HAWAI‘I ENERGY

Technical Reference Manual Framework
Version 1.0

FINAL
As of April 3, 2019
Effective: July 1, 2019

Acknowledgments

The Hawaiʻi Energy Statewide TRM Framework has been created through a collaboration involving Hawaiʻi Energy, Hawaiʻi Public Utilities Commission (HPUC), the Energy Efficiency Manager (EEM), the Evaluation, Measurement, and Verification (EM&V) Contractor, and the Technical Advisory Group (TAG). Collectively, these entities have offered substantial input to the TRM Framework, providing information to the TRM Framework Lead, commenting on work products, and ensuring that the TRM Framework meets the needs of Hawaiʻi.

We would also like to thank the following individuals for providing valuable input through interviews or comments and input on a review draft of this document.

- Ramsey Brown, Leidos / Hawaiʻi Energy
- Caroline Carl, Leidos / Hawaiʻi Energy
- Michael Chang, Hawaiian Electric Company
- Sue Hanson, Tetra Tech
- Rich Hasselman, Tetra Tech
- Brian Kealoha, Leidos / Hawaiʻi Energy
- Dean Nishina, Department of Commerce and Consumer Affairs
- Ashley Norman, Hawaiʻi Public Utilities Commission
- Kelly Parmenter, Applied Energy Group
- Vinh-Phong N. Ngo, Leidos / Hawaiʻi Energy
- Ted Pope, 2050 Partners, Inc.
- Ingrid Rohmund, Applied Energy Group
- Steven R. Schiller, Schiller Consulting

List of Acronyms

B/C Ratio: Benefit/Cost Ratio

BTUh: BTU-hours

CF: Coincidence Factor

CFL: Compact Fluorescent Light

Cv: Coefficient of Variation

DLC: Direct Load Control

DR: Demand Response

DSM: Demand Side Management

EC: Evaluation Contractor, or Verification Team

EE: Energy Efficiency

EEM: Energy Efficiency Management Team

EEPS: Energy Efficiency Portfolio Standard

EER: Energy Efficiency Ratio

EF: Energy Factor

EISA: Energy Independence and Security Act of 2007

EFLH: Equivalent Full Load Hours

EM&V: Evaluation, Measurement, and Verification

EUL: Effective Useful Life

HE: Hawaiʻi Energy

HIM: High-Impact Measure

HPUC: Hawaiʻi Public Utilities Commission

HVAC: Heating, Ventilating, and Air Conditioning

IC: Implementation Contractor

IE: Interactive Effects Factor

IPMVP: International Performance Measurement and Verification Protocol

ISD: In-Service Date

ISR: In-Service Rate

kW: Kilowatt

kWh: Kilowatt-Hour

LED: Light-Emitting Diode

M&V: Measurement and Verification

NPV: Net Present Value

NTG: Net-to-Gross

NTGR: Net-to-Gross Ratio

PBFA: Public Benefits Fee Administrator

PF: Persistence Factor

PY: Program Year

ROB: Replace on Burnout

RUL: Remaining Useful Life

SF: Solar Fraction

SLF: System Loss Factor

SSMVP: Site-Specific M&V Plan

TAG: Technical Advisory Group

TOU: Time-of-Use

TRB: Total Resource Benefit

TRC: Total Resource Cost Test

TRM: Technical Reference Manual

TWG: Technical Working Group

UEF: Uniform Energy Factor

UMP: Uniform Methods Project

WH: Waste Heat Factor

Table of Contents

Section 1. Introduction

This document comprises the first version of the Hawaiʻi Energy Conservation and Efficiency Program (Hawaiʻi Energy) Technical Reference Manual (TRM) Framework. The purpose of this TRM Framework is to guide the development, maintenance, and application of the TRM. The following subsections provide overviews of the TRM and the TRM Framework, with a focus on what each is designed for, how they complement each other, and overarching guiding TRM principles.

1.1. Overview of the TRM

The Hawaiʻi Energy TRM provides methods, formulas, and default assumptions for estimating gross customer-level energy and peak demand impacts from energy efficiency measures offered by Hawaiʻi Energy. The TRM also provides key metrics for determining net program-level energy and peak demand impacts, as well as the lifetime monetary value of those impacts. In essence, the TRM is designed to:

- Provide a transparent and consistent basis for calculating gross customer-level energy savings (electric kilowatt-hour (kWh)) and coincident peak demand reductions (electric kilowatt (kW)), including interactions between efficiency measures as relevant.
- Provide the metrics needed for calculating net program-level impacts from the gross customer-level savings, namely deemed net-to-gross (NTG) values for net savings adjustments and system loss factors (SLF) to account for transmission and distribution losses between the busbar and customer meter.
- Support the determination of lifetime energy efficiency savings.
- Support Total Resource Benefit (TRB) calculations using avoided energy and capacity costs coupled with discount rates to determine the present value of lifetime energy impacts from the program, thereby also supporting cost-effectiveness calculations which are done outside of the TRM for program design, evaluation, and regulatory compliance.
- Document the underlying sources of all approaches and assumptions used throughout the TRM.

Current and past TRMs can be found on the Hawaiʻi Energy website.[1]

1.2. Overview of the TRM Framework

The TRM Framework describes the common understanding all involved parties and stakeholders share regarding the process and assumptions Hawaiʻi Energy and the Verification Team use in determining the impacts of the Hawaiʻi Energy programs. As such, the TRM Framework addresses guiding TRM principles, the TRM updating process, and how to apply the TRM. Specifically, the TRM Framework is designed to:

- Define the roles and responsibilities of all entities involved in TRM development, maintenance, and use.
- Specify the format and type of information to be provided in the TRM.
- Guide how impacts of individual measures and services that result directly in energy and/or demand savings are calculated in the TRM.
- Provide a process for periodically updating and maintaining TRM records that involves identification and prioritization of substantial data gaps that can be addressed through future research, evaluation efforts, and/or other targeted end-use studies.

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1 https://hawaiienergy.com/about/information-reports

- Preserve a clear record of which TRM is in effect at what times to facilitate program planning, implementation, and verification.
- Explain how the TRM is to be applied to determine gross customer-level and net program-level impacts.
- Include placeholder sections for other program categories and activities that may be covered in the future TRM, namely transformational program activities, which provide for energy savings indirectly, and codes and standards initiatives that warrant attributing a portion of savings from codes and standards compliance to the program.

1.3. Guiding TRM Principles

The following key activities were completed to help inform development of the TRM Framework:

- In-depth interviews with key entities involved with the Hawaiʻi Energy programs, as well as other stakeholders.
- Benchmarking of TRM Framework-type documents from other areas of the country.[2]

In reviewing similar documents from across the country, a number of industry best practices were identified. These best practices drive the guiding principles described below, with specific consideration towards the Hawaiʻi Energy programs and context.

The Hawaiʻi Energy TRM will only effectively serve stakeholders and their needs if it is thorough, accurate, transparent, and easy to use. However, there is also a need to balance features, function, and cost, as well as the trade-offs inherent in improvements in each of the key features. To achieve this balance while maximizing value, ongoing TRM development should keep the following principles in mind.

- **Best available data.** As available, Hawaiʻi-specific information should be used whenever possible to inform measure-level savings or generalized key parameters used across the TRM. This approach is not only efficient but also takes advantage of utility and other stakeholders' insights, program knowledge, and internal expertise. The Hawaiʻi Energy TRM started with the common elements of TRMs and other savings estimates from various stakeholders and jurisdictions, and has been, and should continue to be, updated with the most current information and Hawaiʻi-specific inputs as either this information becomes available and/or these activities are prioritized and budget allows. However, information and experiences from other jurisdictions may be the best available data, and most cost-effective to obtain, and should be used to inform or enhance Hawaiʻi-specific information.
- **Best practices.** The approach of using local data as a framework and then benchmarking and supplementing with relevant information, data, and lessons from other jurisdictions leads to measure characterizations that are as accurate as possible and most relevant to Hawaiʻi Energy programs. The TRM should continue to be built on best-practice approaches to TRM development, including those described in both the US Department of Energy's SEE Action[3]

[2] The development of this document draws heavily from the leading industry references used to guide TRMs throughout the United States. The References section contains a complete bibliography of materials referenced to develop this document.

[3] https://www4.eere.energy.gov/seeaction/

publications and Uniform Methods Project (UMP)[4] protocols, when relevant, and include enhancements informed by experience in other jurisdictions when appropriate.

- **Prioritization.** Not all measures or savings assumptions are equally important. The ongoing development objective for the TRM should intentionally focus on establishing reliable results for those measures, assumptions, and protocols that are likely to have the greatest impact on energy savings and cost-effectiveness for Hawaiʻi Energy programs. Shared information and experience, along with a focus on the most substantial assumptions, provides the guidance for the development of measures. Also, continuing to prioritize new and evolving measures which may have substantial impact on the future, through cycles of future characterization development is an effective way to balance considerations of usefulness and cost. (Section 2.3 describes the prioritization process.)
- **Stakeholder involvement.** The most transparent and useful TRMs not only include data from utilities and stakeholders but also reflect their input and buy-in for the process and the final decisions made. The ongoing development of the TRM includes review and input from various entities that include the TRM Administrator, EEM, Hawaiʻi Energy, HPUC, and the Verification Team. Additionally, the TRM development process includes opportunities for stakeholder input and discussion through the TAG forum. Regular meetings among the TRM Administrator, EEM, and Verification Team should be used to maximize the level of collaboration and visibility into the measure characterization and TRM update process. Where consensus does not emerge on specific measures or issues, items should be promptly addressed. The TRM strives to achieve and represent a broad consensus among all of these various entities. (Section 2.1 describes the roles and responsibilities of all entities involved in the TRM update process.)

[4] https://www.nrel.gov/ump/

Section 2. TRM Update Process and Schedule

The process of incorporating new and better information into the TRM occurs annually. Prior to the start of a program year for which the updated TRM will be in effect, Hawai'i Energy will be making portfolio adjustments and tracking system updates based in part on changes reflected in the updated TRM. This section describes the TRM update process and outlines the schedule for these updates.

2.1. Roles and Responsibilities

The TRM update process involves several entities, each with their own roles and responsibilities to ensure effectiveness, sufficient review, and independence. The entities involved are expected to contribute to the process as outlined in Table 1, below.

Table 1. Entities Involved in Hawai'i Energy TRM Update Process

Entity	Overall Role	TRM Update Process Responsibilities
TRM Administrator	• Leads annual TRM development and update process • The TRM Administrator is a role delegated by the HPUC to the EM&V Contractor Team	• Requests input from EEM, Hawai'i Energy, and TAG on recommended changes or topics to address in TRM update • Annually, reviews input received for new measures and/or existing measure revisions; prioritizes the list in consultation with EEM and HPUC • Researches and develops first draft TRM updates for needs identified through the prioritization process (see Section 2.3) • Identifies changes, gathers input, and prepares draft TRM • Reviews draft TRM with EEM, HPUC, and Hawai'i Energy • Prepares updates and submits final TRM for approval by HPUC
Hawai'i Energy (or, PBFA)[5]	• Administers the Public Benefits Fee (PBF) Program in the Hawaiian Electric Companies' service territories	• Identifies needs for new or revised measure characterization, or measure deletion, raises with TRM Administrator, and researches and develops input for first draft measure characterizations for new or revised measures they identified • Provides feedback on TRM revisions
EEM	• The independent contractor team that assists the HPUC with the administration of contracts with Hawai'i Energy and the EM&V Contractor Team	• Provides input on recommended changes or topics to address in TRM update and annual TRM update prioritization • Oversees and provides input on draft measure characterizations and TRM updates for HPUC approval • Facilitates TAG meetings

[5] Hawai'i Energy is the brand name for the ratepayer-funded program offered in the Hawaiian Electric Companies' service territories of Hawai'i, Maui, and Honolulu counties. The program is administered by a third-party Public Benefits Fee Administrator (PBFA), who was selected by the HPUC through a competitive bidding process. In this document, the PBFA is referred to as "Hawai'i Energy."

Entity	Overall Role	TRM Update Process Responsibilities
Verification Team	• The Verification Team is a subset of the EM&V Contractor Team	• Annually verifies Hawaiʻi Energy claims (e.g., TRBs, energy savings, and peak demand savings) of each program and portfolio under direction of EEM and HPUC • Ensures proper Hawaiʻi Energy use of TRM in claiming savings • Through verification activities, identifies any measures that may need updating in the TRM
HPUC (or, Commission)	• Responsible for guiding the development of state utility policies that best serve the long-term interest of Hawaiʻi utility ratepayers, with the goal of the provision of high quality public utility service in Hawaiʻi at reasonable costs	• Approves selection of the TRM Administrator and scope of work for TRM updates • Identifies, discusses, and approves any TRM related policies and the TRM update process, including measure prioritization • Approves any changes to the TRM and the final TRM
TAG Stakeholders	• Members of a stakeholder working group convened to provide review and input for the Hawaiʻi Energy programs	• Identifies needs for new or revised measure characterization or other TRM updates • Participates in TAG discussions related to the TRM and verification
EM&V Contractor Team	• Entity designated by the HPUC to provide independent EM&V services for the Hawaiʻi Energy programs, Energy Efficiency Portfolio Standard (EEPS), and other programs and/or activities as directed by the HPUC • Reports to the EEM	• Designates staff to fill the TRM Administrator and Verification Team roles, with approval from the EEM and HPUC • Manages TRM Administrator and Verification Team, including review of deliverables

2.2. TRM Review and Update Process

This section describes reasons the TRM may need to be updated, measure baselines, and key TRM metrics and adjustment factors.

Reasons to Update the TRM

The degree to which the TRM will be updated in a given year will be driven by a number of considerations. Key reasons for TRM adjustments include:

- Measure-driven changes
- Program-driven changes
- Market-driven changes

These reasons, which can overlap, are described in more detail in Table 2, below.

Table 2. Main Reasons to Update the Hawai'i Energy TRM

Type of Change	Reason for Change
Measure-driven	• New measure additions. As new technologies, or technology advancements, are introduced to the Hawai'i Energy portfolio, they will be characterized and added to the TRM. • Existing measure updates. Updates should occur for a number of reasons. Examples include: baseline changes, such as increases in the federal standard for efficiency of a measure; (see section below), new information from field tests; altered qualification criteria; decrease in measure cost; new information found during verification that provides a better value of an assumption for a variable; and a change in underlying methodology, such as a move from custom to deemed, or using a control group. • Retiring existing measures. Existing TRM measures may be removed from the Hawai'i Energy portfolio when the economics of a measure become such that it is no longer cost-effective, the free-rider rate is considered too high, or Hawai'i Energy ceases claiming savings for a measure. Before retiring an existing TRM measure, there should be agreement among the HPUC, EEM, and Hawai'i Energy.
Program-driven	New or updated program delivery design (direct install versus point of sale) may result in the need for new measure characterization. • Program changes could include change in program focus or more/less emphasis on a particular measure (e.g., it was not a high-impact measure but now it is a high-impact measure, or a measure moves from direct install to point-of-sale). These changes would affect measure eligibility criteria. • If program delivery affects the key parameter assumptions or available measure documentation for claimed savings.
Market-driven	As programs increase market penetration of a measure or the market increases the natural adoption of a measure, measure characterizations need to be updated to meet the changes in the market. Examples of market-driven factors include: • Changes to baselines, energy codes, NTG, new areas of interest, etc. • Market saturation studies indicating high adoption rates for specific segments or across sectors. • More evaluation and market-research data that have become available. • Changes to budgets and/or policy objectives.

During the TRM update process, literature from other jurisdictions that is referenced in the TRM to support savings assumptions should be examined and retained for future reference. This examination would include reviews of the studies and population from which the data were derived, as well as all underlying assumptions. Justification for how to apply the data to Hawai'i should be well documented.

Measure Baselines

A crucial savings impact decision is defining the baseline conditions. Measure savings must be determined against clearly defined baseline conditions. Baseline definitions consist of site-specific conditions, market conditions, or broader policy-oriented considerations. In the Hawai'i TRM, each measure includes a description of the assumed baseline energy use and the high efficiency energy use for that measure type. The energy and peak demand savings represent the difference between the energy usage and peak demand for the high-efficiency case relative to the baseline case.

The type of program and/or measure being verified affects which baseline approach will most effectively create the counterfactual condition to characterize the measure. For measures that characterize savings based on individual unit installations, site-specific key parameters should be considered, such as the characteristics of equipment in place before an efficiency measure is implemented, as well as operating conditions. The use of site-specific key parameters versus market average key parameters will be driven by program delivery considerations as well as the available information about the market. When defining the baseline, it is also important to consider where in the life cycle of the existing equipment or systems the new equipment was installed. There are four main options:

- Replacement of failed equipment with new energy efficient equipment (also referred to as "replace on burnout" or "normal replacement");
- Early replacement of equipment that had not reached the end of its useful life (also referred to as "early retirement");
- Modifications to existing equipment or systems to improve operation or address maintenance (also referred to as "retrofit add-on," "add-on equipment," and/or "operation and maintenance"); or
- New construction.

Table 3 outlines the considerations for assumed baseline conditions for measures in the TRM.

Table 3. Baseline Conditions and Attributes

Baseline Condition	Attributes
Replace on Burnout, or New Equipment Installations	Definition: A measure in which the customer is incented to purchase higher efficiency equipment. These types of measures constitute most of the Hawai'i Energy offerings. Baseline: Typically, the applicable, and most efficient, Code or Standard, or with reasonable justification, standard industry practice[6] – whichever represents a more accurate baseline assumption. If there is not an applicable Code or Standard, then a standard industry practice shall be assumed for the baseline. Efficient Case: New, premium efficiency equipment above federal and state codes or standard industry practice, as defined in the TRM measure characterization. Example: Appliance rebate.
Early Replacement	Definition: A measure that *replaces* existing, operational equipment. Baseline: Dual; it begins as the existing equipment and shifts to federal and state codes or standard industry practice after the remaining useful life of the existing equipment is over. Efficient Case: New, premium efficiency equipment above federal and state codes and standard industry practice. Examples: Refrigerated case lighting, distribution transformers.

[6] Industry Standard Practice (ISP) represents the typical equipment or commonly used current practice absent the program. Per the CPUC, D.12-05-015. Page 351: For purposes of establishing a baseline for energy savings, we interpret the standard practice case as a choice that represents the typical equipment or commonly-used practice, not necessarily predominantly used practice." It also said, "Industry standard practice baselines are established to reflect typical actions absent the program."

Baseline Condition	Attributes
Retrofit Add-On, or Add-On Equipment	Definition: A measure that *upgrades* or enhances existing equipment. Baseline: Existing equipment or the existing condition of the building or equipment. It may be a single or dual baseline. It applies over the equipment's or measure's life, as appropriate to the application. Efficient Case: Post-retrofit efficiency of equipment. Examples: Controls, tune-ups.
New Construction and Major Renovation	Definition: A measure that intervenes during building design to support the use of more-efficient equipment and construction practices. Baseline: Typically, the applicable, and most efficient, Code or Standard, or with reasonable justification, standard industry practice; whichever represents a more accurate baseline assumption. If there is not an applicable Code or Standard, then a standard industry practice shall be assumed for the baseline. Efficient Case: The program's level of building specification. Examples: Building shell, mechanical measures. Hawaiʻi Energy moved the Residential New Construction incentive to a custom incentive in the TRM due to the complex and unique nature of these projects.

For equipment replacements in existing buildings, an early replacement baseline requires a somewhat different treatment from the more standard replace on burnout case. In the early replacement case, the equipment in question is still operational and is exchanged for higher efficiency equipment.[7] If the program administrator can show that the program induced the early replacement of functioning equipment, then the project can generally achieve a higher level of savings by using a dual baseline treatment. The dual baseline treatment uses an existing conditions baseline for the number of years the replaced equipment would have continued to function—the remaining useful life (RUL)[8]—and then uses a codes and standards or industry standard practice baseline for the remaining years of the new measure's effective useful life (EUL).

> Using a replace on burnout condition will generally result in more conservative energy savings than assuming early replacement conditions. However, an early replacement baseline can only be justified with appropriate documentation to validate that the pre-existing baseline equipment was operating and had a meaningful remaining useful life prior to replacement.

For large-scale consumption analyses that use a randomized control trial (RCT) approach or quasi-experimental methods, the baseline is the energy consumption and demand of the control group, against which the treatment group consumption is compared.

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7 The criteria that are used to determine whether equipment is "operational" vary among jurisdictions and there is no related industry standard practice. The Hawaiʻi TRM provides assumptions for estimating savings and costs for early replacement measures, as applicable, and in some cases (e.g., for the Distribution Transformer measure) provides guidance on eligibility criteria for early replacement.

8 RULs apply to retrofit or replacement measures, can be difficult to determine, and vary by project. For example, if an existing working refrigerator is replaced with a high efficiency unit, the RUL is an assumption of how many more years the existing unit would have lasted. If the RUL cannot be determined from the age of the measure, common industry practice is to assume the RUL is 1/3 of the EUL.

The previous and current EM&V Contractors have completed (or are in the process of completing) baseline studies that include primary market research, literature reviews, and review of Hawaiʻi Energy's program materials and past reports. These studies help inform measure-specific baselines appropriate for Hawaiʻi Energy's programs. [9,10,11]

Key TRM Metrics and Adjustment Factors

This section provides a high-level overview of what is included at the portfolio level as well as for each measure in the TRM, with emphasis on the key metrics and common adjustments that are presented in the TRM and how they are used. Additionally, this section describes the measure savings categories (deemed, semi-prescriptive, and custom).

The primary overall economic benefit to the State of Hawaiʻi is the value of saved energy and peak demand reduction resulting from the program—that is, the energy and capacity that does not need to be otherwise provided by the electrical system. The total monetary value of all the energy savings and peak demand reductions is called the Total Resource Benefit (TRB). The TRB calculation is the present value of aggregated energy and demand savings for all deemed, semi-prescriptive, and custom measures installed through the Hawaiʻi Energy programs, multiplied by avoided costs. The TRM presents the avoided energy and capacity cost factors for use in calculating the TRB. Within the TRM, engineering equations are specified at the measure-level for deemed and semi-prescriptive measures, which include measure useful life, a key parameter for developing the present value of measure-level TRBs. The TRM also contains guidance for calculating savings for several custom measures.

> As updates are made, the following information must be provided for each measure in the TRM:
>
> - Measure name
> - Update status
> - Measure description
> - Program criteria
> - Unit of measure
> - Baseline equipment
> - High efficiency equipment
> - Algorithms
> - Definitions & assumptions
> - Savings tables
> - Resources used

As mentioned previously, each measure in the TRM includes a description of the baseline case and the high-efficiency case. The energy saved is the difference between the energy use for the baseline case and the energy use for the high-efficiency case. Similarly, the peak demand reduction is the difference between the coincident peak demand for the baseline case and the coincident peak demand for the high-efficiency case. For some measures and program delivery approaches, a dual baseline is needed to account for baselines changes that occur during the life of the measure. Lifetime energy savings reflect the cumulative saving accrued for the life of the measure.

The description of each measure also includes sections that describe the algorithms used to determine savings, definitions and assumptions, and savings information. The Algorithms section provides the equations used to calculate energy, peak demand, and lifetime energy savings. The Definitions & Assumptions section lists parameters that are used for the savings calculations and provide explanations and sources for the values and assumptions. For some measures, this section also contains look-up

[9] Evergreen Economics, Baseline Energy Appliance, Equipment and Building Characteristics Study Report, Prepared for the State of Hawai'i Public Utilities Commission, February 26, 2014.

[10] Opinion Dynamics Corporation, Memorandum, "Hawaiʻi Baseline and Net-to-Gross Framework," June 27, 2018.

[11] Applied Energy Group is currently in the process of conducting Baseline Studies for the state of Hawai'i.

tables of stipulated values for the parameters that are used for the calculations. The Savings section presents tables of deemed values for deemed measures and refers to calculators for semi-prescriptive measures. The last piece of information for each measure is a list of Resources used to inform the measure characterization.

As part of the savings algorithms, a number of factors, or independent variables, are included that affect energy and demand levels and need to be considered when determining savings. The following two tables describe the common key metrics and adjustment factors—Table 4 describes portfolio-level metrics, and Table 5 describes common measure-level adjustment factors.

All metrics described in both tables should be regularly reviewed and updated as new information is made available. In particular, any TRM metrics and adjustment factors that have been identified as priority items to address in a given year (see Section 2.3), should be reviewed and updated accordingly. Updates to avoided costs, system loss factors, and the definition of the system peak period should include consultation with and review by the Hawaiian Electric Companies.

Table 4. Portfolio-Level Metrics and Definitions

Metric	What It Is and How It Is Calculated
Avoided Costs	The Hawaiʻi Energy program's avoided costs for energy and capacity are developed in consultation with the Hawaiian Electric Companies (HECO). The avoided energy costs should reflect projected costs for fuel and operation and maintenance (O&M) of existing generation resources. The avoided capacity costs should reflect current and projected costs for expanded generation capacity. One way to calculate avoided capacity value for efficiency measures is to estimate the cost of building a power plant in the year of the efficiency measures' installation and using an annual capital recovery value (associated with financing the power plant and perhaps utility rate of return, taxes, depreciation, etc.), plus annual fixed O&M costs, to determine an annual value for that plant's capacity. Other preferable means for calculating avoided costs involve integrated resource planning efforts using capacity expansion models, which are used by HECO from time to time.
Total Resource Benefits (TRB)	The TRB is the estimated total present value (PV) of the avoided costs for the utility from the reduced lifetime demand (kW) and energy (kWh) from energy efficiency projects and measures. To estimate the TRB for individual measures or for the total savings for the Hawaiʻi Energy programs, the cost per kWh supplied and the system capacity cost per kW need to be estimated into the future. The current discount rate is 6 percent, which should be reviewed periodically and revised as necessary to reflect Commission perspectives. One practice is to use the utility's weighted average cost of capital as a discount rate, though other considerations can be incorporated into a discount rate, such as use of societal discount rate (see discussion of discount rates in the National Standard Practice Manual[12]).
System Peak Savings	HECO's system peak period is currently defined as 5-9 PM on non-holiday weekdays throughout the year, regardless of the season or month. Demand savings are calculated as the average hourly savings occurring during the peak period.

[12] See https://nationalefficiencyscreening.org/national-standard-practice-manual/

Metric	What It Is and How It Is Calculated
Gross Savings	In the TRM, this is also referred to as the "gross customer level" savings. Unless otherwise specified, the algorithms shown with each measure calculate gross electricity savings at the customer site (service entrance, meter) without counting the effects of line losses from the generator to the customer or free-ridership or spillover.
System Loss Factor (SLF)	The SLF is defined as marginal electricity losses from the busbar to the customer meter – expressed as a percent of meter-level savings. Each island in Hawaiʻi has a different SLF due to differences in infrastructure. SLF values are derived using island-level loss data published for the Hawaiian Electric Companies. The customer-level electricity savings are multiplied by (1+SLF) to get the system-level savings, or savings at the power plant busbar.
Net Program Savings	Net program savings reflect the calculation based on gross customer savings that takes into account both the SLF and the net-to-gross ratio (NTGR). The formula for calculating net kWh and peak kW are: Net Program Savings, kWh = Gross Customer Level Savings ΔkWh × (1 + SLF) x NTGR Net Program Savings, kW = Gross Customer Level Savings ΔkW × (1 + SLF) x NTGR

Table 5. Common Hawaiʻi Energy TRM Measure-Level Adjustment Factors and Definitions

Metric	What It is and How It Is Used
Demand Coincidence Factors (CF)	Demand CFs are used to describe how a measure's savings affect the peak demand time period. The CFs describe the proportion of the measure rated load reductions to the operational characteristics during the peak demand period. Incorporated into CFs are assumptions to account for load diversity of the measure as well as the percentage of peak measure level kW savings that occurs during the peak demand time period. This factor appears in the TRM algorithms for peak demand reduction and is often derived from measure-level load shape analysis.
Effective Useful Life (EUL)	An EUL is the median length of time (in years) that an energy efficiency measure is still operable and providing savings and is often used interchangeably with the term "measure life." The EUL determines the period of time over which the benefits of the energy efficiency measure are expected to accrue, affecting lifetime energy savings and the TRB present value calculation. EULs should be reviewed periodically and adjusted by standard efficiency evaluation industry practices or for known factors in Hawaiʻi that may affect the operational life of equipment, if that differs from general industry practices.
Remaining Useful Life (RUL)	Applies to early replacement measures. If the RUL cannot be determined from the age of the measure, the RUL is usually assumed to be 1/3 of the EUL.
Hours of Use (HOU)	The hours that equipment is expected to operate in a given period of time (e.g., day, month, year). Hours of use are typically annualized and used as a base assumption for estimating equipment energy consumption. The equipment capacity multiplied by the hours of use results in an estimate of annual energy consumption. Hours of use should be reviewed and updated periodically based on best-available information relevant to the measure use.

Metric	What It is and How It Is Used
Equivalent Full Load Hours (EFLH)	The EFLH is the equivalent hours that equipment would need to operate at its peak capacity in order to consume its estimated annual kWh consumption (annual kWh/connected kW). For example, for an air conditioner, the EFLH is the number of hours it would have to operate at full load to equal the amount of cooling delivered by the system at a constant thermostat setting over a cooling season. An EFLH value is typically included for measures with variable load (such as the air conditioner example). EFLH adapted from other jurisdictions should be adjusted to Hawaiian conditions with respect to known differences between the source EFLH and calculated Hawaiian EFLH. Hawaiʻi-specific EFLH could be developed using approaches outlined in the UMP or with Hawaiʻi-specific building simulations of prototypical buildings types.
Interactive Effects (IE)	Energy effects from an energy efficiency measure that occur outside the measurement boundary of the individual measure. For example, there are IEs between lighting and HVAC equipment, since efficient lighting installed in conditioned spaces decreases air conditioning loads but increases heating loads. For interior lighting measures, the TRM algorithms include IE factors to account for the effects of interactions with space cooling equipment.
Lifetime Installation Rates/ In-Service Rates (ISR)	Installation or in-service rates (ISRs) account for measures or program delivery methods in which the full life of the measure may not be achieved. Typically, ISRs account for the proportion of a measure that would be in storage (i.e. purchased but not installed), measure removal, or breakage, for the lifetime of the measure. ISRs can vary by program delivery mechanism, but they are particularly important in giveaway or upstream programs where the customer is responsible for installation and no direct observation of installation can be made by the program. ISRs should be included in TRM calculations for relevant measure types.
Load Shapes	Load shapes are representations such as graphs, tables, and databases that show the time-of-use pattern of customer or equipment energy use. These are typically shown over a 24-hour or whole-year (8,760 hours) period but can also be seasonal. Load shape data derived from Hawaiʻi Energy participants or Hawaiʻi-specific simulation modeling is valuable for determining Hawaiʻi-specific parameters such as EFLHs, CFs, and IEs for different types of buildings, equipment, and/or systems.
Net-to-gross (NTG) Ratio, or NTGR	A ratio of the net impacts to the gross impacts of an energy efficiency measure or program, where the net impacts represent the difference in energy consumption with the program in place versus what consumption would have been without the program in place. In Hawaiʻi, the primary factor considered in NTG analysis and net savings calculations is free-ridership. However, in the future the NTG value may also include spillover and market effects considerations. For the Hawaiʻi Energy program, NTG factors are different for each program category and for some specific measures. To date, the NTG factors have been stipulated values, determined by the EM&V Contractor through benchmarking of other similar programs.[13,14,15] NTG factors are used to help inform program-level incentives.

[13] Evergreen Economics, Evaluation of the Hawaiʻi Energy Conservation and Efficiency Programs, Program Year 2011, June 20, 2013, Appendix D: Net-to-Gross Assessment Memo. NTG benchmarking analysis covered four resources: Wisconsin Focus on Energy (2011), CPUC DEER (2006-2007), Massachusetts Energy Efficiency Advisory Council (2010), and NYSERDA (2011-12).

[14] Opinion Dynamics Corporation, Memorandum, "Hawaiʻi Baseline and Net-to-Gross Framework," June 27, 2018.

[15] Applied Energy Group, Memorandum, Summary of PY19 TRM Update, January 2019. AEG's NTG benchmarking analysis is summarized in the workbook titled "AEG HPUC NTG Benchmarking Analysis."

Metric	What It is and How It Is Used
Lifetime Persistence Factor (PF)	The metric used to measure lifetime savings persistence. Savings persistence[16] is the percentage of change in expected savings due to changed operating hours, changed process operations, and/or the performance degradation of equipment efficiency relative to the baseline efficiency option. For example, an industrial plant that reduces operation from two shifts to one shift may then have a savings persistence factor of 50%, as only half of the projected energy savings would be realized. Also, improper operation of the equipment may negatively affect savings persistence, so training and commissioning could improve savings persistence. Finally, most equipment efficiency degrades over time, so annual energy savings may increase or decrease relative to the efficiency degradation of the baseline efficiency option. In the TRM, some of the measure-level algorithms contain an entry for PF. The default value if none is indicated is 1.00. A value lower than 1.00 will result in a downward adjustment of lifetime savings and TRB. For any measure with a persistence value less than 1.00, the claimed first year savings are reduced, and claimed for each year of the equipment's EUL.

As part of understanding the measure-level metrics in the TRM, it is also helpful to understand the different type of measure categories described in the TRM. The table below outlines the three types of measure categories as they relate to how energy savings are determined.

[16] The savings persistence definition is from the Uniform Methods Project.

Table 6. Types of Measure-Level Savings Categories in the TRM

Measure Category[17]	Definition	TRM Examples
Deemed	Measure-level savings that are fully deemed (or, prescriptive) are those where there has been a pre-determined estimate of energy and/or peak demand savings attributed based on well-vetted information. These are documented, numerical values in the form of per-unit savings. The savings values are fixed, regardless of any site- or project-specific conditions. Deemed savings values should be based on input assumptions that are realistic and not necessarily conservative or optimistic. Deemed savings values should be applied to:[18] • Measures that are well-understood with documented experience that indicates that there is a strong central tendency in the distribution of savings across installations. • Measures for which savings or calculations can be developed from reliable data sources and analytical methods. • Measures that fit within well-defined boundary conditions that clearly describe the applications for which the measures' deemed savings value(s) do, or do not, apply. • Conditions under which the measure's application can be verified by the nature of the program design (i.e., direct installation delivery) or through post-installation inspection. • Measures with impacts that are not highly dependent upon the application of consistent quality control in their installation. • Measures with impacts that are not highly dependent upon customer behavior. Deemed savings are typically derived through the development of engineering algorithms, tools, or models to estimate average savings as a function of one or more average inputs, including baseline usage patterns, equipment efficiency levels, and building thermal characteristics. The TRM documents the methods and sources used to develop the deemed values by measure category and lays out the resulting savings per measure estimates in the form of energy and demand savings values.	Residential appliances such as clothes washers, clothes dryers, and refrigerators

[17] For all measure-level savings categories, the interactive effects (IEs) among all measures installed for any given project should be considered in determining the project's savings. For example, there are IEs between lighting and HVAC equipment, because efficient lighting installed in conditioned spaces decreases air conditioning loads but increases heating loads.

[18] SEE Action Guide for States: Guidance on Establishing and Maintaining Technical Reference Manuals for Energy Efficiency Measures, June 2017, page 16. https://www4.eere.energy.gov/seeaction/system/files/documents/TRM%20Guide_Final_6.21.17.pdf

Measure Category[17]	Definition	TRM Examples
Semi-Prescriptive	Measure-level savings that are semi-prescriptive (or, partially deemed) are determined with algorithms that have some combination of inputs that are reflective of both stipulated variables or factors, as well as site- or project-specific conditions, variables, and factors. These engineering approaches provide flexibility and the opportunity for users to substitute local, specific information for stipulated input values. The stipulated input variables or factors for any algorithm should be based on realistic assumptions and should not necessarily be conservative or optimistic. The parameters can also be changed in TRM updates to be applied in future years as better information becomes available. Semi-prescriptive approaches should be applied to:[19] • Measures for which some variables and factors are known to vary widely by project site. • Measures for which inputs to site-specific calculations are easily ascertained and verifiable. • Measures for which "reasonableness" ranges for site-specific input variables and factors can be built into the calculation process.	Commercial air conditioning and commercial heat pumps
Custom	Custom savings calculations are most commonly used for measures or packages of measures that are more complex than deemed or semi-prescriptive savings projects or are larger in scope than intended by deemed savings projects. For this reason, the TRM does not prescribe calculation approaches for fully custom measures, but instead provides guidance on the types of measures and projects that should be handled with a custom approach. For the Hawai'i Energy programs, custom projects may be complex projects with multiple components, first-of-their-kind projects, or special projects that are unique to a particular customer and are handled on a case-by-case basis. These projects require a level of transparency and documentation that is not required by most deemed and semi-prescriptive measures. Custom projects should be sufficiently detailed to allow for quality control review. Custom calculations should be derived by industry best practices, such as those found in UMP and IPMVP. The data collected, data editing, and data analysis should be documented so that savings can be reproduced, assuming there is access to any software used by the practitioner.	Transformers, residential new construction

[19] SEE Action Guide for States: Guidance on Establishing and Maintaining Technical Reference Manuals for Energy Efficiency Measures, June 2017, page 16.

Conditions and applications for which each deemed savings value or semi-prescriptive calculation can be applied should be documented:[20]

- The baseline(s) for which the savings value is applicable (with the baseline defined), including the market event (replace on burnout, early retirement, or new construction).
- Measure descriptions and documentation for the application savings values should include those characteristics (e.g., installation specifications, delivery mechanism, location, capacity, etc.) that determine the measure's savings.

All TRM savings values, calculations, factors, and variables should be based on reliable, traceable, publicly available, replicable, and documented sources of information.

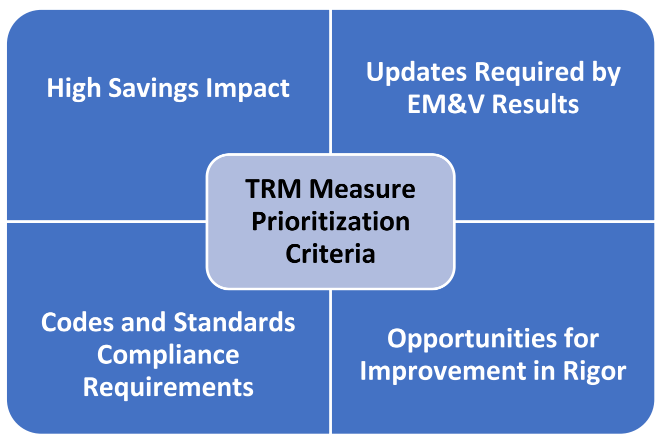
2.3. Prioritization Process

A robust and efficient annual TRM prioritization process ensures that relevant and timely updates are made, which reduces the risk that measure savings and the Hawaiʻi Energy programs are using outdated or faulty assumptions. TRM update activity prioritization should be completed as part of the annual planning process to allocate resources appropriately to the areas where they will provide the greatest value and to build understanding of where TRM updates may need to be made as well as how savings will be verified. This activity will enable all involved entities to provide input effectively throughout the process, which will increase confidence and usability of the final results.

Examples of criteria to use in the prioritization process include the following (see Figure 1):

- Measures with high savings impact based on portfolio savings—or may have high savings impacts in future program years.
- Measures with updates required by recent Hawaiʻi verification results and reporting.
- Measures with codes and standards compliance requirements that would affect first-year or lifetime impacts.
- Measures with significant opportunities for improvement in rigor.

Figure 1. TRM Measure Prioritization Criteria



[20] While not currently included as part of the Hawai'i Energy TRM, an industry best practice is to include as part of the descriptions for the application of savings values any recommended or required installation verification and other quality assurance procedures to ensure actual and proper measure implementation and to improve the reliability of the savings values.

The TRM update prioritization process should also be driven by key factors that affect savings. These factors include:

- Availability of primary data.
- Changes to measures to reflect program design changes since the last major review.
- Changes to relative savings contributions, verification findings, statewide studies, changes to federal and state energy efficiency codes, and recent secondary research or industry best practices.
- Whether or not a review of national deemed savings databases has been recently completed to determine if assumptions used in Hawaiʻi remain reasonable.

Other potential activities to consider prioritizing include quantifying potential non-energy benefits, developing market transformation indicators, estimating measure retention and persistence of savings, and conducting market assessments. The prioritization of research on these topics is part of the larger discussion related to available budget and tradeoffs to address competing priorities.

2.4. Schedule for TRM Updates and Implementation

The Hawaiʻi Energy TRM is used prospectively for planning and implementation purposes and retrospectively for verification activities. This helps ensure that the annual verification activities use the same TRM that was used for program planning and implementation for any given program year. To ensure TRM updates take full advantage of verification activities, the verification process should begin mid-way through the program year,[21] and TRM updates should be completed in time to allow for more accurate annual program planning.

To provide adequate time for annual program planning,[22] the updated TRM will be submitted for review by the TRM Administrator to the EEM, HPUC, and Hawaiʻi Energy by November 30th each year. If there are additional changes, the TRM will be revised accordingly, and then be submitted for approval by the HPUC by January 15th. It will be used by Hawaiʻi Energy for program planning and then become effective the following July for the next program year. A TAG meeting is held annually in March to review the TRM updates.

The first five years of these cycles for Hawaiʻi Energy are summarized in the following table along with the schedule for TRM use. Because verification is an integral piece to the TRM update process, key verification activities are also included in the table.[23] TRM implementation cycles will continue indefinitely absent a formal review and update of this process. The timeline will be adjusted going forward if needed to provide sufficient time for updates and approval.

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[21] Commonly referred to as "integrated evaluation," two core benefits of integrating program implementation and verification are risk mitigation for the program administrator and access to fast feedback from the Verification Team to allow for mid-year program improvements. Check-ins throughout the program year provide an opportunity for conversation about challenging projects being implemented, as well as findings as they occur.

[22] At the time this TRM Framework was prepared, Hawaiʻi Energy was in discussions with the HPUC and EEM about moving to a three-year portfolio planning cycle. Even with a three-year planning cycle, annual program planning should be completed, including updates to the TRM.

[23] We note that this a new process, compared to how verification and TRM updates have been historically completed for the Hawaiʻi Energy programs.

Table 7. Hawaiʻi Energy Program Cycles and Associated TRM and Verification Schedule

Program Year	TRM Activities			Verification Activities				
	Updated TRM Draft Submitted	TRM Approved by HPUC	TRM Effective Date*	Initiate Planning for Verification Activities	Verification Plan Drafted	Initiate Verification Activities	Verification Report Submitted to EEM	Verification Report Approved by HPUC
Program Year 2018 (Jul 1, 2018 – Jun 30, 2019)	--	Jun 25, 2018	Jul 1, 2018	Feb 8, 2019	Mar 8, 2019	April 8, 2019	Nov 30, 2019	Jan 15, 2020
Program Year 2019 (Jul 1, 2019 – Jun 30, 2020)	Jan 7, 2019	Apr 30, 2019	Jul 1, 2019	Feb 8, 2020	Mar 8, 2020	April 8, 2020	Nov 30, 2020	Jan 15, 2021
Program Year 2020 (Jul 1, 2020 – Jun 30, 2021)	Nov 30, 2019	Jan 15, 2020	Jul 1, 2020	Feb 8, 2021	Mar 8, 2021	April 8, 2021	Nov 30, 2021	Jan 15, 2022
Program Year 2021 (Jul 1, 2021 – Jun 30, 2022)	Nov 30, 2020	Jan 15, 2021	Jul 1, 2021	Feb 8, 2022	Mar 8, 2022	April 8, 2022	Nov 30, 2022	Jan 15, 2023
Program Year 2022 (Jul 1, 2022 – Jun 30, 2023)	Nov 30, 2021	Jan 15, 2022	Jul 1, 2022	Feb 8, 2023	Mar 8, 2023	April 8, 2023	Nov 30, 2023	Jan 15, 2024

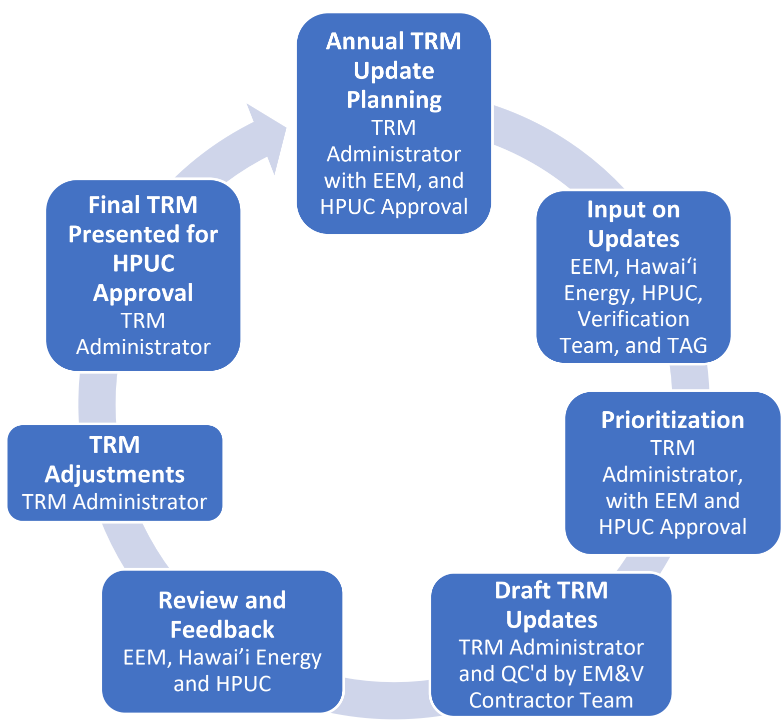
*Used for planning, reporting, verification

2.5. Annual Work Flow

The annual TRM update and finalization process follows the work flow depicted in Figure 2, the roles and responsibilities described in Table 1, and the timeline outlined in Table 7. On an ongoing basis, Hawai'i Energy, the HPUC, the EEM, the Verification Team, and TAG stakeholders should provide the TRM Administrator with input on potential TRM updates. To start the annual update process, the TRM Administrator will consider the input and will conduct an independent assessment of the TRM needs prior to developing a prioritized list of items to review and update. The TRM Administrator will then present the recommended prioritized TRM items to the EEM and HPUC through a Work Plan. Upon agreement of the prioritized list by the other entities, and approval by the HPUC, the TRM Administrator will draft updated TRM material using the best information available with consideration for budget, time, and technical constraints. The TRM Administrator will work with other members of the EM&V Contractor Team to review the updated data and approaches and to perform quality control (QC) checks on all recommended changes to the TRM. When a fully "QC'd" version of the updated TRM is ready, the EEM, Hawai'i Energy, and HPUC will review and provide feedback. The TRM Administrator will make adjustments based on the feedback, and then provide an updated version to the HPUC for approval. The final TRM is signed by Hawai'i Energy, the TRM Administrator, and the HPUC. All TRM updates will apply prospectively for the following program year, with the exception of any errors or emissions that are found in the TRM (see Section 3.3).

> TRM development is guided by a spirit of collaboration and shared goals. The TRM Administrator and EEM solicits input from and considers the advice of a broader group of stakeholders that make up the TAG—utilities, the consumer advocate, consultants, and other credible resources. Parties are expected to share relevant information and resources and be prepared to identify and explain the basis for positions.

Figure 2. Annual Hawai'i Energy TRM Update Work Flow



The development and maintenance of a TRM is best conducted with key entities who can provide input that leads to consensus agreement on measure characterizations, points of uncertainty, and need for future research. In Hawaiʻi, the TRM development and update process is guided by the HPUC, EEM, EM&V Contractor (specifically, the Verification Team), TRM Administrator (currently a member of the EM&V Contractor Team), and Hawaiʻi Energy. These entities ensure that the TRM meets the needs of Hawaiʻi stakeholders. The TRM Administrator participates in every aspect of the development of the TRM with guidance by the EEM. Hawaiʻi Energy staff and the Verification Team are integral to the process, and the HPUC is the oversight body. Collectively, and as described in Table 1, this group provides data and technical input, reviews draft savings calculations, and strives for consensus on decision-making items. Occasional meetings are used to maximize the level of collaboration and visibility into the measure characterization and general TRM update process. The HPUC makes final decisions based on recommendations provided by the TRM Administrator and EEM.

In the event of any disagreement, the TRM Administrator notes the disagreement and seeks feedback from the EEM and HPUC on whether additional research or follow-up is warranted. If, after a reasonable opportunity for discussion, research, and good-faith efforts, consensus cannot be reached on a technical or measure-related issue, the HPUC makes the final decision on the issue.

Section 3. Applying the TRM

The TRM has been developed to provide a transparent and consistent basis for determining savings and other assumptions necessary for the delivery of reliable energy efficiency benefits. As such, it is expected that it will be used by Hawaiʻi Energy, the Verification Team, planners, and regulators as the primary reference standard. Deviations from measure-level savings outlined in the TRM will only occur in exceptional cases where alternative approaches are preapproved by HPUC, preferably as part of the annual program year plan approval but also potentially during the subject program year. Subject to HPUC guidance/approval, the TRM will be fully incorporated into the assessment of potential, energy efficiency plan development, implementation, and verification activities.

The approved TRM is expected to serve as an important source document to inform savings values and measure savings assumptions in the regularly-scheduled Statewide Assessment of Energy Efficiency Potential Study. As a future looking planning effort, the Potential Study may need to make other assumptions related to the future applicability of existing measures, or introduction of new measures into the estimate. Any recommendations from the Potential Study Consultant[24] for TRM measure changes or new measures shall be submitted to the TRM Administrator, HPUC, and EEM for review and comment prior to the completion of the Assessment study, in order to be reviewed and discussed as part of subsequent TRM updates.

The following sub-sections describe how the TRM should applied, both from the implementation and verification perspectives.

3.1. TRM Format and Contents

The TRM is available as an Excel file for ease of use and includes the following general information:

- Changes from the previous year
- Introduction
- Signatures
- Glossary
- Key Metrics
- Master EUL
- Savings Factors
- EFLH & CF
- Custom Measures Overview
- Issues Log

Efficiency and solar water heating measures are organized by the sector for which the measure is eligible—the two sectors are Residential and Commercial. Each measure is presented on its own worksheet within the Excel file as a "measure characterization." The measure characterizations provide a description, program criteria, high efficiency equipment, mathematical equations for determining savings (algorithms), as well as default assumptions and sources, where applicable. In addition, any descriptions of calculation methods or baselines are provided as appropriate. The parameters for

[24] The Potential Study Consultant is part of the EM&V Contractor Team for the May 2018 through June 2020 contract period.

calculating savings are listed in the same order for each measure. Where applicable, supporting documentation (for example, from ENERGY STAR) is also provided.

Algorithms are provided for estimating annual energy and peak demand impacts. Data assumptions are based on Hawaiʻi data where available. Where Hawaiʻi-specific data is not available, assumptions may be based on: 1) manufacturer and industry data; 2) a combination of the best available data from similar jurisdictions; or 3) credible and realistic factors developed using engineering judgment.

3.2. Using the TRM to Calculate Savings

The TRM provides a standardized methodology for calculating energy and demand savings. The TRM also provides a consistent framework for both Hawaiʻi Energy and the Verification Team to estimate savings. The most current approved TRM is expected to serve as the primary source document for the savings values used for deemed and semi-prescriptive measures included as part of Hawaiʻi Energy program plans, annual program adjustments and updates, and for the development and assessment of goals set as part of those plans. The TRM includes information pertinent to the calculation of measure impacts and TRBs and will serve as the primary source for these calculations.

The TRM update schedule is identified in Section 2.4. In particular, Hawaiʻi Energy will make its best efforts to incorporate all aspects of the applicable TRM version into its annual program planning process. Hawai'i Energy is permitted to use additional assumptions other than those contained within the identified TRM in their Plan and annual update filings, provided they are documented and approved by the HPUC.

Hawai'i Energy should use the TRM to calculate savings in the following manner:

- **For deemed measures,** savings are determined by applying the deemed savings values in the TRM. Assumptions, which may be listed in the TRM for transparency, may not be adjusted by using customer-specific or program-specific information.
- **For semi-prescriptive measures,** savings are determined by using the algorithms provided in the TRM; these formulas include both stipulated and variable inputs. Stipulated variables are defined as any variable in the TRM that is fully deemed. These values may not be changed or revised without discussing with the TRM Administrator and EEM and receiving written approval from the HPUC. The variable inputs in TRM algorithms can come from either customer-specific information or default values provided in the TRM. Hawai'i Energy should attempt to collect customer-specific values for each rebated measure through the application process. Only items specifically identified as having variable inputs (e.g. hours of use, building type) may be adjusted using customer-specific information. If Hawaiʻi Energy chooses to utilize the data gathering option for a particular variable input, the findings of the data gathering should be used for all instances of that variable. Hawaiʻi Energy is not allowed to revert to the default value once the data gathering option is chosen. However, if customers are unable to provide data for the variable, then Hawaiʻi Energy should use the default value found in the TRM for those customers only.

The Verification Team also largely uses the TRM to verify Hawaiʻi Energy program impacts, and has primary responsibility to provide independent verification of the performance of the Hawaiʻi Energy program portfolio. For any given program year, the Verification Team is also expected to use the appropriate version of the TRM identified in Table 7 for use in verifying savings. Annual savings verification will be conducted on a retrospective basis using the TRM version active for the program year. Should the Verification Team determine that there are errors and/or omissions in the TRM, these items should be promptly discussed with the TRM Administrator, EEM, and HPUC to determine next steps (see Section 3.3 for a further discussion on TRM errors and omissions).

For verification, all savings calculations begin with the customer-level savings, are adjusted to account for transmission and distribution losses using the SLF values to determine system-level savings, and then are adjusted again to net savings using the NTG ratios to reflect total program net impacts (see Figure 3). The factors used to adjust customer savings to system savings are deemed in the TRM and differ from island to island, reflecting differences in the electrical grid.

Figure 3. Verification Process for Determining Program Net Impacts

Typically, the Verification Team conducts documentation and engineering reviews based on statistically representative samples to determine verified savings. Occasionally, the Verification Team may also conduct research studies and site inspections. The appropriate method used to determine verified savings differs for deemed and semi-prescriptive measure categories and may further depend on the magnitude of the project's savings. These measure categories, summarized in Table 6, dictate the methodology to use for estimating verified savings.

- **For deemed measures,** the TRM provides per-unit savings allowances that both Hawai'i Energy and the Verification Team will use; the energy and demand savings of these measures are deemed with all energy-related variables stipulated. Thus, the verification activity for deemed measures may include verification of measure installation, quantity, and correct use of the TRM measure protocol. The Verification Team will determine verified savings using deemed savings and/or stipulated assumptions in accordance with the TRM.
- **For semi-prescriptive measures,** the Verification Team determines verified savings using the algorithms provided in the TRM; these formulas include both stipulated and variable inputs. The variable inputs typically represent or describe straightforward, key measure-specific inputs in the savings algorithms that improve the reliability of savings estimates (e.g., capacity, efficiency ratings). Verification activities for partially deemed measures may include assessing measure installation, quantity, and the correct use of the TRM protocol; and confirming accurate variable inputs, which may entail reviewing customer-specific key parameters. Verification activities may also include facility staff interviews or measurements of the variable(s), as appropriate for the defined key parameters. The Verification Team should attempt to verify as many variable input values in the TRM algorithm as possible with customer-specific or program-specific information gathered through verification efforts.

Customer-specific data collection and engineering analysis will depend on the type of measure (uncertainty and complexity) and the expected savings (level of impact). The Verification Team is primarily responsible for collecting customer-specific data through supporting documentation or phone interviews with an appropriate site contact. For example, estimating savings for commercial lighting projects requires detailed information about pre- and post-installation conditions for lighting retrofits, such as fixture and ballast type, fixture wattage, building and space type, HOU, and lighting controls. When required by the TRM, using more accurate customer-specific values for a semi-prescriptive measure is mandatory. The Verification Team should verify the customer-specific data for all measures in sampled projects. If the Verification Team determines that the customer-specific data gathered by Hawaiʻi Energy are not reasonably valid, then the Verification Team should conduct independent customer-specific data gathering activities for those measures and discuss with the EEM, and possibly the HPUC.

3.3. TRM Errors

Any time a TRM error is found, the HPUC, TRM Administrator, EEM, and Hawaiʻi Energy should be notified as soon as possible. The TRM Administrator, with input from the other relevant entities, will then make a professional judgement of whether the error should be corrected for retroactive use within the current TRM or if the item is something that can wait to be addressed until the next TRM cycle. The judgement will be based on the nature of the error and the impact on measure-level or total portfolio savings. For example, a decimal point error that leads to a 10x savings error for a measure may be appropriate for retroactive adjustment in the current program year. Other more minor issues may be reasonable to delay until the next TRM cycle. If the error is determined to be substantial enough to warrant immediate correction, the TRM Administrator will work with those necessary to strive for consensus on a solution that will result in a reasonable savings estimate and will then present the solution to the HPUC for approval. As discussed earlier, in the event of any disagreement, the TRM Administrator will note the disagreement and seek feedback from the EEM and HPUC on whether additional research or follow-up is warranted. If, after a reasonable opportunity for discussion, research, and good-faith efforts, consensus cannot be reached on a technical or measure-related issue, the HPUC will make the final decision to resolve the issue. Once resolved, any corrected TRM savings values will be used retrospectively, for the current program year, for the purpose of measuring savings toward compliance with Hawaiʻi Energy's energy savings goals. Errors found in the TRM but not corrected retrospectively will be officially addressed prospectively through the annual TRM Update Process.

3.4. Mid-Program Year Additions and Modifications

It is not uncommon for program opportunities in the form of new or modified measures to emerge during the program year. To pursue these opportunities, there must be a process for submitting new or modified measure entries for the TRM after the initial TRM's effective date of July 1. Proposed mid-program year TRM modifications or additions may be submitted by Hawaiʻi Energy (or TAG members) to the TRM Administrator at any time during the program year.

If the modification or addition relates to new or modified measure(s), the submitted request should be submitted prior to implementation of the new or modified measure(s). Hawaiʻi Energy (or the TAG member) must include a draft of the new or modified measure characterization(s) (i.e., TRM entry) as well as recommended savings calculation procedure(s), and estimates of the expected program-level impacts for the measure(s) for the current and future program years. To streamline the measure addition process, requested additions should be submitted as early in the subject program year as practical and the measures should be vetted as promptly as possible by the TRM Administrator, EEM and HPUC.

The proposed mid-year TRM updates will be reviewed by the TRM Administrator and EEM. Cooperatively working with Hawaiʻi Energy, the party suggesting the change or addition (if not Hawaiʻi Energy), and the HPUC, the EEM and TRM Administrator will recommend next steps. Next steps may include accepting the update(s) as is, conducting further analyses, or considering the update for the next TRM version. Should an update be pursued, HPUC approval of the change(s) is required prior to inclusion of the update(s) in the TRM and prior to implementation of the new measure(s).

Section 4. Transformational Programs

The Hawai‘i Energy program portfolio includes a suite of market transformation programs. “Market transformation programs provide strategic interventions in the market in order to create lasting efficiencies and ultimately pave the way for the integration of clean energy solutions.”[25] Most recently, these market transformation programs have focused on behavior modification initiatives, professional development and technical training, decision-making support for large energy users in developing comprehensive energy management strategies to incorporate into business practices, codes and standards support, and clean energy collaboration with various stakeholders. In general, market transformation efforts create potential energy savings but without a direct link to an incentivized equipment purchase.

While market transformation programs are not a new concept, the energy efficiency industry has been somewhat challenged in how to determine savings from these types of programs. Researchers have undertaken pilot evaluations, market characterization research, baseline research, and assessments of market shifts from other similar types of programs around the country, but these have not yet resulted in a prescriptive path for how to evaluate many of them. That noted, developing appropriate program metrics and tools is critical to assessing the validity of performance for these efforts. As a result, what is offered in the TRM Framework are largely guidelines and key considerations for program tracking to help in determining program savings. Careful consideration of program logic in the context of jurisdictional policy drivers should be the first step undertaken. The following table describes items that are recommended for program tracking, and for program design and analysis methods.

Table 8. Recommended Transformational Program Tracking, Design, and Analysis

Program Tracking	For educational outreach events such as hard-to-reach workshops, professional development, and technical trainings, record names of events, dates, locations, and participant signatures.
	Event participants should complete post-education surveys, with responses recorded electronically for summarization by Hawai‘i Energy and review by the Verification Team.
	For professional development and technical trainings, including educator workshops, participant titles and emails should be collected and recorded electronically for future use.
	For the Continuous Energy Improvement (CEI) efforts, participant contact information should be tracked electronically, along with details of the specific CEI projects.
Program Design and Analysis Methods	Use a theory-driven program design approach that leads to measurable outcomes. Having measurable outcomes helps to ensure that program goals can be validated based on program activities, as implemented.
	Set clear and measurable short-term, mid-term, and long-term indicators to be used as a measure of progress over time as part of the program theory.

[25] Hawai‘i Energy Annual Plan, PY2017-2018, page 14.

In the future, savings research may be allowed for the development of generalizable energy savings results. For example, Building Operator Certification (BOC) training can lead to changes in how building operators manage energy loads. While specific approaches and savings effects can vary from BOC trained building operators, generalizable results may be possible to develop through an evaluation of a sample of buildings' energy consumption changes before and after training.

4.1. Peer Program Savings Calculation

The Peer program delivers Home Energy Reports (HERs) to residential customers in the Hawaiian Electric Companies' service territory. The HERs provide information on how an individual home's energy consumption compares to other similar homes and provides suggestions on opportunities to change energy consuming behaviors. Savings for the Peer program are described in the TRM and are based on deemed annual savings for a single participating home. The deemed savings currently in use were originally derived from billing regression analysis conducted for PY2011 on a sample of participants and a control group.

Historically, savings have been verified through identifying the daily participation rate for each program participant. A program participant is defined as an account that had received a HER during a given program year. Program attrition occurs throughout the year either through a request to opt out of the program, or more commonly, due to HECO accounts becoming inactive.

The Peer program savings approach is in the process of being updated to reflect the maturity of the program, program changes due to a new implementation contractor, and industry best practices for behavioral programs of this type.[26,27] Future versions of the TRM will incorporate findings from the updated savings estimation approach.

4.2. Codes and Standards

Codes and standards that affect equipment and systems sold and installed in Hawaiʻi are periodically updated. Items that affect what is adopted in Hawaiʻi as part of the energy codes and standards may include, but are not limited to:

- Federal codes related to energy efficiency, as defined in the Code of Federal Regulations
- The International Energy Conservation Code, IECC, as adopted by Hawaiʻi
- ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings
- The National Appliance Energy Conservation Act (NAECA)
- EISA – the Energy Independence and Security Act of 2007

The purpose of updates to codes and standards is to increase energy efficiency by codifying minimum equipment performance or baselines. Code and standard changes affect the baseline efficiency or performance used in calculating savings for (1) replace on burnout and (2) new construction projects as well as (3) 'outyear' baselines on dual-baseline early retirement projects.

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[26] Opinion Dynamics, Memorandum, Literature Review of Decay Rates from Home Energy Report Programs, Submitted to Steve Schiller, June 15, 2018.

[27] Opinion Dynamics, Memorandum, Hawaiʻi Peer Comparison Program Stoppage of Treatment Study Sample Selection, Submitted to Steve Schiller, June 18, 2018.

It is recognized that there is a lag between the time when a code or standard comes into force and when the industry or marketplace has made a substantial transition to the new code or standard. In recognition of this lag time, there may be a "grace" period to allow for the industry or market to adjust. In addition, in situations where the actual practice in a specific program jurisdiction is below code, market research can be used by the program administrator to justify claiming savings for moving participants to meet codes and standards.

> Attributing savings for compliance with codes and standards to program administrators is a relatively new practice, but is increasingly being applied in states across the U.S.

Hawaiʻi Energy has been involved in initiatives to help move local jurisdictions to adopt codes and standards. This work is in addition to traditional energy efficiency program efforts, which are intended to motivate participants to install systems and equipment that exceed prevailing codes or standards. Further TRM updates could incorporate methods for attributing savings from codes and standards to the Hawaiʻi Energy program.

Concluding Remarks

In 2008, the State of Hawaiʻi partnered with the United States Department of Energy to establish the Hawaiʻi Clean Energy Initiative ("HCEI"), with a goal of meeting 70% of the State's energy needs through renewable energy and energy efficiency by 2030. The Hawaiʻi State Legislature subsequently passed Act 155, Session Laws of Hawaiʻi 2009 (Act 155), codified under §269-96 Hawaiʻi Revised Statutes ("HRS"), which established the State's energy efficiency goals into an Energy Efficiency Portfolio Standard ("EEPS"). As specified in HRS §269-96, the statewide EEPS goal is 4,300 gigawatt-hours ("GWh") of electricity savings by 2030.

The primary objective of the Hawaiʻi Energy programs is to reach the level of savings specified in Act 155 in a meaningful, efficient, and cost-effective manner. The TRM outlines the expected metrics, methodologies, and guidelines for measuring program performance, and details the processes that should be used to determine program impacts by both Hawaiʻi Energy and the Verification Team. The TRM Framework describes the common understanding all involved parties and stakeholders share regarding the process and assumptions Hawaiʻi Energy and the Verification Team use in determining the impacts of the Hawaiʻi Energy programs. Combined, these two documents set the stage for discussions among the EM&V Contractor Team, the Verification Team, EEM, and HPUC. These ongoing discussions will continue to help add clarity to the TRM, add new prescriptive measures to the TRM, and define acceptable measurement protocols for implementing custom measures in order to mitigate risks to the Hawaiʻi Energy programs. The common goal requires that program savings be clearly defined, auditable, and provide a sound engineering basis for estimating energy savings.

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Glossary

Annual Operating Hours (AOH)	See "Operating Hours" definition. Also referred to as "Hours of Use."
Avoided Costs	Essentially the marginal cost for a public utility to produce one more unit of power. Because Qualifying Facilities (QFs) reduce the utility's need to produce this additional power themselves, the price utilities pay for QF power has been set to the avoided, or marginal, cost.
Baseline	Conditions, such as energy consumption and demand, which would have occurred without implementation of the subject energy efficiency measure. Baseline conditions are sometimes referred to as the counterfactual. There are several baseline options and a range of definitions for these options used in the efficiency industry.
Coefficient of Variation	The sample standard deviation divided by the sample mean ($Cv = \sigma/\mu$).
Coincident Demand	The demand of a device, circuit, end-use, building, or population that occurs at the same time as the utility's system peak load.
Coincidence Factor (CF)	The factor used to determine the coincident peak demand reduction. It represents the fraction of the full load demand that corresponds with utility system peak period. Range = 0-1. See also "System Peak Period" and "Coincident Peak Demand Reduction" definitions.
Coincident Peak Demand Reduction	The reduction in peak electricity use in units of kW from the baseline to the use associated with the energy-efficient measure installation, where the reduction in peak electricity use occurs simultaneously with the servicing utility system's maximum use during a specific period. Hawaiʻi Energy's current definition for coincident peak demand savings is the average demand savings that occur, from implementation of an efficiency measure, during the non-holiday, weekday hours between 5 and 9 PM. This aligns with HECO's System Peak Period. See also "System Peak Period" definition.
Commission	The State of Hawaiʻi Public Utilities Commission (HPUC) is a quasi-judicial body responsible for guiding the development of state utility policies that best serve the long-term interest of Hawaiʻi utility ratepayers, with the goal of the provision of high quality public utility service in Hawaiʻi at reasonable costs.
Connected Load	The maximum wattage of the equipment, under normal operating conditions.

Cost-effectiveness	An indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice. The present value of the estimated benefits produced by an energy efficiency program is compared to the estimated total costs to determine if the proposed investment or measure is desirable from a variety of perspectives (e.g., whether the estimated benefits exceed the estimated costs from a societal perspective).
Custom Measures	Energy efficiency measures that provide efficiency solutions to unique situations that are not amendable to fully deemed savings values or for which an individualized savings determination approach is preferable. Custom measures rely on site-specific information (e.g., hours of operation, horsepower, existing equipment efficiency) that determines their impacts (e.g., energy savings).
Deemed Calculation	Agreed-to engineering algorithm(s) used to calculate energy and/or demand savings associated with installed efficiency measure(s). Referred to in some TRMs as stipulated algorithm(s), standard protocols, or site-specific protocols. Deemed calculations that use only deemed variables or factors define fully deemed savings values. Deemed calculations are used to determine partially deemed savings values when used with a combination of (1) deemed variables/factors and (2) site- or project-specific variables/factors.
Deemed Savings Method	The process used to derive fully deemed savings values.
Deemed Savings Values	Predetermined estimates of energy or peak demand savings attributable to individual energy efficiency measures implemented in a particular type of building, application, climate zone, etc. Referred to in some TRMs as unit energy savings or stipulated savings values. These are documented, numerical values for specific energy efficiency measures, often in the form of per-unit savings that define the agreed-upon performance of an individual energy efficiency measure. Deemed savings values may be either: • Fully deemed savings values—values that are fixed regardless of any site- or project-specific conditions, variables, or factors, or • Partially deemed (semi-prescriptive) savings values—values determined with algorithms, which have as inputs some combination of (1) deemed variables or factors and (2) site- or project-specific conditions, variables, and factors.

Deemed Variable	Values for input assumptions that determine the performance of an energy efficiency measure under different operating conditions, applications, climates, etc. Also referred to as a deemed factor or stipulated variable.
Default Value	When a measure indicates that an input to a prescriptive savings algorithm may take on a range of values, an average value is also provided in many cases. This value is considered the default input to the algorithm, and should be used when the other alternatives listed in the measure are not applicable.
Demand Savings	See the “Coincident Peak Demand Reduction” definition.
Demand-Side Management	Strategies used to manage energy demand, including energy efficiency, load management, fuel substitution, and load building.
Early Retirement	When equipment that is still functioning is replaced early because of a program intervention and energy savings benefits, this is referred to as "early retirement." The remaining life of the existing equipment is estimated, and adjustments are made to the benefits and the costs. An early retirement scenario occurs when existing, functional, actively used equipment is replaced with similar, higher efficiency equipment. The equipment being replaced should have at least one year of remaining useful life (RUL). In this case, a dual baseline will have to be considered, which uses the pre-existing equipment as the baseline for savings during the RUL period, and code requirement/industry standard practice baseline for estimating the balance of the EUL period for the new equipment.
Effective Useful Life (EUL)	The median number of years that a measure is in place and operational after installation. This definition implicitly includes equipment life and measure persistence (defined below) but not savings persistence. [28] See also “Savings Persistence” definition. • "Equipment life” is the number of years installed equipment will operate before it fails. • "Measure persistence” takes into account business turnover, early retirement or failure of the installed equipment, and any other reason the measure would be removed or discontinued.
Energy Efficiency	"Energy efficiency" refers to measures that reduce the amount of energy required to achieve a given task or end use.

[28] Definition is from the Uniform Methods Project.

EEM	The Energy Efficiency Manager (EEM) team is an independent contractor team that assists the Commission with the administration of contracts with the Program Administrator and the EM&V Contractor.
Energy Savings	Reduction in energy use as compared to a baseline consumption. Electricity savings are generally expressed in units of kWh.
Equivalent Full Load Hours (EFLH)	The equivalent hours that equipment would need to operate at its peak capacity in order to consume its estimated annual kWh consumption (annual kWh/connected kW).
Evaluation	Also referred to as "Evaluation, Measurement, and Verification (EM&V). Evaluation is an applied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, accomplishments, value, merit, worth, significance, or quality of a program, product, person, policy, proposal, or plan. Impact evaluation in the energy efficiency arena is an investigation process to determine energy or demand impacts achieved through the program activities, encompassing, but not limited to: savings verification, measure level research, and program level research. Additionally, evaluation may occur outside of the bounds of this TRM structure to assess the design and implementation of the program.
EM&V Contractor	The EM&V Contractor is an entity designated by the Commission to provide independent evaluation, measurement, and verification services for the Public Benefits Fee (PBF) Programs, Energy Efficiency Portfolio Standard (EEPS) and other programs and/or activities as directed by the Commission. The EM&V Contractor reports to the Commission and the EEM.
Failure and Failure Rate	"Failure" is defined as an instance where an implementation contractor reports that a measure has been installed, but a subsequent inspection finds that the equipment is non-operational and/or not properly installed and that difference has not been accounted for elsewhere. "Failure rate" should be defined as the percent of inspected installation sites where any equipment fails inspection (i.e., the equipment is either not installed or not operating) and that possibility has not been otherwise accounted for. Note, the definition of failure is intended to not count issues related to persistence or normal measure lives.

Free-ridership	Program savings attributable to free-riders (program participants who would have implemented a program measure or practice in the absence of the program). (Definition is from Uniform Methods Project.)
Gross Savings	The difference in energy consumption with the energy efficiency measures promoted by the program in place versus what consumption would have been without those measures in place. (Definition is from Uniform Methods Project.)
Hawaiʻi Energy	Hawaiʻi Energy is the brand name for the third-party administered ratepayer-funded conservation and energy efficiency programs for Hawaiʻi, Honolulu and Maui counties.
High Efficiency	General term for technologies and processes that require less energy, water, or other inputs to operate.
Hours of Use (HOU)	See “Operating Hours” definition. Also referred to as “Annual Operating Hours.”
Impact Evaluation	An assessment of the program-specific, directly or indirectly induced changes (e.g., changes in energy use and/or demand) associated with an energy efficiency program.
In Service Rate (ISR)	Some measure types require special attention because ISRs, or installation rates, have been found to be relatively low. For example, the ISR represents the percentage of incented residential lighting products that are ultimately installed by program participants. ISRs vary substantially based on the program delivery mechanism, but they are particularly important in giveaway or upstream programs where the customer is responsible for installation. ISRs should be included in TRM calculations for relevant measure types.
Industry Standard Practice	The Industry Standard Practice (ISP) represents the typical equipment or commonly used current practice absent the program. ISP can be used to define a baseline.
Interactive Effects (IE)	Energy effects from an energy efficiency measure that occur outside the measurement boundary of the individual measure. For example, there are interactive effects between lighting and HVAC equipment, since efficient lighting installed in conditioned spaces decreases air conditioning loads, but increases heating loads.
Interactive Effects Factor (IEF or IF)	The metric used to measure interactive effects. See also "Interactive Effects."

Lifetime	The number of years (or hours) that the new high efficiency equipment is expected to function. These are generally based on engineering lives, but sometimes adjusted based on expectations about frequency of removal, remodeling or demolition. Two important distinctions fall under this definition; Effective Useful Life (EUL) and Remaining Useful Life (RUL). See the “Effective Useful Life” and “Remaining Useful Life” definitions.
Lifetime Savings	Savings may vary over the lifetime of a measure. Savings estimate should typically apply throughout the period between measure delivery and the end of the measure lifetime. If the RUL of a pre-conditions measure is expected to be greater than 0 years but less than 25 years (0<RUL<25 years), then two baselines must be used in estimating lifetime savings. The first baseline applies between measure-delivery and when the RUL of the pre-condition expires. The second baseline applies between expiration of the RUL and the end of the measure lifetime. For example, an air compressor might be scheduled for replacement in 3 years, but is replaced sooner with a more efficient model. The lifetime of the efficient air compressor might be 20 years; however, the RUL would be 3. The first baseline applies to years 1 through 3. A second baseline is applied in years 4 through 20.
Load Factor (LF)	The fraction of full load (wattage) for which the equipment is typically run.
Logic Model	A graphical depiction and description of the logical relationships between the inputs, activities, outputs, and outcomes of a program.
Market Effects	Changes in the structure of a market or the behavior of participants in a market that is reflective of an increase in the adoption of energy efficient products, services, or practices and is causally related to market intervention(s) (e.g., programs).
Market Penetration	A measure of the diffusion of a technology, product, or practice in a defined market, as represented by the percentage of annual sales for a product or practice, the percentage of the existing installed stock for a product or category of products, or the percentage of existing installed stock that uses a practice.
Market Saturation	A percentage indicating the proportion of a specified end-user market that contains a particular product. An example would be the percentage of all households in a given geographical area that have a certain appliance.
Measure	A high efficiency technology or procedure that results in energy savings as compared to the baseline efficiency.

Measure Cost	The incremental (for time of sale measures) or full cost (both capital and labor for retrofit measures) of implementing the High Efficiency measure.
Measure Description	A detailed description of the technology or procedure and the criteria it must meet to be eligible as an energy efficient measure.
Measure Level Research	An evaluation process that takes a deeper look into measure level savings achieved through program activities driven by the goal of providing Hawaiʻi-specific research to facilitate updating measure-specific TRM input values or algorithms.
Net Savings	The difference in energy consumption with the program in place versus what consumption would have been without the program in place. The factors most often considered in net savings calculations are free-ridership, spillover (both participant and nonparticipant), and market effects. (Definition is from Uniform Methods Project.)
Net-to-Gross (NTG) Ratio (NTGR)	A ratio of the net impacts to the gross impacts of an energy efficiency measure or program.
Operating Hours	The hours that equipment is expected to operate in a given period of time (e.g., day, month, year).
Peak Demand	The average demand savings that occur from implementation of an energy efficiency measure during the non-holiday, weekday hours between 5 and 9 PM. This aligns with HECO's System Peak Period: 5-9 PM on the average weekday throughout the year, regardless of the season or month.
Persistence Factor (PF)	The metric used to measure Savings Persistence. Range = 0-100%. See also "Savings Persistence" definition.
Persistence Study	A study to assess changes in program impacts over time (including retention and degradation).
Portfolio	Either (a) a collection of similar programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor-efficiency programs), or mechanisms (e.g., loan programs) or (b) the set of all programs conducted by one organization, such as a utility (and which could include programs that cover multiple markets, technologies, etc.).
Potential Studies	Studies conducted to assess market baselines and savings potentials for different technologies and customer markets. Potential is typically defined in terms of technical potential, market potential, and economic potential.
Prescriptive Measures	See "Deemed" measure definitions.

Program	A group of projects, with similar characteristics and installed in similar applications. Examples could include a utility program to install energy-efficient lighting in commercial buildings, a developer's program to build a subdivision of homes that have photovoltaic systems, or a state residential energy efficiency code program.
Program Year (PY)	The time period approved for program implementation. The Hawaiʻi Energy program year runs from July 1st to the following June 30th.
Regression Analysis	Analysis of the relationship between a dependent variable (response variable) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation.
Remaining Useful Life (RUL)	Applies to retrofit or replacement measures. For example, if an existing working refrigerator is replaced with a high efficiency unit, the RUL is an assumption of how many more years the existing unit would have lasted. If the RUL cannot be determined from the age of the measure, the RUL is usually assumed to be 1/3 of the EUL.
Replace on Burnout	When a piece of equipment has stopped working and is being replaced, this is referred to as "replace on burnout." The benefits are calculated as the cost of the energy saved by using the efficient measure as compared with the energy that would have been used by an off the shelf (less efficient) "stock" version of the measure.
Retrofit Isolation	The savings measurement approach defined in IPMVP Options A and B, as well as ASHRAE Guideline 14, that determines energy or demand savings through the use of meters to isolate the energy flows for the system(s) under consideration. IPMVP Option A involves "Key Parameter Measurement" and IPMVP Option B involves "All Parameter Measurement."
Savings Persistence	The percentage of change in expected savings due to changed operating hours, changed process operations, and/or the performance degradation of equipment efficiency relative to the baseline efficiency option. For example, an industrial plant that reduces operation from two shifts to one shift may then have a savings persistence factor of 50%, as only half of the projected energy savings would be realized. Also, improper operation of the equipment may negatively affect savings persistence, so training and commissioning could improve savings persistence. Finally, most equipment efficiency degrades over time, so annual energy savings may increase or decrease relative to the efficiency degradation of the baseline efficiency option. (Definition is from the Uniform Methods Project.)

Semi-Prescriptive	A type of measure and savings estimation approach that uses a combination of (1) deemed variables/factors and (2) site- or project-specific variables/factors to determine partially deemed savings values. See also “Deemed Calculation” definition.
Spillover	Spillover refers to energy savings that are due to the influence of a program but are not counted in program records. Spillover can be broken out in three categories: 1) Participant Internal Spillover; 2) Participant External Spillover; and 3) Non-Participant Spillover.
Stipulated Variable	See Deemed Variable.
System Loss Factor (SLF)	Energy savings at the customer level are equivalent to even greater savings at the power plant busbar (where the electrons enter the grid) due to energy losses during transmission and distribution. The system loss factor (SLF) is defined as marginal electricity losses from the busbar to the customer meter – expressed as a percent of meter-level savings. Each island in Hawaiʻi has a different SLF due to differences in infrastructure. SLF values are derived using island-level loss data published for HECO, MECO, and HELCO. The customer-level electricity savings are multiplied by (1+SLF) to get the system-level savings, or savings at the power plant busbar.
System Peak Period	HECO’s current definition of system peak period is 5-9 PM on the average non-holiday weekday throughout the year, regardless of the season or month.
Technical Advisory Group	TRM and TRM Framework development is guided by a spirit of collaboration and shared goals. The Technical Advisory Group (“TAG”) provides input to this process. The TAG is made up of a broader group of stakeholders, including utilities, the consumer advocate, consultants, and other credible resources.
Technical Reference Manual	A resource that contains energy efficiency measure information used in program planning, implementation, tracking, and reporting and evaluation of impacts associated with the subject measures.
Total Resource Benefit (TRB)	Total Resource Benefit is the present value of avoided utility costs over the life of the efficiency measures installed through the program. The utilities’ total avoided cost of all saved energy and capacity avoided is called the Total Resource Benefit.
Total Resource Cost (TRC)	Total Resource Cost is the customer’s project or incremental cost to purchase and install the energy-efficient equipment or make operational changes above what would have been done anyway.
Transformational Programs	Hawaiʻi Energy’s energy efficiency portfolio includes a suite or programs labels as “ Transformational Programs.” These programs

	aim to provide strategic interventions in the market in order to create lasting efficiencies and ultimately pave the way for the integration of clean energy solutions.
TRB-TRC Ratio	The societal cost test of the TRB/TRC provides a metric of how much "return on investment" is provided by: (1) Saving energy versus generating it (kWh reductions) and (2) Avoiding the need for increased power plant capacity (Peak kW reductions).
TRM Administrator	The TRM Administrator is a role delegated by the HPUC to the EM&V Contractor Team, and is not necessarily an individual.
Verification Team	The Verification Team is a subset of the EM&V Contractor Team and is responsible for annually verifying energy and peak demand savings claims of each Hawaiʻi Energy program and the portfolio. The Verification Team also ensures proper Hawaiʻi Energy use of the TRM in claiming savings.

Signatures

Publication Date: April 3, 2019

Version Number: V1.0

Approvals:

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