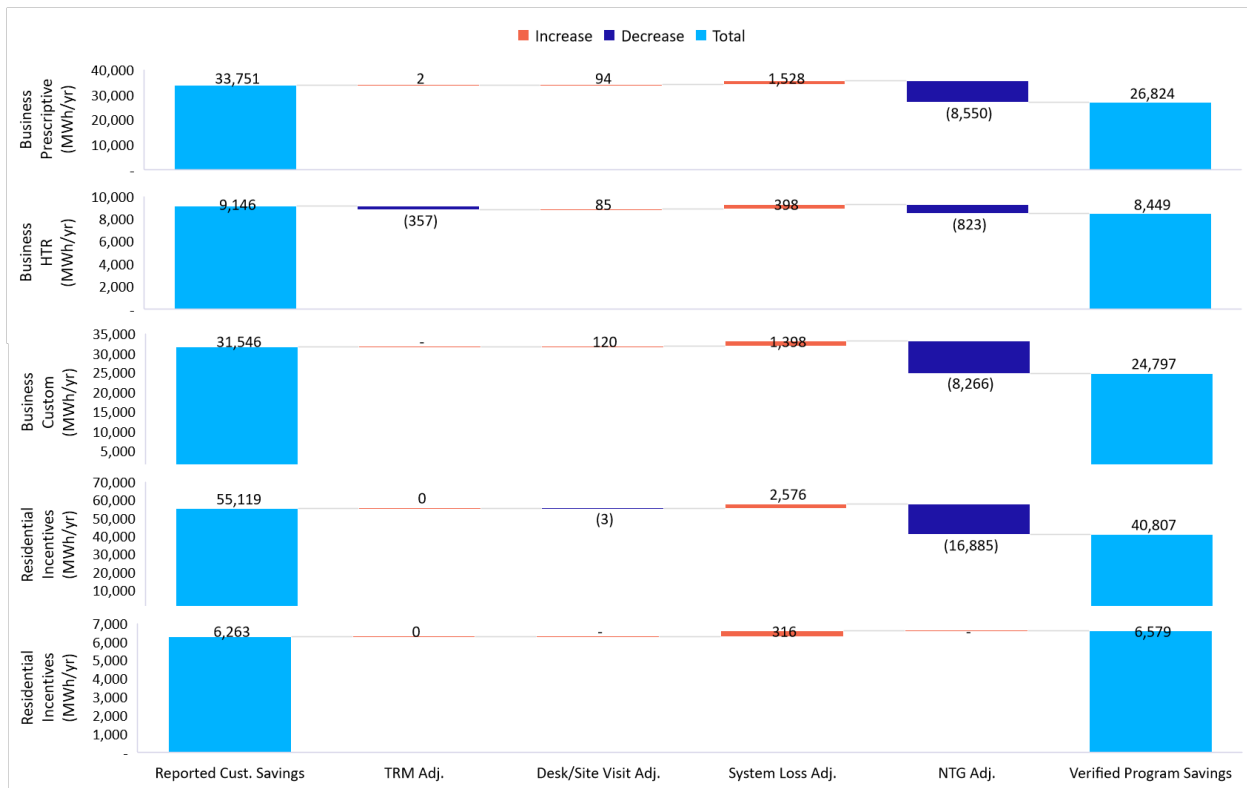
AEG verified energy and demand savings through adjustments to the claimed customer-level savings (gross savings), system-level savings (adjusted for system line losses), and program-level savings (attributable to the PFBA programs after accounting for spillover and free ridership).

Figure 2-3 shows the overall adjustments to first-year energy savings at the customer, system, and program levels by program category. We begin with the customer-level savings tracked in the database on the left and end with the verified program-level savings on the right by making the following adjustments:

- **Customer-Level adjustments** from AEG's TRM replication, desk review, and onsite visit verification activities;
- **System-Loss adjustments** applied by both AEG and Hawai'i Energy; and
- **Net-to-Gross (NTG) adjustments** applied by both AEG and Hawai'i Energy.

Adjustments to the customer-level savings based on the desk reviews and onsite visits resulted in a less than 1% decrease in first-year energy savings, an 8% decrease in lifetime energy savings, and a 4% increase in peak demand reductions. Desk review and onsite visit adjustments were largely driven by Business Custom (-25% of reported lifetime kWh savings and +24% of reported peak demand reductions). Both AEG and Hawai'i Energy made similar adjustments to system loss (+5%) and NTG (-29%). These adjustments all fed directly into the program-level savings. The overall program-level portfolio realization rates of 100% (first-year energy), 92% (lifetime energy), and 104% (peak demand) savings were driven almost entirely by the desk review and onsite visit adjustments to claimed customer-level savings.

Figure 2-3 First-Year Energy Savings Adjustments



In the following subsections, we present more detail about the adjustments made throughout the verification process, including individual results for each Hawai'i Energy program.

Customer-Level Savings Adjustments

As described above, AEG made three sets of adjustments to customer-level savings:

- The **TRM Adjustment** compared the claimed customer-level savings to TRM-adjusted savings, which AEG calculated by applying appropriate TRM algorithms to deemed and semi-prescriptive measures in the tracking data population.
- The **Simple Desk Review Adjustment** compared the TRM-adjusted savings to the savings verified by AEG through desk reviews of a sample of deemed and semi-prescriptive measures. Simple desk reviews focused on ensuring the tracking database aligned with backup project documents such as rebate applications and invoices.
- The **Business Custom Adjustment** compared reported savings to those verified by AEG through a combination of desk reviews and onsite visits conducted with sampled business custom projects. These complex reviews also assessed savings calculation methods for engineering best practices.

See Appendix E for a description of how AEG weighted the sample desk review adjustments to the population of projects.

TRM Adjustment

Table 2-3 shows the claimed and TRM-adjusted savings for first-year energy, lifetime energy, and peak demand savings and the resulting TRM adjustment factors for each program at the customer level. AEG only calculated TRM-adjusted savings for projects with savings that were fully deemed or semi-prescribed in the PY21 TRM. Projects not included in this task, including those with custom claimed savings, were assigned a TRM adjustment factor of 1.0.

As shown in Table 2-3, AEG made few and minimally impactful TRM adjustments to the claimed savings, leading to TRM adjustment factors close to 1.0 for all programs. Any programs with adjustment factors that are different from 1.0 are highlighted in bold, orange font.

Table 2-3 Clean Energy Technology TRM Adjustments to Business Customer-Level Savings

Program	Customer-Level First-Year Energy Savings (MWh/yr)			Customer-Level Lifetime Energy Savings (MWh/yr)			Customer-Level Peak Demand Reductions (MW/yr)		
	Claimed	TRM-Adjusted	TRM Adj. Factor	Claimed	TRM-Adjusted	TRM Adj. Factor	Claimed	TRM-Adjusted	TRM Adj. Factor
BEEM	32,577	32,579	1.00	410,293	410,914	1.00	5.93	5.88	0.99
BESM	1,173	1,173	1.00	9,183	9,183	1.00	0.16	0.16	1.00
BHTR	9,146	8,789	0.96	106,051	102,865	0.97	1.30	1.26	0.97
CBEEM*	31,546	31,546	1.00	486,563	486,563	1.00	3.41	3.41	1.00
REEM	44,557	44,557	1.00	448,654	448,655	1.00	7.87	7.86	1.00
RESM	10,320	10,320	1.00	74,381	74,381	1.00	1.95	1.95	1.00
RHTR	6,263	6,263	1.00	62,919	62,919	1.00	1.07	1.07	1.00
CREEM*	242	242	1.00	2,658	2,658	1.00	0.05	0.05	1.00
Total	135,824	135,468	1.00	1,600,703	1,598,137	1.00	21.73	21.64	1.00

*AEG did not include custom projects in the savings replication analysis and used a 100% adjustment factor to calculate the TRM-adjusted savings for all custom projects.

Key takeaways included the following:

- **Thirty percent of BHTR lighting projects installed through Energy Advantage (small business direct install) incorrectly used the full efficient wattage to claim savings**, which led to TRM adjustment factors of 0.96 for verified first-year energy savings and 0.97 for verified peak demand and lifetime energy savings.
- **Hawai'i Energy correctly applied the dual-baseline approach to calculate lifetime energy savings for BHTR Energy Advantage lighting projects that replaced halogen, incandescent, and pre-existing fluorescent equipment.** Unlike in previous program years, adjustments to Energy Advantage projects were generally unrelated to the dual-baseline approach and affected annual energy and peak demand savings similarly.
- **REEM upstream lighting and BEEM lighting and HVAC projects drove portfolio TRM adjustment factors.** 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, heavily contributing to the near-1.0 TRM adjustment factor for the residential programs overall.

Details on specific adjustments are included in an Excel-based appendix made available upon request.

Simple Desk Review Adjustments

AEG verified savings for a sample of customers through simple engineering desk reviews and estimated sample adjustment factors within program and equipment category strata. These reviews focused on ensuring that metrics critical to the savings for each measure matched between the tracking data and backup documentation, such as measure invoices. Other customer information, such as account number and address, were also checked using rebate applications. AEG only used this simple approach for deemed or semi-prescriptive measures.

We weighted the sample adjustment factors to the population of projects within each stratum to estimate population verified customer-level savings, which are shown in Table 2-4.

As shown, the simple desk reviews led to minimal savings adjustments for most programs, ultimately leading to adjustment factors of 1.0 in first-year and lifetime energy savings and peak demand reductions.

Table 2-4 Clean Energy Technology Simple Desk Review Adjustments to Customer-Level Savings

Program	Customer-Level First-Year Energy Savings (MWh/yr)			Customer-Level Lifetime Energy Savings (MWh/yr)			Customer-Level Peak Demand Reductions (MW/yr)		
	TRM-Adjusted	Verified	Desk Review Adj. Factor	TRM-Adjusted	Verified	Desk Review Adj. Factor	TRM-Adjusted	Verified	Desk Review Adj. Factor
BEEM	32,579	32,673	1.00	410,914	412,492	1.00	5.88	5.90	1.00
BESM*	1,173	1,173	1.00	9,183	9,183	1.00	0.16	0.16	1.00
BHTR	8,789	8,874	1.01	102,865	104,003	1.01	1.26	1.27	1.01
REEM**	44,557	44,554	1.00	448,655	448,615	1.00	7.86	7.86	1.00
RESM	10,320	10,320	1.00	74,381	74,381	1.00	1.95	1.95	1.00
RHTR**	6,263	6,263	1.00	62,919	62,919	1.00	1.07	1.07	1.00
CREEM	242	242	1.00	2,658	2,658	1.00	0.05	0.05	1.00
Total	103,923	104,099	1.00	1,111,574	1,114,251	1.00	18.24	18.27	1.00

*AEG did not conduct desk reviews for BESM projects and assumed an adjustment factor of 1.0.

**AEG did not conduct desk reviews for all components of the REEM or RHTR programs. The desk review adjustment factors shown in this table combine the desk review adjustments for the program components included in the desk reviews and the assumed 1.0 desk review adjustment for program components not included in the program.

Key takeaways for all programs included the following:

- **AEG found few systematic issues in documentation or savings reporting based on the simple desk reviews.** Most systematic discrepancies were either fixed through the TRM adjustment or did not lead to changes in savings. Adjustments made based on the simple desk reviews were largely trivial and expected given the large number of measures rebated through the programs (e.g., updating wattages in Energy Advantage).
- **Hawai'i Energy applied the PY21 TRM deemed savings for residential solar water heater projects to all homes with existing solar water heaters without first determining whether the project met the TRM eligibility requirements.** Four of the five projects solar water heater projects sampled for desk reviews replaced existing solar water heaters, which are sized at higher gallons-per-occupant assumptions than electric resistance water heaters. The PY21 TRM uses an electric resistance water heater baseline per current federal standards for water heaters less than 55 gallons and specifies that qualifying replacements must not exceed this equivalent capacity. Hawai'i Energy did not calculate this baseline equivalent capacity for solar water heater replacements despite tracking the number of occupants per home. One of the projects had six occupants, and the water heating demand of the home could not have been met by the electric resistance water heater baseline used to calculate the deemed savings in the TRM. Since the TRM does not provide clear guidance on how to determine the baseline equivalent capacity for solar water heater replacements, and because these replacements still generated energy savings, AEG allowed the projects to be verified at a 100% realization rate. (See *CET Highlights and Recommendations* for further details about the deemed savings and AEG's recommendations.)
- **AEG could not determine whether all lamps and fixtures rebated through BEEM Midstream lighting program qualified for rebates, though AEG did not make any adjustments to savings.** The different naming conventions between the invoices and qualifying products databases made it difficult to determine definitively whether some rebated lamps/fixtures were eligible for program rebates. AEG assumes that Hawai'i Energy performs this screen internally. Including evidence of this screening process would help AEG complete this verification more thoroughly.

Business Custom Adjustments

The AEG Team, including subcontractor RHA Energy Partners, conducted onsite visits with 30 randomly sampled CBEEEM customers, stratified by lighting and non-lighting projects. For each, the AEG Team completed a desk

review, interviewed customers about baseline conditions, visually inspected key equipment, and made post-onsite visit adjustments to savings as needed. In addition, AEG completed another 15 desk reviews for CBEEM projects that were held outside of the onsite visit sample.⁸

Table 2-5 shows the results of all CBEEM verification activities (desk reviews and onsite visits). Similar to previous verifications, corrections to EULs for non-lighting projects and using appropriate dual-baseline approaches for lighting projects led to larger reductions in lifetime energy savings compared to first-year energy and peak demand savings. Calculation errors by Hawai'i Energy led to large increases in peak demand reductions for non-lighting projects.

Table 2-5 Adjustments to CBEEM Customer-Level Savings

CBEEM Stratum	Customer-Level First-Year Energy Savings (MWh/yr)			Customer-Level Lifetime Energy Savings (MWh/yr)			Customer-Level Peak Demand Reductions (MW/yr)		
	Claimed	Verified	Adj. Factor	Claimed	Verified	Adj. Factor	Claimed	Verified	Adj. Factor
Non-Lighting	21,617	21,548	1.00	355,331	258,133	0.73	2.00	2.74	1.37
Lighting	8,993	9,166	1.02	129,488	96,919	0.75	1.29	1.38	1.06
Lighting (Census)*	936	951	1.02	1,743	2,114	1.21	0.12	0.12	1.02
Total	31,546	31,666	1.00	486,563	357,166	0.73	3.41	4.24	1.24

*The AEG Team purposefully selected one lighting project into the sample because it accounted for more than 10% of all lighting savings. Another lighting project was verified by convenience because it was under the same opportunity name (and installed at the same location) as a randomly sampled non-lighting project. AEG did not extrapolate verified savings from these projects to other custom lighting projects because they were not randomly sampled.

Key takeaways from the onsite visits and analysis follow:

- **AEG only verified first-year savings for two projects based on the onsite inspections.** The projects involved the monitoring and optimization of chiller plant performance. Both sites had energy services contracts with a vendor that installed various sensors to monitor flow, temperature, and pressure for the chiller plants and recommended measures that would result in energy savings. Many of the optimization measures relied on continuous monitoring and adjustment to generate savings.

Onsite, AEG found that all monitoring equipment had been removed from both sites because the customer had ended its contract with the monitoring vendor. While some of the optimization measures installed as a result of the monitoring were still in place, others could not be verified or were noted by the customer as never occurring. In general, the absence of the monitoring equipment puts the persistence of these savings into serious question. The rebate application also applied an EUL of 15 years, a value more aligned with an actual energy management system (EMS) piece of equipment and not optimization using an existing EMS. Therefore, AEG only verified one year of lifetime energy savings for both projects.

Although evaluating net-to-gross ratios is outside of AEG’s scope for the PY21 Verification, AEG flagged both of these sites as strong examples of free-riders of the CBEEM program. Based on the project timeline, the vendor had already completed equipment installations and implemented the chiller plant optimization measures before the project was submitted to Hawai'i Energy for consideration of incentive eligibility. Therefore, it is difficult to attribute the energy savings to the program’s influence. While program rules required all commercial custom projects to receive pre-approval, Hawai'i Energy made an exception for these projects because of the substantial

⁸ The desk reviews for the onsite visit sample were limited to projects with customers who willingly agreed to participate in the onsite visits. With this restriction, the overall desk review sample would be biased towards this subgroup of projects without including the additional desk reviews.

savings estimated by the vendor. Combined, these customers received over \$217,000 in PY21 incentives and accounted for nearly 30% of the sampled non-lighting reported savings.

- **AEG more than doubled the EUL for one lighting project in the census stratum, leading to a lifetime kWh adjustment factor of 1.21 for the census stratum.** AEG found that Hawaii Energy’s savings calculation workbook included the correct EUL. However, they did not provide lifetime savings calculations, so AEG could not determine the exact cause of the discrepancy. It may have been driven by the need for a dual-baseline approach, which lowered the lifetime-weighted EUL. AEG used an approximation for the second baseline (45 lm/W as suggested by the PY22 TRM), which may have differed from Hawaii Energy’s approach and caused differences in lifetime savings.
- **Two of the sampled custom lighting projects that replaced incandescent fixtures incorrectly used a single baseline to calculate lifetime savings.** Using the dual baseline approach reduced lifetime savings for these measures by over 50%. Similarly, lifetime savings for the LEDs installed as part of a large military housing initiative were not calculated using the dual baseline deemed values provided in the PY21 TRM.
- **AEG made large adjustments to peak demand savings for two non-lighting custom projects because of a calculation reference error by Hawai’i Energy, leading to adjustment factors to peak demand savings in CBEEM non-lighting projects of 1.37.** In two large multi-community residential housing upgrades, peak demand savings were calculated based on the per-kW rebate value instead of per-kW peak demand savings, which lead to claimed savings realization rates of over 800% for both projects.
- **Lack of adherence to industry best practices in regression modeling led to adjustments for four sampled non-lighting projects.** AEG updated the regression analysis for a refrigeration upgrade and three central plant optimizations. In one case, the approach approved by Hawai’i Energy used actual post-period consumption instead of regressing post-installation consumption on weather to estimate savings for a typical year, which is recommended in the Custom Project Guidance Document that will go into effect in PY22. In the other case, the Hawai’i Energy model included both pre- and post-installation data, but the model did not allow for separate intercepts in the pre- and post-installation periods, which AEG found to be significant.⁹

Two of the four projects did not attempt to regress energy consumption on cooling degree days, and in particular, one project limited the year of pre-retrofit data available to a single month. AEG included the full year of pre-data in its model. In both cases, AEG developed adequate models showing the significant relationship between energy consumption and cooling degree days and produced weather-normalized savings.

- **Non-routine adjustments and removal of previously-rebated projects affected the energy savings for one non-lighting project.** This project’s savings were calculated using IPMVP Option C, an appropriate method for the type of upgrades that took place at the site. However, between the pre- and post-retrofit months, the site expanded its conditioned square footage (a non-routine adjustment) and implemented two rebated lighting projects. The AEG Team found that while the demand savings appropriately accounted for both events, the energy analysis did not account for either. The non-routine adjustment for the site expansion increased savings, but when combined with the removal of previously rebated project savings, the AEG team verified 67% of the reported first-year and lifetime energy savings.
- **Hawai’i Energy used incorrect EULs for about 40% of custom non-lighting projects.** The PY21 TRM states that custom projects expected to produce meaningful energy savings for more than five years should use an EUL of 13 years. In these cases, Hawai’i Energy used longer EULs without providing any justification for deviating from the TRM’s deemed EULs for custom projects. AEG made an exception for transformer projects (which used an EUL of 25 years) based on its professional engineering opinion that 13 years is unreasonable for this type of upgrade.
- **AEG could not adequately verify savings using engineering best practices in any of the sampled non-lighting custom projects associated with a large energy efficiency initiative at several military housing communities.**

⁹ Separate intercepts allow the model to recognize constant savings associated with the post period, i.e., a change in the baseload consumption, in addition to any changes related to weather.

The supplemental project documentation did not include any of the raw data used to develop per-unit savings estimates. AEG had to rely on the per-unit savings estimates developed by the implementation contractor.

This initiative touched more than 5,000 residential units. The scope of the onsite visits did not allow for robust verification of all neighborhoods and measures (which included lighting upgrades, weatherization, and HVAC upgrades) covered by the sampled opportunities. This is because the AEG Team was limited to visiting vacant units, as it would have been time consuming and burdensome to request access from occupants, especially those on a U.S. Army base, where all customer contact and onsite coordination would need to be made through a military intermediary. However, at least a few vacant units in each of the sampled opportunities (i.e., separately-incentivized projects, in this case defined by measure bundle and neighborhood) were available for onsite verification, allowing us to spot-check some of the measures associated with the larger initiative. Overall, we found that measures had been properly installed and matched the equipment specifications used to calculate savings.

AEG feels that the substantial savings and incentives associated with these military housing opportunities warrants a more robust verification of the initiative in full upon its completion. This would include identifying all opportunities associated with the military housing energy efficiency initiative and verifying the project as a whole, ideally with the time and budget required to sample vacant and occupied units from all affected communities.

Customer-Level Savings Realization Rates

Table 2-6 shows the final customer-level savings realization rates for each program. These final customer-level savings adjustments incorporate the TRM savings replication, desk review, and onsite visit adjustments to the claimed savings. Overall, AEG verified realization rates of 100% for first-year energy savings, 92% for lifetime energy savings, and 104% for peak demand reductions.

Table 2-6 Clean Energy Technology Customer-Level Savings Realization Rates by Program

Program	Customer-Level First-Year Energy Savings (MWh/yr)			Customer-Level Lifetime Energy Savings (MWh/yr)			Customer-Level Peak Demand Reductions (MW/yr)		
	Claimed	Verified	RR	Claimed	Verified	RR	Claimed	Verified	RR
BEEM	32,577	32,673	1.00	410,293	412,492	1.01	5.93	5.90	1.00
BESM	1,173	1,173	1.00	9,183	9,183	1.00	0.16	0.16	1.00
BHTR	9,146	8,874	0.97	106,051	104,003	0.98	1.30	1.27	0.98
CBEEM	31,546	31,666	1.00	486,563	357,166	0.73	3.41	4.24	1.24
REEM	44,557	44,554	1.00	448,654	448,615	1.00	7.87	7.86	1.00
RESM	10,320	10,320	1.00	74,381	74,381	1.00	1.95	1.95	1.00
RHTR	6,263	6,263	1.00	62,919	62,919	1.00	1.07	1.07	1.00
CREEM	242	242	1.00	2,658	2,658	1.00	0.05	0.05	1.00
Total	135,824	135,765	1.00	1,600,703	1,471,417	0.92	21.73	22.51	1.04

System- and Program-Level Savings Adjustments

AEG applied the system loss factors from the PY21 Hawai'i Energy TRM by island to estimate system-level savings. Table 2-7 shows how the verified system-level savings compared to the claimed system-level savings for each business and residential program. The system-loss adjustments made by Hawai'i Energy did not always align with the system-loss adjustments verified by AEG, particularly for projects on Hawaii, Lanai, and Maui islands. Overall, these adjustments were small, and therefore, these realization rates are largely driven by discrepancies from the customer-level savings verification activities (i.e., the system-realization rates are nearly identical to the customer-level realization rates shown in Table 2-6).

Table 2-7 Clean Energy Technology System-Level Savings Realization Rates by Program

Program	System-Level First-Year Energy Savings (MWh/yr)			System-Level Lifetime Energy Savings (MWh/yr)			System-Level Peak Demand Reductions (MW/yr)		
	Claimed	Verified	RR	Claimed	Verified	RR	Claimed	Verified	RR
BEEM	34,041	34,148	1.00	428,853	431,230	1.01	6.19	6.16	1.00
BESM	1,226	1,226	1.00	9,583	9,583	1.00	0.17	0.17	1.00
BHTR	9,548	9,272	0.97	110,699	108,668	0.98	1.35	1.33	0.99
CBEEM	32,938	33,063	1.00	508,062	372,948	0.73	3.56	4.43	1.24
REEM	46,607	46,683	1.00	469,252	469,945	1.00	8.23	8.24	1.00
RESM	10,737	10,757	1.00	77,350	77,517	1.00	2.03	2.03	1.00
RHTR	6,579	6,579	1.00	66,054	66,054	1.00	1.13	1.13	1.00
CREEM	252	252	1.00	2,770	2,770	1.00	0.05	0.05	1.00
Total	141,928	141,980	1.00	1,672,624	1,538,715	0.92	22.71	23.54	1.04

AEG applied NTG ratios from the PY21 Hawai'i Energy TRM to estimate program-level savings for each program and delivery channel. Table 2-8 shows how the verified program-level savings compared to the claimed program-level savings for each program. For most programs, the program-level realization rates are driven by discrepancies from the customer-level savings verification activities.

Table 2-8 Clean Energy Technology Program-Level Savings Realization Rates by Program

Program	Program-Level First-Year Energy Savings (MWh/yr)			Program-Level Lifetime Energy Savings (MWh/yr)			Program-Level Peak Demand Reductions (MW/yr)		
	Claimed	Verified	RR	Claimed	Verified	RR	Claimed	Verified	RR
BEEM	25,531	25,611	1.00	321,640	323,423	1.01	4.64	4.62	1.00
BESM	1,212	1,213	1.00	9,527	9,530	1.00	0.17	0.17	1.00
BHTR	8,771	8,449	0.96	100,767	98,963	0.98	1.25	1.21	0.97
CBEEM	24,703	24,797	1.00	381,047	279,711	0.73	2.67	3.32	1.24
REEM	30,051	30,093	1.00	312,924	313,304	1.00	5.14	5.15	1.00
RESM	10,531	10,550	1.00	76,707	76,873	1.00	1.98	1.99	1.00
RHTR	6,512	6,579	1.01	65,052	66,054	1.02	1.12	1.13	1.01
CREEM	164	164	1.00	1,800	1,800	1.00	0.03	0.03	1.00
Total	107,475	107,456	1.00	1,269,465	1,169,658	0.92	17.00	17.62	1.04

Major findings from the system- and program-level adjustments included the following:

- **Overall, the system-level savings claimed in the tracking database aligned closely with the verified savings.** Therefore, these realization rates are largely driven by discrepancies identified in the customer-level savings verification activities (i.e., the system-level realization rates are nearly identical to the customer-level realization rates shown in Table 2-6). However, the island-specific system loss factors included in the tracking database did not always match the verified system loss factors from the PY21 TRM, particularly for projects on Hawaii and Maui islands.
- **Hawai'i Energy applied more measure-specific NTG ratios in PY21 than in previous program years when the TRM deems NTG ratios by program, leading to discrepancies in RHTR program-level savings.** For example, they used the RESM NTG ratio of 0.92 for 6% of RHTR records (mostly air conditioning and water heater tune-ups)

and the REEM/other NTG ratio of 0.79 for some appliance recycling opportunities. However, the TRM specifies that all RHTR records should have a NTG ratio of 1.0.

AEG has historically allowed Hawai'i Energy to use non-deemed NTG ratios in one case: for multifamily direct-install records under the BHTR ES4H program since this is considered a residential hard-to-reach program and bundled with single-family direct install under A&A.¹⁰ AEG continued to allow this exception for BHTR ES4H but applied the program-specific NTG ratios deemed in the TRM for all other programs and delivery channels. This adjustment led to higher RHTR program-level savings than reported (after factoring in other verification adjustments).

- Hawai'i Energy included savings from codes and standards (C&S) in the RESM and BESM programs, which AEG passed through with a 100% realization rate.** Per the PY21 Verification Workplan, AEG did not verify C&S savings since they were pre-negotiated with and approved by the Hawaii Public Utilities Commission. Consistent with Hawai'i Energy, AEG did not apply a NTG ratio to this component of RESM and BESM savings.

Total Resource Benefits Adjustments

Table 2-9 shows the claimed and verified total resource benefits calculated for each program. TRB realization rates reflect all the adjustments AEG made to the claimed customer-level savings and any differences in how AEG and Hawai'i Energy applied the TRB algorithms provided in the PY21 TRM.

In general, AEG verified similar TRBs as claimed in the tracking database, so realization rates are similar to the customer-level savings realizations rates shown in Table 2-6. In particular, AEG found that issues impacting lifetime energy savings similarly impacted the TRBs, including applying incorrect EULs and not using dual baselines when required to calculate savings for CBEEM projects. In addition, Hawai'i Energy did not correctly apply the dual-baseline approach when estimated TRBs for BEEM lighting measures despite appropriately calculating lifetime savings.

Table 2-9 Clean Energy Technologies Total Resource Benefits Performance

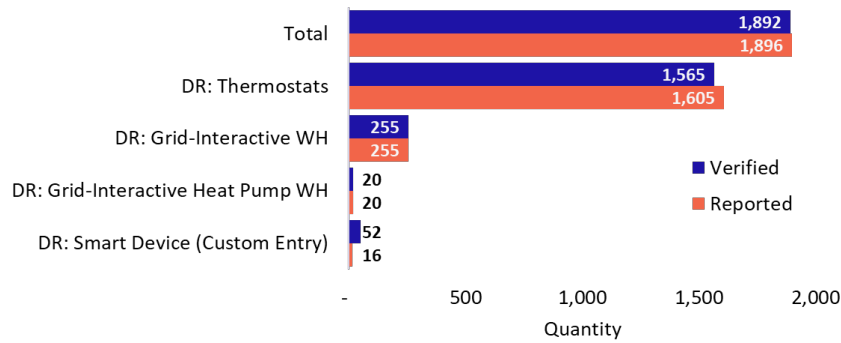
Program	Claimed TRBs	Verified TRBs	Realization Rate
BEEM	\$46,375,442.82	\$45,743,323.54	99%
BESM	\$1,298,384.16	\$1,299,177.00	100%
BHTR	\$13,992,242.91	\$13,801,161.53	99%
CBEEM	\$47,710,717.85	\$37,116,227.24	78%
REEM	\$43,318,269.20	\$43,420,094.29	100%
RESM	\$9,733,375.04	\$9,739,964.94	100%
RHTR	\$9,106,931.79	\$9,276,549.04	102%
CREEM	\$333,907.72	\$333,907.72	100%
Total	171,869,271	160,730,405	94%

Grid Services Ready Adjustments

Figure 2-4 shows the number of Grid Services Ready projects claimed by Hawai'i Energy and verified by AEG using the tracking database. Claimed and verified project counts aligned in total, but AEG could not identify the discrepancies in smart thermostat and smart devices entered as custom measures.

¹⁰ Since multifamily housing is still considered commercial buildings, multifamily ES4H records show up under the BHTR program.

Figure 2-4 Grid Service Ready Performance Against Target

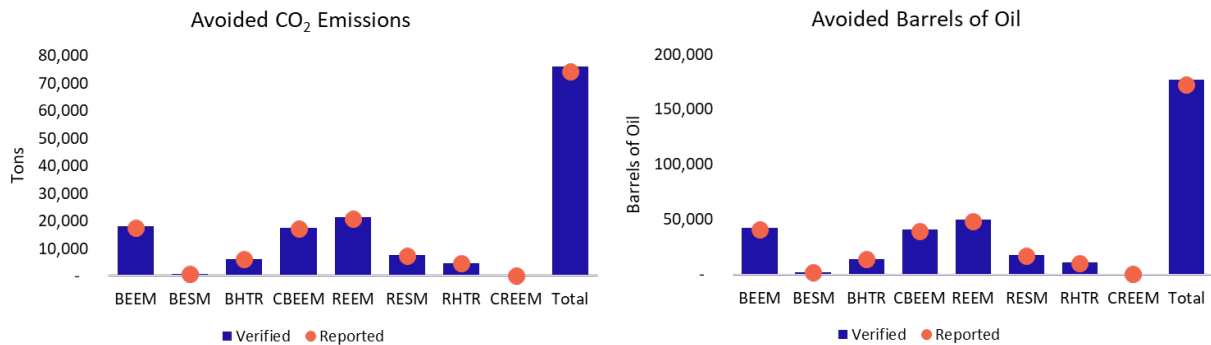


GHG Reductions Adjustments

AEG estimated the GHG emissions avoided in barrels of oil and metric tons of carbon dioxide, or CO₂ through the Hawai'i Energy PBFA programs using the conversion factors provided in the TRM and verified first-year program-level energy savings.

Figure 2-5 shows how claimed and verified GHG reductions performance compared to those claimed by Hawai'i Energy. Across all programs, AEG verified about 103% of Hawai'i Energy's reported GHG emissions. Most differences in verified and claimed GHG avoided emissions appeared driven by the application of TRM algorithms and conversion factors, though AEG could not identify the specific causes. Regardless, the PBFA programs exceeded both GHG reduction targets, consistent with the claimed GHG emission reductions. REEM, CBEEM, and BEEM projects contributed the most GHG avoided emissions (~76% across metrics). RESM and BESM projects contributed another ten percent (due to codes and standards savings), with BHTR, RHTR, and CREEM projects delivering a combined 14%.

Figure 2-5 GHG Reductions Performance Against Targets



CET Performance Awards

Hawai'i Energy must achieve at least 95% of performance targets for first-year and lifetime energy savings, peak demand reductions, and total resource benefits at the program category level to claim any of the performance awards in these key focus areas. AEG calculated the awards Hawai'i Energy received based on its verified performance according to the rules shown in Table A-1 in Appendix A.

Table 2-10 shows the target, reported, and verified awards by metric and program category. Hawai'i Energy achieved 95% of the first-year energy savings award, 34% of the lifetime energy savings award, 100% of the peak demand reductions award, and 31% of the TRBs award.

AEG verified similar awards to those reported by Hawai'i Energy in most program categories. The Business Custom program category (CBEEM) drove most of the differences between claimed and verified awards. Hawai'i Energy claimed awards for two of the four performance metrics based on achieving 101% and 97% of the first-year and lifetime energy savings performance targets, respectively. Verification activities reduced CBEEM lifetime savings by 25%, Hawai'i Energy no longer met the 95% performance threshold for this metric. However, the verification also led to substantial increased in CBEEM peak demand reductions, leading to awards in this category where Hawai'i Energy had not claimed any.

Hawai'i Energy only met lifetime energy savings and TRB performance targets in the two residential program categories (Residential HTR, and Residential Incentives), but all programs except for Business Hard-to-Reach met first-year energy savings awards thresholds. Business Hard-to-Reach additionally achieved awards for peak demand savings.

Table 2-10 CET Performance Awards

Performance Indicator Metric (Program Category)	Target	Claimed		Verified	
	\$ Award	\$ Award	% of Target	\$ Award	% of Target
First-Year Energy Reduction	\$112,500	\$106,192	94%	\$106,449	95%
<i>Business Prescriptive</i>	\$27,427	\$28,771	105%	\$28,881	105%
<i>Business HTR</i>	\$10,966	\$0	0%	\$0	0%
<i>Business Custom</i>	\$26,348	\$26,585	101%	\$26,690	101%
<i>Residential Incentives</i>	\$41,700	\$43,869	105%	\$43,911	105%
<i>Residential HTR</i>	\$6,059	\$6,968	115%	\$6,968	115%
Lifetime Energy Reduction	\$112,500	\$57,412	51%	\$37,939	34%
<i>Business Prescriptive</i>	\$32,342	\$0	0%	\$0	0%
<i>Business HTR</i>	\$11,070	\$0	0%	\$0	0%
<i>Business Custom</i>	\$32,697	\$19,618	60%	\$0	0%
<i>Residential Incentives</i>	\$31,249	\$32,405	104%	\$32,467	104%
<i>Residential HTR</i>	\$5,142	\$5,389	105%	\$5,472	106%
Peak Demand Reduction	\$112,500	\$98,523	88%	\$112,729	100%
<i>Business Prescriptive</i>	\$28,707	\$33,013	115%	\$33,013	115%
<i>Business HTR</i>	\$8,298	\$8,696	105%	\$8,464	102%
<i>Business Custom</i>	\$23,912	\$0	0%	\$14,347	60%
<i>Residential Incentives</i>	\$45,575	\$49,904	110%	\$49,995	110%
<i>Residential HTR</i>	\$6,008	\$6,909	115%	\$6,909	115%
Total Resource Benefits	\$150,000	\$46,355	31%	\$46,495	31%
<i>Business Prescriptive</i>	\$42,399	\$0	0%	\$0	0%
<i>Business HTR</i>	\$14,621	\$0	0%	\$0	0%
<i>Business Custom</i>	\$42,702	\$0	0%	\$0	0%
<i>Residential Incentives</i>	\$43,323	\$38,991	90%	\$38,991	90%
<i>Residential HTR</i>	\$6,954	\$7,364	106%	\$7,504	108%
Grid Services Ready	\$37,500	\$37,500	100%	\$37,500	100%
GHG Reductions (Tons)	\$0	\$0	n/a	\$0	n/a
GHG Reductions (Barrels of Oil)	\$0	\$0	n/a	\$0	n/a

CET Highlights and Recommendations

We close this chapter with a set of highlights from the CET verification findings that call attention to areas where Hawai'i Energy is doing well and a set of recommendations that identify areas for improvement.

Highlights

The following bullets call attention to several key successes for the CET Performance.

- **Hawai'i Energy exceeded the target for installing Grid Service Ready measures.** AEG verified nearly 200% of the target, aligning with Hawai'i Energy's claimed amount. The measures included not only grid-interactive water heaters but also smart devices, smart thermostats, and general demand response equipment.
- **AEG found that Hawai'i Energy's implementation of the TRM algorithms for prescriptive programs was nearly perfect.** We made minimal impactful TRM adjustments to the claimed savings, leading to TRM adjustment factors close to 1.0 for all programs.
- **Hawai'i Energy appears to be making incremental improvements to some of its calculators and tools based on past recommendations.** For example, the PY21 custom lighting calculator directly calculated lifetime kWh savings, which are missing from the PY20 and previous calculators. That said, most of the sampled custom lighting projects still used the PY20 calculator, but AEG assumes it will be phased out over time.

Recommendations

Our verification found that Hawai'i Energy is still struggling with implementing dual baselines and collecting sufficient documentation for custom projects. Below we present two groups of recommendations based largely on the effect or implication of each recommendation on either AEG's ability to verify savings or the accuracy of the savings estimates.

High-Priority Recommendations

High-priority recommendations are those that have the largest impact on verified CET metrics, including energy and demand reductions and TRBs. Each of the items below is critical to either correctly calculating CET metrics or the ability to verify the type or quantity of rebated measures or projects purchased.

1. **Adhere to the documentation requirements outlined in the Custom Project Guidance document to avoid penalties that could hurt the future of the PFBA programs.** The evaluability of program performance and achievements remains a critical verification component that gives stakeholders, including the customers who benefit from these programs, confidence in the process. The AEG Team has seen some incremental improvement over time in the documentation collected for custom projects. However, our review found that hardly any of the savings calculation workbooks included lifetime savings calculations. There were also several cases where equipment specifications, project equipment and labor costs, or some proof of installation were not documented or aligned with how savings were claimed. Note that if Hawai'i Energy cannot provide appropriate proof of project pre-approval, completion, installation, and costs in PY22 custom projects, AEG proposes to apply zero savings in PY22. These fundamental elements of documentation are critical to providing basic assurance that the rebated projects are completed, and that the measures were purchased and installed. Timing of the rebates and pre inspections helps to ensure that the program has a chance of influencing customer behavior, and that rebates are not paid for projects that are already installed.
2. **Document the pre-approval process with customers seeking custom project rebates to mitigate the appearance of free-ridership and ensure all projects conform with Hawai'i Energy's established program rules.** AEG identified several CBEEM projects with unclear timelines that would have benefitted from clearer documentation showing that Hawai'i Energy pre-approved the project before it was underway. Email communications, pre-site inspections, consistent use of the project summary form, or another form preceding the application rebate submission would provide proof of Hawai'i Energy's intervention. Pre-approval is best practice considering the significant incentives associated with many of these projects.

3. **Update solar water heater replacement calculations in the TRM.** Based on the household data being collected, it appears that many of the solar water heater replacements do not qualify for a deemed savings value because the assumed baseline would exceed a storage volume of 55 gallons for an electric resistance. Further, Hawai'i Energy is not consistently calculating the baseline conditions for solar water heater replacements (see additional recommendation #1). The TRM should be updated with guidance that clarifies how to calculate the baseline electric storage tank size using an occupancy rule-of-thumb of 10 gallons per occupant for low-to-normal hot water usage and 15 gallons per occupant for high hot water usage. This additional information would make it easier for Hawai'i Energy to determine which replacements do not qualify for the deemed savings. In addition, AEG and Hawai'i Energy should work together with the EEM and HPUC to expand the measure to include deemed savings for larger capacity equipment replacements in residential homes. For larger capacity equipment, the appropriate baseline would be a heat pump water heater that meets current federal standards for tank sizes greater than 55 gallons.
4. **Account for dual baselines when calculating TRBs.** Consistent with the PY20 Verification, AEG found that Hawai'i Energy did not consistently implement dual-baselines for lighting projects under BHTR Energy Advantage (small-business direct-install), CBEEM, or BEEM lighting. For BHTR and CBEEM lighting, dual-baseline corrections affected both lifetime energy savings and TRBs. However, for BEEM, corrections only affected TRBs, which probably stems from the fact that the PY21 TRM included per-unit lifetime savings that Hawai'i Energy apply directly in the tracking database using a deemed approach. The TRM did not provide deemed per-unit TRBs for any measures. Hawai'i Energy should use the dual-baseline approach to calculate TRBs for BHTR Energy Advantage and prescriptive lighting measures (including prescriptive lighting implemented under the CBEEM program) to avoid overestimating TRBs in the tracking database.
5. **Account for dual baselines for custom lighting projects.** Consistent with the PY20 Verification, AEG found that when custom lighting projects replaced incandescent lamps, Hawai'i Energy used the first-year energy savings for the duration of the measure life. Adjusting lifetime savings for dual baselines lowered verified lifetime savings by more than 50% for those projects.
6. **Clearly investigate, document, and remove savings from previously-rebated projects when using metered or utility billing data as needed to estimate custom project savings.** Customers may engage with Hawai'i Energy over the course of many program years through multiple program channels. Certain estimation methods, such as IPMVP Option C, will attribute any energy reductions to the project under review, including reductions driven by previously-rebated projects. This will lead to double-counting savings and paying incentives for the same projects multiple times unless all previously-rebated projects are appropriately accounted for, i.e., by adding prorated project savings to the metered consumption before modeling. Similarly, other non-routine events (e.g., facility expansions) that will change load on the meter(s) need to be properly identified, defined in both magnitude and timing, and removed from the meter data before modeling.

Additional Recommendations

Additional recommendations focus on enhancing the accuracy of energy and demand reduction estimates; however, they are not linked to issues that directly impacted the verified CET metrics in a meaningful way.

1. **For solar water heater replacements in residential homes, calculate the equivalent electric resistance water heater capacity to determine whether the replacement qualifies for the deemed savings value provided in the TRM (and use a custom baseline if not).** The PY21 TRM states that “homes requiring water heating capacity greater than the equivalent of a 55-gallon electric resistance water heater do not qualify” for the solar water heater deemed savings estimate. This is because the deemed savings approach assumes an electric resistance water heater baseline that meets the current federal standard, whereas the federal standard for an electric storage water heater with a capacity greater than 55 gallons is a heat pump water heater.

The TRM also states that for “homes with a pre-existing solar water heater, the tank size required to meet water heating demand with an electric resistance storage water heater must be determined and limited to

a storage volume of 55 gallons or less". To date, Hawai'i Energy's rebate application has included a calculation of the required solar water heater tank size based on occupancy using an assumption of 20 gallons per occupant.¹¹ However, the rebate application does not include a calculation for the tank capacity of the baseline equipment (i.e., an electric storage water heater).

AEG understands that a precedent has been set to allow the program to use the TRM's deemed savings for all solar water heater replacements, even in the absence of documentation showing a calculation that the tank size required to meet water heating demand with an electric resistance storage water heater is ≤ 55 gallons. However, the TRM intended Hawai'i Energy to follow the custom path for any replacements exceeding the maximum capacity requirements, i.e., a heat pump water heater for baseline equipment capacities greater than 55 gallons.

During its desk reviews, AEG found that Hawai'i Energy consistently collected information on the number of occupants in the home from its trade allies to calculate the solar water heater tank size (# occupants x 20 gallons/occupant) but didn't use the information to calculate the baseline equipment capacity with a similar rule-of-thumb, such as an assumption of 10 gallons per occupant for low-to-normal hot water usage and 15 gallons per occupant for high hot water usage for an electric storage water tank.

AEG feels the language in the TRM is too vague to make a savings adjustment for PY21, but going forward, Hawai'i Energy should use the occupancy data it collects to calculate appropriate savings against an appropriate baseline. For example, one sampled record was for a six-person household. Under typical operating conditions, a 55-gallon electric resistance water heater would not be able to meet the demand of a six-person household adequately, and so this replacement would be ineligible for the deemed savings.

2. **Conduct a thorough investigation of the large military housing initiative upon its completion.** AEG sampled several opportunities (i.e., separately-incentivized projects) for desk reviews and onsite visits that were associated with various project phases, measure bundles, and neighborhoods within military housing communities. AEG could not identify all the opportunities associated with this initiative, but altogether, these opportunities touched more than 5,000 residential units. Once all project phases have been implemented, a more robust verification of the initiative is warranted given the substantial savings and incentives associated with the opportunities. This would include identifying all opportunities associated with the military housing communities energy efficiency initiative and verifying the project as a whole, ideally with the time and budget required to sample vacant and occupied units from all affected communities.
3. **Collect screenshots as proof of qualifying fixtures for commercial midstream lighting projects.** During its desk reviews of BEEM Commercial Midstream lighting projects, AEG could confirm that most, but not all, of the sampled rebated fixtures met program qualifications. Confirming certification can be difficult because of differences in naming conventions between manufacturers and the DLC qualification library, and therefore, AEG verified savings for all sampled fixtures. However, we recommend that Hawai'i Energy start including DLC screenshots, specification sheets, or other proof of fixtures' eligibility for program rebates since this vetting process should be taking place.
4. **Use typical meteorological year (TMY) weather data when using regression analysis to estimate lifetime savings for all custom projects.** AEG sampled seven non-lighting CBEEM projects that relied on regression models to estimate savings. However, Hawai'i Energy used TMY weather to estimate savings for a weather-sensitive custom project in only three of the projects. For the others, Hawai'i Energy estimated savings straight averages of pre- and post-installation energy consumption. None of these projects included a full twelve months of post-period data, and in one case, both the pre- and post-retrofit data included only a single month when more data had been collected.

While actual post-period weather best estimates first-year savings for the current year, they are subject to over- or underestimating savings over the lifetime of the projects, particularly when projects have long

¹¹ For example, a four-person household would need a solar water heater tank of at least 4×20 gallons/occupant = 80 gallons.

estimated useful lives. We recommended that Hawai'i Energy use TMY weather when estimating first-year annual savings to estimate lifetime savings with greater accuracy. Such recommendations are included in the Custom Project Guidance Document, which will go into effect in PY22.

5. **Consider a net-to-gross study for CBEEM.** AEG identified several CBEEM projects with unclear timelines that would have benefitted from clearer documentation showing that Hawai'i Energy pre-approved the project before it was underway. This indicates that there could be much higher free ridership than the 25% assumed by the TRM. Accurate estimates of free ridership ensure that public funds are spent responsibly and influence customers who would not participate otherwise to install energy efficient measures.
1. **Future TRM updates should allow certain projects, such as custom transformers, to use longer measure lives than currently deemed for custom projects in the TRM.** The PY21 TRM provides deemed EULs for custom projects: 13 years, if the project is expected to generate energy savings for more than five years, and five years if not. However, AEG did not enforce the TRM-deemed EULs when verifying custom transformer projects because these types of upgrades typically generate energy savings for upwards of 30 years. Considering that transformer projects comprised about 20% of the total custom non-lighting project population in PY21, the TRM should be updated with guidance for transformer EULs, as the current deemed EUL of 13 years is unreasonable for this type of upgrade.

3

NON-CET VERIFICATION FINDINGS

Non-CET activities are categorized into Accessibility & Affordability (A&A), Economic Development & Market Transformation (MTED), and Customer Satisfaction. Each of these performance categories is comprised of several key focus areas, as outlined in Table 3-1.

Table 3-1 Non-CET Performance Categories and Key Focus Areas

Performance Category	Key Focus Area
<i>Accessibility & Affordability (A&A)</i>	Economically Disadvantaged
	Island Equity
<i>Economic Development & Market Transformation (MTED)</i>	Behavior Change
	Professional Development & Technical Training
	Energy in Decision Making
	Codes & Standards
	Clean Energy Innovation Hub
<i>Customer Satisfaction</i>	Application Processing Customer Experience

Each key focus area is evaluated according to a metric(s) that suits its purpose and contributions toward Hawai'i Energy's overarching goals. AEG verified Hawai'i Energy's performance towards each non-CET target and award by reviewing backup documentation (e.g., invoices, contract agreements, third-party reports, etc.) and conducting independent analyses of the tracking database. Details on methods are provided in the following sections and in Appendix D.

Non-CET Categories and Performance

The sections below outline the purpose of the non-CET category and the key focus areas and metrics that comprise them as well as adjustments and exceptions to claimed performance as identified by AEG. For most metrics, Hawai'i Energy met or exceeded non-CET performance targets.

Accessibility and Affordability (A&A)

A&A performance goals ensure that program services and benefits are equitably allocated across eligible geographies and underserved demographics. As shown in Table 3-2, there are two separate verification efforts under the A&A award for Economically Disadvantaged customers and Island Equity.

Table 3-2 A&A Summary of Metrics and Verification Methods

Metric	Verification Approach
<p>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 multi-family direct install programs, distinct communities through the Community-Based Energy Efficiency program, and nonprofits through the EmPOWER Hawaii Project.</p>	<p>Energy Advantage. Confirmed customer counts in the tracking database.</p> <p>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.¹²</p> <p>Community-Based Energy Efficiency (CBEE). Confirmed community counts through project documentation review.</p> <p>EmPOWER Hawaii Project. Confirmed number of projects by reviewing contractor invoices.</p>
<p>Island Equity Requires that 13 percent of program spending occurs in each of Hawaii and Maui counties.</p>	<p>Confirmed equitable distribution of funds by reviewing program spending by island (program tracking database includes a variable that states the island for each rebate).</p>

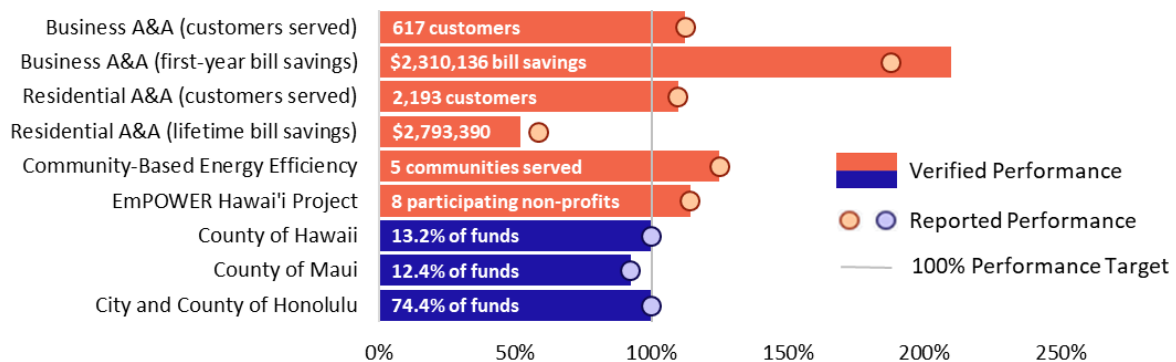
AEG verified A&A efforts by reviewing a combination of program tracking data, geographic distribution of incentives, and agreements with community and non-profit organizations and adjusted lifetime bill savings for CET verification findings.

As shown in Figure 3-1, Hawai'i Energy met all **Economically Disadvantaged** performance targets except for residential customer lifetime bill savings. Consistent with PY20, both the reported and verified bill savings barely reached 50% of target despite exceeding all RHTR CET targets. Only a subset of the RHTR programs contribute to the residential A&A targets, including direct-install channels and bulk appliances trade-ins. This suggests that either that Hawai'i Energy is meeting RHTR targets through primarily non-A&A channels or that the CET targets set for RHTR are too low to meet the bill savings target.

Hawai'i Energy also did not achieve **Island Equity** awards because incentive spending for the County of Maui fell short of the performance target. In response to the HPUC's call for emergency demand response on Oahu, Hawai'i Energy prioritized projects in Honolulu County, which made achieving island equity in other counties more difficult.

Consistent with the verification, Hawai'i Energy did not claim awards for these two key focus areas.

Figure 3-1 A&A Verified Performance Against Key Focus Area Targets



¹² AEG used the 2019 billing to determine the bill savings customers would receive from each tier in the Hawaiian Electric's rate structure, assuming that most bill savings would be recognized at the top-most tier rate.

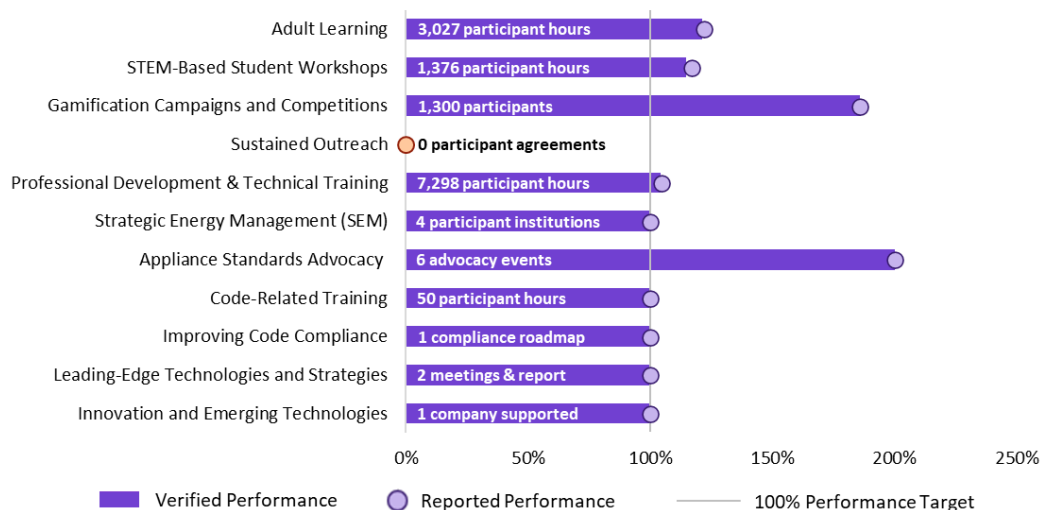
Economic Development & Market Transformation (MTED)

MTED performance goals and programs seek to identify and overcome market barriers that prevent residential and business customers from becoming energy-efficient by encouraging customers to engage in energy-saving behavior and/or invest in energy-saving equipment. In particular, these programs:

- Work to raise energy literacy at every level in [Hawaii] communities,
- Support policies and workforce training that make it easier for industries to adopt clean energy practices,
- Stay at the cutting-edge of new technology developments, and
- Establish strong relationships that help grow Hawai'i Energy's capacity to provide needed trainings and support and improve their reach within communities.

AEG verified MTED activities and achievements by reviewing contractor invoices, participant agreements, virtual workshop rosters and screengrabs, and other backup documents. As shown in Figure 3-2, Hawai'i Energy met all MTED performance targets except for Sustained Outreach within the Behavior Change category. In its interviews with AEG, program staff indicated that Sustained Outreach efforts were being phased out and rolled into the Community-Based Energy Efficiency (CBEE) program with the A&A Economically Disadvantaged key focus area. The CBEE program achieved its target number of communities served (see Figure 3-1).

Figure 3-2 MTED Verified Performance Against Key Focus Area Targets



Supplemental documentation for the Strategic Energy Management (SEM) program showed four agreements with participating institutions reached before PY21, suggesting that Hawai'i Energy did not establish any new participants in PY21. Program staff interpreted the target and metric as addressing the full PY19-PY21 triennium; that is, Hawai'i Energy was expected to establish four new agreements total, not four in each program year. Accordingly, AEG gave credit for sustaining these relationships and verified Hawai'i Energy's claim of achieving this performance target and award in PY21.

Customer Satisfaction

One of Hawai'i Energy's performance targets relates to customers' satisfaction with their rebate experience. To measure residential participant satisfaction, Hawai'i Energy uses the customer management tool Medallia, which sends customers an automated email survey soliciting feedback on their experience with a variety of program interaction elements. For business participants, Hawai'i Energy sends monthly surveys to new participants through an in-house customer experience management tool.

To meet PY21 targets, Hawai'i Energy had to achieve customer satisfaction scores of at least 9.0 (out of a possible 10) on overall customer satisfaction for each of the residential and business sectors. Using output from the Medallia and in-house survey tools, AEG verified 100% of the claimed customer satisfaction scores of 9.6 and 9.4 for business and residential participant satisfaction, respectively.

Low-to-Moderate Income (LMI) Performance Incentive Mechanisms (PIM)

In D&O 37787, the Commission approved the LMI PIM that seeks to incent Hawaiian Electric¹³ to collaborate with Hawai'i Energy in the delivery of energy savings to LMI residential customers.

As part of the PY21 verification effort, AEG calculated the LMI PIM rewards associated with the RHTR and A&A programs implemented by Hawai'i Energy. To calculate rewards, AEG applied the approach laid out in D&O 37787 to estimate the additional net benefits customers received from these initiatives by gathering RHTR incentive and non-incentive funds gathered from Hawai'i Energy and using the targeted and verified first-year energy and peak demand reductions and targeted TRBs associated with RHTR (and resulting from the PY21 verification). AEG also calculated the participation reward associated with Single-Family and Multifamily Direct Install efforts (i.e., the residential A&A Economically Disadvantaged customers).

As shown in Table 3-3, Hawaiian Electric achieved \$453,710 in total rewards.¹⁴ (See Appendix C for calculation details.)

Table 3-3 Hawaiian Electric LMI PIM Achieved Awards

PIM Award Component	Verified Reward
Total Energy Savings Award	\$318,031
Total Peak Demand Reductions Award	\$103,863
Total Participation Award	\$31,816
Total LMI PIM Award	\$453,710

Non-CET Performance Awards

As shown in Table 3-4, AEG verified 40% of the A&A target awards and 100% of MTED and Customer Satisfaction target awards, leading to overall non-CET verified awards of \$135,000 (60% of non-CET target awards). Hawai'i Energy's claimed awards aligned with the final awards as verified by AEG.

Table 3-4 Non-CET Claimed and Verified Performance Awards

Key Focus Area (Performance Indicator)	Target Award	Claimed Award		Verified Award	
	(\$)	(\$)	(% of Target)	(\$)	(% of Target)
Affordability & Accessibility	\$150,000	\$60,000	40%	\$60,000	40%
<i>Economically Disadvantaged</i>	\$75,000	\$60,000	40%	\$60,000	40%
<i>Island Equity</i>	\$75,000	\$0	100%	\$0	100%
Market Transformation & Economic Development	\$60,000	\$60,000	100%	\$60,000	100%
<i>Behavior Change</i>	\$15,000	\$15,000	100%	\$15,000	100%
<i>Professional Development & Technical Training</i>	\$30,000	\$30,000	100%	\$30,000	100%

¹³ Hawaiian Electric is comprised of Hawaiian Electric Company, Inc, Hawaii Electric Light Company, Inc., and Maui Electric Company, LTD.

¹⁴ The awards indicated by the Energy Efficiency Manager (EEM) via a memo dated 2/28/23 (\$453,791.97) were \$82.04 higher than shown in this report (\$453,709.93). That is because the EEM memo used verified savings that were expected to be final as of the end of February. However, AEG made slight updates to kWh and kW savings that reduced the verified savings by 201 kWh and 0.038 kW.

Key Focus Area (Performance Indicator)	Target Award	Claimed Award		Verified Award	
	(\$)	(\$)	(% of Target)	(\$)	(% of Target)
Energy in Decision Making	\$7,500	\$7,500	100%	\$7,500	100%
Codes & Standards	\$7,500	\$7,500	100%	\$7,500	100%
Clean Energy Innovation Hub	\$0	\$0	N/A	\$0	N/A
Customer Satisfaction	\$15,000	\$15,000	100%	\$15,000	100%
Business Customer Application Experience	\$7,500	\$7,500	100%	\$7,500	100%
Residential Customer Application Experience	\$7,500	\$7,500	100%	\$7,500	100%
Total	\$225,000	\$135,000	60%	\$135,000	60%

Lost awards resulted from the Economically Disadvantaged and Island Equity performance indicators of the A&A key focus area, totaling \$90,000 in lost awards.

Non-CET Highlights and Recommendations

We close this chapter with a set of highlights from the non-CET verification findings that call attention to areas where Hawai'i Energy is doing well and recommendations that identify areas for improvement.

Highlights

As noted at the beginning of this chapter, 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.

- Hawai'i Energy met all A&A performance targets except for residential bill savings and program spending in the County of Maui.** While Hawai'i Energy continued to face challenges related to the COVID-19 pandemic, they exceeded targets for residential and business A&A customers served. Even so, the residential A&A target for customer bill savings was missed by a wide margin, consistent with PY20, which suggests misalignment between the targets for customers served and the resulting savings on energy bills. Unlike PY20, the programs missed equity targets, falling short of the 13% target set for spending in the County of Maui (at 12%). In response to the HPUC's call for emergency demand response on Oahu, Hawai'i Energy prioritized projects in Honolulu County, which made achieving island equity in other counties more difficult.
- Hawai'i Energy PBFA programs met or exceeded targets for all MTED performance metrics except for the Sustained Outreach portion of Behavior Change and companies supported through Innovation and Emerging Technologies.** Further, they far exceeded targets in most other MTED focus areas.
- AEG verified 100% of the claimed customer satisfaction scores of 9.6 and 9.4 for business and residential participant satisfaction, respectively.** Each metric exceeded the 9.0 target by over 104%.

Recommendations

AEG did not have any substantive recommendations resulting from the non-CET verification; however, we did note the following potential improvements.

- As in the PY20 Verification, AEG recommends that Hawai'i Energy provide the EM&V contractor with the raw data for the satisfaction survey.** This would allow for more meaningful or interesting insights in reporting beyond the overall score. It would also facilitate recommendations that could be helpful to Hawai'i Energy in the future.
- Hawai'i Energy could consider incorporating discount rates to calculate the net present value of lifetime customer bill savings for the single-family and multifamily direct install components of RHTR and BHTR.** Customers will not experience their lifetime billing savings in a single year; instead, most of these savings

will be recognized in future years when the dollars will have less value to each customer at present. The discount rates account for this effect and better represent the impact of the lifetime bill savings on hard-to-reach customers.

A

DETAILED PERFORMANCE AND AWARDS TABLES

In this section, we provide the detailed target, claimed, and verified performance and awards by program category (CET only), program (CET only), and performance indicator metric. Table A-1 shows how AEG calculated performance awards for each performance metric and key focus area.

Table A-1 Rules for Calculating Performance Awards

Performance Metric/Key Focus Area	Verified Metric as % of Performance Target	Rule for Calculating Award
First-Year Energy Savings, Lifetime Energy Savings, Peak Demand Reductions, and Total Resource Benefits. <i>(metrics and targets set for five program categories)</i>	< 95.0%	No award.
	≥ 95.0% and ≤ 100.0%	A 1% increase in percentage performance corresponds to a 10% increase in achieved awards, starting with 50% of the target award (e.g., 95% of the performance target results in 50% of award achieved, 96% of the performance target results in 60% of award achieved, etc.).
	≥ 100.0% and ≤ 115.0%	The achieved awards equal the proportion of the target award corresponding to the percentage performance, e.g., a performance of 105% means receiving 105% of the target awards.
	≥ 115.0%	Awards are capped at 115% of the target awards.
Other CET, A&A, MTED, and Customer Satisfaction	< 100.0%	No award.
	≥ 100.0%	Achieved awards equal 100% of target award.

CET Performance and Awards Tables

This section provides the CET target, claimed, and verified performance awards by key focus area and program category:

- Table A-2 Clean Energy Technology Verified Performance
- Table A-3 Clean Energy Technology Verified Awards
- Table A-4 Clean Energy Technology Verified Performance by Program Category
- Table A-5 Clean Energy Technology Verified Awards by Program

CET Performance Overall

Table A-2 Clean Energy Technology Verified Performance

Key Focus Areas	Target	Claimed (% of Target)		Verified (% of Target)	
<i>First-Year Energy Reduction (MWh/yr)</i>	104,531	107,475	103%	107,456	103%
<i>Lifetime Energy Reduction (MWh)</i>	1,358,488	1,269,465	93%	1,169,658	86%
<i>Peak Demand Reduction (MW)</i>	16.1	17.0	105%	17.6	109%
<i>Total Resource Benefits (\$)</i>	\$185,408,727	\$171,869,271	93%	\$160,730,405	87%
<i>Grid Services Ready (Projects)</i>	1,000	1,896	190%	1,892	189%
<i>GHG Reductions (Tons)</i>	74,095	74,168	100%	76,168	103%
<i>GHG Reductions (Barrels of Oil)</i>	170,968	172,569	101%	177,135	104%

Table A-3 Clean Energy Technology Verified Awards

Key Focus Areas	Target Award	Claimed Award (% of Target)		Verified (% of Target)	
<i>First-Year Energy Reduction</i>	\$112,500.00	\$106,192.46	94%	\$106,449.26	95%
<i>Lifetime Energy Reduction</i>	\$112,500.00	\$57,412.19	51%	\$37,938.84	34%
<i>Peak Demand Reduction</i>	\$112,500.00	\$98,522.80	88%	\$112,729.00	100%
<i>Total Resource Benefits</i>	\$150,000.00	\$46,355.49	31%	\$46,494.57	31%
<i>Grid Services Ready</i>	\$37,500.00	\$37,500.00	100%	\$37,500.00	100%
<i>GHG Reductions (Tons)</i>	\$0.00	\$0.00	n/a	\$0.00	n/a
<i>GHG Reductions (Barrels of Oil)</i>	\$0.00	\$0.00	n/a	\$0.00	n/a
Total Award	\$525,000.00	\$345,982.94	66%	\$341,111.66	65%

CET Performance by Program Category

Table A-4 Clean Energy Technology Verified Performance by Program Category

Key Focus Areas	Target	Claimed (% of Target)		Verified (% of Target)	
First-Year Energy Reduction (MWh/yr)	104,531	107,475	103%	107,456	103%
Business Prescriptive	25,484	26,743	105%	26,824	105%
Business HTR	10,189	8,771	86%	8,449	83%
Business Custom	24,481	24,703	101%	24,797	101%
Residential Incentives	38,747	40,746	105%	40,807	105%
Residential HTR	5,630	6,512	116%	6,579	117%
Lifetime Energy Reduction (MWh)	1,358,488	1,269,465	93%	1,169,658	86%
Business Prescriptive	390,547	331,167	85%	332,952	85%
Business HTR	133,673	100,767	75%	98,963	74%
Business Custom	394,830	381,047	97%	279,711	71%
Residential Incentives	377,341	391,431	104%	391,977	104%
Residential HTR	62,097	65,052	105%	66,054	106%
Peak Demand Reduction (MW)	16.1	17.0	105%	17.6	109%
Business Prescriptive	4.1	4.8	117%	4.8	117%
Business HTR	1.2	1.2	105%	1.2	102%
Business Custom	3.4	2.7	78%	3.3	97%
Residential Incentives	6.5	7.2	110%	7.2	110%
Residential HTR	0.9	1.1	130%	1.1	131%
Total Resource Benefits (\$)	\$185,408,727	\$171,869,271	93%	\$160,730,405	87%
Business Prescriptive	\$52,407,534	\$47,673,827	91%	\$47,042,501	90%
Business HTR	\$18,072,658	\$13,992,243	77%	\$13,801,162	76%
Business Custom	\$52,782,582	\$47,710,718	90%	\$37,116,227	70%
Residential Incentives	\$53,550,238	\$53,385,552	100%	\$53,493,967	100%
Residential HTR	\$8,595,715	\$9,106,932	106%	\$9,276,549	108%
Grid Services Ready (Projects)	1,000	1,896	190%	1,892	189%
GHG Reductions (Tons)	74,095	74,168	100%	76,168	103%
GHG Reductions (Barrels of Oil)	170,968	172,569	101%	177,135	104%

Table A-5 Clean Energy Technology Verified Awards by Program Category

Key Focus Areas	Target	Claimed (% of Target)	Verified (% of Target)	Target	Verified
First-Year Energy Reduction	\$112,500.00	\$106,192.46	94%	\$106,449.26	95%
Business Prescriptive	\$27,427.18	\$28,771.11	105%	\$28,880.82	105%
Business HTR	\$10,965.83	\$0.00	0%	\$0.00	0%
Business Custom	\$26,347.79	\$26,584.92	101%	\$26,690.31	101%
Residential Incentives	\$41,700.48	\$43,868.91	105%	\$43,910.61	105%
Residential HTR	\$6,058.71	\$6,967.52	115%	\$6,967.52	115%
Lifetime Energy Reduction	\$112,500.00	\$57,412.19	51%	\$37,938.84	34%
Business Prescriptive	\$32,342.24	\$0.00	0%	\$0.00	0%
Business HTR	\$11,069.85	\$0.00	0%	\$0.00	0%
Business Custom	\$32,696.89	\$19,618.13	60%	\$0.00	0%
Residential Incentives	\$31,248.57	\$32,404.77	104%	\$32,467.27	104%
Residential HTR	\$5,142.45	\$5,389.29	105%	\$5,471.57	106%
Peak Demand Reduction	\$112,500.00	\$98,522.80	88%	\$112,729.00	100%
Business Prescriptive	\$28,707.06	\$33,013.12	115%	\$33,013.12	115%
Business HTR	\$8,298.17	\$8,696.48	105%	\$8,464.13	102%
Business Custom	\$23,912.33	\$0.00	0%	\$14,347.40	60%
Residential Incentives	\$45,574.72	\$49,904.32	110%	\$49,995.47	110%
Residential HTR	\$6,007.73	\$6,908.89	115%	\$6,908.89	115%
Total Resource Benefits	\$150,000.00	\$46,355.49	31%	\$46,494.57	31%
Business Prescriptive	\$42,398.92	\$0.00	0%	\$0.00	0%
Business HTR	\$14,621.20	\$0.00	0%	\$0.00	0%
Business Custom	\$42,702.34	\$0.00	0%	\$0.00	0%
Residential Incentives	\$43,323.40	\$38,991.06	90%	\$38,991.06	90%
Residential HTR	\$6,954.13	\$7,364.43	106%	\$7,503.51	108%
Grid Services Ready	\$37,500.00	\$37,500.00	100%	\$37,500.00	100%
GHG Reductions (Tons)	\$0.00	\$0.00	n/a	\$0.00	n/a
GHG Reductions (Barrels of Oil)	\$0.00	\$0.00	n/a	\$0.00	n/a
Total	\$525,000.00	\$345,982.94	66%	\$341,111.66	65%

Non-CET Performance and Awards Tables

The following sections provide the target, claimed, and verified performance and awards for each component of the non-CET key focus areas:

- Table A-6 Accessibility & Affordability Verified Performance
- Table A-7 Accessibility & Affordability Verified Awards
- Table A-8 Market Transformation & Economic Development Verified Performance
- Table A-9 Market Transformation & Economic Development Verified Awards
- Table A-10 Customer Satisfaction Verified Performance
- Table A-11 Customer Satisfaction Verified Awards

Affordability & Accessibility

Table A-6 Accessibility & Affordability Verified Performance

Key Focus Areas		Target Performance	Claimed		Verified	
			Performance	% of Target	Performance	% of Target
Economically Disadvantaged	Business A&A Customers Served	550	619	113%	617	112%
	Business A&A Bill Savings	\$1,100,000	\$2,067,829	188%	\$2,310,136	210%
	Residential A&A Customers Served	2,000	2,193	110%	2,193	110%
	Residential A&A Bill Savings	\$5,400,000	\$3,152,818	58%	\$2,793,390	52%
	Community Based Energy Efficiency	4	5	125%	5	125%
	EmPower Hawai'i Project	7	8	114%	8	114%
Island Equity Incentive Spending	County of Hawaii	13%	13.2%	100%	13.2%	100%
	County of Maui	13%	12.4%	92%	12.4%	95%
	City & County of Honolulu	74%	74.4%	100%	74.4%	100%

Table A-7 Accessibility & Affordability Verified Awards

Key Focus Areas		Target Award	Claimed		Verified	
			Award	% of Target	Award	% of Target
Economically Disadvantaged	Business A&A Customers Served	\$15,000.00	\$15,000.00	100%	\$15,000.00	100%
	Business A&A Bill Savings	\$15,000.00	\$15,000.00	100%	\$15,000.00	100%
	Residential A&A Customers Served	\$15,000.00	\$15,000.00	100%	\$15,000.00	100%
	Residential A&A Bill Savings	\$15,000.00	\$0.00	0%	\$0.00	0%
	Community Based Energy Efficiency	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
	EmPower Hawai'i Project	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
Island Equity Incentive Spending	County of Hawaii					
	County of Maui	\$75,000.00	\$0.00	0%	\$0.00	0%
	City & County of Honolulu					

Market Transformation & Economic Development

Table A-8 Market Transformation & Economic Development Verified Performance

Key Focus Areas		Target	Claimed		Verified	
			Award	% of Target	Award	% of Target
Behavior Change	<i>STEM-Based Student Workshops</i>	1,200	1,406	117%	1,376	115%
	<i>Adult Learning</i>	2,500	3,051	122%	3,027	121%
	<i>Gamification Campaigns and Competitions</i>	700	1,300	186%	1,300	186%
	<i>Exhibit Educational Resources</i>	0	0	n/a	0	n/a
	<i>Sustained Outreach</i>	2	0	0%	0	0%
	<i>Behavioral Insights</i>	0	0	n/a	0	n/a
Prof. Dev. & Technical Training	<i>Clean Energy Ally Support, Targeted Ally Training Opportunities, Targeted Participant Training Opportunities, Educator Training and Grants, Degree Program Support, Vocational Training</i>	7,000	7,313	104%	7,298	104%
Energy in Decision Making	<i>Strategic Energy Management</i>	4	4	100%	4	100%
Codes and Standards	<i>Appliance Standards Advocacy</i>	3	6	200%	6	200%
	<i>Improve Code Compliance</i>	1	1	100%	1	100%
	<i>Code-Related Training</i>	50	50	100%	50	100%
	<i>Leading-edge technologies and strategies</i>	2	2	100%	2	100%
Clean Energy Innovation Hub	<i>Innovation and Emerging Technologies</i>	1	1	100%	1	100%

Table A-9 Market Transformation & Economic Development Verified Awards

Key Focus Areas		Target	Claimed		Verified	
			Award	% of Target	Award	% of Target
Behavior Change	STEM-Based Student Workshops	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
	Adult Learning	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
	Gamification Campaigns and Competitions	\$0.00	\$0.00	n/a	\$0.00	n/a
	Exhibit Educational Resources	\$0.00	\$0.00	n/a	\$0.00	n/a
	Sustained Outreach	\$0.00	\$0.00	n/a	\$0.00	n/a
	Behavioral Insights	\$0.00	\$0.00	n/a	\$0.00	n/a
Prof. Dev. & Technical Training	Clean Energy Ally Support, Targeted Ally Training Opportunities, Targeted Participant Training Opportunities, Educator Training and Grants, Degree Program Support, Vocational Training	\$30,000.00	\$30,000.00	100%	\$30,000.00	100%
Energy in Decision Making	Strategic Energy Management	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
Codes and Standards	Appliance Standards Advocacy Improve Code Compliance	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
	Code-Related Training Leading-edge technologies and strategies					
Clean Energy Innovation Hub	Innovation and Emerging Technologies	\$0.00	\$0.00	0%	\$0.00	0%

Customer Satisfaction

Table A-10 Customer Satisfaction Verified Performance

Key Focus Areas		Target	Claimed (% of Target)		Verified (% of Target)	
Application Processing Customer Experience	Commercial	>9.0	9.6	107%	9.6	107%
	Residential	>9.0	9.4	104%	9.4	104%

Table A-11 Customer Satisfaction Verified Awards

Key Focus Areas		Target	Claimed (% of Target)		Verified (% of Target)	
Application Processing Customer Experience	Commercial	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%
	Residential	\$7,500.00	\$7,500.00	100%	\$7,500.00	100%

B

HISTORICAL VERIFICATION RECOMMENDATIONS

Table B-1 documents the recommendations made by the AEG team beginning in PY17 that remain relevant. 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. An "X" means that the recommendation is applicable.

Table B-1 Historical Verification Recommendations

Recommendation	PY17	PY18	PY19	PY20	PY21	Comments
Continuing Recommendations						
<i>Account for dual baselines when calculating Lifetime Energy savings and TRBs.</i>			X	X	X	AEG saw improvement over PY20, particularly in RHTR, however adjustments were still made in BEEM and CBEEM.
<i>Collect Invoices (or an equivalent form of documentation) for all measures and projects prior to paying out incentives.</i>	X	X	X	X	X	AEG saw little improvement over PY21 particularly for custom projects.
<i>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.</i>	X			X	X	Failure to make changes based on this recommendation led to adjustments for four sampled non-lighting projects.
<i>Ensure all data is collected and tracked so that semi-prescriptive savings can be replicated.</i>			X	X		AEG did not see this as an issue in the PY21 verification.
<i>Ensure site inspections are sufficiently rigorous to verify measure type and quantity.</i>	X	X	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.
<i>Consider using typical meteorological year (TMY) weather data when using regression analysis to estimate lifetime savings for custom projects.</i>				X	X	Using TMY is a best practice and conforms with the Custom Project Guidance Document.
<i>Collect supplemental project documentation before paying out incentives for projects.</i>				X	X	This is a documentation best practice that conforms with the Custom Project Guidance Document.
<i>Include project descriptions for custom projects.</i>				X	X	This is a documentation best practice that conforms with the Custom Project Guidance Document.

Recommendation	PY17	PY18	PY19	PY20	PY21	Comments
<i>Consider collecting DLC screenshots consistently for all custom lighting projects.</i>				X	X	This allows the project team to confirm eligibility for rebated fixtures, it was an issue in the BEEM midstream desk reviews.
<i>Beginning in PY21, use the updated baseline to calculate savings for residential faucet aerators and showerheads.</i>				X		AEG did not see this issue in the PY21 Verification
New Recommendations						
<i>Adhere to Custom Project Guidance</i>					X	It will be critical for projects to adhere to the custom project guidance document beginning in PY22. AEG’s analysis shows that approximately half of the PY21 CBEEM projects would be assigned zero savings for lack of conformance.
<i>For solar water heater replacements in residential homes, calculate the equivalent electric resistance water heater capacity to determine whether the replacement qualifies for the deemed savings value provided in the TRM (and use a custom baseline if not).</i>					X	We believe that many of the replacements did not qualify for deemed savings and should use a custom baseline. Alternatively, the TRM could be expanded to include larger units.
<i>Consider a net-to-gross study for CBEEM.</i>					X	Findings suggest that the current assumed NTG of 75% could be too high for CBEEM.
<i>Future TRM updates should allow certain projects, such as custom transformers, to use longer measure lives than currently deemed for custom projects in the TRM.</i>					X	This would allow a more accurate assessment of lifetime savings for these projects.
<i>Clearly investigate, document, and remove savings from previously-rebated projects when using metered or utility billing data as needed to estimate custom project savings.</i>					X	Doing so avoids double-counting savings between program years and paying incentives for the same projects multiple times.

C

LOW-TO-MODERATE INCOME PERFORMANCE INCENTIVE MECHANISMS

This appendix describes how the AEG team calculated the LMI PIM rewards associated with the RHTR and A&A programs implemented by Hawai'i Energy. Metrics for each program were tracked as part of the verification, and AEG used the following values in the calculation:

Table C-1 LMI PIM Inputs

Cell Ref.	Description	Value	Source
[a]	Total RHTR budget (incentives + non-incentives)	\$4,157,663	Leidos Program Year 2021 Plan Comparison – PY21 Plan finalized November 2021 vs. original PY21 plan included in PY19-21 Triennial Plan finalized September 2019 (Table: Budget Updates – PY10-PY21 Triennial Plan – November 2021 A&A Updated PY21) (LINK) PY21 Bottom Up M1.3.1 FINAL.xlsx (not publicly available)
[b]	Target RHTR energy savings	5,629,546	Hawai'i Energy PY21 Residential HTR Performance Metric (Updated PY19-21 Performance Goals Metrics_9.14.21 (Submission)_V1.xlsx, Performance Metrics by Category, O34) (not publicly available)
[c]	Total verified kWh savings	6,578,752.70	(Program-Level Annual kWh) PY21 Verification Report (full public report expected June 2023)
[d]	Target RHTR demand reductions	861	Hawai'i Energy PY21 Residential HTR Performance Metric (Updated PY19-21 Performance Goals Metrics_9.14.21 (Submission)_V1.xlsx, Performance Metrics by Category, P34) (not publicly available)
[e]	Total verified kW savings	1,129.796	Program-Level Annual kW) PY21 Verification Report (full public report expected June 2023)
[f]	Target RHTR TRBs	\$8,595,715	Hawai'i Energy PY21 Residential HTR Performance Metric (Updated PY19-21 Performance Goals Metrics_9.14.21 (Submission)_V1.xlsx, Performance Metrics by Category, Q34) (not publicly available)
[g]	Target residential A&A customers served	2,000	Leidos Program Year 2021 Plan Comparison – PY21 Plan finalized November 2021 vs. original PY21 plan included in PY19-21 Triennial Plan finalized September 2019 (Table: Performance Indicators – November 2021; A&A Updated PY21) (LINK)
[h]	Target residential A&A customer bill savings	\$5,400,000	Leidos Program Year 2021 Plan Comparison – PY21 Plan finalized November 2021 vs. original PY21 plan included in PY19-21 Triennial Plan finalized September 2019 (Table: Performance Indicators – November 2021; A&A Updated PY21) (LINK)
[i]	Weighted EUL for residential A&A	8.19	PY21 Verification Report (full public report expected June 2023)
[j]	Total verified participation	2,193	PY21 Verification Report (full public report expected June 2023)

**Weighted EUL is calculated by dividing the total lifetime kWh savings by the total annual kWh.*

Table C-2 presents the calculation of the LMI PIM as it is described in Decision and Order 37787.

Table C-2 LMI PIM Calculations

Line #	Description	Value
[L1] = [b]	Target RHTR energy savings	5,629,546
[L2] = [a] x 85%	RHTR total budget (85% to energy)	\$3,534,014
[L3] = [f] x 85%	Target RHTR TRBs (85% to energy)	\$7,306,358
[L4] = ([L3]-[L2])/[L1]	Net utility system benefit per kWh	\$0.67
[L5] = [L4] x 0.5	Net benefit share to Companies	\$0.34
[L6] = ([c]-[L1]) x [L5]	Total Energy Savings Award	\$318,030.52
[L7] = [d]	Target RHTR demand reduction	861
[L8] = [a] x 15%	RHTR total budget (15% to demand)	\$623,649
[L9] = [f] x 15%	Target RHTR TRBs (15% to demand)	\$1,289,357
[L10] = ([L9]-[L8])/[L7]	Net utility system benefit per kWh	\$773.09
[L11] = [L10] x 0.5	Net benefit share to Companies	\$386.54
[L12] = ([e]-[L7]) x [L11]	Total Demand Reductions Savings Award	\$103,863.05
[L13] = [g]	Target residential A&A customers served	2,000
[L14] = [h]	Target residential A&A customer bill savings	\$659,407
[L15] = [L14]/[L13]	First-year bill savings per target customers served	\$329.70
[L16] = [L15] x 0.5	Net benefit share to Companies	\$164.85
[L17] = ([j]-[L13]) x [L16]	Participation Award	\$31,816.36
[L18] = [L6] + [L12] + [L17]	Total Award	\$453,709.93

Because of the timing of the PY21 verification, the awards indicated by the Energy Efficiency Manager (EEM) via a memo dated 2/28/23 were \$82.04 higher than shown in this report. That is because the EEM memo used verified savings that were expected to be final as of the end of February. However, AEG made slight updates to kWh savings that reduced the verified savings by 201.32 kWh (input [b] above) and 0.038 kW (input [e] above). The awards in the EEM memo (that was filed) of \$453,791.97 are \$82.04 higher than shown above.

D

DETAILED METHODOLOGIES

AEG broke the verification activities into two distinct groups: CET program verification activities and non-CET verification activities. This organizational change clearly communicates how we verified the various metrics associated with each portion of the award.

The **CET program verification activities** were designed to verify 70% of Hawai'i Energy's total performance award. AEG conducted two levels of verification depending on the type of measure or project:

- Deemed and Semi-Prescriptive.** Deemed measures should follow the algorithms and assumptions stipulated in the Hawai'i Energy TRM. Partially deemed, semi-prescriptive measures within the TRM allow Hawai'i Energy to use other primary or secondary sources for specific parameters to derive tailored savings. The Residential and Business Energy Efficiency Measures (REEM and BEEM), Energy Services and Maintenance (RESM and BESM), and Hard-to-Reach (RHTR and BHTR) programs include measures with deemed and semi-prescriptive savings.
- Custom.** The Hawai'i TRM does not include stipulated savings for custom measures or projects. Savings estimates for these measures should follow industry best practices outlined in documentation such as the UMP and IPMVP. Only the Residential and Business Custom Energy Efficiency Measures (CREEM and CBEEM) programs include projects with custom savings. We also expect some custom projects to have prescriptive components. We assume that the prescriptive elements will be clearly labeled and allocated to the appropriate program track.

The table below presents a summary of the verification activities conducted by task and program designed specifically to verify first-year savings, lifetime savings, and demand savings. AEG also verified other metrics, including total resource benefits, grid service ready, and greenhouse gas emissions as part of the CET verification activities.

Table D-1 Clean Energy Technologies Verified Performance

Verification Activity	Deemed and Semi-Prescriptive		Custom	
	REEM RESM RHTR	BEEM BESM BHTR	CREEM	CBEEM
Program Manager Interviews	Five interviews to cover all programs			
Tracking System Audit	Audit covered all programs			
CET Verification Activities				
Savings Replication	●	●	●	●
Simple Engineering Desk Review	●	●	-	-
Complex Engineering Desk Review	-	-	●	●
Onsite Verification	-	-	-	●

Non-CET verification activities were designed to verify the remaining 30% of Hawai'i Energy's performance award. These activities focused on collecting and verifying information from Hawai'i Energy around the number of customers or communities served, customer bill savings, training sessions, stakeholder and advocacy events, and customer satisfaction scores. Non-CET Verification Activities included:

- Program documentation collection and review
- Verification of Accessibility and Affordability (A&A) metrics

- Verification of Economic Development and Market Transformation metrics
- Verification of Customer Satisfaction metrics

In addition, AEG also verified the calculation of the Low to Moderate Income (LMI) Performance Incentive Mechanism (PIM) award attributable to RHTR and A&A aspects of the Hawai'i Energy programs.

The following sections describe the verification approach and specific verification activities in greater detail.

Program Manager Interviews

AEG conducted interviews with four key Hawai'i Energy program staff to gain insight into the program design and delivery, assess quality assurance/quality control (QA/QC) procedures, discuss successes and challenges, and identify and prioritize verification tasks. The four staff members interviewed were:

- Mireya Norman, Deputy Director, oversees Operations including Residential (including A&A) and Transformational Programs.
- Eileen Stewart, Business Solutions Manager, oversees Business Programs including A&A programs.
- Vinh Ngo, oversees Technical Services including TRM
- Karen Shishido, manages Transformational Programs

Tracking Systems Audit

Before conducting the CET verification activities, AEG reviewed Hawai'i Energy's data-tracking system database. This audit covered the population of projects and CET customers participating in the PY20 portfolio of programs.

AEG reviewed the PY21 program tracking database in two steps:

- The **first step** allowed AEG to conduct a preliminary review of completed projects and served as the basis for developing the sample plan and memo (including desk review samples). Documentation for the desk review samples was then pulled from the Hawai'i Energy database by AEG staff.
- The **second step** included the final reconciled PY21 tracking system data. This data was used for the savings replication activity and the verification of CET and some non-CET metrics.

We verified the accuracy of the tracking system, including input assumptions and savings calculations. The savings replication and desk reviews supported much of the tracking system assessment. We also reviewed the data dictionary associated with the tracking system to confirm that it correctly defines and references program tracking elements and covers an appropriately comprehensive suite of project information.

Sample Plan

The final sample design was achieved in two phases. First, AEG used the draft tracking database¹⁵ provided by Hawai'i Energy to design the sample plan. Then, after receiving Hawai'i Energy's fully reconciled tracking database,¹⁶ we adjusted the sample plan as appropriate given the differences in the draft and reconciled database.

The database includes equipment and rebate-level savings and TRM inputs for replication, plus incentive amounts, customer bill savings, total resource benefits (TRBs), and barrels of oil avoided, among other fields. Each equipment/service and rebate includes first-year energy and demand savings and lifetime energy savings at the following levels:

- **Customer Level:** Gross savings for each customer before accounting for line losses or net-to-gross.

¹⁵ Provided by Leidos on September 23, 2022: PY21 Data Extract & AR Tables Draft 20220923_1329.xlsx

¹⁶ Provided by Leidos on September 30, 2022: PY21 Data Extract & AR Tables 20220930 FINAL.xlsx

- **System Level:** Savings reflected at the generator that incorporates line losses.
- **Program Level:** Net savings that account for free-ridership and spillover (system-level savings multiplied by the net-to-gross ratio).

AEG focused the sample design on customer-level savings; line losses and net-to-gross ratios are fixed across customers within each island or program and do not add variability to the program-level savings (so would not affect a sample design). Keep in mind that the PY21 verification plan included two levels of verification: database replication (no sampling involved for this) and desk reviews (sampling plan covers this effort). Both types of savings are needed to estimate overall program and portfolio level savings and realization rates.

Population Customer Savings

Like PY20, the Residential Energy Efficiency Measures, Business Energy Efficiency Measures, and Custom Business Energy Efficiency Measures (REEM, BEEM, and CBEEM) programs contribute most of PY21's claimed customer first-year and lifetime savings. In total, these three programs account for 84% of the customer first-year energy savings, as shown in the table below. Residential Energy Service and Maintenance (RESM) contributed 8% of portfolio first-year energy savings, Business and Residential Hard to Reach (BHTR and RHTR) each contributed another 7% and 5%, respectively, and the remaining programs account for less than 1%.

Table D-2 Population Claimed Customer First-Year and Lifetime Savings

Program	Type of Verification	MWh (% of Total)	MW (% of Total)	MWh (% of Total)
REEM	Database Replication; Simple Desk Reviews	44,095 (32.6%)	8 (35.8%)	443,911 (27.9%)
BEEM	Database Replication; Simple Desk Reviews	32,460 (24.0%)	6 (27.5%)	405,171 (25.5%)
CBEEM	Complex Desk Reviews; Onsite Visits	31,478 (23.3%)	3 (15.8%)	485,747 (30.6%)
RESM	Database Replication; Simple Desk Reviews	10,320 (7.6%)	2 (9.0%)	74,382 (4.7%)
BHTR	Database Replication; Simple Desk Reviews; Complex Desk Reviews	9,167 (6.8%)	1 (6.0%)	105,284 (6.6%)
RHTR	Database Replication; Simple Desk Reviews	6,270 (4.6%)	1 (4.9%)	62,996 (4.0%)
BESM	Database Replication	1,173 (0.9%)	0 (0.8%)	9,183 (0.6%)
CREEM	Simple Desk Reviews	242 (0.2%)	0 (0.2%)	2,658 (0.2%)
Total	-	135,204 (100%)	22 (100%)	1,589,332 (100%)

Sample Plan

To maximize the efficiency of the budgeted number of desk reviews and onsite, AEG designed the sample to focus on the three programs with the largest contribution to savings (REEM, BEEM, and CBEEM), while also reviewing a small sample of projects for the smaller programs (RHTR, BHTR, and RESM). AEG designed the sample to verify savings with $\pm 10\%$ relative precision at the 90% confidence level for REEM, BEEM, and CBEEM. The samples for RHTR, BHTR, and RESM represent a less rigorous check of savings estimation and approaches with a target of $\pm 20\%$ precision at 80% confidence.¹⁷

¹⁷ Consistent with PY20, we did not perform desk reviews for Upstream and Midstream REEM components. In addition, some components of BESM and BHTR were not sampled due to the low overall contribution of savings. Note that savings are no longer being claimed for the Peer Comparison program, which was ended partway through PY20.

AEG stratified the population of projects by program, delivery stream, and major equipment/service type. The table that follows shows how AEG allocated the sample points to each program and stratum using Neyman's Allocation. Widely used in industry, Neyman's Allocation¹⁸ considers the distribution of claimed savings across strata and the expected variability in stratum-level realization rates to appropriately allocate sample points. As shown here, we based the allocation on customer first-year energy savings, but because the customer demand and lifetime energy savings follow a similar distribution, the design will be optimized for all three types of savings.

Table D-3 Sample Stratification

Program	Stratum	Type Review	Unique Projects	Customer First-Year Savings		Sampled Projects
				MWh	% of Sample Frame	
Sampled Strata			32,073	99,568	73.6%	155
REEM	Residential Downstream	Simple	7,629	10,558	7.8%	20
BEEM	Commercial Midstream	Simple	4,478	14,168	10.5%	20
	Commercial Downstream	Simple	808	18,292	13.5%	20
	<i>Total</i>		5,286	32,460	24.0%	40
CBEEM	Commercial Custom	Complex (15); Onsite + Complex (30)	224	31,478	23.3%	45
RESM	Whole Building Assistance	Simple	8,350	10,320	7.6%	10
BHTR	Energy Advantage	Complex	2,701	6,106	7.6%	10
	ES4H	Simple	1,276	121	0.1%	3
	Commercial Downstream	Simple	352	1,889	1.4%	5
	Other	Complex	69	163	0.1%	5
	<i>Total</i>		4,398	8,279	6.1%	23
RHTR	ES4H	Simple	3,545	670	0.5%	5
	Residential Downstream and Whole Building Assistance	Simple	2,520	2,158	1.6%	5
	Residential Custom	Simple	119	3,405	2.5%	5
	<i>Total</i>		6,184	6,232	4.6%	15
CREEM	Residential Custom	Complex	2	242	0.2%	2
Non-Sampled Strata			27,057	35,636	26.4%	0
REEM	Residential Upstream	None	22,783	30,759	22.7%	0
	Residential Midstream	None	3,911	2,778	2.1%	0
	<i>Total</i>		26,694	33,537	24.8%	0
BESM	Whole Building Assistance	None	327	1,173	0.9%	0
BHTR	Grid Services	None	33	888	0.7%	0
BHTR	Whole Building Assistance	None	1	0	0.0%	0
RHTR	Grid Services	None	2	37	0.0%	0

¹⁸ Available Online: <https://www.nrel.gov/docs/fy17osti/68567.pdf>

Program	Stratum	Type Review	Unique Projects	Customer First-Year Savings		Sampled Projects
				MWh	% of Sample Frame	
Total			59,130	135,204	100%	155

Note that for the CBEEM we propose both complex desk reviews, and complex desk reviews + onsite. The process for sampling CBEEM projects into these two groups is as follows:

- Establish measure-based sub-stratification for CBEEM if needed (e.g., lighting and non-lighting)¹⁹
- Select a random sample of 15 complex desk reviews independently by sub-strata
- Sub-stratify remaining projects (224-15 = 209)
- Recruit customers for onsite visits using targets for each substratum – we anticipate needing to contact 60-100 participants in order to achieve our target of 30 onsites
- Conduct complex desk reviews and onsite visits

AEG calculated the expected precision for each program and type of desk review, below. In addition to the sample sizes, the assumed error ratios²⁰ largely drive the expected precision within each stratum. Error ratios provide a metric of variability around realization rates that we can expect. AEG assumed an error ratio of 0.5 for all strata, which we consider conservative.²¹

Table D-4 Expected Precision from Desk Reviews by Program

Program	Type of Desk Review	# Unique Projects	Customer First-Year Savings		Desk Review Sample Size	Expected Precision (@ 90% Confidence)
			MWh	% of Sample Frame		
Across Sampled Strata within Program		32,073	99,568	73.6%	155	±2.8%
REEM	Simple	7,629	10,558	7.8%	20	±9.7%
BEEM	Simple	5,286	32,460	24.0%	40	±9.5%
CBEEM	Complex	224	31,478	23.3%	45	±12.5%
RESM	Simple	8,350	10,320	7.6%	10	±29.0%
BHTR	Simple	4,398	8,279	6.1%	23	±13.8%
RHTR	Simple	6,184	6,232	4.6%	15	±14.4%
CREEM	Complex	2	242	0.2%	2	±0.0%
Across Non-Sampled Strata within Program		27,057	35,636	26.4%	0	±0.0%

¹⁹ The program tracking database identifies CBEEM projects as lighting, HVAC, or miscellaneous so that AEG can easily stratify the CBEEM population. AEG anticipates the need for sub-stratification based on an initial review of these identifiers.

²⁰ An error ratio is a measure of variability around a ratio estimator, i.e., the verification realization rates. When the claimed and verified savings for the sample projects are closely aligned (i.e., near-100% realization rates), the error ratio is close to zero. If they are not well-aligned, then the claimed savings tell us less about what the verified savings are for projects that we did not directly observe through the sample, and error ratios will be higher (e.g., near 1.0).

²¹ The PY20 Verification found little discrepancy between the claimed and verified savings for sampled projects in most strata based on desk reviews, leading to small error ratios around verified savings. However, we used the industry-standard default error ratio of 0.5 for all strata when calculating the expected precision to cover the less-ideal case that claimed and verified savings for sampled projects are not as closely aligned in PY21.

Program	Type of Desk Review	# Unique Projects	Customer First-Year Savings		Desk Review Sample Size	Expected Precision (@ 90% Confidence)
			MWh	% of Sample Frame		
REEM	None	26,694	33,537	24.8%	0	±0.0%
BHTR	None	34	888	0.7%	0	±0.0%
RHTR	None	2	37	0.0%	0	±0.0%
BESM	None	327	1,173	0.9%	0	±0.0%
Total		59,130	135,204	100%	155	±2.5%

Below, we compare the current sample design to the planned design included in the PY21 Verification Workplan, which was largely based on the PY20 verification sample design. AEG made the following updates to the planned design:

- Moved 10 sample points from REEM to BEEM given the relative proportion of savings by program.
- Shifted 10 sample points from BHTR to RESM to allow a review for a spot check. (RESM projects contributed more to the overall savings population than anticipated when we created the PY21 Verification Workplan.)
- Shifted 2 sample points from BHTR to CREEM so that we can review the submetering projects implemented under CREEM by HE in PY21.

Table D-5 Comparison of Actual Sample Design to Initial Planned Design

Program	Type of Desk Review	Customer First-Year Savings		Actual Sample Sizes	Sample Sizes from PY21 Verification Plan
		MWh	% of Sample Frame		
REEM	Simple	10,558	7.8%	20	30
BEEM	Simple	32,460	24.0%	40	30
CBEEM	Complex	31,478	23.3%	45	45
RESM	Simple	10,320	7.6%	10	0
BHTR	Simple	8,279	6.1%	23	35
RHTR	Simple	6,232	4.6%	15	15
CREEM	Complex	242	0.2%	2	0
Total	Total	99,568	73.6%	155	155

CET Activities

Savings Replication

AEG used TRM algorithms to directly calculate energy and demand savings and total resource benefits (TRBs) for all deemed and semi-prescriptive measures in the tracking system, assuming the necessary measure attributes for the deemed and semi-prescriptive measures were tracked. We compared the replicated values to those that Hawai'i Energy claimed in the tracking database to catch systematic and isolated errors from incorrect inputs and algorithm implementation.

AEG continued to use the tool that it developed during the PY20 verification to automate the replication process. We updated the tool to include all PY21 measures and comply with the Hawai'i TRM in effect at the time of the measure installations (TRM Program Year 2021 v2).

Desk Reviews

AEG conducted engineering desk reviews for deemed, semi-prescriptive, and custom measures on a representative sample of projects. For each sampled project, we reviewed all project documentation and savings calculations to assess the alignment between project documentation and inputs in the tracking system, thereby confirming the accuracy and reasonableness of the input data and project savings. The desk reviews are in addition to the program documentation and tracking system audit and cover a broad range of project-specific documentation, which AEG reviewed in greater depth for the sampled projects. For example, project documentation included project applications, participant terms and agreements, project calculators, manufacturer's specification, invoices, pre- and/or post-installation site inspection reports or photos of equipment, engineering reports that include baseline, ex-ante, and claimed data calculations, custom calculations of savings, and other documentation AEG deemed necessary for verification.

AEG reviewed the engineering algorithms that Hawai'i Energy applied to calculate the claimed savings estimates. The depth of the algorithm review differed for deemed and semi-prescriptive measures and custom projects:

- **Simple Desk Reviews.** The simple desk review for sampled deemed and semi-prescriptive measures ensures that the inputs and parameters that we found in the tracking database match those on the backup documentation requested, such as the invoice. We also checked to see that the correct incentives were applied for each of the sample points. We did not assess the validity of such algorithms, and we only determined whether Hawai'i Energy correctly used the algorithms in the TRM and applied appropriate factors when calculating the claimed savings.
- **Complex Desk Reviews.** For custom projects sampled for desk reviews, AEG assessed the extent to which savings calculation methods were reasonable and based on fundamental engineering practices. We focused the desk review on the key parameters that drive savings for each type of project when determining whether to accept the savings as verified. When we found substantial deficiencies in the calculation methods, we proposed alternative methods based on industry best practices and reference documentation such as the UMP and IPMVP.

AEG carefully documented any discrepancies found during the desk reviews and reviewed with Hawai'i Energy, the EEM, and the Commission, as appropriate, to resolve before finalizing the verification.

Onsite Visits

Best practice verification methods include physical assessments of a sample of individual projects through onsite visits. Onsite verifications enabled AEG to provide more accurate and meaningful verification findings to Hawai'i Energy, the EEM, and the Commission. AEG identified the following primary goals of onsite visits for the PY21 verification:

- Ensure that projects have been installed correctly and have the potential to generate savings (i.e., in place and operating)
- Gather installation dates and equipment specification data
- Verify inputs key to the custom project calculations
- Inform future TRM updates (to the extent possible) such as for protocols related to custom projects
- Inform best practice guidance for custom savings calculations

For the PY21 Verification, the AEG team conducted in-person onsite visits only for projects implemented through the CBEEM program. This is where we expected to see the greatest value from onsite visits for two primary reasons. First, prior verification efforts have uncovered a persistent lack of basic documentation that made verifying the type and quantity of measures rebated difficult without a physical assessment. (We have not had similar and persisting difficulties verifying non-custom projects.) Second, the custom project guidance

document went into effect in PY22.²² The onsite visits allowed the AEG to assess and provide proactive recommendations to Hawai'i Energy around alignment with the guidance document.

Data Collection Plans

AEG developed data collection plans specific to the projects. These site-specific data collection plans included key parameters to check or confirm during the onsite visits. They were used by the engineers to ensure that all information of interest was gathered consistently. We developed the data collection plans while completing the desk review verification for each site.

As part of the process, we submitted data collection plan templates to the EEM for feedback. We also worked with Hawai'i Energy to ensure that we had the most up-to-date information about each customer before the visit. We gathered information on the following, depending on the type of project:

- (If early-replacement measure) Information about the system in place before the replacement, e.g., operating conditions, photos, cut sheets, owner's manuals, or the equipment itself (if retired in place) to verify that installation conditions are consistent with project documentation.
- Make, model, counts, capacities, and efficiencies of the new equipment.
- Descriptions of the operating conditions at the time of project implementation.
- Interactions (if any) with other energy-consuming systems.

Participant Contact and Appointment

Below we describe the process we employed for participant contact and scheduling.

- Initial contact was made by Hawai'i Energy to introduce AEG/RHA and alert the participant that they have been selected for a study. At this time Hawai'i Energy also screened the sample for particularly sensitive customers. AEG/RHA staff took extra care when contacting sensitive customers.
- AEG/RHA staff then followed up via phone and/or email to schedule the in-person verification activities. We followed-up to schedule with participants a maximum of three times and included additional coordination with Hawai'i Energy if needed.

Data Gathering and Analysis

AEG contracted with RHA Energy Partners (RHA), a Hawaii-based engineering consulting group, to conduct Oahu onsite visits. AEG staff conducted the outer Island visits.

RHA has historically been involved with implementing Hawai'i Energy. To avoid any actual or perceived conflicts of interest, RHA reviewed the project sample and identified those with which it had any associations. They provided a description of all known associations to the EEM and PUC, who determined whether RHA or AEG should perform the onsite visit. The EEM and PUC did not feel that RHA needed to recuse itself from any of the projects.

Safety and Training

Safety procedures - COVID Related. AEG and RHA staff followed the following procedures established by the CDC to prevent transmission of Covid-19.

- Reschedule the visit if onsite staff or business or household member is experiencing any potential symptoms of Covid-19.

²² In the PY20 Verification report, AEG recommended that Hawai'i Energy reference the custom project guidance document in PY21, but because that document was not final until well into PY21, they are not required follow the custom project guidance document until PY22.

- Reschedule the visit if onsite staff or close contact of staff is under direction to quarantine due to exposure to Covid-19.
- Wear a fabric mask, always covering the nose and mouth when requested or required.

Safety procedures - General. Because AEG/RHA staff are not licensed electricians, they are limited to visual inspection only. They did not touch live circuits or conduct any metering or measurements that would require interfacing with live electric circuits.

In addition, onsite staff followed the safety procedures established at each site by participant staff including:

- Follow established rules and signage indicating safe and unsafe areas for entry, stepping, etc.

Additional general safety procedures include:

- Dress appropriately: Long pants, closed-toe shoes or boots, and badge.
- Prep survey tools: Charge tablets and phones; bring customer information sheet, survey spreadsheet, and printout of survey as backup.
- Bring PPE: Hardhat, safety glasses, earplugs, and gloves. An unlikely but possible requirement is steel toe boots.

Training. AEG and RHA followed internal training for all onsite covering the following key topics:

- Overview of verification
- Pre-visit preparation
- Data collection and templates
- Beginning the visit
- Walk-through of the facility
- Ending the visit
- After the visit
- Logistics, safety, and other considerations
- Customer concerns
- Special cases

Non-CET Activities

Customer Satisfaction

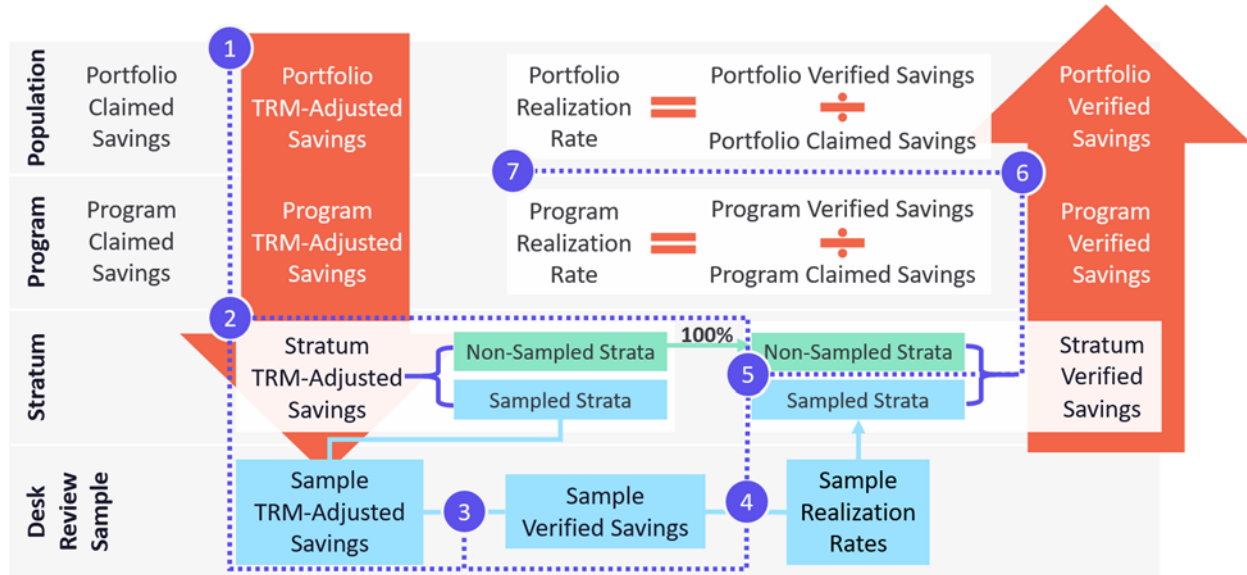
The AEG team received the output results from their customer experience management tool, Medallia, for the residential sector programs. For the residential sector programs, when a customer receives a rebate from Hawai'i Energy, Medallia sends this customer an automated email survey soliciting feedback on their experience with a variety of program interaction elements. For residential participants, these included satisfaction with the rebate experience, likelihood to recommend, and field service experience. For the business sector, Hawai'i Energy created a manual survey based on the Medallia survey. According to Hawai'i Energy, they "send out monthly surveys to new program participants, timed approximately with receiving their rebate check to maximize recognition and awareness. Hawai'i Energy's survey procedures minimized outreach duplication and maximized the number of recipients." Business sector participants were asked about their satisfaction with the rebate experience, likelihood to recommend, and communications.

E

SAMPLE DESIGN AND EXTRAPOLATION

Using the following steps, AEG used the database replication results and desk review findings to inform population-level savings. The figure below shows these steps in general.

Figure E-1 Sample Stratification



1. **Calculate TRM-Adjusted Claimed Savings.** AEG completed its audit of the tracking system and re-calculated the claimed savings (X) with any adjustments. Throughout this report, we refer to these as *TRM-adjusted savings* (X^*). For custom projects not included in the tracking system audit, AEG used the claimed savings as the TRM-adjusted savings.
2. **Stratify Program Savings.** AEG stratified the population of savings by program and major measure category. In addition, RHTR and CREEM were stratified by whether the projects were sampled for desk reviews or not, as we did not extrapolate the sample realization rates to the remaining RHTR and CREEM project populations. For the population, we refer to these as *stratum TRM-adjusted savings* \hat{X}_{hm}^* .
3. **Verify Sampled Project Savings.** AEG gathered backup documentation for each sampled project i within each program h and stratum m and conducted desk reviews to determine the sample-verified savings ($y_{hm,i}$).
4. **Estimate Sample Realization Rates.** Within each program h and stratum m , AEG estimated the *sample realization rate* (\hat{r}_{hm}) as the sum of the sample-verified savings (\hat{y}_{hm}) divided by the sum of the sample TRM-adjusted savings (\hat{x}_{hm}^*).
 - a. For programs and strata where AEG did not conduct desk reviews, savings are the TRM-adjusted savings. This includes projects in the RHTR and CREEM “Not Sampled” strata.
 - b. Sample realization rates are incremental to changes made to the population of claimed savings during the tracking database audit (i.e., the sample realization rates are not double-count any TRM adjustments).

5. **Calculate Stratum Verified Savings.** Within each stratum, we calculated the *stratum verified savings* (\hat{Y}_{hm}) by multiplying the sample realization rate and *stratum TRM-adjusted savings* (\hat{X}^*_{hm}). For REEM, BEEM, and CBEEM, we calculated three values, while for BHTR, RHTR, and CREEM, we used a single value.
6. **Aggregate to Program and Portfolio Levels.** We calculated *program verified savings* (\hat{Y}_h) as the sum of stratum verified savings. For programs without stratification (e.g., BHTR), the program verified savings equal the stratum verified savings. Similarly, we calculated *portfolio verified savings* (\hat{Y}_\cdot) as the sum of program verified savings.
7. **Estimate Program and Portfolio Realization Rates.** To estimate weighted realization rates for each program, AEG divided program verified savings (\hat{Y}_h) by program claimed savings (\hat{X}_h). Similarly, we estimated the portfolio realization rate as the portfolio verified savings (\hat{Y}_\cdot) divided by the portfolio claimed savings (\hat{X}_\cdot). Program and portfolio realization rates incorporate all TRM adjustments and extrapolated desk review results.

F

CONFORMANCE WITH CUSTOM PROJECT GUIDANCE DOCUMENT

As part of the PY21 verification, AEG reviewed the sampled custom projects to determine whether they complied with key elements of the custom project guidance document. This review was conducted independently of the CET verification which followed the same lenient approach to documentation we have employed in past years.

In **Error! Reference source not found.** below, we present the key elements from the custom project guidance document we reviewed and the percent of projects that were compliant. Note that the percentage is calculated based on the CBEM sample and that projects received partial credit for elements where multiple measures were installed and a portion of the rebated measures were in compliance.

As shown, most projects captured general customer information, included appropriate descriptions of the project and baseline conditions, and captured the relevant data. Most also complied with industry best practices for savings estimates of annual kW and kWh. That said, some documentation issues persisted from previous verifications. For example, hardly any of the savings calculation workbooks included lifetime savings calculations. There were also several cases where equipment specifications, project equipment and labor costs, or some proof of installation were not documented or aligned with how savings were claimed.

In the rightmost column, we also present the adjustments that AEG proposes to apply in PY22 when various key elements of PY22 custom projects are missing or not compliant with the Custom Project Guidance document. Note that without appropriate proof of project pre-approval, completion, installation, and costs, AEG proposes to apply zero savings. These fundamental elements of documentation are critical to providing basic assurance that the rebated projects are completed, and that the measures were purchased and installed. Timing of the rebates and pre-inspections help ensure that the program has a chance of influencing customer behavior, and that rebates are not paid for projects that are already installed.

Table F-1 Project Conformance with Custom Project Guidance Document Elements

Key Documentation Element	Detail	% of Compliant Projects	Potential Adjustments to PY22 Non-Compliant projects**
General customer information	Customer Name	100%	Apply zero savings
	Facility Type	100%	
	Street Address	99%	
Appropriate description of project and baseline conditions	Project/Measure Type	96%	Use engineering best practices to develop assumptions for missing/unverified parameters
	Baseline Conditions	90%	
Proof of installation/completion date tracked with qualifying documentation		96%	Apply zero savings
Appropriate data was collected for the measure and IPMVP option		94%	Apply zero savings or use engineering best practices to develop assumptions for missing/unverified parameters
Industry best practice savings calculations were used for the IPMVP option	Annual kW	92%	Use engineering best practices to develop assumptions for missing/unverified parameters
	Annual kWh	93%	
	Lifetime kWh	4%	

Key Documentation Element	Detail	% of Compliant Projects	Potential Adjustments to PY22 Non-Compliant projects**
<i>Appropriate equipment specifications were collected and documented</i>		70%	Use engineering best practices to develop assumptions for missing/unverified parameters
<i>Project costs collected through an invoice, purchase order, or other qualifying document.</i>		67%	Apply zero savings
<i>Proof of Installation of measures through an invoice, post-inspection report, or other qualifying document.</i>		82%	Apply zero savings
<i>Inclusion of a pre-installation inspection report</i>		42%	Apply zero savings
<i>Justification for early retirement</i>		58%	Assume replace-on-burnout

* Adjustments will be applied in PY22 in compliance with the Custom Project Guidance Document effective date of July 1, 2022.

** AEG will request clarification and/or missing data elements from Hawai'i Energy before making these adjustments.

Applied Energy Group, Inc.
2300 Clayton Road, Suite 1370
Concord, CA 94520

P: 510.982.3525