# Report to the Hawai‘i Public Utilities Commission on Hawai‘i's Renewable Portfolio Standards

**Report prepared by**

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## Foreward

The Hawai‘i Public Utilities Commission is required by HRS § 269-92 to evaluate Hawai‘i’s RPS every five years and report its findings to the Legislature. As part of this process, HNEI is required to submit their assessment of the achievability and effectiveness of the RPS to the Commission. This report was prepared in collaboration with Telos Energy who participated under contract to HNEI.

**November 2023**

HNEI
Hawai‘i Natural Energy Institute
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## Executive Summary

The State of Hawai‘i’s (“State”) energy policy is driven, in significant part, by the State’s Renewable Portfolio Standards (RPS) that mandates the percentage of electricity that must be generated from renewable energy resources at different times until achieving 100% in 2045. The RPS targets have evolved through several legislative amendments since the RPS was first established in 2001. Prior to 2022, the RPS requirements were based on the amount of available renewable electricity as a percentage of utility sales. The current RPS, under § 269- 92, Hawai‘i Revised Statutes (HRS), was modified by Act 140 of the 2022 legislature, which requires electric utilities in the State to report electricity from renewable sources based on a percentage of electricity generation including distributed generation. The minimum percentages of renewable energy by year were not changed and remain as shown in Table 1.

*Table 1. Hawai‘i’s Renewable Portfolio Standards by year.*

| Compliance Year | RPS Requirement (% of Generation) |
|---|---|
| 2010 | 10% |
| 2015 | 15% |
| 2020 | 30% |
| 2030 | 40% |
| 2040 | 70% |
| 2045 | 100% |

A side-by-side comparison of the impact of this change was an overall statewide reduction of approximately 7.5% based on the 2022 generation mix. Hawaiian Electric’s 2022 Renewable Portfolio Standard Status Report provides an island by island comparison which shows a reduction of 6 and 12%, respectively for O‘ahu and Hawai‘i Island compared to the old standard. In this assessment, this new framework is considered.

The Hawai‘i Public Utilities Commission’s (“Commission”) evaluation of and reporting on the effectiveness and achievability of the current RPS is submitted to the Hawai‘i legislature pursuant to HRS § 269-95(5). Measuring the success of Hawai‘i’s clean energy policies is an ongoing process. This report (“Report”), part of continuing analyses related to the impacts of RPS on the State, examines and presents findings regarding the achievability and effectiveness of the existing

RPS requirements recognizing that there is uncertainty regarding RPS targets past 2030. Findings in this Report include:

- Achievement of the 2030 RPS requirement of 40% is likely for the Hawaiian Electric Company (HECO) service territory, which includes O‘ahu, Maui County, and the Hawai‘i Island (“Big Island”); and is essentially certain for the Kaua‘i Island Utility Cooperative (KIUC). As of 2022, KIUC has already achieved the 2030 goal.
- Based on current plans for the PUC approved Stage 1 and Stage 2 PV plus storage projects, the HECO territory is expected to reach the 40% by 2030. However, force majeure and related supply chain issues have created problems for State 1 and Stage 2 projects. If these issues continue, it could create problems in achieving the 40% mandated goal. Additionally, the recent Lahaina wildfires could potentially impact the pace of new renewable energy generation on Maui.
- The RPS has led to a substantial reduction of greenhouse gases (GHGs) being emitted in the electricity sector. However, GHGs have not diminished significantly in other sectors (transportation, buildings, etc.) as much as the Hawai‘i Clean Energy Initiative (HCEI) originally projected.
- Increasing electric loads from electric vehicle adoption will make it more difficult to achieve the RPS targets in the future, but will ultimately benefit statewide emissions.
- The costs of renewable energy projects under development and recently proposed in Hawai‘i remain at or below costs of oil-fired generation – making renewable projects cost-competitive alternatives compared to continuing to utilize fossil fuel generation resources. However, recent events including delays in the development of HECO Stage 1 and 2 projects have led to increased costs for renewable energy development and deployment.
- Initial analysis by HNEI to explore the ability to integrate solar + storage or solar/wind and storage suggests that reaching the 70% RPS target by 2040 is feasible and likely cost effective with current technologies. However, land use, community engagement, and transmission will need to be carefully managed.
- The RPS remains effective in helping the State achieve its policies and objectives with respect to developing renewable energy resources in Hawai‘i.

## *Historical RPS and 2030 RPS Achievability*

By the end of 2022, statewide renewable generation totaled 33.2% of total generation, based on the new method for RPS calculation. This value incorporated the combined value of KIUC and HECO Companies generation (10,813 MWh) and renewable energy generation both utility-scale

and behind the meter (3,587 MWh). Figure 1 illustrates the RPS achievement for the consolidated State progress in meeting the RPS.

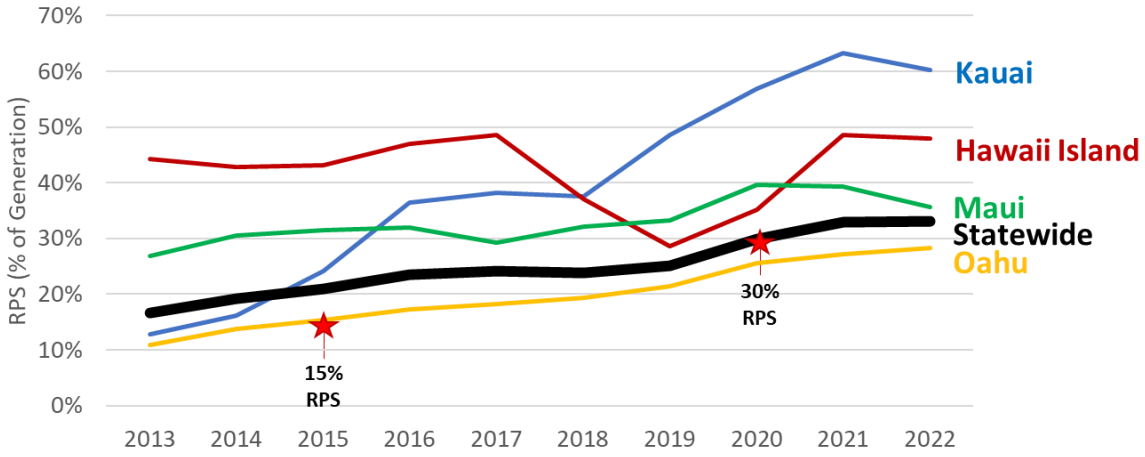


*Figure 1. Consolidated progress in meeting RPS by Island.*

Given KUIC's and HECO progress to date in acquiring renewable generation and reasonable expectations for additional renewable projects, it is likely that the 2030 RPS requirement of 40% is achievable for both the HECO Companies and KIUC. KIUC has already achieved the 2030 RPS requirement, and additional projects are planned or in construction that would further boost KIUC’s RPS achievement above the 2030 requirement.

Since the end of 2022, HECO brought online 105 MW (230,000 MWh of new solar projects) across its service territory. These are part of HECO-procured (with PUC approval) Stage 1 and Stage solar + storage projects on O‘ahu, Maui, and Hawai‘i island. When fully deployed by 2025, the Stage 1 and 2 procurements will total 355 MW of solar PV, approximately 775,000 MWh, and contribute 7% towards the RPS. These projects, if developed, will contribute to the HECO Companies meeting the 2030 RPS goal. In addition, new competitive solicitations (“Stage 3”) for an additional 1,715 GWh (24% of HECO generation) are currently under review and the identification of selected projects are will be announced in December 2023. Figure 2 illustrates the projected achievement of the 2030 goal, not including the HECO Stage 3 proposals. It should also be noted that behind the meter distributed solar + storage is expected to continue to increase, but at a slower rate.

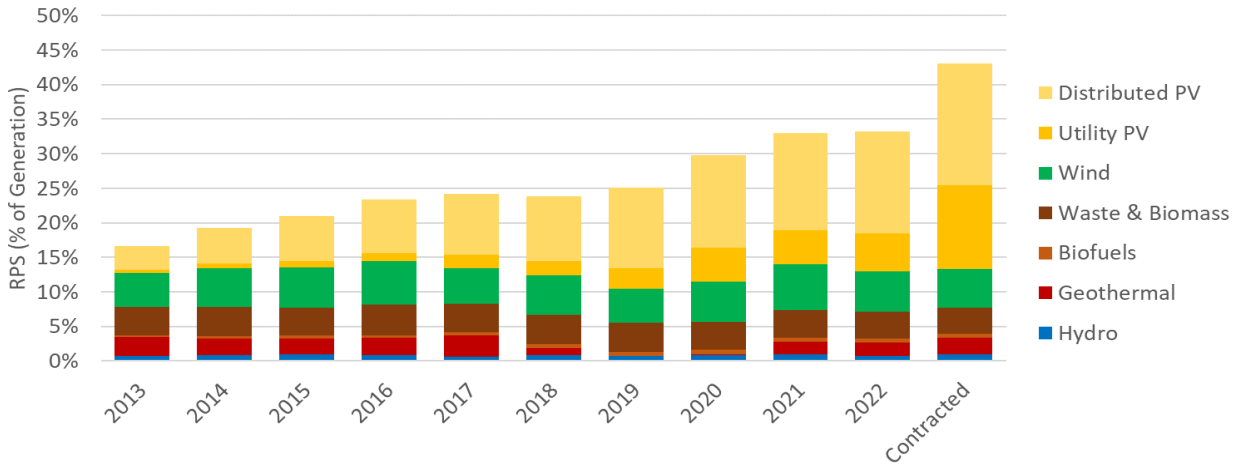


*Figure 2. Projected achievement of state goals with contracted projects. (Note: contracted projects include under construction Stage 1 and Stage 2 projects not already online or cancelled as of October 2023 (HECO Companies) and the West Kaua‘i Energy Project.)*

## *Effectiveness of RPS Requirements*

The RPS requirements continue to serve as an effective driver of renewable generation implementation. The establishment of the RPS by the Hawai‘i State Legislature (“Legislature”) serves as a clear statement of standing policy and priority. The objective of achieving the RPS requirements has been embraced as a mandate by Hawai‘i’s electric utilities and independent renewable power producers. The policy established by the Legislature in the RPS statute provides strong guidance for the Commission in reviewing utility applications and plans that are subject to Commission review and approval.

# 1. Background

The purpose of Hawai‘i’s Renewable Portfolio Standards is to promote Hawai‘i’s energy policy goals by encouraging the development and implementation of locally-sourced renewable energy generation connected to Hawai‘i’s utility electricity systems, while displacing existing fossil fuel generation and reducing the State’s historical dependence on imported oil. Hawai‘i is one of many states to have adopted RPS goals, and was first, in 2015, to establish a 100% RPS.

The Commission is required by statute to evaluate Hawai‘i’s RPS every five years and report its findings to the Legislature. As part of this process, HNEI is required to submit their assessment of the achievability and effectiveness of the RPS to the Commission. The objective is to determine if the standards established by HRS § 269-92 remain effective and achievable based on progress to date and to analyze options for meeting RPS targets in the future. This is the fourth RPS evaluation and status report since Hawai‘i first adopted a legally binding RPS in 2004.

Hawai‘i’s initial RPS – established in 2001 (Act 272, Session Laws of Hawai‘i 2001) – set forth voluntary targets to realize the “economic, environmental, and fuel diversity benefits of renewable energy” by establishing policies to encourage the development of local renewable energy resources and the creation of a market for those resources. The Legislature subsequently set mandatory RPS provisions in Act 95, Session Laws of Hawai‘i 2004. Act 95 also increased the RPS percentage requirements and expanded the types of resources included in the definition of “renewable energy.” While maintaining the same target for 2005, the renewable energy requirements to be met or exceeded, as a percentage of electricity sales, were set to 10% by 2010, 15% by 2015, and 20% by 2020.

HRS § 269-91, as amended by Act 162, Session Laws of Hawai‘i 2006, authorized the Commission to establish standards for each utility that prescribed what portion of the RPS shall be met by specific types of renewable electrical energy resources, provided that: (1) at least 50% of the RPS shall be met by electrical energy generated using renewable energy as the source; (2) where electrical energy is generated or displaced by a combination of renewable and nonrenewable means, the proportion attributable to the renewable means shall be credited as renewable energy; and (3) where fossil and renewable fuels are co-fired in the same generating unit, the unit shall be considered to generate renewable electrical energy (electricity) in direct proportion to the percentage of the total heat value represented by the heat value of the renewable fuels.

HRS § 269-91 also defined “renewable energy” as energy generated or produced utilizing the following sources: (1) wind; (2) sun; (3) falling water; (4) biogas (including landfill and sewage-based digester gas); (5) geothermal; (6) ocean water, currents and waves; (7) biomass (including biomass crops, agricultural and animal residues and wastes, and municipal solid waste); (8) biofuels; and (9) hydrogen produced from renewable energy sources. A utility failing to meet the RPS is subject to penalties to be established by the Commission unless they determine that the utility is unable to meet the RPS due to reasons beyond the reasonable control of the utility.

In January 2008, the State executed a memorandum of understanding with the U.S. Department of Energy establishing the Hawai‘i Clean Energy Initiative (HCEI). The HCEI agenda featured energy efficiency measures and plans to replace fossil fuel use in both the transportation and electrical power sectors by 70% by the year 2030. Act 155, Session Laws of Hawai‘i 2009, increased the RPS goals as a percentage of electricity sales to meet or exceed 25% by 2020 and 40% by 2030. Act 155 also established a separate Energy Efficiency Portfolio Standard in which 4300 gigawatt-hours (GWh) of future energy savings by the year 2030 must be met from energy efficiency and energy management technologies, roughly equivalent to achieve a 30% reduction in forecasted 2030 energy consumption at the time of the Act 155’s passage.

Effective January 1, 2015, Act 155 specified that the RPS for 2015, 2020, and 2030 shall not include energy efficiency and energy offset technologies as had previously been permitted, and only be met by electrical generation from renewable energy sources. In this Act, RPS targets were increased to 100% by 2045, including interim RPS requirements of 30% by 2020, 40% by 2030, and 70% by 2040.

In July 2022, Act 240 (HB 2089) was signed into law that amended the RPS calculation from renewable energy as a percentage of sales to renewable energy as a percentage of total system generation. The new calculation is based on total generation, including generation from private rooftop solar, in the denominator, and total renewable generation, including generation from private rooftop solar, in the numerator. The previous calculation had electric sales in the denominator and renewable generation from private rooftop solar counted in the numerator – thus double counting the contribution of distributed, behind-the-meter, resources. Given the high levels of adoption for rooftop solar in Hawai‘i, this has a large impact on statewide RPS, artificially increasing RPS attainment by approximately 7.5% statewide based on the 2022 end-of-year generation mix. Stated differently, the amended definition results in lower RPS percentages

due to the use of a larger denominator – that of changing sales to overall system generation. The change is illustrated using RPS percentages for 2022 in Figure 3.

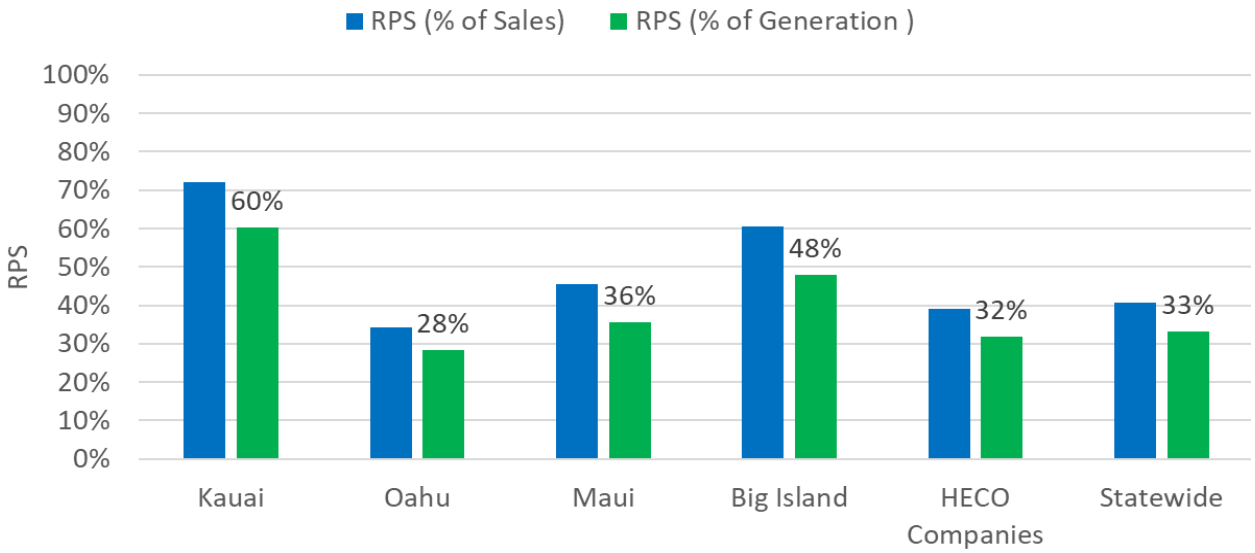


*Figure 3. Change in RPS for 2022, based on amended method for calculation.*

# 2. Notable Changes Since the Last Report

## *Inflation Reduction Act*

Under the Biden administration, several bipartisan laws have been enacted that will allow for the promotion of renewable energy technology deployment and the reduction of greenhouse gas (GHG) emissions. Most notably, the Inflation Reduction Act extended and expanded federal clean energy tax credits for clean energy technologies, clean fuels, electric vehicles, and other climate policies. It also changed tax rules on transferability of tax credits, increasing the number of entities able to invest in, and benefit from tax credits associated with renewable energy. This has resulted in a considerable amount of federal funding being available to states and utilities to increase percentages of renewable technologies and resources in the energy sector. While it is difficult to quantify the impact of this new legislation now, it is reasonable to assume that it will catalyze funding to states such as Hawai‘i to increase the development of these resources.

## *New Utility Procurements and RFPs (Stage 1, 2, 3)*

Since the publication of the last five-year analysis, there have been significant efforts on the part of both utilities to procure more renewable energy resources for electricity production, with a marked shift to utility scale solar plus storage in the HECO service area. For HECO, this has included the development of two major solicitations – called Stage 1 and Stage 2. As of the writing of this report, three of these new facilities have come on-line (105 MW), and eight (250 MW) are currently under construction. Collectively, these Stage 1 and Stage 2 projects are anticipated to increase statewide RPS by up to 7% – a major contribution to HECO meeting the 2030 RPS. However, there have been issues with some of the projects, leading to significant delays and cancelations. These issues are discussed further later in this report.

In addition to the Stage 1 and 2 projects currently operating or under construction, HECO is currently conducting a Stage 3 competitive solicitation and selected projects are scheduled to be announced by December 2023. This is anticipated to bring on up to 1,715 GWh of new generation by 2027 across O‘ahu, Maui, and Hawai‘i Island. Collectively, the Stage 1-3 solicitations could increase RPS contributions by 24% across the HECO service territory or up to 22% towards the statewide total (Table 2).

*Table 2. HECO Stage 1-3 procurement summary.*

| | O‘ahu | Maui | Big Island | Total |
|---|---|---|---|---|
| Stage 1 & 2 (GWh)* | 479 | 164 | 131 | 774 |
| Stage 3 (GWh) | 965 | 425 | 325 | 1,715 |
| **Total Stage 1-3 (GWh)** | **1,444** | **589** | **456** | **2,489** |
| | | | | |
| Stage 1-3 RPS (% of Generation) | 19% | 40% | 33% | 24% |

*Excludes canceled projects

KIUC has also increased the development of renewable energy resources considerably. Since 2019, KIUC added two hybrid solar and storage projects (20 MW and 14 MW) to increase Kaua‘i’s RPS to 60%. In the future, the proposed West Kaua‘i Energy Project – which combines solar, battery storage, hydro, and pumped storage would increase Kaua‘i’s renewable energy by another 60 MW – contributing up to 17% to Kaua‘i’s RPS (1% towards the statewide total).

## *Fossil Retirements and Reliability Concerns*

The utilities have been aware for some time that their aging oil- and diesel- fired power plants are becoming less reliable and more difficult to maintain, as shown in Figure 4. Forced outages (unplanned failures) are increasing as a percentage of operation time. Further, new federal regulations passed in the 2015 for control of fine particulates and trace metals have increased the time necessary for planned outages.

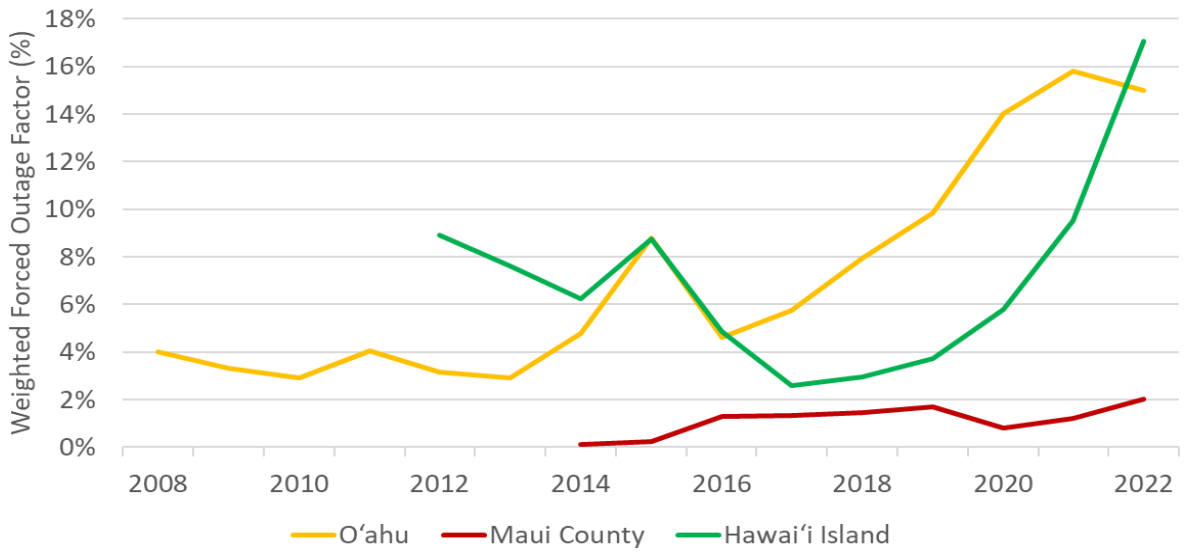


*Figure 4. Weighted equivalent forced outage factor.*

This is happening simultaneously when there is a substantive increase in variable renewable energy systems being placed on the grid. The existing thermal facilities are not designed to respond to relatively rapid and frequent changes in meeting variable loads – a result of the variability from wind and solar resources. As a result, the trend is for increased maintenance requirements to keep the thermal facilities operational.

With increasing age of the plants and the increase of variable renewables, issues related to reliability and resiliency will likely increase. As the older oil-fired facilities are retired, there must be consideration given to the future deployment of other firm resources that can be used to maintain grid services. While these resources, in isolation, will not increase the RPS, newer more flexible thermal generation may help integrate additional renewable energy while also providing important reliability services. Dispatchable firm-renewable resources are currently being solicited in the Stage 3 Firm Capacity solicitation, with the potential to support grid services and RPS goals.

## 3. Status as of December 31, 2022

The RPS is applied to KIUC and the HECO Companies. The 2018 Report from the Commission to the legislature projected that each utility would exceed the 2020 requirement of 30%. Both utilities successfully achieved this goal, which was based on the prior method for determining percentage of renewables. While the advances in the development of utility-scale renewable generation have been significant in both service areas since the 2018 report, it should be noted that in 2022, customer-based generation accounted for 46.6% of renewable energy generation across the state – with this value being 49.9% on O‘ahu. Figure 5 is a pie chart showing the relative percentages of resources providing electricity from renewables across the state.

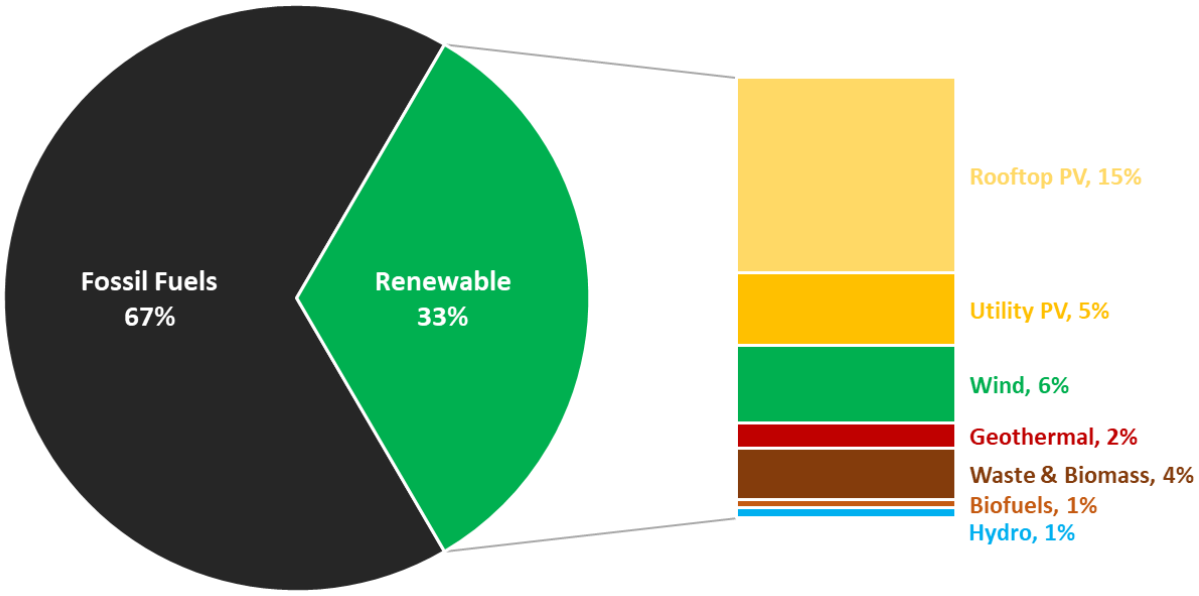


*Figure 5. Percentages of renewable energy sources (statewide).*

### *Kaua‘i Island Utility Cooperative*

The data for this section is based on KIUC’s letter to the Commission on May 4, 2023, which describes the utility’s achievements through the end of 2022 (Appendix A). Based on the legislatively-mandated change in the definition and calculation of RPS, renewable energy resources supplied 60% of KIUC’s net electricity generation during the 2022 calendar year. This is substantially higher than the requirement of 40% by 2030. The KIUC RPS values were reduced by approximately 6%, from 69.5% (pre-legislation) to 63.3% post-legislation (Table 3).

*Table 3. KIUC renewable generation in 2022.*

Kauai Island Utility Cooperative
Renewable Portfolio Standard (RPS) Status Report
Year Ending December 31, 2022
**EXHIBIT A**

| Electrical Energy Generated Using Renewable Energy Sources | 2022 | 2021 post-HB2089* | 2021 pre-HB 2089* |
|---|---|---|---|
| Biomass | 51,555 | 48,479 | 46,019 |
| Hydro | 56,421 | 64,807 | 61,518 |
| Photovoltaic (PV) | 141,770 | 138,251 | 131,235 |
| Customer-Sited, Grid-Connected PV | 68,131 | 64,649 | 63,444 |
| Total Renewable Electrical Energy | 317,877 | 316,186 | 302,217 |
| Total Electrical Energy Generation (Sales for 2021 pre-HB 2089) | 527,924 | 499,413 | 435,156 |
| RPS Percentage | 60.2% | 63.3% | 69.5% |

* H.B. 2089 of 2022 amended the RPS to be based on net electricity generation rather than sales. Prior to HB2089, net electricity generation was reduced by system losses in order to correlate to net electricity sales.

"Renewable portfolio standard" means the percentage of electrical energy generation that is represented by renewable electrical energy, excluding customer-sited, grid connected generation that does not produce renewable energy

KIUC meets electricity needs of its customers by using its own fossil fueled and renewable resource generation, renewable power purchases from independent power producers, and a modest amount of behind the meter (BTM) PV generation. A graph illustrating the growth of percentages of renewable energy generation for KIUC is shown in Figure 6.

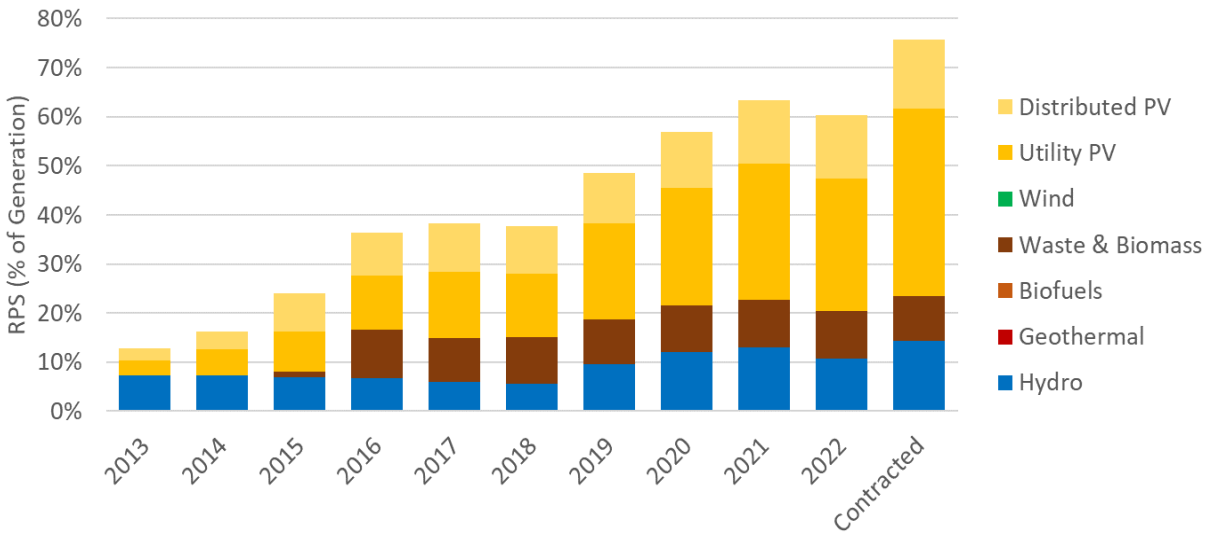


*Figure 6. KIUC historical RPS by renewable fuel type.*

Customer capacity for BTM electricity from renewable resources is calculated to be 40.6 MW. Lastly, the West Kaua‘i Energy Project, which is a combination of solar, storage, and hydro resources has been approved – although it may potentially be delayed due to litigation and community engagement. Assuming completion, this facility could enable KIUC to reach 75-80% RPS.

### *HECO Companies*

HECO submitted their Renewable Portfolio Standard Status Report for 2022 on February 17, 2023 (Appendix B). This submission covers utility operations on the islands of O‘ahu, Moloka‘i, Lāna‘i, Maui, and Hawai‘i. The report shows that by the end of 2022, HECO had achieved a RPS of 31.8% – within 8.2% percent of the 2030 target. The O‘ahu, Hawai‘i Island, and Maui County systems achieved 28%, 48%, and 36% RPS, respectively. It is anticipated that the HECO Companies will achieve the 40% RPS goal in 2030 by continuing development of procurements and awards already planned and approved by the Commission to independent power producers for further development of renewable resource technologies.

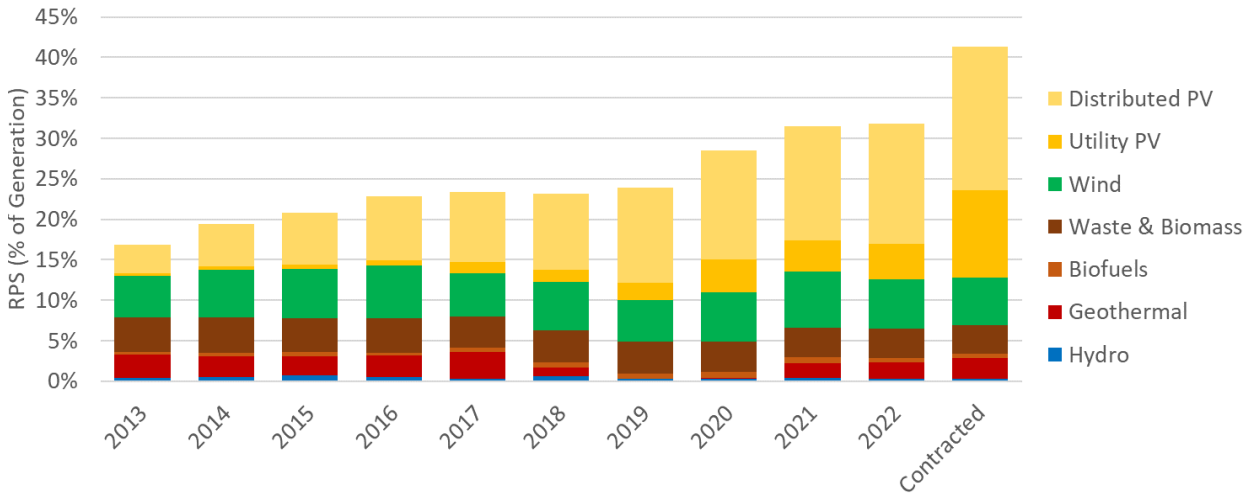


*Figure 7. Renewable generation percentages by resource for HECO Companies.*

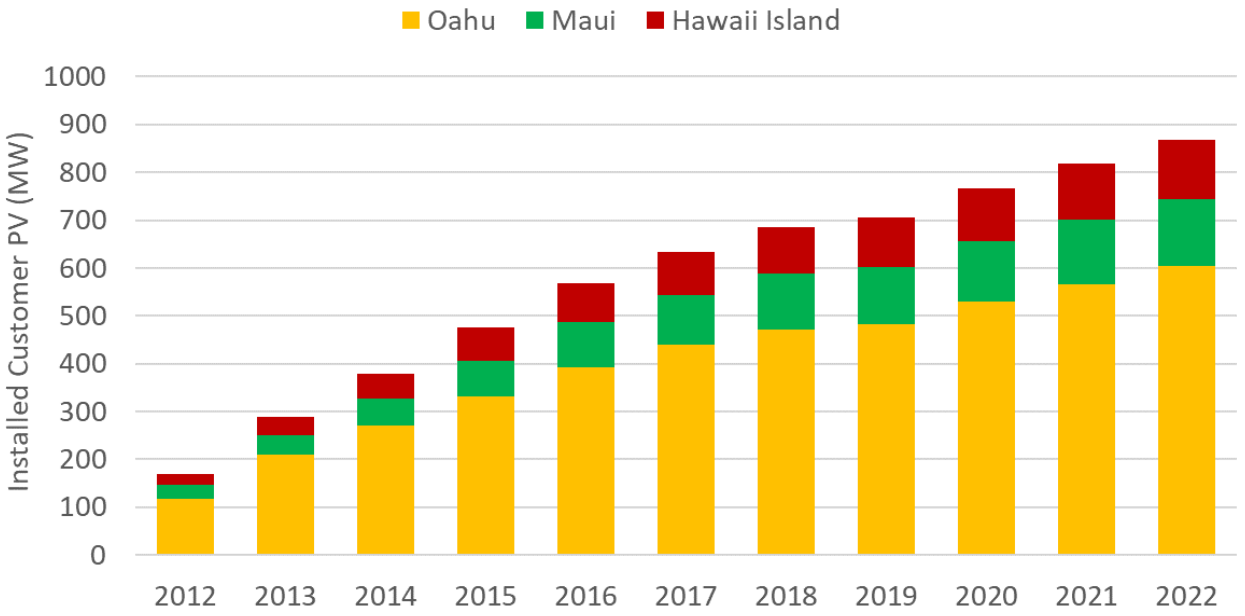


*Figure 8. Growth of customer capacity for renewable energy (HECO Companies).*

Wind, utility-scale solar, geothermal, and biomass (including municipal solid waste [MSW]) are the renewable resources that provide electricity to HECO Companies' grids. However, a significant component of the HECO Companies' renewable generation portfolio continues to be customer-sited distributed solar PV. HECO Companies continued to increase its renewable energy portfolio in 2022. Generation from grid-scale solar increased by 15% due to the start-up of 39 MW Mililani I in July 2022. The 36 MW Waiawa Solar project underwent testing and commissioning in Q4 2022, achieving commercial operations in January 2023. New customer-sited energy resources, Community-Based Renewable Energy, and Feed-In Tariff installations totaled 40 MW. Generation from customer-sited, grid-connected resources increased by 7%.

Geothermal production increased slightly this year as the Puna Geothermal Venture plant continues to return to full service following the 2018 eruptions. Wind production was lower by 11%, compared to 2021. However, 2022 wind production was within the range of historical wind production over the past decade.

*Table 4. HECO Companies renewable generation in 2022.*

**Hawaiian Electric**
**For the Year Ended December 31, 2022**
*(In Net Megawatt Hours)*

| | 2022 | | | | 2021 |
|---|---|---|---|---|---|
| | O‘ahu | Hawai‘i | Maui County | TOTAL | TOTAL |
| **Electrical Energy Generated Using Renewable Energy Sources** | | | | | |
| Biomass (including municipal solid waste)[1] | 370,668 | | | **370,668** | **366,365** |
| Geothermal[1] | | 208,346 | | **208,346** | **183,391** |
| Photovoltaic and Solar Thermal[1] | 433,875 | 4,050 | 12,844 | **450,769** | **390,353** |
| Hydro[1] | | 27,409 | | **27,409** | **43,050** |
| Wind[1] | 249,766 | 141,301 | 234,849 | **625,916** | **701,124** |
| Biofuels | 16,256 | 46,292 | 566 | **63,114** | **71,780** |
| Customer-Sited, Grid-Connected[2] | 1,064,021 | 209,629 | 248,794 | **1,522,444** | **1,418,036** |
| **TOTAL** | 2,134,587 | 637,027 | 497,052 | **3,268,667** | **3,174,100** |
| **TOTAL GENERATION** | 7,559,608 | 1,330,718 | 1,394,862 | **10,285,189** | **10,072,948** |
| **RPS PERCENTAGE (% of Generation)** | **28.2%** | **47.9%** | **35.6%** | **31.8%** | **31.5%** |
| **TOTAL SALES** | 6,210,797 | 1,053,833 | 1,089,324 | **8,353,955** | **8,261,103** |
| **RPS PERCENTAGE (% of Sales)** | **34.4%** | **60.4%** | **45.6%** | **39.1%** | **38.4%** |

## *Statewide*

Since the KIUC and HECO Companies serve the electricity needs across six islands – Kaua‘i, O‘ahu, Hawai‘i, and Maui County – it is useful to look at the current status of each. This is illustrated in Figure 9.

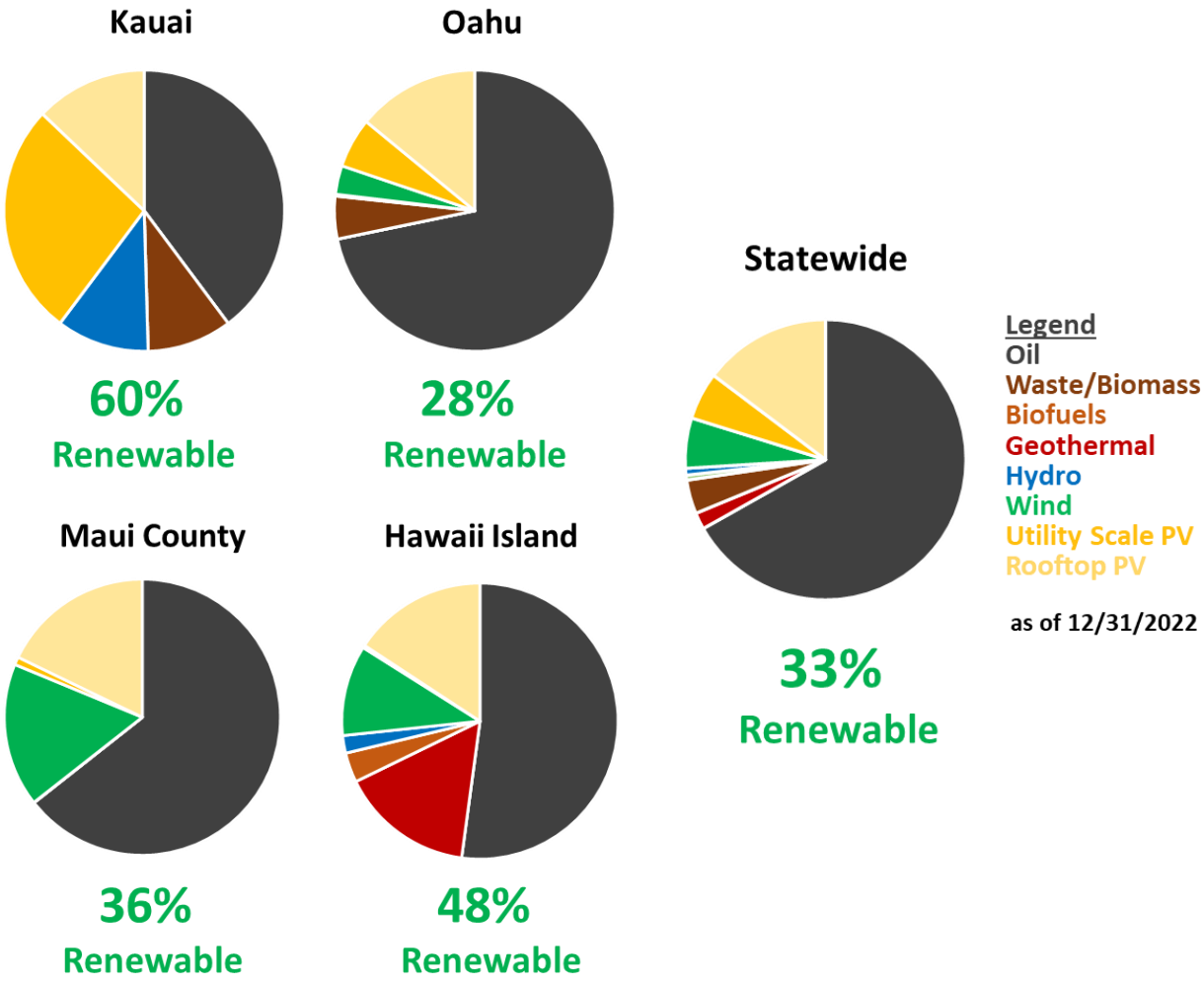


*Figure 9. Energy generation mix by island and statewide.*

# 4. Statement on Effectiveness and Achievability of Renewable Performance Standards

State law requires that the Commission periodically review whether the RPS remain effective and achievable. HRS § 269-95(4) requires the Commission to:

> “Evaluate the renewable portfolio standards every five years, beginning in 2013, and may revise the standards based on the best information available at the time to determine if the standards established by section 269-92 remain effective and achievable.”

The determination of the effectiveness and achievability of the RPS is the central focus of this Report.

## *Effectiveness of the RPS*

Hawai‘i has long-standing policies to reduce imports of fossil fuels, increase the use of indigenous renewable resources, and maintain affordable energy services. The RPS was initially created by Act 272, which states:

> “It is the intent of the legislature to recognize the economic, environmental, and fuel diversity benefits of renewable energy resources and to encourage the establishment of a market for renewable energy in Hawai‘i using the State’s renewable energy resources and to encourage the further development of those resources.... Accordingly, the legislature finds that it should establish goals for electric utilities to guide them in incorporating renewable resources into their resource portfolios to reduce the use of imported oil. (Part I, Section 1, Act 272, Session Laws of Hawai‘i 2001.)”

The Legislature has expressed similar intent in subsequent enactments amending Hawai‘i’s RPS. As such, the Commission’s assessment of the effectiveness of the RPS considers: (1) whether the RPS is effective for increasing the amount of renewable energy generation resources deployed on Hawai‘i’s utility systems and (2) whether the increased utilization of renewable resources is effectively reducing the use of imported oil and promoting Hawai‘i’s policies to increase use of indigenous resources while maintaining affordable energy services. The RPS has been effective in both respects.

Implementation of renewable energy generation promotes Hawai‘i’s energy policies regarding fuel use. Generation using Hawai‘i sources of renewable energy increases the use of indigenous resources and decreases reliance on imported fuels. The RPS requirements serve as an effective driver of renewable generation implementation. The establishment of the RPS by the Legislature serves as a clear statement of standing policy and priority, and the objective of achieving the RPS requirements has been embraced as a mandate by Hawai‘i’s electric utilities and independent renewable power producers. The Commission concurs with and implements the clear policy enunciated by the Legislature in the RPS statute in establishing and implementing the Commission’s own policies and in reviewing the utility applications and plans that are subject to Commission review and approval. Hawai‘i is further along the path to increased utilization of renewable and indigenous resources, reduction in use of imported petroleum fuels, and diversifying its fuel portfolio due to the RPS being part of Hawai‘i’s overall energy policies and programs.

### *Cost Effectiveness of Renewable Generation Resources*

The cost-effectiveness of renewable resources has changed substantially over the past decade. In recent years, the price of petroleum fuels has varied considerably, particularly following the COVID pandemic and the onset of Russia’s invasion of Ukraine. This invasion necessitated the Par Refinery dropping its imports from Russia (approximately 27% of its supply prior to the war) to other international sources. While this invasion caused a spike in oil prices for Hawai‘i, the overall costs for oil tends to track mainland costs. This geopolitical reality, coupled with lower solar technology costs, make the new projects cost competitive with existing fossil-fired facilities.

The proposed projects from the HECO Companies’ ongoing competitive solicitations, as well as experience of other recent renewable projects, shows that renewable energy can be developed in Hawai‘i at prices below the cost of fossil fueled generation. The HECO Companies’ avoided energy costs have ranged between 12 and 28 cents/kWh over the last year (depending on which island) and have recently trended upwards. In contrast, recent Stage 1 and Stage 2 procurements were priced in the 9 to 11 cents/kWh, inclusive of battery energy storage capacity.

Going forward, new renewable energy projects, with long-term fixed prices, are expected to offer savings to ratepayers as the projects are integrated into the energy resource mix. However, as noted above, recent cancellations and supply chain problems have increased the cost of the development of utility-scale solar and utility-scale solar + storage facilities. Available land for solar

development and transmission interconnection is more limited. Thus, it is not a foregone conclusion that these developments will continue to drive electricity rates down.

At current and expected future petroleum prices, economic forces are working in conjunction with the RPS and other Hawai‘i policies and programs to promote the implementation of renewable energy generation resources. The prices paid by utilities for the purchase of energy from renewable resources are now generally less than the avoided costs of the utilities' fossil-fueled generation. As a result, the increased use of renewable generation resources on Hawai‘i's utility systems is expected to reduce costs paid by utility customers in the future.

# 5. Anticipated Achievement of 2030 RPS Requirements

***Achievability*** addresses whether the RPS requirements can be met by each of the utilities or, as allowed under statute, by utilities on an aggregated basis. Two principal considerations are:

- Whether sufficient renewable energy resources currently exist or can be feasibly developed on each utility system to achieve the RPS requirements. This includes consideration of whether sufficient renewable resources are reasonable in terms of cost and can be successfully sited. Factors to be considered include, but may not be limited to, land availability, site control, community impacts, and the ability to successfully obtain project permits.

- Whether the required amounts of renewable energy resources can be connected to and accommodated by the utility electric systems. On the system generation level, this includes consideration of the extent to which each utility system can accommodate assumed levels of variable renewable generation resources. On the distribution circuit level, this includes whether assumed levels of distributed generation resources can be accommodated on distribution circuits economically, safely, and reliably.

An effort is made in this Report to make reasonable considerations regarding incorporation of renewable generation on each utility system. This Report does not, however, attempt to resolve any uncertainties associated with these considerations.

Examination of the achievability of the RPS includes consideration of several factors, such as existing and possible future renewable energy generation resources being identified and the expected or possible amount of energy generation quantified from these resources. Information regarding existing generation and projects that are under construction is more certain than information regarding possible future projects or general estimates of resource potential. For this report, sufficient verified information is available for projects that are existing and/or approved and under construction on a project-by-project basis with some consideration of uncertainties. Projections are based on the successful development of these near-term projects as well as information received from the utilities regarding future near term (proposed to come on-line by 2030) proposals.

In performing the analysis necessary for this Report, the HNEI relied on several sources of information including:

- ***Annual Utility RPS Status Reports***: Each of Hawai‘i’s electric utilities provides annual reports identifying the amount of energy generated by renewable sources and the achievement of the RPS requirements. These reports identify renewable generation resources that are operating as of the dates of the reporting periods. The Commission relies on these reports to quantify historical and existing renewable energy generation. The most recent reports by each utility indicate RPS achievement information for the calendar year 2022.
- ***Future Renewable Generation Projects***: This includes new renewable generation projects that provide electrical power to each utility. Expected renewable generation for these projects is provided by the utilities, based on current estimates. The Commission relies in this Report on approved applications to quantify expected renewable energy generation from projects that are under construction or substantially in progress. In addition, for the HECO Companies, the ongoing competitive-bid process for new renewable generation includes information regarding the possible scope of new renewable resources in the near-to-mid-term. For HECO, more than 500 MW of renewable projects are expected to come online in the next few years.
- ***Mid- and Long-Range Utility Planning Estimates***: Hawai‘i’s electric utilities also provide the Commission with mid-term and long-range planning information and projections of expected and possible capital expenditures in filed reports, periodic briefings, and the Integrated Grid Planning (IGP) process. Planning information includes identification of possible specific future renewable generation projects, possible requests for proposals and general estimates of possible resource potential.
- ***Additional Expert Opinion***: External expert opinion was also factored into the analysis and commentary. A number of anonymized state-based experts were interviewed to obtain their views on the future achievement of RPS goals. These experts including those from non-governmental organizations (NGOs), independent power producers, the utilities, academia, and state agencies.

### *KIUC*

KIUC has already exceeded the 2030 RPS requirement of 40%, with over 60% RPS achieved at the end of 2022. As such, assuming existing projects continue to produce at average historical levels, KIUC will exceed the 2030 RPS requirement. Additional projects planned for Kaua‘i would further

boost KIUC’s RPS achievement. If the West Kaua‘i Energy Project is completed, KIUC’s 2022 RPS of 60.2% is expected to increase up to nearly 80% by 2030. This projection includes a new hydro project nearing completion, as well as a larger pumped storage hydro project that KIUC is actively planning to develop in this timeframe. The KIUC projection does not include CBRE projects, which could further boost KIUC’s RPS achievement. In addition, growth in customer-sited distributed PV could provide a substantial contribution over and above the projection based on expected large- scale projects.

### *HECO*

While the loss of the PGV facility on Hawai‘i island reduced HECO’s near-term RPS by more than 3%, this facility is now back on line. A proposal to increase its capacity to 60 MW requires an Environmental Impact Statement (EIS), which is now undergoing review and comment. Responses to all substantive public comments to the Draft EIS are being reviewed by PGV. PGV's review of the Final EIS is anticipated to be completed by around the end of October. PGV anticipates that the environmental review will be completed in the fourth quarter of 2023.

Several other approved projects in the HECO Companies’ service territories are likely to become operational by 2030, including utility-scale solar PV projects on O‘ahu, Maui, and Moloka‘i, as well as a biomass facility on Hawai‘i Island. These are part of the Stage 1 and Stage 2 projects approved by the Commission. Uncertainty remains regarding whether all of the proposed projects will be able to reach commercial operations. Each project is subject to several contingencies, including obtaining necessary permits, supply-chain issues, successful financing, and project implementation. Thus, a number of approved Stage 1 and Stage 2 projects have been cancelled or have been subject to lengthy delays (Table 5). Assuming that the current under construction (non-cancelled) projects come on-line, HECO will likely achieve the RPS requirement of 40% by 2030, depending on load growth and rooftop solar PV additions.

*Table 5. Recent status of approved Stage 1 and 2 (as of October 2023).*

| | O‘ahu | Maui | Big Island | Total |
|---|---|---|---|---|
| Operating | 75 | 0 | 30 | **105** |
| Construction | 144 | 75 | 30 | **249** |
| Canceled | 208 | 100 | 120 | **428** |
| **Total** | **426** | **175** | **180** | **781** |
| | | | | |
| Standalone BESS | 185 | 40* | 12* | **237** |

*Awaiting PUC approval

HECO is currently developing a Stage 3 competitive solicitation and selected projects are scheduled to be announced by December 2023 and in service by 2027 (Table 6). This request will include specifics on the need for firm power renewable resources. In summary, HECO Companies intend to add a further 1,715 GWh of renewable energy to its grids by 2027. Assuming a portion of these projects come online by 2030, HECO will meet its 40% RPS requirement.

*Table 6. HECO Stage 1-3 procurement summary.*

| | O‘ahu | Maui | Big Island | Total |
|---|---|---|---|---|
| Stage 1 & 2 (GWh)* | 479 | 164 | 131 | 774 |
| Stage 3 (GWh) | 965 | 425 | 325 | 1,715 |
| **Total Stage 1-3 (GWh)** | **1,444** | **589** | **456** | **2,489** |
| | | | | |
| Stage 1-3 RPS (% of Generation) | 19% | 40% | 33% | 24% |

*Excludes canceled projects

HECO also anticipates growth in the number of CBRE projects (primarily solar PV) across all islands. However, there has been concern raised by technology providers that that the tariff-based approach that is being used for CBRE projects is not working well. One comment focused on the fact that all four CBRE projects currently under development were led by only one developer.

## *Statewide Summary for 2030*

KIUC and HECO have both outlined their plans for future development over the next few years. Given these plans, it appears reasonable that the state will achieve its RPS goal of 40% by 2030. This assumption must be caveated by the concern that recent events have demonstrated that

there can be significant delays and cancellations that were unanticipated when plans were developed and contracts were awarded.

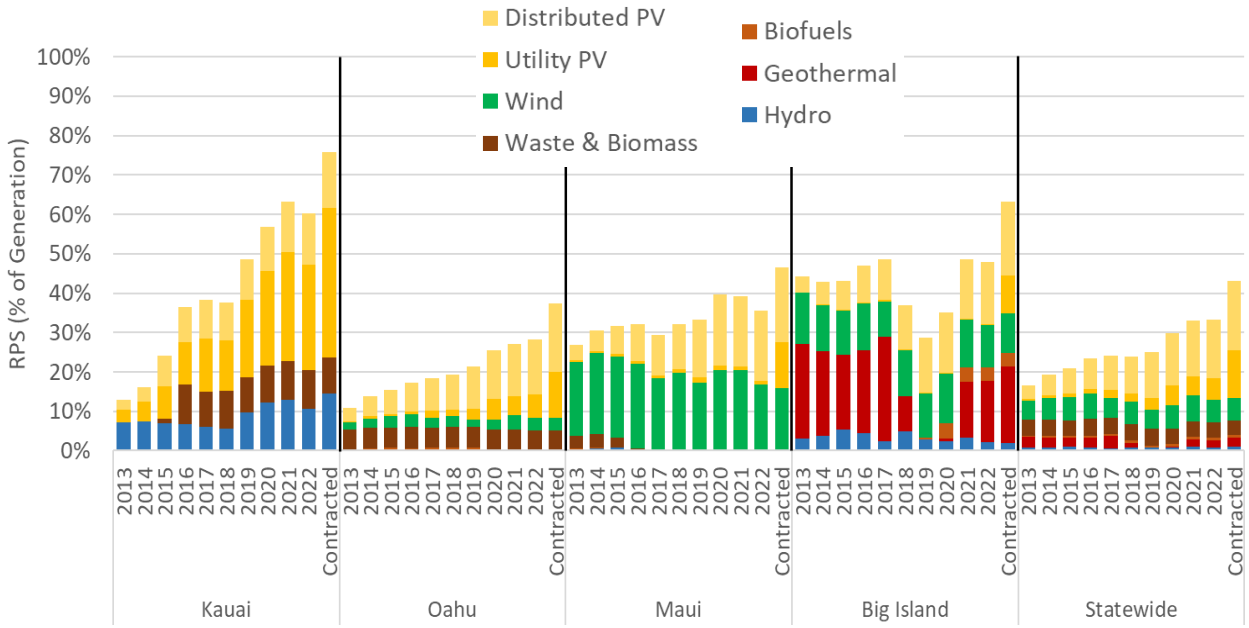


*Figure 10. Projected RPS attainment, assuming completion of contracted projects.*

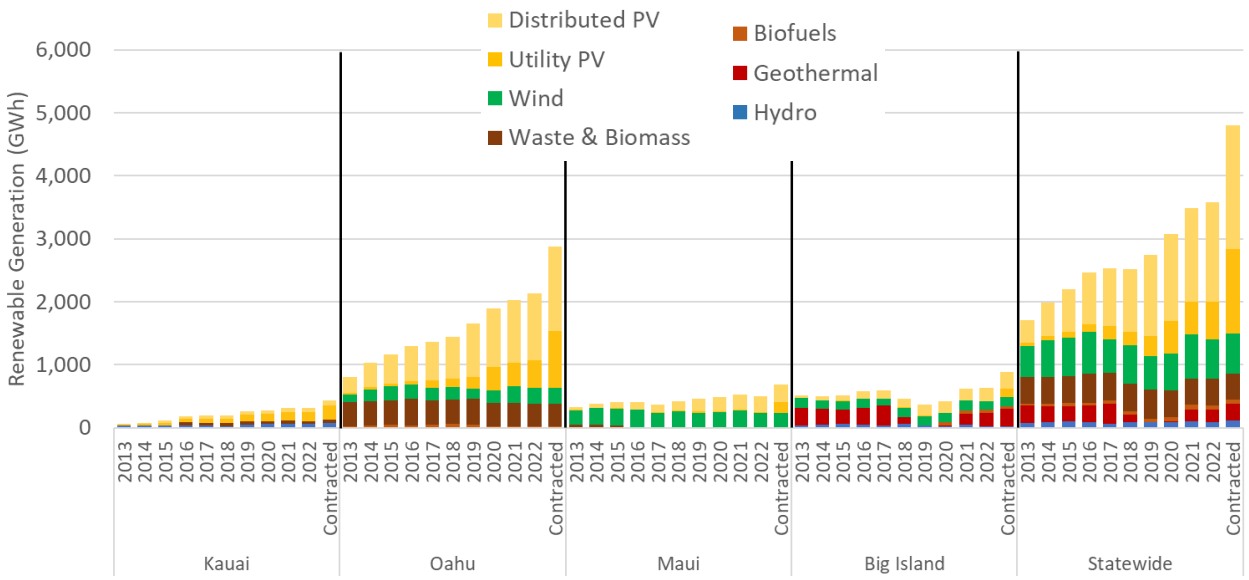


*Figure 11. Projected RPS generation, assuming completion of contracted projects.*

# 6. Challenges and Considerations in Achieving Future RPS

The findings of this report indicate that 40% RPS target for 2030 is achievable for Hawai‘i’s electric utilities. However, there are technical, regulatory, economic, and societal challenges that will need to be monitored, evaluated, and addressed leading up to and beyond 2030. If unmitigated, these challenges could limit the ability to achieve RPS targets – especially at higher load levels and with increased electrification of transportation.

Since there is no specific goal for the upcoming five-year mark (2025), this report has included some observations on the ability of the state and its utilities to reach goals beyond 2030. Due to substantially greater uncertainty, this report does not make a determination on the achievability of the 2040 and 2045 RPS requirements of 70% and 100%, respectively. Research conducted by HNEI and HECO’s Integrated Grid Plan (IGP) process show that reaching the 70% RPS by 2040 is technically feasible and likely cost effective using current commercially available technologies. However, non-technical challenges like land use, community acceptance, and the pace of development will likely determine success or failure to meet the 70% RPS. As a result, it is appropriate to highlight several challenges described below in order to illustrate key considerations for further legislative, regulatory, research, and development activities.

The longer timeframe beyond 2030 presents uncertainties regarding the amount of growth in electricity demand. The amount of required renewable resources depends on future economic, legislative, and technology trends. These higher percentage goals are further exacerbated by the desire to “electrify everything” as the most effective way to achieve cross-sector, statewide emissions reductions. With proposed conversion of ground transportation from gasoline internal combustion engines to electric vehicles, further electrification of buildings and industries, and electrification of industrial processes, it is estimated that electricity sales on O‘ahu will be between 30 and 60% greater than the 2022 levels[1]. Additionally, there will be continued efforts to improve energy efficiency that will lead to reduced electricity needs. Lastly, increased utilization of demand response, primarily in the form of better utilization of customer-owned storage systems will change the profile of electricity use. Better utilization of demand response and load flexibility may be assisted by HECO Companies’ battery bonus program.

[1] Hawaiian Electric Company, *Integrated Grid Plan, Appendix B, Forecasts, Assumptions and Modeling Methods* pg B-25, https://hawaiipowered.com/igpreport/05_IGP-AppendixB_ForecastsandAssumptions.pdf

## *Grid Integration Challenges*

**Managing Weather Variability**

Most of the economic existing and proposed renewable generation projects are variable generation resources – producing energy only when the energy source (e.g., wind or sun) is available and susceptible to both ramping and extended periods of unavailability. Hawai‘i’s grid operators must manage variability of both electricity demand as well as supply from variable resources. The grid must balance generation and load at all times, and grid operators must ensure that the grid is carrying adequate reserves to cover anticipated and/or unexpected drops of wind and solar generation.

The decreasing cost and technical maturity of battery energy storage resources have mitigated much of the variability concern. New battery storage can mitigate short-term fluctuations in wind and solar output and help shift surplus renewable energy to high load periods. However, current 4-hour duration battery storage is insufficient to cover multi-day low wind and solar events. There is growing concern over longer-term variability and unavailability that cannot be mitigated by current short-duration battery technology. For example, longer term weather patterns – such as “40 days of rain in 2006,” and/or extended periods of Kona winds – may require continued use of firm power supplies. This is illustrated in Figure 12.

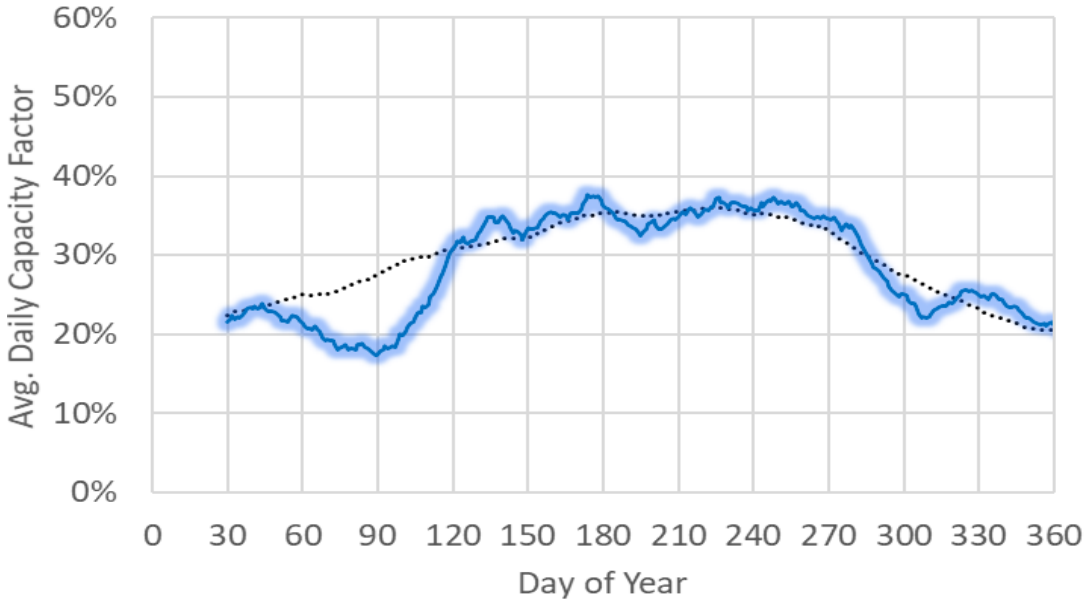


*Figure 12. Average daily capacity during 2006 – year of “40 days of rain”. Note: The dotted line represents a 21-year average. Blue line represents two-week rolling average.*

Other potential reliability events, such as the Kona low in December 2008 (Figure 13), suggest that research and development of grid integration technologies must continue as the management of grid operations becomes more complex as the percentage of variable renewable generation increases. Enabling technologies, such as energy storage and demand response, coupled with system operational experience will be increasingly important as the State develops additional mechanisms to better integrate more variable renewable resources.

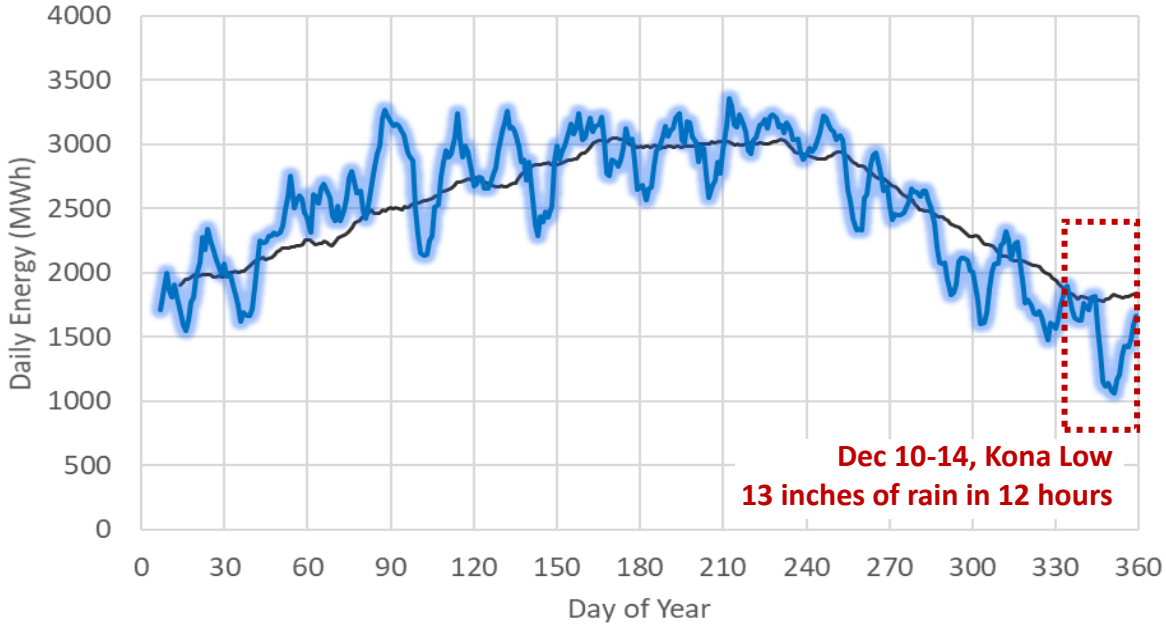


*Figure 13. Historical low solar event (December 2008) on a future O'ahu power system.*

**Low Inertia and Inverter Based Resources**

Wind, solar PV, and battery energy storage technologies are all inverter-based resources (IBRs). IBRs interact differently with the grid as compared to conventional technologies. IBRs utilize inverters to interface with the grid and the dynamics of that interaction are determined by the inverter controls software. In contrast, oil-fired generation and other thermal technologies (biomass, biodiesel, etc.) are synchronous generation and the interaction is based on the physics of the rotating generator and turbine.

The shift to increasing penetration of inverter-based generation changes the way the power grid is managed, particularly related to grid stability during and after grid disturbances. These disturbances can be caused by generator trips (supply dropping offline unexpectedly), load trips, or transmission faults. If inverter controls are not designed and implemented properly, grid stability can be jeopardized. In order to maintain system frequency and voltage, avoid load

shedding, and potential grid collapse, the grid needs to quickly respond to restore balance between generation and load. These challenges are a top concern and area of research for the international power system community, but its effects are more pronounced in Hawai‘i. The Hawai‘i power grid is made up of six isolated, low inertia, power grids. The share of IBR generation and the disproportionate impacts of disturbances make grid stability a more discernible, near-term concern.

Mitigating risks to grid stability is done through several mechanisms that vary in time of response and in duration of response. With increased wind and solar penetration, fossil generation is being displaced and as a result, synchronous inertia is reduced. This subsequently causes the speed at which the system becomes unbalanced (rate of change of frequency) to increase. In order to maintain system stability, a faster response (fast frequency response) will be required either via additional synchronous inertia, frequency responsive wind, solar PV, and loads, or battery energy storage.

Currently HECO is advancing, and requiring, the use of Grid Forming Inverters (GFM) for all new solar and battery storage projects. While most currently in-service IBRs use “Grid-Following Inverters” (GFL), newer GFM technologies have been shown to provide better inherent mitigation of grid stability risks, particularly in low inertia or microgrid applications. These advanced inverter controls are currently being provided by leading OEMs, but the technology is new and definitions, grid codes, and requirements are still being developed internationally. While it is anticipated that grid forming capability will advance, it poses uncertainty for future RPS attainment.

## *Transmission and Distribution Constraints*

**Distribution System Capacity and Integration of Distributed Energy Resources**

While the grid is able to accommodate additional solar PV generation in some areas, there are local, distribution-level, constraints that could limit the further adoption of distributed PV in some locations. Additional solar PV generation on some individual circuits is likely to require additional interconnection studies. This is a concern because in 2022, 46.6% of renewable generation is customer-based.

It is likely that distribution system upgrades will be required to meet utility’s safety standards. The development and deployment of grid following inverters may provide some solution to improving impacts to distribution systems. However, communication protocols will need to be

developed on a system-wide basis. Improved siting of storage systems on distribution systems may provide a partial solution. This may become increasingly important as load-shifting technologies and procedures will be required in the future.

Experts suggested that the CBRE initiative be re-evaluated to better engage communities in addition to developers. Additionally, consideration needs to be given to ensuring that the outcomes for CBRE developments are economic for both the communities and the utility.

**Transmission Interconnection**

Since recent utility-scale renewable generation has been sufficiently close to existing transmission lines, there has been no need for substantive upgrading of transmission or for the development to of new transmission lines. However, current interconnection capacity is becoming more limited. It is very likely that future utility-scale renewable energy development will require either transmission line upgrades (reconductoring) or development of new transmission lines both for interconnection and deliverability to load centers. This need will increase the cost of development, may require additional land for new transmission lines, and will, in all likelihood, lead to another level of community opposition.

In the Integrated Grid Plan, HECO has developed Renewable Energy Zones (REZs) across each island, identifying the potential areas of new renewable energy development and the required transmission upgrades necessary to “unlock” the renewable potential in each region. An example of the REZ is provided for O‘ahu in Figure 14. Additional analysis is needed to understand incremental transmission additions required for near-term projects and the evaluation of Grid Enhancing Technologies (GETs) that could potentially defer or reduce the need for new transmission.

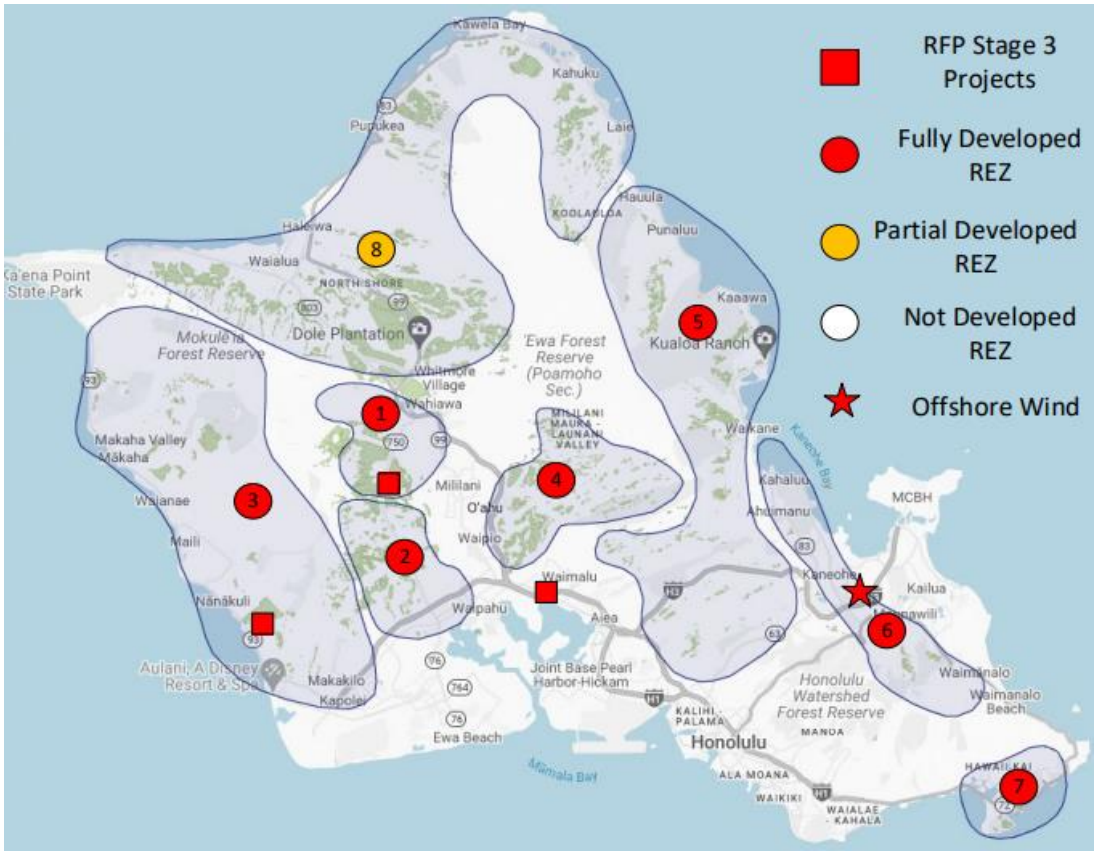


*Figure 14. O‘ahu Renewable Energy Zones. (Source: HECO Integrated Grid Plan, pg. 142.)*

## *Land Use and Community Acceptance Challenges*

**Siting, Permitting, and Land Constraints of Renewable Generation Resources**

The State has abundant natural renewable energy sources. However, the availability of sites for the construction of renewable generation that are not subject to environmental, community, or cultural concerns and competing local agriculture objectives is more limited.

Land availability, particularly for O‘ahu, is likely to become a considerable impediment for adding a significant amount of utility-scale renewable energy resources. Because 70% of the state’s electricity load is located on O‘ahu, land use concerns are significant. A state-based coordinated approach for better management of land and competition for different uses of land is needed. Some experts believe that utility-scale solar farms can be sited on significantly sloped land. However, other independent power producers believe that trying to place solar farms on such land will be very difficult. Among other possibilities, interaction with Department of Hawaiian

Homelands, and the military must be factored into potential solutions for expanding land availability.

There will also need to be better cooperation between state and local authorities for expeditiously permitting approved projects. Some projects in HECO Companies' Stage 1 and Stage 2 developments have been delayed, in part, due to delays in permit applications and approval. These issues, coupled with some national developers' reluctance to work in Hawai‘i or with the utility, may create issues in being able to obtain the lowest cost solutions for future renewable energy development.

**Community Acceptance & Equity**

The achievability of the longer-term RPS requirements depends on public acceptance. While the state's residents, are in general, supportive of local, renewable energy, there is often considerable opposition to specific projects. Impacted community concerns must be addressed regarding how construction of future renewable generation projects will affect them. This can be a key uncertainty in determining 2030, 2040, and 2045 RPS achievability. Better mechanisms must be developed for engaging impacted communities, including improved methods for developing public outreach and related educational programs. Future solicitations by HECO are proposing to require $3000/MW of benefits to local communities that will be impacted by utility-scale renewable energy development. However, it remains uncertain as to how impacted communities and their residents will respond to these enticements. Additionally, determination of how these funds might be used to benefit the community could be contentious.

An additional issue which is now being addressed by the Commission's proceeding to investigate equity (Docket # 2022-0250) is the impact to grid modernization on low and middle income (LMI) households. The outcome of these deliberations could lead to changes for future siting and development of utility-scale renewable projects.

## *Project Development Challenges*

**Cost and Supply Chain Uncertainty**

The capital costs for equipment, construction, and labor have increased for all new power projects, including renewables. This is due to inflation and global supply chain disruptions. Financing costs have also increased due to federal interest rate increases. These rising costs may be exacerbated by the downgrading of HECO's credit rating following the Lahaina fire. The longer-

term uncertainty of how the Lahaina fire may have unintended consequences on HECO's financial well-being can lead to rising costs, according to a number of experts. While federal incentives in the IRA and improving technology help reduce the cost of new technology, these other factors may offset these cost declines. Thus, it should be expected that future costs of renewable energy development may increase above historical norms, especially in near-term solicitations.

**Project Delays and Cancellations**

HECO Companies Stage 1 and Stage 2 projects experienced significant delays and cancellations across almost all projects/developers. Much of this was due to COVID, supply chain disruptions, and cost increases, but failure rates should be considered in future procurements. Experts have pointed out that perceived difficulty in working with the utility leads to some winning bidders backing out of their agreements, leading to other entities taking over these projects, but with higher costs.

## *Increasing Load Challenges*

**Increased Electrification**

The state GHG emissions goal is to be zero by 2045. Currently, the most direct way to reduce the State's GHG emissions is to "electrify everything." While electrification of transportation, buildings (cooking and heating), and industrial and commercial sectors is a viable path for GHG reduction in those sectors, the amount of electricity that is needed to service these sectors would increase substantially. Because the RPS is a function of the total generation, the amounts of renewable generation would increase proportionally to achieve a given RPS goal. Given the practical constraints – such as community acceptance, transmission, and land use – the RPS will be harder to achieve with the electrification of these other sectors.

**Energy Efficiency**

One possibility for improved RPS is more aggressive use and development of energy efficiency technologies and policies. In 2008, HCEI originally proposed that 40% of the improvements in reaching 2030 would be obtained with energy efficiency. Significant advances have been made since then, but more is needed. Possible areas could include better mechanisms for subsidizing building energy use of energy efficient air conditioning, water heating, and other appliances. This would not only improve RPS values, but judicious use of subsidies could support low- and middle-income households in lowering their energy costs.

## *Future Uncertainties*

**Optimal Resource Mix**

The RPS provides timelines for the installation and use of specific amounts of renewable generation to reduce the State's reliance on imported petroleum fuels and increase the use of indigenous resources. This must be accomplished while maintaining reliable and economic delivery of electricity. One concern that has been raised is the current push by the legislature to constrict where technologies, such as wind, should be located. The potential impact of new legislation may make it more difficult to achieve RPS requirements. Providing the necessary analysis, planning, and regulatory guidance to develop an optimal resource mix that best meets State energy objectives, is a challenge that requires the collaboration of many stakeholders, including the utilities and the Commission. The Commission must retain the ability to approve the integration of new systems and technologies into the grid, such as advances in communications and information technologies that can support more efficient management of grid operations.

**Uncertainties Associated with New Resources and Technologies**

HNEI's analysis, consistent with IGP planning, indicates that the 2040 RPS goal of 70%, or even more, is technically achievable with currently available technologies, although other issues, such as land availability and community acceptance, may make this achievement difficult. This analysis also indicates that significant amounts of dispatchable firm capacity will be required to ensure resource reliability needs are met.

HECO Companies have proposed to add up to 400 MW of off-shore wind power by 2035. While this may offer a solution to land constrained development, it is another variable generation source and so will not provide the dispatchability needed to ensure grid reliability. Additionally, the financial, aesthetic, and cultural issues involving the development of this technology are not fully understood. Other emerging technologies, such as ocean thermal energy conversion (OTEC) and enhanced geothermal could potentially support firm dispatchable needs, but they have not, to date, been demonstrated at the scale required. Renewable hydrogen and long-term storage may reduce the firm capacity needs, but are unlikely to eliminate it entirely.

Biofuels are often identified as a solution to provide the final increment of dispatchable firm power, but availability at reasonable cost from certified sources remains uncertain. Continued

research and development is needed to bring down the cost and increase the availability of firm power renewable resources in order to meet 2045 goals.

**Life-Cycle Emissions**

In response to a request by the Commission, HNEI examined life-cycle emissions for various energy technologies and resources used (or potentially planned to be used) in the state. Wind and geothermal were found to be the least emitting, followed by solar and solar with battery storage. Even when mining, material processing, manufacturing, and shipping of these systems is considered, the life-cycle analysis (LCA) GHG emissions remain far below the burning of fossil fuels. While there is considerable debate regarding biomass and biofuels, the predominance of the literature indicates that managed growth of forest for fuels can significantly reduce GHG emissions compared to the mining and use of fossil fuels. Emissions from biofuels are significantly more complex and can range from lower to similar to fossil fuel technologies (for algal derived biofuels). Since climate change is a global problem, importing biofuels with large overall life-cycle carbon dioxide emissions does not support climate change initiatives, even if these would reduce Hawai‘i-based emissions.

**Climate Uncertainty**

A number of experts in Hawai‘i believe that managing the reduction of greenhouse gas emissions is more important than pushing for specific RPS goals. Despite the state’s goals, Hawai‘i is in the top 10% of emissions per capita. Uncertainty due to changes in weather patterns must be factored into any overall grid planning. As the potential for hurricanes hitting the state increases, addressing grid resiliency must be factored into adding more variable renewables to the grid. Additionally, as the August 2023 Maui wildfires have demonstrated, the utilities must be in a better position for addressing risk factors for their infrastructure. Finally, sea level rise may require modification as to where future and even existing facilities are located. Thus, resilience, siting, and utility liability are issues that must be addressed in future planning.

# 7. Summary

This Report presents findings regarding the effectiveness and achievability of the existing RPS requirements, while recognizing that there is uncertainty regarding the RPS targets after 2030. The existing RPS targets remain appropriate and effective at promoting the implementation and operation of renewable generation resources and are achievable based on currently available information. Several principal findings in this Report include:

- The RPS remains effective in helping the State achieve its policies and objectives with respect to developing renewable energy resources in Hawai‘i.
- Achievement of the 2030 RPS requirement of 40% is likely for the Hawaiian Electric Company (HECO) service territory – which includes O‘ahu, Maui County, and Hawai‘i Island (“Big Island”) – and is nearly certain for the Kaua‘i Island Utility Cooperative (KIUC). As of 2022, KIUC has already achieved the 2030 goal, along with Hawai‘i Island.
- Based on current plans for the Commission-approved Stage 1 and Stage 2 solar + storage projects, the HECO territory is expected to reach the 40% by 2030. However, force majeure and related supply chain issues have created problems for State 1 and Stage 2 projects. If these issues continue, it could create problems in achieving the 40% mandated goal. Additionally, the recent Lahaina wildfires could potentially impact the pace of new renewable energy generation on Maui.
- The RPS has led to a substantial reduction of greenhouse gases (GHGs) being emitted in the electricity sector. However, GHGs have not diminished significantly in other sectors (transportation, buildings, etc.) as much as the Hawai‘i Clean Energy Initiative (HCEI) originally projected.
- Increasing electric loads from electric vehicle adoption will make it more difficult to achieve the RPS targets in the future, but will benefit statewide emissions.
- The costs of renewable energy projects under development and recently proposed in Hawai‘i remain at or below costs of oil-fired generation – making renewable projects cost-competitive alternatives compared to continuing to utilize fossil fuel generation resources. However, recent events in the development of HECO Stage 1 and 2 costs and delays have led to increased costs for renewable energy development and deployment.
- Initial analysis by HNEI to explore the ability to integrate solar + storage or solar/wind and storage suggests that reaching the 70% RPS target by 2040 is feasible and likely cost effective with current technologies. However, land use, community engagement, and transmission will need to be carefully managed.

- The RPS remains effective in helping the State achieve its policies and objectives with respect to developing renewable energy resources in Hawai‘i.

The Commission will continue to take steps to investigate uncertainties and will monitor the progress of each utility’s efforts and achievement of the RPS. As provided by the RPS statutes, the Commission will consider, on an ongoing basis, whether the RPS remains effective and achievable and whether the RPS requirements need to be amended. The Commission will continue to report findings to the Legislature every five years.

# 8. Appendix

***Appendix A***

# KIUC Letter to the PUC
# Dated May 4, 2023

Kaua`i Island Utility Cooperative
Your Touchstone Energy® Cooperative

May 4, 2023

The Honorable Chair and Members of the
Hawaii Public Utilities Commission
465 South King Street
Kekuanaoa Building, Room 103
Honolulu, HI 96813

Re: Docket No. 2007-0008 – In the Matter of Public Utilities Commission Instituting a Proceeding to Examine Hawaii's Renewable Portfolio Standards Law, Hawaii Revised Statutes ("HRS") §§ 269-91 – 269-95, as Amended by Act 162, Session Laws of Hawaii 2006: Kauai Island Utility Cooperative's ("KIUC's") 2022 Annual Renewable Portfolio Standards ("RPS") Status Report

Dear Commissioners and Commission Staff:

Please find enclosed KIUC's Annual RPS Status Report for the year ending December 31, 2022 ("2022 RPS Report").

As shown in the attached 2022 RPS Report, renewable energy resources supplied 60.2% of KIUC's net electricity generation during the 2022 calendar year. This exceeds the requirement of 30% by 2020 and 40% by 2030, to be achieved by each electric utility as established by HRS § 269-92(a), as amended.

The attached 2022 RPS Report also includes a breakdown of the renewable energy resources on Kauai comprising the 60.2% RPS for 2022 and the 2021 RPS pre-HB2089 and post-HB2089, which amended the definition of "renewable portfolio standard" to mean a percentage of electrical energy generation, rather than sales, excluding customer-sited fossil fuel generation. Also included in said report is a discussion of KIUC's commitment to continue to increase the growth of renewable energy on Kauai.

We thank you for your consideration of this matter. If you should have any questions concerning this report, please call me at (808) 246-8289.

Very truly yours,

Brad W. Rockwell

Brad W. Rockwell, P.E.
Chief of Operations

Enclosure

cc: Kent Morihara
Consumer Advocate
Mr. Joseph Viola
Mr. Dean Matsuura
Peter Kikuta., Esq.
Craig I. Nakanishi, Esq.
Mr. David Bissell
Mr. Henry Q. Curtis

# Kauai Island Utility Cooperative
# Renewable Portfolio Standards (RPS) Status Report
# Year Ending December 31, 2022

Pursuant to Hawaii Revised Statutes § 269-92, the Renewable Portfolio Standard ("RPS") requirement, as a percentage of net electricity *sales*, for year 2020 is 30%. The RPS requirement, as a percentage of net electricity *generation*, for year 2030 is 40%, for year 2040 is 70%, and for year 2045 is 100%.

Kauai Island Utility Cooperative (KIUC) achieved an RPS percentage of 60.2% of net electricity generation for calendar year 2022, which exceeds the requirement of 30% by 2020 and 40% by 2030.

KIUC met the electrical energy needs of its customers with a combination of Company-owned fossil fueled generation, Company-owned renewable generation, and both non-firm and firm renewable power purchases.[1] In addition to this generated electricity, Photovoltaic (PV) systems and Demand Side Management (DSM) measures, including Solar Water Heating (SWH), also supplied some of KIUC consumers' energy needs, while at the same time, displacing fossil-fuel generated power. As of January 1, 2015, these sources are no longer counted toward KIUC's RPS.

Electrical energy generated using renewable energy as the source totaled 317,877 megawatt-hours (MWh) for 2022. Exhibit A, attached hereto, illustrates how KIUC met the energy needs of its approximately 35,000 accounts.

**KIUC Future RPS Activities**

While KIUC has already exceeded the 2020 and 2030 RPS goals of 30% and 40%, respectively, the Company is committed to even further increasing the growth of renewable energy and energy savings. To accomplish this, KIUC is undertaking the following:

1. On December 30, 2020, KIUC signed a PPA with AES Clean Energy for the purchase of capacity and energy from a new solar, battery, pumped storage, and hydroelectric facility to be located on State land on the west side of Kauai. The Commission approved the PPA on December 1, 2021 but start of construction has been delayed due to pending litigation. This facility, given a full year of production, is expected to increase KIUC's annual RPS by twenty

[1] KIUC has twelve power purchase contracts with Gay & Robinson (G&R) (hydro), Brue Bakol Capital Partners (hydro), Kekaha Agriculture Association (KAA) (hydro), Kapaa Solar (solar), Kaieie Waho Company (solar), MP2 Hawaii (solar), KRS2 Koloa (solar), KRS1 Anahola (solar), Dom Solar Lessor / Tesla (solar and storage), AES Lawai (solar and storage), AES Kekaka (solar and storage), and Mahipapa (biomass).

percentage points (i.e. to 80%), although this depends heavily on future electric sales growth.

2. On November 30, 2022 KIUC signed a biodiesel fuel supply agreement with Pacific Biodiesel Technologies. The Commission approved the fuel supply agreement on an interim basis on March 24, 2023. This agreement is expected to increase KIUC's annual RPS, albeit very slightly (i.e. less than one percentage point) due to the limited nature of the agreement.

Kauai Island Utility Cooperative
Renewable Portfolio Standard (RPS) Status Report
Year Ending December 31, 2022
**EXHIBIT A**

| **Electrical Energy Generated Using Renewable Energy Sources** | **2022** | **2021 post-HB2089*** | **2021 pre-HB 2089*** |
|---|---|---|---|
| Biomass | 51,555 | 48,479 | 46,019 |
| Hydro | 56,421 | 64,807 | 61,518 |
| Photovoltaic (PV) | 141,770 | 138,251 | 131,235 |
| Customer-Sited, Grid-Connected PV | 68,131 | 64,649 | 63,444 |
| Total Renewable Electrical Energy | 317,877 | 316,186 | 302,217 |
| Total Electrical Energy Generation (Sales for 2021 pre-HB 2089) | 527,924 | 499,413 | 435,156 |
| RPS Percentage | 60.2% | 63.3% | 69.5% |

* H.B. 2089 of 2022 amended the RPS to be based on net electricity generation rather than sales. Prior to HB2089, net electricity generation was reduced by system losses in order to correlate to net electricity sales.

"Renewable portfolio standard" means the percentage of electrical energy generation that is represented by renewable electrical energy, excluding customer-sited, grid connected generation that does not produce renewable energy

The foregoing document was electronically filed with the State of Hawaii Public Utilities Commission's Document Management System (DMS).

***Appendix B***

# HECO Letter to the PUC
# Dated February 17, 2023

February 17, 2023

The Honorable Chair and Members of the
Hawai'i Public Utilities Commission
465 South King Street
Kekuanao'a Building, First Floor
Honolulu, Hawai'i 96813

Dear Commissioners:

Subject: Docket No. 2007-0008
Renewable Portfolio Standards Law Examination

In accordance with Decision and Order No. 23912 and the Framework for Renewable Portfolio Standards, issued December 20, 2007, attached is the Renewable Portfolio Standard Status Report for the year ended December 31, 2022 for Hawaiian Electric.[1]

Sincerely,

/s/ Kevin M. Katsura

Kevin M. Katsura
Director, Regulatory Non-Rate Proceedings

c: Division of Consumer Advocacy
R.J Hee/T. Blume
H. Curtis

[1] "Hawaiian Electric" or "Company" refers to Hawaiian Electric Company, Inc., Hawai'i Electric Light Company, Inc., and Maui Electric Company, Limited. On December 20, 2019, the State of Hawai'i Department of Commerce and Consumer Affairs ("DCCA") approved Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc. and Maui Electric Company, Limited's application to do business under the trade name "Hawaiian Electric" for the period from December 20, 2019 to December 19, 2024. See Certificate of Registration No. 4235929, filed December 20, 2019 in the Business Registration Division of the DCCA.

# 2022 Renewable Portfolio Standard Status Report

## Hawaiian Electric
## For the Year Ended December 31, 2022

This report was prepared pursuant to the Framework for Renewable Portfolio Standards, which was adopted by the Hawai'i Public Utilities Commission ("Commission") in Docket No. 2007-0008.[1]

Pursuant to Hawai'i Revised Statutes § 269-92, the Renewable Portfolio Standard ("RPS") requirement for year 2020 is 30%, 2030 is 40%, 2040 is 70%, and 2045 is 100%. In July 2022, Governor Ige signed Act 240 (H.B. 2089) that amended the RPS calculation from renewable energy as a percentage of sales to renewable energy as a percentage of total system generation. The new calculation of RPS includes total generation, including generation from private rooftop solar, in the denominator, and total renewable generation, including generation from private rooftop solar, in the numerator. The previous calculation included electric sales in the denominator, which did not include renewable generation from private rooftop solar. The change in definition causes a lower RPS under the amended definition. The 2022 RPS under the amended and previous definition is provided in Figure 1.

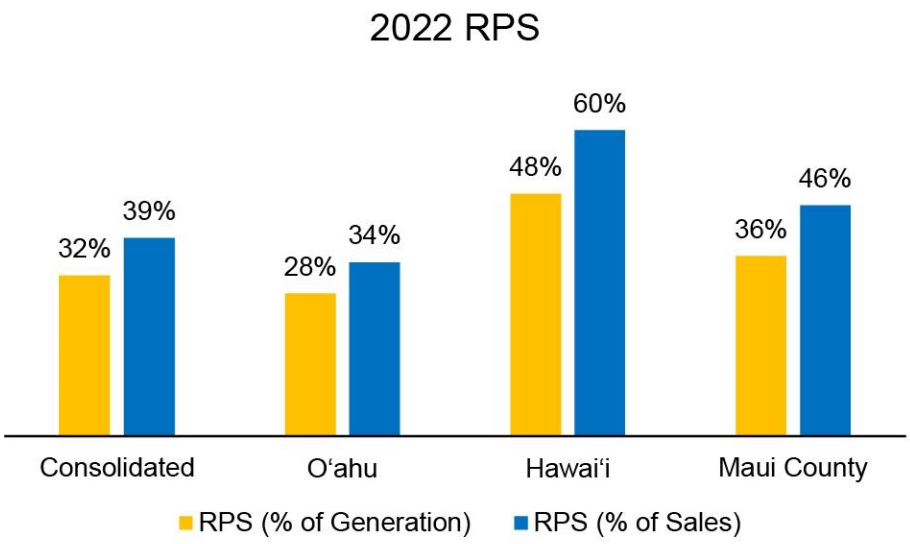


Figure 1: RPS by service territory, amended versus previous RPS definition

Because private rooftop solar represents a significant portion of the renewable generation portfolio, the RPS under the new definition is lower compared to the RPS

[1] The Framework for Renewable Portfolio Standards was adopted by Decision and Order No. 23912, issued December 20, 2007, and revised by the Commission on December 19, 2008 (Order Relating to RPS Penalties).

reported in previous years. However, the Company continues to comply with the RPS requirement.

Figure 2, below, shows Hawaiian Electric's historical RPS progress under the new definition.

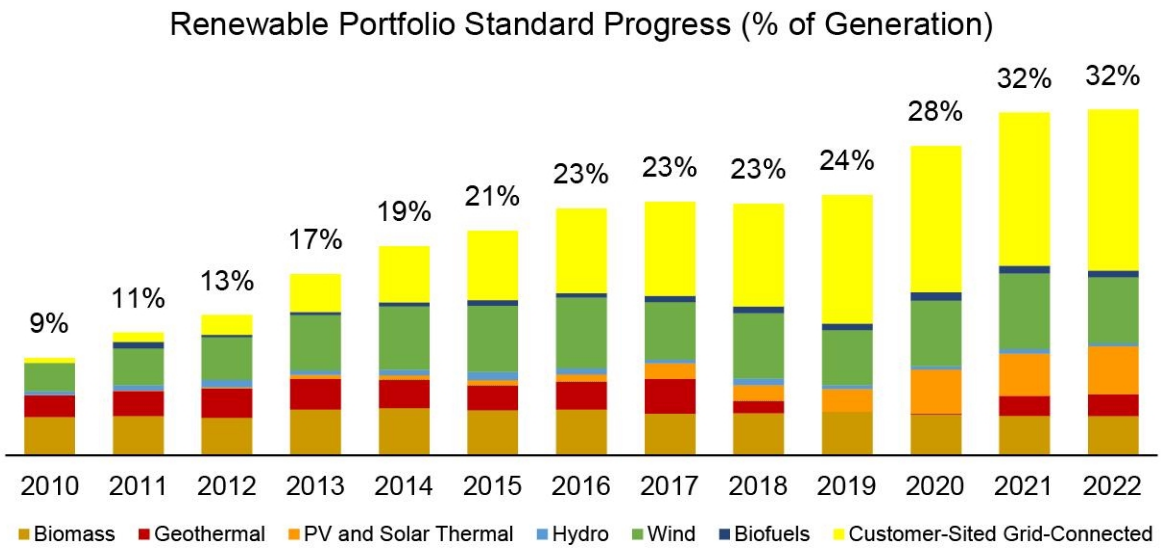


Figure 2: Renewable Portfolio Standards Under Amended Definition

In 2022, Hawaiian Electric achieved a consolidated RPS of 31.8%. In accordance with present RPS guidelines, this RPS does not include the electrical energy savings from energy efficiency and solar water heating technologies and is calculated as a percentage of total system generation.[2, 3] The 31.8% RPS was achieved through use of diverse renewable energy resources (biomass, geothermal, photovoltaic, hydro, wind, and biofuels) and customer-sited, grid-connected technologies (primarily private rooftop solar systems).

The Oʻahu, Hawaiʻi Island, and Maui County systems achieved 28%, 48%, and 36% RPS, respectively.

[2] On April 25, 2011, Act 010 Relating to Renewable Portfolio Standards was signed into law. Act 010 provided that, as of January 1, 2015, electrical energy savings from energy efficiency and solar water heating technologies do not count towards calculating RPS. It also amended the definition of "renewable electrical energy" to include, beginning January 1, 2015, customer-sited, grid-connected renewable energy generation.

[3] On July 5, 2022, Act 240 Relating to Renewable Portfolio Standards was signed into law. Act 240 provided that "renewable portfolio standard" means the percentage of electrical energy generation that is represented by renewable electrical energy, excluding customer-sited, grid connected generation that does not produce renewable energy.

Hawaiian Electric continued to increase its renewable energy portfolio in 2022.

- Generation from grid-scale solar increased by 15% due to the 39 MW Mililani I Solar project achieving commercial operations in July 2022 and 36 MW Waiawa Solar project undergoing testing and commissioning in Q4 2022, achieving commercial operations in January 2023.

- New customer-sited energy resources (private rooftop solar), Community-Based Renewable Energy, and Feed-In Tariff installations totaled 40 MW. Generation from customer-sited, grid-connected resources increased by 7%.

- Geothermal production increased slightly this year as the Puna Geothermal Venture plant continues to return to full service.

- Wind production was down 11% compared to 2021; however, the 2022 wind production was within the range of historical wind production over the past decade.

In total, the electrical energy generated using renewable energy resources, including customer-sited, grid-connected technologies, resulted in a 3% increase compared to the previous year, which was partially offset by an approximate 2% increase in total generation (1% increase in electric sales) compared to 2021. Despite these offsetting changes to RPS, renewable generation continued to increase by 94,567 MWh in 2022, driven by the addition of new customer-sited and grid-scale resources.

In 2023, Hawaiian Electric expects to further increase the renewable energy provided to the system with commercial operations of additional grid-scale solar and battery energy storage projects, a full year production of the Waiawa Solar and Mililani Solar I projects, private rooftop solar additions, and continued progress on a return to full service of Puna Geothermal Venture.

# 2022 Renewable Portfolio Standard Status Report

## Hawaiian Electric
## For the Year Ended December 31, 2022
*(In Net Megawatt Hours)*

| | 2022 | | | | 2021 |
|---|---|---|---|---|---|
| | O'ahu | Hawai'i | Maui County | TOTAL | TOTAL |
| **Electrical Energy Generated Using Renewable Energy Sources** | | | | | |
| Biomass (including municipal solid waste)[1] | 370,668 | | | **370,668** | **366,365** |
| Geothermal[1] | | 208,346 | | **208,346** | **183,391** |
| Photovoltaic and Solar Thermal[1] | 433,875 | 4,050 | 12,844 | **450,769** | **390,353** |
| Hydro[1] | | 27,409 | | **27,409** | **43,050** |
| Wind[1] | 249,766 | 141,301 | 234,849 | **625,916** | **701,124** |
| Biofuels | 16,256 | 46,292 | 566 | **63,114** | **71,780** |
| Customer-Sited, Grid-Connected[2] | 1,064,021 | 209,629 | 248,794 | **1,522,444** | **1,418,036** |
| **TOTAL** | 2,134,587 | 637,027 | 497,052 | **3,268,667** | **3,174,100** |
| **TOTAL GENERATION** | 7,559,608 | 1,330,718 | 1,394,862 | **10,285,189** | **10,072,948** |
| **RPS PERCENTAGE (% of Generation)** | **28.2%** | **47.9%** | **35.6%** | **31.8%** | **31.5%** |
| **TOTAL SALES** | 6,210,797 | 1,053,833 | 1,089,324 | **8,353,955** | **8,261,103** |
| **RPS PERCENTAGE (% of Sales)** | **34.4%** | **60.4%** | **45.6%** | **39.1%** | **38.4%** |

[1] Renewable electrical energy generation is based on recorded data from Feed-In Tariff contracts, Independent Power Producers that have Power Purchase Agreements with Hawaiian Electric, and Hawaiian Electric-owned grid-scale projects such as West Loch PV.

[2] Renewable electrical energy generation from customer-sited, grid-connected technologies is based on known system installations for 2022 including Net Energy Metering ("NEM") installations and non-NEM systems. Recorded generation data was used when available. For systems where recorded data was not available, estimates were made based on reasonable performance assumptions for typical systems.

The foregoing document was electronically filed with the State of Hawaii Public Utilities Commission's Document Management System (DMS).