



September 15, 2026

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

Dear Commissioners:

Subject: Docket No. 2026-0001  
Instituting a Proceeding to Investigate Integrated Grid Planning  
Inputs and Assumptions & Grid Needs Assessment Methodology

The Hawaiian Electric Companies<sup>1</sup> hereby submit the Integrated Grid Planning Second Cycle ("IGP" or "Second Cycle") Inputs and Assumptions ("I&A") and Grid Needs Assessment Methodology ("GNAM") for Commission and stakeholder review. See Attachments 1-4 to this letter. The associated native electronic files for the I&A workbooks are being submitted separately and will also be made available on the Companies' website<sup>2</sup>.

The I&A reflects updated information and forecasts that will serve as the key inputs for the Second Cycle, including revised load and technology forecasts for energy efficiency, distributed energy resources, and electric vehicles; updated fuel forecasts; and enhancements such as revised lifecycle greenhouse gas emissions factors. The Second Cycle GNAM continues to build upon the modeling framework established in the first IGP cycle and describes the analytical approach that will be used in the Second Cycle. The Companies note that the Second Cycle is being conducted under an accelerated schedule established by the Commission in Order No. 42230 in this proceeding. Consistent with that direction, the Companies have focused their efforts on updating and refining the foundational elements of the planning process that were extensively reviewed through stakeholder engagement and approved during the first IGP cycle rather than redeveloping substantially different methodologies.

The Companies are actively developing the scenario design framework with stakeholders, and anticipates submitting a supplemental filing that will describe the Second Cycle modeling scenarios. The Companies respectfully request the Commission's review of the I&A and GNAM and approval for use in the Second Cycle as much of these materials are completed and have

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<sup>1</sup> Hawaiian Electric Company, Inc., Hawai'i Electric Light Company, Inc., and Maui Electric Company, Limited are collectively referred to as the "Hawaiian Electric Companies" or "Companies."

<sup>2</sup> See [Integrated Grid Planning | Hawaiian Electric](#).

been discussed/presented to stakeholders. Specifically, planning scenarios will be developed using the assumptions and data contained in the I&A and will be evaluated using the methodologies described in the GNAM. The forthcoming scenario design filing will therefore build upon, rather than modify, these foundational elements by identifying the specific scenarios to be modeled, the key uncertainties and drivers represented by those scenarios, and the framework that will ultimately be used to evaluate and support development of the Second Cycle Preferred Plan. To summarize, the I&A establishes the data and assumptions used to develop and model scenarios, the GNAM establishes the methodologies through which those scenarios will be analyzed, and the forthcoming scenario design filing will identify the specific scenarios to be evaluated and the framework for assessing scenario results.

For these reasons, the Companies believe that the I&A and GNAM are sufficiently developed, and independent of the final scenario selection, to warrant Commission review at this time. As described in the Companies' Workplan, filed on March 2, 2026 in this proceeding, the next phase of the IGP process is the modeling phase, which must be grounded in an approved I&A and GNAM. To remain on the Commission's Second Cycle schedule, the Companies anticipate beginning the modeling phase in January 2027, in which time the Companies will finalize inputs and assumptions and proceed with the modeling analyses. Accordingly, the Companies respectfully request the Commission's consideration for upfront guidance and approval prior to commencing with the modeling phase in order to reduce the risk of the need to revise completed analyses.

The Companies are currently soliciting stakeholder feedback regarding the priority key drivers which will then lead into the final scenarios. Stakeholders have been asked to submit feedback responses by September 18, 2026, and the Company will summarize those results and present proposed scenarios based on those results at the October 8, 2026 Stakeholder Technical Working Group ("STWG") meeting. Following the October 8, 2026 STWG meeting, the Company will seek additional stakeholder input and propose final scenarios along with the evaluation framework for determining the Second Cycle's Preferred Plan.

The Companies would like to express their appreciation to all stakeholders for their time, feedback, and engagement in striving for a successful Second Cycle.

The Honorable Chair and Members  
of the Hawai'i Public Utilities Commission  
September 15, 2026  
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Sincerely,

/s/ Ken Aramaki

Ken Aramaki  
Director, Integrated Grid Planning

Enclosures  
c: Service List



# **Hawaiian Electric**

## **Integrated Grid Planning**

### **Second Cycle**

### **Inputs and Assumptions**

**September 2026**



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# 1 Introduction

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This document describes the key inputs and assumptions for Hawaiian Electric's second cycle of Integrated Grid Planning (Second Cycle) and provides an overview of how the inputs and assumptions are used by the RESOLVE and PLEXOS models to develop a reference portfolio.

The assumptions described herein include:

- Sales forecast by forecast layer for the underlying load, distributed energy resource, energy efficiency, and electric vehicle layers
- Fuel price forecast
- Resource cost forecast
- Additional assumptions used to characterize the existing and planned resource portfolio

The inputs and assumptions reflect feedback received from stakeholders throughout the first cycle of Integrated Grid Planning (First Cycle), as well as feedback received to date in the Second Cycle. The inputs to be used in the Second Cycle are listed below in Table 1-1 and provided in workbooks that accompany this document.

*Table 1-1: List of inputs and workbook locations*

| Workbook Title                        | Description                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inputs Workbook 1                     | Thermal Generator Properties<br>Thermal Generator Costs<br>Variable Generator Properties<br>Energy Storage Properties<br>Demand Response Properties<br>Maintenance Outage Rates<br>Planned Maintenance Schedule<br>Forced Outage Rates<br>Reliability Parameter<br>Regulating Reserve Requirement<br>Regulating Reserve Coefficients<br>Planned Resources – PPA Costs |
| Inputs Workbook 2                     | Unitized Renewable Profiles<br>Historical Unitized Renewable Profiles                                                                                                                                                                                                                                                                                                 |
| Workbook 3a - EV Load Forecast        | EV Saturation<br>EV Sales Forecasts<br>Unmanaged EV Hourly Load (Base, High, Low)                                                                                                                                                                                                                                                                                     |
| Workbook 3b - EE Load Forecasts       | EE Sales Forecasts (Base, High, Low)<br>EE Hourly Load (Base, High, Low)                                                                                                                                                                                                                                                                                              |
| Workbook 3c - DER Load Forecasts      | DER Capacities Annual (Base, High, Low)<br>DER PV Sales Forecasts (Base, High, Low)<br>DER PV Hourly Load (Base, High, Low)<br>DER BESS Sales Forecasts (Base, High, Low)<br>DER BESS Hourly Load (Base, High, Low)                                                                                                                                                   |
| Workbook 3d - Load Forecast           | Comparative Statistics<br>Underlying Including Acquired EE and Acquired DBESS Sales Forecast Annual (Base, High, Low)<br>Underlying Including Acquired EE and Acquired DBESS Hourly Load Forecast (Base, High, Low)<br>Sales Forecast by Layer (Base)<br>Peak Forecast by Layer (Base)<br>Sales Forecast Options (All Layers, Base, High, Low)                        |
| IGP2 Workbook 4a – Resource Cost Base | IGP Resource Cost – Base Forecast                                                                                                                                                                                                                                                                                                                                     |
| IGP2 Workbook 4b – Resource Cost High | IGP Resource Cost – High Forecast                                                                                                                                                                                                                                                                                                                                     |
| IGP2 Workbook 4c – Resource Cost Low  | IGP Resource Cost – Low Forecast                                                                                                                                                                                                                                                                                                                                      |
| IGP2 Workbook 5 - GHG                 | Greenhouse Gas Emission Factors including Lifecycle Emissions                                                                                                                                                                                                                                                                                                         |
| IGP2 Workbook 6 - Fuel Forecast       | Fuel Price Forecasts (Reference, Low Oil Supply, High Oil Supply)                                                                                                                                                                                                                                                                                                     |



## 2 Stakeholder Engagement

The IGP stakeholder engagement plan has been a significant undertaking for the Company as well as stakeholders with a proactive engagement approach to attain:

- Constructive and long-term working relationships with stakeholders;
- Stronger communication and transparency between parties, regulators, and the utility;
- Building of common ground on key issues and common vocabulary;
- More efficient and streamlined regulatory proceedings related to grid planning;
- Stakeholder feedback to incorporate into the development of planning inputs, assumptions, methodologies, and processes; and
- Transparency, predictability, and buy-in from different interested parties.

In the Second Cycle of IGP, three groups were created to provide information to different audiences and gather feedback throughout the process. Table 2-1 provides an overview of the Stakeholder Technical Working Group, Community Working Group, and Technical Advisory Panel.

*Table 2-1: IGP Second Cycle working groups*

| Group name                          | Participants                                                                                                                       | Purpose or outputs                                                                                                     | Meeting frequency and format                                                                                                                                                                                       |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Stakeholder Technical Working Group | Representatives from cities, each island, the State, partner agencies, experts in energy technologies and engineering, developers. | Provides strategic guidance to Hawaiian Electric and helps to ensure alignment with interests across the islands.      | Every other month. Can be increased as needed through IGP process/milestones.                                                                                                                                      |
| Community Working Group             | Representatives of community-based advocacy and resource groups across the islands.                                                | Provide community-focused input at key milestones through the IGP process, serve as ambassadors and identify concerns. | Every other month. When all islands are meeting together, meetings will be held virtually. If island-specific meetings are held, meetings may be held in-person or virtually, dependent on participant preference. |
| Technical Advisory Panel            | Representatives from research organizations, utilities, and market operators.                                                      | Provides independent review of Hawaiian Electric planning process.                                                     | Every other month and held virtually.                                                                                                                                                                              |

### *Stakeholder Technical Working Group (STWG)*

Hawaiian Electric will work with the STWG to share information with customer and stakeholder representatives. This group will be tasked with providing feedback to Hawaiian Electric to ensure alignment of the updated IGP with customer and stakeholder interests. Participants will include:

- City and county representatives
- Community delegates from each island
- Consumer Advocate
- Hawai'i Public Utilities Commission
- Commercial and industrial customers
- Office of State Planning
- Solar developers
- Hawai'i State Energy Office
- Electric vehicles industry experts
- Energy efficiency industry experts
- Energy storage industry experts
- Environmental advocates
- Local and national sustainability advocates

In addition, the STWG will include industry peer group experts with representatives from internationally recognized utilities, market operators, and research organizations who have demonstrated engineering expertise in methodologies and technologies involving resource, transmission, and distribution planning for large-scale and distributed renewable resources. The STWG will meet every other month and discuss a variety of topics as they arise through the planning process.

### *Community Working Group (CWG)*

On Jan. 13, 2026, Hawaiian Electric kicked off the CWG to strengthen communication with the public, with particular focus on communities that may be most affected by IGP outcomes. The group's priority is to promote transparency and inclusivity by ensuring diverse community perspectives, and to advise and inform Hawaiian Electric on community priorities related to reliability, sustainability and resilience. The CWG will:

- Review and provide input and feedback on planning assumptions, modeling scenarios and proposed solutions
- Advise on community engagement strategies and outreach efforts as appropriate
- Identify potential social, economic and environmental impacts of integrated grid planning decisions and REZ selections
- Recommend ways to integrate community priorities into planning outcomes

The group includes representatives from community advocacy and resource groups and intends to meet (every 1-2 months), with occasional island-specific meetings as needed. If other community members are interested in participating, information will be provided to them about future opportunities. Participants currently include:

- Hawai'i's Carbon Capture Storage and Utilization (CCSU) Consortium
- Ho'āhu Energy Cooperative Moloka'i
- Hui O Hau'ula and Hau'ula Community Association
- Hui Ulu Mea 'Ai
- Lāhainā Strong
- LEI Foundation
- Sustainable Energy Hawai'i
- Sustainable Moloka'i
- Vibrant Hawai'i

Community Working Group meetings will not be recorded or available live to allow for a focused environment that promotes conversation and collaboration. However, meeting agendas and materials presented will be available on the Hawaiian Electric website.

#### *Technical Advisory Panel (TAP)*

Hawaiian Electric will continue to convene the TAP to provide independent peer assessment of the IGP development process, methodologies, tools, and results. The group will consist of industry experts participating voluntarily from utilities, market operators, and research organizations with demonstrated engineering expertise in resource, transmission, and distribution planning.

Like community working group meetings, the TAP meetings will not be recorded to foster collegial, balanced discussions but meeting agendas and materials will also be available on the Hawaiian Electric website.

Participants current include:

- Electric Power Research Institute
- Electric System Integration Group
- Imperial College London
- National Laboratory of the Rockies
- Pacific Northwest National Laboratory
- Telos Energy

## **2.1 Stakeholder Meetings**

### **2.1.1 Stakeholder Technical Working Group (STWG)**

The Stakeholder Technical Working Group (STWG), continued meeting after the acceptance of First Cycle's IGP Report, discussing various technical topics supporting the development of the next Integrated Grid Plan.

Table 2-2 includes a list of meeting dates and links to meeting notes. This information along with supporting documents are available within the [Key Stakeholder Documents Library](#)<sup>1</sup>.

The Stakeholder Technical Working Group (STWG), continued meeting after the acceptance of First Cycle's IGP Report, discussing various technical topics supporting the development of the next Integrated Grid Plan.

*Table 2-2: List of STWG meetings and material since the filing of our Draft Workplan*

| Date              | Notes                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| August 28, 2025   | <a href="#">General Presentation</a><br><a href="#">Meeting Summary</a>                                                                  |
| October 23, 2025  | <a href="#">General Presentation</a><br><a href="#">Meeting Summary</a>                                                                  |
| December 18, 2025 | <a href="#">Renewable Energy Zones Presentation</a><br><a href="#">Energy Efficiency Presentation</a><br><a href="#">Meeting Summary</a> |
| February 26, 2026 | <a href="#">General Presentation</a><br><a href="#">UHERO Presentation</a><br><a href="#">Meeting Summary</a>                            |
| April 23, 2026    | <a href="#">General Presentation</a><br><a href="#">Meeting Summary</a>                                                                  |
| June 25, 2026     | <a href="#">General Presentation</a><br><a href="#">Meeting Summary</a>                                                                  |
| August 6, 2026    | <a href="#">General Presentation</a>                                                                                                     |

## 2.1.2 Community Working Group

The Community Working Group (CWG), was formed to better engage and communicate with community groups in this Second Cycle, discussing various topics supporting the development of the next Integrated Grid Plan. Table 2-3 includes a list of meeting dates and links to meeting notes. This information along with supporting documents are available within the [Key Stakeholder Documents Library](#)<sup>2</sup>.

*Table 2-3: List of CWG meetings and material since the filing of the Draft Workplan*

| Date             | Notes                                                                                   |
|------------------|-----------------------------------------------------------------------------------------|
| January 13, 2026 | <a href="#">CWG Kickoff Presentation</a><br><a href="#">Meeting Summary</a>             |
| January 27, 2026 | <a href="#">REZ Evaluation Criteria Presentation</a><br><a href="#">Meeting Summary</a> |
| March 10, 2026   | <a href="#">REZ Presentation</a>                                                        |
| April 14, 2026   | <a href="#">General Presentation</a><br><a href="#">Meeting Summary</a>                 |
| June 16, 2026    | <a href="#">General Presentation</a>                                                    |

<sup>1</sup> Accessible at: <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>

<sup>2</sup> Accessible at: <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>

|                |                                                                                                |
|----------------|------------------------------------------------------------------------------------------------|
| August 4, 2026 | <a href="#">Sustainable Energy Hawaii Presentation</a><br><a href="#">General Presentation</a> |
|----------------|------------------------------------------------------------------------------------------------|

### 2.1.3 Technical Advisory Panel

The Technical Advisory Panel, also referred to as the TAP, has continued its work since the First Cycle, discussing various technical topics including the evaluation of the Stage 3 RFP and aspects of grid reliability. Table 2-4 includes a list of dates with links to meeting summaries and technical reports. This information along with additional presentations is available within the [Key Stakeholder Documents Library](#)<sup>3</sup>.

*Table 2-4: List of TAP meetings and material since the acceptance of the First Cycle IGP Report*

| Date           | Notes                                                                                            |
|----------------|--------------------------------------------------------------------------------------------------|
| August 8, 2024 | <a href="#">General Presentation</a><br><a href="#">TAP Feedback – Dynamic UFLS Study</a>        |
| March 10, 2025 | <a href="#">General Presentation</a><br><a href="#">TAP Feedback – Dynamic UFLS Study Update</a> |
| August 5, 2026 | <a href="#">General Presentation</a>                                                             |

## 2.2 Incorporating Stakeholder Input

Similar to the First Cycle, the Company worked in a collaborative fashion with stakeholders to develop the Inputs and Assumptions and Grid Needs Methodology to be used in the Second Cycle. Many of the processes and procedures used in the First Cycle are proposed for the Second Cycle. The following summarizes stakeholder feedback that was provided in the First Cycle that was repeated for the Second Cycle, including any additional modifications that were suggested by stakeholders.

### 2.2.1 Resource and Technology Cost Projections

- The cost projections incorporated public information, including the 2024 NLR ATB costs<sup>4</sup>, which were the latest cost projections at the time.
- The First Cycle did not include benchmarking to recent RFPs and that assumption was continued for the Second Cycle. This was based on PUC Order 38253.<sup>5</sup>
- A high resource cost forecast and low resource cost forecast are also provided.

<sup>3</sup> Accessible at: <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>

<sup>4</sup> Available at: <https://atb.nlr.gov/electricity/2024b/technologies>

<sup>5</sup> Available at: <https://www.hawaiianelectric.com/a/10479>

## 2.2.2 Fuel Price Forecasts

- Fuel price forecast uses the 2026 Energy Information Administration ("EIA") Annual Energy Outlook ("AEO")
- A high fuel price forecast and low fuel price forecast are also provided.

## 2.2.3 Load Forecasts

- In the First Cycle, bookends (i.e., a high and a low) for each technology layer (EE, EV, DER) were developed. The same approach was applied for the Second Cycle and in addition, high and low bookends were developed for the underlying layer using high and low economic driver scenarios provided by UHERO.
- The EE forecasts utilize data from the State of Hawai'i Market Potential Study<sup>6</sup> as the basis for the forecast scenarios.
- EE free ridership will not be netted of the historical or future EE forecast layer.
- In the First Cycle, the base electric vehicle forecast remained unchanged. Blue Planet suggested using a 100% zero emission vehicle by 2045 forecast for the high EV forecast and to incorporate assumptions on the light duty vehicle forecast from the Transcending Oil Report and/or a Blue Planet generated forecast based on last 5 years registered vehicle counts. The Company used the Transcending Oil Report's EV forecast for the high EV bookend. Blue Planet also expressed a preference for their forecast over the Transcending Oil report's forecast. For the Second Cycle, a new set of EV forecast scenarios have been developed by NLR, as described in section 4.1.3 of this report.
- In the First Cycle, unmanaged EV Charging Profiles were updated based on Hawai'i specific data from the Company's DC fast charging network and a case study conducted through deployment of EnelX's Level 2 chargers in Hawaii. For the Second cycle, the NLR forecast development incorporated updated EV charging profiles based on various updated assumptions including modeling of EV driver behavior.
- In the First Cycle, EV managed charging system profiles were updated in response to a concern raised by Commission Staff during a STWG meeting that the managed profiles appeared fairly flat, expecting more load shifted to the daytime. Upon further review, the Company's consultant found that their model should have shifted more load to the daytime. The models were re-run and resulted in new managed EV charging shapes with more load shifted to the daytime. For the Second Cycle, managed charging profiles have not yet been updated as explained in section 4.1.3 of this report.
- In the First Cycle, the Company modified the base customer solar and battery storage forecast to include updated system cost projections, tax credit assumptions and future DER program export rates based on the DER docket proceeding. In the case of O'ahu and Maui, additional changes included increasing the addressable market by including NEM customers for a limited time window, including EDRP and long-term upfront incentives for grid services program participation. For the Second Cycle, these assumptions have been reviewed and updated as proposed to the STWG and described in section 4.1.1 of this report.

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<sup>6</sup> Available at: <https://puc.hawaii.gov/wp-content/uploads/2021/02/Hawaii-2020-Market-Potential-Study-Final-Report.pdf>

- In the First Cycle, the Company developed a high customer solar and battery energy storage forecast by adjusting the following adoption drivers: adding a long-term upfront incentive based on the DER docket proceeding, adding NEM customers back to the addressable market pool, extending federal tax credits, increasing addressable market (i.e., from 2-4 multi-unit dwellings to 2-49 multi-unit dwellings, commercial expansion of Rate Schedule P customers to 100% of customers), and assuming lower DER system costs. For the Second Cycle, the assumptions for the high DER forecast have been reviewed and updated as proposed to the STWG and described in section 4.1.1 of this report.
- In the First Cycle, the previous base or market forecast was re-purposed to be the part of the low DER forecast. For the Second Cycle, the assumptions for the low DER forecast have been reviewed and updated as proposed to the STWG and described in section 4.1.1 of this report.
- In the First Cycle, a time-of-use (“TOU”) layer that represented non-DER and non-EV customer participation in an Advanced Rate Design Time of Use program (ARD TOU) was included in response to stakeholder feedback. Prior to the Second Cycle an ARD TOU pilot was conducted. On May 21, 2025, the PUC issued Order No. 41713 closing the Advanced Rate Design Track of Docket no. 2019-0323. As there are no current ARD TOU rates open to new enrollment or defined proposals for a new, broad TOU rate, the Second Cycle forecasts do not include a TOU load shifting layer.

## 2.2.4 Resource Adequacy Analysis

- The RA analysis would incorporate five weather years and 250 outage samples.
- RA analysis will continue to use a loss-of-load-expectation (LOLE) target of 0.1 days/year, based on Commission Order No. 42230.
- RA analysis will continue to report both LOLE and EUE, as was done in the First Cycle.

## 2.2.5 Greenhouse Gas Emissions

- GHG lifecycle emissions, both including and excluding biogenic CO<sub>2</sub> emissions, will be presented.
- GHG policy targets will be applied to non-biogenic CO<sub>2</sub> emissions from combustion.
- Modification for the Second Cycle is the Company will incorporate the non-biogenic GHG emission factors from combustion into the RESOLVE model. This way, RESOLVE will incorporate GHG emissions and targets into its decision-making framework alongside the other objectives considered in the First Cycle.
  - ◆ Inclusion of GHG emissions into the analysis was based on Commission Order No. 41022<sup>7</sup> where the Commission directed the Company to better examine GHG emissions through additional analysis and modeling.

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<sup>7</sup> Available at <https://www.hawaiianelectric.com/a/16193>

## 2.2.6 NLR Resource Potential

- In the Second Cycle, the Company plans to continue to use the resource potential targets set by NLR in the First Cycle, but time permitting, the Company may seek to conduct an updated study of the resource potential with stakeholder input.
- Modification done for the Second Cycle is onshore wind on O'ahu is removed as a resource option.
  - ◆ This modification was based on the Honolulu City Council changing land use regulations that increased the setbacks for wind turbines to a new distance that is the greater of 1.25 miles or 10 times their height, which will make it difficult for new projects to come online and existing facilities to be repowered.<sup>8</sup>
  - ◆ This modification was presented to the STWG in the August 2025 meeting and no concerns were raised regarding this assumption.<sup>9</sup>

## 2.2.7 Modeling Scenarios and Sensitivities

- In the Commission's Order accepting the 2023 final IGP report<sup>10</sup>, the Commission raised concerns that since Hawaiian Electric did not use the full modeling process for all scenarios, there may be reduced confidence that all scenarios were sufficiently examined to develop the preferred plans.
- There were also disagreements among the Company and stakeholders regarding what assumptions were being made for the Base case in the Second Cycle.
  - ◆ To address stakeholders concerns and maintain progress, the Company proposed a change to the scenario framework and how scenarios are developed in the Second Cycle at the June 25, 2026, STWG meeting<sup>11</sup>. In the First Cycle, a Base plan was developed with sensitivities to test the Base plan's robustness and ultimately led to the Preferred Plan. This places significant emphasis and focus on the assumptions used in the Base plan, which can lead to disagreements and the limits the value of scenario planning in an uncertain future. In the Second Cycle, rather than having a single Base plan, the Company is proposing a scenario framework that evaluates a range of possible futures and developing a Preferred Plan that is robust across multiple possible futures, rather than a precise plan for an uncertain future.
  - ◆ Currently, the Company is working with stakeholders to develop possible future scenarios. More information regarding the scenario development will be submitted once additional stakeholder engagement is completed.

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<sup>8</sup> See Honolulu City Council Ordinance No. 25-2 (Jan. 13, 2025). Accessible at: <https://hnlldoc.ehawaii.gov/hnlldoc/measure/2784>

<sup>9</sup> Available at: <https://www.hawaiianelectric.com/a/15612>

<sup>10</sup> See Order No. 40651 at 55

<sup>11</sup> Available at: <https://www.hawaiianelectric.com/a/16515>



### 2.2.8 Offshore Wind Potential

- In 2025, President Trump issued a memorandum for the temporary withdrawal of all areas on the outer continental shelf from offshore wind leasing, pursuant to the Outer Continental Shelf Lands Act. In that same memorandum, President Trump issued a temporary cessation of new or renewed approvals, rights of way, permits, leases, or loans for onshore and offshore wind projects pending the completion of a comprehensive assessment and review of Federal wind leasing and permitting practices. While this withdrawal is noted to be temporary, it is stated to be in effect until revoked. Given the long lead time to develop new offshore wind, this may mean that no new offshore wind can be assumed to be developed in the mid-term of planning horizon and may not be available until 2040 or later.
- Under the initial proposed scenarios, some stakeholders raised concerns about the exclusion of offshore wind in the Base scenario.
  - ◆ Offshore Wind may be assumed to be available in certain scenarios, subject to further stakeholder discussion.

# 3 Overview of the RESOLVE and PLEXOS Models

Similar to the First Cycle, Hawaiian Electric will use the RESOLVE model to produce a reference optimized resource plan that is then verified in PLEXOS through an hourly production simulation to capture total system costs as part of the Grid Needs Assessment.

## 3.1 RESOLVE Capacity Expansion Model

RESOLVE is a mixed-integer linear optimization model that is explicitly tailored to the study of electricity systems with high renewable and clean energy policy goals. The optimization performed in RESOLVE balances the fixed costs of new investments with variable costs of system operations, identifying a least-cost portfolio of resources to meet planning needs across a long-term horizon.

RESOLVE can solve for:

- Optimal investments in renewable resources, energy storage, thermal generating units as well as retention of existing thermal resources.

Subject to the following constraints:

- An annual renewable energy constraint that reflects the State of Hawai'i's Renewable Portfolio Standards policy;
- An annual emissions constraint that reflects the State of Hawai'i's Greenhouse Gas Policy;
- An Energy Reserve Margin constraint to maintain adequacy of supply for reliability;
- Operational reserves for regulating reserve, and other flexibility services;
- Operational restrictions and performance characteristics for generators and resources;
- Hourly load requirements; and
- Constraints on the ability to develop specific new resources (timing and amount).

RESOLVE uses statistical sampling to downscale annual data to 30 representative days per year. These representative days are weighted based on historical data to capture operational costs under most conditions. In addition to the day sampling, resources with similar operating characteristics are aggregated to facilitate efficient solving for the optimized portfolio.

## 3.2 PLEXOS Production Simulation Model

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PLEXOS is a production simulation model that analyzes the chronological, hour-by-hour operation of a utility's generation system. PLEXOS distributes the forecasted hourly net megawatt (MW) load among the dispatchable generating units in operation. Unit commitment (starting and stopping of units) and dispatch levels of generation are generally based on fuel cost and unit efficiency.

The load remaining after accounting for any non-dispatchable energy resources is allocated to the dispatchable resources such that overall expense of the system is minimized (*i.e.*, economically dispatched) within the constraints of the system. The model calculates the fuel consumed using the generating unit dispatch described above. The total fuel consumed is the summation of hourly fuel consumption from all the generating units.

The PLEXOS modeling software provides flexibility to model a wide range of current and future technologies, such as energy storage, demand response, variable generation renewable resources, and firm generating resources.

The key inputs to the PLEXOS production simulation model, as applied to the Hawaiian Electric system, are as follows:

- Hourly load to be served;
- Operating characteristics of Hawaiian Electric and IPP resources;
- Operating constraints such as regulating reserve requirements;
- Contractual terms for Hawaiian Electric and IPP resources;
- Planned maintenance schedules for Hawaiian Electric and IPP resources;
- Estimated maintenance outage rates and forced outage rates for Hawaiian Electric and IPP resources;
- Prices for fuels used by the dispatchable generating resources; and
- Hourly MW profiles for variable renewable generation sources.

Inputs workbooks for O'ahu, Hawai'i Island, Maui, Moloka'i, and Lāna'i are provided with this document and will be made available on the Company's IGP website. These workbooks provide additional information on the modeling inputs used by the RESOLVE and PLEXOS models.

# 4 Forecast Assumptions

The modeling process for the Grid Needs Assessment relies on a set of forecast assumptions to define what the future system could look like. Many of these assumptions have been developed using similar methods as the First Cycle and have been presented to the STWG.

## 4.1 Load Forecast

The load forecast is a key assumption for the planning models that provides the energy requirements and peak demands that must be served by Hawaiian Electric through the planning horizon. The forecasts will be used to start the planning process along with scenarios and sensitivities under development with the TAP and STWG. The load forecast is just one of the many assumptions that the resource planners use in their models to stress test the various plans under varying conditions.

The forecasts were developed for each of the five islands and began with the development of the energy forecast (i.e., sales forecast) by rate class (residential, small, medium and large commercial and street lighting) and by layer (underlying load forecast and adjusting layers – energy efficiency, distributed energy resources, and electric vehicles).

The underlying sales forecast is driven primarily by the economy, weather, electricity price, and known adjustments to large customer loads and is informed by historical data, structural changes<sup>12</sup>, and historical disruptions. The impacts of energy efficiency (EE), distributed energy resources (DER), primarily photovoltaic systems with and without storage (i.e., batteries/DBESS), and electric vehicles (EV) were layered onto the underlying sales outlook to develop the sales forecast at the customer level. Base, high and low scenarios were developed for each of the sales forecast layers including the underlying layer.

Multiple methods and models were analyzed to develop the underlying forecast as presented in the February 26, 2026 STWG meeting.<sup>13</sup> The residential and commercial sectors are forecasted separately as each sector's electricity usage has been found to be related to a different set of drivers as described in Appendix A Underlying Sales Forecast. Historical sales used in econometric models are adjusted to remove sales impact of DER, EE, EV and CBRE, which are treated as separate layers. Input data sources for developing the underlying sales forecast include economic drivers, weather variables, electricity price and historical data from the Company's own records, as shown in the table below.

<sup>12</sup> Structural changes can include things like the addition of new out-of-trend resort loads post-disaster changes that have a persistent impact on the forecast.

<sup>13</sup> See [https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/forecast\\_assumptions/20190717\\_wg\\_fa\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/forecast_assumptions/20190717_wg_fa_meeting_presentation_materials.pdf), slides 4-14.

*Table 4-1: Input data sources for the underlying forecast.*

| Organization                                         | Input Data                                                                                                       |
|------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| University of Hawai'i Economic Research Organization | Personal income<br>Resident population<br>Non-farm jobs<br>Visitor arrivals<br>Visitor days                      |
| NOAA – Honolulu, Kahului, Hilo and Kona Airports     | Cooling degree days<br>Dry bulb temperature<br>Dewpoint Temperature<br>Rainfall                                  |
| Google                                               | Google Mobility Data for a limited period during and post-COVID19 pandemic                                       |
| Hawaiian Electric                                    | Historical kWh sales<br>Historical customer counts<br>Known large customer projects<br>Average electricity price |

### 4.1.1 Distributed Energy Resource Forecasts

The distributed energy resources (DER) layer includes impacts of behind the meter PV and battery energy storage systems (DBESS) as well as known projects for other technologies (e.g., wind).

CBRE projects are not included in the DER load forecast layer. Officially reported “Recorded” kWh sales include reductions from CBRE kWh credited to subscribers. However, recorded peak loads do not include CBRE impacts because subscribers do not receive coincident peak kW credits and operationally, CBRE projects function similar to IPPs. Therefore, for the purposes of the IGP and to keep sales and hourly load on the same basis in the analysis and supporting data sets, historical and forecasted sales exclude CBRE kWh credits to subscribers. Anticipated CBRE projects are accounted for in the production modeling of the Grid Needs Assessment analysis as supply-side resources. Additionally, impacts of VPP are not included in the load forecast layer because VPP-enrolled resources are expected to be dispatchable to meet system needs. Therefore, anticipated VPP resources are accounted for in the resource modeling of the Grid Needs Assessment analysis as supply-side resources rather than static load modifiers embedded in the load forecast. While the VPP docket remains ongoing and the final tariff design and compensation structure have not yet been established, forecasted VPP capacity values are included in Workbook 1 based on the Company's current assumptions regarding the program design. As the VPP docket progresses and additional information becomes available, the VPP resource assumptions used in the IGP may be revised accordingly.

This forecast layer estimates new additions of DER capacity in each month by island, rate class, and program, then projects the resulting monthly sales impact and hourly load impact from these additions. The DER layer in total also includes all historical or “acquired” systems installed prior to the forecast period. Future DER capacity modeling considered two time horizons:

- Near term (next one to three years) reflects the current pace of incoming applications and executed agreements, existing program <sup>14</sup> subscription level and caps, feedback from the Companies' program administrators and installers, and customer input; and
- Longer term forecast, which is model-based as detailed application information is not available.<sup>15</sup>

To extend the DER forecast from the short-term through the full planning period, an economic choice model using simple payback considers a set of assumptions such as the installed cost of PV and DBESS, installation incentives, electricity price, and program structure that affect the economic benefit to the customer, which is the primary driver of their decision to adopt the system. The addressable market, or the number of utility customers that have the potential to install a DER behind the meter is also considered.

Monthly DER capacity factors for each island were used to convert installed capacity to customer energy sales reductions. The monthly capacity factors recognize the variations in solar irradiance throughout the year. A degradation factor of 0.5% per year<sup>16</sup> was applied to the sales impacts to recognize that the DER system's performance degrades over time.

Assumptions for three forecast scenarios were initially proposed in the October 23, 2025 STWG meeting<sup>17</sup> and then revised following the adoption of Act 24 and issuance of Governor Green's Executive Order 26-02, which changed the State of Hawai'i RETITC. Revised assumptions were presented at the June 25, 2026 STWG meeting<sup>18</sup>. Table 4-2, below summarizes assumptions used to produce the low, base, and high DER forecasts.

*Table 4-2. Summary of assumptions used to develop DER forecast sensitivities*

| Input               | Low                                       | Base                                                                   | High                                                                                |
|---------------------|-------------------------------------------|------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Synopsis            | Lower scenario: 75% of Base future uptake | Market forecast based on Smart Renewable Energy Tariff and BYOD riders | Policy-driven 400+ MW in 2025- 2030 with optimistic economic model for 2031-forward |
| Cost Projections    | na                                        | NLR ATB 2024 - Conservative Cost (+15% Hawai'i premium)                | NLR ATB 2024 Advanced Cost (+15% Hawai'i premium)                                   |
| Federal Tax Credits | na                                        | Phased out per current law                                             | Phased out per current law                                                          |

<sup>14</sup> Existing programs include Net Energy Metering, Net Energy Metering Plus, Standard Interconnection Agreement, Customer Grid Supply, Customer Grid Supply Plus, Customer Self Supply, Interim Smart Export, Smart Renewable Energy, Battery Bonus, and Bring Your Own Device.

<sup>15</sup> No model fit was achieved for Lāna'i or Moloka'i due to the historical adoption patterns on those islands. Recent trends and results of the Maui models were used to derive proxy growth rates for the base and high scenarios. As a result, Table 4-6 does not include data for these islands.

<sup>16</sup> Median degradation rate from NREL "Photovoltaic Degradation Rates – An Analytical Review", D.C. Jordan and S.R. Kurz, 2012, <http://www.nrel.gov/docs/fy12osti/51664.pdf>

<sup>17</sup> See <https://www.hawaiianelectric.com/a/15800>, slides 25-36

<sup>18</sup> See <https://www.hawaiianelectric.com/a/16515>, slides 8-14

| Input                          | Low | Base                                                                                                                   | High                                                                         |
|--------------------------------|-----|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| State Tax Credits              | na  | Cap and phase out of State ITC based on Act 24 and Gov. Green Executive Order 26-02                                    | 35% (Reinstate State ITC)                                                    |
| Program Export Compensation    | na  | Smart DER Tariff                                                                                                       | Retail                                                                       |
| System Size                    | na  | Based on recent history                                                                                                | PV based on recent history, BESS reduced to one (due to retail compensation) |
| BYOD                           | na  | BYOD+: Based on current trend. Ends in 2035.                                                                           | BYOD+: Based on current trend. Ends in 2035.                                 |
| Addressable Residential Market | na  | Single Family/2-4 Unit Multi-Family/Owner Occupied/Consumption Threshold. R market reduced due to Act 24 income limits | Base + 25%                                                                   |
| Addressable Commercial Market  | na  | Public or Private Owned/<6 stories/Consumption Thresholds                                                              | Base + 25%                                                                   |
| Add-Ons Market Pool            | na  | NMP adoption continues at 50% of historical pace through 2029. No NMP starting in 2030                                 | Sch-R NEM with usage sufficient for 3 kW NMP included in market pool         |
| New Technology                 | na  | None                                                                                                                   | Balcony Solar: 25% of condos and rentals by 2050                             |

The following tables provide the assumptions for Federal and State investment tax credits. The assumption for the Federal tax credits for residential systems in 2026 and 2027 was held at 30% despite elimination of the residential tax credit based on stakeholder feedback indicating that leased systems can still benefit from the tax incentive via the leasing company claim of the credit in those years. In the case of the State tax credits, the base assumption was lowered to 10% as a proxy for the impact of the \$45 million aggregate tax credit limit enacted in Act 24. It is impossible to know what the actual impact of the aggregate tax credit limit will be on customers' DER adoption choices or the actual effective tax credit rate that will be realized by customers that choose to move forward with projects, but it is reasonable to expect lower adoption, lower effective tax credit rates, or both in response to the changes adopted in Act 24.

*Table 4-3: Federal tax incentive rate schedule (applies to base and high scenarios).*

| Class                     | 2026 | 2027 | 2028 | 2029 | 2030+ |
|---------------------------|------|------|------|------|-------|
| Residential <sup>19</sup> | 30%  | 30%  | 0%   | 0%   | 0%    |
| Commercial                | 30%  | 30%  | 20%  | 10%  | 0%    |

<sup>19</sup> Residential Federal ITC assumption for 2026 and 2027 was set at 30% to acknowledge the potential for leased systems to benefit from the tax incentive via the leasing company claim of the credit.

*Table 4-4: State tax incentive rate schedule (applies to residential and commercial).*

| Forecast Scenario | 2026 | 2027 | 2028 | 2029 | 2030+ |
|-------------------|------|------|------|------|-------|
| Base              | 10%  | 10%  | 10%  | 10%  | 0%    |
| High              | 35%  | 35%  | 35%  | 35%  | 35%   |

One of the key drivers in the long-term DER forecast is the addressable market of potential new adopters and customers that will add-on to existing systems. For the base forecast scenario, the addressable market for residential customers included single family and multi-family homes with a maximum of four units that were owner occupied and with a high enough energy consumption to utilize at least a 3-kW PV system. Historically, only 15-20% of residential PV installations have been below 3 kW. From a practical perspective, customers with low consumption are less likely to make an investment in rooftop PV. Smaller systems are also less cost-effective due to fixed portions of the installation and material costs being spread over smaller total capacity and savings potential. The residential market was reduced by 5-10% (depending on the island) in 2026-2029 as a proxy to reflect the income limits enacted in Act 24 that make some taxpayers ineligible to claim the State tax credits.

The high DER scenario assumptions for the modeled portion (2031-2050) represent a future in which traditional barriers to adoption are addressed somehow to allow expansion of the addressable market by 25%, inclusion of all existing NEM customers who have net usage to utilize at least an additional 3 kW PV system in the addressable market, and a balcony solar solution that enables 25% of multi-family and renter-occupied single family homes to adopt the technology. The resulting percent of current NEM customers that meet the criteria to be added to the high forecast market pool is in Table 4-6.

*Table 4-5: Addressable market and system sizes for residential customers.*

| Island                | Percent of Schedule R Customers | Average PV System Size (KW) | Average Storage Size (KWH) |
|-----------------------|---------------------------------|-----------------------------|----------------------------|
| O'ahu - Base          | 41%                             | 8                           | 23                         |
| Hawai'i Island - Base | 47%                             | 7                           | 20                         |
| Maui - Base           | 45%                             | 8                           | 23                         |
| Lāna'i - Base         | 28%                             | 7                           | 18                         |
| Moloka'i - Base       | 26%                             | 6                           | 18                         |
| O'ahu - High          | 51%                             | 8                           | 13.5                       |
| Hawai'i Island - High | 58%                             | 7                           | 13.5                       |
| Maui - High           | 56%                             | 8                           | 13.5                       |
| Lāna'i - High         | 35%                             | 7                           | 13.5                       |
| Moloka'i - High       | 33%                             | 6                           | 13.5                       |

*Table 4-6: Percent of residential NEM customers included in the high scenario addressable market.*

| Island         | Percent of Schedule-R NEM Customers |
|----------------|-------------------------------------|
| O'ahu          | 33%                                 |
| Hawai'i Island | 24%                                 |
| Maui           | 33%                                 |



For commercial customers, the addressable market assumptions for the Base scenario are unchanged from the first IGP. Public and private building ownership was considered. Structures greater than six stories were excluded. Similar to residential customers, small and medium commercial consumption needed to be above a set threshold. Commercial thresholds were established using rate class customers' previous 12-months usage, historical PV installation data, and business types. PV and non-PV customers were segmented by business type and distributions for total usage<sup>20</sup> were created for PV customers. Usage at the lower 1/8th quantile was used as the threshold for business types that had five or more customers who already installed PV. The default thresholds of 500kWh for Schedule G and 5,000 kWh for Schedule J are used for business types with less than five existing customers with PV already installed.

*Table 4-7: Addressable market, average PV system size, and average storage size for Schedule G customers.*

| Island                | Percent of Schedule G Customers | Average PV System Size (KW) | Average Storage Size (KWH) |
|-----------------------|---------------------------------|-----------------------------|----------------------------|
| O'ahu - Base          | 37%                             | 16                          | 29                         |
| Hawai'i - Base        | 35%                             | 19                          | 49                         |
| Maui - Base           | 41%                             | 16                          | 28                         |
| O'ahu - High          | 46%                             | 16                          | 29                         |
| Hawai'i Island - High | 44%                             | 19                          | 49                         |
| Maui - High           | 51%                             | 16                          | 28                         |

*Table 4-8: Addressable market, average PV system size, and average storage size for Schedule J customers.*

| Island                | Percent of Schedule J Customers | Average PV System Size (KW) | Average Storage Size (KWH) |
|-----------------------|---------------------------------|-----------------------------|----------------------------|
| O'ahu - Base          | 53%                             | 60                          | 110                        |
| Hawai'i - Base        | 68%                             | 46                          | 131                        |
| Maui - Base           | 63%                             | 55                          | 33                         |
| O'ahu - High          | 66%                             | 60                          | 110                        |
| Hawai'i Island - High | 85%                             | 46                          | 131                        |
| Maui - High           | 79%                             | 55                          | 33                         |

<sup>20</sup> Total usage is the sum of the previous 12-months sales plus the sum of the previous 12-months estimated PV generation.

Table 4-9: Addressable market, average PV system size, and average storage size for Schedule P customers.

| Island                | Percent of Schedule P Customers | Average PV System Size (KW) | Average Storage Size (KWH) |
|-----------------------|---------------------------------|-----------------------------|----------------------------|
| O'ahu - Base          | 78%                             | 330                         | 0                          |
| Hawai'i - Base        | 44%                             | 330                         | 0                          |
| Maui - Base           | 68%                             | 308                         | 0                          |
| O'ahu - High          | 98%                             | 330                         | 0                          |
| Hawai'i Island - High | 55%                             | 330                         | 0                          |
| Maui - High           | 85%                             | 308                         | 0                          |

Base, high and low forecasts of DER PV capacity, paired DBESS capacity, sales impacts, and hourly net system load impacts for the full forecast period are provided in Workbook 3c for each island.

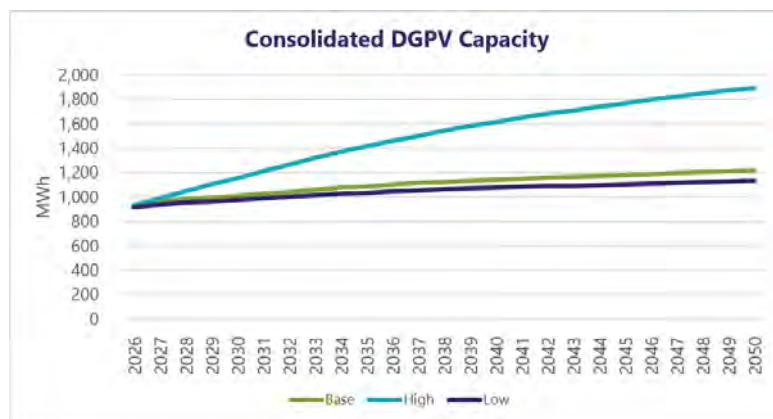


Figure 4-1: DG PV Capacity across Hawaiian Electric's service territory.

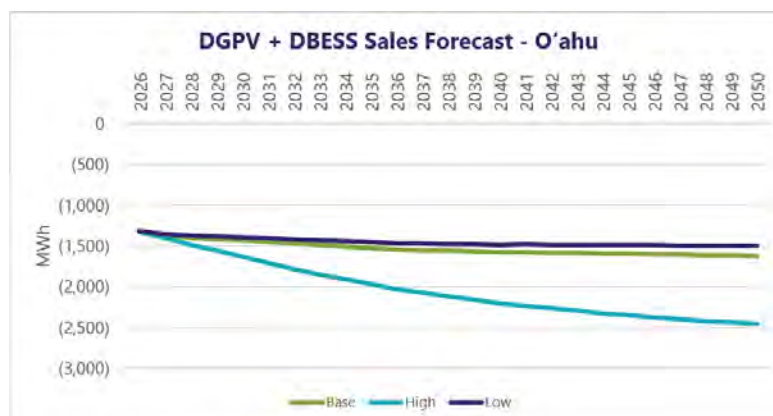


Figure 4-2 DGPV + DBESS sales forecast by scenario, O'ahu.

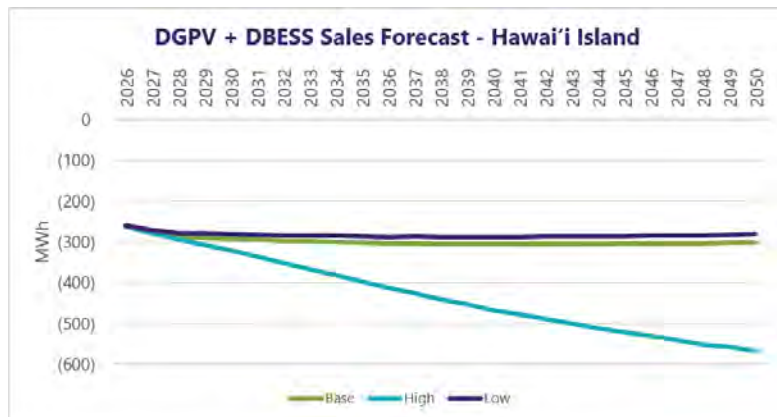


Figure 4-3: DGPV + DBESS sales forecast by scenario, Hawai'i Island.

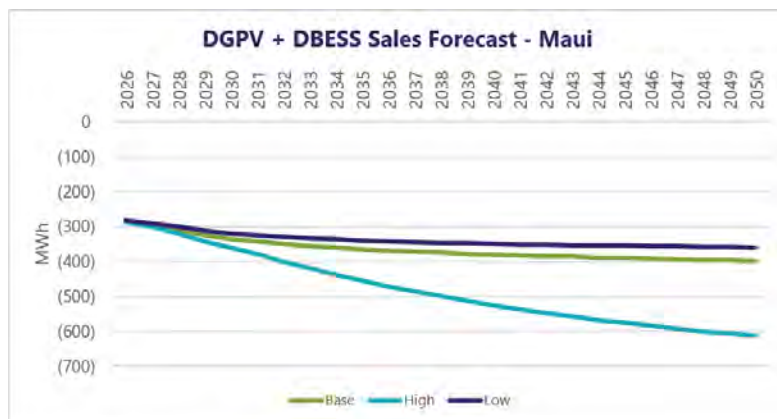


Figure 4-4: DGPV + DBESS sales forecast by scenario, Maui.

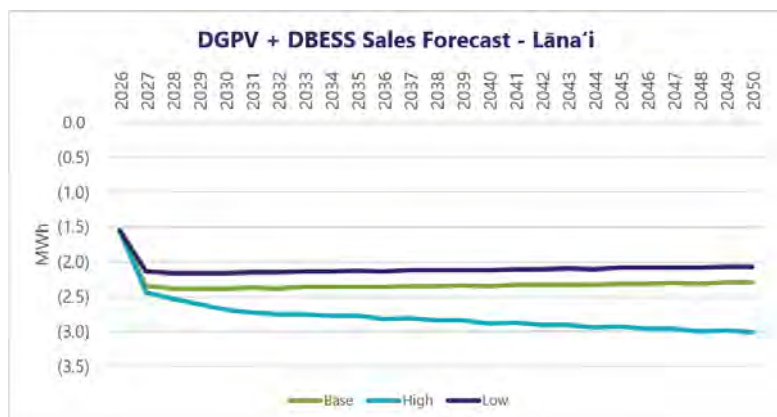


Figure 4-5: DGPV + DBESS sales forecast by scenario, Lāna'i.

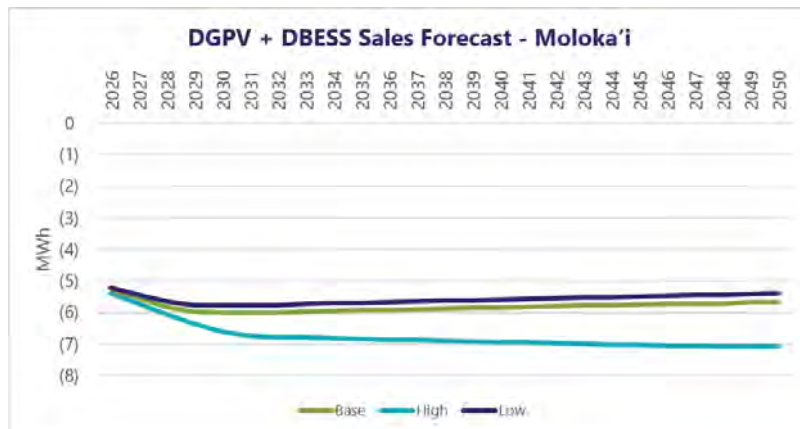


**Figure 4-6: DGPV + DBESS sales forecast by scenario, Moloka'i.**

### 4.1.2 Energy Efficiency

The EE layer in the First Cycle was based on the July 2020 State of Hawai'i Market Potential Study (2020 MPS) prepared by Applied Energy Group (AEG). In response to stakeholder feedback, free riders were included in the EE layer. The EE layer for the second IGP cycle uses the same basis and methodology as the First Cycle with adjustments described below:

- The first year of the forecast period is 2026. As a result, the forecast uses incremental projections from the 2020 MPS incremental projections for 2026-2040.
- Achieved programmatic energy efficiency measures reported by Hawai'i Energy for 2019-2024 were lower than the 2020 MPS Business-as-Usual (BAU) projections for those years. As a result, the low and base programmatic EE forecasts have been adjusted downward by 50% and 25% of BAU, respectively.
- The historical EE data series was adjusted to reflect measures adopted from 2009-2025, as opposed to starting the data series in 1996 as was done in the First Cycle. This was done to align the historical data series with the EEPS period and with the historical periods being used in the underlying sales modeling (which no longer stretch back into the 1990's).

The table below provides the assumptions used to produce the low, base, and high EE forecast. Base, high and low forecasts of future EE sales impacts and hourly net system load impacts for the full forecast period are provided in EE Load Forecasts Workbook 3b for each island.

*Table 4-10: Energy efficiency forecast assumptions.*

| EE Forecast Scenario | Programmatic            | Codes & Standards (C&S) |
|----------------------|-------------------------|-------------------------|
| Low                  | MPS: BAU reduced by 50% | MPS: C&S                |
| Base                 | MPS: BAU reduced by 25% | MPS: C&S                |
| High                 | MPS: Achievable High    | MPS: C&S                |

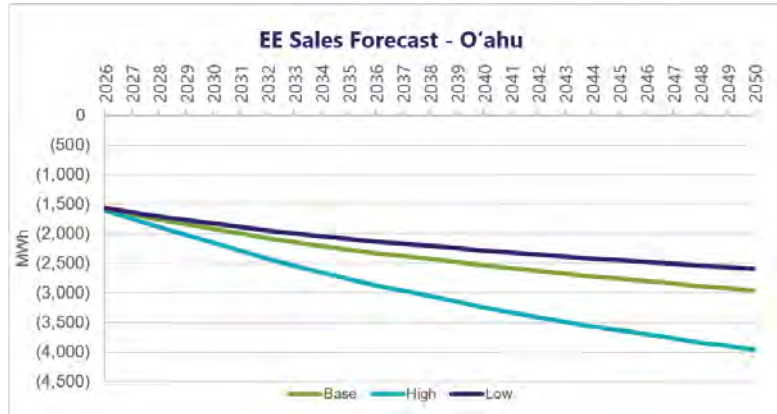


Figure 4-7: Energy efficiency sales forecast by scenario, O'ahu.

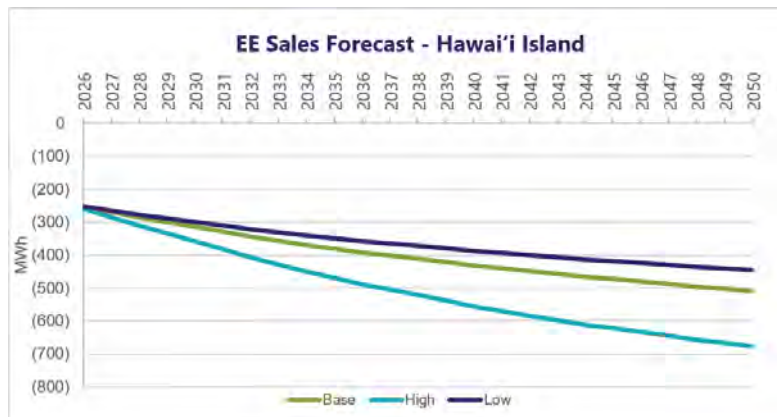


Figure 4-8: Energy efficiency sales forecast by scenario, Hawai'i Island.

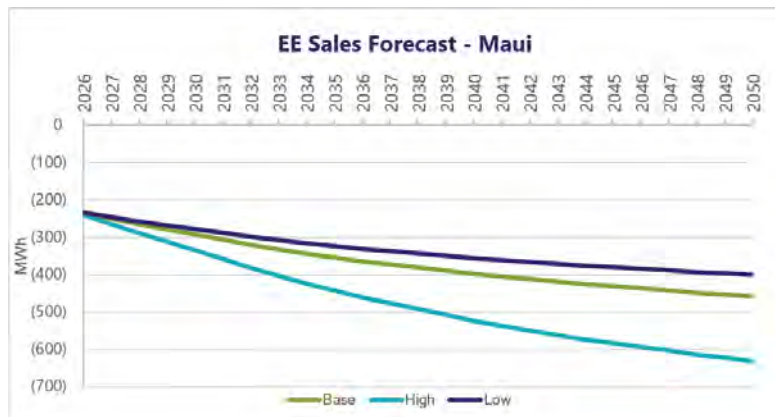


Figure 4-9: Energy efficiency sales forecast by scenario, Maui.

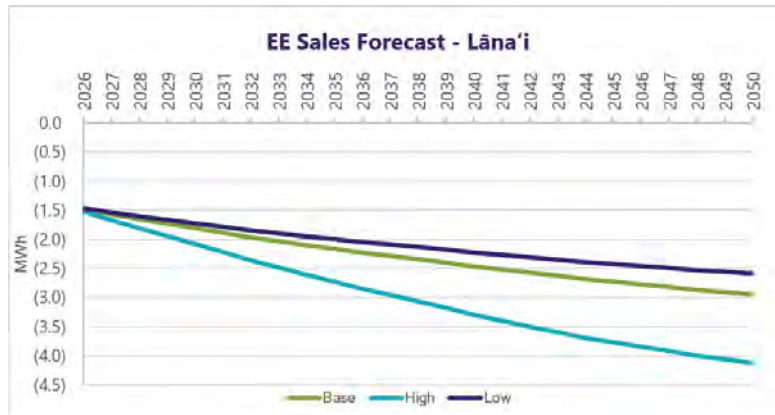


Figure 4-10: Energy efficiency sales forecast by scenario, Lānaʻi.

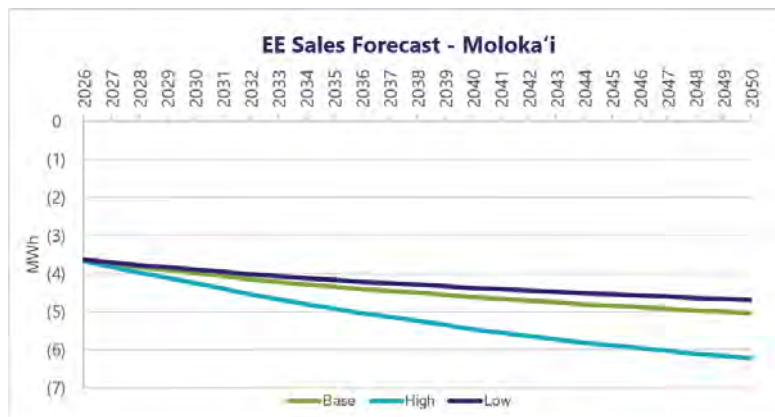


Figure 4-11: Energy efficiency sales forecast by scenario, Molokaʻi.

### 4.1.3 Electric Vehicle

The Electric Vehicle (EV) layer consists of impacts from the charging of electric vehicles from the Hawaiian Electric grids. In the First Cycle, the EV forecast included charging of light duty electric vehicles and electric buses. For the Second Cycle, the Companies partnered with the National Laboratory of the Rockies (NLR, formerly National Renewable Energy Laboratory) to develop the EV forecast using NLR's dynamic input-driven TEMPO™ model. The NLR methodology and proposed forecasts were presented at the October 23, 2025 Stakeholder Technical Working Group meeting<sup>21</sup>. Additional vehicle types were included in the Second Cycle EV forecasts as described below.

The NLR forecasts were developed for the three counties in the Companies service territory on an annual basis for multiple scenarios. The vehicle types/segmentation covered in the forecast accounted for all on-road non-military transportation and included household passenger light-duty vehicles (LDVs), freight and vocational/service medium/heavy duty vehicles (MHDVs), fleet LDVs and transit buses. Each of the segments contribute different proportions to total EV load with different adoption and growth rates as well as different load shapes. Hourly net system load forecasts for unmanaged charging represent hourly system-level load from electric vehicle charging across all segments without future expansion or addition of managed charging programs. NLR's forecast report will be filed in this docket once published.

The NLR Forecast was adjusted and refined by the Companies to adjust for 2025 actual EV counts, to create ramped monthly forecasts based on NLR's annual forecast values and to break-out the Maui County forecast into the three islands. The hourly forecast shapes from NLR were rescaled to the adjusted monthly forecasts at the system level. Table 4-11 below shows the basis for the three scenarios in the Second Cycle EV forecast. Base, high and low forecasts of EV vehicle saturation, sales impacts, and hourly net system load impacts for the full forecast period are provided in EV Load Forecasts Workbook 3a for each county or island.

*Table 4-11: Electric vehicle forecast scenarios.*

| EV Forecast Scenario | NLR Scenario                      |
|----------------------|-----------------------------------|
| Low                  | 50% of NLR Base Scenario          |
| Base                 | NLR Base + 100% State MHDEV Fleet |
| High                 | NLR High Scenario                 |

<sup>21</sup> Accessible at: <https://www.hawaiianelectric.com/a/15800>



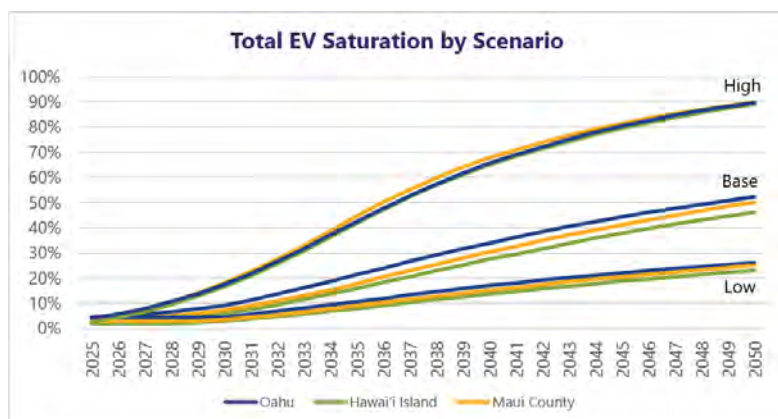


Figure 4-12: Electric Vehicle saturation by scenario.

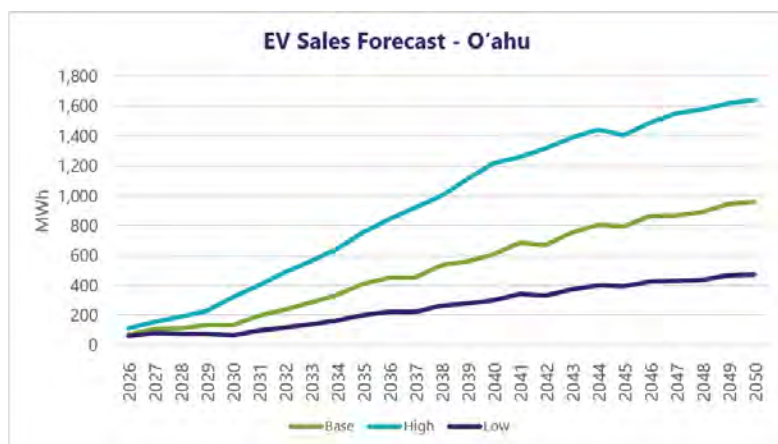


Figure 4-13: Electric vehicle sales forecast, O'ahu.



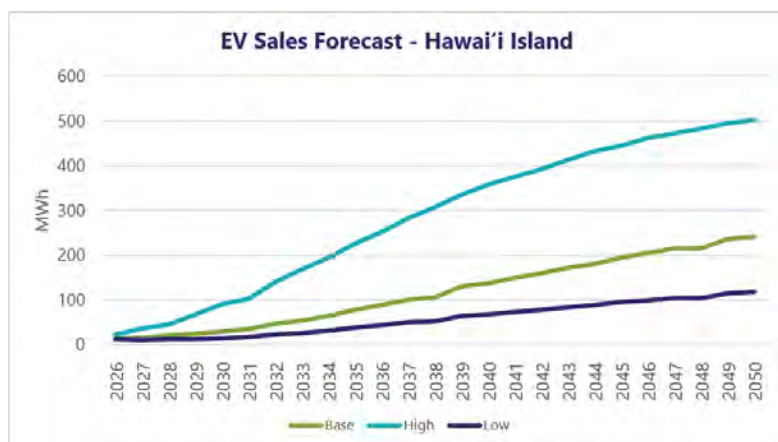


Figure 4-14: Electric vehicle electricity sales forecast, Hawai'i Island.

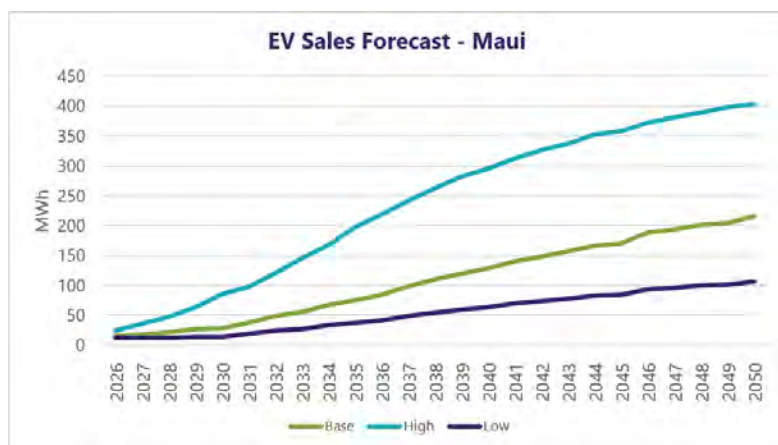


Figure 4-15: Electric vehicle electricity sales forecast, Maui.

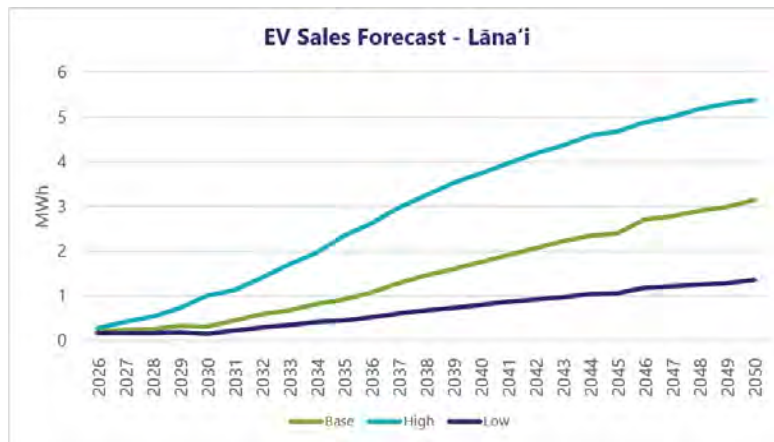


Figure 4-16: Electric vehicle electricity sales forecast, Lānaʻi.

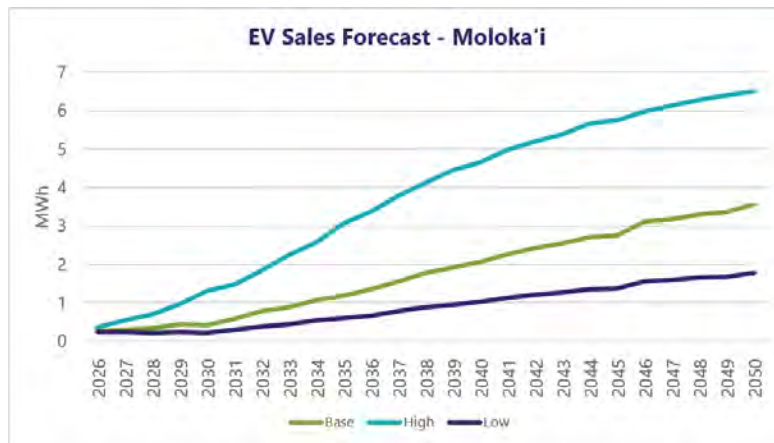


Figure 4-17: Electric vehicles electricity sales forecast, Molokaʻi.

## 4.2 Sales Forecasts

Once all the layers are developed for each island, they are added together to arrive at the sales forecast at the customer level by island. Select years of the Base sales forecast scenarios, which combine the Base scenarios for each layer, are shown in the following tables. The Base scenario sales by layer for all years in the forecast period are provided in Load Forecast Workbook 3d for each island. As additional sales forecast scenarios are defined by stakeholders, sales by layer summaries can be developed and included in future supplemental filings.

Table 4-12: Oʻahu base sales forecast.

| Year | Underlying<br>(GWh) | DER<br>(PV and BESS) | Energy<br>Efficiency | Electric<br>Vehicles | Customer Level<br>Sales Forecast |
|------|---------------------|----------------------|----------------------|----------------------|----------------------------------|
|------|---------------------|----------------------|----------------------|----------------------|----------------------------------|

|      |        | (GWh)   | (GWh)   | (GWh) | (GWh)             |
|------|--------|---------|---------|-------|-------------------|
|      | A      | B       | C       | D     | E = A + B + C + D |
| 2030 | 9,408  | (1,433) | (1,915) | 133   | 6,193             |
| 2035 | 9,810  | (1,525) | (2,266) | 409   | 6,429             |
| 2040 | 10,229 | (1,576) | (2,533) | 608   | 6,728             |
| 2045 | 10,596 | (1,593) | (2,754) | 795   | 7,045             |
| 2050 | 11,012 | (1,618) | (2,955) | 957   | 7,396             |

Table 4-13: Hawai'i Island base sales forecast.

| Year | Underlying<br>(GWh) | DER<br>(PV and BESS)<br>(GWh) | Energy<br>Efficiency<br>(GWh) | Electric<br>Vehicles<br>(GWh) | Customer Level<br>Sales Forecast<br>(GWh) |
|------|---------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------------------|
|      | A                   | B                             | C                             | D                             | E = A + B + C + D                         |
| 2030 | 1,674               | (297)                         | (315)                         | 29                            | 1,091                                     |
| 2035 | 1,747               | (306)                         | (381)                         | 78                            | 1,138                                     |
| 2040 | 1,820               | (311)                         | (432)                         | 137                           | 1,214                                     |
| 2045 | 1,878               | (309)                         | (473)                         | 194                           | 1,290                                     |
| 2050 | 1,940               | (306)                         | (510)                         | 241                           | 1,366                                     |

Table 4-14: Maui base sales forecast.

| Year | Underlying<br>(GWh) | DER<br>(PV and BESS)<br>(GWh) | Energy<br>Efficiency<br>(GWh) | Electric<br>Vehicles<br>(GWh) | Customer Level<br>Sales Forecast<br>(GWh) |
|------|---------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------------------|
|      | A                   | B                             | C                             | D                             | E = A + B + C + D                         |
| 2030 | 1,647               | (336)                         | (293)                         | 28                            | 1,045                                     |
| 2035 | 1,738               | (365)                         | (354)                         | 76                            | 1,094                                     |
| 2040 | 1,819               | (381)                         | (398)                         | 129                           | 1,169                                     |
| 2045 | 1,888               | (389)                         | (430)                         | 170                           | 1,239                                     |
| 2050 | 1,959               | (398)                         | (458)                         | 216                           | 1,320                                     |

Table 4-15: Moloka'i base sales forecast.

| Year | Underlying<br>(GWh) | DER<br>(PV and BESS)<br>(GWh) | Energy<br>Efficiency<br>(GWh) | Electric<br>Vehicles<br>(GWh) | Customer Level<br>Sales Forecast<br>(GWh) |
|------|---------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------------------|
|      | A                   | B                             | C                             | D                             | E = A + B + C + D                         |
| 2030 | 39.29               | (5.99)                        | (3.98)                        | 0.42                          | 29.73                                     |
| 2035 | 39.92               | (5.93)                        | (4.35)                        | 1.20                          | 30.84                                     |
| 2040 | 40.53               | (5.86)                        | (4.63)                        | 2.07                          | 32.12                                     |
| 2045 | 40.92               | (5.75)                        | (4.85)                        | 2.76                          | 33.08                                     |
| 2050 | 41.38               | (5.66)                        | (5.05)                        | 3.55                          | 34.23                                     |

Table 4-16: Lānaʻi base sales forecast.

| Year | Underlying<br>(GWh)<br><b>A</b> | DER<br>(PV and BESS)<br>(GWh)<br><b>B</b> | Energy<br>Efficiency<br>(GWh)<br><b>C</b> | Electric<br>Vehicles<br>(GWh)<br><b>D</b> | Customer Level<br>Sales Forecast<br>(GWh)<br><b>E = A + B + C + D</b> |
|------|---------------------------------|-------------------------------------------|-------------------------------------------|-------------------------------------------|-----------------------------------------------------------------------|
| 2030 | 38.38                           | (2.38)                                    | (1.81)                                    | 0.32                                      | 34.51                                                                 |
| 2035 | 40.43                           | (2.35)                                    | (2.16)                                    | 0.91                                      | 36.82                                                                 |
| 2040 | 43.80                           | (2.34)                                    | (2.47)                                    | 1.75                                      | 40.74                                                                 |
| 2045 | 44.72                           | (2.31)                                    | (2.73)                                    | 2.40                                      | 42.08                                                                 |
| 2050 | 45.76                           | (2.30)                                    | (2.95)                                    | 3.14                                      | 43.65                                                                 |

### 4.3 Hourly and Peak Forecasts

Once the sales forecast is developed by layer (underlying, DER, DBESS, EE and EV) for each island, it is converted from a monthly sales forecast into a load forecast at the system level for each hour over the entire forecast horizon. Figure 4-18 below shows illustrates the process.

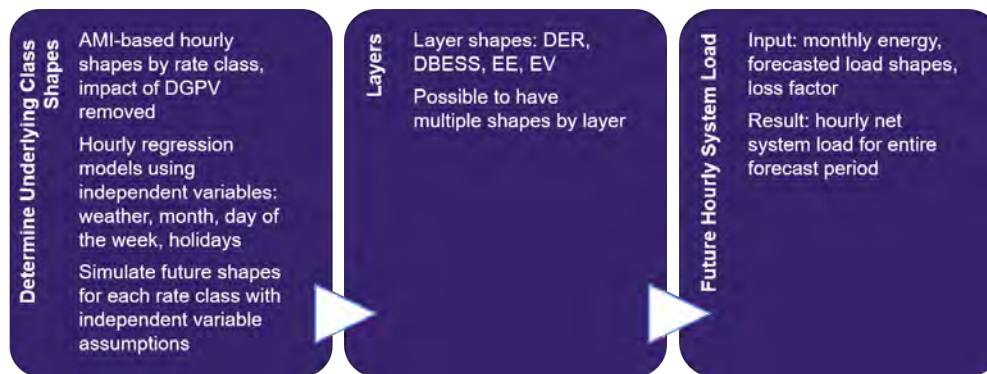


Figure 4-18: Hourly load forecast development process.

Island-specific hourly shapes for each rate class derived from recent Advanced Meter Infrastructure (AMI) data, with DGPV impacts removed, are used to derive the load shape for underlying sales plus acquired EE and acquired DBESS<sup>22</sup>. For Molokaʻi only, due to limitations of the available AMI data, recent hourly total system load, with DGPV impacts removed, was used to derive the load shape for underlying sales plus acquired EE and acquired DBESS. Hourly regression models for each island and rate class are evaluated to identify relationships with explanatory variables (weather, month, day of the week, holidays) to

<sup>22</sup> Acquired EE and Acquired DBESS are defined as EE measures and DBESS equipment installed from 2009-2025. Acquired EE and acquired DBESS cannot be removed from the historical hourly AMI or system load data due to the lack of data to accurately measure or estimate the hourly impacts of EE and DBESS in historical periods. For Hawaiʻi Island, non-PV DER is also included in the underlying hourly load shape.

accommodate change in the hourly shapes over time for each rate class or total system load. The hourly regression models are used to simulate shapes for the underlying forecast (including acquired EE and acquired DBESS) based on future assumptions for primarily weather and day type over the entire horizon. The forecasted energy for the underlying (including acquired EE and acquired DBESS) and each adjusting layer (DER, future DBESS, future EE and EV) is placed under its respective future load shape then converted from the customer level to system level using a loss factor<sup>23</sup>. Figure 4-19 below illustrates how the monthly sales energy is mapped to the available hourly shapes.

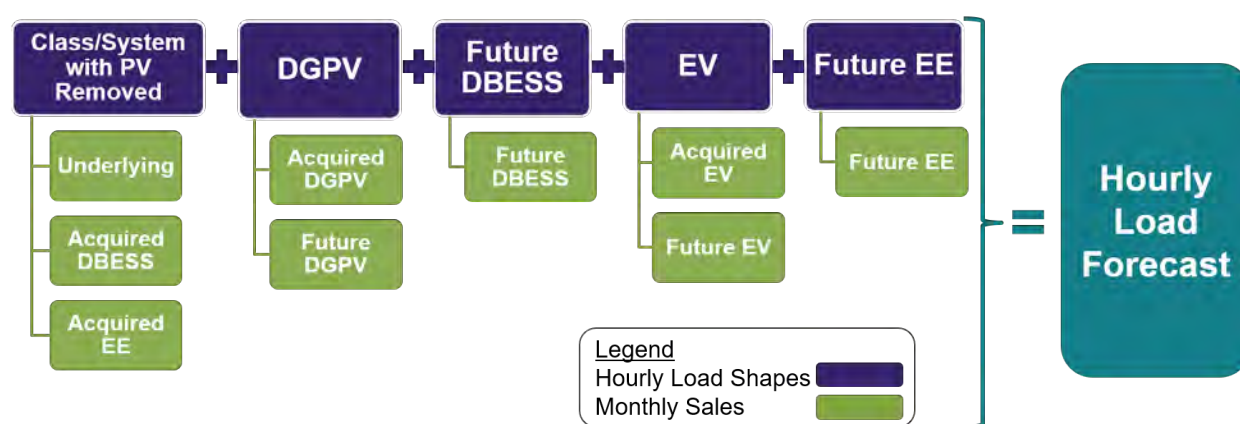


**Figure 4-19: Assignment of monthly sales layers to hourly load shapes.**

Once all the forecasted layers are developed by hour for each island, they are combined to arrive at an aggregate hourly load forecast. The result is an hourly net system load for the entire forecast period. The annual peak forecast is the highest value in each year. Peak forecasts by layer for select years of the base forecast scenario for each island are in the tables below. The values shown for the layers are the values of each layer in the hour coincident with the overall peak load. They do not necessarily represent the maximum or minimum impact of the individual layer in the respective year. The full annual data set is provided in Load Workbook 3d for each island. As additional forecast scenarios are defined by stakeholders, peaks by layer summaries can be developed and included in future supplemental filings.

<sup>23</sup> The net-to-system factor used to convert customer sales to system level load is calculated as equal to  $1/(1-\text{loss factor})$  and include company use. The loss multipliers are included below: - O'ahu: 1.04445 - Hawai'i: 1.06065 - Maui: 1.04738- Lāna'i : 1.04926 - Moloka'i: 1.09641

Table 4-17: O'ahu base peak forecast (MW).

| Year | Underlying incl.<br>Acquired EE<br>and DBESS<br>(MW) | DER<br>(PV and future<br>DBESS)<br>(MW) | Future Energy<br>Efficiency<br>(MW) | Electric Vehicles<br>(MW) | Peak Forecast<br>(MW) |
|------|------------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------|-----------------------|
|      | A                                                    | B                                       | C                                   | D                         | E = A + B + C + D     |
| 2030 | 1,214                                                | (68)                                    | (60)                                | 26                        | 1,113                 |
| 2035 | 1,158                                                | 10                                      | (117)                               | 111                       | 1,163                 |
| 2040 | 1,382                                                | (146)                                   | (134)                               | 102                       | 1,205                 |
| 2045 | 1,232                                                | 31                                      | (203)                               | 185                       | 1,245                 |
| 2050 | 1,527                                                | (158)                                   | (221)                               | 152                       | 1,300                 |

Table 4-18: Hawai'i Island base peak forecast (MW).

| Year | Underlying<br>incl. Acquired<br>EE and DBESS<br>(MW) | DER<br>(PV and future<br>DBESS)<br>(MW) | Future Energy<br>Efficiency<br>(MW) | Electric Vehicles<br>(MW) | Peak Forecast<br>(MW) |
|------|------------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------|-----------------------|
|      | A                                                    | B                                       | C                                   | D                         | E = A + B + C + D     |
| 2030 | 230                                                  | (28)                                    | (9)                                 | 2                         | 194                   |
| 2035 | 216                                                  | (8)                                     | (27)                                | 21                        | 202                   |
| 2040 | 226                                                  | (9)                                     | (37)                                | 35                        | 215                   |
| 2045 | 236                                                  | (9)                                     | (43)                                | 47                        | 230                   |
| 2050 | 234                                                  | (0)                                     | (48)                                | 55                        | 240                   |

Table 4-19: Maui base peak forecast (MW).

| Year | Underlying incl.<br>Acquired EE<br>and DBESS<br>(MW) | DER<br>(PV and future<br>DBESS)<br>(MW) | Future Energy<br>Efficiency<br>(MW) | Electric Vehicles<br>(MW) | Peak Forecast<br>(MW) |
|------|------------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------|-----------------------|
|      | A                                                    | B                                       | C                                   | D                         | E = A + B + C + D     |
| 2030 | 235                                                  | (39)                                    | (10)                                | 3                         | 189                   |
| 2035 | 206                                                  | (3)                                     | (20)                                | 18                        | 201                   |
| 2040 | 216                                                  | (6)                                     | (26)                                | 30                        | 214                   |
| 2045 | 252                                                  | (21)                                    | (28)                                | 19                        | 222                   |
| 2050 | 262                                                  | (31)                                    | (29)                                | 33                        | 235                   |

Table 4-20: Moloka'i base peak forecast (MW).

| Year | Underlying incl.<br>Acquired EE<br>and DBESS<br>(MW) | DER<br>(PV and future<br>DBESS)<br>(MW) | Future Energy<br>Efficiency<br>(MW) | Electric Vehicles<br>(MW) | Peak Forecast<br>(MW) |
|------|------------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------|-----------------------|
|      | A                                                    | B                                       | C                                   | D                         | E = A + B + C + D     |
| 2030 | 5.48                                                 | (0.04)                                  | (0.08)                              | 0.11                      | 5.47                  |
| 2035 | 5.54                                                 | (0.05)                                  | (0.13)                              | 0.31                      | 5.68                  |
| 2040 | 5.64                                                 | (0.05)                                  | (0.20)                              | 0.57                      | 5.95                  |
| 2045 | 5.68                                                 | (0.05)                                  | (0.22)                              | 0.67                      | 6.09                  |
| 2050 | 5.75                                                 | (0.04)                                  | (0.25)                              | 0.84                      | 6.29                  |

Table 4-21: Lāna'i base peak forecast (MW).

| Year | Underlying incl.<br>Acquired EE<br>and DBESS<br>(MW) | DER<br>(PV and future<br>DBESS)<br>(MW) | Future Energy<br>Efficiency<br>(MW) | Electric Vehicles<br>(MW) | Peak Forecast<br>(MW) |
|------|------------------------------------------------------|-----------------------------------------|-------------------------------------|---------------------------|-----------------------|
|      | A                                                    | B                                       | C                                   | D                         | E = A + B + C + D     |
| 2030 | 5.74                                                 | (0.04)                                  | (0.07)                              | 0.09                      | 5.71                  |
| 2035 | 6.09                                                 | (0.04)                                  | (0.13)                              | 0.25                      | 6.17                  |
| 2040 | 6.57                                                 | (0.04)                                  | (0.20)                              | 0.44                      | 6.78                  |
| 2045 | 6.73                                                 | (0.04)                                  | (0.24)                              | 0.56                      | 7.02                  |
| 2050 | 6.89                                                 | (0.04)                                  | (0.22)                              | 0.59                      | 7.22                  |

## 4.4 Fuel Price Forecasts

The cost of producing electricity is dependent upon, in part, the cost of fuels utilized to generate power. Hawaiian Electric uses the following fuel types:

- Low Sulfur Fuel Oil (LSFO): A residual fuel oil similar to No. 6 fuel oil that contains less than 5,000 parts per million of sulfur; about 0.5% sulfur content.
- No. 2 Diesel Oil
- Ultra-Low Sulfur Diesel (ULSD)
- Naphtha
- High Sulfur Fuel Oil (HSFO): Also called Industrial Fuel Oil (IFO), HSFO contains less than 2% sulfur
- Biodiesel

Hawaiian Electric's 2026 forecast was based on the Brent forecast provided by the Energy Information Administration ("EIA") Annual Energy Outlook ("AEO") and is provided in Workbook 6. The Company developed fuel price forecasts by correlating historical prices for each fuel type with Brent Crude prices to

develop regression relationships. These regression equations were then applied to forecasted Brent crude prices to derive the corresponding fuel price forecasts. The regression coefficients and price forecasts by fuel type are provided in the Fuel Forecast Workbook.

LNG price forecasts are developed using the EIA Henry Hub forecast as the underlying fuel price forecast. A \$10/MMBTU adder in 2025 dollars is applied to represents an all-in estimate of the costs required to convert Henry Hub gas into delivered LNG available in Hawai'i, including processing, liquefaction, transportation, terminal costs, regasification and project economics. An LNG infrastructure cost is also included based on assumptions related to capital cost, rate of return, duration, and fuel volume.

$$\text{LNG Fuel Price Forecast} = \text{EIA Henry Hub} + \$10/\text{MMBTU in 2025 real dollars} + \text{LNG Infrastructure}$$

## 4.5 Resource Cost Forecasts

The resource cost forecasts were transparently derived from the 2024 National Laboratory of the Rockies' Annual Technology Baseline ("NLR ATB") technology capital cost forecast that was adjusted for:

- Location-specific capital and O&M cost adjustments for the State of Hawai'i; and
- Applicable State tax incentives

Figure 4-20 is a summary of the resource forecasts in nominal dollars. In the near-term, there are price declines after accounting for the investment tax credit schedules for the State investment tax credits. Over the longer term the resources costs generally increase over time. As noted in the NLR ATB, all technologies include electrical infrastructure and interconnection costs for internal and control connections, onsite electrical equipment e.g. switchyard, power electronics and transmission substation upgrades. Grid connection costs are excluded.<sup>24</sup> Similarly, all technologies also include site costs for access roads, buildings for operation and maintenance, fencing, land acquisition, and site preparation in the capital expenditures as well as land lease payments in the fixed costs for O&M<sup>24</sup>.

<sup>24</sup> Accessible at: <https://atb.nrel.gov/electricity/2024/definitions#capitalexpenditures>



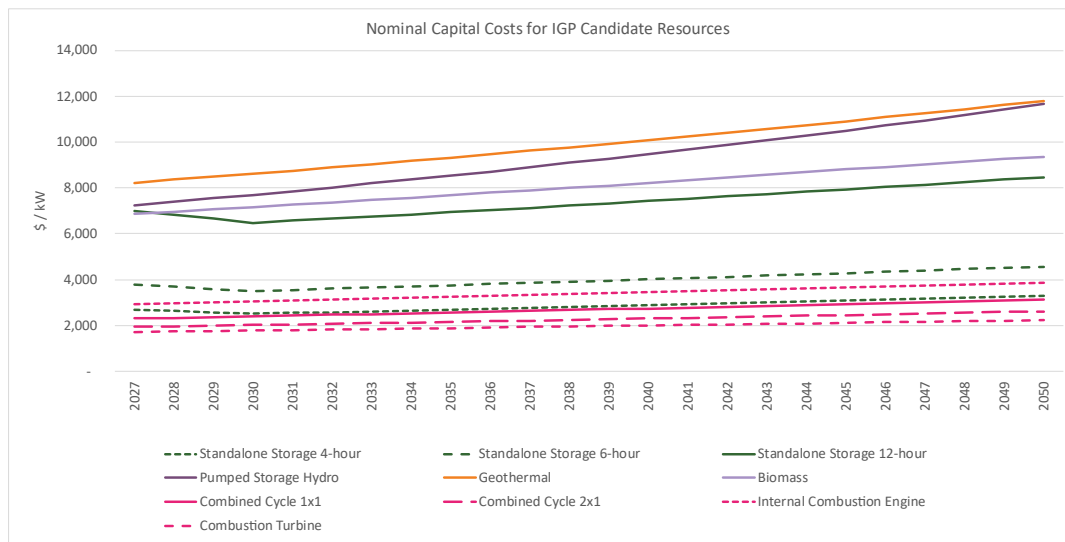


**Figure 4-20: Capital costs for IGP candidate resources.**

### 4.5.1 Resource Cost by Technology

Resource cost assumptions were based on publicly available datasets as shown in Table 4-22. Resource costs based on NLR datasets were updated to the latest Annual Technology Baseline published in 2024. Floating Offshore Wind, Distributed Wind, and Pumped Storage Hydro have been added to the ATB since the 2021 IGP I&A.

NLR's ATB provides resource costs under three different technology innovation scenarios: Conservative, Moderate, and Advanced. These scenarios are defined by the level of public and private R&D funding. The IGP resource costs assume the Conservative scenario with decreased R&D funding, little innovation in the currently available technology, and overall higher resource costs. The Moderate scenario assumes the current level of R&D funding and the level of innovation continues. The Advanced scenario sees lower resource costs driven by increased public and private R&D funding.

Along with the new data, assumptions on tax credits were updated to incorporate changes made by the One Big Beautiful Bill.

Table 4-22: Resource cost data sources.

| Source                                                   | Technology                    |
|----------------------------------------------------------|-------------------------------|
| National Laboratory of the Rockies ("NLR") <sup>25</sup> | Grid-Scale Photovoltaics      |
|                                                          | Community-Scale Photovoltaics |
|                                                          | Residential Photovoltaics     |
|                                                          | Onshore Wind                  |
|                                                          | Offshore Wind                 |
|                                                          | Distributed Wind              |
|                                                          | Geothermal                    |
|                                                          | Biomass                       |
|                                                          | Combustion Turbine            |
|                                                          | Combined Cycle                |
|                                                          | Grid-Scale Storage            |
|                                                          | Community-Scale Storage       |
|                                                          | Residential Storage           |
|                                                          | Pumped Storage Hydro          |
| Hawaiian Electric <sup>26</sup>                          | Internal Combustion Engine    |

#### 4.5.1.1 Photovoltaics (PV)

For Photovoltaics (PV), three different classes were forecasted: Grid-Scale PV, Community-Scale PV, and Residential PV. Each class used a similar process to develop the cost forecast.

##### Data Source

The source data for capital and fixed operations and maintenance (O&M) costs was provided by the 2024 NLR ATB. For Grid-Scale PV, the capital costs provided were in Real 2022 dollars \$/kWac and the O&M costs provided were in Real 2022 dollars \$/kWac-year. For Community-Scale and Residential PV, the capital costs provided were in Real 2022 dollars \$/kWdc and the O&M costs provided were in Real 2022 dollars \$/kWdc-year. The future trend for the capital and fixed O&M cost was derived from the 2024 NLR ATB projections. The Real 2022 dollars were converted to nominal dollars by applying an escalation factor of 2.1%.

##### Location Adjustment

A location adjustment factor was applied to convert both capital costs (\$/kW) and O&M costs (\$/kW-year) to Hawai'i costs. A 63% location adjustment factor for capital<sup>27</sup> was provided by the U.S. Energy Information Administration (EIA)<sup>28</sup> for Grid-Scale PV and a 62% location adjustment factor for Commercial and

<sup>25</sup> National Renewable Energy Laboratory 2024 Annual Technology Baseline, 2024 ATB Data, Accessible at: <https://atb.nrel.gov/electricity/2024/data>

<sup>26</sup> ICE costs are based on the Schofield Generating Station provided in Docket No. 2017-0213, in response to the Consumer Advocate's information request number 19.

<sup>27</sup> A location cost variation percentage from the EIA Capital Cost Estimates for Utility Scale Electricity Generating Plants.

<sup>28</sup> Accessible at: [https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capcost\\_assumption.pdf](https://www.eia.gov/analysis/studies/powerplants/capitalcost/pdf/capcost_assumption.pdf)

Residential PV. An 18.5% location adjustment factor for fixed O&M costs was provided by the RSMeans City Cost Index.<sup>29</sup> Location-specific interconnection costs were not included in the estimate.

#### ***DC to AC Conversion***

Capital costs for Commercial and Residential PV were converted from \$/kWdc to \$/kWac. For Commercial and Residential PV, a DC to AC conversion factor of 1.23 and 1.21 was used, respectively. These conversion factors were based on assumptions provided by NLR.

#### ***Investment Tax Credit Adjustment***

A 35% State ITC<sup>30</sup> is assumed for Commercial and Residential PV.

### **4.5.1.2 Onshore Wind**

#### ***Data Source***

The source data for capital and fixed O&M costs for Onshore Wind was provided by the 2024 NLR ATB. The capital costs were in Real 2022 dollars \$/kW. The fixed O&M costs were in Real 2022 \$/kW-year. The future trend for the capital and O&M costs was derived from the 2024 NLR ATB projections. The Real 2022 dollars were converted to nominal dollars by applying an escalation factor of 2.1%.

#### ***Location Adjustment***

The capital costs were converted to Hawai'i costs using a 35% factor from EIA for wind technology. The O&M costs were converted to Hawai'i costs using an 18.5% RSMeans factor. Location-specific interconnection costs were not included in the estimate.

#### ***Investment Tax Credit Adjustment***

There is no tax credits assumed for Onshore Wind.

### **4.5.1.3 Offshore Wind – Floating**

#### ***Data Source***

In the First Cycle, NLR determined that the deep water surrounding O'ahu means Floating Offshore Wind is needed.<sup>31</sup> The source data for capital and fixed O&M costs for Floating Offshore Wind was provided by the 2024 NLR ATB. The capital costs were in Real 2022 dollars \$/kW. The fixed O&M costs were in Real 2022 \$/kW-year. The future trend for the capital and O&M costs was derived from the 2024 NLR ATB projections. The Real 2022 dollars were converted to nominal dollars by applying an escalation factor of 2.1%.

<sup>29</sup> RSMeans Building Construction Cost Data (BCCD) is a reference book for estimating construction costs in the U.S. and Canada.

<sup>30</sup> Accessible at: <https://tax.hawaii.gov/geninfo/renewable>

<sup>31</sup> Accessible at: <https://docs.nlr.gov/docs/fy22osti/80808.pdf>

**Location Adjustment**

The capital costs were converted to Hawai'i costs using a 35% factor from EIA for wind technology. The O&M costs were converted to Hawai'i costs using an 18.5% RSMeans factor. Location-specific interconnection costs were not included in the estimate.

**Investment Tax Credit Adjustment**

There is no tax credits assumed for Offshore Wind.

**4.5.1.4 Distributed Wind****Data Source**

The source data for capital and fixed O&M costs for Distributed Wind was provided by the 2024 NLR ATB. The capital costs were in Real 2022 dollars \$/kW. The fixed O&M costs were in Real 2022 \$/kW-year. The future trend for capital and O&M costs was derived from the 2024 NLR ATB projections. The Real 2022 dollars were converted to nominal dollars by applying an escalation factor of 2.1%.

**Location Adjustment**

The capital costs were converted to Hawai'i costs using a 35% factor from EIA for wind technology. The O&M costs were converted to Hawai'i costs using an 18.5% RSMeans factor. Location-specific interconnection costs were not included in the estimate.

**Investment Tax Credit Adjustment**

A 20% State ITC<sup>32</sup> is assumed for Distributed Wind.

**4.5.1.5 Geothermal****Data Source**

The source data for Geothermal capital, fixed and variable O&M were provided by the 2024 NLR ATB for Geothermal geo-hydro binary technology. The capital costs, O&M costs and fuel costs in ATB were given in Real 2022 dollars and converted to nominal dollars by applying an escalation factor of 2.1%.

**Location Adjustment**

A 20% EIA factor for Geothermal technology was used to convert capital costs to Hawai'i costs. Fixed O&M and variable O&M costs used an 18.5% RSMeans factor. Location-specific interconnection costs were not included in the estimate.

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<sup>32</sup> Accessible at: <https://tax.hawaii.gov/geninfo/renewable>

### ***Investment Tax Credit Adjustment***

There is no tax credits assumed for Geothermal.

#### **4.5.1.6 Biomass**

##### ***Data Source***

The source data for Biomass capital, fixed O&M, and variable O&M costs, as well as, Biomass fuel sources were provided by the 2024 NLR ATB for dedicated biomass technology. The capital costs, O&M costs, and fuel costs were given in Real 2022 dollars. The Real 2022 costs were converted to nominal dollars by applying an escalation factor of 2.1%.

##### ***Location Adjustment***

Nominal capital, O&M, and fuel costs for Biomass were converted to Hawai'i costs. The capital costs were converted using a 46% EIA factor. The O&M and fuel costs were converted to Hawai'i using an 18.5% RSMeans factor. Location-specific interconnection costs were not included in the estimate.

#### **4.5.1.7 Combustion Turbine and Combined Cycle with Synchronous Condenser Function**

##### ***Data Source***

The source data for Combustion Turbine (CT) and Combined Cycle (CC) capital, fixed O&M, and variable O&M costs were provided by the 2024 NLR ATB forecast. The capital costs, O&M costs, and fuel costs were given in Real 2022 dollars. The Real 2022 costs were converted to nominal dollars by applying an escalation factor of 2.1%.

##### ***Location Adjustment***

A 45% EIA factor for CT and CC technology was used to convert the capital costs to Hawai'i costs and an 18.5% RSMeans factor was used to convert the fixed O&M and variable O&M costs to Hawai'i costs. Location-specific interconnection costs were not included in the estimate.

#### **4.5.1.8 Internal Combustion Engine (ICE)**

##### ***Data Source***

The source data to estimate Internal Combustion Engine (ICE) technology was informed by actual costs for the Schofield Generating Station project constructed on O'ahu. The cost estimates were escalated from 2017 dollars by applying an escalation factor of 2.1%. The future cost trend was estimated using the cost trend for gas CT technology discussed above due to limited information on a future ICE capital cost trend.

#### 4.5.1.9 Battery Energy Storage

##### *Data Source*

The source data for Grid-Scale, Community-Scale, and Residential Battery Energy Storage Systems (BESS) was provided in the 2024 NLR ATB. Both the Balance of System cost, provided in \$/kW, and the Module costs, provided in \$/kWh, were provided in Real 2022 dollars. Embedded interconnection cost was removed from the estimate. The Real 2022 costs were converted to nominal dollars by applying an escalation factor of 2.1%.

##### *Location Adjustment*

The capital costs for Balance of System and Modules were converted to Hawai'i costs using a 32% EIA factor. Fixed O&M and variable O&M costs were converted to Hawai'i costs using an 18.5% RSMeans factor.

##### *Investment Tax Credit Adjustment*

There are no tax credits assumed for Battery Energy Storage, standalone or paired.

#### 4.5.1.10 Pumped Storage Hydro

##### *Data Source*

The source data for capital and fixed O&M costs for Pumped Storage Hydro was provided by the 2024 NLR ATB. The capital costs were in Real 2022 dollars \$/kW. The fixed O&M costs were in Real 2022 \$/kW-year. The future trend for capital and O&M costs was derived from the 2024 NLR ATB projections. The Real 2022 dollars were converted to nominal dollars by applying an escalation factor of 2.1%.

##### *Location Adjustment*

A 45% EIA factor for CT technology was used to convert the capital costs to Hawai'i costs and an 18.5% RSMeans factor was used to convert the fixed O&M and variable O&M costs to Hawai'i costs. Location-specific interconnection costs were not included in the estimate.

##### *Investment Tax Credit Adjustment*

There are no tax credits assumed for Pumped Storage Hydro.

# 5 Resource Potential and Renewable Energy Zones

## 5.1 NREL Solar and Wind Resource Potential Study Update

Similar to the First Cycle, the grid-scale solar and wind potential assumption garnered discussion amongst stakeholders, with varying perspectives on what can realistically be built due to land use and community issues. In the Second Cycle, the Company plans to continue to use the resource potential targets set by NLR in the First Cycle, but time permitting, we may use NLR to conduct an updated study of the resource potential. As mentioned in Section 5.2, in addition to the resource potential, the implementation bandwidth available to develop grid-scale projects should also be assessed in the modeling scenarios.

For the Second Cycle, Onshore wind on O'ahu is removed as a resource option due to the change in Honolulu County's land use regulations that increased the setbacks for wind turbines to a new distance that is the greater of 1.25 miles or 10 times their height, which will make it difficult for new projects to come online and existing facilities to be repowered.

## 5.2 Renewable Energy Zones

Renewable Energy Zones (REZ) are areas with high potential for clean energy generation, such as solar and wind, that can be connected to the system. Identification of REZ help to focus renewable energy development in areas where projects will be most efficient, cost-effective, and impactful.

In the First Cycle, Hawaiian Electric commenced a study to identify the REZ potential on the islands of O'ahu, Maui, and Hawai'i Island. The study allowed the Company and stakeholders to get an initial understanding of the transmission upgrade options to accommodate future amounts of grid-scale renewable energy. As an example, there are high amounts of solar potential on the west and north ends of O'ahu; however, there are currently no transmission lines in those areas. A REZ in those areas could be supported by extending the transmission system in order to facilitate further development of renewable energy. These transmission requirements and cost to interconnect various renewable energy zones served as an input to the RESOLVE model.

Since the conclusion of the First Cycle, the Commission's Inclinations have recognized that renewable energy zones can help streamline renewable project siting and interconnection while addressing community concerns. Governor's Executive Order 25-01 similarly encouraged Hawaiian Electric and State agencies to support the identification of renewable energy zones. Consistent with that direction, the Commission's 2024 Inclinations guided Hawaiian Electric to designate two renewable energy zones on O'ahu by the second

quarter of 2026. On June 30, 2026, the Company submitted its report titled, “Prioritizing and Advancing Renewable Energy Zones” as Attachment 1 in the IGP Action Plan 2026 Annual Update (Dkt. No. 2026-0001). In this report, the Company has designated REZ 1 and 6 on O’ahu as pilot zones for further near-term development. The work on these zones will also serve as an initial foray and lessons learned can be applied to future REZ-related development and decisions.

The additional scenario-planning work should also assess the implementation bandwidth available to develop Renewable Energy Zones (“REZs”). Because REZs can vary significantly in the amount and type of infrastructure required, depending on the level of capacity being added and the available interconnection capacity at the point of connection to the existing transmission system, the planning process should consider potential throughput limitations associated with REZ development. Key implementation constraints may include the availability of qualified labor and specialized resources, as well as the amount of capital that can be deployed to support multiple REZs in parallel. These factors could affect the pace, sequencing, and feasibility of developing REZs across the planning horizon.

Hawaiian Electric has conducted outreach through the Integrated Grid Planning (IGP) process, involving the Stakeholder Technical Working Group (STWG), Community Working Group (CWG), and other engagements with state agencies, state representatives, and local communities. Figure 5-1 shows a timeline of REZ engagement activities, which included educational sessions about REZ and the routing process, offering community members opportunities to provide input that will inform REZ identification and address specific community sensitivities. Community feedback helped Hawaiian Electric refine and prioritize locations and routes aligned with shared objectives. A dedicated webpage that focused on REZ was also developed to provide up-to-date information and accessible resources<sup>33</sup>.

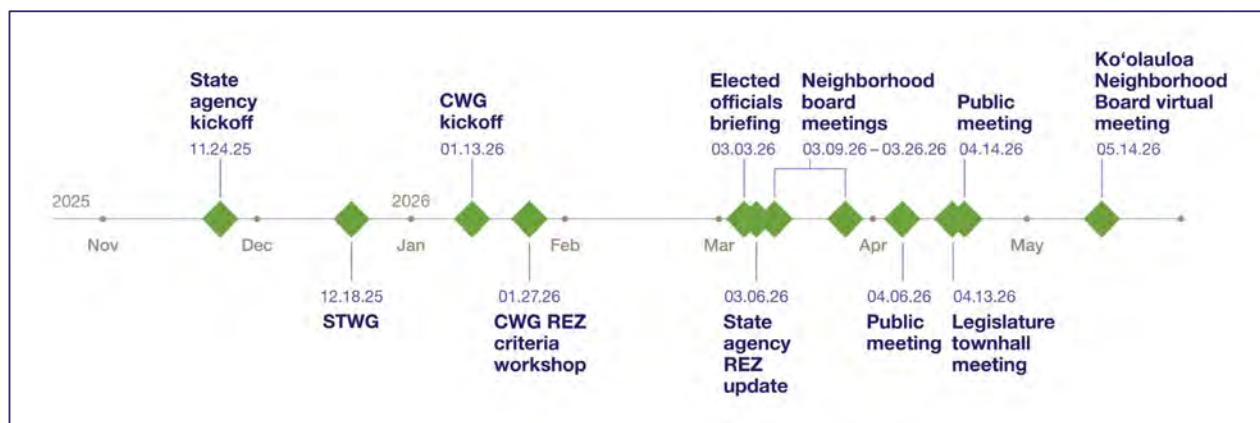


**Figure 5-1: Timeline of partner and public engagement in REZ planning**

<sup>33</sup> Available at: <https://hawaiipowered.com/rez/>



## 5.2.1 O'ahu Transmission REZ

### 5.2.1.1 First Cycle

In the First Cycle, based on the initial study, eight renewable energy zones were identified for O'ahu as shown below in Figure 5-2. Different transmission planning options required for fully developing the eight zones were studied, which can be found in our Grid Needs Assessment Methodology Review Point Book 2<sup>34</sup> which was filed with the Commission during the First Cycle.



Figure 5-2: O'ahu transmission REZ.

### 5.2.1.2 Second Cycle

On June 30, 2026, the Company filed a report titled Prioritizing and Advancing Renewable Energy Zones<sup>35</sup> with the PUC. In that report, the Company outlines the detailed analysis that was carried out and public comments received that resulted in the two zones that were recommended to the Commission. Ultimately, the Company recommended prioritizing Zone 1 and Zone 6 as pilot zones for near-term development. Given

<sup>34</sup> Available at: <https://www.hawaiianelectric.com/a/9997>

<sup>35</sup> Available at: <https://www.hawaiianelectric.com/a/16557>

the scale of renewable energy resources required to meet clean energy goals and requirements, the Company recognizes development of other larger areas requiring higher levels of transmission infrastructure will likely be required. However, through the near-term pilot zone development process, the Company and stakeholders involved in the process will gain valuable insights to apply to decisions and actions for future REZs that require larger investment, and larger land and community impacts.

## 5.2.2 Maui Transmission REZ

### 5.2.2.1 First Cycle and Second Cycle

In the First Cycle, based on the initial study, two REZ options were identified for the island of Maui and are shown below in Figure 5-3 and Figure 5-4. The transmission requirements from these two REZ options will be carried forward for the Second Cycle in order to augment generation resource costs. As the modeling process moves to the detailed system security study, the transmission requirements will be re-assessed based on the proxy generating resources selected in the generation resource portfolio, as well as current system configurations to get a better idea of the transmission resources needed to enable the preferred plan(s). Further information regarding the development of the REZ options for the island of Maui can be found in our Grid Needs Assessment Methodology Review Point Book 2<sup>36</sup> which was filed with the Commission during the First Cycle.

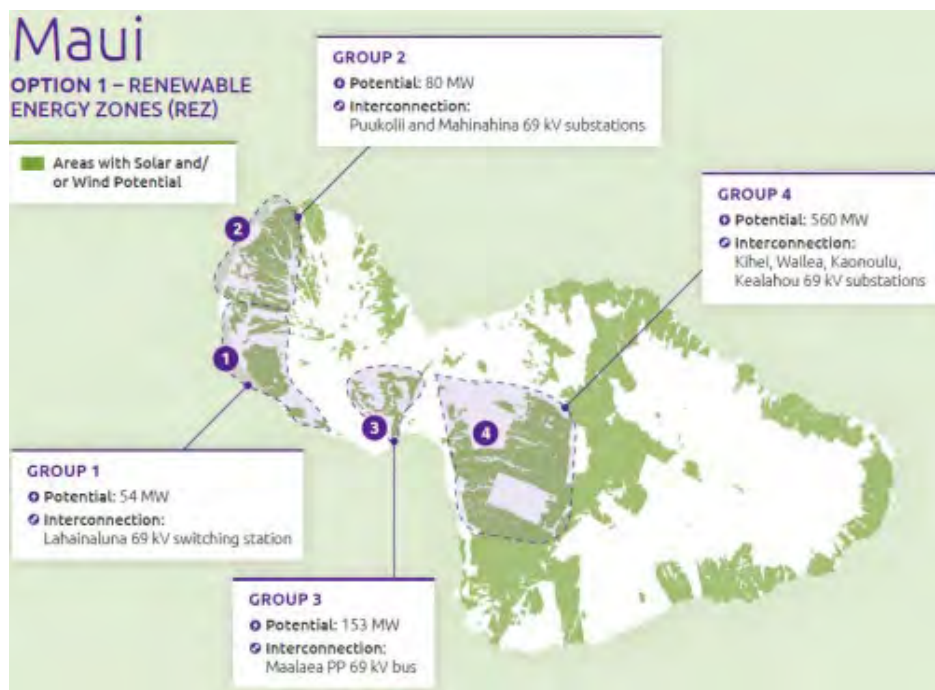


Figure 5-3: Island of Maui transmission REZ Option 1.

<sup>36</sup> Available at: <https://www.hawaiianelectric.com/a/9997>

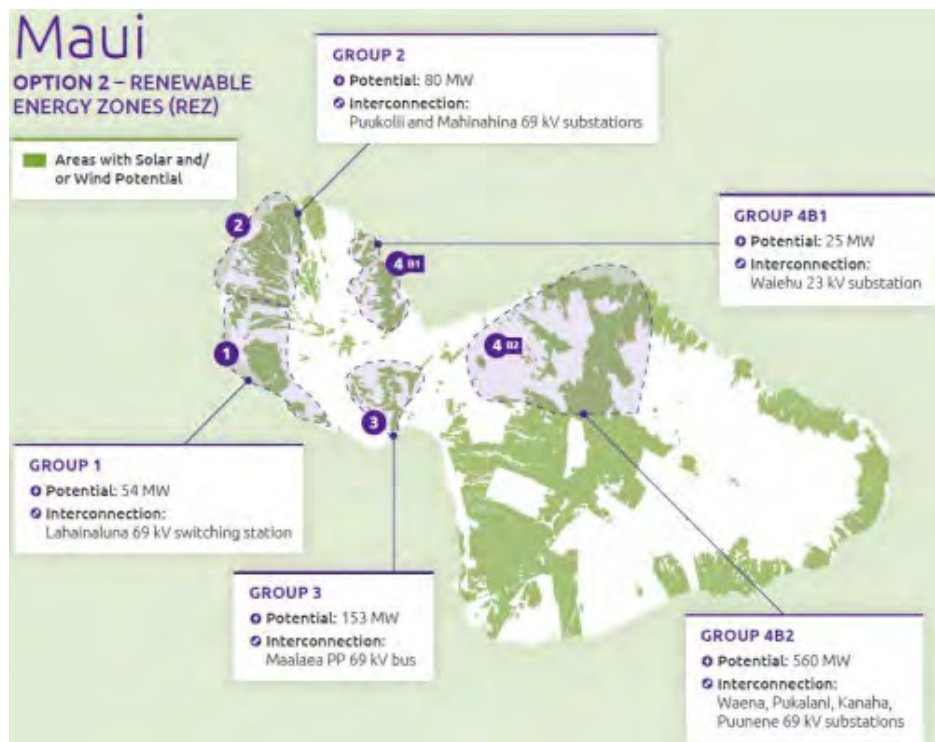


Figure 5-4: Island of Maui transmission REZ Option 2.

## 5.2.3 Hawai'i Island Transmission REZ

### 5.2.3.1 First Cycle and Second Cycle

In the First Cycle, based on the initial study, two REZ options were also identified for Hawai'i Island and are shown below in Figure 5-5 and Figure 5-6. Similar to the island of Maui, these two REZ options will be carried forward for the Second Cycle for the purposes of assessing generation resource portfolios with transmission-related costs. As the modeling process moves to the detailed system security study, the transmission requirements will be re-assessed based on the proxy generating resources selected in the generation resource portfolio, as well as current system configurations to get a better idea of the transmission resources needed to enable the preferred plan(s). Further information regarding the development of the REZ options for Hawai'i Island can be found in our Grid Needs Assessment Methodology Review Point Book 2<sup>37</sup> which was filed with the Commission during the First Cycle.

<sup>37</sup> Available at: <https://www.hawaiianelectric.com/a/9997>

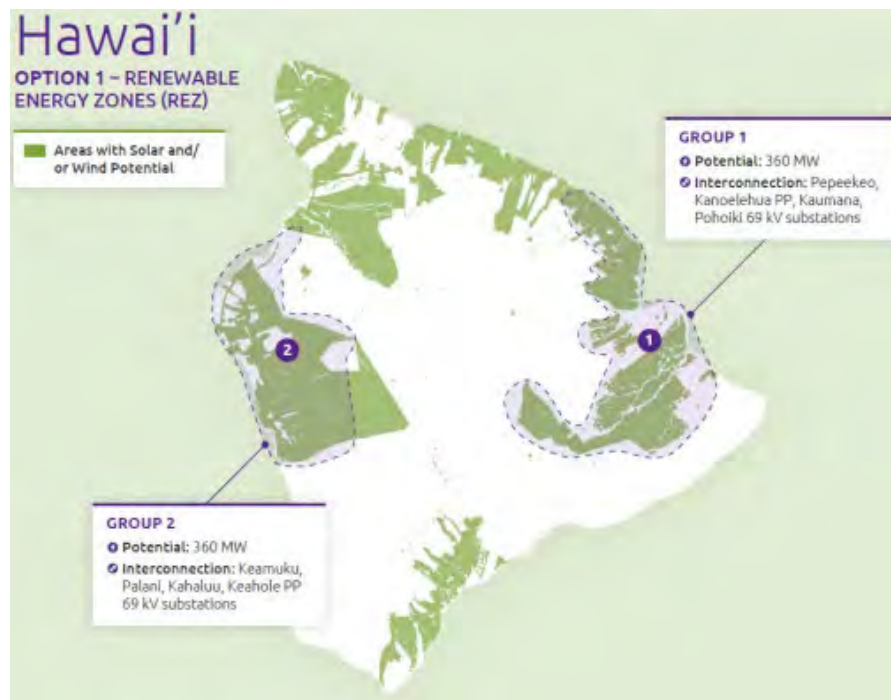


Figure 5-5: Hawai'i Island transmission REZ Option 1.

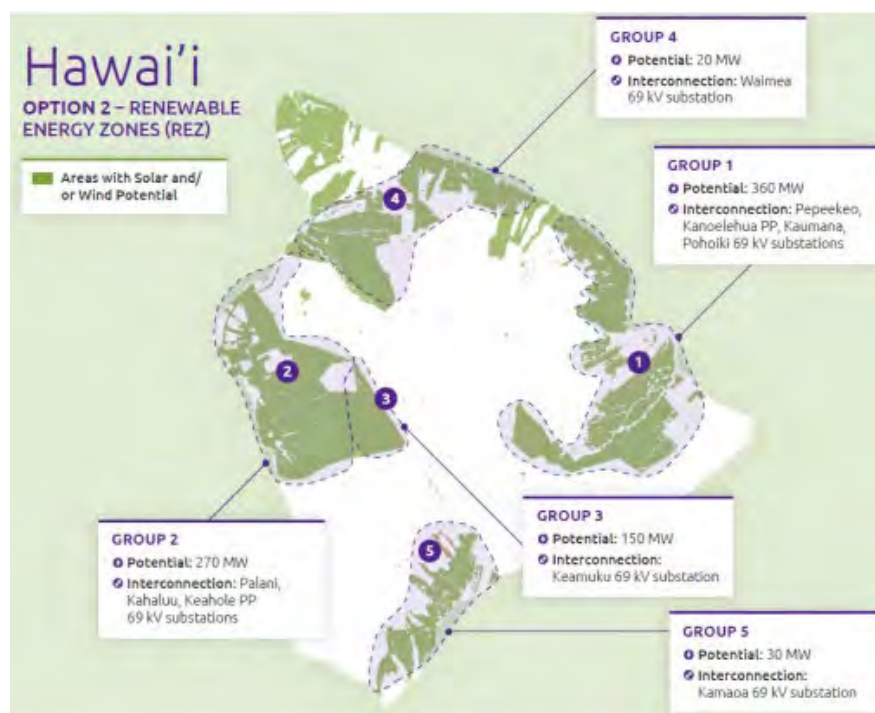


Figure 5-6: Hawai'i Island transmission REZ Option 2.

# 6 Thermal Generating Unit Portfolios

Hawaiian Electric's thermal generating unit capacity is provided by a mix of utility-owned generation and independent power producers (IPPs). Key inputs to characterize the operation of the utility-owned generation include the minimum and maximum capacity, operating fuel, heat rate coefficients, planned maintenance outages, forced outage rates, and maintenance outage rates. These inputs, as well as other generator characteristics, are provided in Workbook 1.

## ***Assumed Start/End Date***

For resources that have PPAs but are currently not operational, the expected Commercial Operation Date (COD) is provided. For potential future resources that can be selected by RESOLVE, the earliest COD we are assuming is provided.

For existing resources, Hawaiian Electric may make certain planning assumptions on the retirement or removal from service of existing units to determine resulting grid needs. To the extent that these assumptions are not being driven by hard requirements such as environmental compliance, these are assumptions made just for planning purposes and should not be perceived as firm commitments to retire units. Firm commitments to retiring a generating unit need to be flexible and contingent upon the successful procurement and commercial operation of new resources.

## ***Minimum and Maximum Capacity***

The minimum and maximum capacity of a generating unit define its dispatchable range. For potential future resources that can be selected by RESOLVE, the information provided represents the maximum and minimum size of a single resource and not the full resource potential.

## ***Operating fuel***

Operating fuel of a generating unit is the fuel assumed to be used by the generator.

## ***Heat Rate Coefficients***

The heat rate coefficients define the heat input function  $y = cx^2 + bx + a$ , where  $y$  is the amount of fuel consumed to produce at the megawatt level,  $x$ , for one hour.

## ***Maintenance Outages and Forced Outages***

Maintenance outages can be defined as discrete occurrences with a start date and duration or can be defined as a percentage of the year that the unit will be out of service on maintenance based on historical data. Forced outages are unexpected and unplanned generating unit outages and are defined as a percentage of the year that the unit may experience a forced outage based on historical data.



In the 2024 IGP Action Plan Annual Update, Hawaiian Electric continued to refine its probabilistic resource adequacy methodology by incorporating the modeling of partial outages based on 2022-2023 outage data. This was an improvement from prior modeling where partial outages were represented by equivalent full unit outages. By directly modeling partial outages, the model can more accurately represent actual outages as they have occurred in the past.

In this IGP cycle, we will expand on what was done in the 2024 IGP Action Plan Annual Update by also including 2024 outage data. Maintenance outage rates for our existing generators will be based on historical maintenance outage events from years 2022-2024 and include both full maintenance outages and derated maintenance outages. Similarly, forced outage rates for our existing generators will be based on historical forced outage events from years 2022-2024 and include both full forced outages and derated forced outages.

# 7 Thermal Generating Unit Removal from Service Schedules

The planned removal from service schedules for O'ahu, Hawai'i Island, and Maui are provided below. These schedules represent initial assumptions made on the timing for the removal of utility-owned, thermal generating units. Actual retirement decisions are operational decisions that will be made at a later date based on several factors, including whether sufficient resources have been acquired and are in service, ancillary services provided by these generators have been sufficiently replaced, and consideration for reliability and resilience factors, among others.

The planning analysis in the Grid Needs Assessment may deem it prudent to delay certain units' removal to address shortfalls in grid services. The order in which units are removed may be further adjusted to account for flexibility needs and unit age.

*Table 7-1: Planned removal from service assumptions for O'ahu, Hawai'i Island, and Maui.*

| Year | O'ahu     | Hawai'i Island                | Maui                     |
|------|-----------|-------------------------------|--------------------------|
| 2027 |           |                               | Kahului 4                |
| 2028 |           | Hill 5-6                      | Kahului 1-2<br>Kahului 3 |
| 2029 | Waiau 5-6 |                               |                          |
| 2030 |           |                               | Maalaea 11               |
| 2031 | Waiau 7-8 | Kanoelehua CT1<br>Keāhole CT2 |                          |
| 2032 |           |                               | Maalaea 10               |
| 2033 | Kahe 1-2  |                               |                          |
| 2035 |           |                               | Maalaea 12-13            |
| 2037 | Kahe 3-4  |                               | Maalaea 7                |
| 2046 | Kahe 5-6  |                               |                          |

## 8 Variable Renewable, Storage, and Grid Service Resource Portfolios

In addition to the thermal generating units, Hawaiian Electric has a diverse range of utility-scale variable renewable resources including wind, solar, and hydro in its portfolio. Several upcoming projects will also add storage to the resource mix, paired with solar or as a standalone resource. Workbook 1 presents the utility-scale renewable, storage, and grid-service resources that are assumed to be online in the RESOLVE and PLEXOS models and are either existing resources that are currently online or have an application submitted for approval. The inputs are similar to the inputs provided above for the thermal units. These resources are in addition to distributed resources which are included in the load forecast.

Workbook 2 provides the unitized hourly profile for each variable renewable generator. The unitized hourly profile multiplied by the maximum capacity results in the hourly available energy. Workbook 2 also provides the historical profile from years 2015-2019. For existing wind resources, the historical data was from actual historical measurements. For new wind resources, the historical data was from the NLR Wind Resource Database (WRDB). For solar resources, the historical data was from NLR National Solar Radiation Database (NSRDB).



## 9 Greenhouse Gas Emissions

The total Project Greenhouse (“GHG”) Lifecycle emissions (“emissions”) are estimated using the GHG Emissions Analysis approach (“Analysis”) that is standard for most projects submitted by Hawaiian Electric to the Commission. This approach addresses the Project’s Upstream, Construction, Operations, and Downstream Stages, as shown in Figure 9-1 and Figure 9-2.

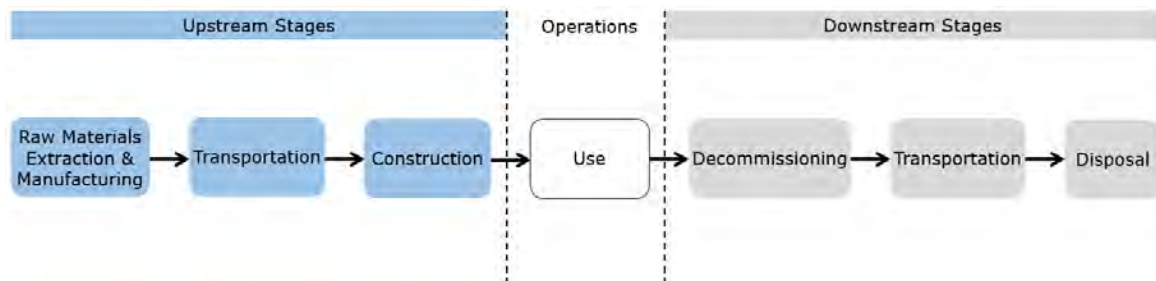


**Figure 9-1: Stages for consideration in general GHG lifecycle emissions estimation.**

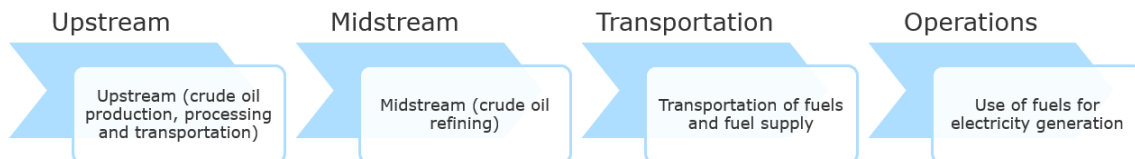


**Figure 9-2: Stages for consideration in GHG lifecycle emissions estimation for fuel.**

Greenhouse gas lifecycle analyses rely on a consistent set of assumptions and input data to estimate GHG emissions across all stages of a product or fuel’s life.

Since many of the specifics including equipment, fuel source, and generation station location, are unknown during the early stages of the IGP process before specific projects are selected through the RFP process, Hawaiian Electric relies on emissions factors found in the published literature, default emissions factors, or previously conducted analyses for low sulfur fuel oil (“LSFO”), diesel, ultra-low sulfur diesel (“ULSD”), naphtha, intermediate fuel oil (“IFO”), biodiesel, biomass (agriculture and forest products), geothermal energy, and liquid natural gas (“LNG”), to reasonably present emissions estimates from these resources for stages prior to the selection of projects during the RFP process.

When each project application is filed with the Commission, a GHG analysis specific to each project that requires an analysis is performed and tailored to the project and site-specific inputs and assumptions.

For existing generation facilities, GHG lifecycle emissions are estimated from the emissions generated by facility operations, primarily from the upstream, midstream, transport, and combustion of the fuel used in the facilities.

The fuel's upstream GHG emissions include the extraction, production, and transportation of crude oil/stock to refineries, where it would be refined into fuels. The fuel's Midstream GHG Emissions include the refining of crude oil/stock into the fuels required by the Companies. The Operations stage of GHG Emissions are assumed to equal the direct generation (i.e., combustion) emissions and are calculated based on the combustion emissions of the fuel that would be consumed at the Companies' system facilities.

### 9.1.1 Emission Factors for Fuels

Emissions factors are provided in Workbook 5. The emissions factors proposed represent reasonable estimates for the early stages of the IGP where specific and accurate information is currently unavailable. Therefore, Hawaiian Electric will rely upon the above referenced literature and other well-established and published literature to present the best available GHG lifecycle emissions estimate at this time.

When each project application is filed in front of the Commission, the GHG analysis specific to each project that requires an analysis will be performed and tailored to the project and site-specific inputs and assumptions.

#### 9.1.1.1 Fossil Fuels (LSFO, Diesel, ULSD, IFO, Naphtha)

For fossil fuel, the majority of the GHG emissions will be generated from the combustion of the fuel itself, which will be calculated based on emissions factors found in 40 CFR Part 98.<sup>38</sup> To estimate GHG emissions from the upstream lifecycle stages of the fuel, Hawaiian Electric will reference the analysis that was previously submitted with the GHG lifecycle analysis for PAR Fuel contract in Docket No. 2022-0014.

#### 9.1.1.2 Natural Gas

Hawaiian Electric looked at GHG Lifecycle Emissions Factors for Natural Gas fired Generating Unit based on published studies by NLR<sup>39</sup> median of the harmonized<sup>40</sup> values. In the lifecycle assessment harmonization study referenced above, NLR reviewed and harmonized life cycle assessments of electricity generation technologies to reduce uncertainty around estimates for environmental impacts and increase the value of these assessments to the policy making and research communities.

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<sup>38</sup> Accessible at: <https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-98>

<sup>39</sup> NLR. September 2021. Life Cycle Greenhouse Gas Emissions from Electricity Generation: Update. Accessible at: <https://docs.nlr.gov/docs/fy21osti/80580.pdf>

<sup>40</sup> Harmonization refers to an analytical procedure used to align, standardize, and reconcile conflicting or highly variable results from different, independent studies

### 9.1.1.3 Biomass

Biomass (agricultural and forest residues) emissions factor is taken from the median values of lifecycle phases also published by NLR.<sup>41</sup> This emissions factor excludes emissions from combustion of the biomass. In this study NLR specifies biomass resources as agricultural and forest residues.<sup>42</sup>

Further, to complete the lifecycle, the emissions from the combustion stage of the biomass (agricultural and forest residues) are calculated from the default emission factors in 40 CFR Part 98 Subpart C Table C-1 and Table C-2.

### 9.1.1.4 Biodiesel

The combustion portion of biodiesel is estimated based on 40 CFR Part 98 emissions factors while the upstream portion of the fuel is estimated based on Argonne National Laboratory's Greenhouse gases, Regulated Emissions, and Energy use in Transportation Model ("GREET"). These sources were utilized to conduct the GHG lifecycle analysis for Hawaiian Electric's Biodiesel fuel contract, submitted as part of Docket No. 2025-0217.

### 9.1.1.5 Geothermal

Geothermal emissions factor is taken from the median values of lifecycle phases as published by NLR.<sup>43</sup>

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<sup>41</sup> Accessible at: <https://docs.nlr.gov/docs/fy21osti/80580.pdf>

<sup>42</sup> NLR. 2012. Renewable Electricity Futures Study. Volume 1 of 4. Accessible at: <https://docs.nlr.gov/docs/fy12osti/52409-1.pdf>

<sup>43</sup> Accessible at: <https://docs.nlr.gov/docs/fy21osti/80580.pdf>

# Appendix A:

## Underlying Sales Forecast

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# 1 Underlying Forecast

The sales forecasts were developed for each of the five islands beginning with the development of the sales forecast by rate class (residential, commercial and street lighting) and by layer (underlying load forecast and adjusting layers – EE, DER, and EV). Key factors that affect sales in the future are identified such as the economic outlook, analysis of existing and proposed large customer loads, and impacts of customer-sited technologies such as energy efficiency measures, distributed energy resources and emerging technologies such as electric vehicles. This section focuses on the development of the underlying sales forecast which excludes impacts from previously installed and future DER, EE, EV, and CBRE.

A description of the assumptions and models used to develop the underlying forecasts by rate class for O‘ahu, Hawai‘i, Maui, Moloka‘i and Lāna‘i are provided below under each island’s section.

## Methods

Multiple methods and models were analyzed to develop the underlying forecasts as one model does not fit all. The available methods, which are consistent with the First Cycle, are described below and were presented in the February 26, 2026 STWG meeting<sup>1</sup>. More than one model or method may be used to blend together a short-term forecast with a long-term forecast. Methods for the underlying layer include:

**Market analysis** - a ground up forecast evaluating individual customers, particularly large commercial customers, forecasting individual projects or awareness of events that may merit a specific carve out if significant, i.e. new large projects or loss of large loads.

**Customer service** - analysis of recent trends in customer counts, sales and use per customer and applies knowledge of local conditions such as construction activity, state of the visitor industry, trends in weather including impacts of storms and volcanic eruptions.

**Trending models** – uses historical data series to project future sales or customer counts. Works well when historical data series has identifiable patterns and future trends aren’t expected to vary significantly from the past.

**Econometric models** – relates sales or customers’ use of electricity to macroeconomic variables such as personal income, jobs, population and visitor arrivals as well as other variables such as temperature, humidity or electricity price. Econometric models may also incorporate time series parameters such as lagged dependent variables or an autoregressive term. The quantification of the impact of changes in economic and other variables on use is the strength of these models.

The econometric model is specified in the following form:

$$Y = \beta_0 + \sum_{i=1}^n (\beta_i \times X_i)$$

<sup>1</sup> See <https://www.hawaiianelectric.com/a/16206>



where the dependent variable,  $Y$ , is kWh sales or use per customer and is related to the independent (explanatory) variables,  $X_i$ , which represent economic or other variables. Variables  $\beta_i$  represent the regression model coefficients. The constant variable  $\beta_0$  represents the Y-intercept.

Various models are evaluated for best fit and explanatory power however, it is important to assess if the models make sense. Is it reasonable to believe that electricity sales are related to the external variables in the model? Is the direction of the relationship plausible?

### ***Economic Driver Forecast and Scenarios***

The University of Hawai'i Economic Research Organization (UHERO) developed forecasts of key economic indicators such as population, income, jobs, and visitor arrivals for each county as part of their Q2 2026 UHERO Forecast for the State of Hawai'i. In addition, UHERO extended their base economic forecasts to 2065 and developed low and high forecast scenarios for each county for 2026-2065. These UHERO forecast scenarios were used as inputs in the econometric models for electricity sales or use per customer to develop base, high and low underlying sales scenarios. The corresponding UHERO reports are provided in Appendix B.

### ***Weather Assumptions***

A monthly 20-year (2006 through 2025) averaged weather profile, including a warming trend, was used as the forecasted weather assumption for monthly econometric models. The warming trend is based on the RCP 4.5 climate scenario statistically downscaled future climate projections provided on the Hawai'i Climate Data Portal<sup>2</sup>. The resulting warming trend, applied to the Second Cycle forecasts, assumed 2.26 degree F [Fahrenheit] increase over the 40-year period beginning at the midpoint of 2006-2025 (2015 midpoint) and ending at the midpoint of the 2040-2069 time period (2055 midpoint).

### ***COVID Variables***

One set of variables included in several of the selected econometric models to account for the impacts of the COVID-19 pandemic is referred to in this report as "Google Mobility."<sup>3</sup> In response to the COVID-19 pandemic, Google published anonymized, aggregated locational mobility data collected from Google services, such as Google Maps, until October 2022. Per Google, the Google Mobility data "charted movement trends over time by geography, across different categories of places such as retail and recreation, groceries and pharmacies, parks, transit stations, workplaces, and residential." Each island reassessed their mobility data's impact to their sales forecast and included an assumption on whether mobility levels returned to pre-pandemic levels beginning in November 2022 or had a persisting "new normal" effect.

<sup>2</sup> <https://www.hawaii.edu/climate-data-portal/>

<sup>3</sup> See <https://www.google.com/covid19/mobility/?hl=en>

## 1.1 O‘ahu Underlying Forecast

Econometric methods were used for deriving the underlying sales for both the residential and commercial sectors. Historical sales used in econometric models were adjusted to remove sales impact of DER, EE, EV, and CBRE, which are treated as separate layers.

### Residential Sales

The residential econometric equation was specified using a monthly use per residential customer in kilowatt-hours (kWh). The monthly econometric model describes residential electricity use per customer as a function of a temperature humidity index, electricity price and real personal income per capita as these variables were all found to have relationships with residential use per customer. To account for changes in electricity use during the COVID-19 pandemic, a residential Google mobility variable was used, as was a dummy variable to account for a period of increased income from COVID-19 related assistance, that did not coincide with an increase in electricity consumption. In addition, monthly dummy variables were included in the model to improve the model statistics.

The specification and evaluation of the hypothetical relationships was performed using a proprietary software package, MetrixND from Itron, Inc. MetrixND is a statistical analysis package which allows Hawaiian Electric to conduct analyses and statistical testing of econometric models. Many hypothetical relationships were considered, tested, and rejected until econometric equations for residential use per customer and commercial kWh sales were identified for use in Hawaiian Electric’s sales projections.

*Table 1-1: O‘ahu residential customer econometric sales model variables.*

| Variables                                                   | Description                                                                                                                                                                                                                                                                                                                | Source                                                        |
|-------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                                         |                                                                                                                                                                                                                                                                                                                            |                                                               |
| Monthly Residential Use Per Customer                        | Monthly residential kWh sales divided by number of residential customers                                                                                                                                                                                                                                                   | Hawaiian Electric’s monthly reports filed with the Commission |
| Weather Variables:                                          |                                                                                                                                                                                                                                                                                                                            |                                                               |
| Monthly Weighted THI                                        | Composite weather variable incorporating both temperature and humidity.<br><br>$THI = 17.5 + (0.55 * \text{Avg Temperature}) + (0.20 * \text{Dewpoint})$<br><br>Forecast uses 20-year average (2006–2025) of average temperature and dewpoint to calculate THI. Warming trend included in forecasted average temperatures. | Historical HNL airport data from NOAA                         |
| Economic Variables:                                         |                                                                                                                                                                                                                                                                                                                            |                                                               |
| Real Residential electricity price, 12-month moving average | Real Residential \$ (1982–84=100) per kWh                                                                                                                                                                                                                                                                                  | Growth rates based on First Cycle results                     |
| Real personal income per capita, 12-month moving average    | Real personal income (1982–84=100) ÷ Resident population                                                                                                                                                                                                                                                                   | UHERO, May 2026                                               |

|                          |                                                                                                            |        |
|--------------------------|------------------------------------------------------------------------------------------------------------|--------|
| Google Mobility          | Google Mobility Residential Index<br>[Indexed value ranging from 0 to 1]                                   | Google |
| Dummy Variables:         |                                                                                                            |        |
| COVID Income Boost dummy | Covers period of time where incomes were temporarily boosted by COVID-related programs (Dec 2020-Jul 2022) | n/a    |
| Monthly dummy variables  | All months except February                                                                                 | n/a    |

To arrive at sales per month, the monthly use per residential customer derived in MetrixND was multiplied by the number of residential customers. The number of customers per month was derived using a linear trend time series model based on historical residential customer data from January 2010 through December 2024.

The resulting residential GWh underlying sales forecast is residential kWh use per customer  $\div 10^6 \times$  number of customers. Growth rates from the econometric forecast are applied to the underlying sales to extend the forecast out to the full forecast horizon.

### Commercial Sales

The econometric model used for underlying commercial sales was run for the combined rate schedules applied to small, medium and large commercial customers excluding street lighting rather than for individual rate schedules (Schedules G, J, P, DS and U) as it typically has stronger explanatory relationships since O'ahu commercial customers historically tend to transfer between commercial rate schedules on a regular basis (based on tariff requirements). The underlying commercial sales econometric equation was specified using monthly sales in kWh. The monthly econometric model describes electricity sales as a function of a temperature humidity index, personal income, visitor arrivals, and non-agricultural jobs as these variables were all found to have relationships with commercial sales. In addition, monthly binary dummy variables representing February, April, June, August and October and the COVID income boost variable also used in the residential model.

*Table 1-2: O'ahu commercial customer econometric sales model variables.*

| Variable             | Description                                                                                                                                                                                                                                                                                                                                               | Source                                                        |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:  |                                                                                                                                                                                                                                                                                                                                                           |                                                               |
| Commercial Sales     | Commercial recorded kWh sales (2013 -2025)                                                                                                                                                                                                                                                                                                                | Hawaiian Electric's monthly reports filed with the Commission |
| Weather Variables:   |                                                                                                                                                                                                                                                                                                                                                           |                                                               |
| Monthly Weighted THI | Composite weather variable to incorporate both temperature and humidity.<br><br>Wtd THI = $17.5 + (0.55 * \text{Wtd Avg Temperature}) + (0.20 * \text{Wtd Dewpoint})$<br><br>Forecast uses 20-year average (2006-2025) of weighted average temperature and weighted dewpoint to calculate THI. Warming trend included in forecasted average temperatures. | Historical HNL airport data from NOAA                         |
| Economic Variables:  |                                                                                                                                                                                                                                                                                                                                                           |                                                               |

|                                       |                                                                                                            |                 |
|---------------------------------------|------------------------------------------------------------------------------------------------------------|-----------------|
| Personal Income, 12-mo moving average | Personal Income for O'ahu                                                                                  | UHERO, May 2026 |
| Visitor Arrivals                      | Monthly visitor arrivals, O'ahu                                                                            | UHERO, May 2026 |
| Non-Ag Jobs                           | Non-agricultural job counts                                                                                | UHERO, May 2026 |
| Dummy Variables:                      |                                                                                                            |                 |
| Monthly dummy variables               | February, April, June, August, and October                                                                 | na              |
| COVID Income Boost dummy              | Covers period of time where incomes were temporarily boosted by COVID-related programs (Dec 2020-Jul 2022) | n/a             |

The resulting commercial GWh sales forecast is commercial kWh underlying sales forecast  $\div 10^6$ . Adjustments were made to include known large projects. Growth rates from the econometric forecast are applied to the 2025 underlying sales to extend the forecast out to the full forecast horizon.

### Street Lighting Sales

Sales for street lighting are less sensitive to changes in economic and weather drivers than sales in other rate schedules and represent less than 0.5% of Hawaiian Electric's sales. Consequently, an econometric or modeled approach to forecasting Schedule F sales was not developed. The forecast is consistent with the last several years which has seen essentially no growth in sales for street lighting.

### Total Underlying Sales and Scenarios

The total underlying sales are the sum of the underlying sales for all rate schedules. The figure below shows the total underlying sales for the base, high and low scenarios. The data for the full forecast period is provided in Load Forecasts Workbook 3d.

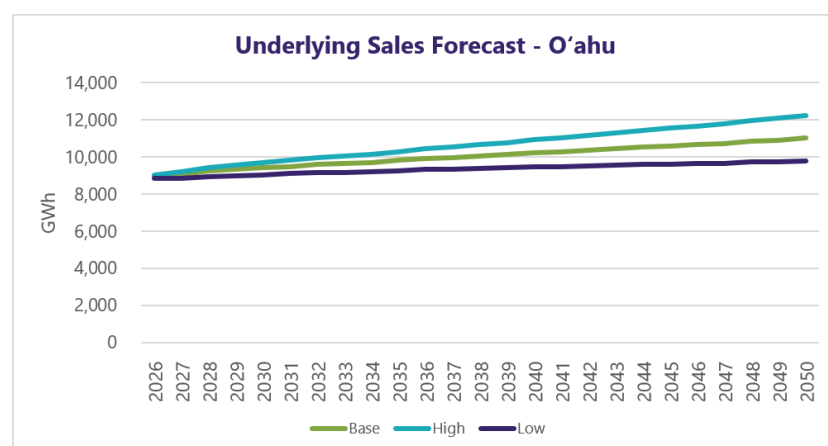


Figure 1-1: Underlying Electric Sales Forecast, O'ahu

## 1.2 Hawai‘i Underlying Forecast

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For Hawai‘i Island the underlying forecast is developed by rate class - residential, small and medium commercial, large power and street lighting. Similar to O‘ahu, historical sales used in the models were adjusted to remove sales impact of DER, EE, EV and CBRE.

### ***Residential Sales***

The residential underlying sales forecast is developed using a combination of two forecast methods, the customer service method in the near term (2026) and then an econometric model for the remainder of the forecast period. The customer service method allows for factors including knowledge of local economic conditions such as construction activity, the state of the visitor industry and a review of weather conditions as well as other island specific circumstances to be considered in the analysis. At the time the underlying forecast was developed, actual Schedule R data was available through March 2026, which was used to inform the forecast for 2026.

The customer service method for residential sales examines historical and recent trends in customer count growth and underlying average use (kWh sales) per customer. The forecasted number of customers multiplied by the forecasted average use per customer results in the forecasted residential underlying sales for 2026.

The residential econometric equation is specified using adjusted residential class underlying monthly average use (kWh sales) per customer. The adjusted average use per customer is the monthly residential kWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV and CBRE) divided by the monthly number of residential customers to result in underlying residential average use.

The monthly econometric model describes residential electricity use per customer as a function of real personal income per capita, monthly visitor arrivals to the County and electricity price. To account for changes in electricity use during the COVID-19 pandemic, a residential Google mobility variable was also used. A temperature humidity index (THI) weather variable is also included as part of two interaction variables. In recognition of the climate differences between the Hilo and Kona sides of the island, the Hilo and Kona weather data is weighted based on historical sales by region and weighted weather variables are utilized in the model. For the forecast years, the weighting is a five-year historical average (2021-2025). The two interaction variables are 1) a dummy variable for air conditioning adoption from June 2015-on, interacted with weighted THI and 2) a dummy variable for July through October (hotter more humid months) interacted with weighted THI to capture weather driven impacts of air conditioning and weather driven usage impacts in the warmer more humid months. These variables were all found to have relationships with residential use per customer. In addition, three sets of binary dummy variables were created – 1) monthly dummy variables representing individual months of the year, excluding February, used to account for seasonal variations, 2) a monthly dummy variable from October 2017 onwards in recognition of the policy change in the timing of transferring customers from a temporary service under commercial rate Schedule G to the residential rate Schedule R, 3) a monthly dummy variable from May 2018-on to capture impacts of additional air conditioners and air purifiers installed as a result of the Leilani Estates volcanic eruption at that time, and 4) a monthly dummy variable from November 2022-on to capture the post-COVID “new normal” behavior after the end of the Google mobility variable.

The specification and evaluation of the hypothetical relationships was performed using a proprietary software package, MetrixND from Itron, Inc. Many hypothetical relationships were considered, tested, and rejected until econometric equations for residential use per customer and commercial kWh sales were identified for use in Hawaiian Electric's sales projections.

Additional details on each variable, dependent and independent, used in deriving the monthly residential customer sales and the source of the information are shown below.

*Table 1-3: Hawai'i Island residential econometric sales model variables.*

| Variable                                                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Source                                                    |
|---------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
| Dependent Variable:                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                           |
| Monthly Residential Use Per Customer                                | Monthly residential recorded kWh sales divided by monthly number of residential customers                                                                                                                                                                                                                                                                                                                                                                                                  | Monthly Residential Use Per Customer                      |
| Economic Variables:                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                           |
| Real Annual Income Per Capita, 12-month moving average              | Real Personal Income (1982-84 = 100) ÷ Resident Population (Hawai'i County)                                                                                                                                                                                                                                                                                                                                                                                                                | UHERO, May 2026                                           |
| Monthly Visitor Arrivals                                            | Visitor Arrivals (Hawai'i County), allocated to monthly values using historical patterns                                                                                                                                                                                                                                                                                                                                                                                                   | UHERO, May 2026                                           |
| Real Monthly Residential Electricity Price, 12-month moving average | Real residential dollars per kwh (1982-84=100) (Hawai'i Island)                                                                                                                                                                                                                                                                                                                                                                                                                            | Growth rates based on First Cycle results                 |
| Google Mobility                                                     | Google Mobility Residential Index [Indexed value ranging from 0 to 1]                                                                                                                                                                                                                                                                                                                                                                                                                      | Google                                                    |
| Weather Interaction Variables:                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                           |
| Monthly Weighted THI x AC dummy                                     | <p>Composite weather variable to incorporate both temperature and humidity interacted with AC dummy variable</p> <p><math>Wtd\ THI = 17.5 + (0.55 * Wtd\ Avg\ Temperature) + (0.20 * Wtd\ Dewpoint)</math></p> <p>Forecast uses 20-year average (2006-2025) of weighted average temperature and weighted dewpoint to calculate THI. Warming trend included in forecasted average temperatures.</p> <p>AC Dummy is a proxy for impacts of increased a/c installs beginning in June 2015</p> | Historical airport weather data (Hilo and Kona) from NOAA |
| Monthly Weighted THI x Summer months dummy                          | Composite weather variable to incorporate both temperature and                                                                                                                                                                                                                                                                                                                                                                                                                             | Historical airport weather data (Hilo and Kona) from NOAA |

| Variable                                              | Description                                                                                                                                                                     | Source                                                                                                                                                                |
|-------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                       | humidity interacted with Summer months dummy variable<br><br>Summer Months dummy is a proxy for the impact of hotter more humid summer weather which is defined as July-October |                                                                                                                                                                       |
| Dummy Variables:                                      |                                                                                                                                                                                 |                                                                                                                                                                       |
| Monthly dummy variables                               | Dummy variable for each individual month to account for seasonal variation, excluding February                                                                                  | na                                                                                                                                                                    |
| Dummy variable for Schedule G to Schedule R transfers | October 2017-on, proxy for policy change for transfer of temporary Schedule G (construction accounts) to Schedule R                                                             | The historical sales data series was adjusted for known transfers, but the dummy variable reflects the change in the transfer process and picks up additional effects |
| Dummy variable starting in May 2018                   | Proxy for additional air conditioners and air purifiers installed as a result of the Leilani Estates volcano eruption                                                           | na                                                                                                                                                                    |
| Dummy variable starting in November 2022              | Proxy for post-covid "new normal" behavior                                                                                                                                      | na                                                                                                                                                                    |

The resulting monthly residential use per customer from the econometric model are then multiplied by the monthly customer count forecast to derive monthly sales which are then summed to annual sales forecast values. The year-over-year growth rates from the annual sales are then applied to the 2026 customer service forecast to extend the forecast to 2050.

### ***Small and Medium Commercial Sales (Rate Schedules G and J)***

The small/medium commercial underlying sales forecast is developed using a combination of two forecast methods, the customer service method in the near term (2026) and then applying year over year growth rates from an econometric model for the remainder of the forecast period. The customer service method allows for factors including knowledge of local economic conditions such as construction activity, the state of the visitor industry, a review of weather conditions, and other island specific circumstances to be considered in the analysis. At the time the underlying forecast was developed, actual Schedule G/J data was available through March 2026, which was used to inform the forecast for 2026.

The customer service method for small/medium commercial sales examines historical and recent trends in customer count growth and underlying average use (kWh sales) per customer similar to the approach for residential sales. Careful analysis of both customer counts underlying average use through March 2026 examining both year-to-date and recent monthly trends in year-over-year changes was undertaken. Forecasted 2026 underlying average use was forecasted taking these factors into consideration. The forecasted number of customers multiplied by the forecasted average use per customer results in the forecasted small/medium commercial underlying sales for 2026.

The Schedule G/J econometric equation is specified using adjusted small/medium commercial class sales per month in megawatt-hours (MWh). The adjusted sales are the monthly Schedule G/J MWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV and CBRE) to result in underlying Schedule G/J sales. This also includes impacts from significant transfers between rate classes, to reflect the accounts currently in the rate class.

The monthly econometric model describes Schedule G/J electricity sales as a function of real personal income per capita, non-farm jobs, electricity price and weather variables (temperature humidity index and precipitation). In recognition of the climate differences between the Hilo and Kona sides of the island, the Hilo and Kona weather data is weighted based on historical sales by region and weighted weather variables are utilized in the model. For the forecast years, the weighting is a five-year historical average (2021-2025). These variables were all found to have relationships with Schedule G/J sales. To account for changes in electricity use during the COVID-19 pandemic, a retail Google mobility variable was also used. In addition, three sets of binary dummy variables were created – 1) monthly dummy variables representing individual months of the year, excluding February, used to account for seasonal variations, 2) a monthly dummy variable from November 2022-on to capture the post-covid “new normal” behavior after the end of the Google mobility variable and 3) a dummy variable in February of historical leap years to account for leap day.

Additional details on each variable, dependent and independent, used in deriving the monthly small/medium commercial sales including the name of the variable and the source of the information are shown below.

*Table 1-4: Hawai'i Island small and medium commercial customer econometric sales model variables.*

| Variable                                                                    | Description                                                                                                                                          | Source                                                        |
|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                                                         |                                                                                                                                                      |                                                               |
| Small/Medium Commercial Sales                                               | Adjusted Schedule G/J Sales (MWh)                                                                                                                    | Hawaiian Electric's monthly reports filed with the Commission |
| Economic Variables:                                                         |                                                                                                                                                      |                                                               |
| Real Annual Income Per Capita, 12-month moving average                      | Real Personal Income (1982-84 = 100) ÷ Resident Population (Hawai'i County)                                                                          | UHERO, May 2026                                               |
| Monthly Non-Farm Jobs                                                       | Non-Farm Jobs (Hawai'i County), allocated to monthly values using historical patterns                                                                | UHERO, May 2026                                               |
| Real Monthly Commercial Rate G/J Electricity Price, 12-month moving average | Real commercial G/J dollars per kwh (1982-84=100) (Hawai'i Island)                                                                                   | Growth rates based on First Cycle results                     |
| Google Mobility                                                             | Google Mobility Retail Index [Indexed value ranging from 0 to 1]                                                                                     | Google                                                        |
| Weather Variables:                                                          |                                                                                                                                                      |                                                               |
| Monthly Weighted THI (temperature humidity index)                           | Composite weather variable to incorporate both temperature and humidity<br><br>Wtd THI = 17.5 + (0.55 * Wtd Avg Temperature) + (0.20 * Wtd Dewpoint) | Historical airport weather data (Hilo and Kona) from NOAA     |



|                                               |                                                                                                                                                                              |                                                           |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------|
|                                               | Forecast uses 20-year average (2006-2025) of weighted average temperature and weighted dewpoint to calculate THI. Warming trend included in forecasted average temperatures. |                                                           |
| Monthly Weighted Precipitation, one-month lag | Rainfall in inches lagged by one month                                                                                                                                       | Historical airport weather data (Hilo and Kona) from NOAA |
| Dummy Variables:                              |                                                                                                                                                                              |                                                           |
| Monthly dummy variables                       | Dummy variable for each individual month to account for seasonal variation, excluding February                                                                               | na                                                        |
| Dummy variable starting in November 2022      | Proxy for post-covid "new normal" behavior                                                                                                                                   | na                                                        |
| Dummy variable for leap day                   | Dummy variable for February in leap years (historical only)                                                                                                                  | na                                                        |

The resulting monthly sales from the econometric model are then summed to annual sales forecast values. The year-over-year growth rates from the annual sales are then applied to the 2026 customer service forecast to extend the forecast to 2050.

### **Large Power Sales (Rate Schedule P)**

The large power (Schedule P) sales forecast is developed using a combination of two forecast methods, the market analysis method in the near term (2026-2028) and an econometric model for the remainder of the forecast (2029-2050). The market analysis method is based on an analysis of the market conditions influencing different rate schedules with special emphasis on customer-by-customer accounting of loads in Large Power Schedule P services. Market analysis is the primary accepted near-term forecasting method for Schedule P services for Hawai'i Island because the small number of large power customers (just over 100) allows for in-depth customer-by-customer analysis by the Company's Commercial Client Managers. The expected addition or loss of specific Schedule P customers is also accounted for.

The large power econometric equation is specified using adjusted monthly large power class sales in MWh. The adjusted sales are the monthly large power MWh sales excluding the historical estimated impacts from each of the layers (DER, EE and EV) to result in underlying large power sales. This also includes impacts from significant transfers between rate classes, to reflect the accounts currently in the rate class.

The monthly econometric model describes large power electricity sales as a function of resident population, visitor arrivals and weather variables (temperature humidity index and precipitation). In recognition of the climate differences between the Hilo and Kona sides of the island, the Hilo and Kona weather data is weighted based on historical sales by region and weighted weather variables are utilized in the model. For the forecast years, the weighting is a five-year historical average (2021-2025). These variables were all found to have relationships with Schedule P sales. To account for changes in electricity use during the COVID-19 pandemic, a retail Google mobility variable was also used. In addition, three sets of binary dummy variables – 1) monthly dummy variables representing individual months of the year, excluding February, used to account for seasonal variations, 2) a dummy variable from September 2001 through August 2002 to account for

impacts to large power sales from 9/11 and the lingering economic impacts and 3) a dummy variable from December 2006 through December 2008 to account for the temporary closure of a large resort due to the 2006 earthquake. These variables were all found to have relationships with large power sales.

Additional details on each variable, dependent and independent, used in deriving the monthly large power sales including the name of the variable and the source of the information are shown below.

*Table 1-5: Hawai'i Island large power customer econometric sales model variables.*

| Variable                                          | Description                                                                                                                                                                                                                                                                                                                                              | Source                                                        |
|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                               |                                                                                                                                                                                                                                                                                                                                                          |                                                               |
| Large Power Sales                                 | Adjusted P Sales (MWh)                                                                                                                                                                                                                                                                                                                                   | Hawaiian Electric's monthly reports filed with the Commission |
| Economic Variables:                               |                                                                                                                                                                                                                                                                                                                                                          |                                                               |
| Resident Population                               | Resident Population, Hawai'i County. Allocated to monthly values using linear extrapolation with annual values assumed to be in July of each year.                                                                                                                                                                                                       | UHERO, May 2026                                               |
| Monthly Visitor Arrivals, one-month lag           | Visitor Arrivals (Hawai'i County), allocated to monthly values using historical patterns                                                                                                                                                                                                                                                                 | UHERO, May 2026                                               |
| Google Mobility                                   | Google Mobility Retail Index [Indexed value ranging from 0 to 1]                                                                                                                                                                                                                                                                                         | Google                                                        |
| Weather Variables:                                |                                                                                                                                                                                                                                                                                                                                                          |                                                               |
| Monthly Weighted THI (temperature humidity index) | Composite weather variable to incorporate both temperature and humidity<br><br>Wtd THI = $17.5 + (0.55 * \text{Wtd Avg Temperature}) + (0.20 * \text{Wtd Dewpoint})$<br><br>Forecast uses 20-year average (2006-2025) of weighted average temperature and weighted dewpoint to calculate THI. Warming trend included in forecasted average temperatures. | Historical airport weather data (Hilo and Kona) from NOAA     |
| Monthly Weighted Precipitation, one-month lag     | Rainfall in inches lagged by one month                                                                                                                                                                                                                                                                                                                   | Historical airport weather data (Hilo and Kona) from NOAA     |
| Dummy Variables:                                  |                                                                                                                                                                                                                                                                                                                                                          |                                                               |
| Monthly dummy variables                           | Dummy variable for each individual month to account for seasonal variation, excluding February                                                                                                                                                                                                                                                           | na                                                            |
| Dummy variable September 2001-August 2002         | Proxy for 9/11 impacts                                                                                                                                                                                                                                                                                                                                   | na                                                            |
| Dummy variable December 2006 – December 2008      | Proxy for temporary resort closure post-earthquake                                                                                                                                                                                                                                                                                                       | na                                                            |

The resulting monthly sales from the econometric model are then summed to annual sales forecast values. The year-over-year growth rates from the annual sales are then applied to the 2028 market analysis forecast to extend the forecast out to 2050.

### ***Street Lighting Sales (Schedule F)***

The Schedule F forecast is developed using a combination of the market analysis and customer service methods for 2026 and growth rates from an annual sales econometric forecast out to 2050. Schedule F makes up a small portion (0.2-0.3%) of total Hawai'i Island sales and is less sensitive to economic drivers than the other rate schedules.

Just under 90% of Schedule F sales are from unmetered accounts, the monthly usage is projected forward based on the most recent monthly sales. For the metered accounts, the forecast is based on recent sales levels projected using historical patterns. Sales growth is based on historical growth of new accounts and the average annual sales for those accounts. This rate schedule regularly undergoes consolidation of accounts as streetlights in sub-divisions are turned over to the county. The Schedule F customer service forecast is an "all-in" forecast as there are no impacts from the layers except for Energy Efficiency, which for Hawai'i Island is included in acquired EE and would be reflected in the recent sales history. This process is used to forecast 2026.

The street lighting econometric equation is specified using adjusted annual streetlight class sales in MWh. The adjusted sales are the annual street lighting MWh sales excluding the historical estimated impacts from the applicable layers (EE only) to result in underlying street lighting sales.

The annual econometric model describes street lighting electricity sales as a function of residential customer count and a dummy variable beginning in 2016 as a proxy for LED lamp conversions. These variables were all found to have relationships with street lighting sales.

Additional details on each variable, dependent and independent, used in deriving the annual street lighting sales including the name of the variable and the source of the information are shown below.

*Table 1-6: Hawai'i Island street lighting customer econometric sales model variables.*

| Variable                    | Description                                     | Source                                                                                               |
|-----------------------------|-------------------------------------------------|------------------------------------------------------------------------------------------------------|
| Dependent Variable:         |                                                 |                                                                                                      |
| Street Lighting Sales       | Adjusted F Sales (MWh)                          | Hawaiian Electric's monthly reports filed with the Commission                                        |
| Economic Variable:          |                                                 |                                                                                                      |
| Residential Customer Count  | Residential Customer Count (# of customers)     | Hawaiian Electric's monthly reports filed with the Commission<br>Residential customer count forecast |
| Dummy Variable:             |                                                 |                                                                                                      |
| Dummy variable from 2016-on | Proxy for street light conversions to LED lamps | na                                                                                                   |

The resulting year-over-year growth rates from annual sales econometric model are then applied to the 2026 customer service/market analysis forecast to extend the forecast to 2050.

### **Total Underlying Sales and Scenarios**

The total underlying sales are the sum of the underlying sales for all rate schedules. The figure below shows the total underlying sales for the base, high and low scenarios. The data for the full forecast period is provided in Load Forecasts Workbook 3d.

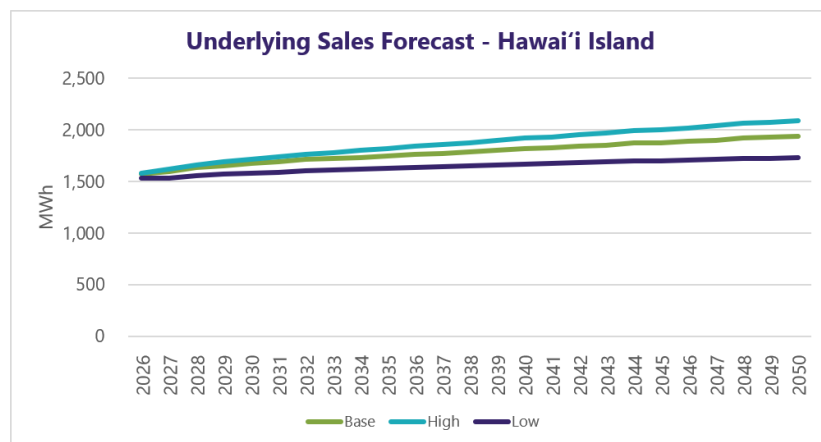


**Figure 1-2: Underlying Electric Sales Forecast, Hawai'i Island**

## **1.3 Maui Underlying Forecast**

For Maui, the underlying forecast is developed by rate class - residential, small and medium commercial, large power, and street lighting. Maui also used historical sales in the models adjusted to remove sales impact of DER, EE, EV and CBRE.

### **Residential Sales**

The residential underlying sales forecast is developed using an econometric model. The residential econometric equation was specified using monthly underlying residential class use per customer per month in kWh from 2013-2025. The underlying average use per customer is the monthly residential kWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV and CBRE) divided by the monthly number of residential customers. The monthly econometric model describes residential electricity use per customer as a function of real personal income per capita, electricity price, visitor arrivals and average billed days along with temperature humidity index, dummy variables and moving average error terms. To account for changes in electricity use during the COVID-19 pandemic, a residential Google mobility variable was used, as was a dummy variable to account for a period of increased income from COVID-19 related assistance that did not coincide with an increase in electricity consumption. Additional

dummy variables included in the model are used to account for seasonal variations and certain historical events.

The specification and evaluation of the hypothetical relationships was performed using a proprietary software package, MetrixND from Itron, Inc. Many hypothetical relationships were considered, tested, and rejected until the selected econometric equation for residential use per customer and commercial kWh sales were identified for use in Hawaiian Electric's sales projections.

Additional details on each variable, dependent and independent, used in deriving the monthly use per residential customer are shown below.

*Table 1-7: Maui residential customer econometric sales model variables.*

| Variable                                                  | Description                                                                                                                                                                                                                                                                                                                | Source                                                        |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                                       |                                                                                                                                                                                                                                                                                                                            |                                                               |
| Use per Customer                                          | Adjusted Underlying Residential Sales ÷ Monthly Total Residential Customer Count                                                                                                                                                                                                                                           | Hawaiian Electric's monthly reports filed with the Commission |
| Economic Variables:                                       |                                                                                                                                                                                                                                                                                                                            |                                                               |
| 12-Month Moving Average Real Personal Income Per Capita   | Real Personal Income (1982-84 = 100) ÷ Resident Population                                                                                                                                                                                                                                                                 | UHERO, May 2026                                               |
| 6-Month Moving Average Real Residential Electricity Price | Real residential dollars per kwh (1982-84=100)                                                                                                                                                                                                                                                                             | Internal Records                                              |
| Monthly Visitor Arrivals                                  | Visitor Arrivals allocated to monthly values using historical patterns                                                                                                                                                                                                                                                     | UHERO, May 2026                                               |
| Google Mobility                                           | Google Mobility Residential Index [Indexed value ranging from 0 to 1]                                                                                                                                                                                                                                                      | Google                                                        |
| Average Billed Days                                       | Monthly Average Number of Billed Days                                                                                                                                                                                                                                                                                      | Internal Records                                              |
| Weather Variables:                                        |                                                                                                                                                                                                                                                                                                                            |                                                               |
| Monthly Weighted THI (temperature humidity index)         | <p>Composite weather variable to incorporate both temperature and humidity</p> $THI = 17.5 + (0.55 * \text{Avg Temperature}) + (0.55 * \text{Dewpoint})$ <p>Forecast uses 20-year average (2006-2025) of average temperature and dewpoint to calculate THI. Warming trend included in forecasted average temperatures.</p> | Kahului Airport Weather, NOAA                                 |

| Variable                                                     | Description                                                                                  | Source |
|--------------------------------------------------------------|----------------------------------------------------------------------------------------------|--------|
| Monthly Dummy Variables                                      | Dummy variable for five months found to be statistically significant Jan, Jul, Aug, Sep, Oct | na     |
| Dummy Variables:                                             |                                                                                              |        |
| Dummy Variable for historical period July 2019-November 2019 | Proxy for period of unusual weather                                                          | na     |
| Dummy variable starting in November 2022                     | Proxy for post-covid "new normal" behavior                                                   | na     |
| Dummy variable for July 2021-June 2022                       | Proxy for COVID subsidies in income data                                                     | na     |
| Dummy variable for August 2023                               | Proxy for impact of wildfire to use per customer data                                        | na     |

To arrive at sales per month, the monthly use per residential customer derived from the econometric equation was multiplied by the number of residential customers.

In August 2023, Lahaina was largely destroyed due to a wildfire event, resulting in the loss of over 2,500 residential customers. Rebuilding and energizing assumptions were based off the status of clearing properties of debris, county updates, recovery dashboard, building permit data, and public media reports covering the rebuilding effort. For schedule R, additions from rebuilt Lahaina customers began in May 2025 and are assumed to continue at a constant rate until April 2035. The residential rebuilding is captured in the forecast via the forecasted customer count additions multiplied by the forecasted use per customer.

Growth rates from the econometric forecast are applied to the 2025 underlying sales to extend the forecast out to the full forecast horizon.

### ***Small and Medium Commercial Sales (Rate Schedules G and J)***

The Maui small and medium commercial (rate classes G and J) underlying sales forecast is developed using the customer service method in 2026 and an econometric model for the remainder of the forecast period.

Small and medium commercial sales were modeled together since there are a significant number of rate transfers between the two commercial rate schedules on a regular basis (based on tariff requirements). The underlying sales are the monthly Schedule G/J MWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV and CBRE) sales. Adjustments are also made to account for significant transfers between G/J and P rate classes to reflect the accounts currently in the G/J rate class.

The underlying small and medium commercial sales econometric equation was specified using monthly sales in MWh. The monthly econometric model describes electricity sales as a function of non-farm jobs, electricity price, visitor arrivals, temperature humidity index, precipitation, and average billed days along with dummy variables and a moving average error term.

Additional details on each variable, dependent and independent, used in deriving the monthly small and medium commercial customer sales are shown below.

*Table 1-8: Maui small and medium commercial customer econometric sales model variables.*

| Variable                                                      | Description                                                                                                                                                                                                                                                                                                                 | Source                                                        |
|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                                           |                                                                                                                                                                                                                                                                                                                             |                                                               |
| Underlying Small and Medium Commercial Sales                  | Monthly Adjusted Underlying Small and Medium Commercial Sales                                                                                                                                                                                                                                                               | Hawaiian Electric's monthly reports filed with the Commission |
| Economic Variables:                                           |                                                                                                                                                                                                                                                                                                                             |                                                               |
| Non-Farm Jobs                                                 | Total Maui Non-Farm jobs allocated to monthly values using historical patterns                                                                                                                                                                                                                                              | UHERO, May 2026                                               |
| 6-Month Moving Average Real Residential Electricity Price     | Real residential dollars per kwh (1982-84=100)                                                                                                                                                                                                                                                                              | Internal Records                                              |
| Monthly Visitor Arrivals                                      | Maui visitor arrivals allocated to monthly values using historical patterns                                                                                                                                                                                                                                                 | UHERO, May 2026                                               |
| Average Billed Days                                           | Monthly Average Number of Billed Days                                                                                                                                                                                                                                                                                       | Internal Records                                              |
| Weather Variables:                                            |                                                                                                                                                                                                                                                                                                                             |                                                               |
| Monthly THI (temperature humidity index)                      | <p>Composite weather variable to incorporate both temperature and humidity.</p> $THI = 17.5 + (0.55 * \text{Avg Temperature}) + (0.55 * \text{Dewpoint})$ <p>Forecast uses 20-year average (2006-2025) of average temperature and dewpoint to calculate THI. Warming trend included in forecasted average temperatures.</p> | Kahului Airport Weather, NOAA                                 |
| Monthly Precipitation                                         | Current month's rainfall in inches                                                                                                                                                                                                                                                                                          | Kahului Airport Weather, NOAA                                 |
| 1-Month Lagged Monthly Precipitation                          | Previous month's rainfall in inches                                                                                                                                                                                                                                                                                         | Kahului Airport Weather, NOAA                                 |
| Dummy Variables:                                              |                                                                                                                                                                                                                                                                                                                             |                                                               |
| Dummy Variable for historical period July 2019 -November 2019 | Proxy for period of unusual weather                                                                                                                                                                                                                                                                                         | na                                                            |
| Monthly Dummy Variables                                       | Dummy variables for months Apr-Nov found to be statistically significant                                                                                                                                                                                                                                                    | na                                                            |
| Dummy variable for August 2023                                | Proxy for impact of wildfire to sales data                                                                                                                                                                                                                                                                                  | na                                                            |

Growth rates from the econometric model are applied to the 2026 forecast to extend the forecast out to the full 30-year range.

### **Large Commercial Sales (Rate Schedule P)**

The large commercial sales forecast is developed using market analysis techniques for the first three years (2026-2028) and an econometric model for the forecast period after 2028. The underlying sales are the monthly Schedule P MWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV and CBRE) sales. Adjustments are also made to account for significant transfers between rate classes G/J and P to reflect the accounts currently in the P rate class.

The market analysis is developed through ground-up forecasting of each customer in the rate class. Commercial Client Managers (CCMs) work with customers in the rate class to forecast customer usage; accounting for individual projects, renovations, expansions, and changes in customer equipment. Engineering requests for service, news articles, and county permitting information is also used to help forecast potential additions of new large loads or loss of large loads. Rate transfers between large commercial rate schedules and small and medium rate schedules along with impending future transfers are also factored into the market analysis forecast.

From 2029-forward, growth rates from the econometric model for underlying large commercial sales are used to forecast the remainder of the forecast period. This model was specified using monthly underlying MWh sales from 2010-2025 as a function of real personal income, electricity price, visitor arrivals, average billed days, temperature humidity index, and precipitation along with Google mobility retail data, monthly dummy variables and moving average error terms.

Additional details on each variable, dependent and independent, used in deriving the monthly large commercial sales are shown below.

*Table 1-9: Maui large power customer econometric sales model variables.*

| Variable                                                  | Description                                                                 | Source                                                        |
|-----------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------|
| Dependent Variable:                                       |                                                                             |                                                               |
| Underlying Large Commercial Sales                         | Monthly Underlying Large Commercial Sales                                   | Hawaiian Electric's monthly reports filed with the Commission |
| Economic Variables:                                       |                                                                             |                                                               |
| 12-Month Moving Average Real Personal Income              | 12-Month Moving Average Real Personal Income (1982-84 = 100) (Maui County)  | UHERO, October 2019                                           |
| 6-Month Moving Average Real Residential Electricity Price | Real residential dollars per kwh (1982-84=100)                              | Internal Records                                              |
| Monthly Visitor Arrivals                                  | Maui visitor arrivals allocated to monthly values using historical patterns | UHERO, May 2026                                               |
| Google Mobility                                           | Google Mobility Retail Index [Indexed value ranging from 0 to 1]            | Google                                                        |



| Variable                                               | Description                                                                                                                                                                                                                                                                                                                                  | Source                                            |
|--------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|
| Average Billed Days                                    | Monthly Average Number of Billed Days                                                                                                                                                                                                                                                                                                        | Internal Records                                  |
| Weather Variables:                                     |                                                                                                                                                                                                                                                                                                                                              |                                                   |
| Monthly Weighted THI<br>(temperature humidity index)   | <p>Composite weather variable to incorporate both temperature and humidity</p> <p><math>THI = 17.5 + (0.55 * \text{Avg Temperature}) + (0.55 * \text{Dewpoint})</math></p> <p>Forecast uses 20-year average (2006-2025) of average temperature and dewpoint to calculate THI. Warming trend included in forecasted average temperatures.</p> | Kahului Airport Weather, NOAA                     |
| Monthly Precipitation                                  | Current month's rainfall in inches                                                                                                                                                                                                                                                                                                           | Historical Kahului airport weather data from NOAA |
| Dummy Variables:                                       |                                                                                                                                                                                                                                                                                                                                              |                                                   |
| Monthly Dummy Variables                                | Dummy variable for months found to be statistically significant, Aug, Oct                                                                                                                                                                                                                                                                    | na                                                |
| Dummy variables for August, September and October 2023 | Proxy for impact of wildfire to sales data                                                                                                                                                                                                                                                                                                   | na                                                |

### ***Street Lighting Sales (Schedule F)***

The Schedule F forecast is developed using the customer service method for the forecast period. Schedule F makes up a small portion (less than 0.5%) of total Maui sales and is less sensitive to economic drivers than the other rate schedules. While historical schedule F sales have been relatively flat, the customer service portion of the forecast reflects a significant decline in sales as the planned replacement of existing streetlight fixtures with LED fixtures are executed. Following completion of the LED conversion in 2028, annual growth rates return to the pre-LED conversion 10-year average for the remaining years of the forecast period.

### ***Total Underlying Sales and Scenarios***

The total underlying sales are the sum of the underlying sales for all rate schedules. The figure below shows the total underlying sales (all rate schedules) for the base, high and low scenarios. The data for the full forecast period is provided in Load Forecasts Workbook 3d.

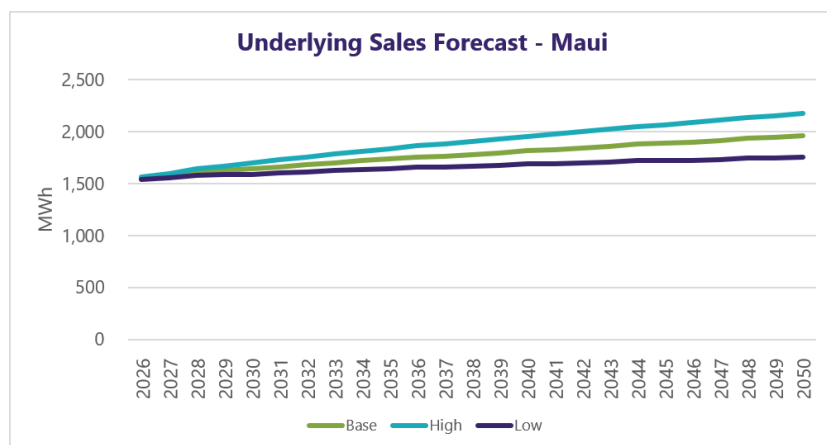


**Figure 1-3: Underlying Electric Sales Forecast, Maui**

## 1.4 Lānaʻi Underlying Forecast

The Lānaʻi underlying forecast is developed by rate class - residential, small and medium commercial, large commercial, and street lighting. Lānaʻi also used historical sales in the models adjusted to remove sales impact of DER, EE, and EV (currently no CBRE on Lānaʻi).

### **Residential Sales**

The residential underlying sales forecast is developed using the customer service method for 2026-2027 and a use per customer trending model for the remainder of the forecast period. The underlying average use per customer is the monthly residential kWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV) divided by the monthly number of residential customers. The customer service method allows for factors including knowledge of local economic conditions such as construction activity, the state of the visitor industry and county permit data. The customer service portion of the forecast was primarily derived from an analysis of average use per customer trends.

An exponential smoothing linear trending model with an additive seasonal component was fit to monthly historical residential underlying use per customer data. To arrive at sales per month, the monthly use per residential customer derived from the trending model was multiplied by the number of residential customers.

Growth rates from the trending model were applied to the 2027 forecast to extend the forecast out to the full forecast period. Residential growth from a planned county affordable housing project was captured via customer count growth of 200 customers ramped up from January 2030 through September 2032.

### **Small and Medium Commercial Sales (Rate Schedules G and J)**

The Lānaʻi small and medium commercial underlying sales forecast was developed using the customer service method for 2026-2027 and a trending model for the remainder of the forecast period. The customer

service model assumed a 5-year historical average growth rate for the small and medium commercial sectors.

An exponential smoothing linear trending model with an additive seasonal component was fit to monthly historical small and medium commercial underlying use per customer data. Growth rates from the trending model were applied to the 2027 forecast to extend the forecast out to the full forecast period.

### ***Large Commercial Sales (Rate Schedule P)***

The large commercial sales forecast is developed using market analysis techniques for the first three years (2026-2028) and the customer service method for the forecast period after 2028. The market analysis is developed through ground-up forecasting of each customer in the rate class. CCMs develop sales forecasts with customers in the rate class to forecast sales to account for individual projects, renovations, expansions, and changes in customer equipment. Engineering requests, news articles, and county permitting information are also used to help forecast potential additions or loss of large loads. Pulama Lānaʻi has indicated through a zoning change request that an expansion of the Four Seasons Sensei Resort is planned. An estimate based on public information was included in the forecast in 2036. A growth rate of 0.2% annual increase in underlying sales was applied in other years to carry the market analysis forecast out to 2050.

### ***Street Lighting Sales (Schedule F)***

The Schedule F forecast is developed using the customer service method for the full forecast period. While historical schedule F sales have been relatively flat, the customer service portion of the forecast reflects a significant decline in sales, as the planned replacement of existing streetlight fixtures with LED fixtures are executed. Following completion of the LED conversion in 2028, annual growth rates return to the pre-LED conversion 20-year average for the remaining years of the forecast period.

### ***Total Underlying Sales and Scenarios***

The total underlying sales are the sum of the underlying sales for all rate schedules. High and low underlying scenarios for Lānaʻi were derived using the spread between the Maui scenarios (percent difference between the base and low, and percent difference between the base and high) as a proxy for the spread between the Lānaʻi scenarios. The low scenario also excludes the possible expansion of the Sensei Resort.

The figure below shows the total underlying sales (all rate schedules) for the base, high and low scenarios. The data for the full forecast period is provided in Load Forecasts Workbook 3d.

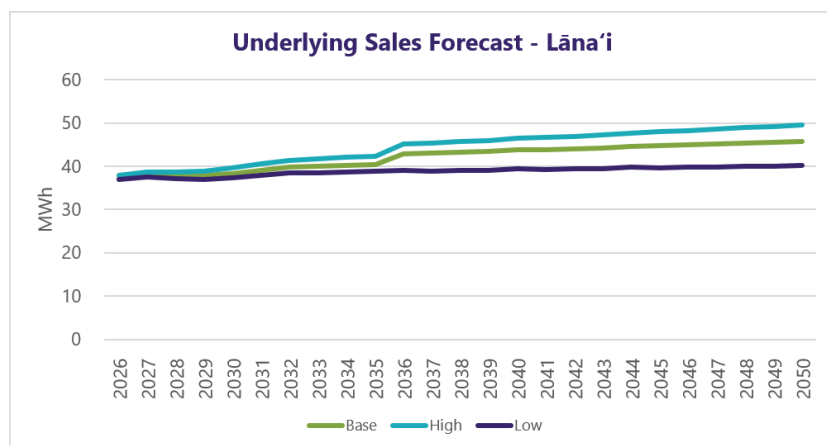


**Figure 1-4: Underlying Electric Sales Forecast, Lānaʻi**

## 1.5 Molokaʻi Underlying Forecast

The Molokaʻi underlying forecast is developed by rate class - residential, small and medium commercial, large power and street lighting. Molokaʻi also used historical sales in the models adjusted to remove sales impact of DER, EE, EV and CBRE.

### **Residential Sales**

The residential underlying sales forecast was developed using the customer service method for 2026-2027 and a use per customer trending model for the remainder of the forecast period. The underlying average use per customer is the monthly residential kWh sales excluding the historical estimated impacts from each of the layers (DER, EE, EV, CBRE) divided by the monthly number of residential customers. The customer service method allows for factors including knowledge of local economic conditions such as construction activity, the state of the visitor industry and county permit data. This portion of the forecast was primarily derived from an analysis of average use per customer trends.

An ARIMA trending model was fit to monthly historical residential underlying use per customer data. Growth rates from the trending model were applied to the 2027 forecast to extend the forecast out to the full forecast period.

### **Small and Medium Commercial Sales (Rate Schedules G and J)**

The Molokaʻi small and medium commercial underlying sales forecast is developed using the customer service method for 2027-2031. The customer service model assumed a 20-year historical average use per customer growth rate for the small and medium commercial sectors.

An exponential smoothing damped trending model was fit to monthly historical small and medium commercial underlying use per customer data. Growth rates from the trending model were applied to the 2027 forecast to extend the forecast out to the full forecast period.

### **Large Commercial Sales (Rate Schedule P)**

The large commercial sales forecast is developed using market analysis techniques for the first three years (2026-2028), the customer service method for 2029-2031, and a trending model for the rest of the forecast period. The market analysis is developed through ground-up forecasting of each customer in the rate class. CCMs develop sales forecasts with customers in the rate class to forecast underlying usage and sales to account for individual projects, renovations, expansions, and changes in customer equipment. Engineering requests, news articles, and county permitting information are also used to help forecast potential additions or loss of large loads. For 2028-2031, a 15-year average underlying sales growth rate was applied. For 2032-2050, an ARIMA model was fit to annual historical large commercial underlying sales. Growth rates from the trending model were applied to the 2031 forecast to extend the forecast out to the full forecast period.

### ***Street Lighting Sales (Schedule F)***

The Schedule F forecast is developed using the customer service method for the full forecast period. While historical schedule F sales have been relatively flat, the customer service portion of the forecast reflects a significant decline in sales, as the planned replacement of existing streetlight fixtures with LED fixtures are executed. Following completion of the LED conversion in 2028, annual growth rates return to a 10-year average for the remaining years of the forecast period.

### ***Total Underlying Sales and Scenarios***

The total underlying sales are the sum of the underlying sales for all rate schedules. High and low underlying scenarios for Moloka'i were derived using the spread between the Maui scenarios (percent difference between the base and low, and percent difference between the base and high) as a proxy for the spread between the Moloka'i scenarios.

The figure below shows the total underlying sales (all rate schedules) for the base, high and low scenarios. The data for the full forecast period is provided in Load Forecasts Workbook 3d.

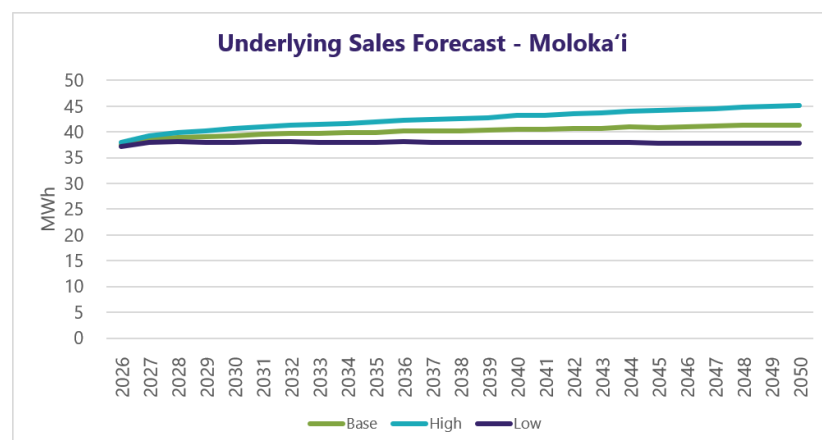


**Figure 1-5: Underlying Electric Sales Forecast, Moloka'i**





UHERO FORECAST FOR THE STATE OF HAWAII

SUPPORTER EDITION

## WAR BRINGS MORE STORMY WEATHER TO HAWAII

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MAY 15, 2026





# UHERO

THE ECONOMIC RESEARCH ORGANIZATION  
AT THE UNIVERSITY OF HAWAII

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## UHERO FORECAST FOR THE STATE OF HAWAII

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## Executive Summary

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Hawaii's economy must weather a new storm. The Iran war has sent oil prices surging, promising to raise inflation, increase travel costs, and slow the major economies that send visitors to the Islands. These headwinds arrive on top of the serious damage from the two March Kona Low storms and an already-slow labor market growth. An outright contraction remains unlikely, but the near-term outlook has materially worsened.

- The war on Iran has upended what had been an improving US outlook. Federal tax cuts were poised to support consumer spending and business investment, but higher oil prices will offset much of these gains. We now project US growth of 1.7% for 2026, with inflation running at 4% for the year. The Fed has limited room to cut rates. Japan and other Asian oil-dependent economies face the sharpest pressures, and Canada remains weakened by trade tensions with the US.
- The visitor industry entered 2026 with some momentum, before the March storms caused a sharp drop in passenger counts. Underlying conditions are now deteriorating. Jet fuel prices have roughly doubled, pushing transpacific fares up 20–25% and prompting some airline capacity cuts. Canadian arrivals continue to slide, and Japanese visitors face the weakest yen purchasing power in decades. On the strength of the year's first months, total arrivals will post roughly 2% growth for 2026. They will slow over the course of the year and average just 0.2% growth in 2027.
- Hawaii's labor market is stable but making little incremental progress. Statewide payroll growth was essentially flat through February, and the labor force has contracted slightly. Federal employment has fallen by more than 3,000 jobs over the past year. Construction and health care remain the bright spots. Overall payrolls will be essentially flat this year, with tourism-linked sectors hit hardest by the oil shock. Real labor income will be unchanged as price increases outpace wage gains.
- The oil shock has materially shifted the inflation outlook. Gasoline stood at \$5.66 per gallon statewide at the time of this writing, and residential electricity bills are on the rise as fuel costs are passed through. The typical Hawaii household faces roughly \$100 per month in additional energy costs. Honolulu inflation will average just over 4% for 2026, peaking near 4.8% mid-year. Inflation will remain above trend until 2028.
- Construction remains a genuine bright spot, with job growth ranging from more than 2% on Oahu to nearly 6% in Maui County. Large federal contracts, Maui wildfire rebuilding, and the launch of the \$4 billion New Aloha Stadium Entertainment District will sustain elevated activity through the end of the decade.
- The housing market remains soft. The median single-family price has held near \$1 million for seven months, but resales are slow and condominium prices continue to slip. Insurance premiums, already up 13% since the Maui wildfires, may face further increases following the March storms, exacerbating historically-poor affordability.
- Hawaii real GDP will grow 1% this year under our baseline forecast, recovering to 1.6% by 2028. Maui wildfire settlement payouts—an estimated \$550 million will reach households in 2026—will raise overall income growth. But there remains considerable uncertainty about how high oil prices may rise and how long that may last. Under a pessimistic oil price scenario, Hawaii GDP growth could slow to 0.4%, consistent with a recession in the Islands.
- Hawaii is now absorbing three major supply-side shocks simultaneously: high tariffs, reduced immigration, and the worst oil disruption in fifty years. The cumulative burden is substantial and equally uncertain. UHERO will of course be updating these forecasts as conditions evolve in coming months.



# Forecast Summary

## MAJOR ECONOMIC INDICATORS

### STATE OF HAWAII FORECAST

|                                        | 2024      | 2025      | 2026             | 2027      | 2028      | 2029      | 2030      |
|----------------------------------------|-----------|-----------|------------------|-----------|-----------|-----------|-----------|
| <b>STATE OF HAWAII</b>                 |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 638.5     | 642.1     | <b>642.7</b>     | 643.5     | 645.5     | 646.9     | 648.5     |
| % Change                               | 1.0       | 0.6       | <b>0.1</b>       | 0.1       | 0.3       | 0.2       | 0.2       |
| Unemployment Rate (%)                  | 2.8       | 2.3       | <b>2.4</b>       | 2.5       | 2.5       | 2.5       | 2.6       |
| Real Personal Income (Mil 2025\$)      | 105,366.4 | 107,611.1 | <b>108,689.9</b> | 110,381.1 | 111,964.9 | 113,330.2 | 113,768.9 |
| % Change                               | 1.5       | 2.1       | <b>1.0</b>       | 1.6       | 1.4       | 1.2       | 0.4       |
| Real GDP (Mil 2025\$)                  | 120,679.1 | 124,607.8 | <b>125,813.7</b> | 127,433.5 | 129,438.2 | 131,070.3 | 132,391.4 |
| % Change                               | 0.9       | 3.3       | <b>1.0</b>       | 1.3       | 1.6       | 1.3       | 1.0       |
| Average Daily Census (Thou)            | 230.6     | 227.7     | <b>231.5</b>     | 233.6     | 238.7     | 242.8     | 247.7     |
| % Change                               | -1.8      | -1.2      | <b>1.7</b>       | 0.9       | 2.2       | 1.7       | 2.0       |
| Real Visitor Expenditures (Mil 2025\$) | 21,016.5  | 21,753.0  | <b>21,918.7</b>  | 21,707.2  | 21,939.9  | 22,153.2  | 22,331.8  |
| % Change                               | -5.1      | 3.5       | <b>0.8</b>       | -1.0      | 1.1       | 1.0       | 0.8       |
| <b>HONOLULU COUNTY</b>                 |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 460.4     | 461.6     | <b>461.8</b>     | 462.1     | 463.5     | 464.7     | 465.9     |
| % Change                               | 1.2       | 0.3       | <b>0.1</b>       | 0.1       | 0.3       | 0.3       | 0.3       |
| Unemployment Rate (%)                  | 2.5       | 2.2       | <b>2.2</b>       | 2.4       | 2.4       | 2.4       | 2.4       |
| Inflation Rate, Honolulu MSA (%)       | 4.4       | 2.6       | <b>4.1</b>       | 3.0       | 2.3       | 2.2       | 2.3       |
| Real Personal Income (Mil 2025\$)      | 76,523.9  | 77,986.6  | <b>78,404.0</b>  | 79,446.4  | 80,567.7  | 81,553.0  | 82,355.4  |
| % Change                               | 1.7       | 1.9       | <b>0.5</b>       | 1.3       | 1.4       | 1.2       | 1.0       |
| Average Daily Census (Thou)            | 112.6     | 108.3     | <b>106.9</b>     | 107.5     | 110.5     | 112.8     | 114.7     |
| % Change                               | 1.4       | -3.9      | <b>-1.3</b>      | 0.6       | 2.8       | 2.0       | 1.7       |
| <b>HAWAII COUNTY</b>                   |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 72.5      | 73.3      | <b>73.2</b>      | 73.3      | 73.6      | 73.8      | 74.1      |
| % Change                               | 1.9       | 1.2       | <b>-0.3</b>      | 0.2       | 0.4       | 0.3       | 0.3       |
| Unemployment Rate (%)                  | 3.0       | 2.6       | <b>2.9</b>       | 3.0       | 2.9       | 2.8       | 2.8       |
| Real Personal Income (Mil 2025\$)      | 12,417.8  | 12,733.3  | <b>12,773.5</b>  | 12,980.9  | 13,199.4  | 13,388.7  | 13,535.7  |
| % Change                               | 1.9       | 2.5       | <b>0.3</b>       | 1.6       | 1.7       | 1.4       | 1.1       |
| Average Daily Census (Thou)            | 37.1      | 36.1      | <b>37.0</b>      | 37.2      | 38.4      | 39.3      | 40.1      |
| % Change                               | -3.5      | -2.5      | <b>2.5</b>       | 0.5       | 3.1       | 2.4       | 2.1       |
| <b>KAUAI COUNTY</b>                    |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 32.4      | 33.1      | <b>33.1</b>      | 33.2      | 33.4      | 33.5      | 33.6      |
| % Change                               | 1.3       | 2.2       | <b>0.1</b>       | 0.3       | 0.4       | 0.3       | 0.3       |
| Unemployment Rate (%)                  | 2.4       | 2.1       | <b>2.4</b>       | 2.5       | 2.5       | 2.5       | 2.5       |
| Real Personal Income (Mil 2025\$)      | 5,088.6   | 5,246.0   | <b>5,267.3</b>   | 5,349.9   | 5,436.6   | 5,511.2   | 5,568.2   |
| % Change                               | 1.4       | 3.1       | <b>0.4</b>       | 1.6       | 1.6       | 1.4       | 1.0       |
| Average Daily Census (Thou)            | 28.4      | 28.7      | <b>28.9</b>      | 28.9      | 29.3      | 29.7      | 30.2      |
| % Change                               | -2.2      | 1.1       | <b>0.8</b>       | -0.1      | 1.6       | 1.4       | 1.4       |
| <b>MAUI COUNTY</b>                     |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 73.3      | 74.0      | <b>74.5</b>      | 74.8      | 75.0      | 74.9      | 74.9      |
| % Change                               | -1.4      | 1.1       | <b>0.6</b>       | 0.4       | 0.3       | -0.2      | 0.0       |
| Unemployment Rate (%)                  | 4.1       | 2.6       | <b>2.6</b>       | 2.8       | 2.9       | 3.4       | 3.7       |
| Real Personal Income (Mil 2025\$)      | 11,339.5  | 11,621.2  | <b>12,245.6</b>  | 12,606.1  | 12,792.7  | 12,952.4  | 12,355.9  |
| % Change                               | 0.0       | 2.5       | <b>5.4</b>       | 2.9       | 1.5       | 1.2       | -4.6      |
| Average Daily Census (Thou)            | 52.5      | 54.6      | <b>58.7</b>      | 60.0      | 60.4      | 60.9      | 62.8      |
| % Change                               | -6.8      | 4.0       | <b>7.5</b>       | 2.1       | 0.8       | 0.9       | 3.0       |

Note: Source is UHERO. State income figures for 2025 are adjusted by UHERO to reflect the timing of the payout of the Maui wildfire settlement. County income figures for 2025 are UHERO estimates. Figures for 2026-2030 are forecasts.

## Second Quarter Hawaii Forecast

In a year that has already seen the most severe storms in decades, the state must now weather another storm. The Iran war's impact on oil prices will raise inflation in the Islands, increase travel costs for visitors, and slow the economies of our major visitor markets. That will weigh on the visitor industry and cause a weaker job and income growth performance than previously forecast. Because the economy was healthy heading into the year, we will likely avoid an outright decline in economic activity.

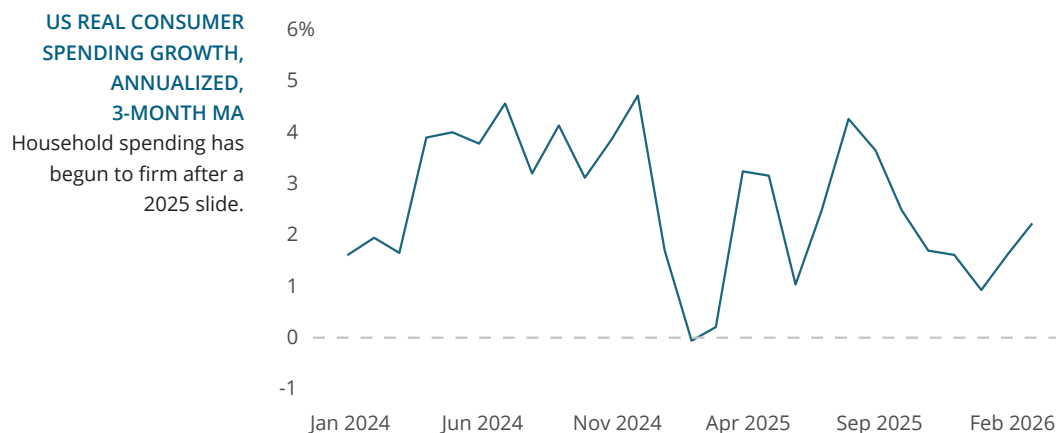
At this time, there remains considerable uncertainty about the future path for oil prices. We do not know when hostilities will end, how long it will take for global oil supplies to approach normal, and for oil prices to return to something approaching normal. In addition, there are particular challenges in the market for jet fuel, where availability and not just price have become problems. Under a pessimistic scenario where oil prices rise further and remain high for longer, there would be more severe effects on tourism and consumers' wallets, and a Hawaii recession could not be avoided.

### War weary already

The war on Iran has introduced a threat to growth and inflation in the US and global economies. At home, higher oil prices will add to an inflation rate that was already moving further away from the Fed's target. Abroad, the war will of course batter Middle Eastern countries but also have an outsized effect on East Asian countries that are heavily dependent on oil imports. Production, which is centered in Asia, will suffer from higher costs and potential delays in getting key inputs.

The US had appeared to face somewhat better prospects entering 2026, even as some worrisome aspects remained. Federal income tax cuts to individuals—many of which were retroactive to 2025—were poised to add to disposable income, supporting a return to healthier consumer spending growth. Tax incentives for businesses were expected to raise business investment, as well. The fiscal measures were expected to support growth in 2026.

These supports were coming at an opportune time. All-important household spending growth had largely ceased by the start of this year, and broader economic activity had slowed sharply by the end of last year. Gross domestic



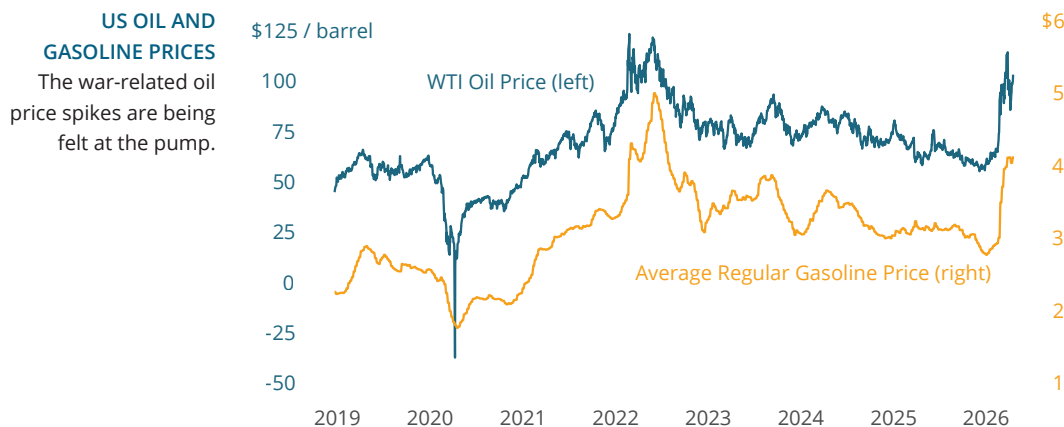
product growth slowed to 0.5% in the fourth quarter. While the government shutdown accounted for as much as 1 percentage point of this slowing, private economic activity was also expanding at a subpar pace.

The first quarter showed some firming of overall growth. Real GDP expanded at a 2% pace, fueled by a return to robust investment spending on AI computing capacity. The rebound from the government shutdown also added to growth. Of some concern was real consumer spending, which rose a paltry 1.6% in the first quarter, its weakest showing since mid-2023. But spending picked up as the quarter progressed, rising at a 2.2% rate for the three months ending in March. Fairly strong growth in purchases of motor vehicles and other durable goods suggests that consumers are still willing to take on larger spending commitments. At the same time, the underlying support for spending is less solid than a year ago. Spending has depended disproportionately on higher-income households with large stock market wealth gains, and falling overall savings rates suggest fewer available resources for spending going forward.

At the same time, inflation has become a renewed concern. Even before the outbreak of the US and Israeli war on Iran, consumer prices measured by the personal consumption expenditure (PCE) index rose 0.4% in February. On a three-month moving average basis, inflation by this Fed-preferred measure had accelerated from 2.7% in November to 4.1% in February, well above the Fed's 2% long-run inflation goal. Of particular concern was inflation in the price of services other than shelter and an uptick in non-energy goods, as tariffs were beginning to be more fully passed along to customers.

The outbreak of war and the surge in oil energy prices led to a marked acceleration of consumer price inflation in March. The PCE price index surged 0.7%, raising year-over-year inflation to 3.5%. The price of gasoline by this measure rose more than 21% in March. Excluding food and energy, "core" PCE inflation edged up to 3.2%.

The labor market remains relatively weak, but with no signs of rapid deterioration. Job growth for all of 2025 averaged just 10,000 per month, compared with more than 200,000 per month as recently as 2023. Preliminary data for March showed an upside surprise, with a net gain of 175,000 jobs. Whether that is sustained in future revisions remains to be seen. The destruction of labor force growth from Trump Administration immigration policy means that very little job growth is now needed to maintain a balance between labor demand and supply. As a result, the



unemployment rate remains at 4.3%, a rate normally associated with a healthy labor market but still almost 1 percentage point higher than its low point in 2023.

The paucity of labor force growth nevertheless represents a medium-term concern, both because labor shortages constrain business expansion and because of looming shortages in particular high-need areas, such as health care. While productivity gains from artificial intelligence may eventually help with the former, they are unlikely to make as much difference with the latter.

The prospects for tax-cut-induced firming of the economy—albeit amid rising inflationary pressures—came largely before the advent of the US and Israeli war on Iran. The war has certainly now reduced US and global economic prospects; the only question is how much. This will depend importantly on the length of the ongoing conflict and how long it takes for energy supplies to recover once hostilities have ended. Even a relatively optimistic oil price scenario will mean a reduction in US growth of somewhat less than a half-percent this year. Below, we consider alternative scenario paths for oil and the Hawaii economy.

The war's effect on growth and inflation will of course not be limited to the US. In its March Economic Outlook, the International Monetary Fund (IMF) lowered its forecast for global growth. For advanced economies, these downward revisions are generally small. For developing and emerging economies, and particularly for the Middle East region, the mark-downs are much larger. The IMF's estimates are based on an assumption of an average oil price of about \$80 for 2026 as a whole. The organization acknowledges that the energy price path and its effects are very uncertain and could lead to larger output losses.

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#### US policy a big part of Canada's weakness

Canada's economy was of course hit hard last year by the Trump tariffs, which led to a nearly 25% drop in exports to the US between March and June. Some of that has been made up in other markets, but the economy nevertheless dipped back into negative territory in the final quarter of last year as businesses reduced inventories of unsold goods. Household spending remained weak last year, and that has continued in recent months.

There has been a notable unwillingness of Canadians to travel to the US in response to aggressive Trump Administration policies. The number of Canadian residents returning from trips to the United States fell 22% in January compared with a year earlier. The biggest drop was in automobile trips, but the number of return trips by air from the United States fell nearly 13%. In contrast, Canadian return trips from overseas countries were up more than 10% in January.

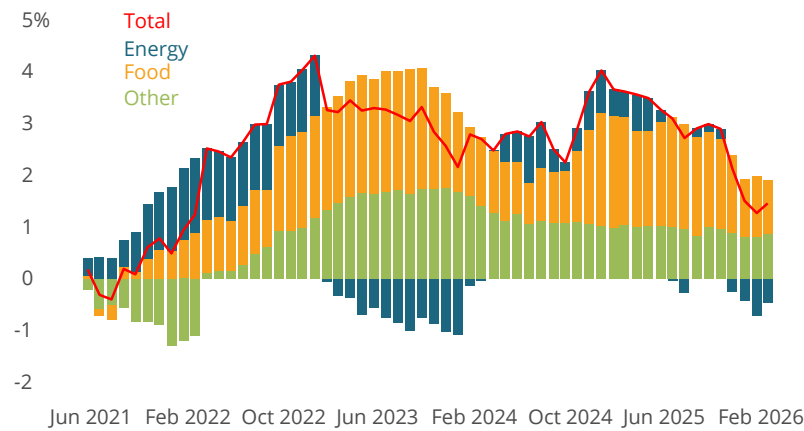
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#### Asian region most exposed to high oil prices

The Asian region has been hit harder than the US by the war on Iran because of its dependence on oil mostly from the mid-East and its large manufacturing base, and supply chain participation. The Japanese government has directly acknowledged these issues, notably committing \$10 billion to assist emerging East Asian countries in dealing with energy price costs to shore up supply chains.

Japan itself is particularly exposed to high oil prices. Forty percent of Japan's energy comes from oil, essentially all from imports. (South Korea has a

**CONTRIBUTIONS TO  
JAPANESE INFLATION,  
YEAR-OVER-YEAR**  
Japan's inflation has  
eased—for now.



similarly large oil dependence.) At the same time, Japan has one of the world's largest oil reserves (254 days). The government is trying to cushion the energy shock to consumers with gasoline subsidies.

Prior to the war, inflation in Japan had receded significantly, from 4% in January 2025 to 1.3% year-over-year in February. This was entirely due to declining inflation in food and energy, making an acceleration of inflation very likely because of higher direct costs of energy and the impact on fertilizer costs. The anticipated pickup in inflation will slow growth as well.

The Chinese economy has continued to expand at a moderate pace, 5% year-over-year in the first quarter of 2026. But exports, which had held up well despite US restrictions, have begun to fade as a growth impetus and were particularly weak in March. Consumer spending remains moderately healthy, despite the still-ongoing challenges in the housing market. In part because of these property industry woes, industrial production of items like cement has languished along with the overbuilding housing boom, as have some consumer goods. In contrast, production of electronics-related products have done well because of the global AI boom.

The Australian economy performed better in 2025 than in 2024. Real gross domestic product expanded at a 2.6% pace in the twelve months ending December 2025, and growth firmed over the course of the year. In the fourth quarter, strength in exports and consumer spending offset a pullback in fixed investment growth. Healthy growth along with rising inflation has made the Reserve Bank of Australia the odd man out among developed countries, raising interest rates over the past year. The inflation impulse from the recent oil price spike will make the Bank's inflation-control efforts even harder to achieve.

The global economic picture has materially worsened as a result of the war on Iran. In some cases, the effects are already apparent in higher inflation and in adverse effects on production costs and energy availability. Impacts on growth will take longer to develop, and the uncertainty is considerable.

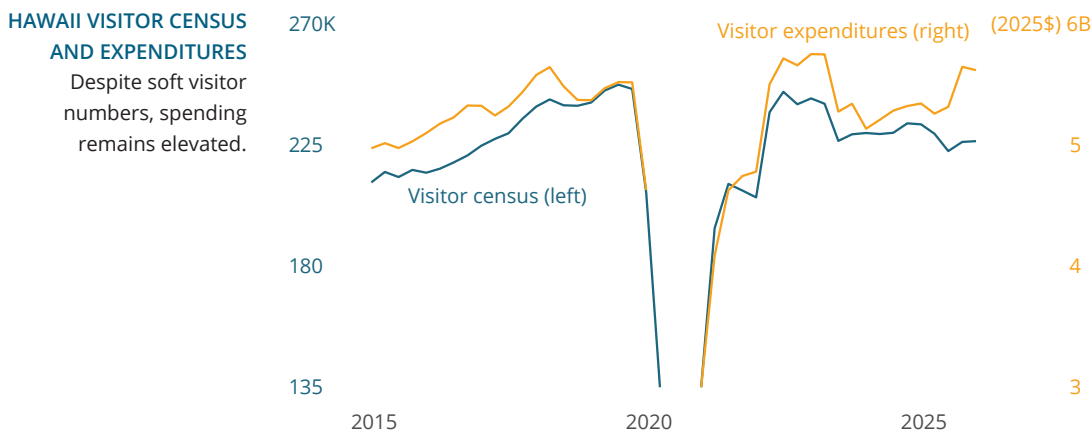
**Tourism  
uncertainty  
persists as new  
headwinds  
emerge**

The unfavorable energy and global growth conditions will form a challenging backdrop for the Hawaii visitor sector over the next two years. Going into this, our leading industry has performed fairly well, even as incremental growth has paused. But conditions will soften in coming months.

Evaluating the state of the visitor industry during the first part of this year is challenging. Early 2026 data should be read with caution. Preliminary figures for January showed a surge in domestic arrivals, which is a significant departure from their historical pattern. Specifically, the January data without seasonal adjustment showed domestic arrivals grew 1.6% from December (14% year-over-year). In every other January since 2000, domestic arrivals have fallen on average by close to 10% below the normally-strong December arrivals. Given this year's unusual pattern, for this forecast we have elected to exclude the January figures for US arrivals, replacing them instead with the average of the December 2025 and February 2026 data. With the January data point excluded, total US visitor arrivals in the first quarter were up 2% year-over-year, much less than implied by the raw data.

The clearest positive development in the data is the ongoing recovery in Maui County. Hotel occupancy on Maui averaged 63–66% through most of 2025, still well below pre-pandemic norms, but the early 2026 readings approached 70%, a meaningful step in the right direction. The average daily visitor census on Maui continued to trend upward, with February showing roughly 58,000 visitors on island each day compared to about 55,000 a year earlier. (County-level visitor census data for March was not available at the time of writing.) The trajectory over the past six months is unmistakably upward, although the pace of recovery will moderate going forward. Visitor census in the other counties has drifted sideways over the past six months.

While the statewide visitor census came in near the year ago level in the first quarter, spending remains elevated. Per-person daily spending ran near \$280 in the early months of 2026, on par with its level at the end of 2025. A portion of that strength reflects price increases for food, lodging, and transportation rather than increased consumption. We see this in the fact that for 2025 as a whole, real per-person spending growth was more modest once adjusted for inflation. Gains in revenue per available room, a commonly-used measure of hotel performance, have decelerated in early 2026 after a strong December, and statewide hotel occupancy has been broadly stable in the 73–75% range. As described in our previous report, performance continues to be bifurcated: high-end resorts and luxury properties on Oahu and Maui are faring better than the broader market, where discounting has offset much of the headline strength.



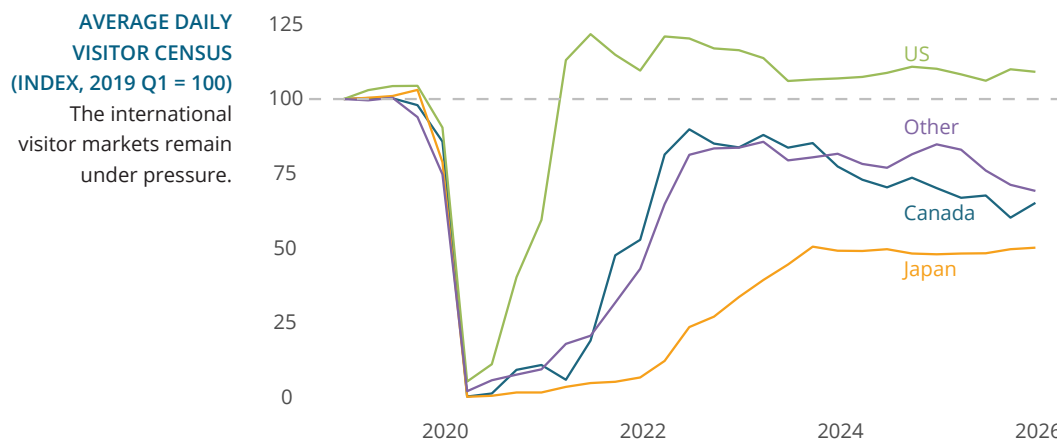
The Hawaii Convention Center (HCC) has begun a two-year, \$100M+ repair and renovation project, with reopening planned for January 2028. Although less than 5% of air travel is associated with business travel to meetings and conventions, the restricted use in the next two years will have some adverse impact on Oahu tourism. In 2025, the center generated over \$27 million in gross revenue, driving millions in additional visitor spending and taxes. Despite assertions that meetings and conventions can be accommodated by hotels and other venues, crowding out of other events will certainly occur, so Hawaii's meetings business will suffer net losses during the two-year closure.

The US and Israeli military strikes on Iran that began in late February represent a substantial risk for Hawaii tourism. By effectively closing the Strait of Hormuz and damaging oil production facilities, the war has sent oil prices surging upward: the benchmark Brent crude averaged \$117 per barrel in April and is expected to remain above pre-war levels for the remainder of the year at least.

For Hawaii, a particular concern is surging jet fuel prices, which have roughly doubled from pre-conflict levels. Airlines have already begun passing costs on through surcharges and fare increases. For example, both Japan Airlines and ANA have imposed fuel surcharges for new bookings in May and June. These are relatively large, in the range of 20-25%. Transpacific routes are among the most fuel-intensive in commercial aviation, and Hawaii's near-total dependence on air travel makes the state particularly exposed. For more, see the box, "Jet fuel prices and shortages threaten carriers and passengers."

The war-related challenges come on top of industry damage already suffered from the disastrous March "Kona Low" storms that disrupted vacation plans for some travelers. Those storms led to a year-over-year decline in March passenger counts of more than 5%, a notable departure from the relatively stable readings at the start of the year. The effect of high energy prices will be felt in coming months. How large and persistent those adverse effects will be will depend on how quickly the Strait reopens, oil flows are restored, and how much airlines ultimately adjust capacity and pricing.

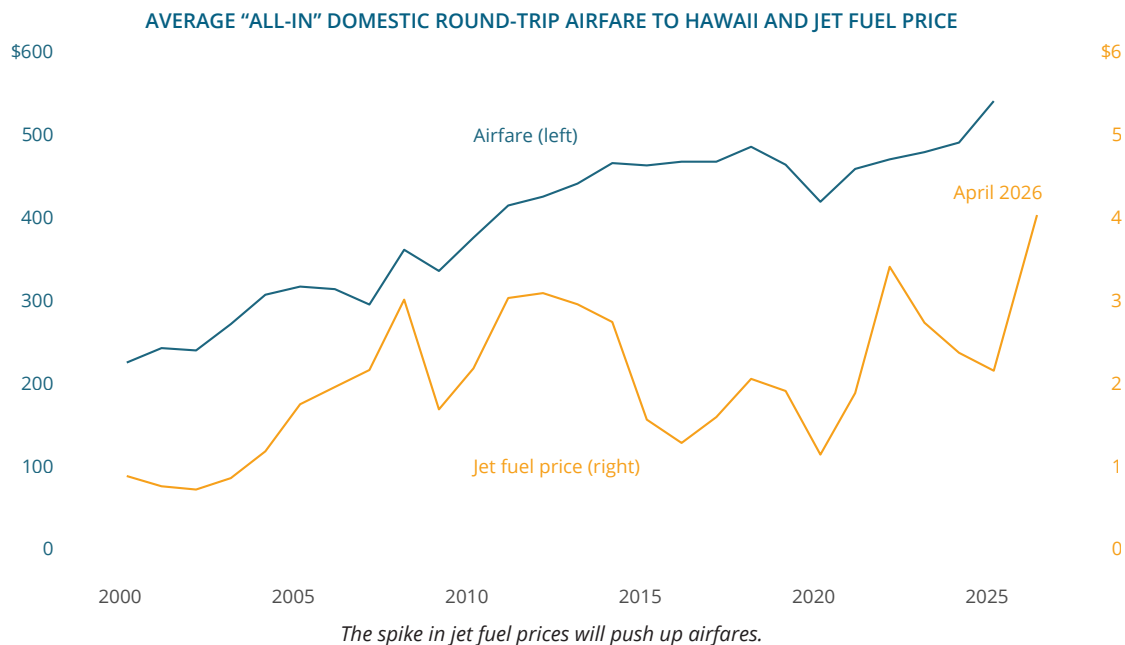
The international markets face compounding pressures on top of the oil shock. In addition to importing nearly all of its oil, Japan has also seen further weakening of the yen, putting additional pressure on Japanese household budgets. Higher airfares and reduced purchasing power create a potential obstacle to recovery of a Japanese visitor market that remains well below





## Jet fuel prices and shortages threaten carriers and passengers

Jet fuel typically accounts for 25–30% of airline operating costs according to the International Air Transport Association (IATA), but the 2026 crisis triggered by the closure of the Strait of Hormuz has upended that baseline. The average price for a gallon of jet fuel reached \$4.90 in early April, up from \$2.50 just before the conflict. This near-doubling has pushed fuel's share of operating expenses to nearly 45% for some airlines in a matter of weeks. Because Hawaii's transpacific routes are among the longest and most fuel-intensive in domestic aviation, the per-seat impact is especially pronounced: the \$2.40-per-gallon increase translates to an estimated \$120–145 in incremental fuel cost per round-trip economy seat from the West Coast and \$200 or more from the East Coast.



To recover those costs, airlines are considering or have begun to raise fares by roughly 20–25%. And baggage and seat selection fees are also rising. Increased costs of this magnitude will inevitably suppress travel demand. The effects are already materializing in airline announcements of schedule changes. United is cutting about 5% of its planned flights systemwide in the near term, while Delta has scrapped plans to add summer seats, leaving roughly 3.5% fewer seats than originally planned. For Hawaii, the combination of higher fares and reduced capacity poses a direct threat to arrivals. IATA director general Willie Walsh has warned that even if the Strait of Hormuz reopens, replenishing jet fuel supplies could take months, suggesting elevated fares and constrained airlift to the islands may persist well beyond any ceasefire.

its pre-pandemic level. The decline in Canadian visitor arrivals that began after the Maui Wildfires accelerated throughout 2025 amid trade tensions and adverse sentiment toward US travel. The slide continued during the first three months of 2026, with arrivals falling by nearly 7% compared with the first quarter of last year. If sustained, these developments in our two most important international markets represent a structural vulnerability for the industry: progress in broadening Hawaii's visitor base will require re-engaging these travelers, and the current environment makes that difficult.

Forward-looking air capacity data offers some tentative reassurance. Scheduled seats into Hawaii for the second quarter are committed well above year-ago levels—domestic routes in particular show healthy increases—but



this capacity and bookings were planned before the Iran conflict began. Airlines facing sharply higher fuel costs may reduce actual operations, adjust pricing enough to suppress demand, or both.

On balance, the visitor industry entered the second quarter facing a more challenging environment than at the time of our last report. The softer spending power of domestic and foreign consumers, the fragility of international markets, the aftereffects of the two Kona Low storms, and now the direct hit to travel affordability from higher airfares all point in the same downward direction. Maui's recovery and the sustained strength of per-person spending remain genuine positives, but they are unlikely to be sufficient to offset broader headwinds if oil prices remain elevated through mid-year. These issues will of course impact the forecast that we present below.

## Labor market soft but stable

Growth in Hawaii's labor market remains sluggish. Statewide nonfarm payroll growth has been essentially flat, with year-over-year job gains near zero as of February. Maui County was the only county to record payroll growth exceeding 1% over the same period. However, this increase largely reflects ongoing post-wildfire recovery rather than broad-based expansion. Nonfarm employment on the Valley Isle remains roughly 1,900 jobs below its pre-wildfire peak.

After growing throughout 2024, the state's labor force has flattened, and in fact declined by a net 1,200 workers over the past year. In part this reflects structurally lower working age population growth, but the number of available jobs has also declined. Over the past several years, job openings have fallen substantially from their exceptionally high levels after the pandemic. They continue to trend downward and are now substantially below their average for the 2018-2019 period. This signals weaker demand for workers. At the same time, the level of employment remains high relative to labor supply, with the state's unemployment rate holding below 2.5% since April of last year. Taken together, these trends suggest a less favorable environment for job seekers than in recent years, even as overall employment conditions remain relatively stable.

Despite low unemployment, Hawaii has seen only limited earnings growth in recent years. (The temporary increase during the pandemic reflected

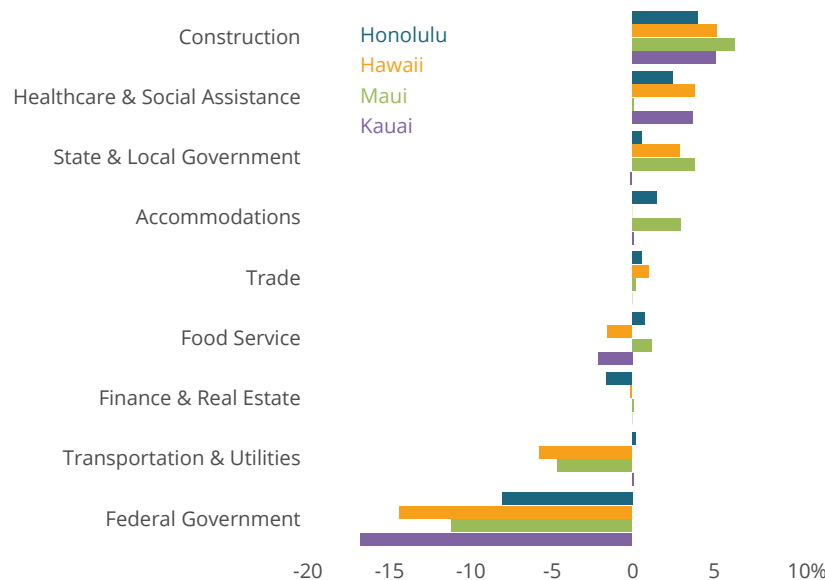
## PRIVATE REAL AVERAGE HOURLY EARNINGS

Growth in real hourly earnings has remained muted.



**GROWTH IN PAYROLL  
JOBS, FEBRUARY 2025 TO  
FEBRUARY 2026**

Construction and health care remain strong while federal government jobs have fallen sharply.



unusually tight labor market conditions.) Tighter hiring conditions should exert upward pressure on wages as employers compete to attract and retain workers, but real hourly earnings were largely flat throughout 2024 and 2025. The absence of meaningful earnings growth reinforces the broader picture of a labor market that lacks strong worker demand. Real hourly earnings growth has begun to pick up in the first two months of this year, but it is hard to disentangle the impact of the increased minimum wage from a more fundamental improvement in labor market conditions.

While overall labor market activity remains largely stable, a sectoral breakdown reveals greater nuance. Several industries have continued to expand over the past year. The construction sector has recorded the strongest year-over-year payroll growth across all counties, ranging from more than 2% on Oahu to nearly 6% in Maui County. Labor demand in this sector is expected to remain strong, supported by a high level of government contracts, ongoing rebuilding efforts on Maui, and investment in infrastructure and residential repairs following the series of Kona Low storms earlier this year. The healthcare and social assistance industry has also seen moderate growth over the same time period.

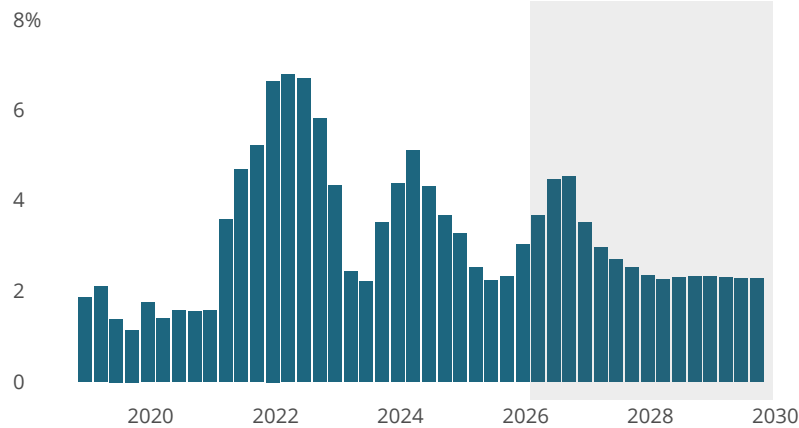
Other industries have posted notable declines over the past year. Federal government employment, in particular, has fallen sharply across all counties, with year-over-year declines ranging from 8% on Oahu to 17% on Kauai. While this sector accounts for less than 2% of nonfarm employment on the Neighbor Islands, the statewide decline totals more than 3,000 jobs over the past year. Beyond the federal government, the transportation and utilities sector has also experienced moderate payroll declines in Hawaii and Maui counties.

**Oil-driven  
inflation is hitting  
households from  
two sides**

The sharp jump in global crude oil prices is resulting in higher prices for both gasoline and electricity in Hawaii. At the time we are writing, the statewide average price of a gallon of regular-grade gas stood at \$5.66, more than a dollar higher than a year ago, according to AAA. The higher transportation fuel prices pose a particularly heavy burden for lower-income families, where this represents a bigger part of their budgets.

#### HONOLULU INFLATION RATE FORECAST, YEAR- OVER-YEAR CHANGE

Surging oil prices will lift local inflation by more than a percentage point this year.



Hawaiian Electric has informed customers that residential bills will rise 20-30%, with the pass-through reaching Oahu in April, Hawaii Island in May, and Maui County in June. On Kauai, the customer-owned KIUC co-op raised rates 13% in April, a smaller increase that reflects its higher share of fixed-price renewable generation. These electricity increases are not discretionary rate hikes but rather automatic monthly pass-throughs of fuel costs under each utility's PUC-approved cost-recovery mechanism. Including the increase in gas prices, the combined cost increase for the typical Hawaii household is on the order of \$100 per month—somewhat more in the HECO-served Neighbor Islands, where baseline electricity bills are already higher than on Oahu, and somewhat less on Kauai, where the April rate rise was more modest.

The March CPI reading for Honolulu, the only inflation indicator for Hawaii, shows that consumer prices have risen 3.7% over the past 12 months, running above the 3.3% national rate. The energy component of the Honolulu CPI increased by 3.3% over the year, reversing the steady decline in energy prices we saw throughout most of 2025. As higher energy prices feed through into utility bills, we will begin to see a substantial impact on overall inflation.

#### State Legislature reaches deal to preserve household tax relief

Large federal funding cuts and policy changes in 2025 created a large State revenue gap, with further shortfalls expected in 2026 and beyond. To restore State revenue, lawmakers considered a partial rollback of the remaining annual income tax cuts scheduled for 2027-2031.

The Legislature passed SB 3125 on May 8, sending the bill to the Governor. The scheduled cuts are preserved for joint filers under \$350,000, heads of household under \$262,500, and single filers under \$175,000. Bracket cuts are paused above those thresholds. A new top bracket applies to joint filers with incomes above \$1 million, heads of household above \$750,000, and single filers above \$500,000. Seven commercial tax credits will also be phased out, projected to retain almost a billion dollars.

Alongside the tax debate, pressure is building on the State's \$1.5 billion Emergency Budget Reserve Fund. The Governor floated the possibility of a drawdown in December to help close the budget, and the March Kona Low storms prompted renewed discussion of using this rainy-day fund or the Major Disaster Fund to finance recovery costs ahead of FEMA reimbursement. No specific drawdown has been authorized, but the convergence of federal cuts, disaster response, and softer State revenue narrows the fund's buffer against further shocks.

### Maui wildfire settlement will finally reach pockets

The \$4 billion global settlement for the Maui wildfires was finalized in April, following the Hawaii Supreme Court's February ruling blocking insurer intervention. Payment will come from seven defendants—Hawaiian Electric Industries (\$1.99 billion), Kamehameha Schools (\$872.5 million), the State of Hawaii (~\$800 million), Maui County (\$10 million), and smaller contributions. HEI paid the first of four approximately \$479 million installments in early 2026; other defendants' specific payment schedules have not been publicly announced but could follow a similar installment pattern.

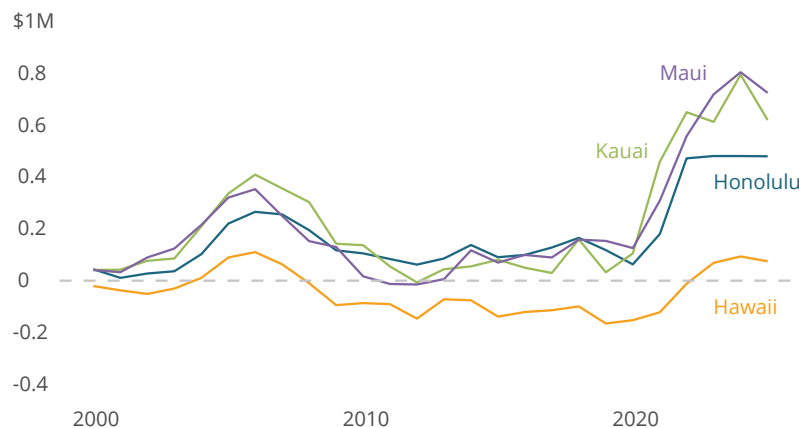
In official economic statistics, the bulk of the \$4 billion is counted as household transfer income when the settlement becomes legally binding, not when the money actually arrives, producing a one-time spike in measured Hawaii personal income, concentrated in Maui County. Actual cash to households will be spread over time and will be reduced by roughly \$1 billion in attorney fees and about \$200 million in insurer liens front-loaded in 2026. But these flows compensate for prior losses and should not be read as welfare gains. The same caveat applies to interpreting the impact on measures of aggregate growth. Below we describe how we are treating the payouts in our forecast.

### Housing affordability is historically poor

The housing market remains soft, with limited activity in both the single-family and condominium markets. Even after a war-related spike, mortgage rates remain in the low 6% range, well below their mid-2025 levels. But lower borrowing costs have not yet translated into stronger home price growth. The median single-family home price statewide has remained essentially flat, holding at just over \$1 million for seven consecutive months.

Despite slow price growth, the typical single-family house still costs far more than what the median household can reasonably afford. We define an "affordable" home as one where a household spends no more than 30% of its gross income on mortgage payments, assuming a 20% down payment and current mortgage rates. The gap between the median single-family home price and this affordable price provides a useful measure of housing affordability.

**DIFFERENCE BETWEEN  
MEDIAN SINGLE-FAMILY  
HOME PRICE AND  
AFFORDABLE PRICE**  
Single-family home prices  
are substantially higher  
than what the median  
household can afford.



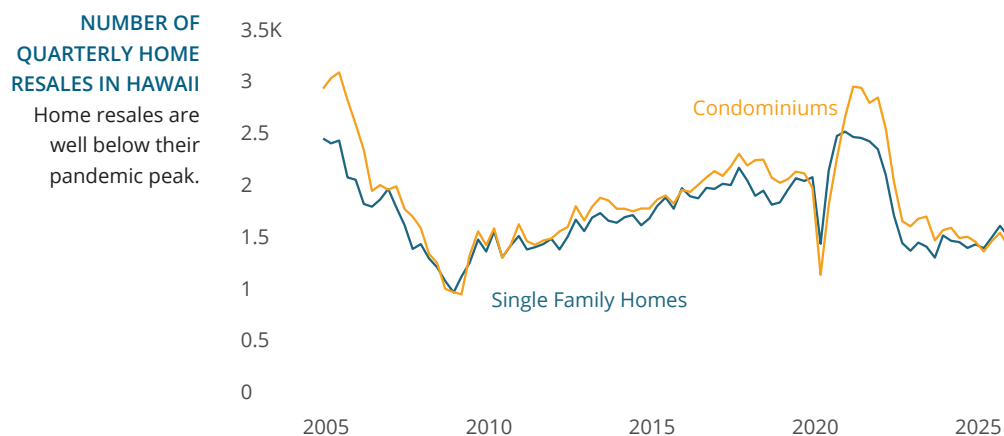
That affordability gap widened dramatically after 2021 as higher interest rates reduced purchasing power and income growth stalled. It reached its highest point in 2024 and has narrowed only slightly as mortgage rates have eased and income growth resumed. Even with this recent improvement, affordability remains much worse than historical norms, and a bit worse than we saw in the mid-2000s. In 2025, the gap between what the median household could afford and the median single-family home price ranged from about \$75,000 on Hawaii Island to more than \$700,000 in Maui County, with Honolulu and Kauai also facing substantial affordability shortfalls.

Condominium prices have continued to soften, falling 6% from their mid-2024 peak. At the same time, recent increases in property insurance costs have offset some of these affordability gains. Since the 2023 Maui wildfires, homeowner insurance premiums in Hawaii have risen by 13%, outpacing the national average.

Residents may face another round of premium increases following the series of Kona Low storms that struck Hawaii in March. These storms caused severe wind and flood damage, with projected losses exceeding \$1 billion according to state and insurance industry estimates. They also temporarily displaced many residents from their homes, which may place additional pressure on the rental market.

The recent storms have also drawn attention to an upcoming federal policy change. Updated FEMA flood maps will expand Special Flood Hazard Areas on Oahu. Properties with federally-backed mortgages located within these zones will be required to carry flood insurance, which averages roughly \$800 annually, varying with estimated flood risk. For newly designated properties, this may increase ongoing ownership costs, tighten lending conditions, and complicate development approvals. These changes could weigh on both housing supply and demand, slowing price and inventory growth in affected areas.

The combination of persistent relatively-high interest rates, natural disasters, and high home prices has contributed to limited resale activity in the single-family market. While resales have risen modestly, activity remains relatively low by historical standards. Median days on market are 27% higher than a year ago. Resale activity is even slower in the condominium market.



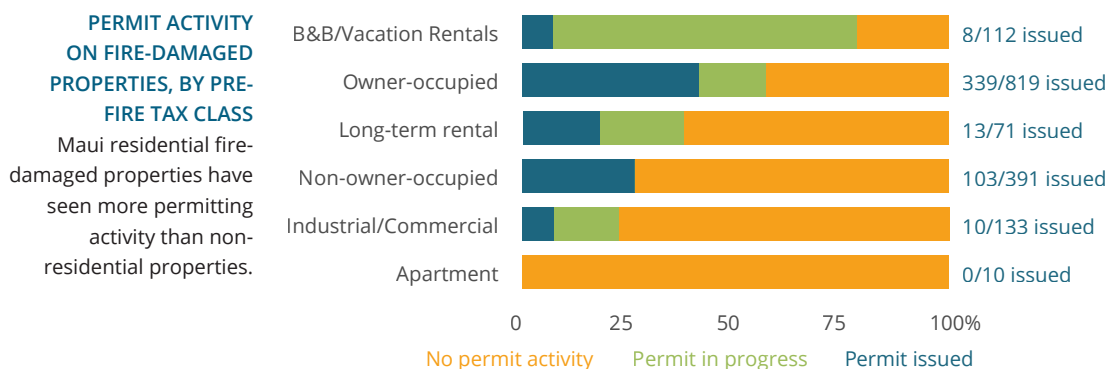
## Another disaster will create new rebuilding challenges

A federal Major Disaster Declaration for the two March Kona Low storms was approved on April 15, covering Honolulu, Hawaii, and Maui counties. Damage estimates range from the Governor's initial figure of approximately \$1 billion to insurance industry numbers that see this as a bottom end for insured costs alone, implying that total damage may be much higher. Approximately 19,000 properties were damaged, concentrated on Oahu, with significant infrastructure losses including \$245 million at state airports and the indefinite closure of Kula Hospital on Maui. FEMA will reimburse 75% of eligible public costs, as well as providing private assistance. Small business loans may also be available. However, some disbursements can take a year or more. Rebuilding activity will add to construction employment and government spending through the remainder of the year, but, as in other natural disasters, this reflects replacement of destroyed capital rather than net welfare gains.

Construction activity in Maui County remains elevated as wildfire recovery continues. To date, 634 permits have been issued to rebuild permanent structures on 473 fire-affected parcels, with more progress for single-family residences than commercial or multi-family properties. The largest volume of permit activity is taking place for owner-occupied properties and for the small number of vacation rentals and bed-and-breakfasts. In contrast, non-owner-occupied residential properties lag behind, with only a quarter of buildings showing ongoing permit activity.

Non-residential rebuilding continues to trail, with only very few permits issued for commercial and industrial properties. This slower pace likely reflects the greater complexity of rebuilding business and industrial sites, particularly in Lahaina's historic commercial core, where shoreline regulations, historic district requirements, floodplain standards, and special management area rules add permitting challenges. As property owners gain access to wildfire settlement, insurance, and other recovery funds, and permitting pathways become clearer, commercial and industrial rebuilding should pick up, supporting the return of local businesses and economic activity to Lahaina.

On Oahu, demolition of the old Aloha Stadium began in March, marking the start of the New Aloha Stadium Entertainment District (NASED), a \$4



billion public-private partnership. The new stadium is scheduled to open in early 2029, with the full development unfolding over 20 years to eventually include 4,100 housing units, hotel towers, and retail spaces. Phase One alone is estimated to generate over \$2 billion in spending and 12,000 temporary construction jobs.

Honolulu County is also working to expand housing supply through incentives for smaller-scale development. Chapter 32 of the Revised Ordinances of Honolulu, informally known as Bill 7, was enacted in 2019 and targets the housing gap for residents with incomes too high to qualify for federal assistance but who cannot otherwise afford market-rate housing. The program allows increased height and density, parking exemptions, and expedited permitting in exchange for meeting affordability requirements. So far, about 2,000 units have been proposed across 65 projects, with the program producing roughly 200 units so far. While the program has the potential to produce a considerable number of units, the gap between proposed and completed projects highlights ongoing challenges in translating proposals into built units.

Beyond affordable housing incentives, Bill 6, approved in April 2026, amends development standards for Honolulu's apartment and apartment mixed-use zoning districts. The ordinance reduces minimum lot size requirements, standardizes lot dimensions, and nearly doubles allowable residential density. UHERO estimates suggest that these changes increase potential housing units in apartment and apartment mixed-use districts by roughly 90%.

These changes address a fundamental mismatch between current zoning regulations and Honolulu's existing development patterns. By simplifying standards and increasing allowable density, the bill makes it cheaper to build each housing unit, allowing moderate-scale development projects on small urban parcels to become financially feasible. The bill also creates opportunities for small and mid-sized local property owners rather than limiting development to large land assemblies.



## THE HAWAII OUTLOOK

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The oil price spike caused by the war on Iran will have notable adverse effects on the Hawaii economy, even if the extent of those effects is difficult to assess. Inflation will be higher this year, and economic activity will be a bit lower than would otherwise have been the case, primarily because of some adverse effect on tourism. At the same time, the economy had strengthened going into this year, so that the net effect of these contrary forces will likely prevent an outright decline in economic activity here.

The “likely” is key: at this point it is impossible to know when hostilities will end, how long it will take for global oil supplies to approach normal, and what that will imply for the trajectory of oil prices. Under a more pessimistic scenario, a larger and longer-lasting oil price rise would mean more persistent inflationary effects, longer adverse effects on jet fuel availability and tourism, and a greater impact on local economic growth.

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### Oil prices mean a less favorable external economic environment

Prospects for the performance of the external economy that affects Hawaii have worsened since the time of our last report. For the US, the anticipated lift to growth from federal tax cuts will be more than offset by the adverse effects of higher oil prices. Consumer spending growth has also slowed at the start of the year. Together, these will reduce 2026 US economic growth to just 1.7%, down four-tenths of a percent from our first-quarter forecast. Growth would be slower still if not for robust AI investment. That investment, together with some bounce back from the oil shock, will drive a return to healthy growth of 2.4% by 2028. Further out, a slower growing and aging labor force will act as a constraint on growth.

The direct and indirect effects of higher energy costs will boost US consumer price inflation to 4% for this year as a whole. Together with already-accelerating inflation pre-war, the Fed’s scope for interest rate cuts will be more limited than expected, although a new Fed Chair makes this uncertain.

Higher oil prices have the potential to raise US growth over the medium-term, through increases in oil patch investment. That could help to strengthen the economy as we move into 2028 and beyond.

Growth and inflation prospects over the next several years will be poorer for other major economies that are important visitor markets. Japan and many other Asian economies are heavily dependent on oil imports from the Middle East and so will face significant inflation and growth risks, even as they benefit from strong semiconductor sales to fuel AI investments. The US-led trade war and policy uncertainty will continue to weigh on global economic conditions.

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### Tourism resilience means healthy 2026 numbers before 2027 dip

Despite the Kona Low storms and the data issues we described above, the visitor industry entered 2026 with strong year-over-year US market growth and an even stronger increase in Japan arrivals. As the effects of high oil prices kick in, visitor numbers will weaken as this year progresses.

Arrivals from all markets will grow by about 2% this year, a significant markup over our previous forecast due to the year’s strong start. US visitors will drive this growth, rising 2.7%. The number of Japanese visitors will increase by 1%



for the year, and visitors from other markets will contract by less than 1%. The average daily census, which takes into account visitors' length of stay, will post 1.7% growth for 2026 overall, after declining for the past two years.

As the effects of oil prices on airfares, other costs, and macroeconomic conditions are felt, visitor arrivals will fall over the course of the year. By the first quarter of next year, arrivals will be more than 3% below their level at the beginning of 2026, with weakness in all markets. Recovery will have begun by then, but growth on an annual basis will remain weak until 2028. And international markets will take even longer to recover from their marked post-election drop, so that the visitor census will remain below its mid-2022 post-pandemic peak until late in the decade.

While returning to recovery in 2025, the number of Japanese visitors to Hawaii remains far below the pre-pandemic level. We anticipate that growth will accelerate by 2028 but that Japanese visitor presence in the Islands will remain below the high levels seen in the past. This reflects our view that part of the falloff reflects the structural challenges of an aging and declining Japanese population and evolving traveler preferences. At least in the near term, an additional headwind will continue to be the loss we have seen in the purchasing power of the yen, which has never been lower. The yen today has just 60% of the dollar purchasing power that it had in January 2020.

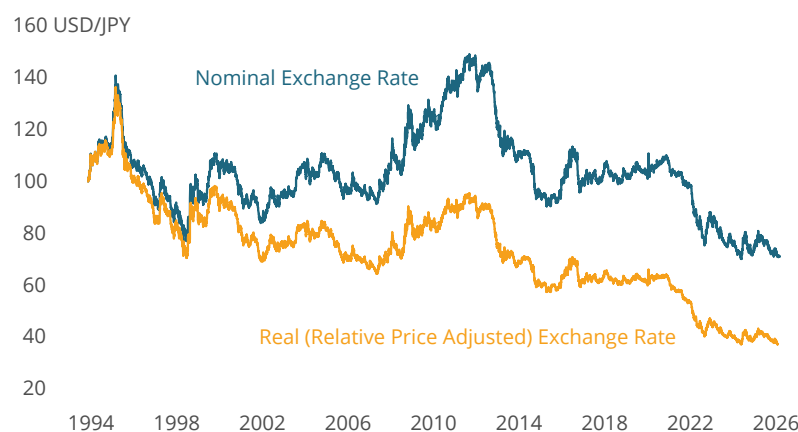
International markets other than Japan will also take time to recover from losses related at least in part to the deterioration of foreign attitudes toward the US. We think these markets will take a considerable time to recover.

Uncertainty about the prospects for the ongoing Iran war, oil prices, and therefore the likely path of the Hawaii economy is acute. Our baseline forecast may be viewed as relatively optimistic, and a much poorer outcome is possible. We discuss an alternative pessimistic scenario and its implication for the Hawaii outlook in the box, "Sky-high oil prices would make a Hawaii downturn inevitable."

Durable US macroeconomic strength has buttressed a healthy US visitor market over the past several years. After the coming oil-price-related lull, we expect relatively good performance for our largest market through the end of the decade. Over the longer run, we continue to believe that the scope for further US market gains is modest, in part because of slower trend US growth and competition from international market recoveries as they occur.

**DOLLAR VALUE OF THE YEN IN NOMINAL AND REAL TERMS (INDEX, JANUARY 4, 1994 = 100)**

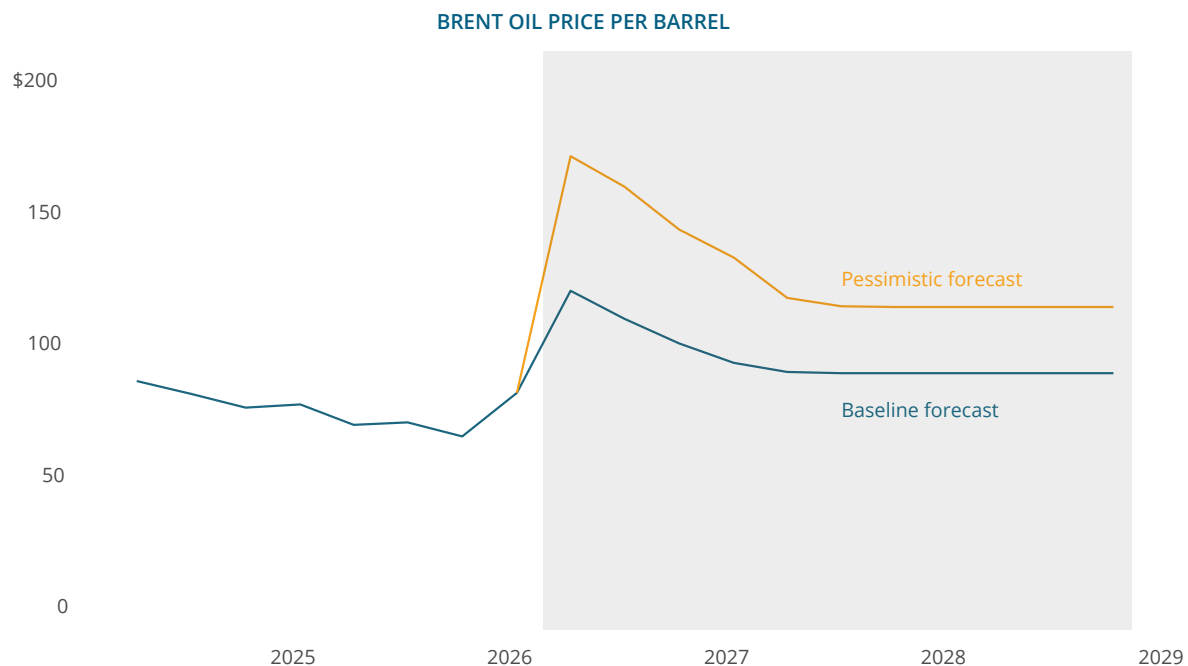
The yen's purchasing power in the US has never been weaker.



## Scenario: Sky-high oil prices would make a Hawaii downturn inevitable

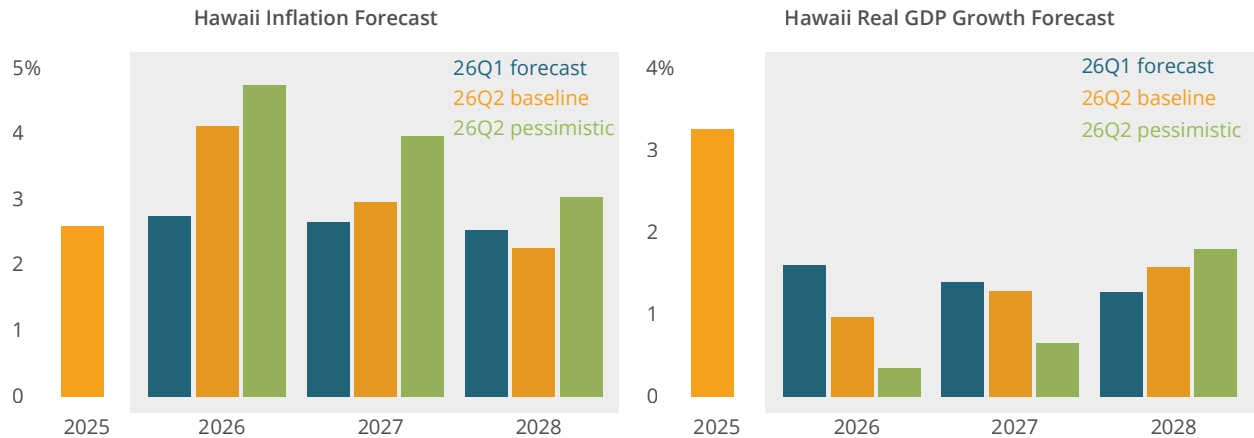
The US and Israeli war on Iran has led to the biggest disruption in global oil flows in a half-century and a pronounced rise in oil prices. At this point, prospects for resolution of the conflict, reopening of the Strait of Hormuz, and the extent of damage to the region's energy infrastructure remain largely unknown. There will also be significant but uncertain delays in returning oil flows to pre-war levels once a resolution to the conflict occurs. As a result, we think it is important to consider possible scenarios when undertaking economic planning.

Oil prices and availability affect the economy through several channels. The most immediate impact has been on consumer prices through the price of gasoline. But oil price increases are also affecting the cost of production for many industries, both through oil-using inputs and the cost of energy needed for operations. These effects will take longer to show up in costs of final goods and services. Higher energy prices for consumers will act as a tax restraining spending on other activities, while higher production costs will adversely affect aggregate supply. Then there are disruptions to particular markets. For Hawaii the most important of these is the shortage of jet fuel, which is already feeding through into higher airfares and could worsen over the summer.



Here we lay out our baseline assumption for oil prices and the Hawaii economy, as well as a pessimistic alternative projection. Because we think our baseline leans toward the optimistic side, we do not present an optimistic alternative. Our baseline forecast sees the spot oil price peaking in the current quarter at about \$119 per barrel (bbl), near its current level, and then receding to \$88/bbl by the second quarter of next year. Our pessimistic scenario sees oil averaging \$170/bbl in the current quarter and \$138/bbl for 2026 overall. This much higher oil price path is considered less likely than the baseline and might occur if the depletion of oil reserves further reduces oil supply and the conflict continues well into the summer.

The implications for Hawaii of the baseline and pessimistic oil price scenarios are stark. Here we show a comparison of inflation and growth rate paths for (a) our previous first quarter forecasts, (b) our new baseline forecast, and (c) our pessimistic alternative forecast path.



Our new baseline forecast sees Honolulu inflation spiking at 4.8% mid-year and averaging 4.1% for 2026 overall. This is fully 1.4 percentage points higher than in our first-quarter forecast. In the pessimistic case, higher oil prices cause annual inflation to rise to 4.8% for the year overall, and it takes considerably longer to decline to a moderate level. Hawaii real gross domestic product posts only 1% growth this year in our current baseline, compared with 1.6% in last quarter's forecast. In the pessimistic oil price scenario, real GDP would average only 0.4% this year, consistent with several quarters of economic contraction in the Islands.

The significant adverse impacts on Hawaii of the war-related energy price increases incorporates our view both of the higher oil price path and a recognition that disturbances to travel may be large because of the effect on airfares and potential jet fuel supply constraints.

Over the medium-term, higher oil prices may spur investment in US oil production capacity. While that will not affect Hawaii directly, we may benefit if it helps to boost mainland growth and household finances. But that is down the road. The near-term costs of the oil price surge remain our primary—if uncertain—concern.

After growing at a moderately rapid clip last year, visitor spending will slow and then dip by 2027. In general, inflation-adjusted visitor spending will grow more slowly than average daily visitor census in coming years, mirroring its long-run underperformance.

There are some differences in the visitor industry forecast across the four counties. After two years of weak US market performance, Hawaii County will see gains in 2026, reinforced by an uptick in the number of Japanese visitors. Visitor numbers in Honolulu County will come in slightly lower, dragged down by another year of US market weakness. The industry will stabilize next year and benefit from firming of the Japanese market thereafter. Kauai raised its US market share last year and that will carry over into a strong 2026 showing, in visitor numbers if not length of stay. Maui will see by far the strongest 2026 growth as its recovery from the post wildfire decline continues. All counties will see weakness developing as the year progresses and will post negative or very small positive tourism growth for 2027 as a whole.

### Construction strength continues to bolster the Hawaii economy

The Hawaii construction industry has been a substantial contributor to growth in recent years. This has been supported by an exceptionally high volume of federal and locally-funded public sector projects, as well as ongoing private residential and nonresidential building. Maui rebuilding has added to the mix.

Overall construction sector activity will remain at a high level for the next several years. While 2026 will be the last year of net job growth, construction payrolls will remain above their 2025 level for the remainder of the decade. The surge in public sector building that has been driven by very large federal contracts will reach a peak within the next couple of years, but private residential and non-residential building will show net growth through the end of the decade. The construction job base will begin to decline over the next few years, but the pace of that decline will be very gradual, because of the large number of projects still in the pipeline. Even in 2030, construction employment will exceed the peak of past building cycles.

High rates of cost inflation will continue to be a challenge for the industry, in part because of the ongoing feed-through of tariffs and now the surge in energy costs. Limits to available labor will also be a problem. Demand for homes will only gradually recover, as 30-year fixed rate mortgage rates remain at or above 6% throughout the forecast period. This is of course considerably higher than the bargain rates seen before and during the pandemic.

Similar to total real building authorizations, the real contracting tax base—a broad measure of industry activity—will slow and approach a peak just below \$16 billion in 2030. Overall sector activity will slow gradually, and construction will continue to play an outsized role in the Islands for some time to come.

### HAWAII CONSTRUCTION JOBS

The falloff in construction will be more gradual than past cycles.



### Oil prices will add to inflation burden

As we noted above, the sharp increase in oil prices has already caused a marked rise in US inflation. This will soon be true in Hawaii, as well. Combined with ongoing feedthrough of tariffs and the cost pressures from deportations, there is now considerable inflationary pressure in the pipeline.

In Hawaii, inflation has been roughly in line with the US overall, with Honolulu averaging 2.6% for 2025, compared with 2.7% for the country overall. Consumer prices had begun to heat up at the start of the year, and in the US case spiked in March following the oil price shock. Local inflation also jumped in March, rising to 3.7% year-over-year, driven not by energy prices, but rather by a jump in shelter costs, likely from higher insurance premiums. The oil price shock to the Honolulu CPI remains in the works.

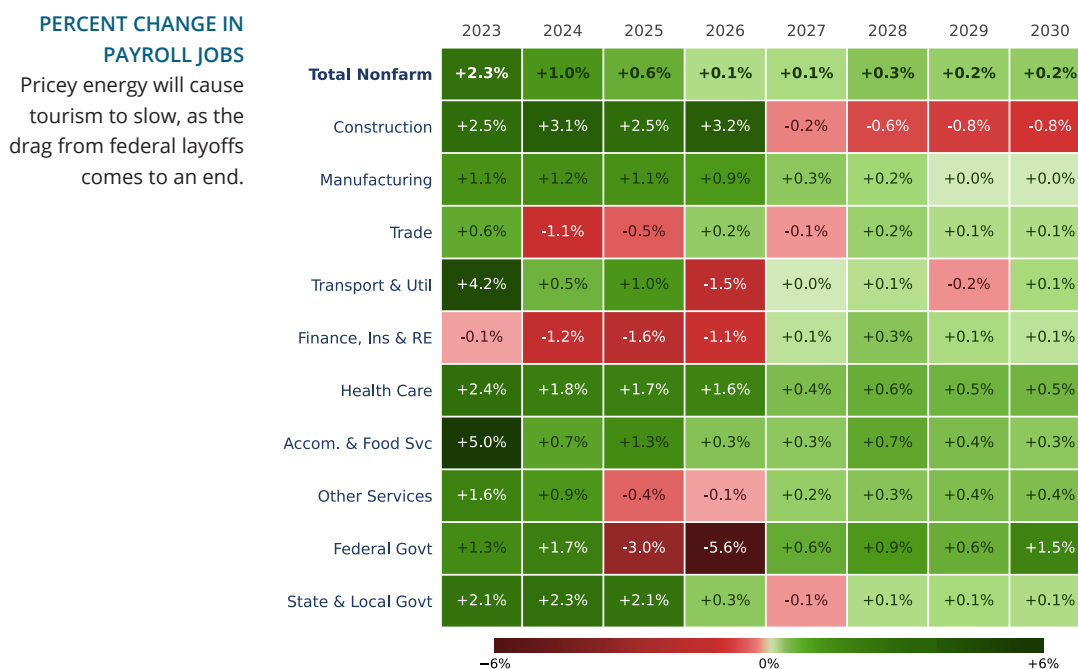
In our first-quarter report, we noted that the imposition of large tariffs had raised our forecast of 2025 inflation to just below 3%. The oil price shock will increase Honolulu consumer price inflation by a further one percentage point above what would otherwise have been the case. Honolulu inflation will average just over 4% this year, easing to 3% in 2027. Local inflation will then fall a bit below its long-run 2.5% path for several years because of relatively weak demand.

### Labor market growth will be marginal

The adverse impact of higher oil prices on consumer demand and production costs will lead to a slightly slower pace of Hawaii aggregate job growth than we had forecast in the first quarter. The markdown from 0.2% to 0.1% would have been a couple tenths-of-a-percent larger but for pre-war data that was coming in a bit more strongly than we had anticipated, primarily in the form of more construction and healthcare jobs.

As we noted above, the visitor industry will post arrivals gains for this year as a whole, because the year has started off in solid fashion. But shorter length of stay means that the all-important average daily visitor census will rise by a smaller amount. Still, total visitor spending will post a small gain this year, providing some growth offset to the adverse oil price effects on employment. As the year develops, this support will largely dissipate, leading to a decline in real spending for 2027.

The majority of sectors that will bear the brunt of the oil price surge are those linked to tourism. These include accommodations and food services, whose job base will expand by just 0.3% this year and next, and



transportation & utilities, which will contract by about 1.5% this year. (But we note that much of the latter weakness is based on developments over the past half-year). Job growth in the trade sector will weaken by 2027.

Hawaii's federal government job losses have been larger than anticipated early on, plummeting by about 3,250 jobs over the course of last year. While they appear to have stabilized, we will nevertheless see a large year-over-year loss for 2026. There have been (so far) no significant losses of state and local government jobs.

Health care is expected to continue its above-trend growth for another year, before slowing toward a roughly half-percent trend. Finance, insurance and real estate jobs will continue their downward trend before stabilizing next year. Construction payroll growth will lead all sectors for one more year before the job base begins a very gradual pullback.

Hawaii's unemployment rate is now very low, 2.3% in February. In part this reflects structural differences such as lower labor turnover and incentives for outmigration in a high-cost, low-growth state. These factors, together with low labor force growth, will keep unemployment near this level over the forecast horizon.

As always, there are some differences in labor market performance across counties. Honolulu and Kauai will see job growth this year near the statewide average of 0.1%. Maui growth will be quite a bit stronger, supported in part by rebuilding activity, as well as recent gains in state and local government employment. Hawaii county will post a net job decline for 2026 overall, but this reflects in part losses in tourism-related sectors and several others that occurred late last year and therefore represent a low starting point for this year's forecasts.

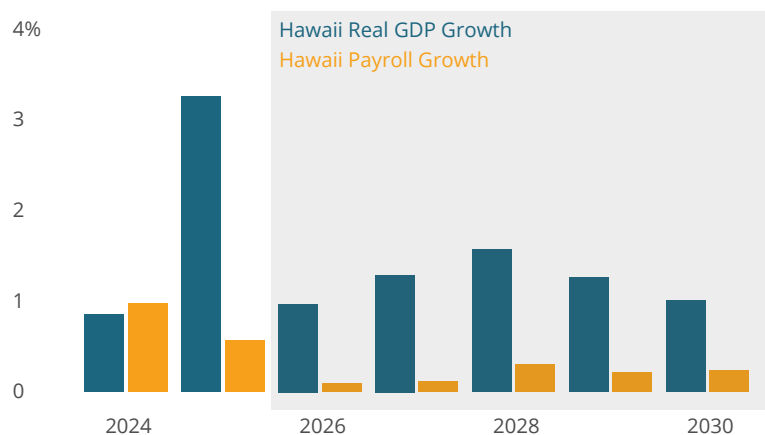
### A poorer aggregate growth forecast

The oil shock induced macroeconomic softening will also be reflected in weaker income growth. Federal income tax cuts and especially business tax incentives will offset some of this weakness, although cuts to federally funded support programs will hurt lower-income families.

The weaker payroll jobs forecast is reflected in sector-level income forecasts. To some extent, industry labor income performance mirrors that of payroll

### HAWAII REAL GDP AND PAYROLL JOB GROWTH

The oil shock will cause a pullback in GDP growth, as job gains converge to a low trend rate.



jobs. But there are also idiosyncratic differences in recent developments that shape these forecasts. Sectors that will impose the most drag on labor income this year include transportation and utilities, and both federal and state and local government. Accommodations and food service income growth will be about a percentage point weaker than in our first quarter forecast. The biggest offsetting positive contributions will come from construction and health care. Overall, real labor income will be essentially flat this year as a surprise jump in consumer prices outstrips largely baked-in wage gains.

### Wildfire compensation will lift forecast income numbers

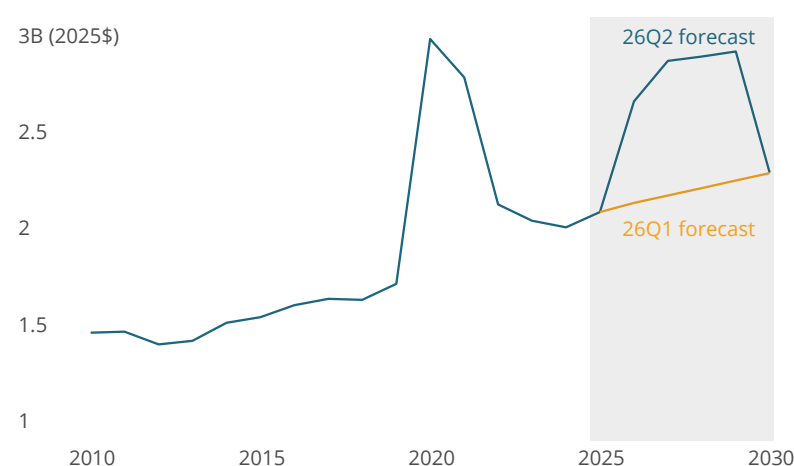
Statewide real income will be stronger than labor income. The primary cause is the beginning of payouts to Maui residents from the global settlement for the Maui wildfire described above. As we noted, the bulk of the \$4 billion is counted as household transfer income in government statistics when the settlement becomes legally binding, not when the money actually arrives, producing one or more spikes in measured Hawaii personal income, concentrated in Maui County. Because actual cash to households net of attorneys' fees and insurance liens will be spread over time, in our forecast we spread out the estimated total payments over the next four years. We estimate cash reaching households of about \$0.55 billion in 2026 and roughly \$0.75 billion annually in 2027 through 2029, for a cumulative \$2.8 billion.

In our model, this raises total transfer income on Maui by more than a quarter of the 2025 level. That drives a roughly 5% jump in total real income for the county. Real income growth in the other counties will be in the 0.3-0.5% range. The Maui payouts will continue for the next several years, maintaining the county's income at an unusually high level through much of the remainder of the decade.

It is important to note that while the income spikes from wildfire settlement payouts will generate additional consumption, construction and employment, they do not represent a net gain in welfare to the extent that they are simply replacing lost housing and commercial structures and reimbursing for other losses suffered by affected families. This problem of insurance outlays and other payments leading to spikes in measured income is common to all recoveries from natural disasters.

### TRANSFER PAYMENTS TO MAUI RESIDENTS

Wildfire compensation will cause a bump in Maui transfers on par with pandemic-era relief.



Overall, real income will rise 1% this year, down from about 2% in 2025. Again this would be weaker without the Maui wildfire compensation payouts. Beyond 2026, we see a return to a restrained growth path for Hawaii, with real labor income growth averaging 0.8% over the 2027-2030 period. As we noted last time, this is about as good as we can expect in Hawaii's slow-growth economy.

Real gross domestic product, our broadest measure of economic activity, will slow to 1% this year after a strong 3%-plus showing last year. Real GDP growth will rebound to 1.6% by 2028 before settling near 1% in the out years. As we discuss in the box above, uncertainty about future oil prices makes much poorer growth performance possible. If oil prices represent a downside rise, the adoption of AI might raise trend growth a bit over time.

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### And the hits they just keep coming

Just when we hoped things were stabilizing, the war on Iran has upended the US and global economy. Higher oil prices will directly raise inflation and indirectly constrain supply through cost increases and supply chain disruptions. Higher prices and the weaker external environment will be felt in Hawaii, with the vital visitor industry potentially most exposed. And all of this on top of a series of truly disastrous spring floods. As a result, we have pulled up our local inflation forecast and pulled down the near-term Hawaii economic growth projections.

We are lucky that we headed into this crisis in reasonably good shape. US consumers have continued to spend, propelled by high-income households with booming stock market wealth. As consumption has eased over the past half-year or so, AI-driven investment has acted as an offsetting support. The labor market remains sound, with job slowing reflecting a flat labor supply rather than a marked falloff in demand. So we have (a little) momentum on our side.

But it is important to note that we are now experiencing just the most recent of three major supply-side shocks. The first was the application of the biggest tariffs in a century. The second has been ramped-up deportations and closed borders. And now the most severe disruption to oil supplies in at least fifty years. Together, these represent a substantial cost for consumers and businesses. And supply shocks post a notorious policy predicament: Does the central bank stimulate the economy to prevent a recession or instead raise interest rates to prevent the new inflation from getting baked-in to the economy for years to come. Already, we saw that tension at play at the most recent Fed policy-setting meeting.

Each of these supply shocks has also brought with it increased uncertainty. Many tariffs that were on are now off, but many will be back under different authority. Because they are in part negotiating hammers, we do not know when they might be lifted on some countries or products. Deportations have not occurred as rapidly as some expected, but that may change, and the impact on legal immigration is uncertain. And who knows how long before conflict conditions will change enough to restore oil flows. Uncertainty is anathema to businesses considering investment. As a result, investment outside of AI has been effectively stalled.

Because of the high uncertainty around our most recent supply shock, we think a scenario analysis may be the best way forward for planners. We have included in this report both a baseline oil price path and a more pessimistic



alternative. The latter of course would mean more inflation in Hawaii and a poorer near-term growth path. As more clarity emerges, we will of course be updating our forecasts accordingly.

These near-term challenges do not change factors that will affect Hawaii's longer-term growth path. As in previous forecasts, that path is characterized by trend growth that is much slower than we have seen in the past. Hawaii's population is aging and its growth is slowing. This will mean slow or no increases in the labor force that underpins growth, posing challenges for businesses needing labor and for governments that rely on revenue growth to meet social and infrastructure needs. At the same time, AI adoption will eventually increase productivity and buoy growth, although estimates vary widely. This has the potential to support growth in per person income even as total growth ebbs. That would be a welcome development in a state that has lagged behind in maintaining a satisfactory standard of living.

TABLE 1: MAJOR ECONOMIC INDICATORS

## STATE OF HAWAII FORECAST

|                                        | 2024      | 2025      | 2026             | 2027      | 2028      | 2029      | 2030      |
|----------------------------------------|-----------|-----------|------------------|-----------|-----------|-----------|-----------|
| <b>MAJOR INDICATORS</b>                |           |           |                  |           |           |           |           |
| Nonfarm Payrolls (Thou)                | 638.5     | 642.1     | <b>642.7</b>     | 643.5     | 645.5     | 646.9     | 648.5     |
| % Change                               | 1.0       | 0.6       | <b>0.1</b>       | 0.1       | 0.3       | 0.2       | 0.2       |
| Unemployment Rate (%)                  | 2.8       | 2.3       | <b>2.4</b>       | 2.5       | 2.5       | 2.5       | 2.6       |
| Population (Thou)                      | 1,434.4   | 1,432.3   | <b>1,431.3</b>   | 1,429.9   | 1,428.3   | 1,427.8   | 1,428.5   |
| % Change                               | 0.0       | -0.1      | <b>-0.1</b>      | -0.1      | -0.1      | 0.0       | 0.1       |
| Nominal Personal Income (Mil \$)       | 102,703.8 | 107,611.1 | <b>113,174.6</b> | 118,336.7 | 122,756.9 | 127,009.1 | 130,421.1 |
| % Change                               | 5.9       | 4.8       | <b>5.2</b>       | 4.6       | 3.7       | 3.5       | 2.7       |
| Inflation Rate, Honolulu MSA (%)       | 4.4       | 2.6       | <b>4.1</b>       | 3.0       | 2.3       | 2.2       | 2.3       |
| Real GDP (Mil 2025\$)                  | 120,679.1 | 124,607.8 | <b>125,813.7</b> | 127,433.5 | 129,438.2 | 131,070.3 | 132,391.4 |
| % Change                               | 0.9       | 3.3       | <b>1.0</b>       | 1.3       | 1.6       | 1.3       | 1.0       |
| Real Personal Income (Mil 2025\$)      | 105,366.4 | 107,611.1 | <b>108,689.9</b> | 110,381.1 | 111,964.9 | 113,330.2 | 113,768.9 |
| % Change                               | 1.5       | 2.1       | <b>1.0</b>       | 1.6       | 1.4       | 1.2       | 0.4       |
| Real Per Capita Income (Thou 2025\$)   | 73.5      | 75.1      | <b>75.9</b>      | 77.2      | 78.4      | 79.4      | 79.6      |
| % Change                               | 1.5       | 2.3       | <b>1.1</b>       | 1.7       | 1.6       | 1.2       | 0.3       |
| <b>TOURISM SECTOR DETAIL</b>           |           |           |                  |           |           |           |           |
| Total Visitor Arrivals by Air (Thou)   | 9,709.1   | 9,649.1   | <b>9,841.5</b>   | 9,860.2   | 10,125.0  | 10,342.8  | 10,531.7  |
| % Change                               | 0.5       | -0.6      | <b>2.0</b>       | 0.2       | 2.7       | 2.1       | 1.8       |
| U.S. Visitors                          | 7,387.2   | 7,416.0   | <b>7,613.4</b>   | 7,616.3   | 7,755.5   | 7,839.1   | 7,916.1   |
| % Change                               | -0.5      | 0.4       | <b>2.7</b>       | 0.0       | 1.8       | 1.1       | 1.0       |
| Japanese Visitors                      | 708.1     | 735.7     | <b>743.2</b>     | 762.5     | 845.8     | 935.9     | 1,007.6   |
| % Change                               | 20.0      | 3.9       | <b>1.0</b>       | 2.6       | 10.9      | 10.7      | 7.7       |
| Other Visitors                         | 1,613.9   | 1,497.5   | <b>1,484.8</b>   | 1,481.4   | 1,523.6   | 1,567.9   | 1,608.0   |
| % Change                               | -1.7      | -7.2      | <b>-0.8</b>      | -0.2      | 2.9       | 2.9       | 2.6       |
| Average Daily Census (Thou)            | 230.6     | 227.7     | <b>231.5</b>     | 233.6     | 238.7     | 242.8     | 247.7     |
| % Change                               | -1.8      | -1.2      | <b>1.7</b>       | 0.9       | 2.2       | 1.7       | 2.0       |
| Average Daily Room Rate (\$)           | 363.4     | 366.4     | <b>368.9</b>     | 371.1     | 379.9     | 391.9     | 403.8     |
| % Change                               | -3.7      | 0.8       | <b>0.7</b>       | 0.6       | 2.4       | 3.1       | 3.0       |
| Occupancy Rate (%)                     | 66.2      | 64.9      | <b>64.2</b>      | 64.9      | 67.2      | 68.9      | 70.3      |
| Real Visitor Expenditures (Mil 2025\$) | 21,013.4  | 21,749.8  | <b>21,915.4</b>  | 21,704.0  | 21,936.6  | 22,149.9  | 22,328.4  |
| % Change                               | -5.1      | 3.5       | <b>0.8</b>       | -1.0      | 1.1       | 1.0       | 0.8       |

Note: Source is UHERO. Income figures for 2025 are adjusted by UHERO to reflect the timing of the payout of the Maui wildfire settlement. Occupancy rate includes UHERO's estimate of TVR occupancy. Figures for 2026-2030 are forecasts.

**TABLE 2: JOBS BY INDUSTRY**

STATE OF HAWAII FORECAST

|                                    | 2024  | 2025  | 2026         | 2027  | 2028  | 2029  | 2030  |
|------------------------------------|-------|-------|--------------|-------|-------|-------|-------|
| Nonfarm Payrolls (Thou)            | 638.5 | 642.1 | <b>642.7</b> | 643.5 | 645.5 | 646.9 | 648.5 |
| % Change                           | 1.0   | 0.6   | <b>0.1</b>   | 0.1   | 0.3   | 0.2   | 0.2   |
| Construction and Mining            | 39.3  | 40.3  | <b>41.5</b>  | 41.5  | 41.2  | 40.9  | 40.5  |
| % Change                           | 3.1   | 2.5   | <b>3.2</b>   | -0.2  | -0.6  | -0.8  | -0.8  |
| Manufacturing                      | 12.9  | 13.0  | <b>13.1</b>  | 13.2  | 13.2  | 13.2  | 13.2  |
| % Change                           | 1.2   | 1.1   | <b>0.9</b>   | 0.3   | 0.2   | 0.0   | 0.0   |
| Trade                              | 81.8  | 81.5  | <b>81.7</b>  | 81.5  | 81.7  | 81.8  | 81.9  |
| % Change                           | -1.1  | -0.5  | <b>0.2</b>   | -0.1  | 0.2   | 0.1   | 0.1   |
| Transportation and Utilities       | 34.6  | 35.0  | <b>34.5</b>  | 34.5  | 34.5  | 34.4  | 34.5  |
| % Change                           | 0.5   | 1.0   | <b>-1.5</b>  | 0.0   | 0.1   | -0.2  | 0.1   |
| Finance, Insurance and Real Estate | 27.4  | 27.0  | <b>26.7</b>  | 26.7  | 26.8  | 26.8  | 26.8  |
| % Change                           | -1.2  | -1.6  | <b>-1.1</b>  | 0.1   | 0.3   | 0.1   | 0.1   |
| Services                           | 316.8 | 318.9 | <b>320.4</b> | 321.2 | 322.8 | 324.2 | 325.3 |
| % Change                           | 1.1   | 0.7   | <b>0.5</b>   | 0.3   | 0.5   | 0.4   | 0.4   |
| Health Care and Soc. Assistance    | 75.5  | 76.8  | <b>78.0</b>  | 78.3  | 78.8  | 79.2  | 79.5  |
| % Change                           | 1.8   | 1.7   | <b>1.6</b>   | 0.4   | 0.6   | 0.5   | 0.5   |
| Accommodation and Food             | 106.0 | 107.4 | <b>107.8</b> | 108.0 | 108.8 | 109.2 | 109.5 |
| % Change                           | 0.7   | 1.3   | <b>0.3</b>   | 0.3   | 0.7   | 0.4   | 0.3   |
| Other                              | 135.2 | 134.7 | <b>134.6</b> | 134.9 | 135.3 | 135.8 | 136.3 |
| % Change                           | 0.9   | -0.4  | <b>-0.1</b>  | 0.2   | 0.3   | 0.4   | 0.4   |
| Government                         | 125.7 | 126.5 | <b>124.8</b> | 124.9 | 125.3 | 125.6 | 126.2 |
| % Change                           | 2.1   | 0.7   | <b>-1.3</b>  | 0.1   | 0.3   | 0.3   | 0.5   |
| Federal Government                 | 35.7  | 34.6  | <b>32.7</b>  | 32.9  | 33.2  | 33.4  | 33.9  |
| % Change                           | 1.7   | -3.0  | <b>-5.6</b>  | 0.6   | 0.9   | 0.6   | 1.5   |
| State and Local Government         | 90.0  | 91.9  | <b>92.2</b>  | 92.0  | 92.1  | 92.2  | 92.3  |
| % Change                           | 2.3   | 2.1   | <b>0.3</b>   | -0.1  | 0.1   | 0.1   | 0.1   |

Note: Source is UHERO. Figures for 2026-2030 are forecasts.

**TABLE 3: PERSONAL INCOME BY INDUSTRY**

STATE OF HAWAII FORECAST

|                                      | 2024      | 2025      | 2026             | 2027      | 2028      | 2029      | 2030      |
|--------------------------------------|-----------|-----------|------------------|-----------|-----------|-----------|-----------|
| Real Personal Income (Mil 2025\$)    | 105,366.4 | 107,611.1 | <b>108,689.9</b> | 110,381.1 | 111,964.9 | 113,330.2 | 113,768.9 |
| % Change                             | 1.5       | 2.1       | <b>1.0</b>       | 1.6       | 1.4       | 1.2       | 0.4       |
| Labor & Proprietors' Income          | 72,308.8  | 73,968.1  | <b>73,955.8</b>  | 74,515.0  | 75,212.8  | 75,790.1  | 76,316.0  |
| % Change                             | 1.1       | 2.3       | <b>0.0</b>       | 0.8       | 0.9       | 0.8       | 0.7       |
| Construction and Mining              | 5,595.8   | 5,696.2   | <b>5,858.7</b>   | 5,863.6   | 5,854.1   | 5,834.8   | 5,809.1   |
| % Change                             | 4.5       | 1.8       | <b>2.9</b>       | 0.1       | -0.2      | -0.3      | -0.4      |
| Manufacturing                        | 1,146.3   | 1,193.4   | <b>1,200.2</b>   | 1,201.3   | 1,207.1   | 1,210.3   | 1,211.0   |
| % Change                             | -0.2      | 4.1       | <b>0.6</b>       | 0.1       | 0.5       | 0.3       | 0.1       |
| Trade                                | 5,770.5   | 5,794.0   | <b>5,817.9</b>   | 5,821.2   | 5,850.1   | 5,879.8   | 5,912.5   |
| % Change                             | -1.9      | 0.4       | <b>0.4</b>       | 0.1       | 0.5       | 0.5       | 0.6       |
| Transportation and Utilities         | 4,365.4   | 4,378.3   | <b>4,288.0</b>   | 4,290.1   | 4,299.8   | 4,306.0   | 4,326.4   |
| % Change                             | 0.6       | 0.3       | <b>-2.1</b>      | 0.1       | 0.2       | 0.1       | 0.5       |
| Finance, Insurance & Real Estate     | 5,383.8   | 5,471.4   | <b>5,447.4</b>   | 5,471.9   | 5,526.9   | 5,576.4   | 5,622.9   |
| % Change                             | -2.5      | 1.6       | <b>-0.4</b>      | 0.5       | 1.0       | 0.9       | 0.8       |
| Services                             | 29,541.7  | 30,127.1  | <b>30,405.5</b>  | 30,663.9  | 30,990.6  | 31,285.4  | 31,546.4  |
| % Change                             | 0.7       | 2.0       | <b>0.9</b>       | 0.8       | 1.1       | 0.9       | 0.8       |
| Health Care & Soc. Assist. (% ch.)   | 1.1       | 3.4       | <b>2.4</b>       | 0.8       | 1.1       | 1.0       | 1.0       |
| Accommodation & Food (% ch.)         | -0.2      | -0.1      | <b>0.6</b>       | 0.8       | 1.6       | 1.1       | 0.7       |
| Other (% ch.)                        | 0.8       | 2.4       | <b>0.2</b>       | 0.9       | 0.8       | 0.8       | 0.8       |
| Government                           | 20,059.5  | 20,759.8  | <b>20,486.4</b>  | 20,750.0  | 21,028.4  | 21,239.3  | 21,427.5  |
| % Change                             | 2.9       | 3.5       | <b>-1.3</b>      | 1.3       | 1.3       | 1.0       | 0.9       |
| Federal, civilian (% ch.)            | 1.0       | -2.9      | <b>-3.9</b>      | 0.9       | 1.2       | 1.1       | 1.3       |
| State & Local (% ch.)                | 3.3       | 7.1       | <b>-3.0</b>      | 1.8       | 1.3       | 0.9       | 0.6       |
| Less Social Security Taxes (-)       | 8,598.5   | 8,838.6   | <b>8,835.2</b>   | 8,902.0   | 8,985.4   | 9,054.3   | 9,117.1   |
| % Change                             | -1.2      | 2.8       | <b>0.0</b>       | 0.8       | 0.9       | 0.8       | 0.7       |
| Transfer Payments                    | 18,543.8  | 19,275.5  | <b>20,247.3</b>  | 20,768.8  | 21,097.8  | 21,440.1  | 21,147.9  |
| % Change                             | -0.3      | 4.0       | <b>5.0</b>       | 2.6       | 1.6       | 1.6       | -1.4      |
| Dividends, Interest and Rent         | 23,112.2  | 23,206.1  | <b>23,322.0</b>  | 23,999.3  | 24,639.8  | 25,154.4  | 25,422.3  |
| % Change                             | 3.2       | 0.4       | <b>0.5</b>       | 2.9       | 2.7       | 2.1       | 1.1       |
| Population (Thou)                    | 1,434.4   | 1,432.3   | <b>1,431.3</b>   | 1,429.9   | 1,428.3   | 1,427.8   | 1,428.5   |
| % Change                             | 0.0       | -0.1      | <b>-0.1</b>      | -0.1      | -0.1      | 0.0       | 0.1       |
| Real Per Capita Income (Thou 2025\$) | 73.5      | 75.1      | <b>75.9</b>      | 77.2      | 78.4      | 79.4      | 79.6      |
| % Change                             | 1.5       | 2.3       | <b>1.1</b>       | 1.7       | 1.6       | 1.2       | 0.3       |
| Inflation Rate, Honolulu MSA (%)     | 4.4       | 2.6       | <b>4.1</b>       | 3.0       | 2.3       | 2.2       | 2.3       |
| Nominal Personal Income (Mil \$)     | 102,703.8 | 107,611.1 | <b>113,174.6</b> | 118,336.7 | 122,756.9 | 127,009.1 | 130,421.1 |
| % Change                             | 5.9       | 4.8       | <b>5.2</b>       | 4.6       | 3.7       | 3.5       | 2.7       |

Note: Source is UHERO. Figures for transfer payments and total income for 2025 are adjusted by UHERO to reflect the timing of the payout for the settlement for the Maui wildfires. Figures for 2026-2030 are forecasts.

**TABLE 4: CONSTRUCTION INDICATORS**

## STATE OF HAWAII FORECAST

|                                         | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|-----------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| <b>BUILDING PERMITS</b>                 |          |          |                 |          |          |          |          |
| Total Commitments to Build (Mil 2025\$) | 9,344.6  | 9,007.4  | <b>9,761.6</b>  | 9,989.9  | 10,192.8 | 10,271.1 | 10,165.2 |
| % Change                                | 11.7     | -3.6     | <b>8.4</b>      | 2.3      | 2.0      | 0.8      | -1.0     |
| Private Building Permits                | 5,188.8  | 4,403.8  | <b>4,198.5</b>  | 4,887.9  | 4,857.6  | 5,121.9  | 5,168.8  |
| % Change                                | 30.9     | -15.1    | <b>-4.7</b>     | 16.4     | -0.6     | 5.4      | 0.9      |
| Residential Building Permits            | 2,337.8  | 2,310.3  | <b>2,032.1</b>  | 2,488.7  | 2,332.2  | 2,466.4  | 2,466.2  |
| % Change                                | 41.7     | -1.2     | <b>-12.0</b>    | 22.5     | -6.3     | 5.8      | 0.0      |
| Non-Residential Building Permits        | 2,850.9  | 2,093.5  | <b>2,166.4</b>  | 2,399.2  | 2,525.4  | 2,655.4  | 2,702.6  |
| % Change                                | 23.2     | -26.6    | <b>3.5</b>      | 10.8     | 5.3      | 5.2      | 1.8      |
| Government Contracts Awarded            | 4,155.8  | 4,603.6  | <b>5,563.1</b>  | 5,102.0  | 5,335.3  | 5,149.2  | 4,996.4  |
| % Change                                | -5.6     | 10.8     | <b>20.8</b>     | -8.3     | 4.6      | -3.5     | -3.0     |
| <b>CONSTRUCTION ACTIVITY</b>            |          |          |                 |          |          |          |          |
| Real Contracting Tax Base (Mil 2025\$)  | 14,525.5 | 14,378.3 | <b>14,158.1</b> | 15,181.6 | 15,341.3 | 15,585.5 | 15,729.0 |
| % Change                                | 13.8     | -1.0     | <b>-1.5</b>     | 7.2      | 1.1      | 1.6      | 0.9      |
| Nominal Contracting Tax Base (Mil \$)   | 13,917.5 | 14,378.3 | <b>15,145.4</b> | 16,662.1 | 17,219.4 | 17,916.0 | 18,534.7 |
| % Change                                | 17.9     | 3.3      | <b>5.3</b>      | 10.0     | 3.3      | 4.0      | 3.5      |
| Construction and Mining Jobs (Thou)     | 39.3     | 40.3     | <b>41.5</b>     | 41.5     | 41.2     | 40.9     | 40.5     |
| % Change                                | 3.1      | 2.5      | <b>3.2</b>      | -0.2     | -0.6     | -0.8     | -0.8     |
| Real Construction Income (Mil 2025\$)   | 5,595.8  | 5,696.2  | <b>5,858.7</b>  | 5,863.6  | 5,854.1  | 5,834.8  | 5,809.1  |
| % Change                                | 4.5      | 1.8      | <b>2.9</b>      | 0.1      | -0.2     | -0.3     | -0.4     |
| <b>PRICES AND COSTS (HONOLULU)</b>      |          |          |                 |          |          |          |          |
| Median Home Price (Thou \$)             | 1,091.9  | 1,140.7  | <b>1,183.6</b>  | 1,206.2  | 1,222.2  | 1,244.1  | 1,271.6  |
| % Change                                | 3.6      | 4.5      | <b>3.8</b>      | 1.9      | 1.3      | 1.8      | 2.2      |
| Median Condo Price (Thou \$)            | 513.7    | 504.9    | <b>517.6</b>    | 525.0    | 534.6    | 542.4    | 549.5    |
| % Change                                | 1.1      | -1.7     | <b>2.5</b>      | 1.4      | 1.8      | 1.5      | 1.3      |
| Honolulu Housing Affordability Index    | 55.2     | 57.5     | <b>58.6</b>     | 60.9     | 63.1     | 64.2     | 64.2     |
| % Change                                | 2.8      | 4.2      | <b>1.9</b>      | 3.9      | 3.7      | 1.7      | 0.1      |
| Construction Cost Index (2025=100)      | 95.8     | 100.0    | <b>107.0</b>    | 109.8    | 112.2    | 115.0    | 117.8    |
| % Change                                | 3.6      | 4.4      | <b>7.0</b>      | 2.6      | 2.3      | 2.4      | 2.5      |
| 30-Year Mortgage Rate (%)               | 6.7      | 6.6      | <b>6.4</b>      | 6.2      | 6.0      | 6.0      | 6.0      |

Note: Source is UHERO. Figures for 2026-2030 are forecasts. Commitments to Build are the sum of private permits and public contracts awarded. Permits and tax base are deflated by Honolulu Construction Cost Index. Figures for Total Commitments to Build and Real Government Contracts Awarded for 2024 and 2025 are UHERO estimates. Income is deflated by Honolulu CPI. Housing affordability index is the ratio of median family income to qualifying income for a loan for the median-priced home (times 100).

TABLE 5: MAJOR ECONOMIC INDICATORS

## HONOLULU COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| <b>MAJOR INDICATORS</b>              |          |          |                 |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 460.4    | 461.6    | <b>461.8</b>    | 462.1    | 463.5    | 464.7    | 465.9    |
| % Change                             | 1.2      | 0.3      | <b>0.1</b>      | 0.1      | 0.3      | 0.3      | 0.3      |
| Unemployment Rate (%)                | 2.5      | 2.2      | <b>2.2</b>      | 2.4      | 2.4      | 2.4      | 2.4      |
| Population (Thou)                    | 989.6    | 988.2    | <b>987.2</b>    | 985.3    | 983.5    | 982.5    | 982.3    |
| % Change                             | 0.0      | -0.1     | <b>-0.1</b>     | -0.2     | -0.2     | -0.1     | 0.0      |
| Nominal Personal Income (Mil \$)     | 74,587.7 | 77,986.6 | <b>81,639.1</b> | 85,170.7 | 88,337.2 | 91,419.2 | 94,457.9 |
| % Change                             | 6.1      | 4.6      | <b>4.7</b>      | 4.3      | 3.7      | 3.5      | 3.3      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Real Personal Income (Mil 2025\$)    | 76,523.9 | 77,986.6 | <b>78,404.0</b> | 79,446.4 | 80,567.7 | 81,553.0 | 82,355.4 |
| % Change                             | 1.7      | 1.9      | <b>0.5</b>      | 1.3      | 1.4      | 1.2      | 1.0      |
| Real Per Capita Income (Thou 2025\$) | 77.3     | 78.9     | <b>79.4</b>     | 80.6     | 81.9     | 83.0     | 83.8     |
| % Change                             | 1.7      | 2.1      | <b>0.6</b>      | 1.5      | 1.6      | 1.3      | 1.0      |
| <b>TOURISM SECTOR DETAIL</b>         |          |          |                 |          |          |          |          |
| Total Visitor Arrivals by Air (Thou) | 5,827.8  | 5,655.4  | <b>5,631.3</b>  | 5,641.6  | 5,809.6  | 5,949.2  | 6,069.5  |
| % Change                             | 3.8      | -3.0     | <b>-0.4</b>     | 0.2      | 3.0      | 2.4      | 2.0      |
| U.S. Visitors                        | 4,012.3  | 3,888.4  | <b>3,858.6</b>  | 3,853.4  | 3,911.1  | 3,932.3  | 3,955.0  |
| % Change                             | 2.3      | -3.1     | <b>-0.8</b>     | -0.1     | 1.5      | 0.5      | 0.6      |
| Japanese Visitors                    | 679.3    | 715.3    | <b>733.8</b>    | 751.8    | 834.1    | 923.2    | 994.3    |
| % Change                             | 18.3     | 5.3      | <b>2.6</b>      | 2.5      | 10.9     | 10.7     | 7.7      |
| Other Visitors                       | 1,136.2  | 1,051.7  | <b>1,038.9</b>  | 1,036.4  | 1,064.5  | 1,093.8  | 1,120.2  |
| % Change                             | 1.7      | -7.4     | <b>-1.2</b>     | -0.2     | 2.7      | 2.8      | 2.4      |
| Average Daily Census (Thou)          | 112.6    | 108.3    | <b>106.9</b>    | 107.5    | 110.5    | 112.8    | 114.7    |
| % Change                             | 1.4      | -3.9     | <b>-1.3</b>     | 0.6      | 2.8      | 2.0      | 1.7      |
| Occupancy Rate (%)                   | 75.2     | 72.4     | <b>69.1</b>     | 69.7     | 71.9     | 73.4     | 74.7     |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Occupancy rate includes UHERO's estimate of TVR occupancy. Figures for 2026-2030 are forecasts.

**TABLE 6: JOBS BY INDUSTRY**

HONOLULU COUNTY FORECAST

|                                    | 2024  | 2025  | 2026         | 2027  | 2028  | 2029  | 2030  |
|------------------------------------|-------|-------|--------------|-------|-------|-------|-------|
| Nonfarm Payrolls (Thou)            | 460.4 | 461.6 | <b>461.8</b> | 462.1 | 463.5 | 464.7 | 465.9 |
| % Change                           | 1.2   | 0.3   | <b>0.1</b>   | 0.1   | 0.3   | 0.3   | 0.3   |
| Construction and Mining            | 28.3  | 29.3  | <b>30.1</b>  | 30.0  | 29.8  | 29.6  | 29.3  |
| % Change                           | 3.3   | 3.5   | <b>2.6</b>   | -0.1  | -0.7  | -0.8  | -0.8  |
| Manufacturing                      | 9.5   | 9.7   | <b>9.9</b>   | 9.9   | 9.9   | 9.9   | 9.9   |
| % Change                           | 2.9   | 2.2   | <b>1.9</b>   | 0.2   | -0.2  | -0.3  | -0.3  |
| Trade                              | 55.5  | 55.1  | <b>55.2</b>  | 55.1  | 55.3  | 55.5  | 55.5  |
| % Change                           | -0.9  | -0.8  | <b>0.2</b>   | -0.1  | 0.3   | 0.3   | 0.2   |
| Transportation and Utilities       | 25.2  | 25.7  | <b>25.4</b>  | 25.3  | 25.3  | 25.4  | 25.4  |
| % Change                           | 0.5   | 1.8   | <b>-1.2</b>  | -0.2  | 0.1   | 0.0   | 0.2   |
| Finance, Insurance and Real Estate | 21.0  | 20.6  | <b>20.3</b>  | 20.3  | 20.3  | 20.3  | 20.3  |
| % Change                           | -1.2  | -2.1  | <b>-1.4</b>  | -0.1  | 0.2   | 0.1   | 0.0   |
| Services                           | 224.2 | 224.3 | <b>225.8</b> | 226.1 | 227.2 | 228.2 | 229.1 |
| % Change                           | 1.3   | 0.1   | <b>0.6</b>   | 0.1   | 0.5   | 0.5   | 0.4   |
| Health Care and Soc. Assistance    | 56.6  | 57.8  | <b>58.7</b>  | 59.0  | 59.3  | 59.6  | 59.9  |
| % Change                           | 1.2   | 2.1   | <b>1.7</b>   | 0.4   | 0.6   | 0.5   | 0.5   |
| Accommodation and Food             | 64.1  | 64.7  | <b>65.1</b>  | 65.0  | 65.4  | 65.8  | 66.0  |
| % Change                           | 1.7   | 0.9   | <b>0.7</b>   | -0.2  | 0.6   | 0.5   | 0.3   |
| Other                              | 103.5 | 101.9 | <b>101.9</b> | 102.1 | 102.5 | 102.9 | 103.3 |
| % Change                           | 1.1   | -1.6  | <b>0.0</b>   | 0.2   | 0.3   | 0.4   | 0.4   |
| Government                         | 96.6  | 96.9  | <b>95.3</b>  | 95.4  | 95.6  | 95.8  | 96.3  |
| % Change                           | 2.1   | 0.3   | <b>-1.7</b>  | 0.1   | 0.3   | 0.2   | 0.5   |
| Federal Government                 | 32.8  | 31.9  | <b>30.2</b>  | 30.4  | 30.6  | 30.8  | 31.2  |
| % Change                           | 1.8   | -2.7  | <b>-5.3</b>  | 0.5   | 0.8   | 0.5   | 1.5   |
| State and Local Government         | 63.8  | 65.0  | <b>65.1</b>  | 65.0  | 65.0  | 65.1  | 65.1  |
| % Change                           | 2.3   | 1.9   | <b>0.1</b>   | -0.2  | 0.0   | 0.1   | 0.1   |

Note: Source is UHERO. Figures for 2026-2030 are forecasts.

TABLE 7: PERSONAL INCOME BY INDUSTRY

## HONOLULU COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| Real Personal Income (Mil 2025\$)    | 76,523.9 | 77,986.6 | <b>78,404.0</b> | 79,446.4 | 80,567.7 | 81,553.0 | 82,355.4 |
| % Change                             | 1.7      | 1.9      | <b>0.5</b>      | 1.3      | 1.4      | 1.2      | 1.0      |
| Labor & Proprietors' Income          | 54,482.7 | 55,552.6 | <b>55,548.2</b> | 55,976.8 | 56,462.0 | 56,889.9 | 57,281.4 |
| % Change                             | 1.3      | 2.0      | <b>0.0</b>      | 0.8      | 0.9      | 0.8      | 0.7      |
| Construction and Mining              | 4,060.6  | 4,175.5  | <b>4,257.4</b>  | 4,263.4  | 4,252.9  | 4,236.3  | 4,216.1  |
| % Change                             | 4.2      | 2.8      | <b>2.0</b>      | 0.1      | -0.2     | -0.4     | -0.5     |
| Manufacturing                        | 942.4    | 978.6    | <b>992.1</b>    | 998.2    | 1,002.1  | 1,000.7  | 998.1    |
| % Change                             | 6.5      | 3.8      | <b>1.4</b>      | 0.6      | 0.4      | -0.1     | -0.3     |
| Trade                                | 3,957.2  | 3,972.3  | <b>3,983.4</b>  | 3,985.8  | 4,004.3  | 4,024.0  | 4,045.3  |
| % Change                             | -1.6     | 0.4      | <b>0.3</b>      | 0.1      | 0.5      | 0.5      | 0.5      |
| Transportation and Utilities         | 3,445.3  | 3,480.4  | <b>3,408.5</b>  | 3,405.2  | 3,413.9  | 3,425.3  | 3,443.0  |
| % Change                             | 0.0      | 1.0      | <b>-2.1</b>     | -0.1     | 0.3      | 0.3      | 0.5      |
| Finance, Insurance & Real Estate     | 4,016.3  | 4,057.8  | <b>4,022.3</b>  | 4,036.2  | 4,072.9  | 4,106.2  | 4,137.3  |
| % Change                             | -2.5     | 1.0      | <b>-0.9</b>     | 0.3      | 0.9      | 0.8      | 0.8      |
| Services                             | 20,975.0 | 21,315.3 | <b>21,498.3</b> | 21,680.3 | 21,899.8 | 22,117.0 | 22,307.0 |
| % Change                             | 0.7      | 1.6      | <b>0.9</b>      | 0.8      | 1.0      | 1.0      | 0.9      |
| Health Care & Soc. Assist. (% ch.)   | 0.9      | 3.6      | <b>2.4</b>      | 0.9      | 1.1      | 1.0      | 1.0      |
| Accommodation & Food (% ch.)         | 1.7      | -0.5     | <b>0.5</b>      | 0.8      | 1.5      | 1.1      | 0.7      |
| Other (% ch.)                        | 0.3      | 1.2      | <b>0.1</b>      | 0.9      | 0.8      | 0.9      | 0.9      |
| Government                           | 16,926.0 | 17,430.0 | <b>17,242.6</b> | 17,464.1 | 17,672.2 | 17,836.2 | 17,990.2 |
| % Change                             | 2.8      | 3.0      | <b>-1.1</b>     | 1.3      | 1.2      | 0.9      | 0.9      |
| Federal, civilian (% ch.)            | 0.9      | -2.8     | <b>-4.0</b>     | 0.9      | 1.2      | 1.0      | 1.3      |
| State & Local (% ch.)                | 3.4      | 6.8      | <b>-3.0</b>     | 2.0      | 0.9      | 0.7      | 0.4      |
| Less Social Security Taxes (-)       | 6,494.7  | 6,634.6  | <b>6,634.1</b>  | 6,685.2  | 6,743.2  | 6,794.3  | 6,841.0  |
| % Change                             | -0.8     | 2.1      | <b>0.0</b>      | 0.8      | 0.9      | 0.8      | 0.7      |
| Transfer Payments                    | 12,348.7 | 12,837.2 | <b>13,132.9</b> | 13,362.7 | 13,587.9 | 13,817.6 | 14,067.1 |
| % Change                             | 0.3      | 4.0      | <b>2.3</b>      | 1.8      | 1.7      | 1.7      | 1.8      |
| Dividends, Interest and Rent         | 16,246.8 | 16,312.8 | <b>16,389.9</b> | 16,855.6 | 17,296.7 | 17,653.1 | 17,844.3 |
| % Change                             | 3.0      | 0.4      | <b>0.5</b>      | 2.8      | 2.6      | 2.1      | 1.1      |
| Population (Thou)                    | 989.6    | 988.2    | <b>987.2</b>    | 985.3    | 983.5    | 982.5    | 982.3    |
| % Change                             | 0.0      | -0.1     | <b>-0.1</b>     | -0.2     | -0.2     | -0.1     | 0.0      |
| Real Per Capita Income (Thou 2025\$) | 77.3     | 78.9     | <b>79.4</b>     | 80.6     | 81.9     | 83.0     | 83.8     |
| % Change                             | 1.7      | 2.1      | <b>0.6</b>      | 1.5      | 1.6      | 1.3      | 1.0      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Nominal Personal Income (Mil \$)     | 74,587.7 | 77,986.6 | <b>81,639.1</b> | 85,170.7 | 88,337.2 | 91,419.2 | 94,457.9 |
| % Change                             | 6.1      | 4.6      | <b>4.7</b>      | 4.3      | 3.7      | 3.5      | 3.3      |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2030 are forecasts.



**TABLE 8: MAJOR ECONOMIC INDICATORS**

## HAWAII COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| <b>MAJOR INDICATORS</b>              |          |          |                 |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.5     | 73.3     | <b>73.2</b>     | 73.3     | 73.6     | 73.8     | 74.1     |
| % Change                             | 1.9      | 1.2      | <b>-0.3</b>     | 0.2      | 0.4      | 0.3      | 0.3      |
| Unemployment Rate (%)                | 3.0      | 2.6      | <b>2.9</b>      | 3.0      | 2.9      | 2.8      | 2.8      |
| Population (Thou)                    | 209.1    | 210.0    | <b>210.6</b>    | 210.6    | 210.6    | 210.7    | 211.1    |
| % Change                             | 0.8      | 0.5      | <b>0.3</b>      | 0.0      | 0.0      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 12,103.6 | 12,733.3 | <b>13,300.5</b> | 13,916.2 | 14,472.3 | 15,008.4 | 15,524.8 |
| % Change                             | 6.3      | 5.2      | <b>4.5</b>      | 4.6      | 4.0      | 3.7      | 3.4      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Real Personal Income (Mil 2025\$)    | 12,417.8 | 12,733.3 | <b>12,773.5</b> | 12,980.9 | 13,199.4 | 13,388.7 | 13,535.7 |
| % Change                             | 1.9      | 2.5      | <b>0.3</b>      | 1.6      | 1.7      | 1.4      | 1.1      |
| Real Per Capita Income (Thou 2025\$) | 59.4     | 60.6     | <b>60.7</b>     | 61.6     | 62.7     | 63.5     | 64.1     |
| % Change                             | 1.1      | 2.1      | <b>0.1</b>      | 1.6      | 1.7      | 1.4      | 0.9      |
| <b>TOURISM SECTOR DETAIL</b>         |          |          |                 |          |          |          |          |
| Total Visitor Arrivals by Air (Thou) | 1,734.2  | 1,739.5  | <b>1,780.2</b>  | 1,779.1  | 1,831.8  | 1,879.2  | 1,922.9  |
| % Change                             | -2.5     | 0.3      | <b>2.3</b>      | -0.1     | 3.0      | 2.6      | 2.3      |
| U.S. Visitors                        | 1,414.9  | 1,418.1  | <b>1,449.8</b>  | 1,443.1  | 1,475.2  | 1,497.0  | 1,517.7  |
| % Change                             | -3.8     | 0.2      | <b>2.2</b>      | -0.5     | 2.2      | 1.5      | 1.4      |
| Japanese Visitors                    | 47.0     | 48.7     | <b>52.0</b>     | 53.4     | 64.0     | 79.1     | 92.4     |
| % Change                             | 4.9      | 3.7      | <b>6.9</b>      | 2.6      | 19.9     | 23.6     | 16.9     |
| Other Visitors                       | 272.3    | 272.7    | <b>278.4</b>    | 282.6    | 292.6    | 303.0    | 312.8    |
| % Change                             | 3.6      | 0.1      | <b>2.1</b>      | 1.5      | 3.5      | 3.6      | 3.2      |
| Average Daily Census (Thou)          | 37.1     | 36.1     | <b>37.0</b>     | 37.2     | 38.4     | 39.3     | 40.1     |
| % Change                             | -3.5     | -2.5     | <b>2.5</b>      | 0.5      | 3.1      | 2.4      | 2.1      |
| Occupancy Rate (%)                   | 57.1     | 57.1     | <b>57.2</b>     | 57.6     | 59.4     | 60.7     | 61.9     |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Occupancy rate includes UHERO's estimate of TVR occupancy. Figures for 2026-2030 are forecasts.

**TABLE 9: JOBS BY INDUSTRY**

## HAWAII COUNTY FORECAST

|                                    | 2024 | 2025 | 2026        | 2027 | 2028 | 2029 | 2030 |
|------------------------------------|------|------|-------------|------|------|------|------|
| Nonfarm Payrolls (Thou)            | 72.5 | 73.3 | <b>73.2</b> | 73.3 | 73.6 | 73.8 | 74.1 |
| % Change                           | 1.9  | 1.2  | <b>-0.3</b> | 0.2  | 0.4  | 0.3  | 0.3  |
| Construction and Mining            | 4.0  | 4.0  | <b>4.1</b>  | 4.1  | 4.1  | 4.1  | 4.0  |
| % Change                           | 3.7  | -1.9 | <b>4.5</b>  | -0.7 | -0.4 | -0.5 | -0.8 |
| Manufacturing                      | 1.7  | 1.8  | <b>1.7</b>  | 1.7  | 1.8  | 1.8  | 1.8  |
| % Change                           | 3.6  | 1.8  | <b>-2.1</b> | 0.5  | 1.1  | 1.1  | 0.9  |
| Trade                              | 12.1 | 12.2 | <b>12.2</b> | 12.2 | 12.2 | 12.1 | 12.2 |
| % Change                           | 1.4  | 1.0  | <b>-0.1</b> | -0.2 | 0.1  | -0.1 | 0.0  |
| Transportation and Utilities       | 3.5  | 3.4  | <b>3.3</b>  | 3.3  | 3.3  | 3.3  | 3.3  |
| % Change                           | 2.2  | -3.0 | <b>-2.7</b> | 0.5  | -0.1 | -0.5 | 0.1  |
| Finance, Insurance and Real Estate | 2.6  | 2.6  | <b>2.6</b>  | 2.6  | 2.6  | 2.6  | 2.6  |
| % Change                           | 0.7  | 0.3  | <b>-0.6</b> | 0.4  | 0.7  | 0.5  | 0.5  |
| Services                           | 33.4 | 34.0 | <b>33.9</b> | 34.1 | 34.2 | 34.4 | 34.6 |
| % Change                           | 1.3  | 1.7  | <b>-0.4</b> | 0.6  | 0.6  | 0.5  | 0.4  |
| Health Care and Soc. Assistance    | 8.0  | 8.1  | <b>8.2</b>  | 8.2  | 8.3  | 8.3  | 8.4  |
| % Change                           | 5.3  | 1.7  | <b>0.9</b>  | 0.3  | 0.7  | 0.7  | 0.6  |
| Accommodation and Food             | 13.5 | 13.4 | <b>13.3</b> | 13.5 | 13.6 | 13.6 | 13.7 |
| % Change                           | -0.9 | -0.1 | <b>-0.8</b> | 1.0  | 0.7  | 0.5  | 0.3  |
| Other                              | 12.0 | 12.5 | <b>12.4</b> | 12.4 | 12.4 | 12.5 | 12.6 |
| % Change                           | 1.2  | 3.7  | <b>-0.8</b> | 0.3  | 0.3  | 0.5  | 0.5  |
| Government                         | 15.1 | 15.5 | <b>15.4</b> | 15.4 | 15.5 | 15.6 | 15.6 |
| % Change                           | 3.1  | 2.3  | <b>-0.6</b> | 0.0  | 0.4  | 0.5  | 0.5  |
| Federal Government                 | 1.4  | 1.3  | <b>1.2</b>  | 1.2  | 1.3  | 1.3  | 1.3  |
| % Change                           | 2.4  | -4.8 | <b>-9.3</b> | 1.7  | 2.2  | 1.5  | 2.4  |
| State and Local Government         | 13.7 | 14.2 | <b>14.2</b> | 14.2 | 14.2 | 14.3 | 14.3 |
| % Change                           | 3.1  | 3.0  | <b>0.3</b>  | -0.1 | 0.3  | 0.4  | 0.3  |

Note: Source is UHERO. Figures for 2026-2030 are forecasts.

**TABLE 10: PERSONAL INCOME BY INDUSTRY**

HAWAII COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| Real Personal Income (Mil 2025\$)    | 12,417.8 | 12,733.3 | <b>12,773.5</b> | 12,980.9 | 13,199.4 | 13,388.7 | 13,535.7 |
| % Change                             | 1.9      | 2.5      | <b>0.3</b>      | 1.6      | 1.7      | 1.4      | 1.1      |
| Labor & Proprietors' Income          | 7,130.1  | 7,359.9  | <b>7,350.3</b>  | 7,400.2  | 7,489.7  | 7,566.2  | 7,631.8  |
| % Change                             | 1.4      | 3.2      | <b>-0.1</b>     | 0.7      | 1.2      | 1.0      | 0.9      |
| Construction and Mining              | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Manufacturing                        | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Trade                                | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Transportation and Utilities         | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Finance, Insurance & Real Estate     | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Services                             | —        | —        | —               | —        | —        | —        | —        |
| % Change                             | —        | —        | —               | —        | —        | —        | —        |
| Health Care & Soc. Assist. (% ch.)   | —        | —        | —               | —        | —        | —        | —        |
| Accommodation & Food (% ch.)         | —        | —        | —               | —        | —        | —        | —        |
| Other (% ch.)                        | —        | —        | —               | —        | —        | —        | —        |
| Government                           | 1,611.2  | 1,721.1  | <b>1,669.8</b>  | 1,691.7  | 1,729.1  | 1,756.1  | 1,775.5  |
| % Change                             | 4.5      | 6.8      | <b>-3.0</b>     | 1.3      | 2.2      | 1.6      | 1.1      |
| Federal, civilian (% ch.)            | 3.0      | -2.2     | <b>-3.4</b>     | 0.8      | 1.6      | 1.8      | 2.0      |
| State & Local (% ch.)                | 4.8      | 8.1      | <b>-3.3</b>     | 1.4      | 2.3      | 1.5      | 1.0      |
| Less Social Security Taxes (-)       | 887.2    | 932.3    | <b>933.8</b>    | 940.9    | 952.9    | 963.0    | 971.6    |
| % Change                             | -1.5     | 5.1      | <b>0.2</b>      | 0.8      | 1.3      | 1.1      | 0.9      |
| Transfer Payments                    | 3,154.2  | 3,277.2  | <b>3,352.2</b>  | 3,412.5  | 3,471.9  | 3,532.6  | 3,592.0  |
| % Change                             | -1.1     | 3.9      | <b>2.3</b>      | 1.8      | 1.7      | 1.8      | 1.7      |
| Dividends, Interest and Rent         | 2,987.2  | 3,007.6  | <b>3,033.9</b>  | 3,126.8  | 3,217.1  | 3,294.7  | 3,334.3  |
| % Change                             | 5.1      | 0.7      | <b>0.9</b>      | 3.1      | 2.9      | 2.4      | 1.2      |
| Population (Thou)                    | 209.1    | 210.0    | <b>210.6</b>    | 210.6    | 210.6    | 210.7    | 211.1    |
| % Change                             | 0.8      | 0.5      | <b>0.3</b>      | 0.0      | 0.0      | 0.1      | 0.1      |
| Real Per Capita Income (Thou 2025\$) | 59.4     | 60.6     | <b>60.7</b>     | 61.6     | 62.7     | 63.5     | 64.1     |
| % Change                             | 1.1      | 2.1      | <b>0.1</b>      | 1.6      | 1.7      | 1.4      | 0.9      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Nominal Personal Income (Mil \$)     | 12,103.6 | 12,733.3 | <b>13,300.5</b> | 13,916.2 | 14,472.3 | 15,008.4 | 15,524.8 |
| % Change                             | 6.3      | 5.2      | <b>4.5</b>      | 4.6      | 4.0      | 3.7      | 3.4      |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2030 are forecasts. Because of data disclosure rules, industry-level income is not available for some sectors.

**TABLE 11: MAJOR ECONOMIC INDICATORS**

## KAUAI COUNTY FORECAST

|                                      | 2024    | 2025    | 2026           | 2027    | 2028    | 2029    | 2030    |
|--------------------------------------|---------|---------|----------------|---------|---------|---------|---------|
| <b>MAJOR INDICATORS</b>              |         |         |                |         |         |         |         |
| Nonfarm Payrolls (Thou)              | 32.4    | 33.1    | <b>33.1</b>    | 33.2    | 33.4    | 33.5    | 33.6    |
| % Change                             | 1.3     | 2.2     | <b>0.1</b>     | 0.3     | 0.4     | 0.3     | 0.3     |
| Unemployment Rate (%)                | 2.4     | 2.1     | <b>2.4</b>     | 2.5     | 2.5     | 2.5     | 2.5     |
| Population (Thou)                    | 73.4    | 73.4    | <b>73.4</b>    | 73.5    | 73.5    | 73.7    | 73.8    |
| % Change                             | -0.3    | -0.1    | <b>0.0</b>     | 0.1     | 0.1     | 0.1     | 0.2     |
| Nominal Personal Income (Mil \$)     | 4,959.9 | 5,246.0 | <b>5,484.6</b> | 5,735.4 | 5,960.9 | 6,178.0 | 6,386.5 |
| % Change                             | 5.8     | 5.8     | <b>4.5</b>     | 4.6     | 3.9     | 3.6     | 3.4     |
| Inflation Rate, Honolulu MSA (%)     | 4.4     | 2.6     | <b>4.1</b>     | 3.0     | 2.3     | 2.2     | 2.3     |
| Real Personal Income (Mil 2025\$)    | 5,088.6 | 5,246.0 | <b>5,267.3</b> | 5,349.9 | 5,436.6 | 5,511.2 | 5,568.2 |
| % Change                             | 1.4     | 3.1     | <b>0.4</b>     | 1.6     | 1.6     | 1.4     | 1.0     |
| Real Per Capita Income (Thou 2025\$) | 69.3    | 71.5    | <b>71.7</b>    | 72.8    | 73.9    | 74.8    | 75.5    |
| % Change                             | 1.7     | 3.1     | <b>0.4</b>     | 1.5     | 1.6     | 1.2     | 0.8     |
| <b>TOURISM SECTOR DETAIL</b>         |         |         |                |         |         |         |         |
| Total Visitor Arrivals by Air (Thou) | 1,391.3 | 1,427.4 | <b>1,446.0</b> | 1,443.0 | 1,459.6 | 1,472.9 | 1,489.6 |
| % Change                             | -1.9    | 2.6     | <b>1.3</b>     | -0.2    | 1.1     | 0.9     | 1.1     |
| U.S. Visitors                        | 1,229.9 | 1,257.5 | <b>1,273.4</b> | 1,267.1 | 1,277.7 | 1,284.8 | 1,296.1 |
| % Change                             | -1.5    | 2.2     | <b>1.3</b>     | -0.5    | 0.8     | 0.6     | 0.9     |
| Japanese Visitors                    | 6.8     | 6.8     | <b>6.8</b>     | 7.8     | 9.1     | 10.3    | 11.2    |
| % Change                             | 15.9    | 0.5     | <b>-0.4</b>    | 14.9    | 16.0    | 12.8    | 8.8     |
| Other Visitors                       | 154.6   | 163.0   | <b>165.7</b>   | 168.0   | 172.8   | 177.8   | 182.4   |
| % Change                             | -6.0    | 5.4     | <b>1.7</b>     | 1.3     | 2.9     | 2.9     | 2.6     |
| Average Daily Census (Thou)          | 28.4    | 28.7    | <b>28.9</b>    | 28.9    | 29.3    | 29.7    | 30.2    |
| % Change                             | -2.2    | 1.1     | <b>0.8</b>     | -0.1    | 1.6     | 1.4     | 1.4     |
| Occupancy Rate (%)                   | 62.9    | 64.7    | <b>66.1</b>    | 65.1    | 65.6    | 66.0    | 66.6    |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Occupancy rate includes UHERO's estimate of TVR occupancy. Figures for 2026-2030 are forecasts.

**TABLE 12: JOBS BY INDUSTRY**

## KAUAI COUNTY FORECAST

|                                    | 2024 | 2025 | 2026        | 2027 | 2028 | 2029 | 2030 |
|------------------------------------|------|------|-------------|------|------|------|------|
| Nonfarm Payrolls (Thou)            | 32.4 | 33.1 | <b>33.1</b> | 33.2 | 33.4 | 33.5 | 33.6 |
| % Change                           | 1.3  | 2.2  | <b>0.1</b>  | 0.3  | 0.4  | 0.3  | 0.3  |
| Construction and Mining            | 2.1  | 2.1  | <b>2.2</b>  | 2.2  | 2.2  | 2.2  | 2.1  |
| % Change                           | 0.4  | -0.7 | <b>4.9</b>  | -0.7 | -0.4 | -0.5 | -0.8 |
| Manufacturing                      | 0.5  | 0.5  | <b>0.5</b>  | 0.5  | 0.5  | 0.5  | 0.5  |
| % Change                           | -9.9 | -1.6 | <b>-2.2</b> | 0.6  | 1.3  | 1.4  | 1.2  |
| Trade                              | 4.3  | 4.3  | <b>4.3</b>  | 4.3  | 4.3  | 4.3  | 4.3  |
| % Change                           | -1.9 | -0.2 | <b>0.4</b>  | -0.3 | 0.0  | -0.1 | 0.0  |
| Transportation and Utilities       | 1.9  | 1.9  | <b>1.9</b>  | 1.9  | 1.9  | 1.9  | 1.9  |
| % Change                           | 5.2  | 2.2  | <b>-1.9</b> | 0.4  | -0.1 | -0.4 | 0.1  |
| Finance, Insurance and Real Estate | 1.1  | 1.1  | <b>1.1</b>  | 1.1  | 1.1  | 1.1  | 1.1  |
| % Change                           | 0.0  | 0.0  | <b>-0.2</b> | 0.4  | 0.7  | 0.6  | 0.5  |
| Services                           | 17.4 | 18.1 | <b>18.0</b> | 18.1 | 18.2 | 18.3 | 18.4 |
| % Change                           | 2.1  | 3.5  | <b>-0.1</b> | 0.6  | 0.6  | 0.5  | 0.4  |
| Health Care and Soc. Assistance    | 2.7  | 2.7  | <b>2.7</b>  | 2.8  | 2.8  | 2.8  | 2.8  |
| % Change                           | 0.0  | 0.0  | <b>1.4</b>  | 0.3  | 0.7  | 0.8  | 0.7  |
| Accommodation and Food             | 9.1  | 9.3  | <b>9.3</b>  | 9.4  | 9.4  | 9.5  | 9.5  |
| % Change                           | 4.3  | 2.9  | <b>-0.4</b> | 0.8  | 0.7  | 0.5  | 0.3  |
| Other                              | 5.7  | 6.0  | <b>6.0</b>  | 6.0  | 6.0  | 6.0  | 6.1  |
| % Change                           | -0.3 | 6.0  | <b>-0.4</b> | 0.2  | 0.3  | 0.5  | 0.4  |
| Government                         | 5.0  | 5.1  | <b>5.1</b>  | 5.1  | 5.2  | 5.2  | 5.2  |
| % Change                           | 2.2  | 2.3  | <b>-0.4</b> | 0.0  | 0.4  | 0.5  | 0.5  |
| Federal Government                 | 0.6  | 0.6  | <b>0.5</b>  | 0.5  | 0.6  | 0.6  | 0.6  |
| % Change                           | 0.0  | -4.2 | <b>-8.6</b> | 1.6  | 2.1  | 1.4  | 2.3  |
| State and Local Government         | 4.4  | 4.6  | <b>4.6</b>  | 4.6  | 4.6  | 4.6  | 4.6  |
| % Change                           | 2.5  | 3.2  | <b>0.7</b>  | -0.2 | 0.2  | 0.4  | 0.3  |

Note: Source is UHERO. Figures for 2026-2030 are forecasts.

TABLE 13: PERSONAL INCOME BY INDUSTRY

## KAUAI COUNTY FORECAST

|                                      | 2024    | 2025    | 2026           | 2027    | 2028    | 2029    | 2030    |
|--------------------------------------|---------|---------|----------------|---------|---------|---------|---------|
| Real Personal Income (Mil 2025\$)    | 5,088.6 | 5,246.0 | <b>5,267.3</b> | 5,349.9 | 5,436.6 | 5,511.2 | 5,568.2 |
| % Change                             | 1.4     | 3.1     | <b>0.4</b>     | 1.6     | 1.6     | 1.4     | 1.0     |
| Labor & Proprietors' Income          | 3,306.1 | 3,426.5 | <b>3,422.8</b> | 3,445.6 | 3,486.7 | 3,521.6 | 3,551.3 |
| % Change                             | 1.7     | 3.6     | <b>-0.1</b>    | 0.7     | 1.2     | 1.0     | 0.8     |
| Construction and Mining              | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Manufacturing                        | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Trade                                | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Transportation and Utilities         | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Finance, Insurance & Real Estate     | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Services                             | —       | —       | —              | —       | —       | —       | —       |
| % Change                             | —       | —       | —              | —       | —       | —       | —       |
| Health Care & Soc. Assist. (% ch.)   | —       | —       | —              | —       | —       | —       | —       |
| Accommodation & Food (% ch.)         | —       | —       | —              | —       | —       | —       | —       |
| Other (% ch.)                        | —       | —       | —              | —       | —       | —       | —       |
| Government                           | 546.1   | 583.1   | <b>568.8</b>   | 575.8   | 588.3   | 597.4   | 604.2   |
| % Change                             | 3.2     | 6.8     | <b>-2.5</b>    | 1.2     | 2.2     | 1.6     | 1.1     |
| Federal, civilian (% ch.)            | -1.3    | -1.6    | <b>-2.8</b>    | 0.8     | 1.6     | 1.8     | 1.9     |
| State & Local (% ch.)                | 4.1     | 8.5     | <b>-2.9</b>    | 1.3     | 2.3     | 1.5     | 1.0     |
| Less Social Security Taxes (-)       | 398.0   | 416.7   | <b>416.0</b>   | 418.9   | 424.0   | 428.3   | 431.9   |
| % Change                             | -0.9    | 4.7     | <b>-0.2</b>    | 0.7     | 1.2     | 1.0     | 0.8     |
| Transfer Payments                    | 1,033.2 | 1,074.2 | <b>1,099.5</b> | 1,120.1 | 1,139.6 | 1,159.7 | 1,179.3 |
| % Change                             | -1.6    | 4.0     | <b>2.4</b>     | 1.9     | 1.7     | 1.8     | 1.7     |
| Dividends, Interest and Rent         | 1,160.2 | 1,162.6 | <b>1,169.5</b> | 1,204.8 | 1,239.1 | 1,268.6 | 1,283.6 |
| % Change                             | 2.4     | 0.2     | <b>0.6</b>     | 3.0     | 2.9     | 2.4     | 1.2     |
| Population (Thou)                    | 73.4    | 73.4    | <b>73.4</b>    | 73.5    | 73.5    | 73.7    | 73.8    |
| % Change                             | -0.3    | -0.1    | <b>0.0</b>     | 0.1     | 0.1     | 0.1     | 0.2     |
| Real Per Capita Income (Thou 2025\$) | 69.3    | 71.5    | <b>71.7</b>    | 72.8    | 73.9    | 74.8    | 75.5    |
| % Change                             | 1.7     | 3.1     | <b>0.4</b>     | 1.5     | 1.6     | 1.2     | 0.8     |
| Inflation Rate, Honolulu MSA (%)     | 4.4     | 2.6     | <b>4.1</b>     | 3.0     | 2.3     | 2.2     | 2.3     |
| Nominal Personal Income (Mil \$)     | 4,959.9 | 5,246.0 | <b>5,484.6</b> | 5,735.4 | 5,960.9 | 6,178.0 | 6,386.5 |
| % Change                             | 5.8     | 5.8     | <b>4.5</b>     | 4.6     | 3.9     | 3.6     | 3.4     |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2030 are forecasts. Because of data disclosure rules, industry-level income is not available for some sectors.

**TABLE 14: MAJOR ECONOMIC INDICATORS**

## MAUI COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| <b>MAJOR INDICATORS</b>              |          |          |                 |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 73.3     | 74.0     | <b>74.5</b>     | 74.8     | 75.0     | 74.9     | 74.9     |
| % Change                             | -1.4     | 1.1      | <b>0.6</b>      | 0.4      | 0.3      | -0.2     | 0.0      |
| Unemployment Rate (%)                | 4.1      | 2.6      | <b>2.6</b>      | 2.8      | 2.9      | 3.4      | 3.7      |
| Population (Thou)                    | 162.3    | 160.7    | <b>160.1</b>    | 160.5    | 160.7    | 161.0    | 161.4    |
| % Change                             | -1.1     | -1.0     | <b>-0.3</b>     | 0.2      | 0.1      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 11,052.6 | 11,621.2 | <b>12,750.6</b> | 13,514.4 | 14,025.5 | 14,515.5 | 14,164.3 |
| % Change                             | 4.4      | 5.1      | <b>9.7</b>      | 6.0      | 3.8      | 3.5      | -2.4     |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Real Personal Income (Mil 2025\$)    | 11,339.5 | 11,621.2 | <b>12,245.6</b> | 12,606.1 | 12,792.7 | 12,952.4 | 12,355.9 |
| % Change                             | 0.0      | 2.5      | <b>5.4</b>      | 2.9      | 1.5      | 1.2      | -4.6     |
| Real Per Capita Income (Thou 2025\$) | 69.9     | 72.3     | <b>76.5</b>     | 78.5     | 79.6     | 80.4     | 76.6     |
| % Change                             | 1.1      | 3.5      | <b>5.7</b>      | 2.7      | 1.3      | 1.1      | -4.8     |
| <b>TOURISM SECTOR DETAIL</b>         |          |          |                 |          |          |          |          |
| Total Visitor Arrivals by Air (Thou) | 2,392.2  | 2,539.8  | <b>2,743.0</b>  | 2,757.8  | 2,760.7  | 2,775.4  | 2,853.3  |
| % Change                             | -5.5     | 6.2      | <b>8.0</b>      | 0.5      | 0.1      | 0.5      | 2.8      |
| U.S. Visitors                        | 2,036.0  | 2,170.5  | <b>2,339.7</b>  | 2,347.3  | 2,343.9  | 2,350.9  | 2,414.9  |
| % Change                             | -3.9     | 6.6      | <b>7.8</b>      | 0.3      | -0.1     | 0.3      | 2.7      |
| Japanese Visitors                    | 14.1     | 15.2     | <b>14.4</b>     | 14.8     | 16.4     | 18.1     | 19.5     |
| % Change                             | 18.5     | 8.0      | <b>-5.3</b>     | 2.9      | 10.6     | 10.3     | 7.4      |
| Other Visitors                       | 342.1    | 354.1    | <b>388.9</b>    | 395.7    | 400.4    | 406.3    | 418.9    |
| % Change                             | -14.4    | 3.5      | <b>9.8</b>      | 1.7      | 1.2      | 1.5      | 3.1      |
| Average Daily Census (Thou)          | 52.5     | 54.6     | <b>58.7</b>     | 60.0     | 60.4     | 60.9     | 62.8     |
| % Change                             | -6.8     | 4.0      | <b>7.5</b>      | 2.1      | 0.8      | 0.9      | 3.0      |
| Occupancy Rate (%)                   | 58.2     | 58.0     | <b>60.3</b>     | 62.0     | 65.8     | 68.5     | 70.5     |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Occupancy rate includes UHERO's estimate of TVR occupancy. Figures for 2026-2030 are forecasts.

**TABLE 15: JOBS BY INDUSTRY**

## MAUI COUNTY FORECAST

|                                    | 2024 | 2025 | 2026        | 2027 | 2028 | 2029 | 2030 |
|------------------------------------|------|------|-------------|------|------|------|------|
| Nonfarm Payrolls (Thou)            | 73.3 | 74.0 | <b>74.5</b> | 74.8 | 75.0 | 74.9 | 74.9 |
| % Change                           | -1.4 | 1.1  | <b>0.6</b>  | 0.4  | 0.3  | -0.2 | 0.0  |
| Construction and Mining            | 4.8  | 4.9  | <b>5.2</b>  | 5.1  | 5.1  | 5.1  | 5.0  |
| % Change                           | 2.7  | 1.6  | <b>4.7</b>  | -0.6 | -0.4 | -0.9 | -1.0 |
| Manufacturing                      | 1.1  | 1.0  | <b>1.0</b>  | 1.0  | 1.0  | 1.0  | 1.0  |
| % Change                           | -9.6 | -7.8 | <b>-1.8</b> | 0.8  | 1.3  | 0.9  | 0.9  |
| Trade                              | 9.9  | 9.9  | <b>10.0</b> | 10.0 | 9.9  | 9.9  | 9.9  |
| % Change                           | -4.2 | -0.5 | <b>1.0</b>  | -0.2 | -0.1 | -0.6 | -0.3 |
| Transportation and Utilities       | 4.1  | 4.0  | <b>4.0</b>  | 4.0  | 4.0  | 4.0  | 3.9  |
| % Change                           | -2.8 | -1.3 | <b>-1.8</b> | 0.6  | -0.2 | -1.0 | -0.2 |
| Finance, Insurance and Real Estate | 2.7  | 2.7  | <b>2.7</b>  | 2.7  | 2.7  | 2.7  | 2.7  |
| % Change                           | -3.5 | 0.0  | <b>0.3</b>  | 0.5  | 0.6  | 0.0  | 0.1  |
| Services                           | 41.7 | 42.5 | <b>42.7</b> | 43.0 | 43.2 | 43.2 | 43.2 |
| % Change                           | -1.0 | 1.9  | <b>0.5</b>  | 0.6  | 0.5  | 0.0  | 0.1  |
| Health Care and Soc. Assistance    | 8.2  | 8.2  | <b>8.3</b>  | 8.4  | 8.4  | 8.4  | 8.5  |
| % Change                           | 2.6  | -0.5 | <b>1.8</b>  | 0.3  | 0.5  | 0.2  | 0.3  |
| Accommodation and Food             | 19.4 | 20.0 | <b>20.0</b> | 20.2 | 20.3 | 20.3 | 20.4 |
| % Change                           | -2.9 | 2.8  | <b>0.2</b>  | 1.0  | 0.7  | 0.0  | 0.0  |
| Other                              | 14.0 | 14.3 | <b>14.3</b> | 14.4 | 14.4 | 14.4 | 14.4 |
| % Change                           | -0.4 | 2.1  | <b>0.2</b>  | 0.3  | 0.1  | 0.0  | 0.1  |
| Government                         | 8.9  | 9.0  | <b>9.0</b>  | 9.0  | 9.1  | 9.1  | 9.1  |
| % Change                           | 0.7  | 0.9  | <b>0.3</b>  | 0.1  | 0.3  | 0.0  | 0.1  |
| Federal Government                 | 0.9  | 0.8  | <b>0.8</b>  | 0.8  | 0.8  | 0.8  | 0.8  |
| % Change                           | 0.0  | -9.3 | <b>-8.3</b> | 1.8  | 2.0  | 1.0  | 2.1  |
| State and Local Government         | 8.0  | 8.2  | <b>8.3</b>  | 8.3  | 8.3  | 8.3  | 8.3  |
| % Change                           | 0.7  | 2.1  | <b>1.2</b>  | -0.1 | 0.1  | -0.1 | -0.1 |

Note: Source is UHERO. Figures for 2026-2030 are forecasts.



TABLE 16: PERSONAL INCOME BY INDUSTRY

## MAUI COUNTY FORECAST

|                                      | 2024     | 2025     | 2026            | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|-----------------|----------|----------|----------|----------|
| Real Personal Income (Mil 2025\$)    | 11,339.5 | 11,621.2 | <b>12,245.6</b> | 12,606.1 | 12,792.7 | 12,952.4 | 12,355.9 |
| % Change                             | 0.0      | 2.5      | <b>5.4</b>      | 2.9      | 1.5      | 1.2      | -4.6     |
| Labor & Proprietors' Income          | 7,394.4  | 7,629.7  | <b>7,635.1</b>  | 7,692.9  | 7,774.9  | 7,812.9  | 7,852.1  |
| % Change                             | -0.8     | 3.2      | <b>0.1</b>      | 0.8      | 1.1      | 0.5      | 0.5      |
| Construction and Mining              | 685.2    | 703.5    | <b>724.3</b>    | 723.4    | 725.3    | 724.1    | 721.8    |
| % Change                             | 8.1      | 2.7      | <b>3.0</b>      | -0.1     | 0.3      | -0.2     | -0.3     |
| Manufacturing                        | 84.1     | 77.7     | <b>75.2</b>     | 76.4     | 78.5     | 80.2     | 81.7     |
| % Change                             | -11.4    | -7.7     | <b>-3.1</b>     | 1.5      | 2.8      | 2.1      | 1.9      |
| Trade                                | 698.7    | 714.9    | <b>719.0</b>    | 720.7    | 727.9    | 728.0    | 730.4    |
| % Change                             | -5.1     | 2.3      | <b>0.6</b>      | 0.2      | 1.0      | 0.0      | 0.3      |
| Transportation and Utilities         | 371.6    | 374.7    | <b>365.0</b>    | 369.2    | 371.6    | 370.3    | 371.6    |
| % Change                             | -2.4     | 0.8      | <b>-2.6</b>     | 1.1      | 0.7      | -0.3     | 0.3      |
| Finance, Insurance & Real Estate     | 517.6    | 523.2    | <b>522.5</b>    | 525.0    | 528.8    | 530.7    | 532.7    |
| % Change                             | -3.4     | 1.1      | <b>-0.1</b>     | 0.5      | 0.7      | 0.4      | 0.4      |
| Services                             | 3,974.3  | 4,145.5  | <b>4,141.2</b>  | 4,186.1  | 4,240.7  | 4,271.4  | 4,299.6  |
| % Change                             | -1.6     | 4.3      | <b>-0.1</b>     | 1.1      | 1.3      | 0.7      | 0.7      |
| Health Care & Soc. Assist. (% ch.)   | 1.5      | 1.6      | <b>1.2</b>      | 0.8      | 1.3      | 0.9      | 0.8      |
| Accommodation & Food (% ch.)         | -4.8     | 6.1      | <b>-0.5</b>     | 1.7      | 1.7      | 0.8      | 0.7      |
| Other (% ch.)                        | 0.4      | 3.8      | <b>-0.4</b>     | 0.6      | 0.8      | 0.6      | 0.6      |
| Government                           | 979.4    | 1,027.4  | <b>1,006.9</b>  | 1,020.1  | 1,040.7  | 1,051.3  | 1,059.4  |
| % Change                             | 0.3      | 4.9      | <b>-2.0</b>     | 1.3      | 2.0      | 1.0      | 0.8      |
| Federal, civilian (% ch.)            | 1.2      | -6.9     | <b>-2.5</b>     | 0.9      | 1.5      | 1.4      | 1.7      |
| State & Local (% ch.)                | 0.0      | 7.0      | <b>-2.3</b>     | 1.4      | 2.1      | 1.0      | 0.6      |
| Less Social Security Taxes (-)       | 819.1    | 855.1    | <b>851.4</b>    | 857.0    | 865.4    | 868.9    | 872.7    |
| % Change                             | -3.6     | 4.4      | <b>-0.4</b>     | 0.7      | 1.0      | 0.4      | 0.5      |
| Transfer Payments                    | 2,006.4  | 2,085.6  | <b>2,661.2</b>  | 2,871.5  | 2,894.2  | 2,919.4  | 2,290.8  |
| % Change                             | -1.7     | 4.0      | <b>27.6</b>     | 7.9      | 0.8      | 0.9      | -21.5    |
| Dividends, Interest and Rent         | 2,718.8  | 2,723.3  | <b>2,728.9</b>  | 2,812.3  | 2,887.0  | 2,938.1  | 2,960.3  |
| % Change                             | 2.2      | 0.2      | <b>0.2</b>      | 3.0      | 2.7      | 1.8      | 0.8      |
| Population (Thou)                    | 162.3    | 160.7    | <b>160.1</b>    | 160.5    | 160.7    | 161.0    | 161.4    |
| % Change                             | -1.1     | -1.0     | <b>-0.3</b>     | 0.2      | 0.1      | 0.2      | 0.2      |
| Real Per Capita Income (Thou 2025\$) | 69.9     | 72.3     | <b>76.5</b>     | 78.5     | 79.6     | 80.4     | 76.6     |
| % Change                             | 1.1      | 3.5      | <b>5.7</b>      | 2.7      | 1.3      | 1.1      | -4.8     |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | <b>4.1</b>      | 3.0      | 2.3      | 2.2      | 2.3      |
| Nominal Personal Income (Mil \$)     | 11,052.6 | 11,621.2 | <b>12,750.6</b> | 13,514.4 | 14,025.5 | 14,515.5 | 14,164.3 |
| % Change                             | 4.4      | 5.1      | <b>9.7</b>      | 6.0      | 3.8      | 3.5      | -2.4     |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2030 are forecasts.

**TABLE 17: EXTERNAL INDICATORS**

STATE OF HAWAII FORECAST

|                               | 2024      | 2025      | 2026             | 2027      | 2028      | 2029      | 2030      |
|-------------------------------|-----------|-----------|------------------|-----------|-----------|-----------|-----------|
| <b>U.S. FACTORS</b>           |           |           |                  |           |           |           |           |
| Employment (Thou)             | 162,902.8 | 163,564.4 | <b>163,241.4</b> | 164,062.8 | 165,431.6 | 167,006.5 | 167,943.5 |
| % Change                      | 0.6       | 0.4       | <b>-0.2</b>      | 0.5       | 0.8       | 0.9       | 0.6       |
| Unemployment Rate (%)         | 4.0       | 4.3       | <b>4.5</b>       | 4.6       | 4.3       | 3.9       | 3.8       |
| Inflation Rate (%)            | 3.0       | 2.7       | <b>4.0</b>       | 3.2       | 2.9       | 2.7       | 2.5       |
| Real GDP (Bil chained 2012\$) | 23,358.4  | 23,850.4  | <b>24,265.0</b>  | 24,728.7  | 25,316.9  | 25,970.0  | 26,504.0  |
| % Change                      | 2.8       | 2.1       | <b>1.7</b>       | 1.9       | 2.4       | 2.6       | 2.1       |
| Population (Thou)             | 340,095.0 | 341,945.0 | <b>342,926.9</b> | 343,735.6 | 344,578.2 | 345,469.2 | 346,401.4 |
| % Change                      | 0.9       | 0.5       | <b>0.3</b>       | 0.2       | 0.2       | 0.3       | 0.3       |
| <b>JAPAN FACTORS</b>          |           |           |                  |           |           |           |           |
| Employment (Thou)             | 67,806.7  | 68,284.2  | <b>68,233.4</b>  | 67,969.5  | 67,795.2  | 67,457.3  | 66,980.5  |
| % Change                      | 0.5       | 0.7       | <b>-0.1</b>      | -0.4      | -0.3      | -0.5      | -0.7      |
| Unemployment Rate (%)         | 2.5       | 2.5       | <b>2.7</b>       | 2.7       | 2.5       | 2.5       | 2.5       |
| Inflation Rate (%)            | 2.7       | 3.2       | <b>3.0</b>       | 2.9       | 1.4       | 1.2       | 1.2       |
| Real GDP (Bil chained 2012\$) | 584,489.4 | 591,461.9 | <b>592,873.6</b> | 595,860.2 | 600,521.6 | 603,752.3 | 605,928.1 |
| % Change                      | -0.2      | 1.2       | <b>0.2</b>       | 0.5       | 0.8       | 0.5       | 0.4       |
| Population (Thou)             | 123,975.4 | 123,372.4 | <b>122,711.3</b> | 122,027.3 | 121,326.0 | 120,613.2 | 119,891.9 |
| % Change                      | -0.4      | -0.5      | <b>-0.5</b>      | -0.6      | -0.6      | -0.6      | -0.6      |
| Exchange Rate (Yen/\$)        | 151.5     | 149.6     | <b>155.2</b>     | 149.8     | 142.7     | 135.8     | 130.9     |
| % Change                      | 7.8       | -1.2      | <b>3.7</b>       | -3.4      | -4.8      | -4.8      | -3.6      |

Note: Source is UHERO. US Employment for 2024 and 2025 is adjusted by UHERO to reflect population revisions by the US Census Bureau. Figures for 2026-2030 are forecasts.

# UHERO

THE ECONOMIC RESEARCH ORGANIZATION  
AT THE UNIVERSITY OF HAWAII

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UHERO FORECAST FOR THE STATE OF HAWAII,  
INCLUDING FORECASTS FOR HONOLULU, MAUI, AND  
HAWAII COUNTIES

## LONG-TERM PROJECTIONS AND SCENARIOS

MAY 15, 2026





## Long-Term Projections and Scenarios

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These tables present economic projections for the State of Hawaii, and for Honolulu, Maui, and Hawaii Counties over the 2026-2065 period. A separate UHERO forecast report, *War brings more stormy weather to Hawaii*, describes the near-term outlook for the state and counties.

The following is a summary of key features of these projections. By and large, these long-term trends are shared by the Hawaii, Honolulu, and Maui Counties.

The war on Iran and its effect on global oil prices has introduced significant new headwinds for the Hawaii economy, compounding the ongoing challenges from federal policy shifts on tariffs, immigration, and federal spending. Higher energy prices will push inflation above 4%, raise travel costs for visitors, and slow the major economies that send tourists to the Islands. These forces will weigh on near-term growth, but with the economy entering this period on reasonably solid footing, an outright contraction remains unlikely under our baseline forecast assumptions.

Recovery is expected to take hold by the second half of 2027 and to gain momentum through 2028. Over the longer run, constraints imposed on the visitor plant will limit tourism gains throughout the state, and job and income creation will decelerate in line with local population and labor force growth. Tourism will remain a key component of the county economies, although other service areas such as health care will grow somewhat in relative importance.

- Following a robust start to 2026, visitor arrivals are facing near-term headwinds from surging jet fuel prices and slowing visitor market economies. Total arrivals will grow roughly 2% this year, largely on the strength of a strong start, but slow to just 0.2% annual growth in 2027. Following a cyclical recovery, the US market will trend up moderately over time. Japanese visitors will gradually return in greater numbers, but will remain well shy of their previous peak. The yen remains at historically weak purchasing power levels, and beginning in the early 2030s, Japan's demographic decline will weigh on visitor numbers, although the country will remain a key source of international visitors. Gradual expansion of international markets other than Japan will raise their share to 19% of all arrivals by the end of the forecast horizon.
- Maui tourism continues its recovery, with hotel occupancy approaching 70% in early 2026, but the county's visitor numbers will remain below pre-pandemic levels until the early-2040s. The Maui county recovery is hindered in part by implementation of the Bill-9 phase out of Minatoya List short term vacation rentals. This forecast assumes that the two-thousand-plus units in West Maui will begin transitioning from STVR to other uses beginning in 2028 and fully phasing out by January 2029. The remaining roughly four-thousand units are not phased out in this forecast.
- Over the long run, local policies restricting the availability of transient vacation rentals and resistance to further resort development will limit tourism expansion statewide. As a result, overall growth in the industry will be modest compared with past history. By 2065, the total number of arrivals will have risen by about 1.3 million over its level in 2019. Even with restrained trend growth, the tourism industry will remain a bulwark of the local economy.
- For the broader local economy, trend economic growth is ultimately driven by expansion of employment and improvements in productivity. The counties will see slower population and labor force growth than in the past because of a continuing downward trend in birth rates, as well as an incomplete reversal of ongoing out-migration. Rising federal debt and the demographic demands of an aging population will constrain the growth of military and other federal spending in the Islands. This will also contribute to slower overall population gains. Population growth over the 2026-2065 forecast period will average near zero in Honolulu County and about 0.1% in Hawaii and Maui Counties. The annual average pace of job growth will range from about 0.1% in Honolulu and Hawaii Counties to about 0.2% in Maui County, the latter reflecting in part ongoing post-fire recovery.

- The scope for productivity gains is limited in Hawaii's heavily service-oriented economy. Efforts to diversify the economy will proceed but will not fundamentally alter this situation. As a result, growth of real per capita income will be constrained to roughly 0.8% per year across the three counties. Taking into account the minimal or absent employment growth, this will generate total annual real income growth in the 0.8-0.9% range across the counties.
- Tourism will retain its key role in the county economies, with accommodation and food services and the trade industry providing about a quarter of all local jobs in Honolulu County and more than 40% of jobs in Maui County. Some non-tourism service sectors will expand in relative terms, reflecting national trends in consumer spending. The aging population and rising consumption of health care will fuel continued growth in the healthcare industry. Budgetary pressures at all levels of government will hold public sector growth below the average of the private sector.
- While this forecast is considered the most likely trend path for the county economies, we evaluate high and low alternative scenarios. The scenarios use statistical methods to describe a range of possible outcomes for the local economy, given past experience and a range of potential paths for conditions in the rest of the world. The high and low scenarios represent a range that would be expected to encompass the actual outcome with an 80% confidence level. In the high scenario, there is a quicker resolution of current energy price pressures and stronger population and employment growth over the long term. There are also productivity gains from artificial intelligence adoption. In this scenario, nonfarm payrolls in the three counties grow at a 0.3-0.4% average annual rate, about 0.2-0.3 percentage points faster than in the baseline scenario. Over the next four decades, real income expands at an average annual rate that is about 0.4-0.5 percentage points faster than in the baseline. In the low scenario, there is an extended period of stagnation, consistent with outmigration and rising burdens from climate change costs. Over the forty-year forecast horizon the pace of job creation is about 0.3 percentage points slower than in the baseline, with employment declining on net. Real income growth is about 0.5 percentage points slower than in the baseline scenario.

TABLE 1: STATE OF HAWAII LONG-TERM FORECAST

## MAJOR ECONOMIC INDICATORS

|                                      | 2024      | 2025      | 2026      | 2027      | 2028      | 2029      | 2030      |
|--------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>BASELINE</b>                      |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 638.4     | 642.4     | 643.0     | 643.8     | 645.7     | 647.2     | 648.7     |
| % Change                             | 1.0       | 0.6       | 0.1       | 0.1       | 0.3       | 0.2       | 0.2       |
| Population (Thou)                    | 1,435.0   | 1,432.8   | 1,431.8   | 1,430.4   | 1,428.8   | 1,428.4   | 1,429.1   |
| % Change                             | 0.0       | -0.1      | -0.1      | -0.1      | -0.1      | 0.0       | 0.1       |
| Nominal Personal Income (Mil \$)     | 102,703.8 | 109,742.4 | 115,416.1 | 120,680.5 | 125,188.2 | 129,524.6 | 133,004.2 |
| % Change                             | 5.9       | 6.8       | 5.2       | 4.6       | 3.7       | 3.5       | 2.7       |
| Nominal Labor Income (Mil \$)        | 70,483.6  | 73,968.1  | 77,006.4  | 79,885.9  | 82,462.7  | 84,938.4  | 87,487.0  |
| % Change                             | 5.5       | 4.9       | 4.1       | 3.7       | 3.2       | 3.0       | 3.0       |
| Inflation Rate, Honolulu MSA (%)     | 4.4       | 2.6       | 4.1       | 3.0       | 2.3       | 2.2       | 2.3       |
| Real Personal Income (Mil 2025\$)    | 105,369.8 | 109,742.4 | 110,842.6 | 112,567.3 | 114,182.5 | 115,574.8 | 116,022.2 |
| % Change                             | 1.5       | 4.2       | 1.0       | 1.6       | 1.4       | 1.2       | 0.4       |
| Real Labor Income (Mil 2025\$)       | 72,313.2  | 73,968.1  | 73,955.9  | 74,515.0  | 75,212.8  | 75,790.1  | 76,316.0  |
| % Change                             | 1.1       | 2.3       | 0.0       | 0.8       | 0.9       | 0.8       | 0.7       |
| Total Visitor Arrivals by Air (Thou) | 9,701.5   | 9,643.0   | 9,835.2   | 9,853.9   | 10,118.5  | 10,336.2  | 10,525.0  |
| % Change                             | 0.5       | -0.6      | 2.0       | 0.2       | 2.7       | 2.1       | 1.8       |
| <b>OPTIMISTIC SCENARIO</b>           |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 638.4     | 642.4     | 651.6     | 656.7     | 661.7     | 665.4     | 669.0     |
| % Change                             | 1.0       | 0.6       | 1.4       | 0.8       | 0.8       | 0.6       | 0.6       |
| Population (Thou)                    | 1,435.0   | 1,432.8   | 1,434.3   | 1,438.6   | 1,442.3   | 1,446.4   | 1,451.2   |
| % Change                             | 0.0       | -0.1      | 0.1       | 0.3       | 0.3       | 0.3       | 0.3       |
| Nominal Personal Income (Mil \$)     | 102,703.8 | 109,742.4 | 119,636.4 | 129,392.6 | 138,009.5 | 145,526.7 | 151,974.2 |
| % Change                             | 5.9       | 6.8       | 9.0       | 8.2       | 6.7       | 5.5       | 4.4       |
| Nominal Labor Income (Mil \$)        | 70,483.6  | 73,968.1  | 79,822.2  | 85,653.0  | 90,908.2  | 95,432.1  | 99,965.0  |
| % Change                             | 5.5       | 4.9       | 7.9       | 7.3       | 6.1       | 5.0       | 4.8       |
| Inflation Rate, Honolulu MSA (%)     | 4.4       | 2.6       | 5.6       | 5.4       | 4.3       | 3.8       | 3.6       |
| Real Personal Income (Mil 2025\$)    | 105,369.8 | 109,742.4 | 113,268.9 | 116,224.8 | 118,789.0 | 120,732.0 | 121,695.1 |
| % Change                             | 1.5       | 4.2       | 3.2       | 2.6       | 2.2       | 1.6       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 72,313.2  | 73,968.1  | 75,574.8  | 76,936.2  | 78,247.1  | 79,171.9  | 80,047.5  |
| % Change                             | 1.1       | 2.3       | 2.2       | 1.8       | 1.7       | 1.2       | 1.1       |
| Total Visitor Arrivals by Air (Thou) | 9,701.5   | 9,643.0   | 10,618.6  | 10,792.3  | 11,202.0  | 11,507.5  | 11,774.3  |
| % Change                             | 0.5       | -0.6      | 10.1      | 1.6       | 3.8       | 2.7       | 2.3       |
| <b>PESSIMISTIC SCENARIO</b>          |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 638.4     | 642.4     | 634.3     | 630.8     | 629.5     | 628.2     | 627.5     |
| % Change                             | 1.0       | 0.6       | -1.3      | -0.6      | -0.2      | -0.2      | -0.1      |
| Population (Thou)                    | 1,435.0   | 1,432.8   | 1,429.2   | 1,421.7   | 1,414.7   | 1,409.9   | 1,406.8   |
| % Change                             | 0.0       | -0.1      | -0.2      | -0.5      | -0.5      | -0.3      | -0.2      |
| Nominal Personal Income (Mil \$)     | 102,703.8 | 109,742.4 | 111,359.4 | 112,683.0 | 113,491.8 | 114,687.1 | 115,217.6 |
| % Change                             | 5.9       | 6.8       | 1.5       | 1.2       | 0.7       | 1.1       | 0.5       |
| Nominal Labor Income (Mil \$)        | 70,483.6  | 73,968.1  | 74,299.7  | 74,591.9  | 74,758.2  | 75,208.4  | 75,787.4  |
| % Change                             | 5.5       | 4.9       | 0.5       | 0.4       | 0.2       | 0.6       | 0.8       |
| Inflation Rate, Honolulu MSA (%)     | 4.4       | 2.6       | 2.7       | 0.6       | 0.1       | 0.3       | 0.6       |
| Real Personal Income (Mil 2025\$)    | 105,369.8 | 109,742.4 | 108,399.0 | 109,033.0 | 109,732.0 | 110,524.7 | 110,422.2 |
| % Change                             | 1.5       | 4.2       | -1.2      | 0.6       | 0.6       | 0.7       | -0.1      |
| Real Labor Income (Mil 2025\$)       | 72,313.2  | 73,968.1  | 72,325.5  | 72,175.5  | 72,281.2  | 72,478.3  | 72,632.5  |
| % Change                             | 1.1       | 2.3       | -2.2      | -0.2      | 0.1       | 0.3       | 0.2       |
| Total Visitor Arrivals by Air (Thou) | 9,701.5   | 9,643.0   | 9,000.2   | 8,955.9   | 9,150.6   | 9,305.1   | 9,434.6   |
| % Change                             | 0.5       | -0.6      | -6.7      | -0.5      | 2.2       | 1.7       | 1.4       |

Note: Source is UHERO. Figures for 2026-2065 are forecasts.

**TABLE 1: STATE OF HAWAII LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2031      | 2032      | 2033      | 2034      | 2035      | 2036      | 2037      |
|--------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>BASELINE</b>                      |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 649.4     | 650.6     | 652.0     | 653.4     | 654.7     | 655.7     | 656.5     |
| % Change                             | 0.1       | 0.2       | 0.2       | 0.2       | 0.2       | 0.1       | 0.1       |
| Population (Thou)                    | 1,430.4   | 1,431.9   | 1,433.5   | 1,435.1   | 1,436.7   | 1,438.2   | 1,439.6   |
| % Change                             | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 137,190.9 | 141,630.4 | 146,415.5 | 151,358.8 | 156,438.7 | 161,598.6 | 166,834.1 |
| % Change                             | 3.1       | 3.2       | 3.4       | 3.4       | 3.4       | 3.3       | 3.2       |
| Nominal Labor Income (Mil \$)        | 89,985.5  | 92,622.0  | 95,436.4  | 98,322.7  | 101,263.9 | 104,214.0 | 107,173.3 |
| % Change                             | 2.9       | 2.9       | 3.0       | 3.0       | 3.0       | 2.9       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.4       | 2.4       | 2.5       | 2.5       | 2.5       | 2.5       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 116,911.4 | 117,835.4 | 118,799.6 | 119,795.6 | 120,807.9 | 121,811.1 | 122,833.3 |
| % Change                             | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 76,683.3  | 77,060.2  | 77,435.3  | 77,818.7  | 78,199.3  | 78,554.8  | 78,906.9  |
| % Change                             | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       |
| Total Visitor Arrivals by Air (Thou) | 10,674.1  | 10,811.6  | 10,910.4  | 10,991.0  | 11,052.2  | 11,101.7  | 11,138.1  |
| % Change                             | 1.4       | 1.3       | 0.9       | 0.7       | 0.6       | 0.5       | 0.3       |
| <b>OPTIMISTIC SCENARIO</b>           |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 671.6     | 674.9     | 678.3     | 681.7     | 684.9     | 687.8     | 690.5     |
| % Change                             | 0.4       | 0.5       | 0.5       | 0.5       | 0.5       | 0.4       | 0.4       |
| Population (Thou)                    | 1,456.3   | 1,461.2   | 1,465.8   | 1,470.2   | 1,474.2   | 1,478.1   | 1,481.7   |
| % Change                             | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.2       |
| Nominal Personal Income (Mil \$)     | 159,225.2 | 166,833.9 | 174,952.2 | 183,382.8 | 192,090.0 | 201,000.5 | 210,110.4 |
| % Change                             | 4.8       | 4.8       | 4.9       | 4.8       | 4.8       | 4.6       | 4.5       |
| Nominal Labor Income (Mil \$)        | 104,438.1 | 109,104.4 | 114,037.2 | 119,125.4 | 124,341.2 | 129,624.1 | 134,973.7 |
| % Change                             | 4.5       | 4.5       | 4.5       | 4.5       | 4.4       | 4.2       | 4.1       |
| Inflation Rate, Honolulu MSA (%)     | 3.5       | 3.5       | 3.6       | 3.5       | 3.5       | 3.4       | 3.2       |
| Real Personal Income (Mil 2025\$)    | 123,127.4 | 124,604.0 | 126,131.1 | 127,700.5 | 129,295.7 | 130,889.6 | 132,512.5 |
| % Change                             | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       |
| Real Labor Income (Mil 2025\$)       | 80,760.4  | 81,486.6  | 82,214.1  | 82,953.7  | 83,693.5  | 84,409.4  | 85,124.8  |
| % Change                             | 0.9       | 0.9       | 0.9       | 0.9       | 0.9       | 0.9       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 11,996.0  | 12,205.2  | 12,371.4  | 12,517.4  | 12,640.5  | 12,749.2  | 12,841.7  |
| % Change                             | 1.9       | 1.7       | 1.4       | 1.2       | 1.0       | 0.9       | 0.7       |
| <b>PESSIMISTIC SCENARIO</b>          |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 625.9     | 625.0     | 624.2     | 623.5     | 622.8     | 621.8     | 620.7     |
| % Change                             | -0.2      | -0.1      | -0.1      | -0.1      | -0.1      | -0.2      | -0.2      |
| Population (Thou)                    | 1,404.7   | 1,403.0   | 1,401.7   | 1,400.5   | 1,399.4   | 1,398.4   | 1,397.3   |
| % Change                             | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 116,435.1 | 117,918.1 | 119,726.6 | 121,687.5 | 123,745.1 | 125,839.3 | 127,964.3 |
| % Change                             | 1.1       | 1.3       | 1.5       | 1.6       | 1.7       | 1.7       | 1.7       |
| Nominal Labor Income (Mil \$)        | 76,371.5  | 77,114.9  | 78,040.1  | 79,048.2  | 80,101.1  | 81,153.0  | 82,203.6  |
| % Change                             | 0.8       | 1.0       | 1.2       | 1.3       | 1.3       | 1.3       | 1.3       |
| Inflation Rate, Honolulu MSA (%)     | 0.8       | 1.0       | 1.2       | 1.3       | 1.3       | 1.4       | 1.3       |
| Real Personal Income (Mil 2025\$)    | 110,735.7 | 111,074.5 | 111,442.7 | 111,832.4 | 112,230.5 | 112,614.0 | 113,009.0 |
| % Change                             | 0.3       | 0.3       | 0.3       | 0.3       | 0.4       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 72,632.6  | 72,638.8  | 72,640.0  | 72,645.9  | 72,647.1  | 72,623.6  | 72,595.9  |
| % Change                             | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Total Visitor Arrivals by Air (Thou) | 9,528.3   | 9,611.2   | 9,659.2   | 9,690.8   | 9,705.3   | 9,709.8   | 9,703.2   |
| % Change                             | 1.0       | 0.9       | 0.5       | 0.3       | 0.1       | 0.1       | -0.1      |





TABLE 1: STATE OF HAWAII LONG-TERM FORECAST (CONTINUED)

|                                      | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|--------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                      | 2045                      | 2046      | 2047      | 2048      | 2049      | 2050      | 2051      |
| <b>BASELINE</b>                      |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 662.0                     | 662.2     | 662.4     | 662.6     | 662.8     | 662.9     | 663.0     |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Population (Thou)                    | 1,446.6                   | 1,447.0   | 1,447.4   | 1,447.6   | 1,447.8   | 1,448.0   | 1,448.1   |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 217,823.4                 | 225,162.2 | 232,758.0 | 240,448.7 | 248,312.4 | 256,405.5 | 264,553.3 |
| % Change                             | 3.4                       | 3.4       | 3.4       | 3.3       | 3.3       | 3.3       | 3.2       |
| Nominal Labor Income (Mil \$)        | 135,712.6                 | 139,734.1 | 143,877.0 | 148,049.8 | 152,294.2 | 156,642.6 | 160,993.6 |
| % Change                             | 3.0                       | 3.0       | 3.0       | 2.9       | 2.9       | 2.9       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.6                       | 2.6       | 2.6       | 2.5       | 2.5       | 2.5       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 131,280.4                 | 132,307.3 | 133,341.1 | 134,384.3 | 135,432.5 | 136,479.1 | 137,535.9 |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 81,792.4                  | 82,108.5  | 82,423.0  | 82,743.0  | 83,062.6  | 83,377.0  | 83,696.8  |
| % Change                             | 0.4                       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 11,350.8                  | 11,368.5  | 11,377.0  | 11,396.5  | 11,414.9  | 11,433.0  | 11,451.6  |
| % Change                             | 0.1                       | 0.2       | 0.1       | 0.2       | 0.2       | 0.2       | 0.2       |
| <b>OPTIMISTIC SCENARIO</b>           |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 710.0                     | 711.8     | 713.5     | 715.2     | 716.9     | 718.5     | 720.1     |
| % Change                             | 0.3                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       |
| Population (Thou)                    | 1,502.6                   | 1,504.4   | 1,506.0   | 1,507.5   | 1,508.8   | 1,510.1   | 1,511.3   |
| % Change                             | 0.1                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 299,118.0                 | 312,148.0 | 325,681.9 | 339,498.7 | 353,711.1 | 368,404.5 | 383,331.9 |
| % Change                             | 4.4                       | 4.4       | 4.3       | 4.2       | 4.2       | 4.2       | 4.0       |
| Nominal Labor Income (Mil \$)        | 186,362.3                 | 193,716.8 | 201,317.0 | 209,037.2 | 216,937.1 | 225,064.7 | 233,276.2 |
| % Change                             | 4.0                       | 4.0       | 3.9       | 3.8       | 3.8       | 3.8       | 3.6       |
| Inflation Rate, Honolulu MSA (%)     | 3.2                       | 3.1       | 3.1       | 3.0       | 3.0       | 3.0       | 2.9       |
| Real Personal Income (Mil 2025\$)    | 146,105.0                 | 147,811.5 | 149,534.5 | 151,276.6 | 153,033.2 | 154,796.8 | 156,580.7 |
| % Change                             | 1.2                       | 1.2       | 1.2       | 1.2       | 1.2       | 1.1       | 1.1       |
| Real Labor Income (Mil 2025\$)       | 91,028.7                  | 91,730.3  | 92,432.8  | 93,144.0  | 93,857.4  | 94,567.6  | 95,286.4  |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 13,449.6                  | 13,510.6  | 13,559.6  | 13,620.9  | 13,679.9  | 13,737.8  | 13,795.5  |
| % Change                             | 0.4                       | 0.5       | 0.4       | 0.5       | 0.4       | 0.4       | 0.4       |
| <b>PESSIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 612.8                     | 611.5     | 610.3     | 609.1     | 607.9     | 606.7     | 605.6     |
| % Change                             | -0.2                      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      |
| Population (Thou)                    | 1,388.7                   | 1,387.5   | 1,386.3   | 1,385.1   | 1,383.8   | 1,382.7   | 1,381.5   |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 150,282.4                 | 153,535.2 | 156,907.5 | 160,287.3 | 163,725.8 | 167,258.1 | 170,768.3 |
| % Change                             | 2.2                       | 2.2       | 2.2       | 2.1       | 2.1       | 2.2       | 2.1       |
| Nominal Labor Income (Mil \$)        | 93,631.9                  | 95,282.9  | 96,990.8  | 98,692.6  | 100,415.8 | 102,180.9 | 103,920.9 |
| % Change                             | 1.8                       | 1.8       | 1.8       | 1.8       | 1.8       | 1.8       | 1.7       |
| Inflation Rate, Honolulu MSA (%)     | 1.9                       | 1.9       | 1.9       | 1.9       | 1.8       | 1.9       | 1.8       |
| Real Personal Income (Mil 2025\$)    | 116,190.1                 | 116,534.5 | 116,879.2 | 117,226.3 | 117,571.9 | 117,910.5 | 118,252.0 |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 72,390.6                  | 72,320.1  | 72,247.3  | 72,178.5  | 72,108.5  | 72,033.2  | 71,961.7  |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Total Visitor Arrivals by Air (Thou) | 9,598.5                   | 9,579.9   | 9,553.9   | 9,537.6   | 9,520.8   | 9,504.1   | 9,488.3   |
| % Change                             | -0.2                      | -0.2      | -0.3      | -0.2      | -0.2      | -0.2      | -0.2      |

**TABLE 1: STATE OF HAWAII LONG-TERM FORECAST (CONTINUED)**

|                                      | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|--------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                      | 2052                      | 2053      | 2054      | 2055      | 2056      | 2057      | 2058      |
| <b>BASELINE</b>                      |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 663.2                     | 663.4     | 663.7     | 664.0     | 664.1     | 664.2     | 664.3     |
| % Change                             | 0.0                       | 0.0       | 0.1       | 0.0       | 0.0       | 0.0       | 0.0       |
| Population (Thou)                    | 1,448.1                   | 1,448.2   | 1,448.2   | 1,448.2   | 1,448.2   | 1,448.2   | 1,448.2   |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 272,574.5                 | 280,695.8 | 289,113.3 | 297,930.1 | 307,060.2 | 316,596.6 | 326,504.8 |
| % Change                             | 3.0                       | 3.0       | 3.0       | 3.0       | 3.1       | 3.1       | 3.1       |
| Nominal Labor Income (Mil \$)        | 165,242.2                 | 169,526.4 | 173,961.5 | 178,594.2 | 183,421.0 | 188,428.9 | 193,625.1 |
| % Change                             | 2.6                       | 2.6       | 2.6       | 2.7       | 2.7       | 2.7       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.2                       | 2.2       | 2.2       | 2.2       | 2.3       | 2.4       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 138,615.1                 | 139,713.3 | 140,820.9 | 141,927.6 | 142,976.4 | 144,034.2 | 145,108.8 |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.7       | 0.7       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 84,031.7                  | 84,379.3  | 84,732.4  | 85,077.9  | 85,405.7  | 85,724.3  | 86,052.4  |
| % Change                             | 0.4                       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 11,470.3                  | 11,490.2  | 11,511.6  | 11,533.9  | 11,555.5  | 11,575.1  | 11,592.6  |
| % Change                             | 0.2                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.1       |
| <b>OPTIMISTIC SCENARIO</b>           |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 721.6                     | 723.3     | 725.0     | 726.7     | 728.1     | 729.5     | 730.9     |
| % Change                             | 0.2                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       |
| Population (Thou)                    | 1,512.4                   | 1,513.4   | 1,514.3   | 1,515.3   | 1,516.1   | 1,517.0   | 1,517.7   |
| % Change                             | 0.1                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 398,228.7                 | 413,422.3 | 429,205.7 | 445,741.5 | 462,912.2 | 480,868.1 | 499,568.1 |
| % Change                             | 3.9                       | 3.8       | 3.8       | 3.9       | 3.9       | 3.9       | 3.9       |
| Nominal Labor Income (Mil \$)        | 241,417.2                 | 249,686.7 | 258,256.1 | 267,199.7 | 276,518.5 | 286,198.3 | 296,255.8 |
| % Change                             | 3.5                       | 3.4       | 3.4       | 3.5       | 3.5       | 3.5       | 3.5       |
| Inflation Rate, Honolulu MSA (%)     | 2.7                       | 2.6       | 2.6       | 2.7       | 2.7       | 2.7       | 2.8       |
| Real Personal Income (Mil 2025\$)    | 158,399.1                 | 160,248.3 | 162,117.6 | 163,995.0 | 165,814.6 | 167,653.4 | 169,520.7 |
| % Change                             | 1.2                       | 1.2       | 1.2       | 1.2       | 1.1       | 1.1       | 1.1       |
| Real Labor Income (Mil 2025\$)       | 96,025.3                  | 96,781.4  | 97,546.6  | 98,306.1  | 99,047.9  | 99,781.6  | 100,529.1 |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.7       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 13,852.6                  | 13,910.4  | 13,969.2  | 14,028.7  | 14,086.5  | 14,141.3  | 14,192.9  |
| % Change                             | 0.4                       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| <b>PESSIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 604.5                     | 603.5     | 602.6     | 601.7     | 600.7     | 599.7     | 598.7     |
| % Change                             | -0.2                      | -0.2      | -0.1      | -0.1      | -0.2      | -0.2      | -0.2      |
| Population (Thou)                    | 1,380.3                   | 1,379.1   | 1,378.0   | 1,376.8   | 1,375.8   | 1,374.7   | 1,373.7   |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 174,141.5                 | 177,525.0 | 181,041.5 | 184,750.8 | 188,594.4 | 192,625.4 | 196,817.4 |
| % Change                             | 2.0                       | 1.9       | 2.0       | 2.0       | 2.1       | 2.1       | 2.2       |
| Nominal Labor Income (Mil \$)        | 105,569.4                 | 107,216.4 | 108,933.9 | 110,748.8 | 112,656.0 | 114,644.9 | 116,717.4 |
| % Change                             | 1.6                       | 1.6       | 1.6       | 1.7       | 1.7       | 1.8       | 1.8       |
| Inflation Rate, Honolulu MSA (%)     | 1.7                       | 1.6       | 1.7       | 1.7       | 1.8       | 1.9       | 1.9       |
| Real Personal Income (Mil 2025\$)    | 118,606.9                 | 118,972.1 | 119,339.3 | 119,699.6 | 120,005.3 | 120,313.1 | 120,629.3 |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 71,902.3                  | 71,852.8  | 71,806.8  | 71,753.4  | 71,684.2  | 71,606.3  | 71,535.6  |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Total Visitor Arrivals by Air (Thou) | 9,473.0                   | 9,458.9   | 9,446.5   | 9,435.2   | 9,423.6   | 9,410.8   | 9,396.5   |
| % Change                             | -0.2                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |



**TABLE 2: HONOLULU COUNTY LONG-TERM FORECAST**

MAJOR ECONOMIC INDICATORS

|                                      | 2024     | 2025     | 2026     | 2027     | 2028     | 2029      | 2030      |
|--------------------------------------|----------|----------|----------|----------|----------|-----------|-----------|
| <b>BASELINE</b>                      |          |          |          |          |          |           |           |
| Nonfarm Payrolls (Thou)              | 460.0    | 462.2    | 462.4    | 462.7    | 464.1    | 465.3     | 466.5     |
| % Change                             | 1.1      | 0.5      | 0.1      | 0.1      | 0.3      | 0.3       | 0.3       |
| Population (Thou)                    | 990.1    | 988.7    | 987.7    | 985.9    | 984.0    | 983.0     | 982.8     |
| % Change                             | 0.0      | -0.1     | -0.1     | -0.2     | -0.2     | -0.1      | 0.0       |
| Nominal Personal Income (Mil \$)     | 74,587.7 | 77,986.6 | 81,639.1 | 85,170.7 | 88,337.2 | 91,419.3  | 94,457.9  |
| % Change                             | 6.1      | 4.6      | 4.7      | 4.3      | 3.7      | 3.5       | 3.3       |
| Nominal Labor Income (Mil \$)        | 53,104.2 | 55,552.6 | 57,838.9 | 60,010.0 | 61,903.2 | 63,755.6  | 65,665.1  |
| % Change                             | 5.7      | 4.6      | 4.1      | 3.8      | 3.1      | 3.0       | 3.0       |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 4.1      | 3.0      | 2.3      | 2.2       | 2.3       |
| Real Personal Income (Mil 2025\$)    | 76,523.9 | 77,986.6 | 78,404.0 | 79,446.4 | 80,567.7 | 81,553.0  | 82,355.5  |
| % Change                             | 1.7      | 1.9      | 0.5      | 1.3      | 1.4      | 1.2       | 1.0       |
| Real Labor Income (Mil 2025\$)       | 54,482.7 | 55,552.6 | 55,548.2 | 55,976.8 | 56,462.0 | 56,889.9  | 57,281.4  |
| % Change                             | 1.3      | 2.0      | 0.0      | 0.8      | 0.9      | 0.8       | 0.7       |
| Total Visitor Arrivals by Air (Thou) | 5,794.9  | 5,679.1  | 5,654.9  | 5,665.2  | 5,833.9  | 5,974.1   | 6,094.8   |
| % Change                             | 3.2      | -2.0     | -0.4     | 0.2      | 3.0      | 2.4       | 2.0       |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |           |           |
| Nonfarm Payrolls (Thou)              | 460.0    | 462.2    | 468.6    | 472.0    | 475.6    | 478.4     | 481.1     |
| % Change                             | 1.1      | 0.5      | 1.4      | 0.7      | 0.8      | 0.6       | 0.6       |
| Population (Thou)                    | 990.1    | 988.7    | 989.4    | 991.5    | 993.3    | 995.4     | 998.1     |
| % Change                             | 0.0      | -0.1     | 0.1      | 0.2      | 0.2      | 0.2       | 0.3       |
| Nominal Personal Income (Mil \$)     | 74,587.7 | 77,986.6 | 84,624.3 | 91,319.3 | 97,384.3 | 102,713.6 | 107,930.1 |
| % Change                             | 6.1      | 4.6      | 8.5      | 7.9      | 6.6      | 5.5       | 5.1       |
| Nominal Labor Income (Mil \$)        | 53,104.2 | 55,552.6 | 59,953.8 | 64,342.2 | 68,243.0 | 71,632.2  | 75,030.7  |
| % Change                             | 5.7      | 4.6      | 7.9      | 7.3      | 6.1      | 5.0       | 4.7       |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 5.6      | 5.4      | 4.3      | 3.8       | 3.6       |
| Real Personal Income (Mil 2025\$)    | 76,523.9 | 77,986.6 | 80,120.3 | 82,027.8 | 83,818.2 | 85,192.1  | 86,382.2  |
| % Change                             | 1.7      | 1.9      | 2.7      | 2.4      | 2.2      | 1.6       | 1.4       |
| Real Labor Income (Mil 2025\$)       | 54,482.7 | 55,552.6 | 56,764.2 | 57,795.6 | 58,739.9 | 59,428.4  | 60,082.2  |
| % Change                             | 1.3      | 2.0      | 2.2      | 1.8      | 1.6      | 1.2       | 1.1       |
| Total Visitor Arrivals by Air (Thou) | 5,794.9  | 5,679.1  | 6,105.3  | 6,204.7  | 6,458.6  | 6,651.1   | 6,818.3   |
| % Change                             | 3.2      | -2.0     | 7.5      | 1.6      | 4.1      | 3.0       | 2.5       |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |           |           |
| Nonfarm Payrolls (Thou)              | 460.0    | 462.2    | 456.2    | 453.4    | 452.4    | 451.7     | 451.2     |
| % Change                             | 1.1      | 0.5      | -1.3     | -0.6     | -0.2     | -0.2      | -0.1      |
| Population (Thou)                    | 990.1    | 988.7    | 985.9    | 979.8    | 974.2    | 970.3     | 967.5     |
| % Change                             | 0.0      | -0.1     | -0.3     | -0.6     | -0.6     | -0.4      | -0.3      |
| Nominal Personal Income (Mil \$)     | 74,587.7 | 77,986.6 | 78,769.6 | 79,526.5 | 80,083.8 | 80,946.8  | 81,826.1  |
| % Change                             | 6.1      | 4.6      | 1.0      | 1.0      | 0.7      | 1.1       | 1.1       |
| Nominal Labor Income (Mil \$)        | 53,104.2 | 55,552.6 | 55,805.9 | 56,033.2 | 56,119.5 | 56,452.1  | 56,883.7  |
| % Change                             | 5.7      | 4.6      | 0.5      | 0.4      | 0.1      | 0.6       | 0.8       |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 2.7      | 0.6      | 0.1      | 0.3       | 0.6       |
| Real Personal Income (Mil 2025\$)    | 76,523.9 | 77,986.6 | 76,675.6 | 76,952.1 | 77,427.5 | 77,989.5  | 78,380.4  |
| % Change                             | 1.7      | 1.9      | -1.7     | 0.4      | 0.6      | 0.7       | 0.5       |
| Real Labor Income (Mil 2025\$)       | 54,482.7 | 55,552.6 | 54,323.6 | 54,219.3 | 54,261.3 | 54,404.0  | 54,516.6  |
| % Change                             | 1.3      | 2.0      | -2.2     | -0.2     | 0.1      | 0.3       | 0.2       |
| Total Visitor Arrivals by Air (Thou) | 5,794.9  | 5,679.1  | 5,174.8  | 5,148.9  | 5,275.9  | 5,378.2   | 5,463.4   |
| % Change                             | 3.2      | -2.0     | -8.9     | -0.5     | 2.5      | 1.9       | 1.6       |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2065 are forecasts.

**TABLE 2: HONOLULU COUNTY LONG-TERM FORECAST (CONTINUED)**

|                                      | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|--------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                      | 2031                      | 2032      | 2033      | 2034      | 2035      | 2036      | 2037      |
| <b>BASELINE</b>                      |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 466.9                     | 467.6     | 468.5     | 469.3     | 470.1     | 470.6     | 471.0     |
| % Change                             | 0.1                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.1       | 0.1       |
| Population (Thou)                    | 983.2                     | 983.7     | 984.3     | 984.9     | 985.5     | 986.1     | 986.6     |
| % Change                             | 0.0                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 97,452.0                  | 100,603.2 | 103,994.1 | 107,485.4 | 111,067.3 | 114,689.2 | 118,339.5 |
| % Change                             | 3.2                       | 3.2       | 3.4       | 3.4       | 3.3       | 3.3       | 3.2       |
| Nominal Labor Income (Mil \$)        | 67,541.6                  | 69,504.5  | 71,610.8  | 73,770.9  | 75,978.9  | 78,188.3  | 80,391.4  |
| % Change                             | 2.9                       | 2.9       | 3.0       | 3.0       | 3.0       | 2.9       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.4                       | 2.4       | 2.5       | 2.5       | 2.5       | 2.5       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 82,988.8                  | 83,628.6  | 84,294.3  | 84,976.7  | 85,670.0  | 86,348.9  | 87,027.9  |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 57,558.2                  | 57,827.8  | 58,104.6  | 58,387.9  | 58,674.4  | 58,937.9  | 59,189.6  |
| % Change                             | 0.5                       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 6,201.6                   | 6,306.3   | 6,386.5   | 6,445.5   | 6,485.5   | 6,512.8   | 6,526.8   |
| % Change                             | 1.8                       | 1.7       | 1.3       | 0.9       | 0.6       | 0.4       | 0.2       |
| <b>OPTIMISTIC SCENARIO</b>           |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 482.9                     | 485.1     | 487.4     | 489.6     | 491.8     | 493.7     | 495.4     |
| % Change                             | 0.4                       | 0.5       | 0.5       | 0.5       | 0.5       | 0.4       | 0.3       |
| Population (Thou)                    | 1,001.0                   | 1,003.8   | 1,006.5   | 1,008.9   | 1,011.2   | 1,013.5   | 1,015.5   |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.2       | 0.2       | 0.2       | 0.2       |
| Nominal Personal Income (Mil \$)     | 113,103.9                 | 118,505.9 | 124,262.7 | 130,226.8 | 136,378.8 | 142,653.4 | 149,036.5 |
| % Change                             | 4.8                       | 4.8       | 4.9       | 4.8       | 4.7       | 4.6       | 4.5       |
| Nominal Labor Income (Mil \$)        | 78,389.5                  | 81,873.0  | 85,567.8  | 89,379.1  | 93,294.0  | 97,252.6  | 101,244.7 |
| % Change                             | 4.5                       | 4.4       | 4.5       | 4.5       | 4.4       | 4.2       | 4.1       |
| Inflation Rate, Honolulu MSA (%)     | 3.5                       | 3.5       | 3.6       | 3.5       | 3.5       | 3.4       | 3.2       |
| Real Personal Income (Mil 2025\$)    | 87,401.2                  | 88,432.3  | 89,496.5  | 90,584.0  | 91,689.0  | 92,784.4  | 93,885.7  |
| % Change                             | 1.2                       | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       |
| Real Labor Income (Mil 2025\$)       | 60,618.4                  | 61,149.4  | 61,690.4  | 62,240.8  | 62,796.8  | 63,330.6  | 63,853.7  |
| % Change                             | 0.9                       | 0.9       | 0.9       | 0.9       | 0.9       | 0.8       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 6,969.7                   | 7,119.2   | 7,241.7   | 7,340.6   | 7,417.6   | 7,479.3   | 7,525.1   |
| % Change                             | 2.2                       | 2.1       | 1.7       | 1.4       | 1.1       | 0.8       | 0.6       |
| <b>PESSIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 450.0                     | 449.2     | 448.5     | 447.9     | 447.2     | 446.3     | 445.3     |
| % Change                             | -0.3                      | -0.2      | -0.1      | -0.1      | -0.1      | -0.2      | -0.2      |
| Population (Thou)                    | 965.5                     | 963.9     | 962.4     | 961.1     | 959.9     | 958.8     | 957.7     |
| % Change                             | -0.2                      | -0.2      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 82,708.4                  | 83,759.9  | 85,037.8  | 86,414.7  | 87,855.8  | 89,310.2  | 90,768.3  |
| % Change                             | 1.1                       | 1.3       | 1.5       | 1.6       | 1.7       | 1.7       | 1.6       |
| Nominal Labor Income (Mil \$)        | 57,323.2                  | 57,867.8  | 58,557.4  | 59,309.4  | 60,100.3  | 60,886.4  | 61,661.5  |
| % Change                             | 0.8                       | 0.9       | 1.2       | 1.3       | 1.3       | 1.3       | 1.3       |
| Inflation Rate, Honolulu MSA (%)     | 0.8                       | 1.0       | 1.2       | 1.3       | 1.3       | 1.4       | 1.3       |
| Real Personal Income (Mil 2025\$)    | 78,605.1                  | 78,830.4  | 79,074.3  | 79,328.1  | 79,587.4  | 79,829.3  | 80,067.3  |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 54,517.7                  | 54,509.8  | 54,506.4  | 54,506.7  | 54,508.5  | 54,487.9  | 54,455.6  |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | -0.1      |
| Total Visitor Arrivals by Air (Thou) | 5,535.9                   | 5,606.1   | 5,654.1   | 5,683.0   | 5,695.1   | 5,696.2   | 5,686.0   |
| % Change                             | 1.3                       | 1.3       | 0.9       | 0.5       | 0.2       | 0.0       | -0.2      |

**TABLE 2: HONOLULU COUNTY LONG-TERM FORECAST (CONTINUED)**

|                                      | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|--------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                      | 2038                      | 2039      | 2040      | 2041      | 2042      | 2043      | 2044      |
| <b>BASELINE</b>                      |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 471.5                     | 472.0     | 472.6     | 473.0     | 473.4     | 473.6     | 473.9     |
| % Change                             | 0.1                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.0       |
| Population (Thou)                    | 987.1                     | 987.5     | 987.8     | 988.1     | 988.4     | 988.6     | 988.7     |
| % Change                             | 0.1                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 122,068.7                 | 125,987.8 | 130,157.0 | 134,555.3 | 139,115.9 | 143,883.2 | 148,704.6 |
| % Change                             | 3.1                       | 3.2       | 3.3       | 3.4       | 3.4       | 3.4       | 3.4       |
| Nominal Labor Income (Mil \$)        | 82,637.1                  | 85,002.9  | 87,531.3  | 90,198.6  | 92,954.4  | 95,824.5  | 98,709.7  |
| % Change                             | 2.8                       | 2.9       | 3.0       | 3.0       | 3.1       | 3.1       | 3.0       |
| Inflation Rate, Honolulu MSA (%)     | 2.3                       | 2.4       | 2.5       | 2.6       | 2.6       | 2.7       | 2.6       |
| Real Personal Income (Mil 2025\$)    | 87,724.2                  | 88,435.9  | 89,153.1  | 89,860.5  | 90,556.9  | 91,244.1  | 91,930.8  |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 59,452.2                  | 59,726.4  | 60,007.4  | 60,279.4  | 60,540.1  | 60,789.3  | 61,035.8  |
| % Change                             | 0.4                       | 0.5       | 0.5       | 0.5       | 0.4       | 0.4       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 6,534.6                   | 6,536.1   | 6,534.7   | 6,537.0   | 6,545.2   | 6,551.7   | 6,569.7   |
| % Change                             | 0.1                       | 0.0       | 0.0       | 0.0       | 0.1       | 0.1       | 0.3       |
| <b>OPTIMISTIC SCENARIO</b>           |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 497.2                     | 499.0     | 500.8     | 502.6     | 504.1     | 505.6     | 507.0     |
| % Change                             | 0.3                       | 0.4       | 0.4       | 0.3       | 0.3       | 0.3       | 0.3       |
| Population (Thou)                    | 1,017.4                   | 1,019.1   | 1,020.7   | 1,022.2   | 1,023.6   | 1,024.9   | 1,026.0   |
| % Change                             | 0.2                       | 0.2       | 0.2       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 155,592.2                 | 162,466.2 | 169,744.0 | 177,407.5 | 185,375.7 | 193,713.8 | 202,221.1 |
| % Change                             | 4.4                       | 4.4       | 4.5       | 4.5       | 4.5       | 4.5       | 4.4       |
| Nominal Labor Income (Mil \$)        | 105,331.6                 | 109,614.6 | 114,153.9 | 118,924.3 | 123,864.3 | 129,011.0 | 134,233.8 |
| % Change                             | 4.0                       | 4.1       | 4.1       | 4.2       | 4.2       | 4.2       | 4.0       |
| Inflation Rate, Honolulu MSA (%)     | 3.2                       | 3.2       | 3.2       | 3.3       | 3.3       | 3.3       | 3.2       |
| Real Personal Income (Mil 2025\$)    | 95,011.4                  | 96,159.7  | 97,319.9  | 98,475.4  | 99,624.8  | 100,769.9 | 101,920.1 |
| % Change                             | 1.2                       | 1.2       | 1.2       | 1.2       | 1.2       | 1.1       | 1.1       |
| Real Labor Income (Mil 2025\$)       | 64,390.8                  | 64,942.7  | 65,504.3  | 66,058.4  | 66,602.2  | 67,135.7  | 67,668.1  |
| % Change                             | 0.8                       | 0.9       | 0.9       | 0.8       | 0.8       | 0.8       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 7,562.8                   | 7,592.6   | 7,618.2   | 7,647.2   | 7,682.5   | 7,715.2   | 7,760.7   |
| % Change                             | 0.5                       | 0.4       | 0.3       | 0.4       | 0.5       | 0.4       | 0.6       |
| <b>PESSIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 444.4                     | 443.7     | 443.0     | 442.2     | 441.4     | 440.5     | 439.6     |
| % Change                             | -0.2                      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      |
| Population (Thou)                    | 956.5                     | 955.4     | 954.4     | 953.3     | 952.3     | 951.3     | 950.2     |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 92,267.3                  | 93,888.1  | 95,669.4  | 97,589.5  | 99,594.8  | 101,713.7 | 103,835.1 |
| % Change                             | 1.6                       | 1.8       | 1.9       | 2.0       | 2.0       | 2.1       | 2.1       |
| Nominal Labor Income (Mil \$)        | 62,462.4                  | 63,345.5  | 64,338.2  | 65,418.7  | 66,547.2  | 67,740.1  | 68,925.4  |
| % Change                             | 1.3                       | 1.4       | 1.6       | 1.7       | 1.7       | 1.8       | 1.8       |
| Inflation Rate, Honolulu MSA (%)     | 1.3                       | 1.4       | 1.6       | 1.7       | 1.8       | 1.9       | 1.8       |
| Real Personal Income (Mil 2025\$)    | 80,317.3                  | 80,577.1  | 80,837.8  | 81,085.4  | 81,319.1  | 81,540.7  | 81,757.9  |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 54,432.3                  | 54,418.8  | 54,410.5  | 54,393.1  | 54,364.3  | 54,324.6  | 54,281.8  |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | -0.1      | -0.1      | -0.1      |
| Total Visitor Arrivals by Air (Thou) | 5,670.6                   | 5,650.2   | 5,627.6   | 5,608.5   | 5,594.9   | 5,580.1   | 5,575.2   |
| % Change                             | -0.3                      | -0.4      | -0.4      | -0.3      | -0.2      | -0.3      | -0.1      |



**TABLE 2: HONOLULU COUNTY LONG-TERM FORECAST (CONTINUED)**

|                                      | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|--------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                      | 2045                      | 2046      | 2047      | 2048      | 2049      | 2050      | 2051      |
| <b>BASELINE</b>                      |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 474.0                     | 474.2     | 474.3     | 474.4     | 474.5     | 474.6     | 474.7     |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Population (Thou)                    | 988.8                     | 988.8     | 988.8     | 988.8     | 988.7     | 988.6     | 988.5     |
| % Change                             | 0.0                       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 153,683.0                 | 158,784.1 | 164,066.0 | 169,417.3 | 174,893.9 | 180,537.3 | 186,217.7 |
| % Change                             | 3.4                       | 3.3       | 3.3       | 3.3       | 3.2       | 3.2       | 3.1       |
| Nominal Labor Income (Mil \$)        | 101,673.3                 | 104,693.1 | 107,805.4 | 110,943.0 | 114,138.9 | 117,418.9 | 120,702.3 |
| % Change                             | 3.0                       | 3.0       | 3.0       | 2.9       | 2.9       | 2.9       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.6                       | 2.6       | 2.6       | 2.5       | 2.5       | 2.5       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 92,618.8                  | 93,310.0  | 94,006.7  | 94,712.0  | 95,423.1  | 96,135.8  | 96,855.2  |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Real Labor Income (Mil 2025\$)       | 61,278.3                  | 61,519.2  | 61,759.5  | 62,005.4  | 62,253.2  | 62,500.1  | 62,751.2  |
| % Change                             | 0.4                       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 6,585.2                   | 6,602.4   | 6,614.0   | 6,631.3   | 6,647.7   | 6,663.5   | 6,679.3   |
| % Change                             | 0.2                       | 0.3       | 0.2       | 0.3       | 0.2       | 0.2       | 0.2       |
| <b>OPTIMISTIC SCENARIO</b>           |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 508.4                     | 509.6     | 510.9     | 512.1     | 513.3     | 514.4     | 515.6     |
| % Change                             | 0.3                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       |
| Population (Thou)                    | 1,027.1                   | 1,028.0   | 1,028.9   | 1,029.6   | 1,030.3   | 1,031.0   | 1,031.6   |
| % Change                             | 0.1                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| Nominal Personal Income (Mil \$)     | 211,039.6                 | 220,126.4 | 229,566.0 | 239,206.7 | 249,129.4 | 259,396.6 | 269,825.4 |
| % Change                             | 4.4                       | 4.3       | 4.3       | 4.2       | 4.2       | 4.1       | 4.0       |
| Nominal Labor Income (Mil \$)        | 139,619.2                 | 145,138.6 | 150,844.5 | 156,644.6 | 162,586.3 | 168,707.9 | 174,895.0 |
| % Change                             | 4.0                       | 4.0       | 3.9       | 3.9       | 3.8       | 3.8       | 3.7       |
| Inflation Rate, Honolulu MSA (%)     | 3.2                       | 3.1       | 3.1       | 3.0       | 3.0       | 3.0       | 2.9       |
| Real Personal Income (Mil 2025\$)    | 103,077.5                 | 104,244.4 | 105,423.2 | 106,617.6 | 107,824.2 | 109,038.8 | 110,266.9 |
| % Change                             | 1.1                       | 1.1       | 1.1       | 1.1       | 1.1       | 1.1       | 1.1       |
| Real Labor Income (Mil 2025\$)       | 68,198.0                  | 68,728.2  | 69,259.8  | 69,799.6  | 70,343.6  | 70,888.6  | 71,440.4  |
| % Change                             | 0.8                       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       |
| Total Visitor Arrivals by Air (Thou) | 7,802.9                   | 7,846.5   | 7,882.8   | 7,925.6   | 7,966.8   | 8,006.8   | 8,046.4   |
| % Change                             | 0.5                       | 0.6       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       |
| <b>PESSIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 438.7                     | 437.8     | 436.9     | 436.1     | 435.2     | 434.4     | 433.6     |
| % Change                             | -0.2                      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      | -0.2      |
| Population (Thou)                    | 949.2                     | 948.1     | 947.1     | 946.0     | 945.0     | 944.0     | 943.0     |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Nominal Personal Income (Mil \$)     | 106,030.2                 | 108,272.9 | 110,600.7 | 112,936.5 | 115,317.0 | 117,767.8 | 120,202.9 |
| % Change                             | 2.1                       | 2.1       | 2.1       | 2.1       | 2.1       | 2.1       | 2.1       |
| Nominal Labor Income (Mil \$)        | 70,147.3                  | 71,388.9  | 72,674.1  | 73,956.5  | 75,258.0  | 76,594.5  | 77,912.9  |
| % Change                             | 1.8                       | 1.8       | 1.8       | 1.8       | 1.8       | 1.8       | 1.7       |
| Inflation Rate, Honolulu MSA (%)     | 1.9                       | 1.9       | 1.9       | 1.9       | 1.8       | 1.9       | 1.8       |
| Real Personal Income (Mil 2025\$)    | 81,972.5                  | 82,186.2  | 82,400.9  | 82,619.4  | 82,838.9  | 83,056.1  | 83,275.1  |
| % Change                             | 0.3                       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| Real Labor Income (Mil 2025\$)       | 54,234.5                  | 54,185.3  | 54,134.9  | 54,088.7  | 54,043.4  | 53,996.7  | 53,952.8  |
| % Change                             | -0.1                      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      |
| Total Visitor Arrivals by Air (Thou) | 5,568.6                   | 5,563.7   | 5,554.1   | 5,549.7   | 5,544.6   | 5,539.3   | 5,534.2   |
| % Change                             | -0.1                      | -0.1      | -0.2      | -0.1      | -0.1      | -0.1      | -0.1      |





**TABLE 2: HONOLULU COUNTY LONG-TERM FORECAST (CONTINUED)**

## MAJOR ECONOMIC INDICATORS

|                                      | 2059      | 2060      | 2061      | 2062      | 2063      | 2064      | 2065      |
|--------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| BASELINE                             |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 475.3     | 475.3     | 475.4     | 475.5     | 475.4     | 475.3     | 475.2     |
| % Change                             | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Population (Thou)                    | 987.4     | 987.2     | 987.1     | 987.0     | 987.0     | 987.0     | 986.9     |
| % Change                             | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 236,376.2 | 243,702.8 | 251,353.6 | 259,405.5 | 267,697.1 | 276,157.4 | 284,801.9 |
| % Change                             | 3.1       | 3.1       | 3.1       | 3.2       | 3.2       | 3.2       | 3.1       |
| Nominal Labor Income (Mil \$)        | 149,339.7 | 153,507.1 | 157,867.8 | 162,457.4 | 167,163.1 | 171,943.2 | 176,821.0 |
| % Change                             | 2.8       | 2.8       | 2.8       | 2.9       | 2.9       | 2.9       | 2.8       |
| Inflation Rate, Honolulu MSA (%)     | 2.4       | 2.4       | 2.4       | 2.5       | 2.5       | 2.5       | 2.4       |
| Real Personal Income (Mil 2025\$)    | 102,699.7 | 103,436.3 | 104,183.6 | 104,934.6 | 105,676.4 | 106,414.1 | 107,163.1 |
| % Change                             | 0.7       | 0.7       | 0.7       | 0.7       | 0.7       | 0.7       | 0.7       |
| Real Labor Income (Mil 2025\$)       | 64,834.2  | 65,100.5  | 65,377.8  | 65,656.8  | 65,925.4  | 66,188.4  | 66,461.0  |
| % Change                             | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| Total Visitor Arrivals by Air (Thou) | 6,802.5   | 6,814.5   | 6,826.3   | 6,837.6   | 6,847.9   | 6,857.4   | 6,866.3   |
| % Change                             | 0.2       | 0.2       | 0.2       | 0.2       | 0.1       | 0.1       | 0.1       |
| OPTIMISTIC SCENARIO                  |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 523.9     | 524.8     | 525.8     | 526.8     | 527.5     | 528.2     | 528.7     |
| % Change                             | 0.2       | 0.2       | 0.2       | 0.2       | 0.1       | 0.1       | 0.1       |
| Population (Thou)                    | 1,035.3   | 1,035.7   | 1,036.1   | 1,036.5   | 1,036.9   | 1,037.3   | 1,037.5   |
| % Change                             | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       | 0.0       |
| Nominal Personal Income (Mil \$)     | 364,281.9 | 378,241.2 | 392,840.2 | 408,209.1 | 424,103.7 | 440,416.9 | 456,066.5 |
| % Change                             | 3.8       | 3.8       | 3.9       | 3.9       | 3.9       | 3.9       | 3.5       |
| Nominal Labor Income (Mil \$)        | 230,149.0 | 238,252.2 | 246,731.4 | 255,648.3 | 264,830.9 | 274,215.6 | 283,151.7 |
| % Change                             | 3.5       | 3.5       | 3.6       | 3.6       | 3.6       | 3.5       | 3.3       |
| Inflation Rate, Honolulu MSA (%)     | 2.7       | 2.7       | 2.8       | 2.8       | 2.8       | 2.8       | 2.6       |
| Real Personal Income (Mil 2025\$)    | 120,413.2 | 121,716.1 | 123,037.8 | 124,370.1 | 125,697.6 | 127,026.5 | 128,204.7 |
| % Change                             | 1.1       | 1.1       | 1.1       | 1.1       | 1.1       | 1.1       | 0.9       |
| Real Labor Income (Mil 2025\$)       | 76,016.8  | 76,605.4  | 77,209.2  | 77,817.4  | 78,415.5  | 79,009.2  | 79,510.7  |
| % Change                             | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.8       | 0.6       |
| Total Visitor Arrivals by Air (Thou) | 8,345.6   | 8,377.4   | 8,408.5   | 8,438.6   | 8,467.4   | 8,494.7   | 8,515.4   |
| % Change                             | 0.4       | 0.4       | 0.4       | 0.4       | 0.3       | 0.3       | 0.2       |
| PESSIMISTIC SCENARIO                 |           |           |           |           |           |           |           |
| Nonfarm Payrolls (Thou)              | 427.6     | 427.0     | 426.4     | 425.7     | 425.0     | 424.2     | 423.7     |
| % Change                             | -0.2      | -0.2      | -0.1      | -0.1      | -0.2      | -0.2      | -0.1      |
| Population (Thou)                    | 935.9     | 935.1     | 934.4     | 933.7     | 933.1     | 932.5     | 932.1     |
| % Change                             | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | 0.0       |
| Nominal Personal Income (Mil \$)     | 141,190.8 | 144,261.6 | 147,475.3 | 150,872.9 | 154,356.5 | 157,883.2 | 161,968.3 |
| % Change                             | 2.2       | 2.2       | 2.2       | 2.3       | 2.3       | 2.3       | 2.6       |
| Nominal Labor Income (Mil \$)        | 89,202.7  | 90,869.7  | 92,624.9  | 94,486.9  | 96,387.6  | 98,302.4  | 100,559.0 |
| % Change                             | 1.9       | 1.9       | 1.9       | 2.0       | 2.0       | 2.0       | 2.3       |
| Inflation Rate, Honolulu MSA (%)     | 1.9       | 1.9       | 2.0       | 2.1       | 2.1       | 2.1       | 2.2       |
| Real Personal Income (Mil 2025\$)    | 84,965.1  | 85,164.3  | 85,368.6  | 85,572.1  | 85,764.3  | 85,949.5  | 86,295.2  |
| % Change                             | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.2       | 0.4       |
| Real Labor Income (Mil 2025\$)       | 53,638.4  | 53,600.6  | 53,570.9  | 53,541.8  | 53,503.4  | 53,459.7  | 53,519.1  |
| % Change                             | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | 0.1       |
| Total Visitor Arrivals by Air (Thou) | 5,497.3   | 5,490.8   | 5,484.3   | 5,477.5   | 5,470.1   | 5,462.3   | 5,459.8   |
| % Change                             | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | -0.1      | 0.0       |

**TABLE 3: MAUI COUNTY LONG-TERM FORECAST**

MAJOR ECONOMIC INDICATORS

|                                      | 2024     | 2025     | 2026     | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 73.3     | 74.1     | 74.5     | 74.8     | 75.0     | 74.9     | 74.9     |
| % Change                             | -1.2     | 1.1      | 0.6      | 0.4      | 0.3      | -0.2     | 0.0      |
| Population (Thou)                    | 162.3    | 160.7    | 160.1    | 160.5    | 160.7    | 161.0    | 161.4    |
| % Change                             | -1.1     | -1.0     | -0.3     | 0.2      | 0.1      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 11,052.6 | 11,621.2 | 12,750.5 | 13,514.3 | 14,025.5 | 14,515.5 | 14,164.3 |
| % Change                             | 4.4      | 5.1      | 9.7      | 6.0      | 3.8      | 3.5      | -2.4     |
| Nominal Labor Income (Mil \$)        | 7,207.3  | 7,629.7  | 7,950.0  | 8,247.2  | 8,524.2  | 8,755.8  | 9,001.4  |
| % Change                             | 3.6      | 5.9      | 4.2      | 3.7      | 3.4      | 2.7      | 2.8      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 4.1      | 3.0      | 2.3      | 2.2      | 2.3      |
| Real Personal Income (Mil 2025\$)    | 11,339.5 | 11,621.2 | 12,245.6 | 12,606.0 | 12,792.7 | 12,952.3 | 12,355.9 |
| % Change                             | 0.0      | 2.5      | 5.4      | 2.9      | 1.5      | 1.2      | -4.6     |
| Real Labor Income (Mil 2025\$)       | 7,394.4  | 7,629.7  | 7,635.1  | 7,692.9  | 7,775.0  | 7,813.0  | 7,852.1  |
| % Change                             | -0.8     | 3.2      | 0.1      | 0.8      | 1.1      | 0.5      | 0.5      |
| Total Visitor Arrivals by Air (Thou) | 2,388.2  | 2,549.3  | 2,753.3  | 2,768.2  | 2,771.1  | 2,785.8  | 2,864.0  |
| % Change                             | -5.7     | 6.8      | 8.0      | 0.5      | 0.1      | 0.5      | 2.8      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 73.3     | 74.1     | 75.5     | 76.3     | 76.9     | 77.0     | 77.2     |
| % Change                             | -1.2     | 1.1      | 2.0      | 1.0      | 0.7      | 0.2      | 0.3      |
| Population (Thou)                    | 162.3    | 160.7    | 160.4    | 161.4    | 162.2    | 163.0    | 163.9    |
| % Change                             | -1.1     | -1.0     | -0.2     | 0.6      | 0.5      | 0.5      | 0.5      |
| Nominal Personal Income (Mil \$)     | 11,052.6 | 11,621.2 | 13,216.8 | 14,490.0 | 15,461.9 | 16,308.8 | 16,184.5 |
| % Change                             | 4.4      | 5.1      | 13.7     | 9.6      | 6.7      | 5.5      | -0.8     |
| Nominal Labor Income (Mil \$)        | 7,207.3  | 7,629.7  | 8,240.6  | 8,842.6  | 9,397.2  | 9,837.6  | 10,285.2 |
| % Change                             | 3.6      | 5.9      | 8.0      | 7.3      | 6.3      | 4.7      | 4.5      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 5.6      | 5.4      | 4.3      | 3.8      | 3.6      |
| Real Personal Income (Mil 2025\$)    | 11,339.5 | 11,621.2 | 12,513.6 | 13,015.6 | 13,308.8 | 13,530.3 | 12,960.0 |
| % Change                             | 0.0      | 2.5      | 7.7      | 4.0      | 2.2      | 1.7      | -4.2     |
| Real Labor Income (Mil 2025\$)       | 7,394.4  | 7,629.7  | 7,802.3  | 7,942.9  | 8,088.6  | 8,161.6  | 8,236.1  |
| % Change                             | -0.8     | 3.2      | 2.3      | 1.8      | 1.8      | 0.9      | 0.9      |
| Total Visitor Arrivals by Air (Thou) | 2,388.2  | 2,549.3  | 2,972.6  | 3,031.8  | 3,067.8  | 3,101.5  | 3,203.9  |
| % Change                             | -5.7     | 6.8      | 16.6     | 2.0      | 1.2      | 1.1      | 3.3      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 73.3     | 74.1     | 73.5     | 73.3     | 73.1     | 72.7     | 72.4     |
| % Change                             | -1.2     | 1.1      | -0.7     | -0.3     | -0.2     | -0.6     | -0.4     |
| Population (Thou)                    | 162.3    | 160.7    | 159.8    | 159.5    | 159.1    | 158.9    | 158.9    |
| % Change                             | -1.1     | -1.0     | -0.5     | -0.2     | -0.2     | -0.1     | 0.0      |
| Nominal Personal Income (Mil \$)     | 11,052.6 | 11,621.2 | 12,302.4 | 12,618.8 | 12,715.1 | 12,852.7 | 12,270.1 |
| % Change                             | 4.4      | 5.1      | 5.9      | 2.6      | 0.8      | 1.1      | -4.5     |
| Nominal Labor Income (Mil \$)        | 7,207.3  | 7,629.7  | 7,670.5  | 7,700.6  | 7,727.8  | 7,752.8  | 7,797.6  |
| % Change                             | 3.6      | 5.9      | 0.5      | 0.4      | 0.3      | 0.3      | 0.6      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 2.7      | 0.6      | 0.1      | 0.3      | 0.6      |
| Real Personal Income (Mil 2025\$)    | 11,339.5 | 11,621.2 | 11,975.6 | 12,210.2 | 12,294.0 | 12,386.4 | 11,759.5 |
| % Change                             | 0.0      | 2.5      | 3.0      | 2.0      | 0.7      | 0.8      | -5.1     |
| Real Labor Income (Mil 2025\$)       | 7,394.4  | 7,629.7  | 7,466.8  | 7,451.4  | 7,471.9  | 7,471.6  | 7,473.1  |
| % Change                             | -0.8     | 3.2      | -2.1     | -0.2     | 0.3      | 0.0      | 0.0      |
| Total Visitor Arrivals by Air (Thou) | 2,388.2  | 2,549.3  | 2,519.5  | 2,515.9  | 2,506.0  | 2,507.9  | 2,567.3  |
| % Change                             | -5.7     | 6.8      | -1.2     | -0.1     | -0.4     | 0.1      | 2.4      |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2065 are forecasts.

**TABLE 3: MAUI COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2031     | 2032     | 2033     | 2034     | 2035     | 2036     | 2037     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 75.0     | 75.2     | 75.5     | 75.7     | 75.9     | 76.2     | 76.4     |
| % Change                             | 0.1      | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      |
| Population (Thou)                    | 161.8    | 162.1    | 162.5    | 162.9    | 163.3    | 163.7    | 164.0    |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 14,600.0 | 15,070.7 | 15,579.5 | 16,108.7 | 16,653.8 | 17,213.2 | 17,789.9 |
| % Change                             | 3.1      | 3.2      | 3.4      | 3.4      | 3.4      | 3.4      | 3.4      |
| Nominal Labor Income (Mil \$)        | 9,254.5  | 9,532.9  | 9,825.8  | 10,126.3 | 10,429.9 | 10,736.8 | 11,050.2 |
| % Change                             | 2.8      | 3.0      | 3.1      | 3.1      | 3.0      | 2.9      | 2.9      |
| Inflation Rate, Honolulu MSA (%)     | 2.4      | 2.4      | 2.5      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 12,442.0 | 12,538.9 | 12,641.1 | 12,749.7 | 12,860.9 | 12,975.2 | 13,098.1 |
| % Change                             | 0.7      | 0.8      | 0.8      | 0.9      | 0.9      | 0.9      | 0.9      |
| Real Labor Income (Mil 2025\$)       | 7,886.6  | 7,931.4  | 7,972.6  | 8,014.7  | 8,054.4  | 8,093.4  | 8,135.9  |
| % Change                             | 0.4      | 0.6      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      |
| Total Visitor Arrivals by Air (Thou) | 2,911.2  | 2,943.4  | 2,968.4  | 2,992.9  | 3,014.1  | 3,033.1  | 3,049.6  |
| % Change                             | 1.6      | 1.1      | 0.8      | 0.8      | 0.7      | 0.6      | 0.5      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 77.5     | 78.0     | 78.5     | 79.0     | 79.4     | 79.9     | 80.3     |
| % Change                             | 0.4      | 0.6      | 0.6      | 0.6      | 0.6      | 0.6      | 0.6      |
| Population (Thou)                    | 164.7    | 165.5    | 166.2    | 166.9    | 167.6    | 168.2    | 168.8    |
| % Change                             | 0.5      | 0.5      | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      |
| Nominal Personal Income (Mil \$)     | 16,944.9 | 17,752.6 | 18,616.0 | 19,517.0 | 20,449.1 | 21,410.2 | 22,404.6 |
| % Change                             | 4.7      | 4.8      | 4.9      | 4.8      | 4.8      | 4.7      | 4.6      |
| Nominal Labor Income (Mil \$)        | 10,740.9 | 11,229.4 | 11,740.9 | 12,268.8 | 12,806.8 | 13,354.8 | 13,916.6 |
| % Change                             | 4.4      | 4.5      | 4.6      | 4.5      | 4.4      | 4.3      | 4.2      |
| Inflation Rate, Honolulu MSA (%)     | 3.5      | 3.5      | 3.6      | 3.5      | 3.5      | 3.4      | 3.2      |
| Real Personal Income (Mil 2025\$)    | 13,103.5 | 13,259.1 | 13,421.3 | 13,591.0 | 13,764.5 | 13,942.2 | 14,130.3 |
| % Change                             | 1.1      | 1.2      | 1.2      | 1.3      | 1.3      | 1.3      | 1.4      |
| Real Labor Income (Mil 2025\$)       | 8,306.0  | 8,387.0  | 8,464.7  | 8,543.6  | 8,620.3  | 8,696.6  | 8,777.0  |
| % Change                             | 0.8      | 1.0      | 0.9      | 0.9      | 0.9      | 0.9      | 0.9      |
| Total Visitor Arrivals by Air (Thou) | 3,271.8  | 3,322.8  | 3,365.9  | 3,408.6  | 3,447.3  | 3,483.2  | 3,516.0  |
| % Change                             | 2.1      | 1.6      | 1.3      | 1.3      | 1.1      | 1.0      | 0.9      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.3     | 72.2     | 72.2     | 72.2     | 72.2     | 72.2     | 72.2     |
| % Change                             | -0.2     | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Population (Thou)                    | 158.8    | 158.9    | 158.9    | 159.0    | 159.1    | 159.1    | 159.2    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.1      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 12,391.2 | 12,547.5 | 12,739.6 | 12,950.9 | 13,173.4 | 13,404.2 | 13,645.1 |
| % Change                             | 1.0      | 1.3      | 1.5      | 1.7      | 1.7      | 1.8      | 1.8      |
| Nominal Labor Income (Mil \$)        | 7,854.4  | 7,936.9  | 8,034.8  | 8,141.2  | 8,250.2  | 8,360.9  | 8,475.7  |
| % Change                             | 0.7      | 1.1      | 1.2      | 1.3      | 1.3      | 1.3      | 1.4      |
| Inflation Rate, Honolulu MSA (%)     | 0.8      | 1.0      | 1.2      | 1.3      | 1.3      | 1.4      | 1.3      |
| Real Personal Income (Mil 2025\$)    | 11,784.7 | 11,819.5 | 11,858.3 | 11,902.2 | 11,947.7 | 11,995.5 | 12,050.5 |
| % Change                             | 0.2      | 0.3      | 0.3      | 0.4      | 0.4      | 0.4      | 0.5      |
| Real Labor Income (Mil 2025\$)       | 7,470.0  | 7,476.4  | 7,478.9  | 7,482.0  | 7,482.6  | 7,482.3  | 7,485.2  |
| % Change                             | 0.0      | 0.1      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Total Visitor Arrivals by Air (Thou) | 2,598.7  | 2,616.6  | 2,628.0  | 2,638.9  | 2,646.8  | 2,652.8  | 2,656.7  |
| % Change                             | 1.2      | 0.7      | 0.4      | 0.4      | 0.3      | 0.2      | 0.1      |

**TABLE 3: MAUI COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2038     | 2039     | 2040     | 2041     | 2042     | 2043     | 2044     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 76.6     | 76.9     | 77.1     | 77.3     | 77.4     | 77.5     | 77.6     |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      | 0.1      | 0.1      |
| Population (Thou)                    | 164.3    | 164.6    | 164.9    | 165.2    | 165.4    | 165.6    | 165.8    |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 18,391.5 | 19,030.0 | 19,709.5 | 20,424.2 | 21,159.0 | 21,920.8 | 22,689.9 |
| % Change                             | 3.4      | 3.5      | 3.6      | 3.6      | 3.6      | 3.6      | 3.5      |
| Nominal Labor Income (Mil \$)        | 11,377.0 | 11,722.5 | 12,088.2 | 12,470.0 | 12,857.5 | 13,255.0 | 13,652.7 |
| % Change                             | 3.0      | 3.0      | 3.1      | 3.2      | 3.1      | 3.1      | 3.0      |
| Inflation Rate, Honolulu MSA (%)     | 2.3      | 2.4      | 2.5      | 2.6      | 2.6      | 2.7      | 2.6      |
| Real Personal Income (Mil 2025\$)    | 13,231.5 | 13,371.2 | 13,511.9 | 13,649.4 | 13,780.6 | 13,906.2 | 14,030.0 |
| % Change                             | 1.0      | 1.1      | 1.1      | 1.0      | 1.0      | 0.9      | 0.9      |
| Real Labor Income (Mil 2025\$)       | 8,185.1  | 8,236.8  | 8,287.1  | 8,333.7  | 8,374.0  | 8,408.7  | 8,442.0  |
| % Change                             | 0.6      | 0.6      | 0.6      | 0.6      | 0.5      | 0.4      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 3,066.8  | 3,083.7  | 3,100.6  | 3,116.7  | 3,132.6  | 3,144.8  | 3,160.3  |
| % Change                             | 0.6      | 0.6      | 0.6      | 0.5      | 0.5      | 0.4      | 0.5      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 80.8     | 81.3     | 81.7     | 82.1     | 82.5     | 82.8     | 83.0     |
| % Change                             | 0.6      | 0.6      | 0.6      | 0.5      | 0.4      | 0.3      | 0.3      |
| Population (Thou)                    | 169.4    | 169.9    | 170.4    | 170.9    | 171.3    | 171.7    | 172.1    |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 23,442.3 | 24,539.9 | 25,704.0 | 26,928.7 | 28,194.9 | 29,512.5 | 30,855.7 |
| % Change                             | 4.6      | 4.7      | 4.7      | 4.8      | 4.7      | 4.7      | 4.5      |
| Nominal Labor Income (Mil \$)        | 14,501.4 | 15,116.7 | 15,764.8 | 16,441.3 | 17,133.0 | 17,845.5 | 18,566.1 |
| % Change                             | 4.2      | 4.2      | 4.3      | 4.3      | 4.2      | 4.2      | 4.0      |
| Inflation Rate, Honolulu MSA (%)     | 3.2      | 3.2      | 3.2      | 3.3      | 3.3      | 3.3      | 3.2      |
| Real Personal Income (Mil 2025\$)    | 14,330.6 | 14,539.0 | 14,749.6 | 14,958.0 | 15,160.5 | 15,358.0 | 15,554.5 |
| % Change                             | 1.4      | 1.4      | 1.4      | 1.4      | 1.4      | 1.3      | 1.3      |
| Real Labor Income (Mil 2025\$)       | 8,865.0  | 8,956.1  | 9,046.2  | 9,132.6  | 9,212.5  | 9,286.6  | 9,359.3  |
| % Change                             | 1.0      | 1.0      | 1.0      | 0.9      | 0.9      | 0.8      | 0.8      |
| Total Visitor Arrivals by Air (Thou) | 3,549.4  | 3,582.2  | 3,614.7  | 3,646.0  | 3,676.9  | 3,703.3  | 3,733.2  |
| % Change                             | 0.9      | 0.9      | 0.9      | 0.9      | 0.8      | 0.7      | 0.8      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.2     | 72.2     | 72.3     | 72.3     | 72.2     | 72.1     | 72.0     |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | -0.1     | -0.1     | -0.1     |
| Population (Thou)                    | 159.2    | 159.3    | 159.3    | 159.4    | 159.4    | 159.4    | 159.4    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 13,901.5 | 14,181.4 | 14,487.0 | 14,813.1 | 15,148.0 | 15,496.2 | 15,843.6 |
| % Change                             | 1.9      | 2.0      | 2.1      | 2.2      | 2.3      | 2.3      | 2.2      |
| Nominal Labor Income (Mil \$)        | 8,599.5  | 8,735.8  | 8,885.2  | 9,044.1  | 9,204.9  | 9,370.2  | 9,533.2  |
| % Change                             | 1.5      | 1.6      | 1.7      | 1.8      | 1.8      | 1.8      | 1.7      |
| Inflation Rate, Honolulu MSA (%)     | 1.3      | 1.4      | 1.6      | 1.7      | 1.8      | 1.9      | 1.8      |
| Real Personal Income (Mil 2025\$)    | 12,114.3 | 12,183.0 | 12,251.6 | 12,316.5 | 12,374.8 | 12,427.3 | 12,477.5 |
| % Change                             | 0.5      | 0.6      | 0.6      | 0.5      | 0.5      | 0.4      | 0.4      |
| Real Labor Income (Mil 2025\$)       | 7,493.9  | 7,504.8  | 7,514.2  | 7,519.9  | 7,519.7  | 7,514.5  | 7,507.8  |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      | -0.1     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 2,661.3  | 2,665.8  | 2,670.2  | 2,674.0  | 2,677.7  | 2,678.4  | 2,681.9  |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.1      | 0.1      | 0.0      | 0.1      |

TABLE 3: MAUI COUNTY LONG-TERM FORECAST (CONTINUED)

|                                      | MAJOR ECONOMIC INDICATORS |          |          |          |          |          |          |
|--------------------------------------|---------------------------|----------|----------|----------|----------|----------|----------|
|                                      | 2045                      | 2046     | 2047     | 2048     | 2049     | 2050     | 2051     |
| <b>BASELINE</b>                      |                           |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 77.6                      | 77.7     | 77.8     | 77.8     | 77.8     | 77.9     | 77.9     |
| % Change                             | 0.1                       | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      |
| Population (Thou)                    | 166.0                     | 166.2    | 166.3    | 166.5    | 166.6    | 166.7    | 166.8    |
| % Change                             | 0.1                       | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 23,483.4                  | 24,296.8 | 25,138.7 | 25,990.5 | 26,860.3 | 27,753.6 | 28,654.2 |
| % Change                             | 3.5                       | 3.5      | 3.5      | 3.4      | 3.4      | 3.3      | 3.2      |
| Nominal Labor Income (Mil \$)        | 14,060.2                  | 14,475.4 | 14,902.5 | 15,331.4 | 15,765.6 | 16,207.9 | 16,649.6 |
| % Change                             | 3.0                       | 3.0      | 3.0      | 2.9      | 2.8      | 2.8      | 2.7      |
| Inflation Rate, Honolulu MSA (%)     | 2.6                       | 2.6      | 2.6      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 14,153.4                  | 14,277.2 | 14,401.4 | 14,526.0 | 14,650.0 | 14,772.8 | 14,896.9 |
| % Change                             | 0.9                       | 0.9      | 0.9      | 0.9      | 0.8      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 8,474.0                   | 8,506.0  | 8,537.4  | 8,568.6  | 8,598.8  | 8,627.2  | 8,655.9  |
| % Change                             | 0.4                       | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      |
| Total Visitor Arrivals by Air (Thou) | 3,172.3                   | 3,185.1  | 3,195.2  | 3,208.3  | 3,221.0  | 3,233.5  | 3,246.1  |
| % Change                             | 0.4                       | 0.4      | 0.3      | 0.4      | 0.4      | 0.4      | 0.4      |
| <b>OPTIMISTIC SCENARIO</b>           |                           |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 83.3                      | 83.5     | 83.7     | 84.0     | 84.2     | 84.4     | 84.6     |
| % Change                             | 0.3                       | 0.3      | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      |
| Population (Thou)                    | 172.4                     | 172.8    | 173.1    | 173.4    | 173.6    | 173.9    | 174.1    |
| % Change                             | 0.2                       | 0.2      | 0.2      | 0.2      | 0.2      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 32,247.7                  | 33,683.3 | 35,174.8 | 36,697.0 | 38,261.4 | 39,876.4 | 41,519.3 |
| % Change                             | 4.5                       | 4.5      | 4.4      | 4.3      | 4.3      | 4.2      | 4.1      |
| Nominal Labor Income (Mil \$)        | 19,307.6                  | 20,067.6 | 20,852.0 | 21,646.9 | 22,457.4 | 23,287.5 | 24,125.0 |
| % Change                             | 4.0                       | 3.9      | 3.9      | 3.8      | 3.7      | 3.7      | 3.6      |
| Inflation Rate, Honolulu MSA (%)     | 3.2                       | 3.1      | 3.1      | 3.0      | 3.0      | 3.0      | 2.9      |
| Real Personal Income (Mil 2025\$)    | 15,751.6                  | 15,950.2 | 16,150.4 | 16,351.9 | 16,554.0 | 16,755.5 | 16,959.7 |
| % Change                             | 1.3                       | 1.3      | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      |
| Real Labor Income (Mil 2025\$)       | 9,431.0                   | 9,502.8  | 9,574.2  | 9,645.7  | 9,716.3  | 9,785.1  | 9,854.5  |
| % Change                             | 0.8                       | 0.8      | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      |
| Total Visitor Arrivals by Air (Thou) | 3,758.9                   | 3,785.3  | 3,808.2  | 3,834.6  | 3,860.1  | 3,885.3  | 3,910.5  |
| % Change                             | 0.7                       | 0.7      | 0.6      | 0.7      | 0.7      | 0.7      | 0.7      |
| <b>PESSIMISTIC SCENARIO</b>          |                           |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 71.9                      | 71.8     | 71.6     | 71.5     | 71.4     | 71.3     | 71.2     |
| % Change                             | -0.2                      | -0.1     | -0.2     | -0.2     | -0.1     | -0.2     | -0.2     |
| Population (Thou)                    | 159.4                     | 159.4    | 159.3    | 159.3    | 159.3    | 159.2    | 159.2    |
| % Change                             | 0.0                       | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 16,201.8                  | 16,567.7 | 16,946.6 | 17,325.7 | 17,710.5 | 18,104.2 | 18,496.2 |
| % Change                             | 2.3                       | 2.3      | 2.3      | 2.2      | 2.2      | 2.2      | 2.2      |
| Nominal Labor Income (Mil \$)        | 9,700.5                   | 9,870.6  | 10,046.1 | 10,220.1 | 10,395.1 | 10,572.7 | 10,747.3 |
| % Change                             | 1.8                       | 1.8      | 1.8      | 1.7      | 1.7      | 1.7      | 1.6      |
| Inflation Rate, Honolulu MSA (%)     | 1.9                       | 1.9      | 1.9      | 1.9      | 1.8      | 1.9      | 1.8      |
| Real Personal Income (Mil 2025\$)    | 12,526.5                  | 12,575.1 | 12,623.5 | 12,671.3 | 12,718.0 | 12,762.9 | 12,808.2 |
| % Change                             | 0.4                       | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.4      |
| Real Labor Income (Mil 2025\$)       | 7,500.0                   | 7,491.9  | 7,483.4  | 7,474.6  | 7,464.8  | 7,453.4  | 7,442.2  |
| % Change                             | -0.1                      | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 2,682.6                   | 2,684.0  | 2,683.2  | 2,685.0  | 2,686.5  | 2,688.0  | 2,689.6  |
| % Change                             | 0.0                       | 0.1      | 0.0      | 0.1      | 0.1      | 0.1      | 0.1      |

**TABLE 3: MAUI COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2052     | 2053     | 2054     | 2055     | 2056     | 2057     | 2058     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 78.0     | 78.0     | 78.1     | 78.2     | 78.2     | 78.3     | 78.3     |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Population (Thou)                    | 166.9    | 167.0    | 167.1    | 167.2    | 167.3    | 167.3    | 167.4    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 29,546.0 | 30,454.6 | 31,398.2 | 32,385.1 | 33,398.5 | 34,463.0 | 35,576.1 |
| % Change                             | 3.1      | 3.1      | 3.1      | 3.1      | 3.1      | 3.2      | 3.2      |
| Nominal Labor Income (Mil \$)        | 17,082.7 | 17,522.3 | 17,977.2 | 18,448.4 | 18,933.8 | 19,439.3 | 19,968.4 |
| % Change                             | 2.6      | 2.6      | 2.6      | 2.6      | 2.6      | 2.7      | 2.7      |
| Inflation Rate, Honolulu MSA (%)     | 2.2      | 2.2      | 2.2      | 2.2      | 2.3      | 2.4      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 15,025.5 | 15,158.5 | 15,293.5 | 15,427.7 | 15,551.5 | 15,678.9 | 15,811.2 |
| % Change                             | 0.9      | 0.9      | 0.9      | 0.9      | 0.8      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 8,687.3  | 8,721.6  | 8,756.4  | 8,788.5  | 8,816.2  | 8,843.9  | 8,874.7  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      |
| Total Visitor Arrivals by Air (Thou) | 3,258.5  | 3,271.2  | 3,284.2  | 3,297.5  | 3,310.7  | 3,323.3  | 3,335.2  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 84.8     | 85.1     | 85.3     | 85.6     | 85.8     | 86.0     | 86.2     |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      | 0.3      |
| Population (Thou)                    | 174.3    | 174.6    | 174.7    | 174.9    | 175.1    | 175.3    | 175.4    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 43,166.5 | 44,854.9 | 46,612.4 | 48,452.3 | 50,350.3 | 52,344.8 | 54,433.1 |
| % Change                             | 4.0      | 3.9      | 3.9      | 4.0      | 3.9      | 4.0      | 4.0      |
| Nominal Labor Income (Mil \$)        | 24,957.7 | 25,807.7 | 26,688.2 | 27,601.1 | 28,543.9 | 29,525.7 | 30,552.6 |
| % Change                             | 3.5      | 3.4      | 3.4      | 3.4      | 3.4      | 3.4      | 3.5      |
| Inflation Rate, Honolulu MSA (%)     | 2.7      | 2.6      | 2.6      | 2.7      | 2.7      | 2.7      | 2.8      |
| Real Personal Income (Mil 2025\$)    | 17,170.0 | 17,386.5 | 17,606.4 | 17,826.5 | 18,035.5 | 18,250.0 | 18,471.2 |
| % Change                             | 1.2      | 1.3      | 1.3      | 1.2      | 1.2      | 1.2      | 1.2      |
| Real Labor Income (Mil 2025\$)       | 9,927.3  | 10,003.6 | 10,080.7 | 10,154.9 | 10,224.5 | 10,294.2 | 10,367.7 |
| % Change                             | 0.7      | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      | 0.7      |
| Total Visitor Arrivals by Air (Thou) | 3,935.3  | 3,960.2  | 3,985.3  | 4,010.8  | 4,035.8  | 4,060.0  | 4,083.3  |
| % Change                             | 0.6      | 0.6      | 0.6      | 0.6      | 0.6      | 0.6      | 0.6      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 71.1     | 71.0     | 70.9     | 70.9     | 70.8     | 70.7     | 70.6     |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     |
| Population (Thou)                    | 159.1    | 159.1    | 159.0    | 158.9    | 158.9    | 158.8    | 158.8    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 18,876.3 | 19,260.9 | 19,661.4 | 20,082.5 | 20,513.2 | 20,968.2 | 21,445.3 |
| % Change                             | 2.0      | 2.0      | 2.1      | 2.1      | 2.1      | 2.2      | 2.3      |
| Nominal Labor Income (Mil \$)        | 10,913.8 | 11,081.9 | 11,257.3 | 11,440.1 | 11,629.0 | 11,827.4 | 12,037.0 |
| % Change                             | 1.6      | 1.5      | 1.6      | 1.6      | 1.6      | 1.7      | 1.8      |
| Inflation Rate, Honolulu MSA (%)     | 1.7      | 1.6      | 1.7      | 1.7      | 1.8      | 1.9      | 1.9      |
| Real Personal Income (Mil 2025\$)    | 12,856.6 | 12,908.2 | 12,960.5 | 13,011.5 | 13,052.9 | 13,096.7 | 13,143.9 |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.4      |
| Real Labor Income (Mil 2025\$)       | 7,433.4  | 7,426.9  | 7,420.6  | 7,412.1  | 7,399.8  | 7,387.4  | 7,377.5  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.2     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 2,691.1  | 2,692.9  | 2,695.0  | 2,697.5  | 2,699.9  | 2,701.9  | 2,703.4  |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |

**TABLE 3: MAUI COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2059     | 2060     | 2061     | 2062     | 2063     | 2064     | 2065     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 78.4     | 78.5     | 78.6     | 78.6     | 78.6     | 78.7     | 78.7     |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      | 0.0      | 0.1      |
| Population (Thou)                    | 167.4    | 167.5    | 167.6    | 167.6    | 167.7    | 167.7    | 167.8    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 36,731.1 | 37,926.3 | 39,176.2 | 40,483.2 | 41,820.6 | 43,197.2 | 44,619.1 |
| % Change                             | 3.2      | 3.2      | 3.3      | 3.3      | 3.3      | 3.3      | 3.3      |
| Nominal Labor Income (Mil \$)        | 20,516.5 | 21,082.3 | 21,673.6 | 22,283.8 | 22,896.2 | 23,526.6 | 24,180.7 |
| % Change                             | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      |
| Inflation Rate, Honolulu MSA (%)     | 2.4      | 2.4      | 2.4      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 15,946.4 | 16,084.1 | 16,224.0 | 16,361.2 | 16,493.1 | 16,628.5 | 16,770.8 |
| % Change                             | 0.8      | 0.9      | 0.9      | 0.8      | 0.8      | 0.8      | 0.9      |
| Real Labor Income (Mil 2025\$)       | 8,907.1  | 8,940.8  | 8,975.7  | 9,006.0  | 9,029.8  | 9,056.4  | 9,088.7  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 3,346.9  | 3,358.2  | 3,369.3  | 3,380.2  | 3,390.8  | 3,401.0  | 3,410.8  |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 86.4     | 86.7     | 86.9     | 87.1     | 87.3     | 87.4     | 87.5     |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      | 0.2      | 0.2      |
| Population (Thou)                    | 175.6    | 175.7    | 175.9    | 176.0    | 176.2    | 176.3    | 176.4    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 56,606.7 | 58,863.9 | 61,228.4 | 63,705.8 | 66,255.0 | 68,891.1 | 71,450.6 |
| % Change                             | 4.0      | 4.0      | 4.0      | 4.0      | 4.0      | 4.0      | 3.7      |
| Nominal Labor Income (Mil \$)        | 31,618.3 | 32,721.0 | 33,873.6 | 35,066.6 | 36,273.8 | 37,520.3 | 38,721.6 |
| % Change                             | 3.5      | 3.5      | 3.5      | 3.5      | 3.4      | 3.4      | 3.2      |
| Inflation Rate, Honolulu MSA (%)     | 2.7      | 2.7      | 2.8      | 2.8      | 2.8      | 2.8      | 2.6      |
| Real Personal Income (Mil 2025\$)    | 18,696.8 | 18,926.5 | 19,160.1 | 19,391.5 | 19,617.9 | 19,849.5 | 20,063.8 |
| % Change                             | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      | 1.1      |
| Real Labor Income (Mil 2025\$)       | 10,443.4 | 10,520.8 | 10,600.0 | 10,674.0 | 10,740.5 | 10,810.7 | 10,873.3 |
| % Change                             | 0.7      | 0.7      | 0.8      | 0.7      | 0.6      | 0.7      | 0.6      |
| Total Visitor Arrivals by Air (Thou) | 4,106.1  | 4,128.4  | 4,150.3  | 4,171.8  | 4,192.7  | 4,213.0  | 4,230.1  |
| % Change                             | 0.6      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      | 0.4      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 70.6     | 70.5     | 70.5     | 70.4     | 70.3     | 70.2     | 70.2     |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.1     | 0.0      |
| Population (Thou)                    | 158.7    | 158.7    | 158.6    | 158.6    | 158.5    | 158.5    | 158.5    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 21,940.0 | 22,450.8 | 22,985.6 | 23,545.5 | 24,114.1 | 24,696.5 | 25,375.1 |
| % Change                             | 2.3      | 2.3      | 2.4      | 2.4      | 2.4      | 2.4      | 2.8      |
| Nominal Labor Income (Mil \$)        | 12,254.8 | 12,479.8 | 12,716.4 | 12,960.5 | 13,202.2 | 13,450.5 | 13,751.7 |
| % Change                             | 1.8      | 1.8      | 1.9      | 1.9      | 1.9      | 1.9      | 2.2      |
| Inflation Rate, Honolulu MSA (%)     | 1.9      | 1.9      | 2.0      | 2.1      | 2.1      | 2.1      | 2.2      |
| Real Personal Income (Mil 2025\$)    | 13,192.7 | 13,242.9 | 13,294.1 | 13,342.2 | 13,385.4 | 13,430.7 | 13,505.0 |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.6      |
| Real Labor Income (Mil 2025\$)       | 7,368.9  | 7,361.4  | 7,354.7  | 7,344.2  | 7,328.3  | 7,314.8  | 7,318.9  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.2     | 0.1      |
| Total Visitor Arrivals by Air (Thou) | 2,704.7  | 2,705.9  | 2,706.9  | 2,707.9  | 2,708.6  | 2,709.1  | 2,712.2  |
| % Change                             | 0.1      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.1      |



TABLE 4: HAWAII COUNTY LONG-TERM FORECAST

## MAJOR ECONOMIC INDICATORS

|                                      | 2024     | 2025     | 2026     | 2027     | 2028     | 2029     | 2030     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.7     | 73.0     | 72.8     | 73.0     | 73.3     | 73.5     | 73.7     |
| % Change                             | 2.0      | 0.4      | -0.3     | 0.2      | 0.4      | 0.3      | 0.3      |
| Population (Thou)                    | 209.1    | 210.0    | 210.6    | 210.6    | 210.6    | 210.7    | 211.1    |
| % Change                             | 0.8      | 0.5      | 0.3      | 0.0      | 0.0      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 12,103.6 | 12,733.3 | 13,300.5 | 13,916.2 | 14,472.3 | 15,008.5 | 15,524.8 |
| % Change                             | 6.3      | 5.2      | 4.5      | 4.6      | 4.0      | 3.7      | 3.4      |
| Nominal Labor Income (Mil \$)        | 6,949.7  | 7,359.9  | 7,653.4  | 7,933.4  | 8,211.4  | 8,479.3  | 8,748.7  |
| % Change                             | 5.9      | 5.9      | 4.0      | 3.7      | 3.5      | 3.3      | 3.2      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 4.1      | 3.0      | 2.3      | 2.2      | 2.3      |
| Real Personal Income (Mil 2025\$)    | 12,417.8 | 12,733.3 | 12,773.5 | 12,980.9 | 13,199.4 | 13,388.7 | 13,535.7 |
| % Change                             | 1.9      | 2.5      | 0.3      | 1.6      | 1.7      | 1.4      | 1.1      |
| Real Labor Income (Mil 2025\$)       | 7,130.1  | 7,359.9  | 7,350.3  | 7,400.2  | 7,489.7  | 7,566.2  | 7,631.8  |
| % Change                             | 1.4      | 3.2      | -0.1     | 0.7      | 1.2      | 1.0      | 0.9      |
| Total Visitor Arrivals by Air (Thou) | 1,735.4  | 1,752.6  | 1,793.5  | 1,792.4  | 1,845.6  | 1,893.2  | 1,937.3  |
| % Change                             | -2.5     | 1.0      | 2.3      | -0.1     | 3.0      | 2.6      | 2.3      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.7     | 73.0     | 73.8     | 74.5     | 75.1     | 75.6     | 76.0     |
| % Change                             | 2.0      | 0.4      | 1.1      | 0.9      | 0.8      | 0.7      | 0.6      |
| Population (Thou)                    | 209.1    | 210.0    | 210.9    | 211.8    | 212.6    | 213.4    | 214.3    |
| % Change                             | 0.8      | 0.5      | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      |
| Nominal Personal Income (Mil \$)     | 12,103.6 | 12,733.3 | 13,786.9 | 14,920.8 | 15,954.5 | 16,862.7 | 17,739.1 |
| % Change                             | 6.3      | 5.2      | 8.3      | 8.2      | 6.9      | 5.7      | 5.2      |
| Nominal Labor Income (Mil \$)        | 6,949.7  | 7,359.9  | 7,933.2  | 8,506.1  | 9,052.4  | 9,526.9  | 9,996.5  |
| % Change                             | 5.9      | 5.9      | 7.8      | 7.2      | 6.4      | 5.2      | 4.9      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 5.6      | 5.4      | 4.3      | 3.8      | 3.6      |
| Real Personal Income (Mil 2025\$)    | 12,417.8 | 12,733.3 | 13,053.1 | 13,402.6 | 13,731.9 | 13,986.1 | 14,197.6 |
| % Change                             | 1.9      | 2.5      | 2.5      | 2.7      | 2.5      | 1.9      | 1.5      |
| Real Labor Income (Mil 2025\$)       | 7,130.1  | 7,359.9  | 7,511.2  | 7,640.7  | 7,791.8  | 7,903.8  | 8,004.9  |
| % Change                             | 1.4      | 3.2      | 2.1      | 1.7      | 2.0      | 1.4      | 1.3      |
| Total Visitor Arrivals by Air (Thou) | 1,735.4  | 1,752.6  | 1,936.4  | 1,963.1  | 2,043.2  | 2,107.8  | 2,167.3  |
| % Change                             | -2.5     | 1.0      | 10.5     | 1.4      | 4.1      | 3.2      | 2.8      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 72.7     | 73.0     | 71.8     | 71.5     | 71.4     | 71.4     | 71.3     |
| % Change                             | 2.0      | 0.4      | -1.6     | -0.4     | -0.1     | -0.1     | -0.1     |
| Population (Thou)                    | 209.1    | 210.0    | 210.2    | 209.3    | 208.5    | 208.0    | 207.8    |
| % Change                             | 0.8      | 0.5      | 0.1      | -0.4     | -0.4     | -0.2     | -0.1     |
| Nominal Personal Income (Mil \$)     | 12,103.6 | 12,733.3 | 12,833.0 | 12,994.0 | 13,120.1 | 13,289.2 | 13,448.7 |
| % Change                             | 6.3      | 5.2      | 0.8      | 1.2      | 1.0      | 1.3      | 1.2      |
| Nominal Labor Income (Mil \$)        | 6,949.7  | 7,359.9  | 7,384.4  | 7,407.6  | 7,444.2  | 7,508.0  | 7,578.8  |
| % Change                             | 5.9      | 5.9      | 0.3      | 0.3      | 0.5      | 0.9      | 0.9      |
| Inflation Rate, Honolulu MSA (%)     | 4.4      | 2.6      | 2.7      | 0.6      | 0.1      | 0.3      | 0.6      |
| Real Personal Income (Mil 2025\$)    | 12,417.8 | 12,733.3 | 12,491.9 | 12,573.3 | 12,684.9 | 12,803.7 | 12,882.4 |
| % Change                             | 1.9      | 2.5      | -1.9     | 0.7      | 0.9      | 0.9      | 0.6      |
| Real Labor Income (Mil 2025\$)       | 7,130.1  | 7,359.9  | 7,188.3  | 7,167.9  | 7,197.8  | 7,235.6  | 7,263.4  |
| % Change                             | 1.4      | 3.2      | -2.3     | -0.3     | 0.4      | 0.5      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 1,735.4  | 1,752.6  | 1,641.3  | 1,629.1  | 1,669.0  | 1,704.4  | 1,736.6  |
| % Change                             | -2.5     | 1.0      | -6.3     | -0.7     | 2.5      | 2.1      | 1.9      |

Note: Source is UHERO. Income figures for 2025 are UHERO estimates. Figures for 2026-2065 are forecasts.

**TABLE 4: HAWAII COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2031     | 2032     | 2033     | 2034     | 2035     | 2036     | 2037     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 73.8     | 74.0     | 74.2     | 74.5     | 74.7     | 74.8     | 75.0     |
| % Change                             | 0.1      | 0.3      | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      |
| Population (Thou)                    | 211.5    | 211.9    | 212.3    | 212.8    | 213.2    | 213.6    | 214.0    |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 16,032.3 | 16,577.2 | 17,161.4 | 17,764.2 | 18,380.3 | 19,007.2 | 19,647.3 |
| % Change                             | 3.3      | 3.4      | 3.5      | 3.5      | 3.5      | 3.4      | 3.4      |
| Nominal Labor Income (Mil \$)        | 9,001.2  | 9,271.8  | 9,556.3  | 9,848.0  | 10,142.5 | 10,440.1 | 10,743.7 |
| % Change                             | 2.9      | 3.0      | 3.1      | 3.0      | 3.0      | 2.9      | 2.9      |
| Inflation Rate, Honolulu MSA (%)     | 2.4      | 2.4      | 2.5      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 13,652.9 | 13,780.2 | 13,910.5 | 14,044.2 | 14,177.4 | 14,310.5 | 14,448.9 |
| % Change                             | 0.9      | 0.9      | 0.9      | 1.0      | 0.9      | 0.9      | 1.0      |
| Real Labor Income (Mil 2025\$)       | 7,670.7  | 7,714.2  | 7,754.0  | 7,794.4  | 7,832.5  | 7,869.7  | 7,910.3  |
| % Change                             | 0.5      | 0.6      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      |
| Total Visitor Arrivals by Air (Thou) | 1,968.8  | 1,994.7  | 2,011.7  | 2,026.7  | 2,038.8  | 2,048.9  | 2,057.0  |
| % Change                             | 1.6      | 1.3      | 0.8      | 0.8      | 0.6      | 0.5      | 0.4      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 76.4     | 76.8     | 77.2     | 77.7     | 78.1     | 78.5     | 78.9     |
| % Change                             | 0.5      | 0.5      | 0.6      | 0.6      | 0.5      | 0.5      | 0.5      |
| Population (Thou)                    | 215.3    | 216.2    | 217.1    | 218.0    | 218.8    | 219.5    | 220.2    |
| % Change                             | 0.5      | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      |
| Nominal Personal Income (Mil \$)     | 18,607.2 | 19,527.2 | 20,506.2 | 21,522.7 | 22,569.0 | 23,641.7 | 24,743.8 |
| % Change                             | 4.9      | 4.9      | 5.0      | 5.0      | 4.9      | 4.8      | 4.7      |
| Nominal Labor Income (Mil \$)        | 10,446.9 | 10,921.8 | 11,418.9 | 11,931.6 | 12,453.9 | 12,985.6 | 13,530.6 |
| % Change                             | 4.5      | 4.5      | 4.5      | 4.5      | 4.4      | 4.3      | 4.2      |
| Inflation Rate, Honolulu MSA (%)     | 3.5      | 3.5      | 3.6      | 3.5      | 3.5      | 3.4      | 3.2      |
| Real Personal Income (Mil 2025\$)    | 14,378.8 | 14,571.8 | 14,769.0 | 14,970.9 | 15,173.4 | 15,377.0 | 15,587.4 |
| % Change                             | 1.3      | 1.3      | 1.4      | 1.4      | 1.4      | 1.3      | 1.4      |
| Real Labor Income (Mil 2025\$)       | 8,078.6  | 8,157.3  | 8,232.5  | 8,308.8  | 8,382.8  | 8,456.2  | 8,533.6  |
| % Change                             | 0.9      | 1.0      | 0.9      | 0.9      | 0.9      | 0.9      | 0.9      |
| Total Visitor Arrivals by Air (Thou) | 2,212.6  | 2,251.8  | 2,281.1  | 2,308.1  | 2,331.7  | 2,353.0  | 2,371.7  |
| % Change                             | 2.1      | 1.8      | 1.3      | 1.2      | 1.0      | 0.9      | 0.8      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 71.2     | 71.1     | 71.1     | 71.1     | 71.0     | 71.0     | 70.9     |
| % Change                             | -0.2     | -0.1     | 0.0      | 0.0      | -0.1     | -0.1     | -0.1     |
| Population (Thou)                    | 207.7    | 207.6    | 207.6    | 207.7    | 207.7    | 207.7    | 207.7    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 13,606.7 | 13,801.8 | 14,033.2 | 14,281.8 | 14,539.1 | 14,801.2 | 15,069.8 |
| % Change                             | 1.2      | 1.4      | 1.7      | 1.8      | 1.8      | 1.8      | 1.8      |
| Nominal Labor Income (Mil \$)        | 7,639.4  | 7,719.5  | 7,814.4  | 7,917.4  | 8,022.8  | 8,129.8  | 8,240.6  |
| % Change                             | 0.8      | 1.1      | 1.2      | 1.3      | 1.3      | 1.3      | 1.4      |
| Inflation Rate, Honolulu MSA (%)     | 0.8      | 1.0      | 1.2      | 1.3      | 1.3      | 1.4      | 1.3      |
| Real Personal Income (Mil 2025\$)    | 12,931.7 | 12,989.6 | 13,049.1 | 13,110.6 | 13,170.8 | 13,230.0 | 13,293.2 |
| % Change                             | 0.4      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      |
| Real Labor Income (Mil 2025\$)       | 7,265.5  | 7,271.6  | 7,273.8  | 7,276.3  | 7,276.4  | 7,275.5  | 7,277.6  |
| % Change                             | 0.0      | 0.1      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Total Visitor Arrivals by Air (Thou) | 1,757.5  | 1,773.3  | 1,781.0  | 1,786.9  | 1,790.3  | 1,792.0  | 1,792.0  |
| % Change                             | 1.2      | 0.9      | 0.4      | 0.3      | 0.2      | 0.1      | 0.0      |

**TABLE 4: HAWAII COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2038     | 2039     | 2040     | 2041     | 2042     | 2043     | 2044     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 75.2     | 75.4     | 75.6     | 75.7     | 75.8     | 75.8     | 75.9     |
| % Change                             | 0.3      | 0.3      | 0.2      | 0.2      | 0.1      | 0.1      | 0.0      |
| Population (Thou)                    | 214.3    | 214.6    | 214.9    | 215.2    | 215.4    | 215.7    | 215.9    |
| % Change                             | 0.2      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 20,307.4 | 21,000.8 | 21,732.4 | 22,499.4 | 23,288.7 | 24,109.2 | 24,939.1 |
| % Change                             | 3.4      | 3.4      | 3.5      | 3.5      | 3.5      | 3.5      | 3.4      |
| Nominal Labor Income (Mil \$)        | 11,060.1 | 11,394.6 | 11,748.5 | 12,117.8 | 12,492.9 | 12,877.5 | 13,262.7 |
| % Change                             | 3.0      | 3.0      | 3.1      | 3.1      | 3.1      | 3.1      | 3.0      |
| Inflation Rate, Honolulu MSA (%)     | 2.3      | 2.4      | 2.5      | 2.6      | 2.6      | 2.7      | 2.6      |
| Real Personal Income (Mil 2025\$)    | 14,593.9 | 14,741.3 | 14,886.0 | 15,025.8 | 15,159.7 | 15,289.0 | 15,417.6 |
| % Change                             | 1.0      | 1.0      | 1.0      | 0.9      | 0.9      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 7,957.1  | 8,006.4  | 8,054.2  | 8,098.3  | 8,136.5  | 8,169.3  | 8,200.8  |
| % Change                             | 0.6      | 0.6      | 0.6      | 0.6      | 0.5      | 0.4      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 2,065.2  | 2,073.0  | 2,080.6  | 2,088.0  | 2,095.4  | 2,100.4  | 2,107.5  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.3      | 0.4      | 0.2      | 0.3      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 79.3     | 79.7     | 80.1     | 80.4     | 80.7     | 81.0     | 81.2     |
| % Change                             | 0.5      | 0.5      | 0.5      | 0.4      | 0.4      | 0.3      | 0.3      |
| Population (Thou)                    | 220.9    | 221.5    | 222.1    | 222.6    | 223.1    | 223.6    | 224.0    |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      | 0.2      | 0.2      |
| Nominal Personal Income (Mil \$)     | 25,884.4 | 27,081.3 | 28,342.3 | 29,664.8 | 31,032.8 | 32,458.9 | 33,914.3 |
| % Change                             | 4.6      | 4.6      | 4.7      | 4.7      | 4.6      | 4.6      | 4.5      |
| Nominal Labor Income (Mil \$)        | 14,097.6 | 14,693.9 | 15,321.7 | 15,977.0 | 16,647.1 | 17,337.4 | 18,035.7 |
| % Change                             | 4.2      | 4.2      | 4.3      | 4.3      | 4.2      | 4.2      | 4.0      |
| Inflation Rate, Honolulu MSA (%)     | 3.2      | 3.2      | 3.2      | 3.3      | 3.3      | 3.3      | 3.2      |
| Real Personal Income (Mil 2025\$)    | 15,806.2 | 16,028.8 | 16,249.6 | 16,466.3 | 16,677.7 | 16,885.2 | 17,092.9 |
| % Change                             | 1.4      | 1.4      | 1.4      | 1.3      | 1.3      | 1.2      | 1.2      |
| Real Labor Income (Mil 2025\$)       | 8,618.1  | 8,705.6  | 8,792.0  | 8,874.7  | 8,951.2  | 9,022.2  | 9,091.9  |
| % Change                             | 1.0      | 1.0      | 1.0      | 0.9      | 0.9      | 0.8      | 0.8      |
| Total Visitor Arrivals by Air (Thou) | 2,390.2  | 2,408.1  | 2,425.6  | 2,442.6  | 2,459.5  | 2,473.4  | 2,489.5  |
| % Change                             | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      | 0.6      | 0.7      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 70.9     | 70.9     | 70.8     | 70.8     | 70.7     | 70.5     | 70.4     |
| % Change                             | 0.0      | 0.0      | 0.0      | -0.1     | -0.1     | -0.2     | -0.2     |
| Population (Thou)                    | 207.7    | 207.7    | 207.7    | 207.6    | 207.6    | 207.5    | 207.5    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 15,349.6 | 15,650.1 | 15,974.0 | 16,318.2 | 16,672.7 | 17,043.3 | 17,414.1 |
| % Change                             | 1.9      | 2.0      | 2.1      | 2.1      | 2.2      | 2.2      | 2.2      |
| Nominal Labor Income (Mil \$)        | 8,360.0  | 8,491.5  | 8,635.5  | 8,788.7  | 8,943.8  | 9,103.4  | 9,260.9  |
| % Change                             | 1.4      | 1.6      | 1.7      | 1.8      | 1.8      | 1.8      | 1.7      |
| Inflation Rate, Honolulu MSA (%)     | 1.3      | 1.4      | 1.6      | 1.7      | 1.8      | 1.9      | 1.8      |
| Real Personal Income (Mil 2025\$)    | 13,361.7 | 13,431.4 | 13,497.6 | 13,558.5 | 13,613.2 | 13,663.1 | 13,711.5 |
| % Change                             | 0.5      | 0.5      | 0.5      | 0.5      | 0.4      | 0.4      | 0.3      |
| Real Labor Income (Mil 2025\$)       | 7,285.2  | 7,294.9  | 7,303.0  | 7,307.5  | 7,306.5  | 7,300.5  | 7,293.4  |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      | -0.1     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 1,792.2  | 1,792.0  | 1,791.8  | 1,791.4  | 1,791.2  | 1,788.9  | 1,788.5  |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | -0.1     | 0.0      |

**TABLE 4: HAWAII COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2045     | 2046     | 2047     | 2048     | 2049     | 2050     | 2051     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 75.9     | 75.9     | 75.9     | 75.9     | 75.9     | 75.9     | 75.9     |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Population (Thou)                    | 216.1    | 216.2    | 216.3    | 216.5    | 216.6    | 216.7    | 216.8    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 25,797.1 | 26,678.3 | 27,592.2 | 28,518.5 | 29,466.4 | 30,441.9 | 31,425.4 |
| % Change                             | 3.4      | 3.4      | 3.4      | 3.4      | 3.3      | 3.3      | 3.2      |
| Nominal Labor Income (Mil \$)        | 13,657.4 | 14,059.9 | 14,474.1 | 14,890.2 | 15,311.7 | 15,741.4 | 16,170.9 |
| % Change                             | 3.0      | 3.0      | 3.0      | 2.9      | 2.8      | 2.8      | 2.7      |
| Inflation Rate, Honolulu MSA (%)     | 2.6      | 2.6      | 2.6      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 15,546.9 | 15,677.6 | 15,809.9 | 15,943.2 | 16,077.0 | 16,210.3 | 16,345.0 |
| % Change                             | 0.8      | 0.8      | 0.8      | 0.8      | 0.8      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 8,231.3  | 8,261.8  | 8,291.9  | 8,322.0  | 8,351.3  | 8,378.9  | 8,407.0  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      |
| Total Visitor Arrivals by Air (Thou) | 2,112.3  | 2,117.6  | 2,121.2  | 2,126.8  | 2,132.1  | 2,137.3  | 2,142.6  |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.3      | 0.2      | 0.2      | 0.2      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 81.4     | 81.6     | 81.8     | 81.9     | 82.1     | 82.3     | 82.4     |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      |
| Population (Thou)                    | 224.4    | 224.8    | 225.1    | 225.4    | 225.7    | 226.0    | 226.2    |
| % Change                             | 0.2      | 0.2      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 35,424.9 | 36,984.8 | 38,607.9 | 40,266.4 | 41,973.7 | 43,739.1 | 45,534.7 |
| % Change                             | 4.5      | 4.4      | 4.4      | 4.3      | 4.2      | 4.2      | 4.1      |
| Nominal Labor Income (Mil \$)        | 18,754.6 | 19,491.6 | 20,252.5 | 21,024.0 | 21,811.0 | 22,617.3 | 23,431.2 |
| % Change                             | 4.0      | 3.9      | 3.9      | 3.8      | 3.7      | 3.7      | 3.6      |
| Inflation Rate, Honolulu MSA (%)     | 3.2      | 3.1      | 3.1      | 3.0      | 3.0      | 3.0      | 2.9      |
| Real Personal Income (Mil 2025\$)    | 17,302.5 | 17,514.8 | 17,729.9 | 17,947.3 | 18,166.4 | 18,386.0 | 18,608.3 |
| % Change                             | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      | 1.2      |
| Real Labor Income (Mil 2025\$)       | 9,160.8  | 9,229.9  | 9,298.9  | 9,368.1  | 9,436.6  | 9,503.5  | 9,571.1  |
| % Change                             | 0.8      | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      | 0.7      |
| Total Visitor Arrivals by Air (Thou) | 2,502.9  | 2,516.6  | 2,528.1  | 2,541.9  | 2,555.1  | 2,568.1  | 2,581.1  |
| % Change                             | 0.5      | 0.6      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 70.2     | 70.1     | 69.9     | 69.8     | 69.6     | 69.5     | 69.3     |
| % Change                             | -0.2     | -0.2     | -0.2     | -0.2     | -0.2     | -0.2     | -0.2     |
| Population (Thou)                    | 207.4    | 207.3    | 207.2    | 207.1    | 207.0    | 206.9    | 206.8    |
| % Change                             | 0.0      | 0.0      | 0.0      | -0.1     | -0.1     | -0.1     | -0.1     |
| Nominal Personal Income (Mil \$)     | 17,798.1 | 18,191.6 | 18,600.6 | 19,011.0 | 19,428.8 | 19,857.8 | 20,285.0 |
| % Change                             | 2.2      | 2.2      | 2.2      | 2.2      | 2.2      | 2.2      | 2.1      |
| Nominal Labor Income (Mil \$)        | 9,422.6  | 9,587.3  | 9,757.3  | 9,926.0  | 10,095.9 | 10,268.4 | 10,438.2 |
| % Change                             | 1.8      | 1.8      | 1.8      | 1.7      | 1.7      | 1.7      | 1.6      |
| Inflation Rate, Honolulu MSA (%)     | 1.9      | 1.9      | 1.9      | 1.9      | 1.8      | 1.9      | 1.8      |
| Real Personal Income (Mil 2025\$)    | 13,759.8 | 13,808.6 | 13,858.0 | 13,907.6 | 13,956.8 | 14,004.8 | 14,053.2 |
| % Change                             | 0.3      | 0.3      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      |
| Real Labor Income (Mil 2025\$)       | 7,285.1  | 7,276.9  | 7,268.2  | 7,259.5  | 7,249.9  | 7,238.9  | 7,228.3  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 1,786.2  | 1,784.5  | 1,781.3  | 1,779.9  | 1,778.3  | 1,776.7  | 1,775.2  |
| % Change                             | -0.1     | -0.1     | -0.2     | -0.1     | -0.1     | -0.1     | -0.1     |

**TABLE 4: HAWAII COUNTY LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                      | 2052     | 2053     | 2054     | 2055     | 2056     | 2057     | 2058     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| <b>BASELINE</b>                      |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 75.9     | 76.0     | 76.0     | 76.0     | 76.0     | 76.0     | 76.1     |
| % Change                             | 0.0      | 0.1      | 0.1      | 0.0      | 0.0      | 0.0      | 0.0      |
| Population (Thou)                    | 216.8    | 216.9    | 217.0    | 217.0    | 217.1    | 217.1    | 217.2    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 32,397.0 | 33,383.8 | 34,406.3 | 35,474.1 | 36,569.9 | 37,719.0 | 38,917.3 |
| % Change                             | 3.1      | 3.0      | 3.1      | 3.1      | 3.1      | 3.1      | 3.2      |
| Nominal Labor Income (Mil \$)        | 16,592.2 | 17,020.2 | 17,463.5 | 17,922.8 | 18,396.5 | 18,890.1 | 19,407.0 |
| % Change                             | 2.6      | 2.6      | 2.6      | 2.6      | 2.6      | 2.7      | 2.7      |
| Inflation Rate, Honolulu MSA (%)     | 2.2      | 2.2      | 2.2      | 2.2      | 2.3      | 2.4      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 16,483.4 | 16,625.4 | 16,768.2 | 16,909.5 | 17,039.2 | 17,172.0 | 17,308.8 |
| % Change                             | 0.8      | 0.9      | 0.9      | 0.8      | 0.8      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 8,437.9  | 8,471.7  | 8,506.2  | 8,538.2  | 8,566.0  | 8,594.0  | 8,625.2  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 2,147.8  | 2,153.2  | 2,158.9  | 2,164.7  | 2,170.4  | 2,175.8  | 2,180.7  |
| % Change                             | 0.2      | 0.2      | 0.3      | 0.3      | 0.3      | 0.2      | 0.2      |
| <b>OPTIMISTIC SCENARIO</b>           |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 82.6     | 82.8     | 83.0     | 83.2     | 83.4     | 83.5     | 83.7     |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      |
| Population (Thou)                    | 226.4    | 226.7    | 226.9    | 227.1    | 227.2    | 227.4    | 227.6    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      |
| Nominal Personal Income (Mil \$)     | 47,331.7 | 49,169.3 | 51,078.1 | 53,073.7 | 55,131.4 | 57,290.1 | 59,545.3 |
| % Change                             | 4.0      | 3.9      | 3.9      | 3.9      | 3.9      | 3.9      | 3.9      |
| Nominal Labor Income (Mil \$)        | 24,241.1 | 25,068.2 | 25,925.5 | 26,814.9 | 27,733.9 | 28,691.5 | 29,693.7 |
| % Change                             | 3.5      | 3.4      | 3.4      | 3.4      | 3.4      | 3.5      | 3.5      |
| Inflation Rate, Honolulu MSA (%)     | 2.7      | 2.6      | 2.6      | 2.7      | 2.7      | 2.7      | 2.8      |
| Real Personal Income (Mil 2025\$)    | 18,836.0 | 19,069.0 | 19,304.1 | 19,538.6 | 19,760.9 | 19,988.0 | 20,220.7 |
| % Change                             | 1.2      | 1.2      | 1.2      | 1.2      | 1.1      | 1.1      | 1.2      |
| Real Labor Income (Mil 2025\$)       | 9,642.2  | 9,716.9  | 9,792.6  | 9,865.7  | 9,934.4  | 10,003.3 | 10,076.2 |
| % Change                             | 0.7      | 0.8      | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      |
| Total Visitor Arrivals by Air (Thou) | 2,593.9  | 2,606.7  | 2,619.8  | 2,632.9  | 2,645.8  | 2,658.2  | 2,669.9  |
| % Change                             | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      | 0.5      | 0.4      |
| <b>PESSIMISTIC SCENARIO</b>          |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 69.2     | 69.1     | 69.0     | 68.9     | 68.8     | 68.7     | 68.6     |
| % Change                             | -0.2     | -0.1     | -0.1     | -0.1     | -0.2     | -0.2     | -0.1     |
| Population (Thou)                    | 206.7    | 206.6    | 206.4    | 206.3    | 206.2    | 206.1    | 206.0    |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     |
| Nominal Personal Income (Mil \$)     | 20,697.7 | 21,113.5 | 21,545.1 | 21,998.0 | 22,461.0 | 22,949.2 | 23,459.4 |
| % Change                             | 2.0      | 2.0      | 2.0      | 2.1      | 2.1      | 2.2      | 2.2      |
| Nominal Labor Income (Mil \$)        | 10,600.4 | 10,764.4 | 10,935.5 | 11,114.2 | 11,299.0 | 11,493.2 | 11,698.6 |
| % Change                             | 1.6      | 1.6      | 1.6      | 1.6      | 1.7      | 1.7      | 1.8      |
| Inflation Rate, Honolulu MSA (%)     | 1.7      | 1.6      | 1.7      | 1.7      | 1.8      | 1.9      | 1.9      |
| Real Personal Income (Mil 2025\$)    | 14,104.2 | 14,157.2 | 14,210.3 | 14,261.2 | 14,301.6 | 14,343.9 | 14,388.9 |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.3      |
| Real Labor Income (Mil 2025\$)       | 7,219.9  | 7,214.1  | 7,208.6  | 7,201.0  | 7,189.8  | 7,178.7  | 7,170.1  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.1     | -0.1     |
| Total Visitor Arrivals by Air (Thou) | 1,773.8  | 1,772.6  | 1,771.6  | 1,770.8  | 1,770.0  | 1,769.0  | 1,767.6  |
| % Change                             | -0.1     | -0.1     | -0.1     | 0.0      | -0.1     | -0.1     | -0.1     |

**TABLE 4: HAWAII COUNTY LONG-TERM FORECAST (CONTINUED)**

## MAJOR ECONOMIC INDICATORS

|                                      | 2059     | 2060     | 2061     | 2062     | 2063     | 2064     | 2065     |
|--------------------------------------|----------|----------|----------|----------|----------|----------|----------|
| BASELINE                             |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 76.1     | 76.2     | 76.2     | 76.3     | 76.2     | 76.2     | 76.2     |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.0      | 0.0      | 0.0      | 0.0      |
| Population (Thou)                    | 217.2    | 217.2    | 217.3    | 217.3    | 217.3    | 217.4    | 217.4    |
| % Change                             | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 40,157.5 | 41,437.5 | 42,772.7 | 44,168.1 | 45,595.8 | 47,062.1 | 48,571.5 |
| % Change                             | 3.2      | 3.2      | 3.2      | 3.3      | 3.2      | 3.2      | 3.2      |
| Nominal Labor Income (Mil \$)        | 19,943.0 | 20,496.7 | 21,075.6 | 21,673.6 | 22,274.3 | 22,893.1 | 23,535.8 |
| % Change                             | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      | 2.8      |
| Inflation Rate, Honolulu MSA (%)     | 2.4      | 2.4      | 2.4      | 2.5      | 2.5      | 2.5      | 2.4      |
| Real Personal Income (Mil 2025\$)    | 17,447.5 | 17,587.6 | 17,728.9 | 17,866.9 | 17,999.5 | 18,134.8 | 18,276.1 |
| % Change                             | 0.8      | 0.8      | 0.8      | 0.8      | 0.7      | 0.8      | 0.8      |
| Real Labor Income (Mil 2025\$)       | 8,658.1  | 8,692.4  | 8,728.0  | 8,759.3  | 8,784.5  | 8,812.6  | 8,846.4  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      | 0.3      | 0.4      |
| Total Visitor Arrivals by Air (Thou) | 2,185.5  | 2,190.0  | 2,194.5  | 2,198.8  | 2,202.8  | 2,206.7  | 2,210.3  |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      | 0.2      |
| OPTIMISTIC SCENARIO                  |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 83.9     | 84.1     | 84.3     | 84.5     | 84.6     | 84.7     | 84.8     |
| % Change                             | 0.2      | 0.2      | 0.2      | 0.2      | 0.1      | 0.1      | 0.1      |
| Population (Thou)                    | 227.7    | 227.9    | 228.0    | 228.2    | 228.3    | 228.5    | 228.6    |
| % Change                             | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.1      | 0.0      |
| Nominal Personal Income (Mil \$)     | 61,887.1 | 64,313.4 | 66,849.5 | 69,504.4 | 72,235.9 | 75,054.8 | 77,779.8 |
| % Change                             | 3.9      | 3.9      | 3.9      | 4.0      | 3.9      | 3.9      | 3.6      |
| Nominal Labor Income (Mil \$)        | 30,734.5 | 31,812.0 | 32,939.0 | 34,106.3 | 35,288.4 | 36,510.1 | 37,689.0 |
| % Change                             | 3.5      | 3.5      | 3.5      | 3.5      | 3.5      | 3.5      | 3.2      |
| Inflation Rate, Honolulu MSA (%)     | 2.7      | 2.7      | 2.8      | 2.8      | 2.8      | 2.8      | 2.6      |
| Real Personal Income (Mil 2025\$)    | 20,456.8 | 20,695.7 | 20,937.3 | 21,176.1 | 21,409.6 | 21,647.6 | 21,864.7 |
| % Change                             | 1.2      | 1.2      | 1.2      | 1.1      | 1.1      | 1.1      | 1.0      |
| Real Labor Income (Mil 2025\$)       | 10,151.5 | 10,228.6 | 10,307.6 | 10,381.7 | 10,448.8 | 10,519.6 | 10,583.3 |
| % Change                             | 0.8      | 0.8      | 0.8      | 0.7      | 0.7      | 0.7      | 0.6      |
| Total Visitor Arrivals by Air (Thou) | 2,681.2  | 2,692.3  | 2,703.1  | 2,713.6  | 2,723.8  | 2,733.6  | 2,741.2  |
| % Change                             | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      | 0.4      | 0.3      |
| PESSIMISTIC SCENARIO                 |          |          |          |          |          |          |          |
| Nonfarm Payrolls (Thou)              | 68.5     | 68.4     | 68.4     | 68.3     | 68.1     | 68.0     | 68.0     |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.2     | -0.1     |
| Population (Thou)                    | 205.9    | 205.8    | 205.7    | 205.6    | 205.5    | 205.4    | 205.3    |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | 0.0      | 0.0      | 0.0      |
| Nominal Personal Income (Mil \$)     | 23,986.6 | 24,529.2 | 25,095.8 | 25,688.6 | 26,290.9 | 26,906.1 | 27,622.8 |
| % Change                             | 2.2      | 2.3      | 2.3      | 2.4      | 2.3      | 2.3      | 2.7      |
| Nominal Labor Income (Mil \$)        | 11,912.3 | 12,133.1 | 12,365.6 | 12,605.6 | 12,843.6 | 13,088.3 | 13,385.0 |
| % Change                             | 1.8      | 1.9      | 1.9      | 1.9      | 1.9      | 1.9      | 2.3      |
| Inflation Rate, Honolulu MSA (%)     | 1.9      | 1.9      | 2.0      | 2.1      | 2.1      | 2.1      | 2.2      |
| Real Personal Income (Mil 2025\$)    | 14,434.6 | 14,480.8 | 14,527.1 | 14,570.1 | 14,607.9 | 14,647.3 | 14,717.2 |
| % Change                             | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.3      | 0.5      |
| Real Labor Income (Mil 2025\$)       | 7,163.0  | 7,156.9  | 7,151.8  | 7,143.1  | 7,129.3  | 7,117.9  | 7,123.7  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.2     | -0.2     | 0.1      |
| Total Visitor Arrivals by Air (Thou) | 1,766.2  | 1,764.6  | 1,763.0  | 1,761.4  | 1,759.6  | 1,757.7  | 1,757.6  |
| % Change                             | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | -0.1     | 0.0      |

TABLE 5: EXTERNAL LONG-TERM FORECAST

## MAJOR ECONOMIC INDICATORS

|                                     | 2024      | 2025      | 2026      | 2027      | 2028      | 2029      | 2030      |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>BASELINE</b>                     |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 23,358.4  | 23,850.4  | 24,265.0  | 24,728.7  | 25,316.9  | 25,970.0  | 26,504.0  |
| % Change                            | 2.8       | 2.1       | 1.7       | 1.9       | 2.4       | 2.6       | 2.1       |
| Japan Real GDP (Bil chained 2012\$) | 584,489.4 | 591,461.9 | 592,873.6 | 595,860.2 | 600,521.6 | 603,752.3 | 605,928.1 |
| % Change                            | -0.2      | 1.2       | 0.2       | 0.5       | 0.8       | 0.5       | 0.4       |
| <b>OPTIMISTIC SCENARIO</b>          |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 23,358.4  | 23,850.4  | 24,696.1  | 25,287.5  | 26,008.8  | 26,829.2  | 27,554.3  |
| % Change                            | 2.8       | 2.1       | 3.5       | 2.4       | 2.9       | 3.1       | 2.7       |
| Japan Real GDP (Bil chained 2012\$) | 584,489.4 | 591,461.9 | 600,965.4 | 606,336.4 | 613,207.4 | 619,103.2 | 624,199.2 |
| % Change                            | -0.2      | 1.2       | 1.6       | 0.9       | 1.1       | 1.0       | 0.8       |
| <b>PESSIMISTIC SCENARIO</b>         |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 23,358.4  | 23,850.4  | 23,834.5  | 24,113.2  | 24,529.0  | 24,998.5  | 25,344.9  |
| % Change                            | 2.8       | 2.1       | -0.1      | 1.2       | 1.7       | 1.9       | 1.4       |
| Japan Real GDP (Bil chained 2012\$) | 584,489.4 | 591,461.9 | 585,067.8 | 585,981.6 | 588,567.1 | 588,859.8 | 587,686.5 |
| % Change                            | -0.2      | 1.2       | -1.1      | 0.2       | 0.4       | 0.1       | -0.2      |

Note: Source is UHERO. US Employment for 2024 and 2025 is adjusted by UHERO to reflect population revisions by the US Census Bureau. Figures for 2026-2065 are forecasts.





TABLE 5: EXTERNAL LONG-TERM FORECAST (CONTINUED)

| MAJOR ECONOMIC INDICATORS           |           |           |           |           |           |           |           |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                     | 2038      | 2039      | 2040      | 2041      | 2042      | 2043      | 2044      |
| <b>BASELINE</b>                     |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 30,305.7  | 30,784.7  | 31,264.4  | 31,744.5  | 32,225.3  | 32,707.2  | 33,190.3  |
| % Change                            | 1.6       | 1.6       | 1.6       | 1.5       | 1.5       | 1.5       | 1.5       |
| Japan Real GDP (Bil chained 2012\$) | 615,393.8 | 616,032.7 | 616,665.4 | 617,329.1 | 618,050.5 | 618,846.7 | 619,730.9 |
| % Change                            | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |
| <b>OPTIMISTIC SCENARIO</b>          |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 32,735.5  | 33,360.2  | 33,983.3  | 34,604.7  | 35,224.8  | 35,844.3  | 36,463.5  |
| % Change                            | 1.9       | 1.9       | 1.9       | 1.8       | 1.8       | 1.8       | 1.7       |
| Japan Real GDP (Bil chained 2012\$) | 654,221.6 | 657,038.2 | 659,792.0 | 662,525.5 | 665,269.7 | 668,045.9 | 670,870.9 |
| % Change                            | 0.5       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       | 0.4       |
| <b>PESSIMISTIC SCENARIO</b>         |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 27,889.5  | 28,257.3  | 28,629.0  | 29,004.0  | 29,382.1  | 29,763.6  | 30,148.2  |
| % Change                            | 1.3       | 1.3       | 1.3       | 1.3       | 1.3       | 1.3       | 1.3       |
| Japan Real GDP (Bil chained 2012\$) | 574,392.6 | 572,679.2 | 571,027.8 | 569,469.8 | 568,026.3 | 566,709.7 | 565,528.8 |
| % Change                            | -0.3      | -0.3      | -0.3      | -0.3      | -0.2      | -0.2      | -0.2      |

**TABLE 5: EXTERNAL LONG-TERM FORECAST (CONTINUED)**

|                                     | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|-------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                     | 2045                      | 2046      | 2047      | 2048      | 2049      | 2050      | 2051      |
| <b>BASELINE</b>                     |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 33,676.7                  | 34,166.5  | 34,660.3  | 35,154.1  | 35,648.5  | 36,142.5  | 36,638.9  |
| % Change                            | 1.5                       | 1.4       | 1.4       | 1.4       | 1.4       | 1.4       | 1.4       |
| Japan Real GDP (Bil chained 2012\$) | 620,711.1                 | 621,803.7 | 623,029.6 | 624,401.2 | 625,920.1 | 627,578.3 | 629,363.5 |
| % Change                            | 0.2                       | 0.2       | 0.2       | 0.2       | 0.2       | 0.3       | 0.3       |
| <b>OPTIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 37,084.6                  | 37,708.2  | 38,334.8  | 38,960.2  | 39,585.0  | 40,208.5  | 40,833.4  |
| % Change                            | 1.7                       | 1.7       | 1.7       | 1.6       | 1.6       | 1.6       | 1.6       |
| Japan Real GDP (Bil chained 2012\$) | 673,756.0                 | 676,721.5 | 679,793.1 | 682,986.5 | 686,306.4 | 689,746.2 | 693,294.9 |
| % Change                            | 0.4                       | 0.4       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       |
| <b>PESSIMISTIC SCENARIO</b>         |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 30,537.7                  | 30,932.1  | 31,331.6  | 31,732.5  | 32,135.2  | 32,538.9  | 32,945.6  |
| % Change                            | 1.3                       | 1.3       | 1.3       | 1.3       | 1.3       | 1.3       | 1.2       |
| Japan Real GDP (Bil chained 2012\$) | 564,487.5                 | 563,597.6 | 562,875.0 | 562,327.6 | 561,953.9 | 561,743.8 | 561,683.7 |
| % Change                            | -0.2                      | -0.2      | -0.1      | -0.1      | -0.1      | 0.0       | 0.0       |

**TABLE 5: EXTERNAL LONG-TERM FORECAST (CONTINUED)**

MAJOR ECONOMIC INDICATORS

|                                     | 2052      | 2053      | 2054      | 2055      | 2056      | 2057      | 2058      |
|-------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| <b>BASELINE</b>                     |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 37,139.4  | 37,643.9  | 38,153.0  | 38,667.4  | 39,139.6  | 39,640.9  | 40,146.4  |
| % Change                            | 1.4       | 1.4       | 1.4       | 1.4       | 1.2       | 1.3       | 1.3       |
| Japan Real GDP (Bil chained 2012\$) | 631,254.4 | 633,230.4 | 635,264.9 | 637,333.4 | 639,411.5 | 641,477.4 | 643,505.4 |
| % Change                            | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       | 0.3       |
| <b>OPTIMISTIC SCENARIO</b>          |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 41,462.2  | 42,094.3  | 42,730.9  | 43,372.7  | 43,966.3  | 44,591.9  | 45,221.7  |
| % Change                            | 1.5       | 1.5       | 1.5       | 1.5       | 1.4       | 1.4       | 1.4       |
| Japan Real GDP (Bil chained 2012\$) | 696,930.7 | 700,632.8 | 704,373.4 | 708,126.4 | 711,865.8 | 715,568.2 | 719,205.6 |
| % Change                            | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       | 0.5       |
| <b>PESSIMISTIC SCENARIO</b>         |           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 33,357.2  | 33,773.1  | 34,194.2  | 34,620.7  | 35,010.1  | 35,426.3  | 35,846.9  |
| % Change                            | 1.2       | 1.2       | 1.2       | 1.2       | 1.1       | 1.2       | 1.2       |
| Japan Real GDP (Bil chained 2012\$) | 561,752.1 | 561,928.8 | 562,188.2 | 562,507.2 | 562,862.8 | 563,234.8 | 563,599.9 |
| % Change                            | 0.0       | 0.0       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       |

TABLE 5: EXTERNAL LONG-TERM FORECAST (CONTINUED)

|                                     | MAJOR ECONOMIC INDICATORS |           |           |           |           |           |           |
|-------------------------------------|---------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                                     | 2059                      | 2060      | 2061      | 2062      | 2063      | 2064      | 2065      |
| <b>BASELINE</b>                     |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 40,655.1                  | 41,166.6  | 41,681.4  | 42,200.0  | 42,720.0  | 43,241.5  | 43,763.4  |
| % Change                            | 1.3                       | 1.3       | 1.2       | 1.2       | 1.2       | 1.2       | 1.2       |
| Japan Real GDP (Bil chained 2012\$) | 645,420.6                 | 647,437.9 | 649,877.9 | 652,342.8 | 654,672.0 | 656,874.7 | 658,948.7 |
| % Change                            | 0.3                       | 0.3       | 0.4       | 0.4       | 0.4       | 0.3       | 0.3       |
| <b>OPTIMISTIC SCENARIO</b>          |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 45,854.4                  | 46,489.7  | 47,128.1  | 47,770.4  | 48,413.8  | 49,058.5  | 49,683.6  |
| % Change                            | 1.4                       | 1.4       | 1.4       | 1.4       | 1.4       | 1.3       | 1.3       |
| Japan Real GDP (Bil chained 2012\$) | 722,694.7                 | 726,276.5 | 730,312.6 | 734,358.4 | 738,233.6 | 741,948.2 | 745,050.4 |
| % Change                            | 0.5                       | 0.5       | 0.6       | 0.6       | 0.5       | 0.5       | 0.4       |
| <b>PESSIMISTIC SCENARIO</b>         |                           |           |           |           |           |           |           |
| US Real GDP (Bil chained 2012\$)    | 36,270.9                  | 36,698.0  | 37,128.5  | 37,562.9  | 37,999.0  | 38,436.8  | 38,884.7  |
| % Change                            | 1.2                       | 1.2       | 1.2       | 1.2       | 1.2       | 1.1       | 1.2       |
| Japan Real GDP (Bil chained 2012\$) | 563,892.0                 | 564,297.9 | 565,095.1 | 565,935.0 | 566,677.9 | 567,331.6 | 568,350.8 |
| % Change                            | 0.1                       | 0.1       | 0.1       | 0.1       | 0.1       | 0.1       | 0.2       |

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# **Hawaiian Electric**

## **Integrated Grid Planning**

### **Second Cycle**

## **Grid Needs Assessment & Solution**

## **Evaluation Methodology**

September 2026

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# 1 Introduction

---

## 1.1 Intent & Purpose

---

This document describes how Hawaiian Electric plans to use a suite of modeling tools in the Second Cycle of IGP (Second Cycle) to:

1. Identify the near-term quantity and timing of Grid Needs<sup>1</sup> that will drive future program development and procurement in each IGP cycle as part of the Grid Needs Assessment<sup>2</sup> over the next decade;
2. Develop resource plans to identify potential pathways to solve for near-term needs and long-term objectives such as achieving 100 percent renewable energy by 2045; and
3. Evaluate proposed solutions as part of an RFP to meet the Grid Needs defined in the Grid Needs Assessment ("GNA").

The main body of this document focuses on the overall process flow of and methodology behind the modeling and analysis, conducted in RESOLVE & PLEXOS, among other modeling tools, to derive the Grid Needs to inform solution sourcing and to evaluate or select solutions.

---

<sup>1</sup> "Grid Needs" means the specific grid services (including but not limited to capacity, energy and ancillary services) identified in the Grid Needs Assessment, including transmission and distribution system needs that may be addressed through a Non-Wires Alternative.

<sup>2</sup> "Grid Needs Assessment" means the process step in the IGP where the technical analyses are conducted to determine the generation, transmission, and distribution grid service(s) needs to serve our customers while meeting state policy objectives, reliability standards, among other goals. The Grid Needs Assessment will be presented to the Commission for review and approval.

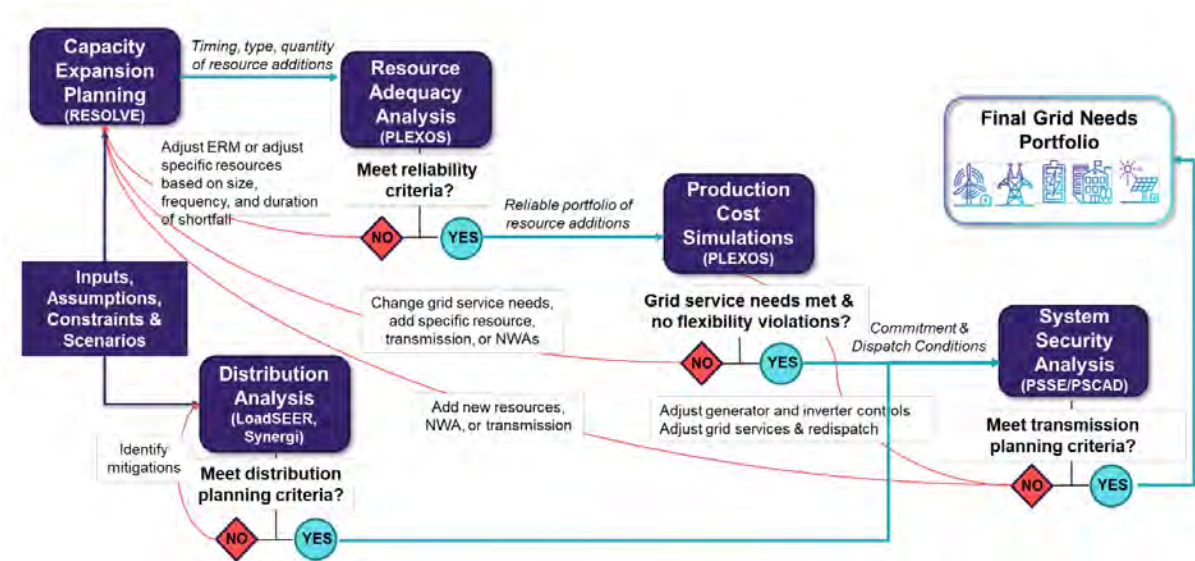


**Figure 1-1: Grid needs assessment modeling framework.**

The process flow in Figure 1-1 starts with the development of the inputs and assumptions used for the modeling analysis. These inputs and assumptions form the first review point to be reviewed by the Commission, Consumer Advocate, Technical Advisory Panel, the Parties, and stakeholders. Details are available through several documents:

- 2026 Inputs and Assumptions Workbooks, September 2026 Update<sup>3</sup> ("September I&A Update")
- 2026 Workplan, March 2026<sup>4</sup>

Once the inputs and assumptions have been established, the planning work to identify the Grid Needs starts. The inputs and assumptions feed into both the Distribution Analysis and the Capacity Expansion Planning. The portfolio of resources that are identified during Capacity Expansion Planning will be run through a Resource Adequacy Analysis to ensure that there are sufficient resources on the system to provide reliable service. Once it is confirmed that the portfolio is reliable, the portfolio will be run through a Production Cost Simulation to produce hourly generator dispatch over the planning horizon. The generator dispatch along with results from the Distribution Analysis will feed into the System Security Analysis to ensure the overall portfolio meets the Transmission Needs. Collectively, these analyses form the Grid Needs Assessment. Their results will feed into the competitive procurement process, to take place after the Docketed IGP Process. The competitive procurement process will include bid evaluations and contract negotiations with final awardees.

<sup>3</sup> Available at, <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>, latest version available under "Inputs and Assumptions".

<sup>4</sup> Available at, <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>

## 1.2 Modeling Objectives

---

The Company aims to achieve six overarching objectives to deliver reliable, clean, and cost-effective service to customers.

- Renewable Portfolio Standards
- Environmental Carbon Impact Reduction
- System Reliability
- Affordability
- Grid Resilience
- Community Impacts and Land Use

### 1.2.1 Renewable Portfolio Standards (RPS)

Hawai'i Revised Statutes (HRS) § 269-92 defines the RPS that Hawaiian Electric must meet for renewable generation as a percentage of net electricity generation of 40% by 2030, 70% by 2040 and 100% by 2045.

Table 1-1 below summarizes the varying RPS and GHG emissions goals provided by the Governor's Executive Order, the Commission's Inclinations, GHG Law, and RPS law. Hawaiian Electric proposes the outlined goals as the base assumption for the Second Cycle, reflecting our commitment to advancing Hawai'i's clean energy future. Future scenarios developed through the stakeholder process may explore a range of policy outcomes and target pathways beyond those prescribed by HRS § 269-92 and HRS § 225P-5.

**Table 1-1: Summary of RPS and GHG goals**

| Zone           | 2030                                                                                 | 2035              | 2040    | 2045                           |
|----------------|--------------------------------------------------------------------------------------|-------------------|---------|--------------------------------|
| Statewide      | 40% RPS<br>50% GHG reduction <sup>5</sup>                                            |                   | 70% RPS | 100% RPS<br>Net-zero emissions |
| O'ahu          | 60% generation from non-oil sources<br>50% GHG reduction                             | 70% GHG reduction |         |                                |
| Hawai'i Island | 60% generation from non-oil sources<br>50% GHG reduction                             | 100% RPS          |         |                                |
| Maui County    | 60% generation from non-oil sources (each island)<br>50% GHG reduction (each island) | 100% RPS          |         |                                |
| Governor's EO  | Commission Inclinations                                                              | GHG Law           | RPS Law |                                |

## 1.2.2 Environmental Carbon Impact Reduction

HRS § 225P-5 establishes a zero emissions clean economy target to sequester more GHG than emitted by 2045 and reduce statewide greenhouse gas emissions by 50% by 2030 compared to 2005 levels.

## 1.2.3 System Reliability

In addition to RPS and GHG targets, the Commission Order No. 42230 directs Hawaiian Electric shall use a 0.1 day/year loss-of-load expectation (LOLE) as the standard for planning and determining resource requirements, however this standard may change as the Hawaii Electric Reliability Administrator (HERA) works to develop recommendations for a future reliability standard.

<sup>5</sup> While statewide emissions targets in HRS § 225P-5 include all industries, they are assumed to be Hawaiian Electric targets for modeling purposes.



As noted in the Companies' comments to the HERA Resource Adequacy Working Group,<sup>6</sup> Hawaiian Electric further recommends that retaining a LOLE criterion of 0.1 days/year remain the default option to maintain the IGP schedule. An updated resource adequacy target can

be implemented for the Second Cycle, if an updated resource adequacy metric or revised LOLE criterion is established before the commencement of the modeling phase. This approach would avoid delaying portfolio modeling and stakeholder review while preserving the opportunity to evaluate potential refinements to the resource adequacy framework in parallel. In particular, island-specific review of reliability, LOLE, and cost considerations is expected to occur in parallel with the modeling effort and is unlikely to produce a new metric before the Second Cycle modeling process begins.

### 1.2.4 Affordability

The RESOLVE model will develop a resource portfolio to solve for RPS, GHG, and system reliability objectives in a least-cost manner. The model will also consider the costs of installing new resources as well as the costs of operating existing resources in the development of the resource plans. The resource plan will provide insight into resource procurement and system investment decisions needed to achieve our RPS, GHG, and reliability objectives over the near-term and long-term horizon.

### 1.2.5 Grid Resilience and Safety

Safety is uncompromised and remains a core value that guides all planning, operational, and investment decisions. The Company recognizes that reliability and resilience also play a key role in safety and are closely related and often mutually reinforcing. Many investments made to improve day-to-day system reliability, asset condition, operational awareness, and maintenance practices can also enhance resilience during major disruptive events. Accordingly, the IGP will consider resilience opportunities alongside ongoing reliability investments, including actions identified and updated through the Company's Action Plan updates and other planning initiatives.

The Company will coordinate with ongoing wildfire mitigation and risk assessment efforts to identify opportunities for wildfire-related design requirements, operational considerations, and risk reduction strategies to inform location-specific grid needs and associated planning analyses. Stakeholder input, including feedback from Critical Customer Hub initiatives on Maui, O'ahu, and North Kohala, as well as continued engagement with the Moloka'i Clean Energy Hui and other community stakeholders, may be considered in identifying resilience-related needs and priorities.

The Company recognizes two complementary dimensions of resilience: (1) enhancing the ability of transmission and distribution infrastructure to withstand disruptive events through hardening, modernization, and operational improvements; and (2) improving the ability of the electric system and affected communities to respond to and recover from major outage events. Consistent with the first IGP cycle's (First Cycle) Resilience Working Group Report, input from first responders, critical infrastructure

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<sup>6</sup> Hawaii Electric Utilities Reliability Standard and Generation Resource Adequacy Criteria Working Group, Hawaiian Electric Comments on Fourth Working Group Meeting (PC-201715, dated July 6, 2026).

providers, government agencies, and other stakeholders may be used to inform resilience-related planning needs, priorities, and potential solutions, including consideration of microgrids, distributed energy resources, and other measures that can support critical services during emergency conditions.

The IGP may also consider the effects of increasingly severe weather conditions and other climate-related risks to better understand the robustness of alternative plans and strategies under a range of future conditions.

Given the diverse nature of resilience challenges, the Company does not anticipate that a single planning framework or predefined set of solutions will be appropriate in all circumstances. Resilience needs, potential solutions, and associated benefits are often highly dependent on the specific hazard, geographic location, affected customers and communities, system conditions, implementation costs, and expected resilience outcomes. Accordingly, resilience needs and opportunities will be evaluated on a case-by-case basis using available information and stakeholder input, with the objective of identifying practical, cost-effective measures that improve both system resilience and customer benefits while supporting broader planning objectives.

## 1.2.6 Equitable

The viability of a long-term plan will depend on an assessment of the community impacts and land use in Hawaii. It is imperative that any long-term plans balance multiple state policy objectives, such as housing, energy, and food sustainability. The IGP process will be responsive to the feedback received as part of the Company's broad public engagement.<sup>7</sup>

On Jan. 13, 2026, Hawaiian Electric kicked off the CWG to strengthen communication with the public, with particular focus on communities that may be most affected by IGP outcomes. The group's priority is to promote transparency and inclusivity by ensuring diverse community perspectives, and to advise and inform Hawaiian Electric on community priorities related to reliability, sustainability and resilience. The CWG will:

- Review and provide input and feedback on planning assumptions, modeling scenarios and proposed solutions
- Advise on community engagement strategies and outreach efforts as appropriate
- Identify potential social, economic and environmental impacts of integrated grid planning decisions and REZ selections
- Recommend ways to integrate community priorities into planning outcomes

Similar to the First Cycle, the Company will continue to evaluate affordability and equity metrics like energy burden, particularly for LMI customers, and bill and rate impacts of resulting plans in the Second Cycle. Additionally, the Company recognizes that the allocation of costs and benefits associated with certain programs may raise equity considerations for both participating and non-participating

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<sup>7</sup> See <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/broad-public-engagement>

customers. Consistent with issues previously examined in DER-related proceedings, the Company will continue to consider potential cost-shifting impacts as part of the IGP evaluation.



# 2 Grid Needs Assessment Methodology

## 2.1 Overview & Purpose of Modeling Tools

The intent of the modeling objectives and characteristics described herein is to provide a transparent and detailed view of the steps needed to identify the Grid Needs for the Integrated Grid Planning process, as well as, the evaluation and optimization of solutions sourced through the Grid Needs procurement.

Through engagement with Hawaii Natural Energy Institute (“HNEI”) and the Technical Advisory Panel in the First Cycle, the Company established a modeling framework for the Grid Needs Assessment methodology. Hawaiian Electric adapted the framework presented by HNEI, as shown in Figure 2-1. This framework will continue to be used for the Second Cycle.

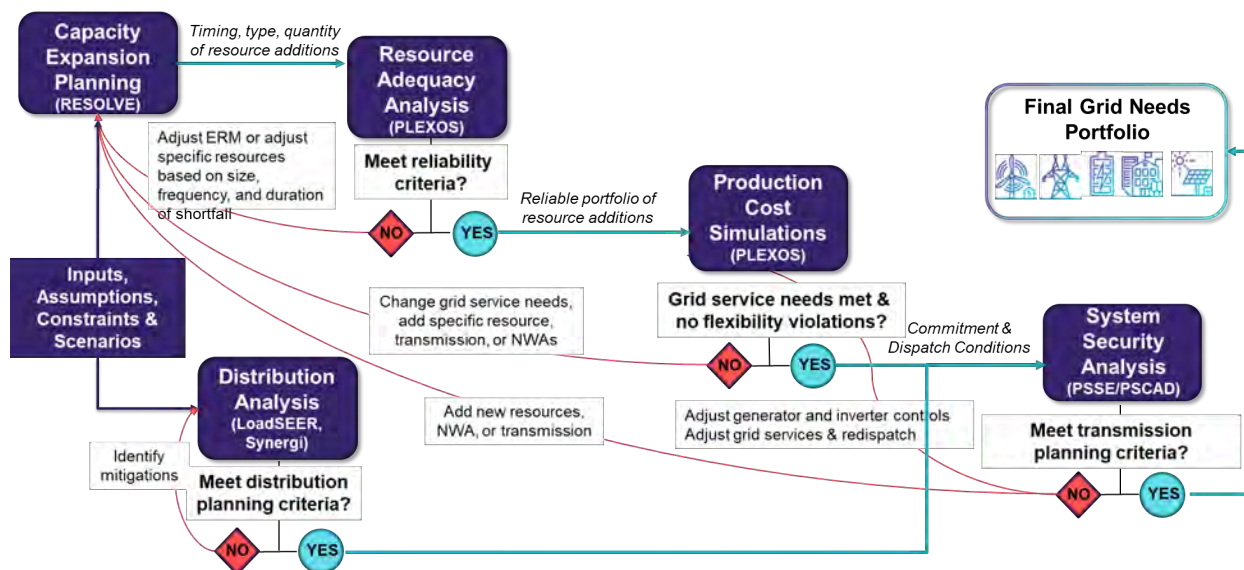


**Figure 2-1: Grid Needs Assessment modeling framework (Adapted from HNEI).**

Two models used to identify and verify the Grid Needs are the RESOLVE model and the PLEXOS model. RESOLVE produces a proposed optimized resource plan of proxy resources that can fulfill the Grid Needs. The primary objective of this phase of the process is to identify Grid Needs using proxy resources. The Grid Needs Assessment is not intended to select or express a preference for a technology; rather identify what is needed for the system and allow the market to propose solutions to meet those needs.

The reliability of the resource plan is then evaluated in PLEXOS to assess Resource Adequacy. Next, the operations of the resource plans are verified through an hourly production simulation to ensure that the Grid

Needs continue to be met on an 8760 hourly basis and to more accurately capture the annual total system costs than the directional costs captured by RESOLVE. The results of the production simulation in PLEXOS are then used as inputs for the System Security analysis. The System Security analysis will be completed in PSS/E, PSCAD, and/or ASPEN Oneliner to evaluate needs to mitigate future overload conditions and system stability issues, such as short circuit current, inertia, frequency response, voltage support, assess inverter control interactions, and weak grid/system strength issues. If the System Security step (or any of the other steps) identifies any shortfalls in the Grid Needs, the resource plan may be iterated upon to meet those residual needs. To address shortfalls in the Grid Needs, the proxy resources identified in the resource plan may be increased or accelerated from future years.

## 2.2 Modeling Framework

Each step in the modeling framework has a different objective, and different steps utilize different modeling tools in assessing the grid needs. Figure 2-2 is an overview of the objectives, key inputs, and key outputs of each modeling step and tool. Each modeling software tool is described in the following sections, including a discussion of when adjustments or iterations may be made in each step. These decisions cannot be quantified by a set of criteria. Typically, planners will use engineering judgment when making decisions to adjust or iterate a modeling step.

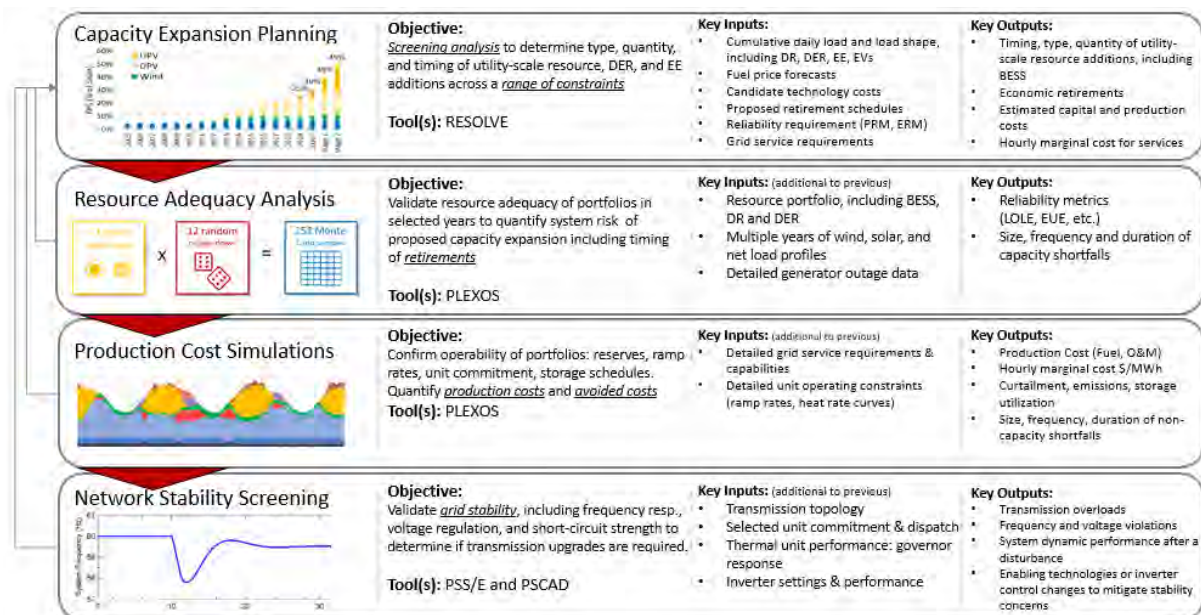


**Figure 2-2: Key inputs and outputs of modeling steps.**

As part of the Grid Needs Assessment and stakeholder process, the Company intends to continue being as transparent as possible in making decisions on adjustments or iterations. The Company intends to share the results of its modeling with stakeholders through its various stakeholder engagement groups, during which there will be opportunities for discussion and feedback. Through these discussions, the Company will decide

whether additional iterations are needed or how the results of the various cases may inform modifications to the base case assumptions to carry forward through the process. The Company will present the stakeholder feedback and the Company's recommendations to the TAP for their review and recommendations on any iterations necessary.

Ultimately this process will inform the base plan and load bookend plans, both of which will move on to the Resource Adequacy and Production Cost Simulation steps done in PLEXOS. Adjustments may be made to the plans to ensure a reliable portfolio. A review with stakeholders and TAP may take place before moving onto the System Security step. For this process to be effective and streamlined, the Company will require timely engagement of all interested stakeholders. The Company notes during this modeling review process, iterations may include changes or tweaks to modeling parameters but not changes to cost projections, forecasts, or changes that would cause additional analysis to create a new input or assumption; the bookend scenarios should be relied upon to inform what-if type of scenarios and uncertainties.

## 2.3 Scenario Design for Grid Service Needs Identification

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In the First Cycle, the planning framework took a set of base assumptions to develop a resource plan and then tested if that plan changed drastically if the assumptions were to change; for example, if the load assumption was higher. In the Second Cycle, rather than having a single Base plan, the Company is proposing a scenario framework that evaluates a range of possible futures and developing a Preferred Plan that is robust across multiple possible futures, rather than a precise plan for an uncertain future.

Currently, Hawaiian Electric is working with stakeholders to develop the unknown future scenarios to analyze in the Second Cycle. At the August 6, 2026, STWG meeting, the Company gathered feedback from stakeholders regarding factors and uncertainties that they feel will influence Hawai'i's energy future. A follow-up survey was also sent out to stakeholders asking them to provide up to three drivers.

The Company are currently soliciting stakeholder feedback regarding the priority key drivers which will then lead into the final scenarios. Specifically, stakeholders have been requested to identify drivers that may have a high impact on the energy future and have high uncertainty of occurring by September 18, 2026. Using these key drivers which have high uncertainty of occurring but could have high impact, we would then develop diverse unknown future scenarios. The Company will summarize those results and present proposed scenarios based on those results at a future STWG meeting and seek additional stakeholder input and propose final scenarios along with the evaluation framework for determining the Second Cycle's Preferred Plan. When this process is completed, the Company is planning to file a supplemental report with the proposed modeling scenarios that will be analyzed in the Second Cycle.

## 2.4 Generation Needs

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Generation Needs will be analyzed by the applicable system models. Identified needs, as described in this section, include the following services:

- Energy
- Capacity

There are three major components to inform generation needs – capacity expansion, resource adequacy, and production cost.

### 2.4.1 Capacity Expansion (RESOLVE)

The RESOLVE modeling software will be used to perform the capacity expansion step. RESOLVE identifies potential least cost portfolios that meet RPS/GHG requirements based on a user defined reliability requirement such as Energy Reserve Margin ("ERM").

RESOLVE uses statistical sampling to downscale annual data to 30 representative days per year. These representative days are weighted based on historical data to capture operational costs under most conditions. In addition to the day sampling, resources with similar operating characteristics are aggregated to facilitate efficient solving for the optimized portfolio.

For ERM, however, RESOLVE analyzes the load plus margin on an hourly basis for all years in the planning horizon. This is to ensure that while RESOLVE production costs are based on typical days, the reliability requirement meets a stricter hourly standard for all hours in the year.

Detailed inputs into RESOLVE are provided in the September 2026 Input Workbooks. Some of the primary inputs consists of load forecasts, technology adoption forecasts, fuel price forecasts, technology cost projections, generator characteristics, proposed retirement schedules, and grid service requirements.

Detailed outputs from RESOLVE include the timing, type, and quantity of resource additions to enable generating unit retirements and compliance with RPS, GHG, and other grid service requirements.

### 2.4.2 Resource Adequacy (PLEXOS)

The Resource Adequacy modeling used in both the First Cycle and the Stage 3 RFP analysis will be used for the Second Cycle. The PLEXOS modeling software will be used to complete the detailed reliability assessment. A stochastic analysis will be performed for key critical years to quantify if a portfolio meets a 0.1 days/year LOLE<sup>8</sup> requirement based on Commission guidance in Order 42230.

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<sup>8</sup> Note this standard may change as the Hawaii Electric Reliability Administrator (HERA) works to develop recommendations for a future reliability standard.



The stochastic analysis incorporates wind and solar variability, as well as, random generator outages to determine probability of unserved load. Typically, simplifications of grid operations for generating and other unit properties are assumed for these types of analyses.

Outputs from a detailed reliability analysis may include LOLE and EUE, which may be used to adjust the resource mix derived from the capacity expansion plan, or if needed, rerun the capacity expansion plan with a higher reliability requirement.

### 2.4.3 Production Cost Simulations (PLEXOS)

The PLEXOS modeling software will also be used to perform Production Cost Simulations. The objective of the production cost simulation is to confirm operability of the portfolios by modeling operation of the electric system while accounting for regulating reserves, ramp rates, unit commitment, and storage charging and discharging through economic dispatch. Total production costs are quantitative outputs of the production cost simulations.

PLEXOS will determine if a portfolio is operable on an hourly basis for every day of the year over the planning horizon. The detailed inputs in the PLEXOS model are provided in the I&A Workbooks and include full 8760 hourly profiles.

The production simulation yields high-fidelity representation of unit characteristics, grid services, system constraints, and more granular costs. Operating violations can be used to adjust or iterate reliability requirements and grid service needs for RESOLVE or specific resource changes.

## 2.5 Transmission Needs

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Transmission Needs will be analyzed by the applicable system models. Identified needs, as described in this section, include transmission grid services, are listed as following:

- Transmission Capacity
- Voltage control
- Frequency response
- System strength

There are two major components to inform transmission needs – system security analysis and Renewable Energy Zone (REZ) study, which will be guided by the Transmission Planning Criteria for each island described in Appendix E.

### 2.5.1 System Security Study

The system security analysis that occurs later in the process, shown in Figure 2-3, will be used to identify the transmission needs to maintain system reliability. This includes steady state and dynamic analysis to inform needs such as transmission capacity, inertia, short-circuit current, voltage support, and frequency response services.



The preferred procurement scenario described in Section 2.7 will undergo a more extensive system security analysis in PSS/E, PSCAD, and/or Aspen Oneliner based on the outputs of hourly PLEXOS modeling, with the intent to validate the transmission grid needs. The objective of the system security analysis is to understand the grid security and stability under a range of severe yet credible operating conditions of the preferred procurement scenario. High level system security study flowchart is shown in Figure 2-3.

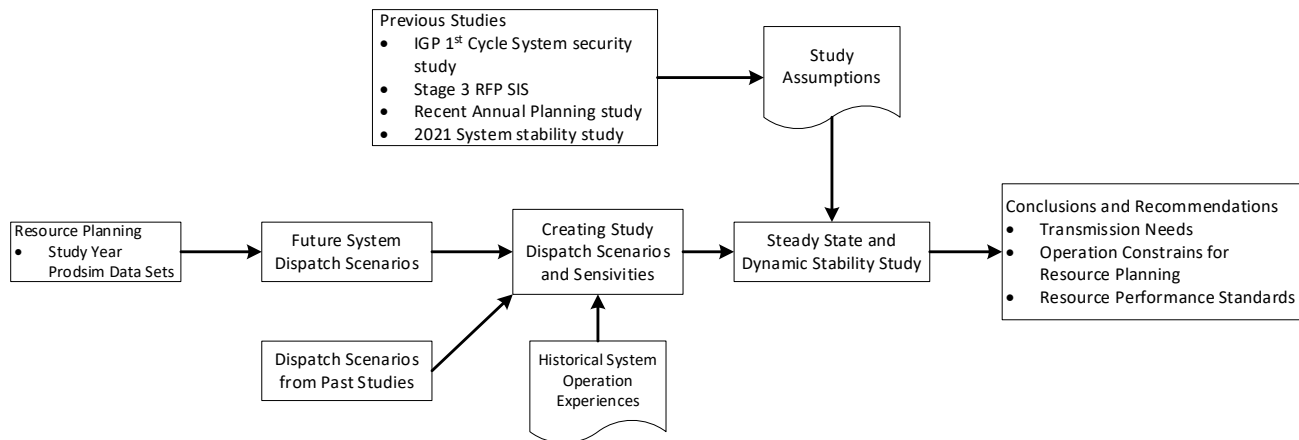


**Figure 2-3: High level flowchart of system security study.**

The system security study consists of four major steps: 1) scenario preparation, 2) assumption preparation, 3) simulations and analyses, and 4) conclusions and recommendations. In the first step, dispatch scenarios are selected to be analyzed in the system security analysis based on production simulation data generated by the PLEXOS and input from system operation. At minimum, the studied generation dispatch scenarios cover day minimum load, day peak load, night minimum load, and/or evening peak load system conditions. Consistent with the Transmission Planning Criteria, past studies are reviewed in the assumption preparation step, which generates study assumptions for the system security study. In the simulations and analyses steps, system PSS/E, PSCAD, and ASPEN/Oneliner models are created which represents both studied scenarios and planning events. From PSS/E power flow simulations and analyses transmission thermal capacity and voltage are analyzed in various planning events under different system dispatches. From PSCAD stability study, system stability condition will be reviewed. With ASPEN/Oneliner model, transmission system circuit breaker duty cycle rating is reviewed to determine if larger circuit breaker will be needed. All these analyses and identification of needs and mitigations will be performed in accordance with the Hawaiian Electric transmission planning criteria described in Appendix F, and common industry practices, as applicable.

The steady state analysis part of the system security study will identify the needs of transmission capacity and steady state voltage support to ensure that transmission element thermal loading and voltage levels are maintained within the planning criteria (including necessary margin for steady state voltage stability).

The need for voltage support also will be determined from dynamic stability study performed in PSCAD, which evaluates maintaining system capability of avoiding both under and over voltage condition, voltage instability, or even system collapse from a system event. This is also highly related with the need of system

strength. Besides voltage stability related needs, frequency stability is also investigated in the system security study. The adequacy of frequency response resource will be evaluated in the study. The need of frequency response can be filled by adding inertia, primary frequency response or fast frequency response which is determined from the PSS/E and PSCAD dynamic study results. The system security analysis will include a more detailed evaluation of varying system conditions and credible contingencies including loss of the largest generation event. The analysis will produce the following key deliverables:

- Strategies and mitigations required for safe and reliable operation of the grid based on resource portfolio(s)
- Typical and/or boundary dispatch and operational requirements for grid operation based on resource portfolio(s)
- Frequency stability, voltage stability, control stability and rotor angle stability (if applicable) performance of the future grid
- Impacts of transmission events on the distribution system and vice versa
- Evaluation of the need for grid forming technology and demonstration of system performance with this technology when and if needed for the future grid
- Evaluation of weak grid issues and development of a “weak grid” definition for each of the island grids, which includes investments or mitigation strategies to operate a grid with limited to no synchronous generation. Weak grid conditions could include low short circuit current availability, low inertia, and limited reactive power support.
- Identification of additional transmission grid services needed over the near-term 5-year planning horizon
- Roadmap of transmission needs and strategies required to achieve 100 percent renewable energy goals by 2045 based on portfolio(s) identified in the resource modeling phase

### 2.5.1.1 Grid Forming Inverter Technology

Grid Forming technology is an emerging technology that can assist in achieving system security. It is important to note that currently there is no universally accepted definition of grid forming technology. Grid forming inverters are capable of operating in grid forming mode supporting system operation under normal and emergency conditions without relying on the characteristics of synchronous machines. This includes operation as a current independent AC voltage source during normal and transient conditions (as long as no limits are reached within the inverter), and the ability to synchronize to other voltage sources or operate autonomously if a grid reference is unavailable. These capabilities will vary from manufacturer to manufacturer. However, it is expected that the grid forming inverters will enable safe and reliable grid operation when less synchronous generation is present on the grid. The grid forming inverters will also help with integrating more grid following inverters. While there are some uncertainties related to the impacts of grid forming technology, as the industry evolves and the technology matures, grid forming inverters will play a key role in achieving the 100 percent RPS goal. Thus far, grid forming technology is only commercially available for battery energy storage system (“BESS”) inverters. From the IGP first cycle system security study, it is concluded that with sufficient headroom from GFM resources, the grid stability can be maintained within planning criteria under very high penetration level of grid-scale inverter-based resources and DER.

Operating and maintaining these levels of dynamic headroom as reserves will require coordination, tools, and resources that have not been implemented yet in the industry.

## 2.5.2 Renewable Energy Zones

Renewable Energy Zones (REZ) are areas with high potential for clean energy generation, such as solar and wind, that can be connected to the system. Identification of REZ help to focus renewable energy development in areas where projects will be most efficient, cost-effective, and impactful.

In the First Cycle, Hawaiian Electric commenced a study to identify REZ on the islands of O‘ahu, Maui, and Hawaii Island. The study allowed the Company and stakeholders to get an initial understanding of the transmission upgrade options to accommodate future amounts of grid-scale renewable energy. As an example, there are high amounts of solar potential on the west and north ends of O‘ahu; however, there are currently no transmission lines in those areas. Creating a REZ by bringing out transmission lines to these areas would facilitate further development of renewable energy. These transmission requirements and cost to interconnect various renewable energy zones served as an input to the RESOLVE model.

## 2.5.3 Virtual Inertia and Fast Frequency Response Rules in RESOLVE

As part of the first cycle, the Company initially proposed an inertial and fast frequency response constraint in RESOLVE. Under this proposal, resources needed to provide sufficient inertia and fast frequency response would be selected as part of the least cost optimization in the initial capacity expansion modeling step. The intent was to potentially reduce iterations between the system security step and earlier modeling steps in the modeling framework.

Through stakeholder feedback and in considering the relatively negligible difference in cost of including these resources as constraints (see Table 2-1), the IGP first cycle adopted a proposed approach to remove the inertia and fast frequency response requirement from RESOLVE, and determine those needs through the stability studies in the System Security analysis.

**Table 2-1: Inertia Criteria Testing**

| NPV (2018\$, \$MM)                   | O‘ahu  | Hawai‘i Island | Maui  |
|--------------------------------------|--------|----------------|-------|
| Reference (with inertia requirement) | 15,772 | 2,103          | 2,471 |
| Remove Inertia Requirement           | 15,646 | 2,092          | 2,405 |
| % Difference compared to Base        | -0.8%  | -0.5%          | -2.7% |

As shown in Table 2-1, removing the inertia requirement had a negligible difference in cost over the 25-year study horizon (years 2025-2050). The Hawaii Island plan did not have any substantial differences in the resource plan. The O‘ahu resource plan built approximately 467 MW additional solar paired with 4-hr PV without the inertia requirement than with the inertia requirement; however, the cost difference between the

two plans were only 0.8%. The Maui plan built 13 MW of synchronous condensers over the 25 years in the reference plan, which led to about a 2.7% decrease in costs when the inertia requirement was removed.

## 2.5.4 Iterations Between System Security Study and Resource Planning

According to the System Security analysis methodology, selected planning events will be simulated in an electromagnetic transient simulation software or power flow software and analyzed by comparing against the transmission planning criteria to determine if there is any planning criteria violation. In this methodology, it would be more appropriate to characterize violations within a class of planning events instead of one contingency or a few contingencies. However, a violation only triggers mitigation identification and may not necessarily require a new model iteration in the IGP process. A new model iteration will only be triggered if the proposed mitigation solution passes a certain threshold and impacts the resource plan.

Early in the IGP process, the Company included an inertia and fast frequency response requirement in the capacity expansion and production simulation models. Based on stakeholder feedback, and as provided in numerous presentations to stakeholders, the Company adopted an unconstrained approach to developing the production simulation, with the objective to determine an optimized resource mix that was not biased to a certain inertia or FFR criteria. Regardless of how the resource portfolios are developed in the capacity expansion and production simulation modeling, system stability must still be maintained. As such, the stability analysis was added to the end of the process where an unconstrained resource portfolio may have issues that need to be resolved. Solutions to these issues may range from protection requirements, telecommunication requirements, setting changes to existing or future resources, additional requirements for future programs or procurements, or addressing instantaneous supply/demand balancing issues with load reductions or fast frequency response resources.

For example, should there be a requirement to manage stability by dictating a particular technology (e.g., requiring synchronous machines over inverter-based resources), modifying the size of certain resources (e.g., increasing capacity for contingency reserves), or adding dispatch constraints to avoid transmission congestion, an iteration would be required. Whether an iteration would need to be made in RESOLVE to adjust the resource plan or in PLEXOS to adjust the dispatch of certain resources would depend upon two factors: 1) Can the added requirements be modeled in RESOLVE or PLEXOS? and 2) If the requirements can be modeled, are they expected to cause a significant change in either the resource plan or dispatch, above a certain threshold that accounts for the inherent uncertainty in the long term plans? If the planning criteria violation can be resolved in a manner that does not change the resource mix or dispatch (e.g., solved in a technologically-agnostic manner, or resolved by non-generating resource changes, such as operational mitigation, protection settings update), then an iteration of the capacity expansion and production simulation models is not required.

In cases where an iteration is still required between system security and resource planning, they will likely still need to be done manually and require engineering judgement. The RESOLVE and PLEXOS models can only optimize the resource mix or dispatch when given explicit requirements. Because the resource portfolios are developed in an unconstrained manner with respect to transmission planning requirements, additional resources that provide mitigations to transmission planning criteria violations will need to be manually

inserted into the portfolio. These manual changes will be communicated through the IGP working groups such as the Stakeholder Technical Working Group, filed in writing in the IGP docket, and posted to the IGP website, consistent with Commission guidance.

Examples of typical mitigations are provided in Table 2-2 below. These mitigations and the triggers required to iterate the resource modeling process have been reviewed by the TAP and are summarized in the table below.

**Table 2-2: Example Transmission Planning Criteria Violation Mitigations**

| Examples of Mitigation Solutions Required by System Security Analysis                                                                       | Needs a new model iteration                                                                                                                                           |
|---------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Install traditional wire solutions (e.g. reconductor, cable replacement, add transformers to increase steady state capacity, add cap banks) | Maybe. Depends on capacity of wire solution; likely iterate production cost only.                                                                                     |
| Add synchronous condensers, STATCOM to address dynamic voltage support and increase short circuit current                                   | Yes.                                                                                                                                                                  |
| Short duration, temporary curtailment of a non-GFM resource                                                                                 | Maybe. Depends on magnitude, duration, and expected frequency of curtailment. E.g., >5% of expected runtime curtailed, or >5% of expected resource MWhs.              |
| Short duration, temporary charge of grid-scale GFM BESS and increase rotating machine generation                                            | Maybe. Depends on magnitude, duration, and expected frequency of charging event. E.g. event applies to >5% of expected runtime of BESS, or >5% of expected BESS MWhs. |
| Short duration, temporary increase in generation at certain locations to provide voltage support                                            | No                                                                                                                                                                    |
| Install additional centralized FFR resource                                                                                                 | Yes                                                                                                                                                                   |
| Reserve headroom on GFM or GFL resource                                                                                                     | Yes                                                                                                                                                                   |
| Increase number of inverter units to increase IBR short circuit capacity, overcurrent capacity                                              | Yes                                                                                                                                                                   |
| Retrofit a GFL resource to enable GFM function (currently only for the resources with BESS, future could be for standalone PV and wind)     | Yes, after GNA models have been modified to include GFM-related constraints/metrics. (Prior to that, iteration will not result in a different outcome.)               |
| Retrofit DER inverter ride-through settings                                                                                                 | Maybe. Depends on whether the change is expected to impact the GNA (e.g., via spinning reserve requirements) substantially enough to warrant the study.               |
| Revise Rule 14H source requirements document                                                                                                | No                                                                                                                                                                    |
| Add additional communication and control to increase capacity of controllable DER                                                           | Maybe, Depends on total capacity retrofitted.                                                                                                                         |
| Add GFM STATCOM to address system stability issue                                                                                           | Yes                                                                                                                                                                   |
| Increase circuit breaker size to host more firm generation                                                                                  | Maybe. Depends on whether firm generation capacity was previously limited in capacity planning by circuit breaker size.                                               |

| Examples of Mitigation Solutions Required by System Security Analysis                                                  | Needs a new model iteration                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Use dynamic UFLS to improve UFLS effectiveness                                                                         | No                                                                                                                                            |
| Use dual-pilot communication or other advanced protection to address high inverter penetration system protection issue | Maybe. Depends on whether protection solution impacts GNA models (e.g., by limiting dispatch of a resource, or increasing cost of a resource) |
| Add power quality filter to mitigate power quality issue                                                               | No                                                                                                                                            |
| Add individual equipment (e.g., BESS) to provide damping for system oscillation                                        | Maybe. Depends on total capacity retrofitted.                                                                                                 |

## 2.6 Distribution Needs

Distribution needs will be analyzed by the applicable system models. Identified needs include the following:

- Distribution Capacity
- Distribution Reliability (back-tie)
- DER Hosting Capacity

The major component informing the distribution needs is the location-based forecasts. The identification of distribution needs will follow the distribution planning process (Figure 2-4) summarized here and explained in more detail in the Distribution Planning Methodology in Appendix F. Two different software tools are used in the forecast and analysis portions of the distribution planning process to determine grid needs: (1) LoadSEER, an agent-based forecasting engine, and (2) Synergi software, a steady-state distribution power flow modeling tool.

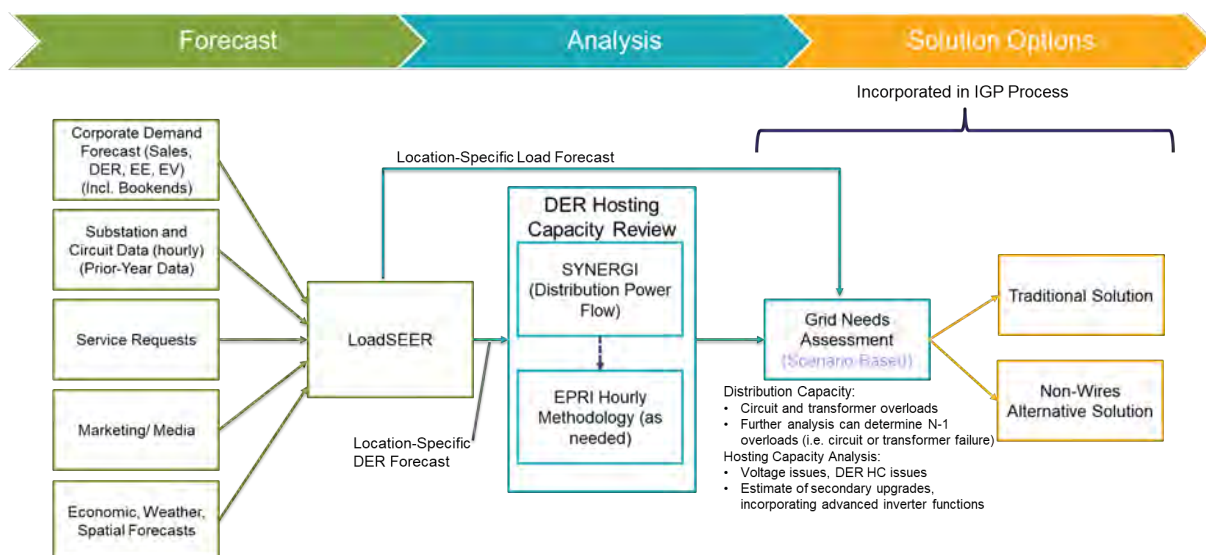


Figure 2-4: Distribution planning process.



As part of identifying distribution needs in the grid needs assessment step, the Distribution Planning Working Group (DPWG) developed a Non-Wires Opportunity Evaluation Methodology (see Appendix G) to appropriately identify the capital investments that are prime opportunities to be deferred by NWA solutions.

The framework, shown in Figure 2-5, is a three-step methodology that incorporates 1) an initial NWA opportunity screen, 2) an NWA opportunity sourcing evaluation and 3) an action plan. The initial opportunity screen is intended to quickly and simply identify “qualified” and “non-qualified” T&D opportunities based on technical requirements and timing of need. The opportunity sourcing evaluation in the second step further evaluates and prioritizes the “qualified” opportunities in terms of the grid project avoided cost (economics), uncertainty regarding timing and/or scope of need, and market potential to support a procurement. This three-step approach is based on leading practices from states in the Northeast and from California as well as stakeholder feedback tailored to Hawai‘i’s needs.



**Figure 2-5: NWA opportunity evaluation methodology**

## 2.6.1 LoadSEER

The objective of LoadSEER is to statistically represent the geographic, economic, and weather diversity across a utility’s service territory, and to use that information to forecast how circuit- and transformer-level hourly load profiles will change over the forecast horizon. Because of the complexity of the forecasting challenge, LoadSEER employs multiple statistical methods, including hourly load modeling, macro-economic modeling, customer-level economic modeling, and geospatial agent-based modeling, which taken together increase the validity and reduce uncertainty associated with the forecasts.

The bottom-up parcel level methodology used by LoadSEER is aligned with corporate-level forecasts, such that stakeholders are assured that these scenarios are grounded in a shared vision of the service territory, in aggregate. Planners can generate bottom-up scenarios (*i.e.*, high and low bookends) constrained to not exceed the corporate forecast scenarios provided by the corporate level forecasts.

Hourly customer class and feeder load shapes, distribution energy resource (“DER”) shapes, and DER forecasts are jointly overlaid within the base load and agent model growth to derive the overall forecast load profile for each circuit, such that all resource and load factors contributing to the circuit’s load at risk can be accurately assessed.

The resultant location-based forecasts are used to determine the distribution capacity and reliability needs based on the Distribution Planning Criteria in Appendix F. The forecast profiles are compared against the feeder and transformer thermal ratings to determine when an overload may occur and how much the equipment could be overloaded in normal (distribution capacity) and contingency (back tie or distribution reliability) conditions.

## 2.6.2 Synergi

As part of the location-based forecasts in LoadSEER, a DER layer is developed that is also used to determine the DER hosting capacity needs. This DER layer forecasts how much DER each distribution feeder adopts in each forecast scenario and the circuit total anticipated DER amounts are compared to the current hosting capacity limits. For circuits over hosting capacity, analysis in Synergi is performed to identify any DER hosting capacity needs and possible mitigations.

The Synergi modeling tool is a steady-state power flow software that models the equipment at the primary voltage level for each distribution substation and circuit. Although the secondary wires are not included in the model, behind-the-meter customer assets such as rooftop solar and battery energy storage are modeled and aggregated at the distribution service transformer. Stochastic and probabilistic methods are employed to identify the DER hosting capacity needs. These methods are explained in the Distribution Planning Methodology (Appendix F).

## 2.7 Grid Needs Assessment Modeling Process

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Based on Order 42230 Opening the Second Cycle of Integrated Grid Planning, the Commission adopts a five-year cadence which consists of one year of preparatory work, three years of formal docketed planning process, and one year of implementation and Commission review. Similar to the First Cycle, Hawaiian Electric will seek input and feedback from external stakeholders within the community. Hawaiian Electric also plans to seek the expertise of the TAP to provide independent evaluation of the process and results.

The resource portfolio selected at the end of each IGP cycle will form the basis for the assumptions in the next cycle. At the start of each cycle, as shown in Figure 1-1, existing resource plans and input assumptions will be re-evaluated and refreshed based on the best-available information on each island. Additionally, the Company will solicit stakeholder, Commission, and Consumer Advocate ("CA") review on these input assumptions.

### 2.7.1 Initial Scenario Analysis

In the first phase of Grid Needs Assessment, Hawaiian Electric will run RESOLVE in annual and 5-year increments through the modeling horizon (2030, 2035, 2040, 2045, 2050) to develop long-term resource portfolios based on various scenarios. The Company will seek stakeholder and TAP feedback on these initial RESOLVE portfolios.



The objective in this first phase is to understand how the various assumptions influence the portfolio of resources. Not all RESOLVE sensitivities are intended to progress into PLEXOS to evaluate reliability and production costs. Other than cost, the Company along with stakeholders will consider the objectives described in Section 1.2. For example, RPS achievement, GHG emissions reduction, reliability, community impacts and land use, and resilience. Quantifiable factors from RESOLVE such as cost, RPS, GHG emissions reduction, and reliability can be quantitatively compared to other plans or sensitivities. Community impacts and land use and resilience may require qualitative assessments by the Company and stakeholders.

## 2.7.2 Preferred Grid Needs Portfolio

The portfolios from wide range of scenarios, will be carried forward into PLEXOS, where they will be analyzed for Resource Adequacy and Production Cost Simulations. We are currently in the process of engaging stakeholders to establish a framework for defining and then evaluating the scenarios considered during the Second Cycle and selecting the Preferred Grid Needs Portfolio.

The System Security analysis will review dispatches from the Production Cost Simulation results to identify typical and boundary cases to study. Typical dispatches have common characteristics across year(s), while boundary cases would review high-IBR dispatches to test the stability of the system. In cases where planning criteria violations are identified, a high-level assessment of potential NWAs would be done to determine if the NWA is a viable solution and the Company will rely on the framework in Table 2-2 to determine if a model iteration is appropriate.

Distribution analyses will identify the infrastructure upgrades needed to accommodate location-specific load growth and forecasted additions of distributed energy resources. In parallel, the Company will evaluate potential non-wires alternatives using the Non-Wires Opportunity Evaluation Methodology. These alternatives may provide opportunities to defer, reduce, or avoid traditional investments. However, their assumed implementation should not be incorporated into the default resource portfolio before their feasibility and market availability have been established.

Unlike conventional upgrades, non-wires alternatives depend on a defined need at a specific location and time. Their viability is influenced by uncertainty in localized forecasts, the ability of the market to provide a solution with the required scale and performance, and whether the proposed solution is cost-effective compared with the traditional alternative. In the first IGP cycle, five potential opportunities advanced through the evaluation methodology and were publicized through expressions of interest. Two responses were received out of all and ultimately was not able to meet the need,<sup>9</sup> demonstrating the uncertainty associated with assuming market availability before a solicitation is completed. Accordingly, non-wires alternatives will not be assumed as a default portfolio input requiring a separate modeling iteration. Instead, the Company will continue to evaluate and procure them when appropriate, and will implement them when they provide a viable and cost-effective alternative to traditional infrastructure.

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<sup>9</sup> The Company received responses for the Kakaako/Kewalo NWA EOI and Waikoloa NWA EOI, but after further discussions the NWAs were ultimately unable to fully defer the traditional investment.

Throughout this process, the Company will continue to engage stakeholders to seek feedback and provide transparency in decision making. Similar to the First Cycle, based on stakeholder and Commission feedback, a Final Grid Needs Portfolio will be established for use in defining the Grid Needs to be used in a future RFP.

### 2.7.3 Solution Sourcing

The solution sourcing step is an integrated part of the IGP process where market-based solutions are sought to fulfill the needs identified in the grid needs assessment. The resource plans produced by the grid needs assessment provide directional guidance; however specific technologies and pricing are determined by market procurements, programs, or rate design. In competitive situations, such as procurements, the pricing of project proposals will determine the actual resource portfolio and cost – not the grid needs assessment. The actual resource portfolio will consist of projects awarded through competitive procurement for system resources (and actual pricing), customer programs for customer technologies like rooftop solar, energy efficiency, and batteries, and pricing signals to incentivize smart charging of electric vehicles to reduce overall system production and T&D costs. Although the three channels of solution sourcing are completed in separate tracks, they come back together to comprise the final portfolio as guided by the grid needs assessment.

The evaluation of the procurements, programs, and pricing are tied to the grid needs analysis through the use of the same models and assumptions used to develop the grid needs. However, instead of the proxy resources used in the grid needs analysis, actual programs or project proposals are plugged into the models. Through the evaluation process, the suite of modeling tools can determine whether the actual programs and project proposals meet the needs for reliability, system stability, among other considerations at the best fit, least cost possible. In other words, the same planning tools will be used as part of the solution evaluation process.

# 3 Solution Evaluation Methodology

## 3.1 Overview & Purpose

The Solution Evaluation phase comes after the Grid Needs Assessment phase and after solution options have been proposed by the market via competitive procurements. Solution Evaluation methodologies have evolved over the past couple of years based on the Company's experience evaluating solutions through the Stage 1, 2, and 3 RFPs, various CBRE RFPs, designing programs in the DER proceeding, and preparations for upcoming procurements such as the IGP RFP. Solution Evaluation methodologies have evolved over the past couple of years based on the Company's experience evaluating solutions through the Stage 1, 2, and 3 RFPs, various CBRE RFPs, designing programs in the DER proceeding, and preparations for upcoming procurements such as the IGP RFP. This is an evolving area and the Company will continue to work with the TAP and stakeholders, as well as Independent Observers in various procurements to inform how solutions are evaluated. This section summarizes the latest solution methods.

The two solution sourcing tracks described in this section are Programs and Competitive Procurements. They are intended to be separate means of procuring solutions that can run in parallel.

- Solutions that will be fulfilled via programs include the distributed energy resources that were included in the load forecast.
- Remaining solutions that will be fulfilled through competitive procurement and include grid-scale resources for capacity, energy, and other ancillary services.

Importantly, for programs, their contribution toward meeting Grid Needs is embedded in the resource plan as these resources are considered first as a planned part of the portfolio. Solutions to be fulfilled through competitive procurements are to account for the residual Grid Needs. Because the targets for each of these solution sourcing processes meet their own portion of the total Grid Needs portfolio, proposals for programs and competitive procurements will each be evaluated on a standalone basis within their own track and cost information from other programs or procurements may not be included. This allows each solution sourcing track to proceed expediently through the evaluation without needing to wait for the results of any of the other tracks. Any track that has unmet targets can be rolled into the next round of IGP.

## 3.2 Competitive Procurement Evaluations

Another option to evaluate solutions is through a competitive procurement to acquire resources through an all-source procurement. An example of this type of evaluation can be found in the proposed Stage 3 RFP for

the Hawai'i Island. Competitive procurements normally consist of an initial evaluation that considers price and non-price factors, a priority list that combines the price and non-price scoring, and a detailed evaluation to determine a final award group. The following is an illustrative example of a price evaluation for an all-source procurement.

### 3.2.1 Initial Evaluation of the Price Related Criteria

For the initial price analysis, the Company completes a levelized price calculation ("LP") for each project. The calculation is based on the project's proposed energy output and/or capacity and uses the project's variable and/or fixed pricing, respectively, depending on the technology being proposed.

In order to fairly evaluate solutions or proposals with different technologies and characteristics, solutions can be grouped into technology-based evaluation categories. For example, (1) Wind generation (MWh) only; (2) Wind generation (MWh) and Energy storage; (3) Solar generation (MWh) only; (4) Solar generation (MWh) and Energy storage; (5) Firm synchronous generation; (6) Aggregator generation (MWh).

The proposal with the lowest LP in each evaluation category receives maximum points. All other proposals in that evaluation category receive points based on a proportionate reduction using the percentage by which the proposal's LP exceeds the lowest LP in that evaluation category. For example, if a proposal's LP is ten percent (10%) higher than the lowest LP in that evaluation category, the proposal would be awarded maximum points minus 10%. The result of this assessment is a ranking and scoring of each solution or proposal within each evaluation category.

A priority list is determined by combining the price and non-price scoring which results in a ranking of proposals within each technology-based evaluation category. Following the price and non-price scoring, an initial pool of top scoring proposals for each technology-based category is determined.

### 3.2.2 Detailed Evaluation to Identify Proposals selected to a Final Award Group

Once a priority list is determined, the Company uses RESOLVE and PLEXOS to evaluate the total net cost (cost and benefits) of integrating and operating the priority projects onto the Company's system.

All solutions or proposals from the priority list are input into the RESOLVE model using the proposal's performance data (i.e., potential energy output, contracted firm capacity, etc.), and proposal costs (i.e., lump sum payments, capacity charge payments, energy charge payments, etc.). An optimal, least-cost resource portfolio is then selected by RESOLVE. Depending on the number of proposals on the priority list, multiple iterations may be needed.

The resource portfolio selected by RESOLVE is then evaluated in the PLEXOS model. The evaluation is based on the total net cost (and benefits) to the Company of integrating the combination of priority list proposals into the Company's System which includes:

1. The cost to dispatch the project or combination of projects and the energy and storage purchased;

2. The fuel cost savings (benefits) and any other direct savings (IPP savings from dispatchable fossil fuel savings, where applicable) resulting from the displacement of generation by the portfolio, including consideration of round-trip efficiencies for proposals with storage; and
3. The estimated increase (or decrease) in operating cost, if any, incurred by the Company to maintain system reliability

Additional analyses of the portfolio may be performed to verify other operating requirements are met (i.e. reliability).

The detailed evaluation may also include load flow analyses to determine if certain projects or combinations of projects introduce line constraints that will factor into the selection process. This is to address the possibility that even though sufficient MW capacity was identified for an individual project, projects that are in close proximity with each other could introduce additional constraints that limit capacity that is realistically available.

The detailed evaluation may consider other factors to ensure that the final combination of projects provides the contemplated benefits that the Company seeks. The Company could consider the implementation of a combination of projects, including consideration of geographic diversity, resource diversity, interconnection complexity, and flexibility and latitude of operation control of the projects.

# Appendix A. RESOLVE & PLEXOS Modeling Description

## A.1 INTRODUCTION TO RESOLVE & PLEXOS

As discussed above, the Company proposes to use the RESOLVE model, a capacity expansion model, to create resource plans for the Grid Needs Assessment phase. These resource plans would be verified by PLEXOS, which is an hourly production simulation model.

## A.2 CREATING THE RESOURCE PLAN IN RESOLVE MODEL

RESOLVE is a capacity expansion model used to determine an optimal resource plan to meet the RPS and GHG objectives and identify the required grid services needed to support the resource portfolio. The model creates a least-cost portfolio, including timing and quantity of resources, to serve the system needs of each island over a set of representative days and a multi-year horizon.

## A.3 VERIFYING RESULTS USING PLEXOS

PLEXOS is the production simulation model used by Hawaiian Electric to analyze the least cost dispatch of resources on the electric system and co-optimize resources for the provision of energy and ancillary services.

## A.4 MODELING INPUTS

RESOLVE & PLEXOS models use similar data inputs to characterize resources on the system, as summarized in the table below:

**Table A-1: RESOLVE and PLEXOS inputs.**

| Resource Category | RESOLVE Inputs                                                                                                                                                                                                                 | PLEXOS Inputs                                                                                                                                                                                                                   |
|-------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Firm / Variable   | <ul style="list-style-type: none"> <li>• <b>Fuel Inputs</b> <ul style="list-style-type: none"> <li>o Fuel type/name</li> <li>o Fuel cost (\$/MMBtu)</li> <li>o Fuel GHG content (tCO<sub>2</sub>/MMBtu)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• <b>Fuel Inputs</b> <ul style="list-style-type: none"> <li>o Fuel type/name</li> <li>o Fuel cost (\$/MMBtu)</li> <li>o Fuel GHG content (tCO<sub>2</sub>e/MMBtu)</li> </ul> </li> </ul> |

|                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                  | <ul style="list-style-type: none"> <li>o Can blend with biofuel (w/ associated cost adder) (T/F)</li> <li>• <b>Operating Inputs</b> <ul style="list-style-type: none"> <li>o Nameplate capacity (MW)</li> <li>o Unit Pmax rating (MW)</li> <li>o Unit Pmin rating (% of Pmax)</li> <li>o Unitized profile</li> <li>o Fuel burn slope (MMBtu/MW-hr)</li> <li>o Fuel burn intercept (MMBtu/hr)</li> <li>o Minimum up/down time (hr)</li> <li>o Startup/shutdown costs (\$/MW)</li> <li>o Start fuel (MMBtu/start)</li> <li>o Max ramp up/down (MW/hr)</li> <li>o Fixed O&amp;M cost (\$/kW-year)</li> <li>o Variable O&amp;M cost (\$/MWh)</li> <li>o Is Curtailable (T/F)</li> <li>o Is RPS Eligible (T/F)</li> </ul> </li> <li>• <b>Ancillary Service Capability</b> <ul style="list-style-type: none"> <li>o Regulating reserve</li> </ul> </li> <li>• <b>Capacity Expansion Inputs</b> <ul style="list-style-type: none"> <li>o Levelized capital cost (\$/kW-year)</li> <li>o New capacity limit (MW)</li> </ul> </li> <li>• <b>Miscellaneous Inputs</b> <ul style="list-style-type: none"> <li>o Must-Run (base-loaded) (T/F)</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>o Can blend with biofuel (w/ associated cost adder) (T/F)</li> <li>• <b>Operating Inputs</b> <ul style="list-style-type: none"> <li>o Nameplate capacity (MW)</li> <li>o Unit Pmax rating (MW)</li> <li>o Unit Pmin rating (MW)</li> <li>o Unitized profile</li> <li>o Heat rate (using quadratic <math>a + bx + cx^2</math> where a, b, and c inputs)</li> <li>o Minimum up/down time (hr)</li> <li>o Startup/shutdown costs (\$/MW)</li> <li>o Start fuel (MMBtu/start)</li> <li>o Max ramp up/down (MW/hr)</li> <li>o Fixed O&amp;M cost (\$/kW-year)</li> <li>o Variable O&amp;M cost (\$/MWh)</li> <li>o Is Curtailable (T/F)</li> <li>o Mark-Up (\$/MWh)</li> </ul> </li> <li>• <b>Ancillary Service Capability</b> <ul style="list-style-type: none"> <li>o Regulating reserve (20-30 minute, 1-minute)</li> </ul> </li> <li>• <b>Outage</b> <ul style="list-style-type: none"> <li>o Maintenance outage rate (%)</li> <li>o Forced outage rate (%)</li> <li>o Outage Rating Factor (%)</li> <li>o Repair time (hr)</li> </ul> </li> <li>• <b>Miscellaneous Inputs</b> <ul style="list-style-type: none"> <li>o Must-Run (base-loaded) (T/F)</li> </ul> </li> </ul> |
| Storage<br>(Paired / Standalone) | <ul style="list-style-type: none"> <li>• <b>Operating Inputs</b> <ul style="list-style-type: none"> <li>o Power rating (MW)</li> <li>o Energy capacity (MWh)</li> <li>o Charge/discharge efficiency (%)</li> <li>o Paired generator (if applicable)</li> </ul> </li> <li>• <b>Capacity Expansion Inputs</b> <ul style="list-style-type: none"> <li>o Levelized capital costs (\$/kW-year &amp; \$/kWh-year)</li> <li>o New capacity limit (MW)</li> <li>o Storage duration constraint (minimum or fixed duration for new-built capacity)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <ul style="list-style-type: none"> <li>• <b>Operating Inputs</b> <ul style="list-style-type: none"> <li>o Power rating (MW)</li> <li>o Energy capacity (MWh)</li> <li>o Charge/discharge efficiency (%)</li> <li>o Paired generator (if applicable)</li> <li>o Cycles (#/year)</li> <li>o Custom constraints (create a custom constraint/rule in PLEXOS stating that battery must only charge from paired generator)</li> </ul> </li> <li>• <b>Outage</b> <ul style="list-style-type: none"> <li>o Maintenance outage rate (%)</li> <li>o Forced outage rate (%)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |

|  |                                                                                                                                      |                                                                                                          |
|--|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"> <li>o Pairing Ratio<br/>(MW of paired supply resource / MW of paired storage resource)</li> </ul> | <ul style="list-style-type: none"> <li>o Outage Rating Factor (%)</li> <li>o Repair time (hr)</li> </ul> |
|--|--------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|

## A.4.1 LOADS & HOURLY PROFILES

While PLEXOS is a detailed production simulation that models every hour in a year, RESOLVE samples 8760-hour profiles and reduces it to a representative set of 30-40 days to reduce computation time. These days are weighted and selected based on multiple criteria—most commonly the long-run distribution of gross load, wind, solar, net load, net load ramp, and day type—to estimate the annual operating costs of the system. This sampling process is shown graphically in Figure A-1 below:

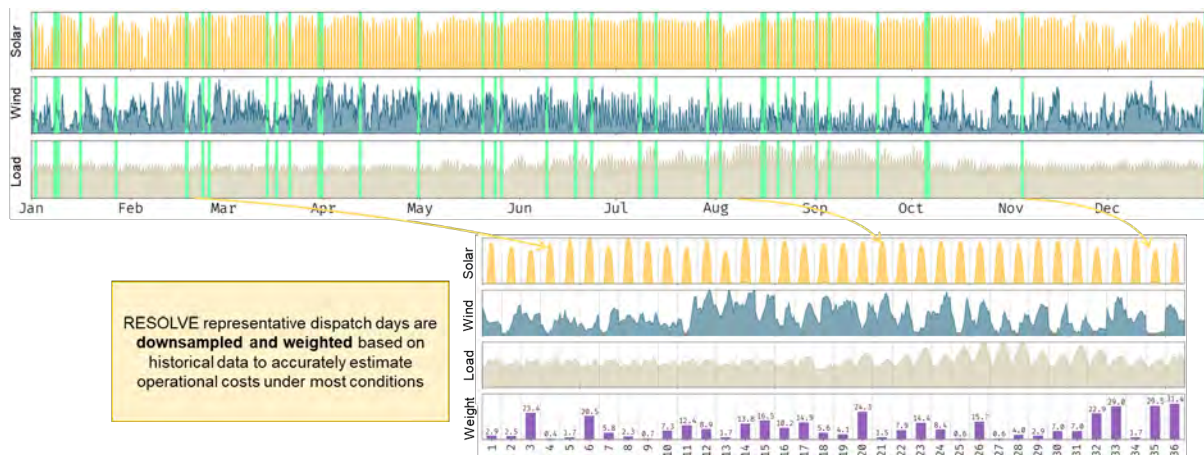


**Figure A-1: RESOLVE sampling process.**

Once the days have been selected and weighted, all hourly profiles are sampled using the representative days.

## A.5 RESOLVE OUTPUTS

RESOLVE uses a spreadsheet called the Results Tool to extract the modeling results for review and analysis. The Results Tool packages the optimized resource plan in a stacked-bar chart form, with specific MW quantities of resources, as shown in Figure A-2.



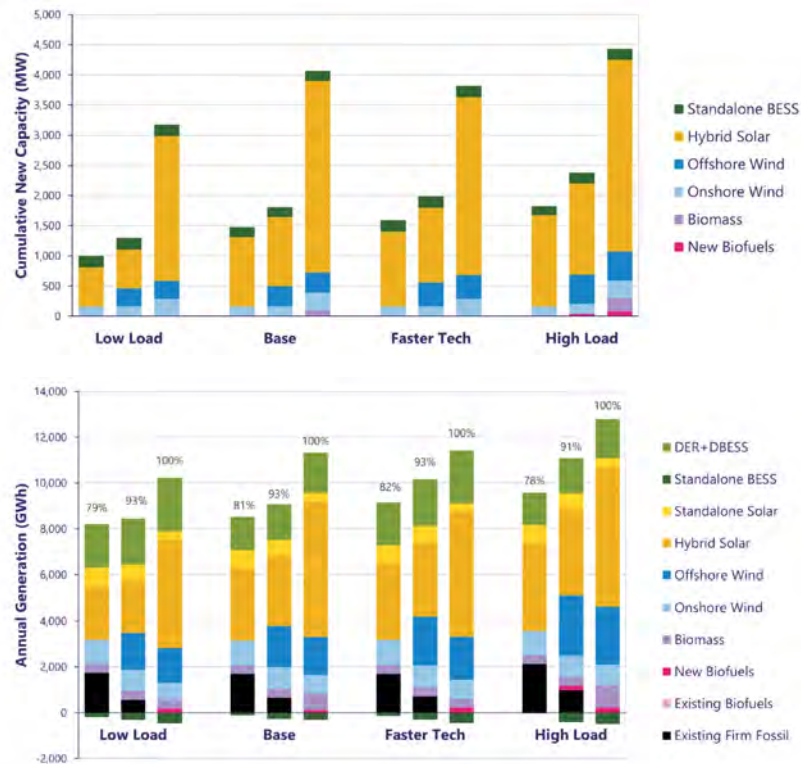


**Figure A-2: Illustrative output of RESOLVE results tool from the First Cycle.**

Various costs are also produced, including the net present value (\$MM) and annual (\$MM/year) capital cost, fixed costs, and operating costs. The costs produced by RESOLVE are used as a representative check to compare different scenarios and portfolios that are produced by RESOLVE. The actual hourly total system costs are determined after running the resource plan in the PLEXOS model, which is an hourly production simulation model. RESOLVE's resource plan is performed in increments of about 5 years for an entire 20-30 year planning horizon, using typical day-weights (not all days of the year are modeled). PLEXOS fills in the details of the proposed resource plan and includes finer tuning of the operational and system constraints.

RESOLVE also produces annual effective RPS (%/year), greenhouse gas emissions (MMtCO<sub>2</sub>/year), renewable curtailment (GWh/year), unserved energy (GWh/year), and overgeneration (GWh/year).

## A.6 PLEXOS OUTPUTS

PLEXOS generates a solution file that contains many output properties that can be examined. Each property can be examined based on intervals ranging from hourly to annually. Some of the outputs that are used to characterize a resource plan are generation, fuel costs, unserved energy, and reserve shortage.

The solution file contains the hourly energy generation (MWh) for all generators modeled on the system. The yearly energy generation of each system is used to determine system costs.

Fuel costs of the system are based on the fuel offtake of the generator multiplied by the price of that fuel. Costs for startup fuels are also included in the model but are separated to allow the use of a different start up fuel.

Unserved energy (MWh) and Shortage (MW) are important outputs that measure whether an adequate amount of grid services were made available in the model. Unserved energy is the amount of load that was not able to be served due to a lack of available resources. Shortage is the amount of reserve that was required but not by available resources.

# Appendix B. Model Input Definitions

## B.1 DEFINITIONS FOR VARIOUS MODEL INPUTS

The table below describes the various inputs that can be captured in the RESOLVE and PLEXOS models. Detailed workbooks of assumptions currently assumed in the modeling for O'ahu, Hawai'i Island, Maui, Moloka'i, and Lāna'i, are provided in the September 2026 Input Workbooks.

**Table B-1: Model input definitions.**

| Property Name           | Description                                                                                                                                         | Unit   | Category  |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------|-----------|
| <b>Generator Inputs</b> |                                                                                                                                                     |        |           |
| Bid-Cost Mark-up        | A modifier to offer price to influence the order units are dispatched. NOTE: Offer price is not actually used when calculating costs of the system. | %      | Generator |
| Mark-up                 | A modifier to offer price to influence the order units are dispatched. NOTE: Offer price is not actually used when calculating costs of the system. | \$/MWh | Generator |
| Commit                  | Number of units on a generator that must be used when it is available. NOTE: This is a fixed commitment and not minimum                             |        | Generator |
| Forced Outage Rate      | Annual expected levels of unplanned outages                                                                                                         | %      | Generator |
| Maintenance Rate        | Annual expected levels of planned outages                                                                                                           | %      | Generator |
| Heat Rate Base          | Heat rate is defined by $a + bx + cx^2$<br>This is a 'a' term of the equation                                                                       | -      | Generator |
| Heat Rate Incr          | Heat rate is defined by $a + bx + cx^2$<br>This is a 'b' term of the equation                                                                       | -      | Generator |
| Heat Rate Incr2         | Heat rate is defined by $a + bx + cx^2$<br>This is a 'c' term of the equation                                                                       | -      | Generator |
| Max Capacity            | Max power of each unit on a generator                                                                                                               | MW     | Generator |
| Max Ramp Down           | Limit on the amount that generation can decrease                                                                                                    | MW/min | Generator |
| Max Ramp Up             | Limit on the amount that generation can increase                                                                                                    | MW/min | Generator |

| Property Name            | Description                                                                                                                                              | Unit     | Category  |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------|
| Mean Time to Repair      | How long outages will take                                                                                                                               | hrs      | Generator |
| Repair Time Distribution | Distribution used to generate repair times                                                                                                               | -        | Generator |
| Min Up Time              | Minimum number of hours the unit must be run after being started                                                                                         | hrs      | Generator |
| Min Stable Level         | Unit minimum power, not including ramp-up and ramp-down                                                                                                  | MW       | Generator |
| Random Number Seed       | Random number seed assigned to the generator for the generation of outages                                                                               | -        | Generator |
| Rating Factor            | Maximum dispatchable capacity of each unit expressed as a percentage of Max Capacity                                                                     | %        | Generator |
| Start Cost Time          | Incremental cooling time over which the corresponding Start Cost applies                                                                                 | hrs      | Generator |
| Units                    | Number of installed units                                                                                                                                | -        | Generator |
| Units Out                | Number of units out of service                                                                                                                           |          | Generator |
| <b>Fuel Inputs</b>       |                                                                                                                                                          |          |           |
| Price                    | Fuel price                                                                                                                                               | \$/MMBTU | Fuel      |
| Is Available             | Flag if fuel exists                                                                                                                                      | 0 or 1   | Fuel      |
| <b>Reserve Inputs</b>    |                                                                                                                                                          |          |           |
| Is Enabled               | Flag if the reserve is enabled                                                                                                                           | 0 or 1   | Reserves  |
| Min Provision            | Minimum required reserve                                                                                                                                 | MW       | Reserves  |
| Timeframe                | Timeframe in which the reserve is required                                                                                                               | Seconds  | Reserves  |
| Type                     | Type of reserve, i.e., Raise, Reg, Replacement                                                                                                           |          | Reserves  |
| VoRS                     | Value of reserve shortage                                                                                                                                | \$/MW    | Reserves  |
| <b>Battery Inputs</b>    |                                                                                                                                                          |          |           |
| Capacity                 | Energy the battery can store                                                                                                                             | MWh      | Batteries |
| Charge Efficiency        | Efficiency of charging the battery                                                                                                                       | %        | Batteries |
| Discharge Efficiency     | Efficiency of discharging the battery                                                                                                                    | %        | Batteries |
| Initial SoC              | Initial state of charge of the battery at the start of the run                                                                                           | %        | Batteries |
| Maintenance Rate         | Expected levels of unplanned outages                                                                                                                     | %        | Batteries |
| Max Cycles Year          | Max cycles the battery is allowed to use in a year                                                                                                       | Cycles   | Batteries |
| Max Power                | Max power the battery can generate excluding inverter losses<br>i.e., If Max power is 100MW with 99% discharge efficiency, total effective power is 99MW | MW       | Batteries |
| Max SoC                  | Maximum state of charge                                                                                                                                  | %        | Batteries |
| Min SoC                  | Minimum state of charge                                                                                                                                  | %        | Batteries |
| Mean Time to Repair      | How long the outages will take                                                                                                                           | %        | Batteries |
| Random Number Seed       | Random number seed assigned to the generator for the generation of outages                                                                               | -        | Batteries |

| Property Name           | Description                                                                                         | Unit            | Category    |
|-------------------------|-----------------------------------------------------------------------------------------------------|-----------------|-------------|
| Units                   | Number of BESS units installed                                                                      |                 | Batteries   |
| VO&M Charge             | Variable operation and maintenance charge                                                           | \$/MWh          | Batteries   |
| <b>Region Input</b>     |                                                                                                     |                 |             |
| Load                    | System Load                                                                                         | MW              | Region      |
| Fixed Load              | Additional load added to Load<br>Used for different layers                                          | MW              | Region      |
| Price of Dump Energy    | Price of energy in excess of total load                                                             | \$/MWh          | Region      |
| VoLL                    | Value of unserved load<br>Usually quite high so that to deter model from<br>having unserved energy. | \$/MWh          | Region      |
| <b>Constraint Input</b> |                                                                                                     |                 |             |
| Penalty Price           | Price for violating the constraint                                                                  | \$              | Constraints |
| RHS                     | Right hand side of inequality equation                                                              |                 | Constraints |
| LHS                     | Left hand side of inequality equation                                                               |                 | Constraints |
| Sense                   | Type of inequality for constraint                                                                   | $\leq, \geq, =$ | Constraints |

# Appendix C. Capacity Planning Criteria

## C.1 ENERGY RESERVE MARGIN (“ERM”) AND HOURLY DEPENDABLE CAPACITY (“HDC”)

In the First Cycle, there was extensive discussion around our capacity planning criteria. The function of a capacity planning criteria is to establish guidelines to minimize the risk of insufficient generation capability from a diverse mix of generating resources available to the system in long-range generation expansion studies. Resource plan development is evaluated based on consistent guidelines or criteria to provide adequate generation to meet customer demand, with reasonable reserves to account for routine maintenance or overhauls of units, unexpected outages of generating units, growth in customer demand over time, and possibilities of higher than forecasted instantaneous peak demand. Because each island has an isolated electrical system, and is not interconnected to other utilities, it has been necessary to consider different planning criteria than mainland utilities.

In the First Cycle, the concept of Energy Reserve Margin (“ERM”) and Hourly Dependable Capacity (“HDC”) were introduced. There was much discussion and feedback regarding this concept. The Company even contracted E3 to do an independent analysis comparing three different planning criteria: Energy Reserve Margin (“ERM”) and Hourly Dependable Capacity (“HDC”), Energy Reserve Margin (“ERM”) and Hourly Expected Capacity (“HEC”), and Planning Reserve Margin (“PRM”) and Effective Load Carrying Capability (“ELCC”). Results of the analysis showed that these three capacity planning criteria showed similar resource capacity and cost. The final report, Hawaiian Electric Resource Adequacy Planning Methods, was filed with the Commission on April 8, 2024.<sup>10</sup>

Given that the three planning criteria showed similar results and cost, the Company will continue to use ERM and HDC along with probabilistic resource adequacy analysis, described below in C.2 Probabilistic Resource Adequacy, for the Second Cycle. In the Commission’s guidance for the next round of IGP, the Commission noted that they understood the advantage of continuing to use same capacity planning criteria in the

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<sup>10</sup> Filing F-304174 available at: <https://puc.hawaii.gov/>

Second Cycle that was used in the First Cycle.<sup>11</sup> For additional background on ERM and HDC, please see the Grids Needs Assessment Methodology report that was filed in the First Cycle.<sup>12</sup>

The Commission did provide some guidance for the Second Cycle. First, the Commission asked the Company to reassess its HDC accreditation and determine if 80% is appropriate. In response, the Company notes that E3's study showed similar results between ERM and HDC versus ERM and HEC, the difference between the 80% exceedance method for HDC and hourly historical output for the HEC method. As a result, continuing with the same process as the First Cycle and continuing with 80% seems appropriate. Second, the Commission asked the Company to re-evaluate the forced outage rates of existing thermal units. In response, starting with the 2024 Action Plan Update, the Company has updated its forced outage rate and maintenance outage rates for existing generators to account for their recent performance. The Company plans to incorporate an additional year of outage data information in the Second Cycle. Third, the Commission asked the Company to reconsider the use of a single-year hourly load shape. In response, the Company clarified in its Draft Integrated Grid Planning Second Cycle Workplan that was filed with the Commission on August 1, 2025 that for ERM, in RESOLVE, the load plus margin is modeled on an hourly basis for all years in the planning horizon.

## C.2 PROBABILISTIC RESOURCE ADEQUACY

### C.2.1 FIRST CYCLE

The probabilistic RA analysis used in the First Cycle was first developed for the Stage 3 O'ahu GNA<sup>13</sup>. We used 5 weather years, and 50 outage draws for a total of 250 samples. Only 250 samples were analyzed due to the computationally-intensive nature of a probabilistic analysis. We used a loss-of-load expectation (LOLE) of 0.1 days/year, which is commonly used in North America. While we used LOLE as our reliability target, we also reported loss-of-load events (LOLEv), loss-of-load hours (LOLH), and expected unserved energy (EUE).

We performed multiple RA analyses including adjustments to firm and variable additions, deactivation scenarios, and load scenarios. Since the First Cycle, refinements have been made during the 2024 Action Plan Annual Update to improve the analysis such as looking at recent existing generator reliability trends and including derates to more accurately reflect their performance<sup>14</sup>, but the overall methodology remained the same.

<sup>11</sup> Available at: <https://www.hawaiianelectric.com/a/16193>

<sup>12</sup> Available at: <https://www.hawaiianelectric.com/a/9995>

<sup>13</sup> Available at: <https://www.hawaiianelectric.com/a/11166>

<sup>14</sup> Available at: <https://shareus11.springcm.com/Public/DownloadNative/25256/a6894cf1-9235-ef11-b846-48df377ee718/65947521-a135-ef11-b846-48df377ee718>

## C.2.2 HERA

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In 2025, the Commission established the Hawai'i Electric Reliability Administrator ("HERA"). The purpose of HERA was to oversee the development and implementation of reliability standards and interconnection processes. Between November 2025 and June 2026, HERA has held four working group meetings. In its latest working group meeting in June 2026, HERA proposed a phased approach where changes and enhancements are made to the resource adequacy framework over time. In this phased approach, HERA recommended maintaining a LOLE target no greater than 0.1 days/year as the binding constraint in the Second Cycle, while also reporting EUE.<sup>15</sup>

## C.2.3 SECOND CYCLE

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The RA methodology for the Second Cycle will be similar to what was done in the First Cycle and the 2024 Action Plan Update. We plan to continue to use 5 weather years but increase the number of outage draws to 250 unique outage draws. The number of samples will still be 250 samples due to the time-intensive nature of past RA analysis. Based on Commission Order No. 42230 and the latest recommendation from HERA, we plan to continue targeting a LOLE no greater than 0.1 day/year as the standard for planning and determining resource requirements.

In the Second Cycle, we plan to expand on what was done in the 2024 Action Plan Annual Update. The maintenance outage rates and forced outage rates for our existing generators will now include historical performance from 2022-2024 and include derates.

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<sup>15</sup> Filing F-345934 available at: <https://puc.hawaii.gov/>



# Appendix D. Regulating Reserve Criteria

The purpose of the regulation criteria is to establish guidelines to minimize the risk of supply and demand imbalances by ensuring sufficient regulating reserves are available to the system in long-range planning studies. The methodology used during the Second Cycle is similar to the First Cycle and can be found in the Grids Needs Assessment Methodology report that was filed in the First Cycle.<sup>16</sup>

## D.1 UPDATES FOR THE SECOND CYCLE

While the overall methodology was the same as the First Cycle, there were some updates that were made in the Second Cycle, primarily around raw data gathering and assumptions for paired resources.

### D.1.1 EXPAND AND UPDATE HISTORICAL DATA TIME HORIZON

First, in the First Cycle, minutely data was collected for solar, wind, DER, and load for two years, from 2017-2018. In the Second Cycle, minutely data was collected for five years, from 2019-2023. Due to a shortage of grid-scale solar resources on Hawai'i Island and Maui from 2019-2023, data from these islands was combined with grid-scale solar data from O'ahu to create a larger data pool. Due to the lack of data on Lāna'i and Moloka'i, data from the rest of the State for grid-scale solar projects and Maui data for grid-scale wind projects were used. Lāna'i and Moloka'i also lacked minutely estimated DER generation, so net load was used in place of DER generation and gross load.

### D.1.2 USE "POWER POSSIBLE" DATA WHEN AVAILABLE

In the First Cycle, generation data was used for most solar resources. At that time, Hawai'i Island had no installed solar resources and used location-based irradiance data instead. Irradiance data is based on the weather in a certain area but isn't tied to an actual resource. Generation data is tied to an actual resource but includes curtailment and paired battery generation. During the First Cycle, paired solar resources have been installed. We believe solar data showing generation uncurtailed and unaffected by paired batteries shows the maximum energy the resource can dispatch to the system and better represents the reserves need of the system.

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<sup>16</sup> Available at: <https://www.hawaiianelectric.com/a/9995>

“Power Possible” data, which excludes curtailment and paired battery impacts, is now available for all paired and newer standalone solar resources. It’s also available for some wind resources. We will use “Power Possible” data when available and use generation data otherwise.

### D.1.3 CALCULATING THE RESERVE REQUIREMENTS

In the First Cycle, we assumed all paired generators would not count towards the regulating reserve because the paired BESS would provide the regulation for the generating resource. At the same time, because the paired BESS was providing the regulation for itself, we also assumed that the paired BESS would not provide regulation towards the system.

In the Second Cycle, we are treating paired resources the same as standalone resources. Therefore, all generators, paired and standalone, will be used to calculate the regulation. At the same time, all BESS, paired and standalone, will be able to contribute towards that regulation requirement. Shown below in Table D-1 is the assumptions used in the Second Cycle.

**Table D-1: Resources included and excluded from the calculation of regulation up and regulation down for 20-minute or 30-minute intervals.**

|                                     | Regulation Calculation<br>20 or 30-minute interval |                                               | Regulation Provision<br>20 or 30-minute interval |                                |
|-------------------------------------|----------------------------------------------------|-----------------------------------------------|--------------------------------------------------|--------------------------------|
|                                     | Included in<br>Regulation Up<br>Calculation        | Included in<br>Regulation Down<br>Calculation | Provides<br>Regulation Up                        | Provides<br>Regulation<br>Down |
| Uncontrollable Customer Resources   | Yes                                                | Yes                                           | No                                               | No                             |
| Controllable Customer Resources     | Yes                                                | No                                            | Yes                                              | Yes                            |
| Uncontrollable Grid-Scale Resources | Yes                                                | Yes                                           | No                                               | No                             |
| Controllable Grid-Scale Resources   | Yes                                                | No                                            | Yes                                              | Yes                            |

Similar to the First Cycle, all controllable resources were not included in the calculation of Down Regulation because it is assumed that our operators would be able to control these resources if an emergency arises. By not including controllable resources in calculating the Down Regulation, this prevents the need to turn on generators solely to provide Down Regulation for these controllable resources.

It is important to note that for the 1-minute time interval, it was assumed that the operator would not be able to react fast enough to control these resources in an emergency. As a result, unlike for the longer duration time-intervals, controllable resources were included in the Down Regulation calculation for the 1-minute time-interval. An update to Table D-1: for the 1-minute regulation calculation is shown in Table D-2 below.

**Table D-2: Resources included and excluded from the calculation of regulation up and regulation down for 1-minute intervals.**

|                                     | Regulation Calculation<br>1-minute Interval |                                | Regulation Provision<br>1-minute Interval |                                |
|-------------------------------------|---------------------------------------------|--------------------------------|-------------------------------------------|--------------------------------|
|                                     | Included in<br>Regulation Up                | Included in<br>Regulation Down | Provides<br>Regulation Up                 | Provides<br>Regulation<br>Down |
| Uncontrollable Customer Resources   | Yes                                         | Yes                            | No                                        | No                             |
| Controllable Customer Resources     | Yes                                         | Yes                            | Yes                                       | Yes                            |
| Uncontrollable Grid-Scale Resources | Yes                                         | Yes                            | No                                        | No                             |
| Controllable Grid-Scale Resources   | Yes                                         | Yes                            | Yes                                       | Yes                            |

# Appendix E. Transmission Planning Criteria<sup>17</sup>

The transmission planning criteria for O’ahu, Hawai’i Island, and Maui will be used in the identification of transmission needs, including system security. The Transmission Planning Criteria underwent multiple reviews by the Technical Advisory Panel dating back to 2019. The most recent TAP review and feedback that has been incorporated is included in Appendix G.

## E.1 O’AHU TRANSMISSION CRITERIA

### E.1.1 PURPOSE

The purpose of these criteria is to establish guidelines for planning the Hawaiian Electric Oahu Transmission System to ensure safe and reliable service to its customers to serve current and future system needs. These criteria also apply to facilities that interconnect to the Oahu Transmission System. The primary objectives of these criteria to maintain reliable Transmission System operation (i.e., continuity of service) include the following:

- Ensure public safety.
- Maintain system stability under a wide range of operating conditions identified in Section 1.8.4.
- Maintain equipment operating limits under a wide range of operating conditions identified in Section 1.8.4.
- Minimize losses where cost effective.
- Preserve the reliability of the existing transmission infrastructure.
- Maintain an acceptable level of impact to customers for contingencies and events as defined within this planning criteria.
- Prevent cascading outages or system failure following credible contingencies and events.

The criteria outlined below are intended to be used as a general guide in planning the Oahu Transmission System, for which transmission needs for reinforcement, enhancements, and mitigations will be determined.

<sup>17</sup> Refiling for reference, no changes from the first IGP cycle

## E.1.2 DEFINITIONS

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**Acceptable Damping:** A continuous attenuation of oscillations required to achieve equilibrium over a four-cycle period.

**Cascading:** The uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Consequential Load Loss:** All load that is no longer served by the Transmission System as a result of Transmission System Facilities being removed from service by a Protection System operation designed to isolate the fault. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Contingency:** The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Contingency Reserve:** The provision of capacity deployed by system operator to meet reliability requirements in Section E.1.8.

**Corrective Action Plan:** A list of actions and an associated timetable for implementation to remedy a specific problem. (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Distributed Energy Resources or DER:** Resources interconnected to the distribution system that produce electricity.

**Droop Response or Primary Frequency Response:** Open-loop proportional control defined as a percentage of turbine speed or system frequency divided by its rated capacity (i.e., turbine or IBR rating). For a 5% droop response, a unit operating at full speed no load or zero output will instantaneously, without any intentional time delays, issue a control signal to export 100% rated capacity for a 5% decrease in turbine speed or system frequency.

**Element or Elements:** Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An Element may be comprised of one or more components. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Equipment Rating:** The rating as defined by the equipment owner that specifies the level of electrical loading or output, usually expressed in megawatts (MW) or Mvar or other appropriate units, that a system, facility, or element can support, produce, or withstand for a finite period. The rating assumes acceptable loss

of equipment life or other physical or safety limitations for the equipment involved. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Extreme Events:** Less frequent but more severe Contingencies that could result in a cascading effect.

**Facility or Facilities:** A set of electrical equipment that operates as a single bulk electric system Element (for example, a line, a generator, a shunt compensator, transformer, etc.). (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Fast Frequency Response:** Power injected to (or absorbed from) the grid in response to changes in measured or observed frequency during the arresting phase of a frequency excursion event to improve the frequency nadir or initial rate-of-change of frequency. (Source: NERC Fast Frequency Response Concepts and Bulk Power System Reliability Needs – NERC Inverter-Based Resource Performance Task Force; March 2020)

**Inverter-Based Resource or IBR:** A resource that is asynchronously connected to the sub-transmission or Transmission System through power electronics.

**Long-Term Transmission Planning Horizon:** Transmission planning period that covers years six through ten or beyond when required to accommodate any known longer lead time projects that may take longer than ten years to complete. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Near-Term Transmission Planning Horizon:** The transmission planning period that covers year one through five. (Source: Glossary of Terms Used in NERC Reliability Standards; January 24, 2011)

**Non-Consequential Load Loss:** Load that is disconnected from the system by the utility to stabilize system frequency or voltage. Non-Consequential Load loss does not include: (1) Consequential Load Loss, (2) the response of voltage sensitive load, or (3) load that is disconnected from the system by end-user equipment.

**Planning Assessment:** Documented evaluation of future Transmission System performance and Corrective Action Plans to remedy identified deficiencies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Protection System:** Includes, protective relays which respond to electrical quantities; communications systems necessary for correct operation of protective functions; voltage and current sensing devices providing inputs to protective relays; station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply); and control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date April 1, 2013)

**Short Circuit Ratio or SCR<sup>18</sup>:** Short circuit ratio is defined as the ratio between short circuit apparent power (SCMVA) from a 3LG fault at a given location in the power system to the rating of the Inverter-Based Resource connected to that location. Since the numerator of the SCR metric is dependent on the specific measurement location, this location is usually stated along with the SCR number.

$$SCR_{POI} = \frac{SCMVA_{POI}}{MW_{IBR}}$$

Where SCMVA is the short circuit MVA level at the POI without the current contribution of the Inverter-Based Resource, and MW IBR is the nominal power rating of the Inverter-Based Resource being connected at the POI.

**Stability:** The ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or disturbances. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**System:** A combination of generation, transmission, and distribution components. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Termination:** Point at which an Element or Elements connect to a transmission bus or bay.

**Transmission System:** A network of circuits that operate at a nominal voltage of 138 kV. The Transmission System can also include sections of the 46 kV sub-transmission system as defined by these criteria.

**Weak Grid:** A transmission system that has at least one transmission node with a calculated short circuit ratio of less than 3 (i.e.,  $SCR < 3$ ).

### E.1.3 TRANSMISSION SYSTEM DEFINED

For the purpose of these criteria, the Transmission System is defined as all transmission lines, substation equipment, structures, and land utilized for transporting power at 138 kV and above. In addition, the following 138-46 kV transformers, 46 kV buses, and 46 kV circuits are part of the transmission system.

- Honolulu-School No. 1 and No. 2, 46 kV circuits.
- Honolulu-Iwilei No. 1 and No. 2, 46 kV circuits.
- Iwilei-School 46 kV circuit.
- School Street 48/80 MVA, 138-46 kV Transformers A and B.
- Iwilei 48/80 MVA, 138-46 kV Transformers A and B.

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<sup>18</sup> NERC Reliability Guidelines, December 2017 - Integrating Inverter Based Resources into Low Short Circuit Ratio Systems

- Waiau 48/80 MVA, 138-46 kV Transformers A and B.
- Honolulu 46 kV Buses A and B.
- Waiau 46 kV Buses A and B.
- School 46 kV Buses A and B.
- Iwilei 46 kV Buses A and B.

### E.1.3.1 Crossing Points

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All transmission line crossing points are to be considered while planning the Transmission System. Following is a list of known crossing points.

- 1) Halawa-Makalapa and Waiau-Koolau 1 & 2 (just outside of Halawa Sub)
- 2) Kahe-Halawa No. 1 and Waiau-Wahiawa (between Structures 21 and 22)
- 3) Kahe-Halawa No. 2 (Structure 85) and Waiau-Wahiawa (Structure 26)
- 4) Waiau-Koolau 2 and Waiau-Wahiawa (between Structures 18 and 19)

The following line crossings are partially protected by an “apron,” which is designed to prevent lines from coming into contact upon conductor failure at their supported ends. This factor should be considered prior to initiating projects related to eliminating these line crossings.

- 5) Waiau-Koolau 1 & 2 and Halawa-Iwilei (just outside of Halawa Sub)
- 6) Waiau-Koolau 1 & 2 and Halawa-School (just outside of Halawa Sub)

## E.1.4 TRANSMISSION PLANNING CRITERIA – THERMAL LIMITS

---

At a minimum, the O’ahu system shall meet the performance requirements specified by Planning Events P0 through P4 in Section E.1.8. In addition, the O’ahu Transmission System shall meet the following steady-state performance requirements:

- 1) With any generating unit offline for maintenance, all Transmission System Elements will operate within their NORMAL ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
  - o Any other generating unit or IBR that is deemed as a single Contingency equivalent
  - o Any synchronous condenser or IBR equivalent
  - o Any transmission circuit
  - o Any transmission transformer
  - o Any transmission bus
- 2) With any generating unit offline for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any multiple transmission circuit outages caused by a line down at a crossing point.



- 3) With any generating unit offline for maintenance, and any transmission line out of service for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
- o Any other generating unit or IBR equivalent
  - o Any synchronous condenser or IBR equivalent
  - o Any other transmission circuit
  - o Any multiple transmission circuit outage caused by a line down at a crossing point
  - o Any transmission transformer
  - o Any transmission bus

The purpose of this criterion is to ensure the system will remain stable but all loads may not continue to be served. These conditions must be met without operator intervention.

- 4) Any generating station must be able to export real and reactive power equal to the sum of the individual generating unit's NORMAL capability ratings in MW at 100 percent of rated generator field current /power factor with no Transmission System Element loading exceeding its EMERGENCY rating while maintaining voltage levels within their upper or lower limits for any of the following outages:
- o Any transmission circuit
  - o Any multiple transmission circuit outage caused by a line down at a crossing point
  - o Any transmission transformer
  - o Any transmission bus

Additionally, for any transmission Element outage, the aggregate generating capacity on any remaining radial transmission circuit will not exceed the maximum single-point failure for the system.

- 5) With the Transmission System intact, the failure of any single transmission Element, coupled with a 138 kV breaker failure while attempting to clear the initial failure, will not result in the loss of:
- o More than one generator or IBR Termination
  - o More than one sub-transmission transformer Termination
  - o More than one "source" circuit to a transmission station Termination
- 6) With two 138 kV transmission circuits on common steel poles taken out of service at the same time for maintenance, all Transmission System Elements will operate within their NORMAL ratings while maintaining voltage levels within their upper or lower limits. This is a maintenance requirement based on present maintenance practices.

The 138 kV system is the backbone of the O'ahu electrical system. Excessive segmentation of a 138 kV transmission line can result in increasingly complex protection coordination schemes, greater susceptibility to mis-operation of relays, maintenance and operational issues, and excessive curtailment of resources for

certain transmission line contingencies. The total generation on any transmission line must be limited to the single-point failure capacity of the system. Generating Facilities should interconnect to an existing substation if practical or interconnect to multiple transmission lines through a new standard transmission substation.

## E.1.5 LOADING LIMITS

Conductor loading limits are based on the Overhead and Underground Engineering Standards or by ampacity calculations performed by Engineering. Operational planning mitigations that utilize operator interventions within the duration of allowed Equipment Ratings are not governed by this transmission planning criteria.

### E.1.5.1 Power Transformer Loading Limits

Loading limits of transmission power transformers shall be as follows:

- 1) The normal loading limit of a transmission power transformer shall be its zero percent loss-of-life kVA capability.
- 2) The emergency loading limit of a transmission power transformer shall be its one percent loss-of-life kVA capability.
- 3) The extreme emergency loading limit of a transmission power transformer shall be 200 percent of its maximum nameplate rating.

Loading limits shall be determined in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise.

### E.1.5.2 Current Carrying Capacity

#### Overhead

Conductors for overhead transmission lines shall be considered to have current carrying capacity in accordance with Engineering Standard 1-2038, "Current Carrying Capacity Outdoor Bare Conductor." A conductor bundle with identical conductors shall have the rating of a single conductor multiplied by the number of conductors per phase in the bundle.

#### Underground

The 46 kV underground circuit ampacities are:

**Table E-1: 46 kV underground ampacities.**

| CIRCUIT | NORMAL | EMERGENCY "A" | EMERGENCY "B" |
|---------|--------|---------------|---------------|
|---------|--------|---------------|---------------|

|                    |          |          |           |
|--------------------|----------|----------|-----------|
| Honolulu-Iwilei #1 | 320 Amps | 523 Amps | 536 Amps  |
| Honolulu-Iwilei #2 | 320 Amps | 526 Amps | 563 Amps  |
| Honolulu-School #1 | 300 Amps | 532 Amps | 534 Amps  |
| Honolulu-School #2 | 300 Amps | 553 Amps | 551 Amps  |
| Iwilei-School      | 250 Amps | 503 Amps | 403 Amps* |

\*Assume all circuits in the same duct bank of Iwilei-School circuit are energized.

The Emergency "A" rating is based on one Honolulu-Iwilei circuit out of service. Emergency "B" rating is based on one Honolulu-School circuit out of service.

## Open Bus

Open buses shall be considered to have current carrying capacity in accordance with Engineering Standard, 1-2039, "Current Carrying Capacity- Outdoor Open Bus."

## Power Transformer Equipment

Transmission power transformer connections, switches, protective relays, and current transformers shall be designed to allow the power transformer to carry 200 percent of maximum nameplate rating under extreme emergency conditions in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise. (The relay settings associated with this type of transformer shall allow the transformer to carry 200 percent of maximum nameplate rating.)

## Substation Equipment

Switches, disconnects, circuit breakers, and associated equipment shall be considered to have a current carrying capacity equivalent to their respective nameplate current rating.

### E.1.5.3 Generator MVAR Loading Limits

For planning purposes, the reactive capability of a given machine will be determined using the manufacturer's machine capability curve and normal MW at rated power factor for generating units. At no time will the system be planned with any generator or IBR exceeding its rating as determined by its capability curve corresponding to the appropriate ambient temperature suitable for the O'ahu system.

## E.1.6 VOLTAGE LEVELS

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Transmission voltage levels shall be kept within the prescribed limits for any condition for which the Transmission System is planned. These limits apply after automatic corrective action has been taken by LTC and/or switched capacitors.

The maximum voltage limits are based on *Standards for Electric Utility Service in the State of Hawaii* (General Order No.7).

- 1) 138 kV System. For any system operating condition, the voltage at any 138 kV bus shall not exceed 145 kV.
- 2) 46 kV System. For any system operating condition, the voltage on the 46 kV system shall not exceed 48 kV.

The minimum voltage limits are based upon maintaining customer voltages in accordance with *Standards for Electric Utility Service in the State of Hawaii* (General Order No.7). To accomplish this, the 46 kV bus voltages at the transmission substations must be maintained within the limits that are used to plan the sub-transmission system.

- 1) 138 kV System. The minimum allowable voltage on any 138 kV bus is 126.5 kV for any operating condition for which the transmission system is planned.
- 2) 46 kV System. The minimum allowable voltage on any 46 kV bus is 45 kV for any operating condition for which the system is planned.

The system's short-circuit current requirements and resources should be considered when evaluating near-term voltage and MVAR mitigation alternatives.

## E.1.7 SYSTEM STABILITY

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Displacement of synchronous generation has a direct impact on dynamic and transient stability. In addition to traditional analyses, new planning metrics and analysis are required to maintain Stability under plausible operating conditions. If the conditions for Weak Grid are met, further analysis may be required in appropriate software modeling platform to fully investigate any Stability concerns.

### E.1.7.1 Steady State Voltage

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The power-voltage (PV) and reactive power-voltage (QV) analysis shall be performed to determine the steady-state voltage stability of critical load buses.

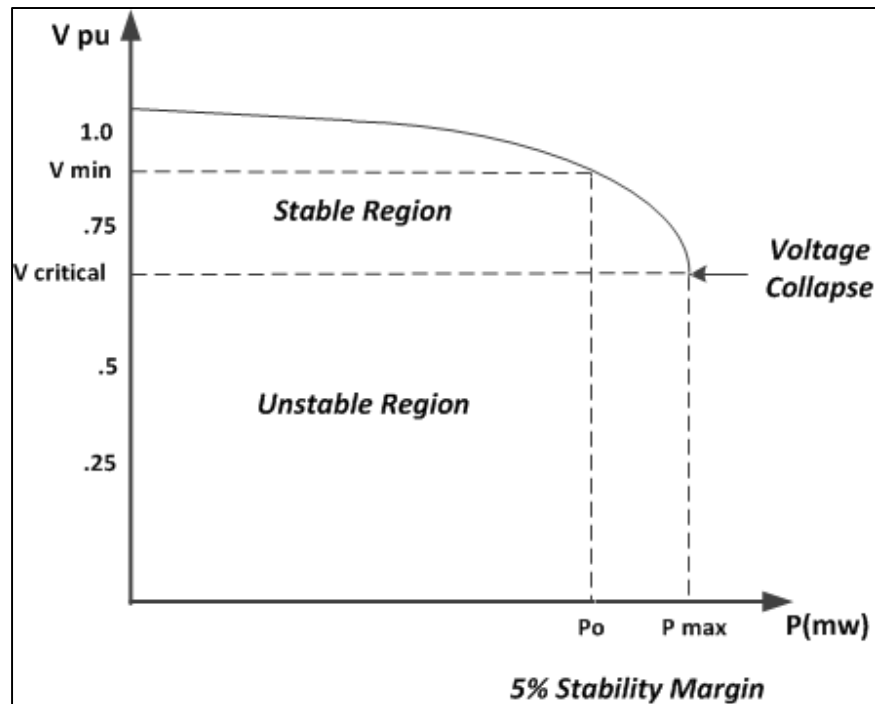


**Figure E-1: Typical PV curve.**

Figure E-1 shows a typical PV curve that depicts the thermal limit of the transmission system. To ensure voltage stability, a 5% margin from  $P_0$  to  $P_{max}$ , identified as  $P_0$ , shall be maintained under planning events described in Section E.1.8. In addition, the intersection of the QV curve with the x-axis shall occur above the minimum allowable voltage level, and the reactive power margin, represented by the value at the minimum point of the QV curve, shall be greater than the size of a nearby capacitor bank or reactive power device.

### E.1.7.2 Weak Grid Assessment

Weak power systems are more susceptible to voltage transients and can be exacerbated by control instabilities. Short circuit ratio (SCR) is the most basic metric to assess the relative strength of an electrical system for a specific area when evaluating performance of a specific IBR<sup>19</sup>. For system planning purposes, a more appropriate quantity is the weighted short circuit ratio (WSCR)<sup>20</sup>, defined by:

$$WSCR = \frac{\sum_i^N SCMVA_i * P_{RMW_i}}{(\sum_i^N P_{RMW_i})^2}$$

<sup>19</sup> NERC Reliability Guideline – Integrating Variable Energy Resources into Weak Power Systems

<sup>20</sup> Elextrix, System Strength Assessment of the Panhandle System, Electric Reliability Council of Texas, 2016

Where  $SCMVA_i$  is the short circuit capacity at bus  $i$  and  $P_{RMWi}$  is the MW rating of the IBR;  $N$  is the number of total IBR fully interacting with each other and  $i$  is the IBR index. The WSCR takes into account the aggregate IBR of the system to ensure the system has sufficient short circuit current for transient voltage stability. There is currently no industry standard for WSCR of a transmission system.

## Control Stability

Control stability refers to the behavior of grid-connected IBR like wind and solar PV plants to operate in a stable manner for both small disturbances and large disturbances on the grid over a wide range of operating conditions and disturbances. Unstable behavior can result in oscillatory behavior, extreme overshoots in voltage or current, and/or a failure to ride-through a disturbance. The stability of equipment controls is impacted by many factors, including equipment tuning, operating conditions, grid strength, disturbance types, and the electrical proximity to other IBR or synchronous machines on the grid, among others.

As more IBR with complex control system connect to the system, it is important to assess the control stability of these resources to assess the robustness of controls to the range of expected operating conditions over the planning horizon. This will be done through a combination of screening, scenario modeling, and testing/demonstration of performance. As such, supplying accurate and sufficiently detailed models of equipment and functional descriptions of equipment control and protection schemes is necessary well in advance of interconnection. Equipment performance will be evaluated for combinations of:

- Full and partial power operating conditions, high and low voltages (within continuous limits)
- Symmetric and asymmetric fault disturbances (with reclosing), line switching disturbances, loss of generation and load disturbances
- Low grid strength conditions

The system shall maintain operating equilibrium with acceptable damping ratio of 3% for all reasonable combinations of planned outages and system contingencies defined in Section 8.4. Power oscillations exhibit an acceptable damping ratio of 3% when the oscillation magnitude decreases by 17% over the first period of oscillation, or by 53% over four periods of oscillations.

### E.1.7.3 Rotor Angle Stability Criteria

Rotor angle stability simulations involve the evaluation of critical clearing times ("CCT") for close-in faults to generating stations, generating units, and transmission lines. Generator rotor angle deviation with respect to a "distant" generator shall be less than 180 degrees to prevent generator pole-slipping and in addition to avoiding loss of synchronism. Dynamic performance shall exhibit acceptable damping to ensure rotor angle stability. Pole-slipping could impose mechanical stresses on the generator shaft and could result in catastrophic failure of the unit.

## Critical Clearing Times

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The Transmission Planning Department performs Stability simulations using the standard fault clearing times for breakers provided by the System Protection Department. If a fault event results in a planning criteria violation, the Transmission Planning Department shall determine the CCT for that event and will provide it to the System Protection Department for its review and feedback. If the CCT cannot be achieved by the existing protective devices, Transmission Planning Department will work with System Protection Department to develop appropriate mitigation measures. Such mitigation measures may include but not limited to the system protection upgrade, generator size or power export reduction, application of synchronous condenser or adjustments to resource commitment as applicable.

### E.1.7.4 Frequency Stability

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Frequency stability is determined by 1) the amount of inertia on the system; 2) the amount and response characteristics of fast-frequency and primary frequency response reserves on the system; and 3) the magnitude of the generation Contingency. The system shall carry sufficient, fast and timely delivered frequency response (including some combination of rotating machine inertia, frequency response reserves, and inverter-based frequency response capabilities) to mitigate credible contingencies, including expected aggregate loss of distributed energy resources in response to the Contingency events in Table E-3, with appropriate Non-Consequential Load Loss criteria defined in E.1.8. In order to meet these criteria, mitigation measures may require establishing minimum inertia requirement for a generation loss event.

### E.1.7.5 Planning Criteria for Stability

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Stability of an electric power system is the attribute of the system to regain a state of operating equilibrium after being subjected to disrupting forces (Contingency events), such that the majority of the system remains intact. Generating units and transmission Elements must remain online and in synchronism with the system to prevent an island-wide blackout. Therefore, the Transmission System shall be tested by simulating frequent Contingency events and reasonable cascading Contingency events that may occur on the system to ensure operating equilibrium is restored.

- 1) For the more frequent types of contingencies listed below, not more than one generating unit can disconnect from the system, all remaining generating units must remain connected and synchronized to the system, all remaining generating units must participate towards beneficial system response, no circuits should trip on stability swings, transient voltage stability must be maintained, and no Non-Consequential Load should take place.
    - o Normally cleared, three-phase faults on transmission lines with automatic reclosing as applicable to the circuit being analyzed.
    - o Delayed clearing of three-phase faults due to failure of the pilot relay on circuits that have one pilot scheme, and one step-distance scheme for backup to the pilot scheme. Dual-pilot
-

- relay schemes require independent communication technologies (e.g., both microwave and fiber-optic cable) to mitigate failure of single-pilot relay schemes. Analysis shall be performed for the simulation of the longest delayed clearing time scenario.
- o Delayed clearing of single line-to-ground faults due to failure of a circuit breaker to open.
  - o Normally cleared simultaneous single line-to-ground faults on both circuits that share a common tower (on different phase of each circuit).
  - o Exceptions include small units (e.g., internal combustion engines) that share a common generator step-up transformer and combined-cycle units. Other exceptions will be considered on a case-by-case basis.
- 2) For the less frequent contingencies listed below, Non-Consequential Load Loss or generator tripping may be required to prevent equipment damage and maintain Stability.
- o Sudden loss of all transmission lines emanating from a power plant switching station.
  - o Sudden loss of all transmission lines in a common right-of-way.
  - o Sudden loss of any combined cycle units or any two synchronous generating units (synchronous, asynchronous, or both), including any aggregate loss of DER.
  - o Sudden loss of any combination of two transmission Elements.
  - o Cascading loss of generation
- 3) Extreme Events—For Extreme Events system preservation shall be tested. An objective of the planning process should be to minimize the likelihood and magnitude of Non-Consequential Load Loss following Contingency events. If any Extreme Events result in an island-wide blackout, mitigation measures shall be formulated and analyzed to see if a reasonable solution can be implemented. Examples of Extreme Events include but not limited to:
- o A three-phase fault on generator, transmission circuit, transformer or bus section with stuck breaker resulting in delayed fault clearing
  - o A three-phase fault on generator, transmission circuit, transformer, or bus section with failure of a non-redundant component of a Protection System resulting in delayed fault clearing
  - o Three phase internal breaker fault
  - o Other events based upon operating experience, such as consideration of initiating events that experience suggests may result in wide area disturbances.

## E.1.8 TRANSMISSION PLANNING ASSESSMENT

A Planning Assessment of the Transmission System must be performed on an annual basis to ensure compliance with these criteria for the Near-Term Planning Horizon and Long-Term Planning Horizons. This Planning Assessment must use current models to analyze steady-state, dynamic, and transient system stability to ensure compliance with these criteria. Updated assumptions, forecasts, and study results shall be summarized and documented in a report.



### E.1.8.1 Near-Term Transmission Planning Horizon

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The Near-Term Transmission Planning Horizon should assess a five-year period and evaluate year one, year five, and any other year in between that has a significant system change, e.g., the planned addition or deactivation of a generating unit, the addition of a transmission line, etc. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load
- Night minimum load

Base cases may include consideration of each major unit outage period. Sensitivity cases may include consideration of system conditions and operating periods beyond the conditions listed above.

For each of these periods, only the applicable Stability analysis and system events shall be performed. Additional sensitivity cases and/or analyses should be performed on an as-needed basis to ensure system performance meets the Stability criteria specified in Section E.1.7, and may be informed by identified operational constraints.

The Planning Assessment should periodically analyze cascading Contingency events to ensure preservation of the system for plausible planning events. As a minimum, the system shall meet performance requirements of Planning Events P5 through P7 from Table E-3.

### E.1.8.2 Long-Term Transmission Planning Horizon

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The Long-Term Transmission Planning Horizon should be performed in conjunction with the Integrated Grid Planning process. Evaluation years will be dictated by the proposed resource plans. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load
- Night minimum load

For each of these periods, only the applicable Stability analysis and system events shall be performed. Models of future generating units will not be readily available; therefore, discretion should be used in: 1) developing the scope of work and sensitivity cases for this Planning Assessment, and 2) interpreting results of these analyses.

### E.1.8.3 Past Studies

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Past studies may be used to support the Planning Assessment if they meet the following requirements:

For steady state, short circuit, or Stability analysis:

- The study must contain a technical rationale that can be provided to demonstrate that the results of an older study are still valid, or
- No material changes have occurred to the system represented in the study. Documentation to support the technical rationale for determining material changes must be included.

### E.1.8.4 Planning Events

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As a minimum, the Stability criteria in Section E.1.7 ensures that the transmission system meets or exceeds the performance requirements of Planning Events P1 through P4 in Table E-3. A periodic assessment of the under- frequency load shed scheme should be performed to ensure that the system meets the minimum requirements of Planning Events P5 through P7 in Table E-3.

**Table E-2: Steady state and stability performance planning events.****Steady State & Stability:**

1. The system must remain stable. Cascading and uncontrolled islanding shall not occur.
2. Consequential Load Loss as well as generation loss is acceptable as a consequence of any event excluding P0.
3. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event.
4. Simulate normal clearing unless otherwise specified.
5. Planned system adjustments such as transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Equipment Rating.
6. Phase angle separation for line Contingency shall not preclude automatic reclosing unless system adjustments can be performed within fifteen minutes.

**Steady State Only:**

7. Applicable Equipment Rating must not be exceeded.
8. System steady state voltages and post-Contingency voltage deviations must be within acceptable limits as established by this Planning Criteria.
9. Planning event P0 is applicable to steady state only.

**Table E-3: Categories of contingency events.**

| Category                 | Initial Condition                                                                               | Event                                                                                                                                                              | Fault(s) Type | Non- Consequential Load Loss Allowed |
|--------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------|
| P0<br>No Contingency     | Normal system                                                                                   | None                                                                                                                                                               | N/A           | None                                 |
| P1<br>Single Contingency | Normal system                                                                                   | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device-Ancillary Service Device <sup>3</sup>  | 3Ø            | None                                 |
|                          |                                                                                                 | 5. Generator – no fault                                                                                                                                            | N/A           |                                      |
| P2<br>Single Contingency | Normal system                                                                                   | 1. Bus Section fault<br>2. Internal Breaker Fault <sup>4</sup> (Transmission line breaker)                                                                         | 3Ø            | None                                 |
| P3<br>Single Contingency | Loss of generator unit followed by system adjustments (e.g., corrective action and re-dispatch) | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device/ Ancillary Service Device <sup>3</sup> | 3Ø            | None                                 |

| Category                                                                                                  | Initial Condition                                                                                                                             | Event                                                                                                                                                                                                                                                                                                       | Fault(s) Type | Non- Consequential Load Loss Allowed |
|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------------|
| P4<br>Multiple Contingency (Fault plus stuck breaker)                                                     | Normal system                                                                                                                                 | Loss of multiple elements caused by a stuck breaker <sup>5</sup> (non-Bus-tie Breaker) attempting to clear a fault on one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section                                    | SLG           | None                                 |
|                                                                                                           |                                                                                                                                               | 6. Loss of multiple elements caused by a stuck breaker <sup>5</sup> (Bus-tie Breaker) attempting to clear a fault on the associated bus                                                                                                                                                                     | SLG           | None                                 |
| P5<br>Multiple Contingency (Fault plus non-redundant component of a Protection System failure to operate) | Normal system                                                                                                                                 | Delayed fault clearing due to the failure of a non-redundant component of a Protection System protecting the faulted element to operate as designed, for one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section | 3Ø            | None                                 |
| P6<br>Multiple Contingency (Two overlapping singles)                                                      | Loss of one of the followed by system adjustments:<br>1. Transmission Circuits<br>2. Transformer <sup>2</sup><br>3. Shunt Device <sup>3</sup> | Loss of one of the following:<br>1. Transmission Circuits<br>2. Transformer <sup>2</sup><br>3. Shunt Device <sup>3</sup>                                                                                                                                                                                    | 3Ø            | None                                 |
| P7<br>Multiple Contingency                                                                                | Normal system                                                                                                                                 | Loss of one of the following:<br>1. Cascading Generators<br>2. Transmission Corridor<br>3. Any two adjacent circuits on common structure                                                                                                                                                                    | SLG           | None                                 |

**Table E-4: Steady state & stability performance extreme events.****Steady State & Stability**

For all extreme events evaluated:

**1. Simulate the removal of all elements that Protection Systems and automatic controls are expected to disconnect for each Contingency.**

**2. Simulate normal clearing unless otherwise specified.**

**Steady State**

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service followed by another single generator, transmission circuit, shunt device, or transformer forced out of service prior to system adjustments.
2. Local area events affecting the Transmission System such as:
  - a. Loss of a tower line with three or more circuits<sup>6</sup>.
  - b. Loss of all transmission lines on a common Right-of-Way<sup>6</sup>
  - c. Loss of a switching station or substation (loss of one voltage level plus transformers).
  - d. Loss of all generating units at a generating station.
  - e. Loss of a large load or major load center.
3. Wide area events affecting the Transmission System based on system topology such as:
  - a. Loss of two generating stations resulting from conditions such as:
    - i. Loss of a large fuel line into an area.
    - ii. Loss of the use of a large body of water as the cooling source for generation.
    - iii. Wildfires
    - iv. Severe weather, for example, hurricanes
    - v. A successful cyber attack
    - vi. Large earthquake, tsunami or volcanic eruption
  - b. Other events based upon operating experience that may result in wide area disturbances.

**Stability**

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service apply a 3Ø fault on another single generator, transmission circuit, shunt device, or transformer prior to system adjustments.
2. Local area events affecting the Transmission System such as:
  - a. 3Ø fault on generator with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - b. 3Ø fault on transmission circuit with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - c. 3Ø fault on transformer with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - d. 3Ø fault on bus section with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - e. 3Ø internal breaker fault<sup>4</sup>.
  - f. Other events based upon operating experience, such as consideration of initiating events that experience, such as consideration of initiating events that experience suggests may result in wide area disturbances.

**Table E-5: Steady state & stability performance footnotes (Planning events and extreme events).**

**Planning Events and Extreme Events**

1. Unless specified otherwise, simulate Normal Clearing of faults. Single line to ground (SLG) or three-phase (3Ø) are the fault types that must be evaluated in Stability simulations for the event described. A 3Ø or a double line to ground fault study indicating the criteria are being met is sufficient evidence that a SLG condition would also meet the criteria.
2. For non-generator step up transformer outage events, the reference voltage, applies to the low-side winding (excluding tertiary windings). For generator and Generator Step Up transformer outage events, the reference voltage applies to the BES connected voltage (high-side of the Generator Step Up transformer). Requirements which are applicable to transformers also apply to variable frequency transformers and phase shifting transformers.

3. Requirements which are applicable to shunt devices also apply to FACTS devices that are connected to ground.
4. An internal breaker fault means a breaker failing internally, thus creating a System fault which must be cleared by protection on both sides of the breaker.
5. A stuck breaker means that for a gang-operated breaker, all three phases of the breaker have remained closed. For an independent pole operated (IPO) or an independent pole tripping (IPT) breaker, only one pole is assumed to remain closed. A stuck breaker results in Delayed Fault Clearing.
6. Excludes circuits that share a common structure (Planning event P7, Extreme event steady state 2a) or common Right-of-Way (Extreme event, steady state 2b) for 1 mile or less.

For purposes of this standard, non-redundant components of a Protection System to consider are as follows:

- a. A single protective relay which responds to electrical quantities, without an alternative (which may or may not respond to electrical quantities) that provides comparable Normal Clearing times;
- b. A single communications system associated with protective functions, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing (an exception is a single communications system that is both monitored and reported at a Control Center);
- c. A single station dc supply associated with protective functions required for Normal Clearing (an exception is a single station dc supply that is both monitored and reported at a Control Center for both low voltage and open circuit);
- d. A single control circuitry (including auxiliary relays and lockout relays) associated with protective functions, from the dc supply through and including the trip coil(s) of the circuit breakers or other interrupting devices, required for Normal Clearing (the trip coil may be excluded if it is both monitored and reported at a Control Center).

## E.2 HAWAI'I ISLAND TRANSMISSION CRITERIA

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### E.2.1 PURPOSE

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The purpose of these criteria is to establish guidelines for planning the Hawaiian Electric Hawai'i Island Transmission System to ensure safe and reliable service to its customers to serve current and future system needs. These criteria also apply to facilities that interconnect to the Hawai'i Island Transmission System. The primary objectives of these criteria to maintain reliable Transmission System operation (i.e., continuity of service) include the following:

- Ensure public safety.
- Maintain system stability under a wide range of operating conditions identified in Section E.2.8.
- Maintain equipment operating limits under a wide range of operating conditions identified in Section E.2.8.
- Minimize losses where cost effective.
- Preserve the reliability of the existing transmission infrastructure.
- Maintain an acceptable level of impact to customers for contingencies and events as defined within this planning criteria.
- Prevent cascading outages or system failure following credible contingencies and events.

The criteria outlined below are intended to be used as a general guide in planning the Hawai'i Island Transmission System, for which transmission needs for reinforcement, enhancements, and mitigations will be determined.

### E.2.2 DEFINITIONS

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**Acceptable Damping:** A continuous attenuation of oscillations required to achieve equilibrium over a four-cycle period.

**Cascading:** The uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Consequential Load Loss:** All load that is no longer served by the Transmission System as a result of Transmission System Facilities being removed from service by a Protection System operation designed to isolate a fault. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Contingency:** The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Contingency Reserve:** The provision of capacity deployed by the Balancing Authority to meet reliability requirements in Section E.2.8.

**Corrective Action Plan:** A list of actions and an associated timetable for implementation to remedy a specific problem. (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Distributed Energy Resources or DER:** Resources interconnected to the distribution system that produce electricity.

**Droop Response or Primary Frequency Response:** Open-loop proportional control defined as a percentage of turbine speed or system frequency divided by its rated capacity (i.e., turbine or IBR rating). For a 5% droop response, a unit operating at full speed no load or zero output will instantaneously, without any intentional time delays, issue a control signal to export 100% rated capacity for a 5% decrease in turbine speed or system frequency.

**Element or Elements:** Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An Element may be comprised of one or more components. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Equipment Rating:** The maximum and minimum voltage, current, frequency, real and reactive power flows on individual equipment under steady state, short-circuit and transient conditions, as permitted or assigned by the equipment owner. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Extreme Events:** Less frequent but more severe Contingencies that could result in a cascading effect.

**Facility or Facilities:** A set of electrical equipment that operates as a single bulk electric system Element (for example, a line, a generator, a shunt compensator, transformer, etc.). (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Fast Frequency Response:** Power injected to (or absorbed from) the grid in response to changes in measured or observed frequency during the arresting phase of a frequency excursion event to improve the frequency nadir or initial rate-of-change of frequency. (Source: NERC Fast Frequency Response Concepts and Bulk Power System Reliability Needs – NERC Inverter-Based Resource Performance Task Force; March 2020)

**Inverter-Based Resource:** A resource that is asynchronously connected to the sub-transmission or Transmission System through power electronics.



**Long-Term Transmission Planning Horizon:** Transmission planning period that covers years six through ten or beyond when required to accommodate any known longer lead time projects that may take longer than ten years to complete. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Near-Term Transmission Planning Horizon:** The transmission planning period that covers year one through five. (Source: Glossary of Terms Used in NERC Reliability Standards; January 24, 2011)

**Non-Consequential Load Loss:** Load that is disconnected from the system by the utility to stabilize system frequency or voltage. Non-Consequential Load loss does not include: (1) Consequential Load Loss, (2) the response of voltage sensitive load, or (3) load that is disconnected from the system by end-user equipment.

**Planning Assessment:** Documented evaluation of future Transmission System performance and Corrective Action Plans to remedy identified deficiencies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Protection System:** Includes, protective relays which respond to electrical quantities; communications systems necessary for correct operation of protective functions; voltage and current sensing devices providing inputs to protective relays; station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply); and control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date April 1, 2013)

**Short Circuit Ratio or SCR<sup>21</sup>:** Short circuit ratio is defined as the ratio between short circuit apparent power (SCMVA) from a 3LG fault at a given location in the power system to the rating of the Inverter-Based Resource connected to that location. Since the numerator of the SCR metric is dependent on the specific measurement location, this location is usually stated along with the SCR number.

$$SCR_{POI} = \frac{SCMVA_{POI}}{MW_{IBR}}$$

Where SCMVA is the short circuit MVA level at the POI without the current contribution of the Inverter-Based Resource, and MW IBR is the nominal power rating of the Inverter-Based Resource being connected at the POI.

**Stability:** The ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or disturbances. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

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<sup>21</sup> NERC Reliability Guidelines, December 2017 - Integrating Inverter Based Resources into Low Short Circuit Ratio Systems

**System:** A combination of generation, transmission, and distribution components. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Termination:** Point at which an Element or Elements connect to a transmission bus or bay.

**Transmission System:** A network of circuits that operate at a nominal voltage of 69 kV. The Transmission System can also include sections of the 34.5 kV sub-transmission system as defined by these criteria.

**Weak Grid:** A transmission system that has at least one transmission node with a calculated short circuit ratio of less than 3 (i.e.,  $SCR < 3$ ).

### E.2.3 TRANSMISSION SYSTEM DEFINED

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For the purpose of these criteria, the Transmission System is defined as all transmission lines, substation equipment, structures, and land utilized for transporting power at 69 kV & 34.5 kV. In addition, the 69-34.5 kV, 69-13.8 kV, and 34.5-13.8 kV tie transformers are part of the Transmission System.

### E.2.4 TRANSMISSION PLANNING CRITERIA – THERMAL LIMITS

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At a minimum, the Hawai'i Island system shall meet the performance requirements specified by Planning Events P0 through P4 in Section E.2.8. In addition, the Hawai'i Island Transmission System shall meet the following steady-state performance requirements:

- 1) With any generating unit offline for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
  - o Any other generating unit or IBR that is deemed as a single Contingency equivalent
  - o Any synchronous condenser or IBR equivalent
  - o Any transmission circuit
  - o Any transmission transformer
  - o Any transmission bus
  - o Any wood transmission structure
- 2) Any generating station must be able to export real and reactive power equal to the sum of the individual generating unit's NORMAL capability ratings in MW at 100 percent of rated generator field current/power factor with no Transmission System Element loading exceeding its EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
  - o Any transmission circuit
  - o Any wood transmission structure

- o Any transmission transformer
- o Any transmission bus

Additionally, for any transmission Element outage, the aggregate generating capacity on any remaining radial transmission circuit will not exceed the maximum single-point failure for the system.

- 3) The outage of not more than one generating unit Termination caused by the failure of a transmission circuit breaker to operate during fault conditions.
- 4) With two 69 kV transmission circuits on common steel poles taken out of service at the same time for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits. This is a maintenance requirement based on present maintenance practices.

Excessive segmentation of a 69 kV or a 34 kV transmission line can result in increasingly complex protection coordination schemes, greater susceptibility to mis-operation of relays, maintenance and operational issues, and excessive curtailment of resources for certain transmission line contingencies. The total generation on any transmission line must be limited to the single-point failure capacity of the system. Generating Facilities should interconnect to an existing substation if practical or interconnect to multiple transmission lines through a new standard configured transmission substation.

## E.2.5 LOADING LIMITS

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Conductor loading limits are based on the Overhead Engineering Standards or by ampacity calculations for Underground circuits performed by Engineering. Operational planning mitigations that utilize operator interventions within the duration of allowed Equipment Ratings are not governed by this transmission planning criteria.

### E.2.5.1 Power Transformer Loading Limits

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Loading limits of transmission power transformers shall be as follows:

- 1) The normal loading limit of a transmission power transformer shall be its zero percent loss-of-life kVA capability.
- 2) The emergency loading limit of a transmission power transformer shall be its one percent loss-of-life kVA capability.
- 3) The extreme emergency loading limit of a transmission power transformer shall be 200 percent of its maximum nameplate rating.

Loading limits shall be determined in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise.

## E.2.5.2 Current Carrying Capacity

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### Overhead

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Conductors for overhead transmission lines shall be considered to have current carrying capacity in accordance with Engineering Standard 1-2038, "Current Carrying Capacity Outdoor Bare Conductor" or other applicable standard. A conductor bundle with identical conductors shall have the rating of a single conductor multiplied by the number of conductors per phase in the bundle.

### Underground

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Cable for underground transmission circuits shall be based on ampacity calculations performed by Engineering.

### Open Bus

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Open buses shall be considered to have current carrying capacity in accordance with Engineering Standard, 1-2039, "Current Carrying Capacity- Outdoor Open Bus" or other applicable standard.

### Power Transformer Equipment

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Transmission power transformer connections, switches, protective relays, and current transformers shall be designed to allow the power transformer to carry 200 percent of maximum nameplate rating under extreme emergency conditions in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise. (The relay settings associated with this type of transformer shall allow the transformer to carry 200 percent of maximum nameplate rating.)

### Substation Equipment

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Switches, disconnects, circuit breakers, and associated equipment shall be considered to have a current carrying capacity equivalent to their respective nameplate current rating.

## E.2.5.3 Generator MVAR Loading Limits

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For planning purposes, the reactive capability of a given machine will be determined using the manufacturer's machine capability curve and normal MW at rated power factor for generating units. At no time will the system be planned with any generator or IBR exceeding its rating as determined by its capability curve corresponding to the appropriate ambient temperature suitable for the Hawai'i Island system.

## E.2.6 VOLTAGE LEVELS

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Transmission voltage levels shall be kept within the prescribed limits for any condition for which the Transmission System is planned. These limits apply after automatic corrective action has been taken by LTC and/or switched capacitors.

The maximum voltage limits are based on *Utility Service in the State of Hawaii* (General Order No.7).

- 1) 69 kV System. For any system operating condition, the voltage at any 69 kV bus shall not exceed 72.5 kV.
- 2) 34.5 kV System. For any system operating condition, the voltage on the 34.5 kV system shall not exceed 36.2 kV.

The minimum voltage limits are based upon maintaining customer voltages in accordance with *Standards for Electric Utility Service in the State of Hawaii* (General Order No.7). To accomplish this, bus voltages at the transmission and sub-transmission substations must be maintained within the limits that are used to plan the distribution system.

- 1) 69 kV System. The minimum allowable voltage on any 69 kV bus is 62.1 kV for any emergency condition for which the transmission system is planned.
- 2) 34.5 kV System. The minimum allowable voltage on any 34.5 kV bus is 31.05 kV for any emergency condition for which the system is planned.

The system's short-circuit current requirements and resources should be considered when evaluating near-term voltage and MVAR mitigation alternatives.

## E.2.7 SYSTEM STABILITY

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Displacement of synchronous generation has a direct impact on dynamic and transient stability. In addition to traditional analyses, new planning metrics and analysis are required to maintain Stability under plausible operating conditions. If the conditions for Weak Grid are met, further analysis may be required in appropriate software modeling platform to fully investigate any Stability concerns.

### E.2.7.1 Steady State Voltage

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The power-voltage (PV) and reactive power-voltage (QV) analysis shall be performed to determine the steady-state voltage stability of critical load buses.

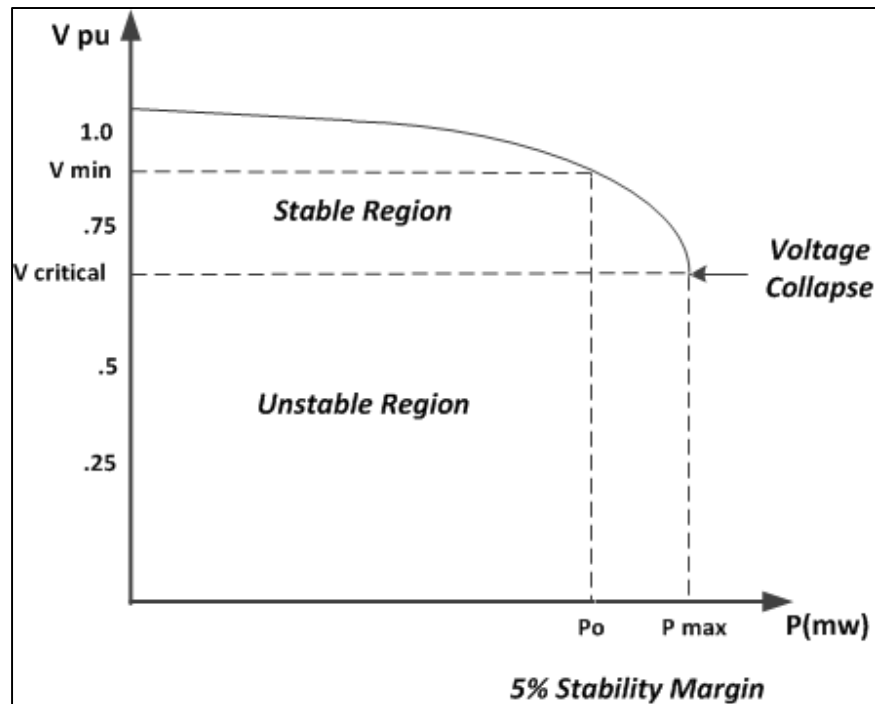


**Figure E-2: Typical PV curve.**

Figure E-2 shows a typical PV curve that depicts the thermal limit of the transmission system. To ensure voltage stability, a 5% margin from  $P_0$  to  $P_{max}$ , identified as  $P_0$ , shall be maintained under planning events described in Section E.2.8. In addition, the intersection of the QV curve with the x-axis shall occur above the minimum allowable voltage level, and the reactive power margin, represented by the value at the minimum point of the QV curve, shall be greater than the size of a nearby capacitor bank or reactive power device.

### E.2.7.2 Weak Grid Assessment

Weak power systems are more susceptible to voltage transients and can be exacerbated by control instabilities. Short circuit ratio (SCR) is the most basic metric to assess the relative strength of an electrical system for a specific area when evaluating performance of a specific IBR<sup>22</sup>. For system planning purposes, a more appropriate quantity is the weighted short circuit ratio (WSCR)<sup>23</sup>, defined by:

<sup>22</sup> NERC Reliability Guideline – Integrating Variable Energy Resources into Weak Power Systems

<sup>23</sup> Electraxis, System Strength Assessment of the Panhandle System, Electric Reliability Council of Texas, 2016

$$WSCR = \frac{\sum_i^N SCMVA_i * P_{RMW_i}}{(\sum_i^N P_{RMW_i})^2}$$

Where **SCMVA<sub>i</sub>** is the short circuit capacity at bus **i** and **P<sub>RMW<sub>i</sub></sub>** is the MW rating of the IBR; **N** is the number of total IBR fully interacting with each other and **i** is the IBR index. The WSCR takes into account the aggregate IBR of the system to ensure the system has sufficient short circuit current for transient voltage stability. There is currently no industry standard for WSCR of a transmission system.

## Control Stability

Control stability refers to the behavior of grid-connected IBR like wind and solar PV plants to operate in a stable manner for both small disturbances and large disturbances on the grid over a wide range of operating conditions and disturbances. Unstable behavior can result in oscillatory behavior, extreme overshoots in voltage or current, and/or a failure to ride-through a disturbance. The stability of equipment controls is impacted by many factors, including equipment tuning, operating conditions, grid strength, disturbance types, and the electrical proximity to other IBR or synchronous machines on the grid, among others.

As more IBR with complex control system connect to the system, it is important to assess the control stability of these resources to assess the robustness of controls to the range of expected operating conditions over the planning horizon. This will be done through a combination of screening, scenario modeling, and testing/demonstration of performance. As such, supplying accurate and sufficiently detailed models of equipment and functional descriptions of equipment control and protection schemes is necessary well in advance of interconnection. Equipment performance will be evaluated for combinations of:

- o Full and partial power operating conditions, high and low voltages (within continuous limits)
- o Symmetric and asymmetric fault disturbances (with reclosing), line switching disturbances, loss of generation and load disturbances
- o Low grid strength conditions

The system shall maintain operating equilibrium with acceptable damping ratio of 3% for all reasonable combinations of planned outages and system contingencies defined in Section 8.4. Power oscillations exhibit an acceptable damping ratio of 3% when the oscillation magnitude decreases by 17% over the first period of oscillation, or by 53% over four periods of oscillations.

### E.2.7.3 Rotor Angle Stability Criteria

Rotor angle stability simulations involve the evaluation of critical clearing times ("CCT") for close-in faults to generating stations, generating units, and transmission lines. Generator rotor angle deviation with respect to a "distant" generator shall be less than 180 degrees to prevent generator pole-slipping and in addition to avoiding loss of synchronism. Dynamic performance shall exhibit acceptable damping to ensure rotor angle

stability. Pole-slipping could impose mechanical stresses on the generator shaft and could result in catastrophic failure of the unit.

## Critical Clearing Times

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The Transmission Planning Department performs Stability simulations using the standard fault clearing times for breakers provided by the System Protection Department. If a fault event results in a planning criteria violation, the Transmission Planning Department shall determine the CCT for that event and will provide it to the System Protection Department for its review and feedback. If the CCT cannot be achieved by the existing protective devices, Transmission Planning Department will work with System Protection Department to develop appropriate mitigation measures. Such mitigation measures may include but not limited to the system protection upgrade, generator size or power export reduction, application of synchronous condenser or adjustments to resource commitment as applicable.

### E.2.7.4 Frequency Stability

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Frequency stability is determined by 1) the amount of inertia on the system; 2) the amount and response characteristics of fast-frequency and primary frequency response reserves on the system; and 3) the magnitude of the generation Contingency. The system shall carry sufficient, fast and timely delivered frequency response (including some combination of rotating machine inertia, frequency response reserves, and inverter-based frequency response capabilities) to mitigate credible contingencies, including expected aggregate loss of distributed energy resources in response to the Contingency events, with appropriate Non-Consequential Load Loss criteria defined in Section E.2.8. In order to meet these criteria, mitigation measures may require establishing minimum inertia requirement for a generation loss event.

## Planning Criteria for Stability

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Stability of an electric power system is the attribute of the system to regain a state of operating equilibrium after being subjected to disrupting forces (Contingency events), such that the majority of the system remains intact. Generating units and transmission Elements must remain online and in synchronism with the system to prevent an island-wide blackout. Therefore, the Transmission System shall be tested by simulating frequent Contingency events and reasonable cascading contingency events that may occur on the system to ensure operating equilibrium is restored.

- 1) For the more frequent types of contingencies listed below, not more than one generating unit can disconnect from the system, all remaining generating units must remain connected and synchronized to the system, all remaining generating units must participate towards beneficial system response, no circuits should trip on stability swings, transient voltage stability must be maintained, and Non-Consequential Load Loss defined in Section E.2.2.



- o Normally cleared, three-phase faults on transmission lines with automatic reclosing as applicable to the circuit being analyzed.
  - o Delayed clearing of three-phase faults due to failure of the pilot relay on circuits that have one pilot scheme, and one step-distance scheme for backup to the pilot scheme. Dual-pilot relay schemes require independent communication technologies (e.g., both microwave and fiber-optic cable) to mitigate failure of single-pilot relay schemes. Analysis shall be performed for the simulation of the longest delayed clearing time scenario.
  - o Delayed clearing of single line-to-ground faults due to failure of a circuit breaker to open. Exceptions include small units (e.g., internal combustion engines) that share a common generator step-up transformer and combined-cycle units. Other exceptions will be considered on a case-by-case basis.
- 2) For the less frequent contingencies listed below, Non-Consequential Load Loss or generator tripping may be required to prevent equipment damage and maintain Stability.
- o Sudden loss of all transmission lines emanating from a power plant switching station.
  - o Sudden loss of all transmission lines in a common right-of-way.
  - o Sudden loss of any combined cycle units or any two synchronous generating units (synchronous, asynchronous, or both), including any aggregate loss of DER.
  - o Sudden loss of any combination of two transmission Elements.
  - o Cascading loss of generation
- 3) Extreme Events – For Extreme Events system preservation shall be tested. An objective of the planning process should be to minimize the likelihood and magnitude of Non-Consequential Load Loss following Contingency events. If any Extreme Events result in an island-wide blackout, mitigation measures shall be formulated and analyzed to see if a reasonable solution can be implemented. Examples of Extreme Events include but not limited to:
- o A three-phase fault on generator, transmission circuit, transformer or bus section with stuck breaker resulting in delayed fault clearing
  - o A three-phase fault on generator, transmission circuit, transformer or bus section with failure of a non-redundant component of a Protection System resulting in delayed fault clearing
  - o Three phase internal breaker fault
  - o Other events based upon operating experience, such as consideration of initiating events that experience suggests may result in wide area disturbances

## E.2.8 TRANSMISSION PLANNING ASSESSMENT

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A Planning Assessment of the Transmission System must be performed on an annual basis to ensure compliance with these criteria for the Near-Term Planning Horizon and Long-Term Planning Horizons. This Planning Assessment must use current models to analyze steady-state, dynamic, and transient system stability to ensure compliance with these criteria. Updated assumptions, forecasts, and study results shall be summarized and documented in a report.

### E.2.8.1 Near-Term Transmission Planning Horizon

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The Near-Term Transmission Planning Horizon should assess a five year period and evaluate year one, year five, and any other year in between that has a significant system change, e.g., the planned addition or deactivation of a generating unit, the addition of a transmission line, etc. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load
- Night minimum load

Base cases may include consideration of each major unit outage period. Sensitivity cases may include consideration of system conditions and operating periods beyond the conditions listed above.

For each of these periods, only the applicable Stability analysis and system events shall be performed. Additional sensitivity cases and/or analyses should be performed on an as-needed basis to ensure system performance meets the stability criteria specified in Section E.2.7, and may be informed by identified operational constraints.

The Planning Assessment should periodically analyze cascading Contingency events to ensure preservation of the system for plausible planning events. As a minimum, the system shall meet performance requirements of Planning Events P5 through P7 from Table E-7.

### E.2.8.2 Long-Term Transmission Planning Horizon

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The Long-Term Transmission Planning Horizon should be performed in conjunction with the Integrated Grid Planning process. Evaluation years will be dictated by the proposed resource plans. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load

- Night minimum load

For each of these periods, only the applicable Stability analysis and system events shall be performed. Models of future generating units will not be readily available; therefore, discretion should be used in: 1) developing the scope of work and sensitivity cases for this Planning Assessment and 2) interpreting results of these analyses.

### E.2.8.3 Past Studies

Past studies may be used to support the Planning Assessment if they meet the following requirements:

- For steady state, short circuit, or Stability analysis:
  - The study must contain a technical rationale that can be provided to demonstrate that the results of an older study are still valid, or
  - No material changes have occurred to the system represented in the study. Documentation to support the technical rationale for determining material changes must be included.

### E.2.8.4 Planning Events

As a minimum, the Stability criteria in Section E.2.7 ensures that the transmission system meets or exceeds the performance requirements of Planning Events P1 through P4 in Table E-7. A periodic assessment of the under-frequency load shed scheme should be performed to ensure that the system meets the minimum requirements of Planning Events P5 through P7 in Table E-7.

**Table E-6: Steady state and stability performance planning events.**

**Steady State & Stability:**

1. The system must remain stable. Cascading and uncontrolled islanding shall not occur.
2. Consequential Load Loss as well as generation loss is acceptable as a consequence of any event excluding P0.
3. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event.
4. Simulate normal clearing unless otherwise specified.
5. Planned system adjustments such as transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Equipment Rating.
6. Phase angle separation for line Contingency shall not preclude automatic reclosing unless system adjustments can be performed within fifteen minutes.

**Steady State Only:**

7. Applicable Equipment Rating must not be exceeded.
8. System steady state voltages and post-Contingency voltage deviations must be within acceptable limits as established by this Planning Criteria.
9. Planning event P0 is applicable to steady state only.

**Table E-7: Categories of contingency events.**

| Category                                                                                                  | Initial Condition                                                                               | Event                                                                                                                                                                                                                                                                                                       | Fault(s) Type <sup>1</sup> | Non-Consequential Load Loss Allowed |
|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|-------------------------------------|
| P0<br>No Contingency                                                                                      | Normal system                                                                                   | None                                                                                                                                                                                                                                                                                                        | N/A                        | None                                |
| P1<br>Single Contingency                                                                                  | Normal system                                                                                   | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device-Ancillary Service Device <sup>3</sup>                                                                                                                                           | 3Ø                         | Up to 15% for Generator Trip Only   |
|                                                                                                           |                                                                                                 | 5. Generator – no fault                                                                                                                                                                                                                                                                                     | N/A                        |                                     |
| P2<br>Single Contingency                                                                                  | Normal system                                                                                   | 1. Bus Section fault<br>2. Internal Breaker Fault <sup>4</sup> (Transmission line breaker)                                                                                                                                                                                                                  | 3Ø                         | Up to 15%                           |
| P3<br>Single Contingency                                                                                  | Loss of generator unit followed by system adjustments (e.g., corrective action and re-dispatch) | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer<br>4. Shunt Device/ Ancillary Service Device                                                                                                                                                                    | 3Ø                         | Up to 20%                           |
| P4<br>Multiple Contingency (Fault plus stuck breaker <sup>5</sup> )                                       | Normal system                                                                                   | Loss of multiple elements caused by a stuck breaker (non-Bus-tie Breaker) attempting to clear a fault on one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section                                                 | SLG                        | Up to 40%                           |
|                                                                                                           |                                                                                                 | 6. Loss of multiple elements caused by a stuck breaker (Bus-tie Breaker) attempting to clear a fault on the associated bus                                                                                                                                                                                  | SLG                        | Up to 40%                           |
| P5<br>Multiple Contingency (Fault plus non-redundant component of a Protection System failure to operate) | Normal system                                                                                   | Delayed fault clearing due to the failure of a non-redundant component of a Protection System protecting the faulted element to operate as designed, for one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section | 3Ø                         | Up to 15%                           |
| P6<br>Multiple Contingency                                                                                | Loss of one of the followed by system adjustments:                                              | Loss of one of the following:<br>1. Transmission Circuits<br>2. Transformer <sup>2</sup>                                                                                                                                                                                                                    | 3Ø                         | Up to 65%                           |

| Category                      | Initial Condition                                                                       | Event                                                                                                                                    | Fault(s)<br>Type <sup>1</sup> | Non-<br>Consequential<br>Load Loss<br>Allowed |
|-------------------------------|-----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-----------------------------------------------|
| (Two overlapping singles)     | 1. Transmission Circuits<br>2. Transformer <sup>2</sup><br>3. Shunt Device <sup>3</sup> | 3. Shunt Device <sup>3</sup>                                                                                                             |                               |                                               |
| P7<br>Multiple<br>Contingency | Normal system                                                                           | Loss of one of the following:<br>1. Cascading Generators<br>2. Transmission Corridor<br>3. Any two adjacent circuits on common structure | SLG                           | Up to 65%                                     |

**Table E-8: Steady state & stability performance extreme events.**

#### Steady State & Stability

For all extreme events evaluated:

1. Simulate the removal of all elements that Protection Systems and automatic controls are expected to disconnect for each Contingency.
2. Simulate normal clearing unless otherwise specified.

#### Steady State

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service followed by another single generator, transmission circuit, shunt device, or transformer forced out of service prior to system adjustments.
2. Local area events affecting the Transmission System such as:
  - a. Loss of a tower line with three or more circuits<sup>6</sup>.
  - b. Loss of all transmission lines on a common Right-of-Way<sup>6</sup>
  - c. Loss of a switching station or substation (loss of one voltage level plus transformers).
  - d. Loss of all generating units at a generating station.
  - e. Loss of a large load or major load center.
3. Wide area events affecting the Transmission System based on system topology such as:
  - a. Loss of two generating stations resulting from conditions such as:
    - i. Loss of a large fuel line into an area.
    - ii. Loss of the use of a large body of water as the cooling source for generation.
    - iii. Wildfires
    - iv. Severe weather, for example, hurricanes

#### Stability

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service apply a 3Ø fault on another single generator, transmission circuit, shunt device, or transformer prior to system adjustments.
2. Local area events affecting the Transmission System such as:
  - a. 3Ø fault on generator with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - b. 3Ø fault on transmission circuit with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - c. 3Ø fault on transformer with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - d. 3Ø fault on bus section with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.
  - e. 3Ø internal breaker fault<sup>4</sup>.
  - f. Other events based upon operating experience, such as consideration of

|                                                                                                                                                                                                                                                |                                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>v. A successful cyber attack</li> <li>vi. Large earthquake, tsunami or volcanic eruption</li> <li>b. Other events based upon operating experience that may result in wide area disturbances.</li> </ul> | <p>initiating events that experience, such as consideration of initiating events that experience suggests may result in wide area disturbances.</p> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|

**Table E-9: Steady state & stability performance footnotes (Planning events and extreme events).**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Planning Events and Extreme Events</p> <ol style="list-style-type: none"> <li>1. Unless specified otherwise, simulate Normal Clearing of faults. Single line to ground (SLG) or three-phase (3Ø) are the fault types that must be evaluated in Stability simulations for the event described. A 3Ø or a double line to ground fault study indicating the criteria are being met is sufficient evidence that a SLG condition would also meet the criteria</li> <li>2. For non-generator step up transformer outage events, the reference voltage, applies to the low-side winding (excluding tertiary windings). For generator and Generator Step Up transformer outage events, the reference voltage applies to the BES connected voltage (high-side of the Generator Step Up transformer). Requirements which are applicable to transformers also apply to variable frequency transformers and phase shifting transformers.</li> <li>3. Requirements which are applicable to shunt devices also apply to FACTS devices that are connected to ground.</li> <li>4. An internal breaker fault means a breaker failing internally, thus creating a System fault which must be cleared by protection on both sides of the breaker.</li> <li>5. A stuck breaker means that for a gang-operated breaker, all three phases of the breaker have remained closed. For an independent pole operated (IPO) or an independent pole tripping (IPT) breaker, only one pole is assumed to remain closed. A stuck breaker results in Delayed Fault Clearing.</li> <li>6. Excludes circuits that share a common structure (Planning event P7, Extreme event steady state 2a) or common Right-of-Way (Extreme event, steady state 2b) for 1 mile or less.</li> </ol> <p>For purposes of this standard, non-redundant components of a Protection System to consider are as follows:</p> <ol style="list-style-type: none"> <li>a. A single protective relay which responds to electrical quantities, without an alternative (which may or may not respond to electrical quantities) that provides comparable Normal Clearing times;</li> <li>b. A single communications system associated with protective functions, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing (an exception is a single communications system that is both monitored and reported at a Control Center);</li> <li>c. A single station dc supply associated with protective functions required for Normal Clearing (an exception is a single station dc supply that is both monitored and reported at a Control Center for both low voltage and open circuit);</li> <li>d. A single control circuitry (including auxiliary relays and lockout relays) associated with protective functions, from the dc supply through and including the trip coil(s) of the circuit breakers or other interrupting devices, required for Normal Clearing (the trip coil may be excluded if it is both monitored and reported at a Control Center).</li> </ol> |
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## E.3 MAUI TRANSMISSION CRITERIA

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### E.3.1 PURPOSE

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The purpose of these criteria is to establish guidelines for planning the Hawaiian Electric Maui Island Transmission System to ensure safe and reliable service to its customers to serve current and future system needs. These criteria also apply to facilities that interconnect to the Maui Island Transmission System. The primary objectives of these criteria to maintain reliable Transmission System operation (i.e., continuity of service) include the following:

- Ensure public safety.
- Maintain system stability under a wide range of operating conditions identified in Section E.3.8.
- Maintain equipment operating limits under a wide range of operating conditions identified in Section E.3.8.
- Minimize losses where cost effective.
- Preserve the reliability of the existing transmission infrastructure.
- Maintain an acceptable level of impact to customers for contingencies and events as defined within this planning criteria.
- Prevent cascading outages or system failure following credible contingencies and events.

The criteria outlined below are intended to be used as a general guide in planning the Maui Island Transmission System, for which transmission needs for reinforcement, enhancements, and mitigations will be determined.

### E.3.2 DEFINITIONS

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**Acceptable Damping:** A continuous attenuation of oscillations required to achieve equilibrium over a four-cycle period.

**Cascading:** The uncontrolled successive loss of System Elements triggered by an incident at any location. Cascading results in widespread electric service interruption that cannot be restrained from sequentially spreading beyond an area predetermined by studies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Consequential Load Loss:** All load that is no longer served by the Transmission System as a result of Transmission System Facilities being removed from service by a Protection System operation designed to isolate a fault. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Contingency:** The unexpected failure or outage of a system component, such as a generator, transmission line, circuit breaker, switch or other electrical element. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Contingency Reserve:** The provision of capacity deployed by the Balancing Authority to meet reliability requirements in Section E.3.8.

**Corrective Action Plan:** A list of actions and an associated timetable for implementation to remedy a specific problem. (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Distributed Energy Resources or DER:** Resources interconnected to the distribution system that produce electricity.

**Droop Response or Primary Frequency Response:** Open-loop proportional control defined as a percentage of turbine speed or system frequency divided by its rated capacity (i.e., turbine or IBR rating). For a 5% droop response, a unit operating at full speed no load or zero output will instantaneously, without any intentional time delays, issue a control signal to export 100% rated capacity for a 5% decrease in turbine speed or system frequency.

**Element or Elements:** Any electrical device with terminals that may be connected to other electrical devices such as a generator, transformer, circuit breaker, bus section, or transmission line. An Element may be comprised of one or more components. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date July 1, 2016)

**Equipment Rating:** The maximum and minimum voltage, current, frequency, real and reactive power flows on individual equipment under steady state, short-circuit and transient conditions, as permitted or assigned by the equipment owner. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Extreme Events:** Less frequent but more severe Contingencies that could result in a cascading effect.

**Facility or Facilities:** A set of electrical equipment that operates as a single bulk electric system Element (for example, a line, a generator, a shunt compensator, transformer, etc.). (Source: Glossary of Terms Used in NERC Reliability Standards; February 7, 2006)

**Fast Frequency Response:** Power injected to (or absorbed from) the grid in response to changes in measured or observed frequency during the arresting phase of a frequency excursion event to improve the frequency nadir or initial rate-of-change of frequency. (Source: NERC Fast Frequency Response Concepts and Bulk Power System Reliability Needs – NERC Inverter-Based Resource Performance Task Force; March 2020)

**Inverter-Based Resource:** A resource that is asynchronously connected to the sub-transmission or Transmission System through power electronics.



**Long-Term Transmission Planning Horizon:** Transmission planning period that covers years six through ten or beyond when required to accommodate any known longer lead time projects that may take longer than ten years to complete. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Near-Term Transmission Planning Horizon:** The transmission planning period that covers year one through five. (Source: Glossary of Terms Used in NERC Reliability Standards; January 24, 2011)

**Non-Consequential Load Loss:** Load that is disconnected from the system by the utility to stabilize system frequency or voltage. Non-Consequential Load loss does not include: (1) Consequential Load Loss, (2) the response of voltage sensitive load, or (3) load that is disconnected from the system by end-user equipment.

**Planning Assessment:** Documented evaluation of future Transmission System performance and Corrective Action Plans to remedy identified deficiencies. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date January 1, 2015)

**Protection System:** Includes, protective relays which respond to electrical quantities; communications systems necessary for correct operation of protective functions; voltage and current sensing devices providing inputs to protective relays; station dc supply associated with protective functions (including station batteries, battery chargers, and non-battery-based dc supply); and control circuitry associated with protective functions through the trip coil(s) of the circuit breakers or other interrupting devices. (Source: Glossary of Terms Used in NERC Reliability Standards; Effective Date April 1, 2013)

**Short Circuit Ratio or SCR<sup>24</sup>:** Short circuit ratio is defined as the ratio between short circuit apparent power (SCMVA) from a 3LG fault at a given location in the power system to the rating of the Inverter-Based Resource connected to that location. Since the numerator of the SCR metric is dependent on the specific measurement location, this location is usually stated along with the SCR number.

$$SCR_{POI} = \frac{SCMVA_{POI}}{MW_{IBR}}$$

Where SCMVA is the short circuit MVA level at the POI without the current contribution of the Inverter-Based Resource, and MW IBR is the nominal power rating of the Inverter-Based Resource being connected at the POI.

**Stability:** The ability of an electric system to maintain a state of equilibrium during normal and abnormal conditions or disturbances. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

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<sup>24</sup> NERC Reliability Guidelines, December 2017 - Integrating Inverter Based Resources into Low Short Circuit Ratio Systems

**System:** A combination of generation, transmission, and distribution components. (Source: Glossary of Terms Used in NERC Reliability Standards; February 8, 2005)

**Termination:** Point at which an Element or Elements connect to a transmission bus or bay.

**Transmission System:** A network of circuits that operate at a nominal voltage of 69 kV and 23 kV.

**Weak Grid:** A transmission system that has at least one transmission node with a calculated short circuit ratio of less than 3 (i.e.,  $SCR < 3$ ).

### E.3.3 TRANSMISSION SYSTEM DEFINED

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For the purpose of these criteria, the Transmission System is defined as all transmission lines, substation equipment, structures, and land utilized for transporting power at 69 kV and 23 kV. In addition, the 69-23 kV tie transformers are part of the Transmission System.

### E.3.4 TRANSMISSION PLANNING CRITERIA – THERMAL LIMITS

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At a minimum, the Maui Island system shall meet the performance requirements specified by Planning Events P0 through P4 in Section E.3.8. In addition, the Maui Island Transmission System shall meet the following steady-state performance requirements:

- 1) With any generating unit offline for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
  - o Any other generating unit or IBR that is deemed as a single Contingency equivalent
  - o Any synchronous condenser or IBR equivalent
  - o Any transmission circuit
  - o Any transmission transformer
  - o Any transmission bus
  - o Any wood transmission structure
- 2) Any generating station must be able to export real and reactive power equal to the sum of the individual generating unit's NORMAL capability ratings in MW at 100 percent of rated generator field current/power factor with no Transmission System Element loading exceeding its EMERGENCY ratings while maintaining voltage levels within their upper or lower limits for any of the following outages:
  - o Any transmission circuit
  - o Any wood transmission structure
  - o Any transmission transformer

- o Any transmission bus

Additionally, for any transmission Element outage, the aggregate generating capacity on any remaining radial transmission circuit will not exceed the maximum single-point failure for the system.

- 3) The outage of not more than one generating unit Termination caused by the failure of a transmission circuit breaker to operate during fault conditions.
- 4) With two 69 kV transmission circuits on common steel poles taken out of service at the same time for maintenance, all Transmission System Elements will operate within their EMERGENCY ratings while maintaining voltage levels within their upper or lower limits. This is a maintenance requirement based on present maintenance practices.

Excessive segmentation of a 69 kV or 23 kV transmission line can result in increasingly complex protection coordination schemes, greater susceptibility to mis-operation of relays, maintenance and operational issues, and excessive curtailment of resources for certain transmission line contingencies. The total generation on any transmission line must be limited to the single-point failure capacity of the system. Generating Facilities should interconnect to an existing substation if practical or interconnect to multiple transmission lines through a new standard configured transmission substation.

## E.3.5 LOADING LIMITS

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Conductor loading limits are based on the Overhead Engineering Standards or by ampacity calculations for Underground circuits performed by Engineering. Operational planning mitigations that utilize operator interventions within the duration of allowed Equipment Ratings are not governed by this transmission planning criteria.

### E.3.5.1 Power Transformer Loading Limits

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Loading limits of transmission power transformers shall be as follows:

- 1) The normal loading limit of a transmission power transformer shall be its zero percent loss-of-life kVA capability.
- 2) The emergency loading limit of a transmission power transformer shall be its one percent loss-of-life kVA capability.
- 3) The extreme emergency loading limit of a transmission power transformer shall be 200 percent of its maximum nameplate rating.

Loading limits shall be determined in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise.

### E.3.5.2 Current Carrying Capacity

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#### Overhead

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Conductors for overhead transmission lines shall be considered to have current carrying capacity in accordance with Engineering Standard 1-2038, "Current Carrying Capacity Outdoor Bare Conductor" or other applicable standard. A conductor bundle with identical conductors shall have the rating of a single conductor multiplied by the number of conductors per phase in the bundle.

#### Underground

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Cable for underground transmission circuits shall be based on ampacity calculations performed by Engineering.

#### Open Bus

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Open buses shall be considered to have current carrying capacity in accordance with Engineering Standard, 1-2039, "Current Carrying Capacity- Outdoor Open Bus."

#### Power Transformer Equipment

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Transmission power transformer connections, switches, protective relays, and current transformers shall be designed to allow the power transformer to carry 200 percent of maximum nameplate rating under extreme emergency conditions in accordance with the latest edition of C-57.92, ANSI Guide for Loading Mineral - Oil - Immersed Power Transformers Up to and Including 100 MVA with 55°C or 65°C Winding Rise. (The relay settings associated with this type of transformer shall allow the transformer to carry 200 percent of maximum nameplate rating.)

#### Substation Equipment

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Switches, disconnects, circuit breakers, and associated equipment shall be considered to have a current carrying capacity equivalent to their respective nameplate current rating.

### E.3.5.3 Generator MVAR Loading Limits

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For planning purposes, the reactive capability of a given machine will be determined using the manufacturer's machine capability curve and normal MW at rated power factor for generating units. At no time will the system be planned with any generator or IBR exceeding its rating as determined by its capability curve corresponding to the appropriate ambient temperature suitable for the Maui Island system.

## E.3.6 VOLTAGE LEVELS

---

Transmission voltage levels shall be kept within the prescribed limits for any condition for which the Transmission System is planned. These limits apply after automatic corrective action has been taken by LTC and/or switched capacitors.

The maximum voltage limits are based on *Utility Service in the State of Hawaii* (General Order No.7).

- 1) 69 kV System. For any system operating condition, the voltage at any 69 kV bus shall not exceed 72.5 kV.
- 2) 23 kV System. For any system operating condition, the voltage on the 23 kV system shall not exceed 24.15 kV.

The minimum voltage limits are based upon maintaining customer voltages in accordance with *Standards for Electric Utility Service in the State of Hawaii* (General Order No.7). To accomplish this, bus voltages at the transmission substations must be maintained within the limits that are used to plan the distribution system.

- 1) 69 kV System. The minimum allowable voltage on any 69 kV bus is 62.1 kV for any emergency condition for which the transmission system is planned.
- 2) 23 kV System. The minimum allowable voltage on any 23 kV bus is 20.7 kV for any emergency condition for which the system is planned.

The system's short-circuit current requirements and resources should be considered when evaluating near-term voltage and MVAR mitigation alternatives.

## E.3.7 SYSTEM STABILITY

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Displacement of synchronous generation has a direct impact on dynamic and transient stability. In addition to traditional analyses, new planning metrics and analysis are required to maintain Stability under plausible operating conditions. If the conditions for Weak Grid are met, further analysis may be required in appropriate software modeling platform to fully investigate any Stability concerns.

### E.3.7.1 Steady State Voltage

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The power-voltage (PV) and reactive power-voltage (QV) analysis shall be performed to determine the steady-state voltage stability of critical load buses.

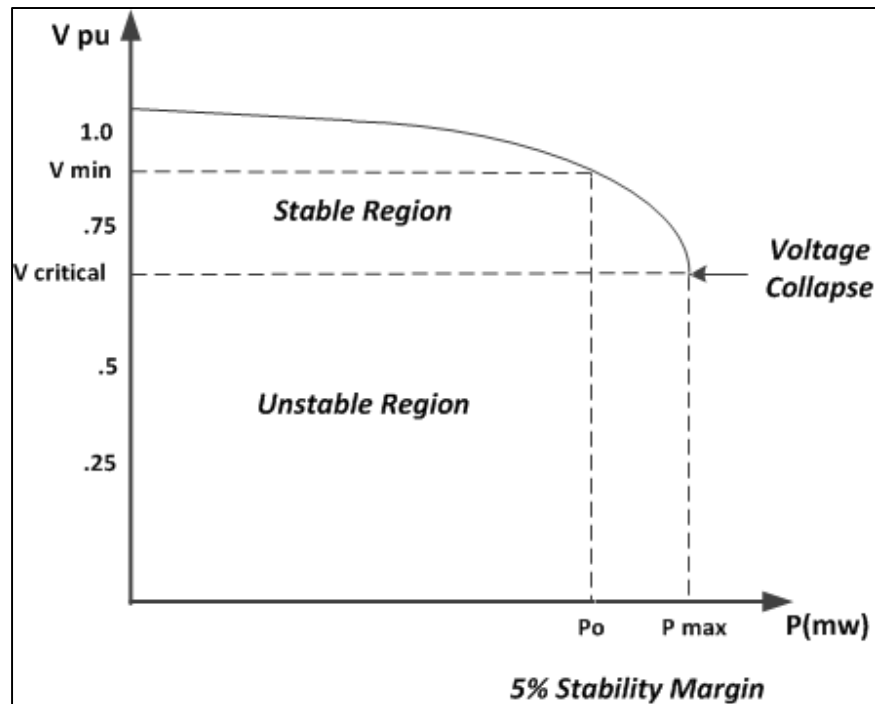


**Figure E-3: Typical PV curve.**

Figure E-3 shows a typical PV curve that depicts the thermal limit of the transmission system. To ensure voltage stability, a 5% margin from  $P_0$  to  $P_{max}$ , identified as  $P_0$ , shall be maintained under planning events described in Section E.3.8. In addition, the intersection of the QV curve with the x-axis shall occur above the minimum allowable voltage level, and the reactive power margin, represented by the value at the minimum point of the QV curve, shall be greater than the size of a nearby capacitor bank or reactive power device.

### E.3.7.2 Weak Grid Assessment

Weak power systems are more susceptible to voltage transients and can be exacerbated by control instabilities. Short circuit ratio (SCR) is the most basic metric to assess the relative strength of an electrical system for a specific area when evaluating performance of a specific IBR<sup>25</sup>. For system planning purposes, a more appropriate quantity is the weighted short circuit ratio (WSCR)<sup>26</sup>, defined by:

<sup>25</sup> NERC Reliability Guideline – Integrating Variable Energy Resources into Weak Power Systems

<sup>26</sup> Electranix, System Strength Assessment of the Panhandle System, Electric Reliability Council of Texas, 2016

$$WSCR = \frac{\sum_i^N SCMVA_i * P_{RMW_i}}{(\sum_i^N P_{RMW_i})^2}$$

Where **SCMVA<sub>i</sub>** is the short circuit capacity at bus **i** and **P<sub>RMW<sub>i</sub></sub>** is the MW rating of the IBR; **N** is the number of total IBR fully interacting with each other and **i** is the IBR index. The WSCR takes into account the aggregate IBR of the system to ensure the system has sufficient short circuit current for transient voltage stability. There is currently no industry standard for WSCR of a transmission system.

## Control Stability

Control stability refers to the behavior of grid-connected IBR like wind and solar PV plants to operate in a stable manner for both small disturbances and large disturbances on the grid over a wide range of operating conditions and disturbances. Unstable behavior can result in oscillatory behavior, extreme overshoots in voltage or current, and/or a failure to ride-through a disturbance. The stability of equipment controls is impacted by many factors, including equipment tuning, operating conditions, grid strength, disturbance types, and the electrical proximity to other IBR or synchronous machines on the grid, among others.

As more IBR with complex control systems connect to the system, it is important to assess the control stability of these resources to assess the robustness of controls to the range of expected operating conditions over the planning horizon. This will be done through a combination of screening, scenario modeling, and testing/demonstration of performance. As such, supplying accurate and sufficiently detailed models of equipment and functional descriptions of equipment control and protection schemes is necessary well in advance of interconnection. Equipment performance will be evaluated for combinations of:

- Full and partial power operating conditions, high and low voltages (within continuous limits)
- Symmetric and asymmetric fault disturbances (with reclosing), line switching disturbances, loss of generation and load disturbances
- Low grid strength conditions

The system shall maintain operating equilibrium with acceptable damping ratio of 3% for all reasonable combinations of planned outages and system contingencies defined in Section 8.4. Power oscillations exhibit an acceptable damping ratio of 3% when the oscillation magnitude decreases by 17% over the first period of oscillation, or by 53% over four periods of oscillations.

### E.3.7.3 Rotor Angle Stability Criteria

Rotor angle stability simulations involve the evaluation of critical clearing times ("CCT") for close-in faults to generating stations, generating units, and transmission lines. Generator rotor angle deviation with respect to a "distant" generator shall be less than 180 degrees to prevent generator pole-slipping and in addition to avoiding loss of synchronism. Dynamic performance shall exhibit acceptable damping to ensure rotor angle

stability. Pole-slipping could impose mechanical stress on the generator shaft and could result in catastrophic failure of the unit.

## Critical Clearing Times

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The Transmission Planning Department performs Stability simulations using the standard fault clearing times for breakers provided by the System Protection Department. If a fault event results in a planning criteria violation, the Transmission Planning Department shall determine the CCT for that event and will provide it to the System Protection Department for its review and feedback. If the CCT cannot be achieved by the existing protective devices, Transmission Planning Department will work with System Protection Department to develop appropriate mitigation measures. Such mitigation measures may include but are not limited to the system protection upgrade, generator size or power export reduction, application of synchronous condenser or adjustments to resource commitment as applicable.

### E.3.7.4 Frequency Stability

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Frequency stability is determined by 1) the amount of inertia on the system; 2) the amount and response characteristics of fast-frequency and primary frequency response reserves on the system; and 3) the magnitude of the generation Contingency. The system shall carry sufficient, fast and timely delivered frequency response (including some combination of rotating machine inertia, frequency response reserves, and inverter-based frequency response capabilities) to mitigate credible contingencies, including expected aggregate loss of distributed energy resources in response to the Contingency events, with appropriate Non-Consequential Load Loss criteria defined in Section E.3.8. In order to meet these criteria, mitigation measures may require establishing minimum inertia requirement for a generation loss event.

## Planning Criteria for Stability

---

Stability of an electric power system is the attribute of the system to regain a state of operating equilibrium after being subjected to disrupting forces (Contingency events), such that the majority of the system remains intact. Generating units and transmission Elements must remain online and in synchronism with the system to prevent an island-wide blackout. Therefore, the Transmission System shall be tested by simulating frequent Contingency events and reasonable cascading contingency events that may occur on the system to ensure operating equilibrium is restored.

- 1) For the more frequent types of contingencies listed below, not more than one generating unit can disconnect from the system, all remaining generating units must remain connected and synchronized to the system, all generating units must participate towards beneficial system response, no circuits should trip on stability swings, transient voltage stability must be maintained, and Non-Consequential Load Loss defined in Section E.3.8 is allowable.



- o Normally cleared, three-phase faults on transmission lines with automatic reclosing as applicable to the circuit being analyzed.
  - o Delayed clearing of three-phase faults due to failure of the pilot relay on circuits that have one pilot scheme, and one step-distance scheme for backup to the pilot scheme. Dual-pilot relay schemes require independent communication technologies (e.g., both microwave and fiber-optic cable) to mitigate failure of single-pilot relay schemes. Analysis shall be performed for the simulation of the longest delayed clearing time scenario.
  - o Delayed clearing of single line-to-ground faults due to failure of a circuit breaker to open. Exceptions include small units (e.g., internal combustion engines) that share a common generator step-up transformer and combined-cycle units. Other exceptions will be considered on a case-by-case basis.
- 2) For the less frequent contingencies listed below, increased amounts of Non-Consequential Load Loss or generator tripping may be required to prevent equipment damage and maintain Stability.
- o Sudden loss of all transmission lines emanating from a power plant switching station.
  - o Sudden loss of all transmission lines in a common right-of-way.
  - o Sudden loss of any combined cycle units or any two synchronous generating units (synchronous, asynchronous, or both), including any aggregate loss of DER.
  - o Sudden loss of any combination of two transmission Elements.
  - o Cascading loss of generation
- 3) Extreme Events – For Extreme Events system preservation shall be tested. An objective of the planning process should be to minimize the likelihood and magnitude of Non-Consequential Load Loss following Contingency events. If any Extreme Events result in an island-wide blackout, mitigation measures shall be formulated and analyzed to see if a reasonable solution can be implemented. Examples of Extreme Events include but are not limited to:
- o A three-phase fault on generator, transmission circuit, transformer or bus section with stuck breaker resulting in delayed fault clearing
  - o A three-phase fault on generator, transmission circuit, transformer or bus section with failure of a non-redundant component of a Protection System resulting in delayed fault clearing
  - o Three phase internal breaker fault
  - o Other events based upon operating experience, such as consideration of initiating events that experience suggests may result in wide area disturbances

### E.3.8 TRANSMISSION PLANNING ASSESSMENT

A Planning Assessment of the Transmission System must be performed on an annual basis to ensure compliance with these criteria for the Near-Term Planning Horizon and Long-Term Planning Horizons. This

Planning Assessment must use current models to analyze steady-state, dynamic, and transient system stability to ensure compliance with these criteria. Updated assumptions, forecasts, and study results shall be summarized and documented in a report.

### E.3.8.1 Near-Term Transmission Planning Horizon

---

The Near-Term Transmission Planning Horizon should assess a five-year period and evaluate year one, year five, and any other year in between that has a significant system change, e.g., the planned addition or deactivation of a generating unit, the addition of a transmission line, etc. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load
- Night minimum load

Base cases may include consideration of each major unit outage period. Sensitivity cases may include consideration of system conditions and operating periods beyond the conditions listed above.

For each of these periods, only the applicable Stability analysis and system events shall be performed. Additional sensitivity cases and/or analyses should be performed on an as-needed basis to ensure system performance meets the stability criteria specified in Section E.3.7, and may be informed by identified operational constraints.

The Planning Assessment should periodically analyze cascading Contingency events to ensure preservation of the system for plausible planning events. As a minimum, the system shall meet performance requirements of Planning Events P5 through P7 from Table E-11.

### E.3.8.2 Long-Term Transmission Planning Horizon

---

The Long-Term Transmission Planning Horizon should be performed in conjunction with the Integrated Grid Planning process. Evaluation years will be dictated by the proposed resource plans. As a minimum, the study shall assess system performance for the following operating periods and conditions:

- Day minimum load (high DER, low gross load)
- Day peak load (low DER, high gross load)
- Evening peak load
- Night minimum load

For each of these periods, only the applicable Stability analysis and system events shall be performed. Models of future generating units will not be readily available; therefore, discretion should be used in: 1)

developing the scope of work and sensitivity cases for this Planning Assessment and 2) interpreting results of these analyses.

### E.3.8.3 Past Studies

---

Past studies may be used to support the Planning Assessment if they meet the following requirements:

- For steady state, short circuit, or Stability analysis:
  - The study must contain a technical rationale that can be provided to demonstrate that the results of an older study are still valid, or
  - No material changes have occurred to the system represented in the study. Documentation to support the technical rationale for determining material changes must be included.

### E.3.8.4 Planning Events

---

As a minimum, the Stability criteria in E.3.7 ensures that the transmission system meets or exceeds the performance requirements of Planning Events P1 through P4 in Table E-11. A periodic assessment of the under-frequency load shed scheme should be performed to ensure that the system meets the minimum requirements of Planning Events P5 through P7 in Table E-11.

**Table E-10: Steady state and stability performance planning events.**

|                                                                                                                                                                                                                    |  |  |  |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|--|
| Steady State & Stability:                                                                                                                                                                                          |  |  |  |  |
| 1. The system must remain stable. Cascading and uncontrolled islanding shall not occur.                                                                                                                            |  |  |  |  |
| 2. Consequential Load Loss as well as generation loss is acceptable as a consequence of any event excluding P0.                                                                                                    |  |  |  |  |
| 3. Simulate the removal of all elements that Protection Systems and other controls are expected to automatically disconnect for each event.                                                                        |  |  |  |  |
| 4. Simulate normal clearing unless otherwise specified.                                                                                                                                                            |  |  |  |  |
| 5. Planned system adjustments such as transmission configuration changes and re-dispatch of generation are allowed if such adjustments are executable within the time duration applicable to the Equipment Rating. |  |  |  |  |
| 6. Phase angle separation for line Contingency shall not preclude automatic reclosing unless system adjustments can be performed within fifteen minutes.                                                           |  |  |  |  |
| Steady State Only:                                                                                                                                                                                                 |  |  |  |  |
| 7. Applicable Equipment Rating must not be exceeded.                                                                                                                                                               |  |  |  |  |
| 8. System steady state voltages and post-Contingency voltage deviations must be within acceptable limits as established by this Planning Criteria.                                                                 |  |  |  |  |
| 9. Planning event P0 is applicable to steady state only.                                                                                                                                                           |  |  |  |  |

**Table E-11: Categories of contingency events.**

| Category                 | Initial Condition                                                                               | Event                                                                                                                                                             | Fault(s) Type <sup>1</sup> | Non- Consequential Load Loss Allowed |
|--------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------------------------------------|
| P0<br>No Contingency     | Normal system                                                                                   | None                                                                                                                                                              | N/A                        | None                                 |
| P1<br>Single Contingency | Normal system                                                                                   | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device-Ancillary Service Device <sup>3</sup> | 3Ø                         | Up to 15% for Generator Trip Only    |
|                          |                                                                                                 | 5. Generator – no fault                                                                                                                                           | N/A                        |                                      |
| P2<br>Single Contingency | Normal system                                                                                   | 1. Bus Section fault<br>2. Internal Breaker Fault <sup>4</sup> (Transmission line breaker)                                                                        | 3Ø                         | Up to 15%                            |
| P3<br>Single Contingency | Loss of generator unit followed by system adjustments (e.g., corrective action and re-dispatch) | Loss of one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer<br>4. Shunt Device/ Ancillary Service Device                          | 3Ø                         | Up to 20%                            |
| P4<br>Multiple           | Normal system                                                                                   | Loss of multiple elements caused by a stuck breaker <sup>5</sup> (non-Bus-tie Breaker) attempting to clear a fault on one of the following:                       | SLG                        | Up to 40%                            |

|                                                                                                              |                                                                                                                                               |                                                                                                                                                                                                                                                                                                             |     |           |
|--------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|-----------|
| Contingency (Fault plus stuck breaker <sup>5</sup> )                                                         |                                                                                                                                               | 1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section                                                                                                                                                                                   |     |           |
|                                                                                                              |                                                                                                                                               | 6. Loss of multiple elements caused by a stuck breaker <sup>5</sup> (Bus-tie Breaker) attempting to clear a fault on the associated bus                                                                                                                                                                     | SLG | Up to 40% |
| P5<br>Multiple<br>Contingency (Fault plus non-redundant component of a Protection System failure to operate) | Normal system                                                                                                                                 | Delayed fault clearing due to the failure of a non-redundant component of a Protection System protecting the faulted element to operate as designed, for one of the following:<br>1. Generator<br>2. Transmission Circuits<br>3. Transformer <sup>2</sup><br>4. Shunt Device <sup>3</sup><br>5. Bus Section | 3Ø  | Up to 15% |
| P6<br>Multiple<br>Contingency (Two overlapping singles)                                                      | Loss of one of the followed by system adjustments:<br>1. Transmission Circuits<br>2. Transformer <sup>2</sup><br>3. Shunt Device <sup>3</sup> | Loss of one of the following:<br>1. Transmission Circuits<br>2. Transformer <sup>2</sup><br>3. Shunt Device <sup>3</sup>                                                                                                                                                                                    | 3Ø  | Up to 65% |
| P7<br>Multiple<br>Contingency                                                                                | Normal system                                                                                                                                 | Loss of one of the following:<br>1. Cascading Generators<br>2. Transmission Corridor<br>3. Any two adjacent circuits on common structure                                                                                                                                                                    | SLG | Up to 65% |

**Table E-12: Steady state & stability performance extreme events.**

#### Steady State & Stability

For all extreme events evaluated:

**1. Simulate the removal of all elements that Protection Systems and automatic controls are expected to disconnect for each Contingency.**

**2. Simulate normal clearing unless otherwise specified.**

#### Steady State

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service followed by another single generator, transmission circuit, shunt device, or transformer forced out of service prior to system adjustments.
2. Local area events affecting the Transmission System such as:

#### Stability

1. Loss of a single generator, transmission circuit, shunt device, or transformer force out of service apply a 3Ø fault on another single generator, transmission circuit, shunt device, or transformer prior to system adjustments.
2. Local area events affecting the Transmission System such as:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>a. Loss of a tower line with three or more circuits<sup>6</sup>.</li> <li>b. Loss of all transmission lines on a common Right-of-Way<sup>6</sup></li> <li>c. Loss of a switching station or substation (loss of one voltage level plus transformers).</li> <li>d. Loss of all generating units at a generating station.</li> <li>e. Loss of a large load or major load center.</li> </ul> <p>3. Wide area events affecting the Transmission System based on system topology such as:</p> <ul style="list-style-type: none"> <li>a. Loss of two generating stations resulting from conditions such as: <ul style="list-style-type: none"> <li>i. Loss of a large fuel line into an area.</li> <li>ii. Loss of the use of a large body of water as the cooling source for generation.</li> <li>iii. Wildfires</li> <li>iv. Severe weather, for example, hurricanes</li> <li>v. A successful cyber attack</li> <li>vi. Large earthquake, tsunami or volcanic eruption</li> </ul> </li> <li>b. Other events based upon operating experience that may result in wide area disturbances.</li> </ul> | <ul style="list-style-type: none"> <li>a. 3Ø fault on generator with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.</li> <li>b. 3Ø fault on transmission circuit with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.</li> <li>c. 3Ø fault on transformer with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.</li> <li>d. 3Ø fault on bus section with stuck breaker<sup>5</sup> or a relay failure resulting in delayed fault clearing.</li> <li>e. 3Ø internal breaker fault<sup>4</sup>.</li> <li>f. Other events based upon operating experience, such as consideration of initiating events that experience, such as consideration of initiating events that experience suggests may result in wide area disturbances.</li> </ul> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Table E-13: Steady state & stability performance footnotes**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>Planning Events and Extreme Events</p> <ul style="list-style-type: none"> <li>1. Unless specified otherwise, simulate Normal Clearing of faults. Single line to ground (SLG) or three-phase (3Ø) are the fault types that must be evaluated in Stability simulations for the event described. A 3Ø or a double line to ground fault study indicating the criteria are being met is sufficient evidence that a SLG condition would also meet the criteria</li> <li>2. For non-generator step up transformer outage events, the reference voltage, applies to the low-side winding (excluding tertiary windings). For generator and Generator Step Up transformer outage events, the reference voltage applies to the BES connected voltage (high-side of the Generator Step Up transformer). Requirements which are applicable to transformers also apply to variable frequency transformers and phase shifting transformers.</li> <li>3. Requirements which are applicable to shunt devices also apply to FACTS devices that are connected to ground.</li> <li>4. An internal breaker fault means a breaker failing internally, thus creating a System fault which must be cleared by protection on both sides of the breaker.</li> </ul> |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

5. A stuck breaker means that for a gang-operated breaker, all three phases of the breaker have remained closed. For an independent pole operated (IPO) or an independent pole tripping (IPT) breaker, only one pole is assumed to remain closed. A stuck breaker results in Delayed Fault Clearing.
6. Excludes circuits that share a common structure (Planning event P7, Extreme event steady state 2a) or common Right-of-Way (Extreme event, steady state 2b) for 1 mile or less.

For purposes of this standard, non-redundant components of a Protection System to consider are as follows:

- a. A single protective relay which responds to electrical quantities, without an alternative (which may or may not respond to electrical quantities) that provides comparable Normal Clearing times;
- b. A single communications system associated with protective functions, necessary for correct operation of a communication-aided protection scheme required for Normal Clearing (an exception is a single communications system that is both monitored and reported at a Control Center);
- c. A single station dc supply associated with protective functions required for Normal Clearing (an exception is a single station dc supply that is both monitored and reported at a Control Center for both low voltage and open circuit);
- d. A single control circuitry (including auxiliary relays and lockout relays) associated with protective functions, from the dc supply through and including the trip coil(s) of the circuit breakers or other interrupting devices, required for Normal Clearing (the trip coil may be excluded if it is both monitored and reported at a Control Center).

# Appendix F. Distribution Planning Methodology

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## F.1.1 BACKGROUND

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This document was filed as part of the IGP First Cycle to explain the distribution planning process and is now being revised to reflect the analysis performed in the First Cycle. The major change to the document is in the Hosting Capacity Analysis portion because the process used in the IGP First Cycle and explained in the Distribution DER Hosting Capacity Grid Needs<sup>27</sup> are now being incorporated into the methodology. Other minor revisions have also been made to clarify and update old information. This revised methodology document will be submitted to the TAP for feedback and updated as necessary at a later time.

## F.1.2 INTRODUCTION

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As it strives to provide 100 percent renewable energy by 2045, Hawaiian Electric (Company) faces an unprecedented situation: a comprehensive transformation of its five electric power grids. Attaining the state's renewable energy goals represents uncharted territory for both short-term and long-term resource planning. Performing the analyses necessary to attain this goal is a complicated resource planning process, requiring new tools and new processes: modeling across generation, transmission, distribution, infrastructure, and behind-the-meter resource options. This report describes the distribution planning methodology used to analyze the current state of the grid and its capability to meet future needs. Through this process, grid needs essential to support the transformation to a clean energy future are identified and solution options are explored.

The Company's distribution system is the part of its electric power system that distributes or disperses power to individual customers. The electrical distribution system (commonly referred to as the distribution grid) was originally planned and designed for the sole purpose of delivering electricity to customers from a small number of large power plants. In general, power flowed in only one direction, and it did not have to be flexible or adaptable—just strong and reliable.

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<sup>27</sup> Hawaiian Electric, *Distribution DER Hosting Capacity Grid Needs*, Exhibit 4 in Grid Needs Assessment Methodology Review Point, filed November 5, 2021 in HPUC Docket No. 2018-0165



Because centralized power plants have provided all of the power for its customers, the Company's traditional distribution planning methodology did not have to consider power generation. Instead, its methodology concentrated only on developing a distribution system that had the capacity to serve customers while maintaining power quality and a high level of reliability. Any deficiencies in the distribution system were solved by upgrades to the existing electrical system, including the installation of more substation transformers, more circuits, larger circuits, or larger distribution substation transformers.

Today, power plants can be found everywhere, connected to the distribution system in the form of privately owned rooftop solar systems, for example, that send power back onto the grid to serve other customers. The Company recognizes the potential and value of these distributed energy resources (DER) and agrees with the Commission's direction to "include the locational benefits of customer-sited distributed energy resources"<sup>28</sup> in the distribution planning process.

As the power supply and electrical distribution systems transition to an integrated system, the planning processes must also transition. Hence today's distribution planning methodology must ensure the orderly expansion of the distribution system and fulfill the following core functions:

- Plan the distribution system's capability to serve new and future electrical load growth, including electric vehicle (EV) growth
- Safely interconnect DER, such as photovoltaic (PV) systems and energy storage systems that transmit power across the system in a two-way flow, while maintaining power quality and reliability for all customers
- Incorporate the locational benefits of DER in the evaluation of grid needs and system upgrades

The Company engaged with customers and stakeholders to seek input and feedback on the distribution planning methodology as part of the Distribution Planning Working Group in the First Cycle of IGP. This afforded opportunities for stakeholders to collaborate and co-develop the Company's distribution planning methodology for identifying grid needs.

### F.1.3 SCOPE

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The objective of this report is to describe the first three stages of the distribution planning process, particularly the planning methodology that will be used to identify distribution grid needs. The grid needs will be the foundation that drives solution options, including non-wires alternative (NWA) opportunities.

This report is a Distribution Planning Working Group deliverable as described in the Integrated Grid Planning (IGP) Workplan accepted by the Commission.<sup>29</sup>

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<sup>28</sup> HPUC Docket No. 2018-0055, Decision and Order No. 36288 Ka'aahi Substation, filed May 3, 2019, at 22.

<sup>29</sup> HPUC Order No. 36218, Accepting the IGP Workplan and Providing Guidance, Docket No. 2018-0165.

## F.2 DISTRIBUTION PLANNING PROCESS

### F.2.1 OVERVIEW

The distribution planning process occurs annually and includes four stages: forecast, analysis, solution options, and evaluation (see Figure F-1). This report focuses on the first three stages, and the fourth stage is described in the *Non-Wires Opportunity Evaluation Methodology* (Appendix H below).

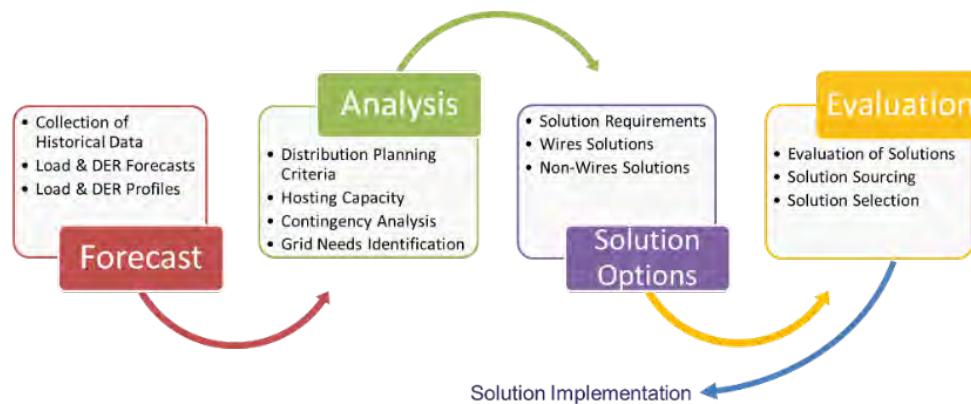


**Figure F-1: Stages of the distribution planning process.**

### F.2.2 STAGES

The forecast stage begins at the start of the calendar year when the prior year's data and corporate demand forecast are available for analysis (see Figure F-2). LoadSEER, an integrated spatial load forecasting product developed by Integral Analytics, Inc., is used to create circuit- and transformer-level<sup>30</sup> forecasts.

The analysis stage involves the analysis of the electrical system to ensure that there is adequate capacity and reliability (back-tie capabilities). Planning criteria have been established that provide the basis for determining the adequacy of the electric distribution system. In situations where the criteria are not met, grid needs are identified.

In the solution options stage, requirements to meet the grid needs are determined, and wires and non-wires options are developed. These options are evaluated in the fourth stage of the distribution planning process, which is discussed in the *Non-Wires Opportunity Evaluation Methodology* report.

<sup>30</sup> Transformer – Unless stated otherwise, defined throughout document as substation transformer.

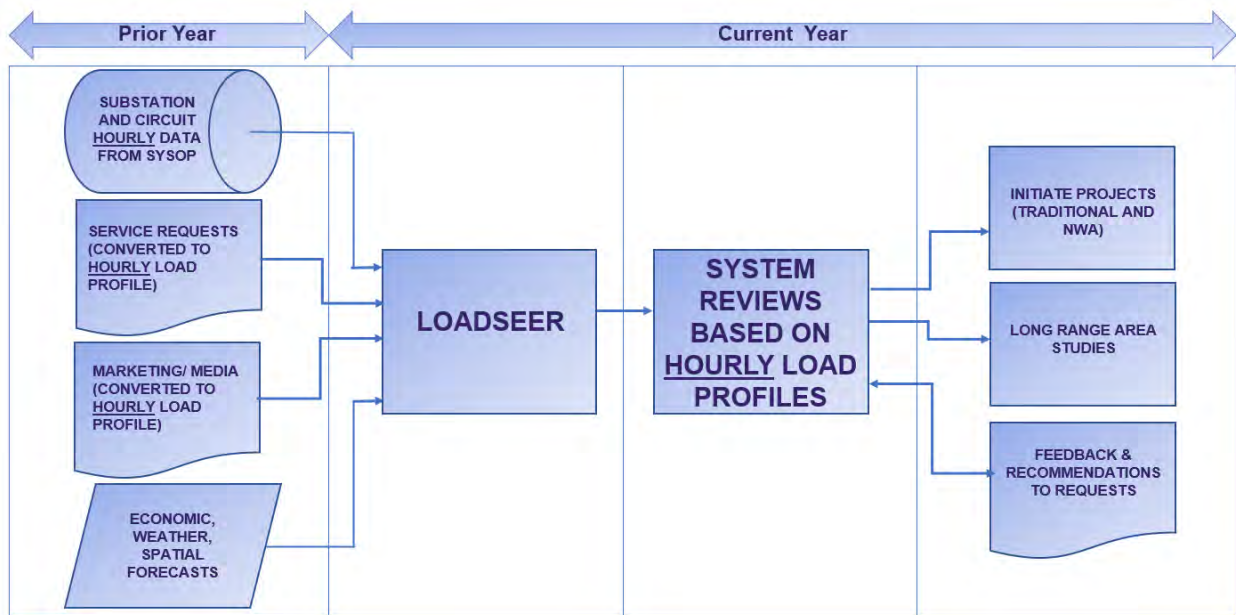


**Figure F-2: Data from prior years used for current year analysis.**

It is worth noting that during the calendar year, it is expected that new service requests or projects will arise that will require modifications to the circuit- and or transformer-level forecasts. The Company will, therefore, continually evaluate grid needs throughout the year and make decisions on when to address any grid deficiencies identified outside of the forecast and analysis stages.

## F.3 FORECAST STAGE

During the forecast stage of the distribution planning process, the Company develops a corporate demand forecast and uses LoadSEER to create circuit- and transformer-level forecasts.

### F.3.1 CORPORATE DEMAND FORECAST

The Company develops a corporate demand forecast that will be used throughout the distribution planning process. This forecast is built with layers that include net load sales, DER (PV and battery energy storage system), energy efficiency (EE), and EV. The corporate forecast is developed as an 8760 for the Company by layers. The 8760 is named for the number of data points it contains: one for every hour of every day of the year ( $24 \times 365 = 8760$ ). For further information on the methodology of developing the corporate forecast, see the Inputs and Assumptions for the Second Cycle of IGP being filed along with this document.<sup>31</sup>

<sup>31</sup> Hawaiian Electric, Integrated Grid Planning Second Cycle Inputs and Assumptions

## F.3.2 LOADSEER

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LoadSEER is recognized as an industry-leading tool for use in forecasting and integrating DER with distribution planning.<sup>32</sup> LoadSEER has been adopted by the Company as a key component to advancing the distribution planning methodology. This electric load forecasting software uses the Company's corporate load forecasts and a multitude of other inputs (see Figure F-2). to create forecasts at the circuit and transformer level.

The objective of LoadSEER is to statistically represent the geographic, economic, and weather diversity across a utility's service territory, and to use that information to forecast how circuit- and transformer-level hourly load profiles will change over the forecast horizon. Because of the complexity of the forecasting challenge, LoadSEER employs multiple statistical methods, including hourly load modeling, macro-economic modeling, customer-level economic modeling, and geospatial agent-based modeling, which taken together increase the validity and reduce uncertainty associated with the forecasts.

### F.3.2.1 Circuit-Level Forecasts

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The allocation of the forecasts to the circuit level is accomplished by integrating geospatial factors, historian data, historical and forecast weather, and customer billing information. This provides the granular data sets that are required to properly analyze the integration of increasingly dynamic DER.

LoadSEER employs familiar econometric forecasting methods at the circuit level and adds GIS-based spatial forecasting capabilities to aid in the identification of granular pockets of load growth, changes in loads, and load shape alterations that occur over time. Using these forecasting and modeling methodologies, LoadSEER is able to produce circuit-level new load, DER, EE, and EV forecasts.

### F.3.2.2 Granular Data Sets

---

Traditionally, non-coincident peak loading was used in the distribution planning process. For instance, the peak load for a new service that was proposed to be energized in year X was added to the peak load forecast for year X to determine the new forecast. If the peak load for the new service did not occur at the same time as the peak load for the circuit or transformer, the resultant peak forecast may be overestimated.

The Company has recognized that this methodology does not account for the temporal nature of load and, in a similar manner, does not properly evaluate the effect of DER. By using LoadSEER, the annual circuit-level peak load has been replaced by an 8760 hourly load profile as the mechanism for

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<sup>32</sup> See

forecasting future load. While traditional planning used one value to plan for a year, this methodology uses a large set of hourly profiles.

### F.3.2.3 Forecasting Tools

A component of LoadSEER is SCADA Scrubber (see Figure F-3). This tool takes the hourly data and analyzes it for trends, which the tool then uses to normalize periods where planned maintenance or system interruptions occurred.

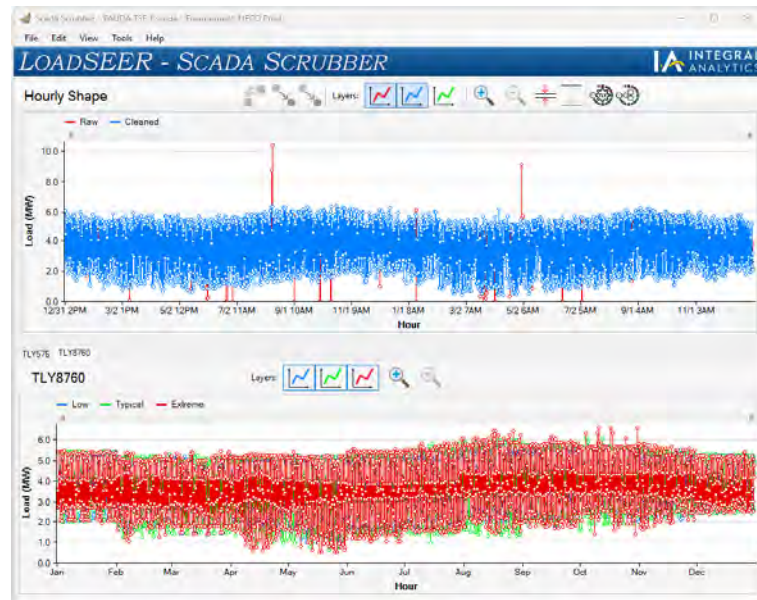


**Figure F-3: LoadSEER SCADA scrubber screenshot.**

After the data has been “cleaned,” 8760 profiles based on actual data are available to determine the historical peak load and to provide base profiles for future year forecasts.

New load requests, DER requests, and marketing and media information of new developments that have been received in the past calendar year are used to refine the forecasts at the circuit and transformer level. Normally, customers who submit new service requests to the Company provide only a peak load estimate and a rough in-service date. As such, LoadSEER has default commercial and residential load profile shapes that are based on the Company’s actual commercial and residential load profiles, respectively (see Figure F-4). The Company is continuing to explore ways to work with large real estate developers to gain better insight and local knowledge to inform load forecasts, such as, to the extent possible, requiring developers to provide expected load profiles of their developments rather than just a peak megawatt load increase.



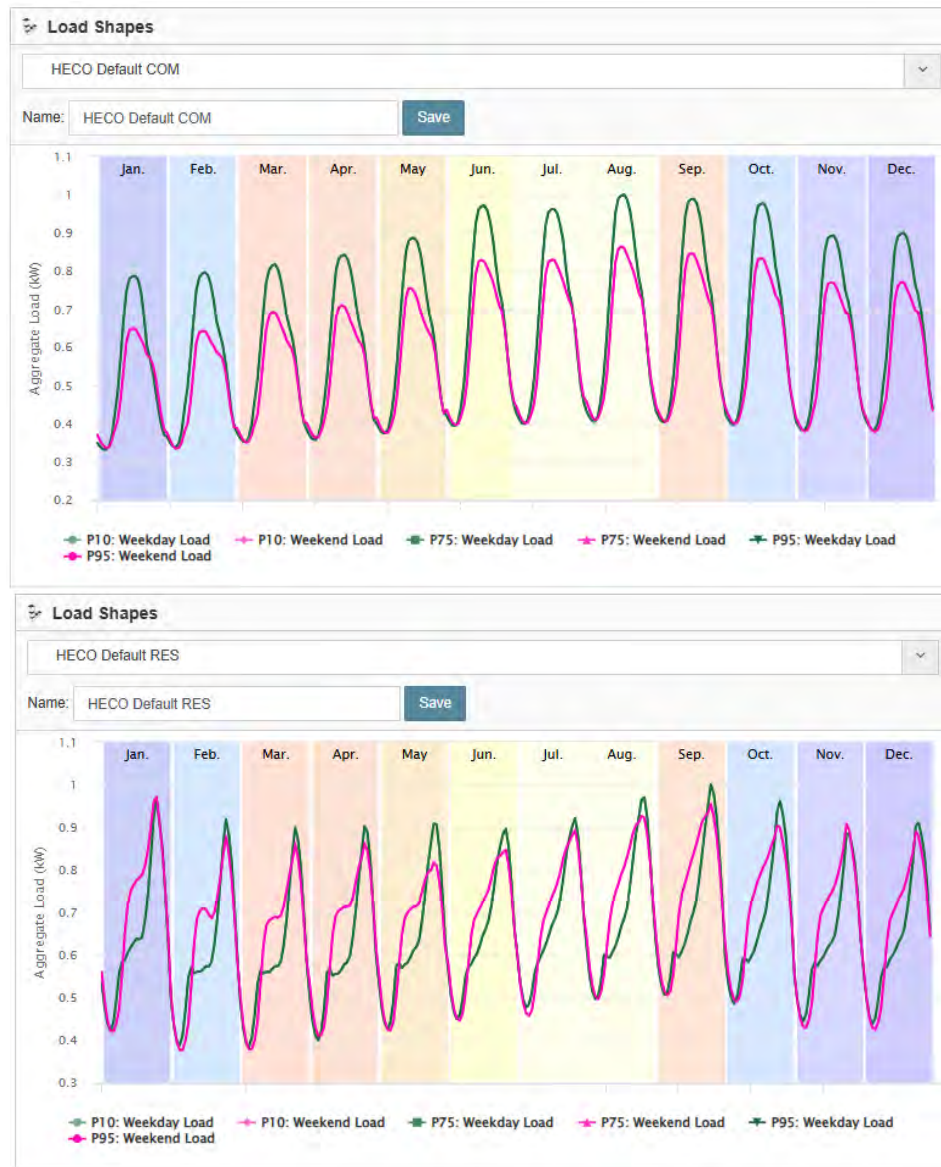


**Figure F-4: Scalable commercial and residential profiles developed with AMI.**

The Company completed AMI deployment in 2024 and has worked with Integral Analytics to update those default residential and commercial profiles based on AMI data. These customer class profiles are used to scale the peak load estimates for the new developments to create a proxy load profile. Similarly, a load profile of an existing, comparable customer could be used in this manner. This local knowledge is a key component because it generally has the greatest impact on circuit-level forecasts.

LoadSEER also has tools to apply various scenarios to the forecasts. This helps to manage the different scenarios of the corporate forecasts and to organize the resultant circuit-level forecasts for reporting.

## F.4 ANALYSIS STAGE

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During the analysis stage of the distribution planning process the Company uses various tools, such as Synergi and LoadSEER, to analyze the grid conditions and forecasts against the distribution planning criteria to determine the adequacy of the electric distribution system. In addition, the Company assesses DER hosting capacity, conducts a contingency analysis, and identifies grid needs.

### F.4.1 DISTRIBUTION PLANNING CRITERIA

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Distribution planning criteria have been established as technical guidelines to ensure that the distribution system has adequate capacity and reliability for the Company's customers. Hence, the distribution system is planned and designed to operate under both normal and contingency conditions. In addition, it is important to consider normal and contingency overloads, and thermal and voltage issues.

#### F.4.1.1 Normal Conditions

---

The distribution system, or a subset of the distribution system, is operating under normal conditions when all circuits and transformers in the subject area are configured and operating as designed. Under this normal condition, the circuits and transformers are planned to have adequate capacity to serve electrical peak load. With DER, the circuits and transformers are also planned to have adequate capacity for the backflow of generation caused by the DER.

#### F.4.1.2 Contingency N-1 Conditions

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The distribution system, or a subset of the distribution system, is operating under contingency conditions when one or more circuits or one or more transformers are out of service. HECO's planning process primarily focuses on the substation distribution transformer and mainline feeder levels. HECO's radial distribution system is planned to serve all customer load under both normal conditions and the loss of a single element, which is also referred to as an N-1 scenario. A circuit or transformer may be out of service or de-energized because of equipment failure or planned maintenance. As such, a level of capacity must be available on the circuits and transformers to be available to serve the Company's customers during these N-1 scenarios. For instance, because an adjacent circuit or transformer is often used as a backup source for another circuit or transformer, N-1 scenarios also need to be analyzed to ensure that back-tie capacity is available.

### F.4.1.3 Normal and Contingency Overloads

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Normal overload occurs when the load exceeds the normal equipment rating of distribution circuits or distribution substation transformers under normal operating conditions. Future normal overloads are identified by comparing the forecasted load with the equipment rating.

Contingency overload occurs when the load exceeds the emergency equipment ratings of a piece of equipment due to other equipment failure or other equipment being out for maintenance. Future contingency overloads are identified by studying the forecasted load for possible contingency situations.

### F.4.1.4 Thermal and Voltage Issues

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The overload of a circuit or transformer may lead to overheating issues that will damage equipment; hence, overloads are considered thermal issues. In addition to thermal overloads, the Company also ensures that there are no voltage issues. In general, the voltage level must be maintained within 5 percent of the nominal voltage at any point on the distribution system (primary and secondary).

When circuit or transformer loading exceeds the equipment thermal ratings, damage may occur to the equipment. This damage may lead to extended service interruptions and high maintenance expenses. Low or high voltage may lead to power quality issues that could damage customer-owned equipment or cause nuisance electrical issues, such as flickering light or tripping of equipment.

## F.4.2 EQUIPMENT THERMAL RATINGS

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Distribution circuit thermal ratings are primarily based on the following factors:

- Conductor size
- Conductor material
- Number of conductors in a duct bank (underground construction)
- Temperature
- Type of insulation
- Conductor configuration

Distribution substation transformer thermal ratings for normal and contingency conditions are primarily based on the following factors:

- Manufacturer test report data
- Transformer nameplate characteristics
- Expected hourly loading
- Oil and ambient temperature
- Allowable insulation degradation (loss-of-life limits)



- o A 0 percent loss-of-life factor is the basis for the normal transformer rating.
- o A 1 percent loss-of-life factor is the basis for the emergency rating.

### F.4.3 GRID ANALYSIS AND MODELING

Analysis is necessary to identify any violations of the distribution planning criteria. The load forecasts are analyzed under normal and contingency operating conditions to determine the location, cause, and severity of any unacceptable thermal or voltage situations.

Simulations of the various normal and contingency operating conditions are analyzed using LoadSEER as well as Synergi, which is a load flow software developed by DNV. By using LoadSEER and Synergi in concert, the Company determines any existing or forecasted grid needs. Both software products also facilitate the development of solution options for the identified issues.

### F.4.4 DER HOSTING CAPACITY

During the analysis stage, DER hosting capacity is assessed to determine any future grid needs required to create capacity for future DER. The methodology involves a multi-step screening process, which increases in complexity (i.e., time and resources) to further assess the circuit's ability to host forecasted DER. The three-step process is shown in Figure F-5.

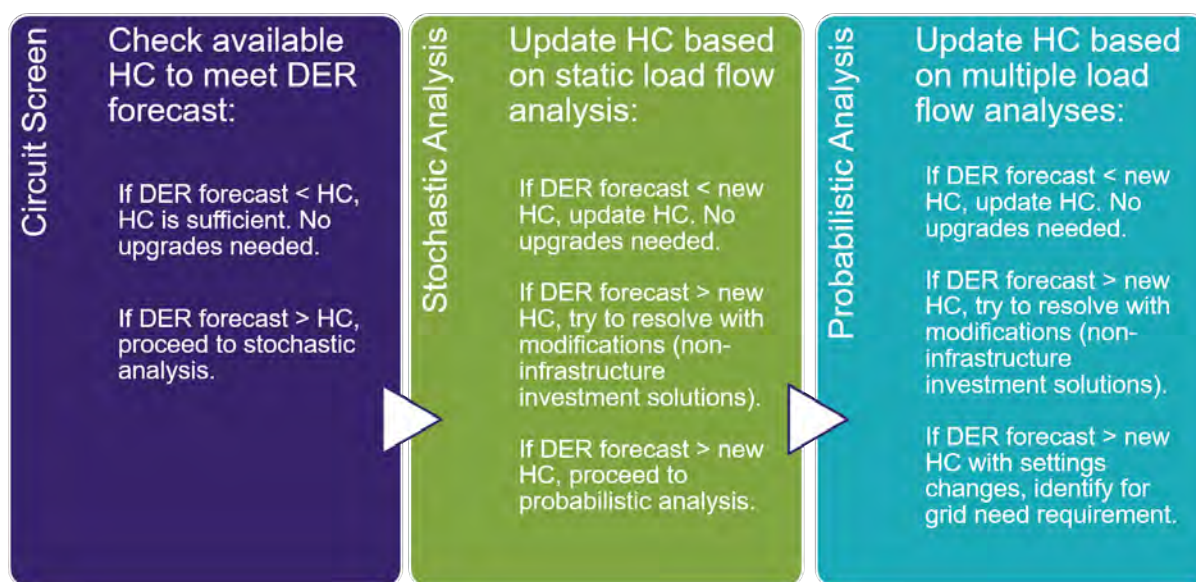


**Figure F-5: DER Hosting Capacity Methodology.**

In general, the methodology involves using Synergi to simulate DER growth to determine the maximum amount a circuit can host before any thermal or voltage violations occur. The load flow

capabilities of Synergi provide information on the location and magnitude of these issues (see Figure F-6).

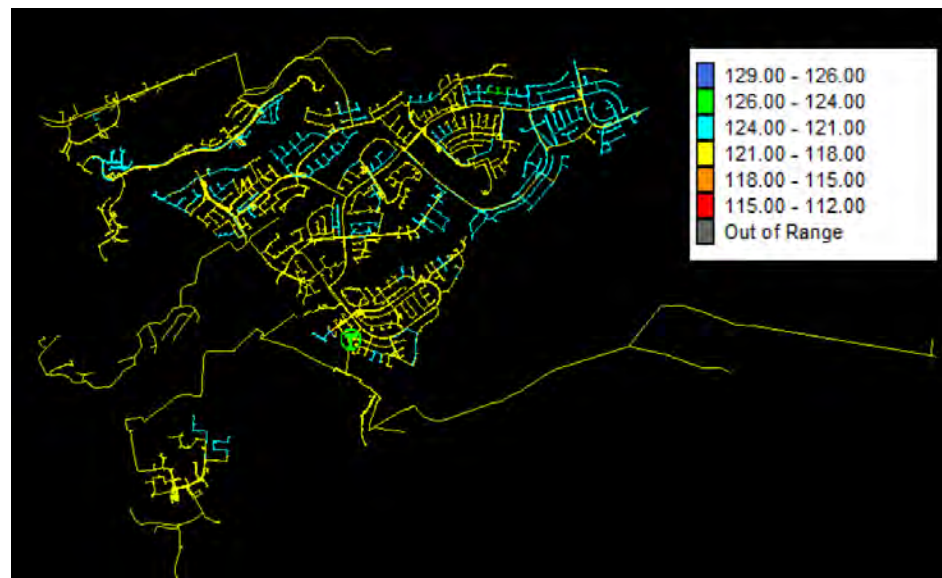


**Figure F-6: Synergi screenshot.**

Since the first cycle of IGP, DNV has released new versions of the Synergi software that are not fully compatible with the scripts developed by EPRI to perform probabilistic analysis. The Company is working with DNV to develop new probabilistic hosting capacity tools in Synergi to support performing the analysis as outlined in the methodology. This would eliminate the need to maintain the EPRI scripts and the compatibility issues with Synergi.

#### F.4.4.1 Current Hosting Capacity

The first step in the process is to compare the circuit DER forecasts to current hosting capacity. If a circuit is unable to accommodate the forecasted DER with its current hosting capacity, the circuit is selected for further analysis where the hosting capacity is reassessed.

#### F.4.4.2 Stochastic Hosting Capacity Methodology

Figure F-7 illustrates the second step, the stochastic hosting capacity methodology. DER is added to a circuit in proportion to customer load, and those amounts are grown until a violation occurs.

As illustrated, the stochastic methodology uses only a single, minimum-load profile and does not consider the capacity available during all other hours. Although this does not account for the temporal nature of solar output, this single hosting capacity figure still provides valuable screening thresholds to help determine the circuit's ability to accommodate additional DER without the need for in-depth analysis.

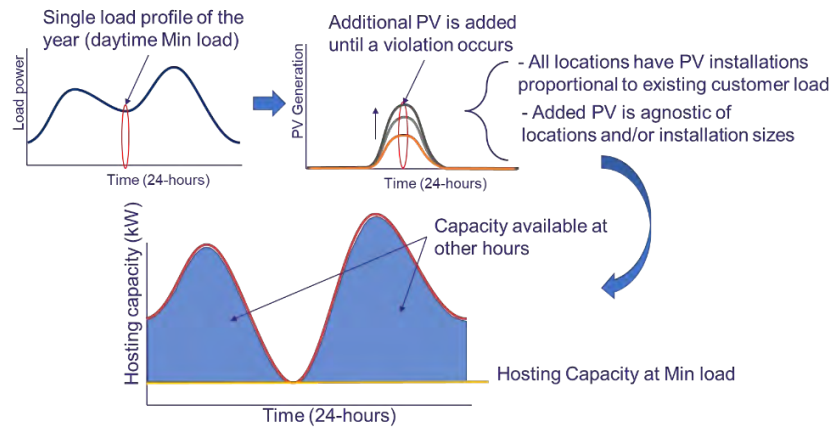


**Figure F-7: Existing hosting capacity methodology.**

If there are violations, such as high/low voltages or thermal overloads, then simple mitigation solutions such as modifications to existing equipment (i.e. modifications that do not require infrastructure investments) will be applied and simulated again. These modifications may include substation LTC settings changes, switching, or phase balancing. If no solution can be found using the stochastic method, then additional analysis may be performed using the probabilistic hosting capacity.

### F.4.4.3 Probabilistic Hosting Capacity Methodology

The next step in the methodology is the probabilistic analysis that accounts for the hosting capacity available during all hours. This is accomplished by using time-sensitive profiles of the unique DER programs as well as the modeling of advanced inverters in a time-series analysis. Furthermore, because there are many ways that DER can develop on a feeder, multiple DER growth scenarios need to be studied, applying probabilistic modeling techniques and analysis. A comparison of the stochastic hosting capacity with the probabilistic hosting capacity analysis is shown in Table F-1.

**Table F-1: Hosting Capacity Analysis Comparison**

|                               | Stochastic Hosting Capacity Analysis | Probabilistic Hosting Capacity Analysis                                        |
|-------------------------------|--------------------------------------|--------------------------------------------------------------------------------|
| DER technology representation | Solar PV only                        | Solar PV, PV-plus-battery systems including non-exporting systems and SmartDER |
| Advanced inverter functions   | Included                             | Included                                                                       |
| Temporal resolution           | Single-hour snapshot                 | Time-series simulation (576 or 8760 hours)                                     |
| Operating scenarios           | Daytime minimum-load condition       | Multiple load scenarios evaluated probabilistically                            |

|                                      | Stochastic Hosting Capacity Analysis                                     | Probabilistic Hosting Capacity Analysis                                                              |
|--------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|
| DER adoption and installation sizing | Realistic installation sizes are not represented                         | DER adoption is modeled using discrete, realistic installation sizes                                 |
| Analysis complexity                  | Low, shorter study time                                                  | High, requiring additional processing time, data inputs, and analytical resources                    |
| Analysis level of detail             | Simplified estimate of hosting capacity under selected system conditions | More comprehensive assessment considering variability in load, DER production, and adoption patterns |

The Company worked with Electric Power Research Institute (EPRI) to refine the hosting capacity analysis and develop the methodology for probabilistic hosting capacity analysis that was used in the first cycle of IGP.<sup>33</sup>

This probabilistic analysis incorporates several aspects to determine an hourly circuit hosting capacity profile. The assessment considers the effects of smart inverter functions and the temporal load characteristics of the different Company programs, such as smart-export systems, non-export systems, and storage profiles via time-based analysis.

It uses circuit-level forecasts (for example, circuit load shapes and future DER growth) that are generated from LoadSEER. The Company will use a 576-hour time-series model format that corresponds to 24-hour observations for 24 days. Typically, this represents 2 days for each month. These 2 days are either the peak/minimum load days or the weekday/weekend days of the months. Alternatively, the profile can be expanded to include as many hours as desired, such as a full 8760-hour profile representing all 365 days of the year at a 1-hour resolution.

An additional enhancement is the modeling of future DER deployments. Incorporating user input, the addition of future DER will be modeled in a more realistic manner. The size of each new residential DER is randomly chosen between the bounds defined by the user, allowing flexibility to preserve the prevalent DER size belonging to circuits in unique areas. The user also defines the threshold to identify either a commercial or residential load type. The DER is then sized according to the load type it is connected to. The size and location of future DER installations are normally unknown variables in hosting capacity analysis. Unlike the stochastic hosting capacity methodology, which simply adds DER growth in proportion to customer load, the new methodology explores

<sup>33</sup> Hawaiian Electric, Distribution Planning Working Group Meeting, November 18, 2019 (available at [https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20191204\\_dpwg\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20191204_dpwg_meeting_presentation_materials.pdf)).

multiple scenarios where DER deployments of different sizes and locations are added to the model to develop a probabilistic hosting capacity. Traditionally, hosting capacity is set by the first DER scenario, causing the first bus/element to have a violation at any instance in time. Probabilistic hosting capacity, on the other hand, allows one to consider additional hours, buses, and/or DER deployments beyond the first violation before the hosting capacity is determined.

The probabilistic hosting capacity assessment is performed in three primary steps: base case, forecasted DER, and agnostic DER. The base case assessment analyzes the existing circuit conditions for the year. The forecasted DER assessment explores multiple scenarios of adding new DER deployments onto the circuit, totaling the forecasted DER amount for the year of study. The generation profile for the forecasted DER deployments is a function of the DER size, program type, and solar irradiance for the area. Finally, the agnostic DER assessment adds agnostic DER deployments on top of the forecasted DER assessment. Full generation output is considered from each agnostic DER at each hour because it is not known how or when that resource would be online (such as solar plus storage projects), thus providing circuit impact results agnostic to future DER type. The order by which the agnostic DER is allocated is cumulatively split into a number of penetration levels that are independently analyzed so that the impacts from the additional agnostic DER can inform hosting capacity. More penetration levels can be analyzed and will effectively produce finer resolution hosting capacity results because the maximum agnostic DER penetration level scenario is always based on full feeder saturation where all customers have DER. Figure F-8 illustrates two penetration levels out of ten, which would take the feeder to 100 percent customer penetration.



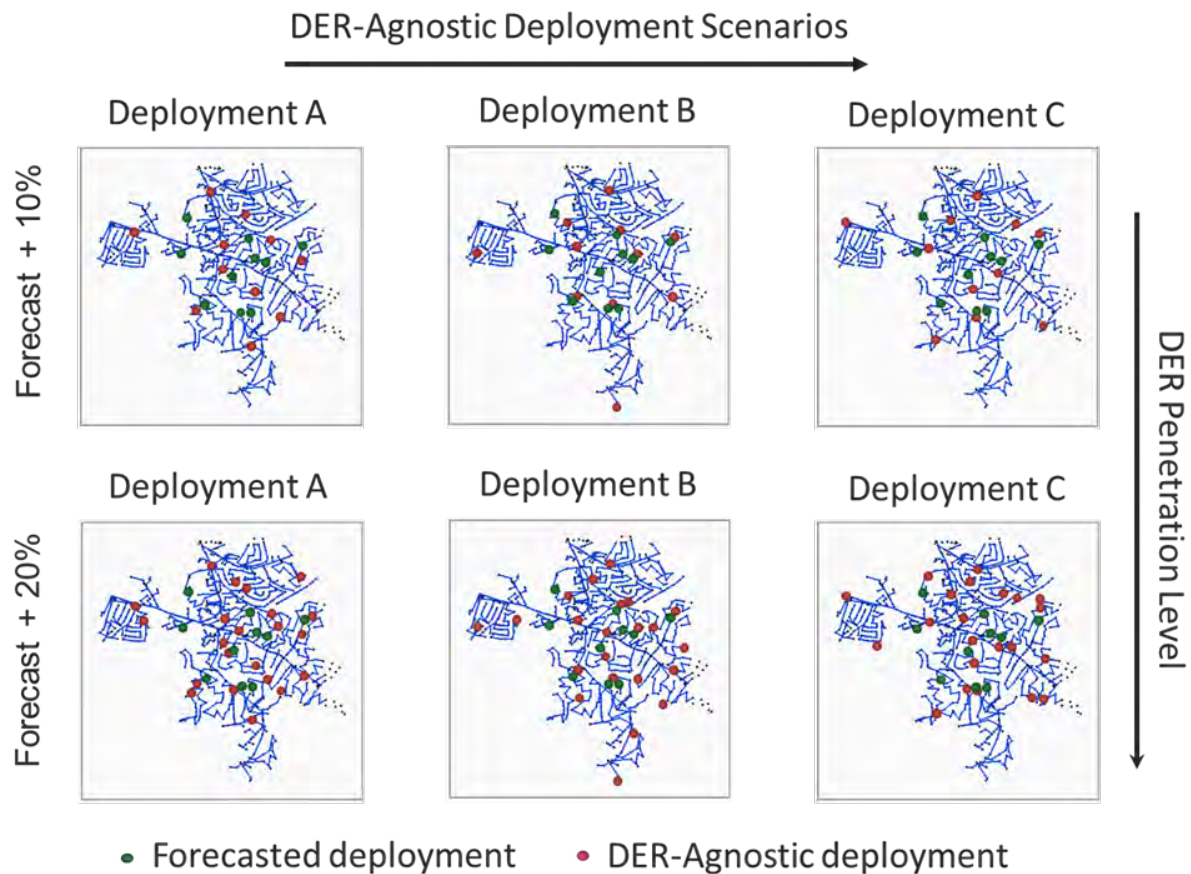


**Figure F-8: Forecasted and agnostic DER deployment scenarios.**

After each simulation, power flow data is captured to quantify impacts. This data is used to process the probabilistic hosting capacity depending on time, breadth of the violation, and number of agnostic DER deployments indicating violation. Therefore, the probabilistic hosting capacity is dependent on the number of violated hours, the number of violated locations, and the number of agnostic DER deployments experiencing a violation. In planning studies with so many variables, these probabilistic metrics are more beneficial than planning for the worst-case scenario. The worst-case scenario would identify when the first sampled condition experiences a violation, but it also has the lowest chance of occurrence/risk. The probabilistic hosting capacity allows one to identify a more likely chance of occurrence with slightly increased risk. For example, if the probabilistic hosting capacity is based on 10 percent of the sampled conditions experiencing a violation, the amount of DER that can be accommodated is greater than the conservative worst-case scenario. In this example, this probabilistic hosting capacity defines that 10 percent of the sampled conditions could not accommodate more DER due to more adverse violation, whereas 90 percent of the sampled conditions could still accommodate more DER. The analysis illustrated in Figure F-9 shows the

frequency of hosting capacity of a circuit throughout the hours in a day. Figure F-10 is the associated color index.

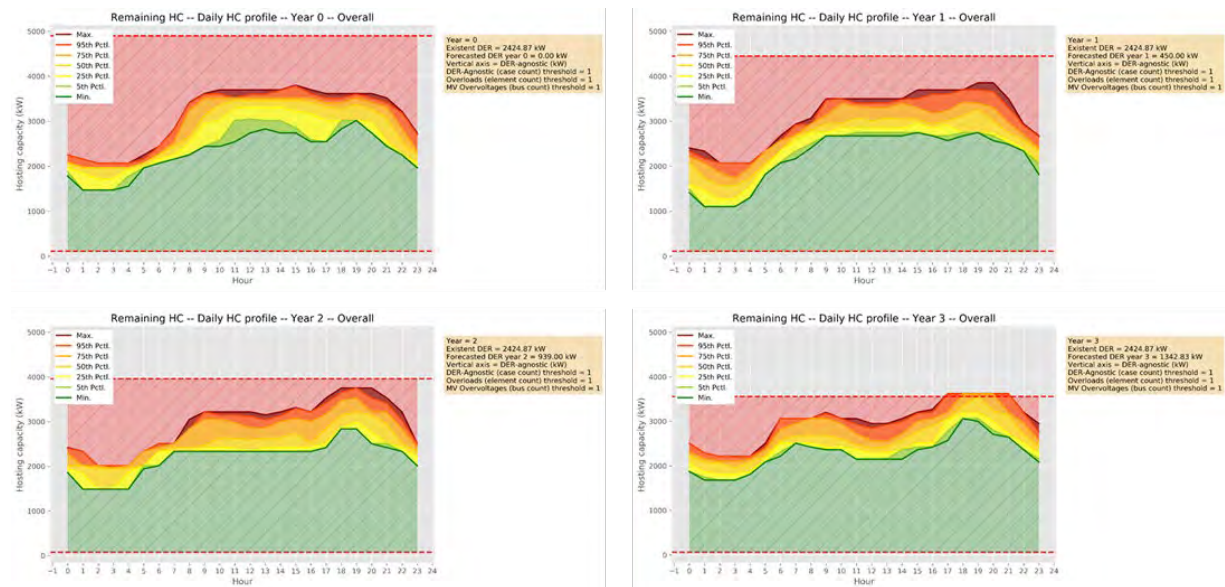


Figure F-9: Daily hosting capacity profile.

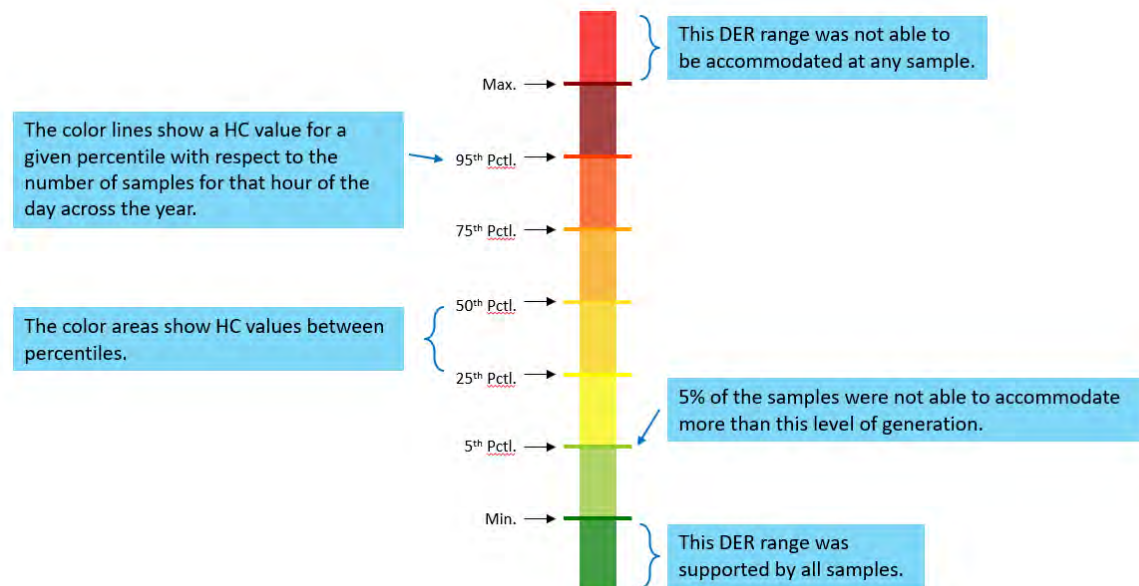


Figure F-10: Daily hosting capacity color code.

In the example shown in Figure F-11, the results of a probabilistic analysis of the fifth percentile shows the daily hosting capacity available forecasted over multiple years on a circuit.

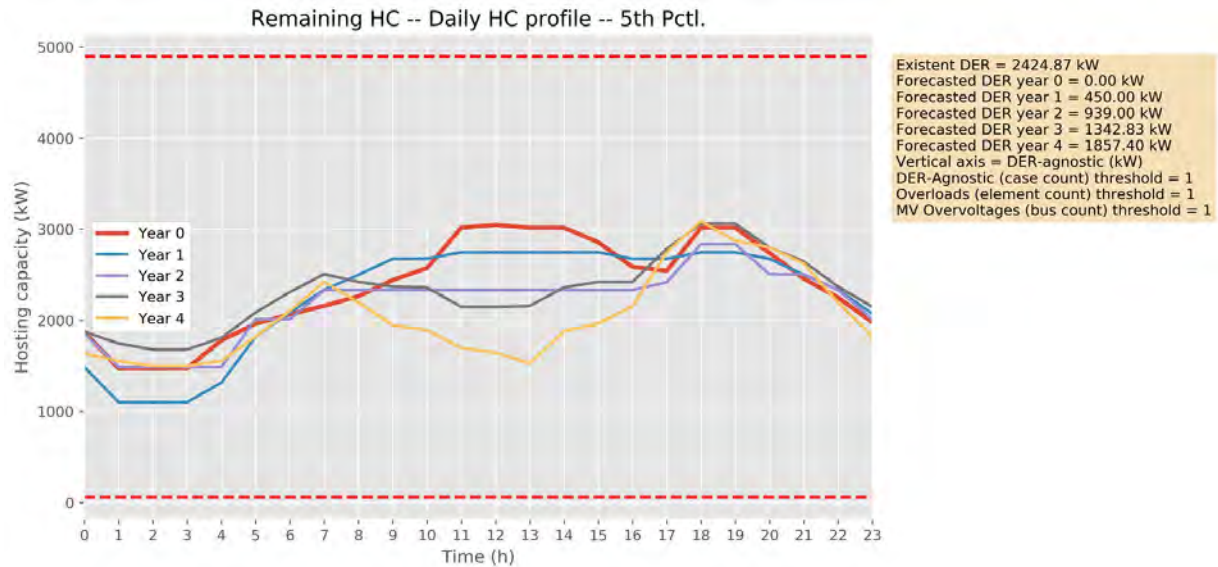


**Figure F-11: Example daily percentile-specific hosting capacity result.**

Overall, the Company's probabilistic hosting capacity methodology is a time-based analysis that takes into consideration the Company's unique programs, the impact of advanced inverter functions, and the two key variables of DER deployment—size and location—that form the core structure for a probabilistic analysis. By considering these new variables, it is expected that the methodology will produce less conservative and more realistic hosting capacity results. The updated methodology is performed in three steps that each provide different objectives: (1) the base case assessment to identify any underlying conditions on the feeder; (2) the forecasted DER assessment to identify underlying conditions due to the DER forecast; and (3) the agnostic DER assessment to identify the remaining hosting capacity. Separating these steps helps the analysis incorporate the information from the Company's forecasting tool and inform its future grid needs assessments.

## F.4.5 CONTINGENCY ANALYSIS

For the Company circuits and transformers, LoadSEER produces profiles for normal operating conditions. These profiles can subsequently be used in external analyses to evaluate a variety of N-1 contingency scenarios. Furthermore, new developments that have a direct impact on the circuits or transformers that are being analyzed can be added to the profiles created for the various cases.

Figure F-12 shows an example of a contingency analysis based on the hourly profile from LoadSEER. The darker group of lines represent the forecast loading on a distribution substation transformer for a peak day per month when an adjacent distribution substation transformer fails. The lighter group of lines represents the forecast loading if new large services are energized in the area. The example shows that the forecast for this N-1 scenario does not cause a thermal rating violation.



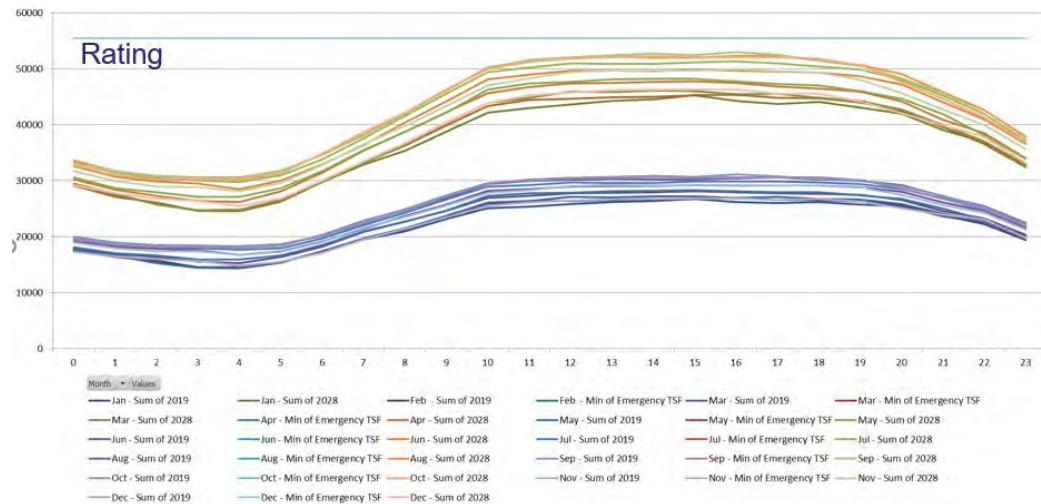


**Figure F-12: N-1 example.**

## F.4.6 PLANNING CRITERIA VIOLATION

The analysis stage of the distribution planning process should identify existing or forecasted thermal or voltage issues on the Company's circuits and substation transformers. Issues may also be identified through data provided directly by devices installed throughout the Company's system that record voltage and current. These devices include AMI and OptaNode Grid2020 units. OptaNode Grid2020 are devices that gather power quality data, similar to an advanced meter, but at the distribution transformer.

Regardless of the manner in which an issue is identified, any situation where planning criteria are violated will need further review to determine the grid needs and the associated solution options.

## F.4.7 GRID NEEDS IDENTIFICATION

To identify grid needs, the Company develops a demand forecast, a demand forecast by load type, a grid needs assessment, and an hourly grid needs summary, as discussed in the following sections.

### F.4.7.1 Demand Forecast

The Company will submit a demand forecast that will list the grid assets and show the net peak forecast (including DER layers) for these assets over the next 5 years. The data to be provided for this demand forecast is described in Table F-2.

**Table F-2: Demand forecast.**

| Specification | Definition             |
|---------------|------------------------|
| Facility type | Circuit or transformer |

|                            |                                    |
|----------------------------|------------------------------------|
| Facility name              | Circuit or transformer identifier  |
| Equipment rating (MW)      | Equipment's rated capacity         |
| Year XXXX peak load (MW)   | Peak load forecast for year XXXX   |
| Year XXXX+1 peak load (MW) | Peak load forecast for year XXXX+1 |
| Year XXXX+2 peak load (MW) | Peak load forecast for year XXXX+2 |
| Year XXXX+3 peak load (MW) | Peak load forecast for year XXXX+3 |
| Year XXXX+4 peak load (MW) | Peak load forecast for year XXXX+4 |

### F.4.7.2 Demand Forecast By Load Type

The Company will submit a demand forecast by circuit by load type per year (5 years of forecasts). The data that will be included is described in Table F-3.

**Table F-3: Demand forecast by load type.**

| Specification                   | Definition                              |
|---------------------------------|-----------------------------------------|
| Circuit name                    | Circuit identifier                      |
| Year XXXX residential load (MW) | Residential load forecast for year XXXX |
| Year XXXX commercial load (MW)  | Commercial load forecast for year XXXX  |
| Year XXXX EV                    | EV load forecast for year XXXX          |
| Year XXXX DER                   | DER load forecast for year XXXX         |
| Year XXXX EE                    | EE load forecast for year XXXX          |

### F.4.7.3 Grid Needs Assessment

A grid needs assessment will be performed to identify situations where planning criteria are violated based on the per circuit or transformer forecasted net demand described in Section 4.7.1. In addition, a traditional solution will be defined for each grid need identified, as discussed in Section 6, Solution Options. The data that will be included in the grid needs assessment is described in Table F-4.

**Table F-4: Grid needs assessment.**

| Specification                 | Definition                                                                                                                      |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Substation                    | Transformer asset identification                                                                                                |
| Circuit                       | Feeder asset identification                                                                                                     |
| Distribution service required | Distribution capacity or distribution reliability (back-tie) service                                                            |
| Primary driver of grid need   | Whether the identified grid need is primarily driven by DER growth, demand growth, other factor(s), or a combination of factors |

| Specification             | Definition                                                                                                                                               |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Operating date            | The date at which traditional infrastructure must be constructed and energized in advance of the forecasted grid need to maintain safety and reliability |
| Equipment rating (MW)     | Equipment's rated capacity                                                                                                                               |
| Peak load (MW)            | Peak loading on asset for given year                                                                                                                     |
| Deficiency (%)            | Deficiency divided by the rating for each of the forecasted years                                                                                        |
| Traditional solution      | Traditional solution identified, as discussed in Section 6, Solution Options                                                                             |
| NWA qualified opportunity | Whether the grid need is a qualified opportunity for further evaluation based on technical requirements and timing of need                               |

Note: A qualified opportunity has passed "Step 1" as outlined in the *Non-Wires Opportunity Evaluation Methodology* report and will proceed to "Step 2," where it will be further analyzed and prioritized. See Section H.4.2 in Appendix H.

#### F.4.7.4 Hourly Grid Needs Summary

For the grid needs determined to be qualified opportunities, solution requirements will be defined in technology-neutral terms, such as the amounts of energy, time(s) of day, and days of the year. This hourly grid needs summary will be provided as described in Table F-5.

**Table F-5: Hourly Grid Needs Summary**

| Specification                    | Definition                                               |
|----------------------------------|----------------------------------------------------------|
| Substation                       | Transformer asset identification                         |
| Circuit                          | Feeder asset identification                              |
| Capacity (MW)                    | Amount of power required to mitigate the grid need       |
| Energy (MWH)                     | Amount of energy required to mitigate the grid need      |
| Delivery time frame              | Months/hours when the planning criteria violations occur |
| Duration (hours)                 | Length of time of the grid need                          |
| Maximum number of calls per year | Maximum number of days in the year requiring mitigation  |

During the NWA opportunity evaluation, as outlined in the *Non-Wires Opportunity Evaluation Methodology* report, each NWA opportunity assigned to Transmission and Distribution Action Plan Track 1 or Track 2 will have an associated map of the general area of need overlaid with available hosting capacity. An example of this integrated map for the Ho'opili area is provided in Figure F-13.

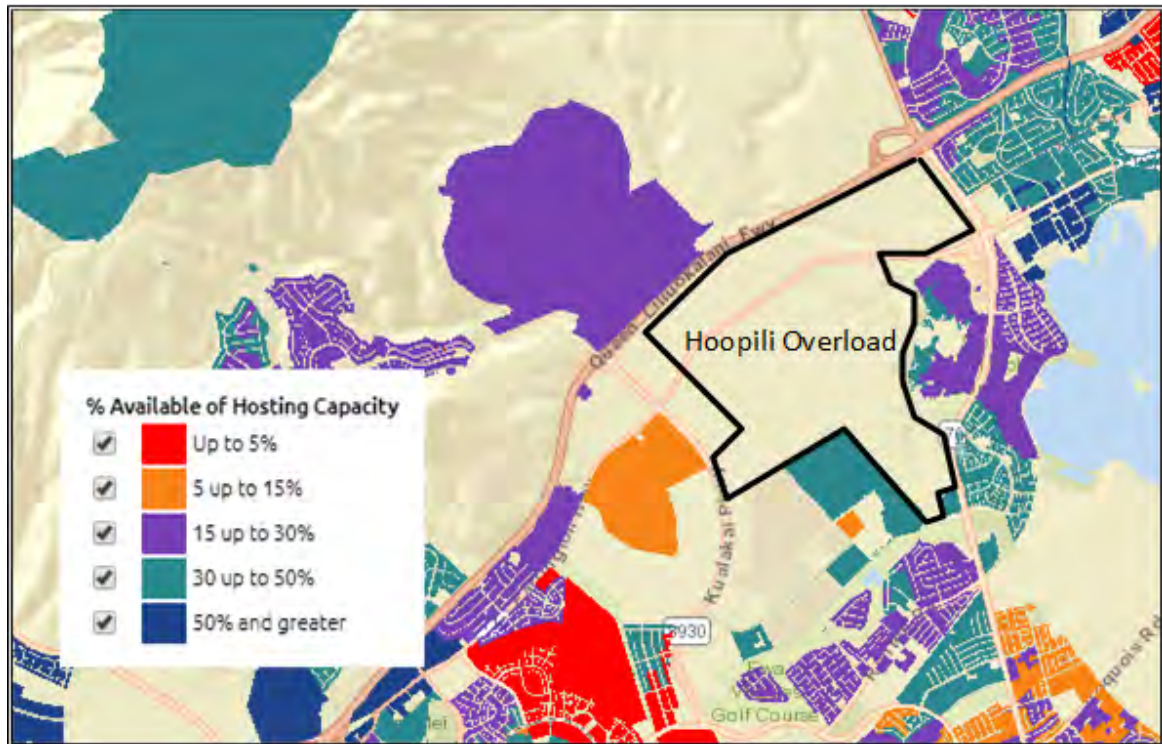


**Figure F-13: Integrated grid needs map example.**

## F.5 SOLUTION OPTIONS STAGE

During the solution options stage of the distribution planning process, the Company determines solution requirements and develops wires and non-wires solution options.

### F.5.1 SOLUTION REQUIREMENTS

An identified grid need is the foundation of a solution's requirements. There may be other requirements, including some unique to the specific opportunity, that will provide additional constraints that solution options must meet. Examples of additional requirements may include a minimum level of reliability or physical/economic constraints. While factoring the solution requirements, a project scope for solution options will be developed that may involve the creation of work plans, such as planning single-line diagrams for wires solutions or time-based capacity requirements for non-wires solutions.

## F.5.2 WIRES SOLUTION DEVELOPMENT PROCESS

Creating a cost effective, valid solution is a very complex and iterative process. In general, the more complex the solution, the more expensive the solution. When the Company develops the scope of a wires solution, the simplest solution is usually considered first, followed by solutions of increasing

complexity. During the development of a mitigation, possible solutions are created and analyzed for the capability of solving the shortfall where consideration of the cost and ongoing maintenance is the most significant consideration in comparing varying solutions. In many situations the studied solution is inadequate and another potential solution is analyzed. This iterative solutions analyses process occurs until probable solution options of the lowest complexity are exhausted, in which case the next set of complex solutions are added to the solutions options. Having historical and forecasted knowledge of the area or equipment is invaluable in eliminating solution options with a high probability of failure. Once a solution is identified that fulfills the grid need, any additional, more costly solutions will not be analyzed. LoadSEER or Synergi, or both, will be used to analyze the solutions. The general process flow is shown in Figure F-14.

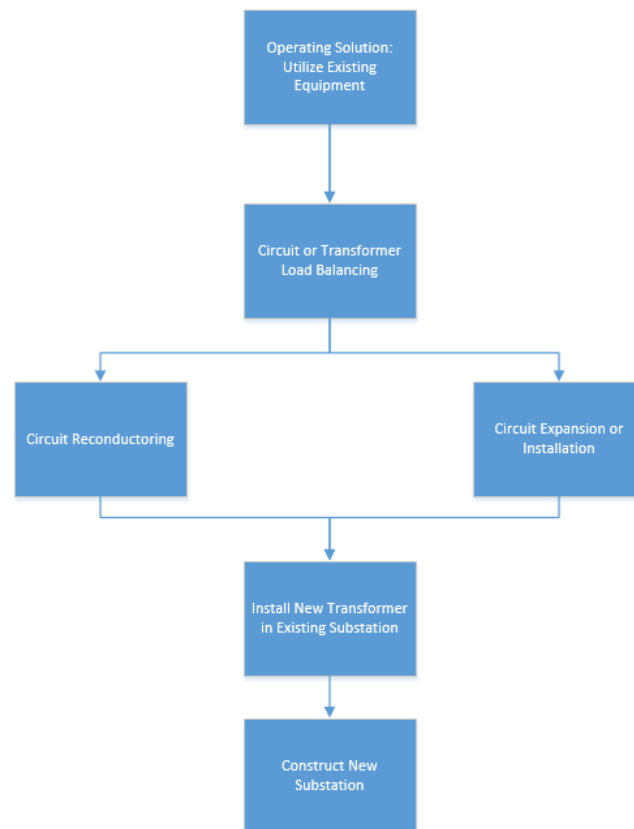


**Figure F-14: Wires solution development steps.**

Once the least complex solution is identified, a project scope is typically developed in the form of a planning single-line diagram. This diagram is a sketch that provides sufficient information for design engineers to develop a project scope and cost estimates, and if necessary, to provide the guidance to develop drawings and specifications used by construction personnel to execute the work. The project scope and cost estimates will inform the avoided cost that will be used in the NWA screen and will be evaluated as described in the *Non-Wires Opportunity Evaluation Methodology* report.

### F.5.2.1 Operating Solution: Use Existing Equipment

---

It is possible that a particular grid need can be satisfied by a simple reconfiguration of the existing distribution system. For instance, existing switches could be operated to resolve overload conditions, and the recalibration of the settings for existing voltage regulation devices could be employed to increase hosting capacity.

In this solution scenario, no cost estimates would be developed, and the Company would proceed without any further wires or non-wires analysis.

### F.5.2.2 Circuit or Transformer Load Balancing

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If the existing electrical system cannot be simply reconfigured using existing equipment, the next type of solutions to be analyzed involves circuit or transformer load balancing. Load balancing can often resolve capacity issues. For instance, new switches may be installed on existing overhead circuits to provide circuit sectionalization to balance circuit loading (that is, reduce capacity on one circuit but increase capacity on another). Also, taps on overhead circuits could be cut and tapped elsewhere to change the configuration and loading on circuits. Similarly, cuts and taps (new splices) can be made in manholes of existing underground distribution systems to balance underground cable loading.

The taps of individual distribution transformers could also be modified to balance the loading among the three electrical phases. This type of balancing is referred to as phase balancing and is a method that can increase hosting capacity.

### F.5.2.3 Circuit Reconductoring or Circuit Expansion/Installation

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The next type of solutions, in terms of complexity and cost, to be analyzed involve upgrades to the distribution circuits. One type of upgrade is the reconductoring of existing overhead conductors or underground cables. In general, this involves the removal and replacement of the existing lines with larger-sized lines. This will directly increase the available capacity on the circuit.

For overhead systems, it may not only involve changing the conductors but also may require installation of new poles because the existing poles may not be strong enough to carry the weight of the larger-sized conductors. Similarly, for underground systems, the existing underground infrastructure (handholes, manholes, conduits) may not be large enough to accommodate physically larger-sized cables. Therefore, reconductoring of underground cables may also involve installation of new underground infrastructure.

Another type of upgrade on a distribution circuit involves the expansion of the circuit. In this situation, new overhead conductors or underground cables are installed where existing equipment does not exist. For instance, a new pole-line consisting of new wires and new poles may be

constructed between two existing circuits to create back-tie capacity. For underground systems, new cables can be installed in existing spare conduits to create new underground ties or to balance underground circuits.

Circuit reconductoring and circuit expansion are considered in parallel because the complexity and, therefore, the cost is highly dependent on physical conditions. For example, for the same physical distance, reconductoring is typically cheaper than new construction. However, if reconductoring involves changes in the existing infrastructure, as noted previously, new construction could potentially be less complex to execute and more cost effective.

#### F.5.2.4 New Transformer in Existing Substation

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The Company's substations are typically designed to accommodate more than one substation transformer. If grid needs cannot be fulfilled with distribution circuit line work, the next solution option is to analyze installation of new transformers at existing substations. This solution involves the installation of a new substation transformer and associated circuits.

#### F.5.2.5 New Substation

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The last wires solution to analyze is the construction of a new substation.

### F.5.3 NON-WIRES SOLUTION OPTIONS EXAMPLES

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The following sections are some examples of non-wires solution options that could be utilized to mitigate a grid need.

#### F.5.3.1 Distributed Energy Resources

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DERs such as distributed renewable generation and energy storage, can be a potential NWA option to solve a grid need. In situations such as thermal constraints, properly sized and sited DERs could eliminate or defer overloading due to load or DER production by injecting or absorbing power as needed to mitigate violation concerns. NWA options include both utility-scale and behind-the-meter customer systems.

#### F.5.3.2 Energy Efficiency and Demand-Side Management (DSM)

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Energy efficiency and DSM, such as conservation, curtailment, or reduction of energy use, may eliminate the grid need caused by thermal loading if the capacity demand causing the overloading is decreased below the rating of the equipment of concern. Similar to DERs, Energy efficiency and DSM, are location-specific NWA opportunities.



### F.5.3.3 Power Electronics Devices

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Power electronic devices, such as capacitors or dynamic secondary VAR controllers, have been used by the Company to manage areas with voltage issues. By having devices that can actively raise or lower voltage as needed, the overall voltage envelope experienced by the customer is lessened. For example, the Company was able to utilize dynamic VAR controllers to level the voltage along a distribution circuit which increased the circuit hosting capacity to accommodate more DER.

### F.5.3.4 Advanced Inverter Functionality

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With the advancement of inverter technology, the Company has been able to leverage the increasing functionality to mitigate potential voltage issues caused by customer adoption of DER. For example, the advanced inverter functions volt-var and volt-watt can be used to mitigate voltage issues in lieu of secondary upgrade work..

## F.5.4 CONTINGENCY PLANS AND SCHEDULE

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The lead times to engineer and execute wires solutions is highly dependent on the required permitting and approvals. In general, the least complex solutions, as shown in Figure F-14 and discussed in Section G.5.2, have the shortest lead times. The following lead times will need to be incorporated into any contingency plans, as described in the *Non-Wires Opportunity Evaluation Methodology* report:

- Operating solution: 1 month
- Circuit or transformer load balancing: 18 months
- Circuit reconductoring or expansion (infrastructure upgrades not required): 24 months
- Circuit reconductoring or expansion (infrastructure upgrades required): 36 months
- New transformer (existing substation): 36–48 months
- New substation: 48 months

Except for operating solutions, deferral of capital expenditures opportunities may exist for the type of solutions listed above. However, as described in the *Non-Wires Opportunity Evaluation Methodology* report, the economic assessment and lead times will be taken into account when determining the path forward on non-wires solutions, if any.



# Appendix G. Non-Wires Opportunity Evaluation Methodology<sup>34</sup>

## G.1 INTRODUCTION

As it strives to provide 100 percent renewable energy by 2045, Hawaiian Electric (Company) faces a comprehensive transformation of our five electric power grids. Attaining our state's renewable energy goals represents uncharted territory for both short-term and long-term resource planning. Performing the analyses necessary to attain this goal is a complicated resource planning process, requiring new tools and new processes. This report defines and explains the methodology involved in evaluating grid needs as possible non-wires alternatives opportunities. This process is essential to support the transformation to a clean energy future that leverages the continuous advancement in power technology.

The Company believes customers should have opportunities to deliver energy and other services to the electrical distribution system (commonly referred to as the distribution grid). In addition, the Company believes it should enable significant numbers of diverse providers to participate, and should facilitate competition to the benefit of all customers. By using a broad definition of distributed energy resources (DER), which include a variety of asset types, the Company is providing an increasing number of customers with the opportunity to participate in the DER marketplace. Expanding opportunities for DER services is essential to meeting renewable energy needs without sacrificing the reliable delivery of electricity, which customers deem a top priority.

This strategy is consistent with the Commission's direction to fully and fairly consider non-transmission alternatives (NTA) and non-distribution alternatives (NDA), otherwise known as non-wires alternatives (NWA), when evaluating transmission and distribution (T&D) system upgrades.<sup>35</sup> The Commission also indicated that it will scrutinize whether NWA "solutions, regardless of ownership, are evaluated as part of any economic justification for new utility distribution system investment projects in the same fashion as it currently evaluates NTAs with respect to new transmission projects."<sup>36</sup>

<sup>34</sup> Refiling for reference, no changes from the first IGP cycle

<sup>35</sup> HPUC Docket No. 2018-0055, Decision and Order No. 36288 Ka'aahi Substation, filed May 3, 2019, at 22.

<sup>36</sup> HPUC Docket No. 2015-0070, Decision and Order No. 33584, filed March 11, 2016, at 46.

In 2019, the Commission reiterated its expectation that the distribution planning process “must transition and evolve accordingly, such that the locational benefits of customer-sited distributed energy resources are included and evaluated on a comparable basis as utility-sited NDAs as part of any economic justification for distribution system upgrades.”<sup>37</sup> The Commission further directed the Company to “strive to make their non-wires alternatives analysis more transparent and thorough.”<sup>38</sup>

Additionally, the Company is expanding options for broad DER participation necessary to grow a viable market, and for customers to directly benefit from competition. The Company’s strategy is to offer a range of proven and innovative options to expand access for all customers—not just for a few.

This approach recognizes that the market for NWAs is nascent but represents a tangible opportunity for reducing customer costs and enabling a lower-carbon electricity grid.<sup>39</sup> As such, procurements may not fully enable a range of DER-based solutions. The Company’s approach to NWAs specifically includes consideration of pricing through customer rates and programs in addition to procurement opportunities. This will enable customers to better manage their electricity use and provide grid services. As a result, the Company believes that customers, DER developers, and aggregators will have the potential to fully realize the value of DER for Hawai‘i.

The Company has engaged, and will continue to engage, with customers and stakeholders to seek input and feedback on the Integrated Grid Planning (IGP) development and subsequent planning and sourcing. As part of the IGP development effort, the Distribution Planning Working Group (DPWG) is to inform and educate stakeholders on various aspects of distribution planning at the Company, and to afford stakeholders opportunities to collaborate on and co-develop the Company’s methodologies to identify distribution grid needs as well as a framework to evaluate NWA opportunities. As described in the *Distribution Planning Methodology* report, grid needs will be identified through the distribution planning process and then evaluated for NWA opportunity suitability as discussed in this *Non-Wires Opportunity Evaluation Methodology* report.

The DPWG deliverables, as described in the IGP Workplan accepted by the Commission,<sup>40</sup> include identifying NWA opportunities and the related information requirements to effectively and efficiently procure and evaluate potential solutions. However, the need for an NWA opportunity evaluation methodology was not identified in the original IGP Workplan.<sup>41</sup> The Company and stakeholders subsequently recognized the need to incorporate a screening process, based on the leading industry practices and practical considerations, into the IGP and annual distribution planning cycles. This *Non-Wires Opportunity Evaluation Methodology* report addresses this additional scope and deliverable discussed by the DPWG.

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<sup>37</sup> HPUC Docket No. 2018-0055, Decision and Order No. 36288 Ka’aahi Substation, filed May 3, 2019, at 22.

<sup>38</sup> HPUC Order No. 36725 Docket No. 2018-0165, Proceeding To Investigate Integrated Grid Planning, filed November 4, 2019, at 9.

<sup>39</sup> M. Dyson, J. Prince, et al., “The Non-Wires Solutions Implementation Playbook,” Rocky Mountain Institute, 2018.

<sup>40</sup> HPUC Order No. 36218, Accepting the IGP Workplan and Providing Guidance, Docket No. 2018-0165.

<sup>41</sup> HECO, IGP Workplan, December 2018 filed December 14, 2018 in HPUC Docket No. 2018-0165

Specifically, this *Non-Wires Opportunity Evaluation Methodology* report discusses the Company's industry survey and stakeholder feedback on best practices for NWA opportunity evaluation and sourcing, defines NWAs and grid services, presents the Company's NWA opportunity evaluation methodology, and provides case examples that the Company and stakeholders used to jointly validate the proposed NWA opportunity evaluation methodology. Two of the case examples were used in the Company's IGP Soft Launch, which was conducted to demonstrate the distribution planning process from circuit-level load forecasting to solution evaluation to defer an actual capital investment to solve a grid need. The two examples used in the soft launch were the Ho'opili and East Kapolei cases, later described in Section 5.3. Through that effort, the Company gained invaluable experience that will help improve the full-scale IGP planning and sourcing effort. This report reflects a key milestone in the Company's efforts to comply with the Commission's guidance regarding systematic and transparent consideration of NWAs, leveraging industry best practices, and stakeholder engagement.<sup>42</sup>

**March 2023 update.** This Non-Wires Opportunity Evaluation Methodology is being submitted with the IGP Grid Needs Assessment and Solution Evaluation Methodology (Dkt. No. 2018-0165, dated March 31, 2023) and supersedes previously filed versions. This update incorporates the Company's learnings from recent NWA activities, as well as discussions with the IGP TAP. Notable updates include 1) additional definition to the NWA sourcing evaluation (Section G.4.2) to classify whether potential solutions are considered favorable, moderate, or unfavorable across the various dimensions, and 2) additional case examples of experiences with the NWA process (Section G.5).

## G.2 INDUSTRY SURVEY

In 2019, the Company engaged the Pacific Energy Institute to conduct an industry survey<sup>43</sup> of best practices for NWA opportunity evaluation and sourcing in seven states (including California, Connecticut, Hawaii, Maine, New Hampshire, New York, and Rhode Island) as well as to review documents prepared by several organizations, including Rocky Mountain Institute (RMI),<sup>44</sup> Northeast Energy Efficiency Partnerships,<sup>45</sup> Smart Electric Power Alliance (SEPA),<sup>46</sup> and ICF.<sup>47</sup> Additionally, an NWA workshop was held on March 26, 2019,<sup>48</sup> where the Company sought to learn from experienced practitioners (that is, utility and DER solution providers). The industry survey findings are summarized in Section 2.1.

<sup>42</sup> HPUC Order No. 33584, Maui Elec. Co., Ltd., Docket No. 2015-0070, filed March 11, 2016, at 45-46, and HPUC Order No. 36288, Ka'aahi Substation application, Docket No. 2018-0055, at 22-25.

<sup>43</sup> P. De Martini and A. De Martini, NWA Opportunity Evaluation Survey of Current Practice, Pacific Energy Institute, March 2020.

<sup>44</sup> M. Dyson, J. Prince, et al., "The Non-Wires Solutions Implementation Playbook," Rocky Mountain Institute, 2018..

<sup>45</sup> Northeast Energy Efficiency Partnerships, State Leadership Driving Non-Wires Alternatives Projects and Policy, 2017.

<sup>46</sup> SEPA, PLMA and E4The Future, Non-Wires Alternatives: Case Studies From Leading U.S. Projects, November 2018.

<sup>47</sup> ICF presentation in Michigan PSC workshop, June 2019

[https://www.michigan.gov/documents/mpsc/062719\\_PDF\\_Presentations\\_660616\\_7.pdf](https://www.michigan.gov/documents/mpsc/062719_PDF_Presentations_660616_7.pdf).

<sup>48</sup> IGP Soft Launch WG Meeting speaker presentations:

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/soft\\_launch/20190326\\_igp\\_soft\\_launch\\_wg\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/soft_launch/20190326_igp_soft_launch_wg_meeting_presentation_materials.pdf).

The Company also held 10 stakeholder working group meetings in 2019 where stakeholders discussed NWA services definitions, distribution grid needs identification, NWA opportunity evaluation, and information requirements. Stakeholder feedback is summarized in Section 2.2.

## G.2.1 INDUSTRY SURVEY FINDINGS

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Based on the industry survey and observations of industry analysts, the use of NWAs for distribution grid needs is at an early stage. The industry is still learning and refining approaches to improve on the early mixed success to-date.<sup>49</sup> However, commonalities are emerging from these early states' and utilities' lessons learned that provide valuable insights for Hawai'i's success.

The Company has considered the following key findings from this survey in the development of its NWA opportunity evaluation process:

- The NWA opportunity evaluation should be integrated into standard, open, and transparent utility planning processes to encourage the effective engagement of market participants to best meet regulatory and utility-level objectives.<sup>50</sup>
- Traditional (T&D) planning processes can better support NWA solutions if screening criteria are used to determine when alternatives should be considered for a given need.
- Information should be shared with stakeholders regarding an NWA opportunity, including engineering analysis, performance requirements, and other data needed to assess the opportunity.
- Evaluation of opportunities is done on a technology agnostic, comparable basis as part of the economic justification for distribution system upgrades.<sup>51</sup>
- Evaluation processes focus on identifying high-confidence recommendations for DER solicitations that are likely to result in successful, cost-effective investment deferrals.<sup>52</sup>
- NWA opportunities to date have initially addressed grid needs for capacity increases.
- Reliability, voltage/reactive power, and resilience have been identified for future consideration.
- The type of T&D need, time frame for in-service date, and reference T&D project cost are common criteria used by all states surveyed to evaluate NWA opportunities.
- Not all T&D capital projects are suited for an NWA opportunity. T&D capital projects involving break-fix, outage replacements, aging infrastructure replacement, infrastructure relocation, or customer service connections should be excluded.

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<sup>49</sup> Reported California initial NWA procurement results and ICF 2019.

<sup>50</sup> M. Dyson, J. Prince, et al., "The Non-Wires Solutions Implementation Playbook," Rocky Mountain Institute, 2018 and SEPA, PLMA and E4The Future, 2018.

<sup>51</sup> HPUC Order No. 36725 Docket No. 2018-0165, Proceeding To Investigate Integrated Grid Planning.

<sup>52</sup> CPUC Decision on the Distribution Investment and Deferral Process (D.18-02-004).

- Procurements may not be best suited for all NWA opportunities (for example, smaller value projects and/or reaching certain customer classes), instead other programmatic options may be considered, such as:
- Targeted energy efficiency (EE)/demand-side management programs are employed.
- DER services tariffs are under discussion in a few states.
- States and utilities should first consider no-cost (capital) operational options (for example, circuit reconfiguration and phase balancing) as well as low-cost grid technology alternatives (for example, sensing and analytics, and power flow controllers) as an alternative to traditional capital projects.

Additionally, the survey identified several themes regarding the evaluation criteria. As noted above, the type of T&D need, timing for in-service date, and reference T&D project cost are common criteria. The type of grid needs and the related performance requirements are considered. The timing for in-service includes consideration of the procurement/program development process, regulatory approval, and implementation timelines. Project cost is based on the capital cost of the traditional wires project.

However, the application of these criteria differs among states and utilities. The states in the Northeast have clearly defined the types of T&D projects that are suitable for NWA opportunities and have defined minimum thresholds for timing and project cost. These minimums have been developed through stakeholder discussions and consideration of the timing in that state. An example is provided in Figure G-1.

| Criteria                 | Potential Elements Addressed                                                                                                                                                      |                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| Project Type Suitability | Project types include Load Relief and Reliability. Other types have minimal suitability and will be reviewed as suitability changes due to State policy or technological changes. |                                 |
| Timeline Suitability     | Large Project                                                                                                                                                                     | 36-60 months                    |
|                          | Small Project                                                                                                                                                                     | 18-24 months                    |
| Cost Suitability         | Large Project                                                                                                                                                                     | Greater than or equal to \$1M   |
|                          | Small Project                                                                                                                                                                     | Greater than or equal to \$500K |

Source: National Grid 2017

**Figure G-1: National Grid's New York NWA Opportunity Evaluation Criteria**

Like New York, as shown in Figure G-1, California also employs these three criteria and adds two: forecast uncertainty of timing and scope, and market assessment. California's evaluation is focused on whether an NWA procurement should be pursued and uses a tiered prioritization approach to identify the ripest opportunities (Tier 1), opportunities that may be less certain (Tier 2), and opportunities that are not suitable for NWAs (Tier 3). This is illustrated in the Southern California Edison (SCE) example in Figure G-2. As seen in other states, California utilities each have their own version of the criteria and a slightly different prioritization tier structure.

| Tier | Project                  | Cost Effective | Forecast Certainty | Market Assessment |
|------|--------------------------|----------------|--------------------|-------------------|
| 1    | Nogales 66/12 (D)        |                |                    |                   |
|      | Lockheed 66/16 (D)       |                |                    |                   |
|      | Sun City 115/12          |                |                    |                   |
|      | Mira Loma 66/12 (D)      |                |                    |                   |
| 2    | Newhall 66/16 (D)        |                |                    |                   |
|      | Crater 66/16 (D)         |                |                    |                   |
|      | MacArthur 66/12 (D)      |                |                    |                   |
|      | Mariposa 66/12 (D)       |                |                    |                   |
|      | Moorpark 'A' 220/66 (S)  |                |                    |                   |
|      | Saugus 'C' 220/66 (S)    |                |                    |                   |
|      | Elizabeth Lake 66/16 (D) |                |                    |                   |
|      | Elizabeth Lake 66/16 (D) |                |                    |                   |
| 3    | Vera 66/12 (D)           |                |                    |                   |
|      | Hathaway 66/12           |                |                    |                   |
|      | Rector 220/66 (S)        |                |                    |                   |
|      | Springville 220/66 (S)   |                |                    |                   |
|      | Garnet 115/33 (D)        |                |                    |                   |
|      | Lindsay 66/12 (D)        |                |                    |                   |
|      | Live Oak 66/12 (D)       |                |                    |                   |
|      | Mira Loma 220/66 (S)     |                |                    |                   |

**Figure G-2: SCE NWA Opportunity Prioritization**

The California NWA evaluation methodology offers useful additional criteria to evaluate opportunities as compared to the states in the Northeast. However, the California methodology is overly complex in its attempt to quantify the metrics. In practice, California's prioritization is effectively based on a smaller set of factors similar to the northeastern states.<sup>53</sup> That is, the T&D grid need requirements (including timing), related grid service, and project-related avoided cost were used to determine whether a procurement makes sense. The California process is also singularly focused on evaluating procurement opportunities, so it does not consider alternative sourcing options, such as programs.

The Company does think the use of the California metrics for forecast certainty and market assessment are useful in the context of considering alternative NWA sourcing options involving programs and pricing, or reconsideration of procurement at a later date.

Based on the insights drawn from the industry survey and practitioners, simplicity and flexibility appear to be important considerations in developing NWA opportunity evaluation criteria. Simplicity is important in terms of the ability to implement a fair and repeatable process, and to provide clarity to the market. Flexibility is important in terms of allowing opportunities to pursue viable NWAs through sourcing means other than all-or-nothing procurements. For example, consideration should be given to the role that programmatic options may provide for opportunities that might otherwise not make sense economically for a procurement. The Company has incorporated these findings into its approach.

## G.2.2 STAKEHOLDER FEEDBACK

As mentioned at the beginning of Section 2, the Company held 10 stakeholder working group meetings in 2019 where stakeholders discussed NWA services definitions, distribution grid needs identification, NWA

<sup>53</sup> See [https://www.pge.com/en\\_US/for-our-business-partners/energy-supply/electric-rfo/wholesale-electric-power-procurement/2019-didf-rfo.page?ctx=large-business](https://www.pge.com/en_US/for-our-business-partners/energy-supply/electric-rfo/wholesale-electric-power-procurement/2019-didf-rfo.page?ctx=large-business)



opportunity evaluation, and information requirements. These discussions included the findings from the industry survey and NWA workshop, discussed in Section 2.1. This stakeholder engagement also included using specific grid needs in Ho’opili and East Kapolei as case examples to shape the IGP Soft Launch.

Importantly, these discussions considered the development of the IGP methodology to identify and assess NWA opportunities as a key step in the handoff from grid needs to NWA sourcing (for example, procurements and programs). Stakeholders’ input and feedback is reflected in the NWA opportunity evaluation process and criteria. The stakeholder feedback received in the DPWG and Soft Launch working group meetings is summarized in the following sections.<sup>54</sup>

The Company also presented the NWA Methodology along with more detailed evaluation threshold criteria and additional sample evaluations to the Technical Advisory Panel (TAP) on November 16, 2022 and received generally positive feedback.

### G.2.2.1 Overall Process

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Stakeholders shared that the NWA opportunity evaluation process needs to be transparent and less restrictive with respect to screening criteria at this initial stage in Hawai’i to open up the potential market for procurements. Stakeholders also shared that a technology agnostic approach to assessing opportunities is needed and that it is important to not prejudge what the market may provide.

Stakeholders support consideration of other sourcing mechanisms beyond procurement (programs, tariffs) and flexibility in sourcing to achieve the most cost-effective outcome. This includes the potential to participate in multiple non-conflicting grid services opportunities. Additionally, the IGP process should continue to reassess projects in subsequent planning cycles that are initially assessed as uncertain because of the constant changing nature of the distribution system. The T&D grid needs and NWA opportunity evaluations and supporting analysis should be shared publicly as part of the IGP process.

### G.2.2.2 Defining Grid Needs

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The output of the distribution planning process is a set of grid needs. Stakeholders should have sufficient information on these needs to consider potential solutions and understand the application of the evaluation criteria. This includes technical performance requirements, including quantity (MW, MWh), dispatch frequency and time (month/day/hour), duration, and in-service date. The supporting engineering analysis, and a description and technical details of the wires solution are also desired (for example, information on type of infrastructure location, timing, and avoided cost). Stakeholders suggested simplifying the requirements to the extent possible to allow for more potential NWA solutions.

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<sup>54</sup> Drawn from DPWG minutes: <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/working-groups/distribution-planning-and-grid-services-documents>

### G.2.2.3 Opportunity Criteria

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Stakeholders appreciate the simplicity of the three-criteria approach used by the states in the Northeast but also like aspects of the California prioritization model. Stakeholders suggested using clearly defined metrics for minimum timing for in-service date and project economics criteria for procurements, as follows:

- Timing: in-service date – minimum of 2 years to provide enough time to run a procurement and regulatory process, and install NWAs
- Project economics: minimum of \$1 million capital project cost threshold for NWA procurements

Stakeholders also suggested consideration of greenhouse gas emissions reductions and other societal criteria (for example, community impact) in prioritizing NWA opportunities. The question of whether to consider greenhouse gas emissions was not resolved in the working group discussion, but stakeholders recognized that greenhouse gas benefits are important, but not necessary, for NWA opportunity sourcing evaluation. Stakeholders suggested that NWA societal value considerations may be better suited to evaluating the specific proposed NWA solutions resulting from procurements/programs as is done in New York. The recommendation is for this issue to be taken up in the Solution Evaluation and Optimization Working Group.

### G.2.2.4 Sourcing Options

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Stakeholders noted that across the industry, NWAs have largely not been successful thus far. Stakeholders recognize that procurements are one type of NWA sourcing mechanism and that programs and pricing options should be considered as well. A programmatic approach that looks to fulfill more global power system needs was suggested. Programs also may be easier for customers to understand. Stakeholders agree that an NWA program, as with procurements, must be cost-effective for all customers.

During the Soft Launch discussion regarding Ho’opili, stakeholders recognized the NWA procurement challenge for new real estate developments: that NWA solutions may need to be sited and ready to go at the same time the house is built. Stakeholders suggested that a programmatic approach (including EE and other DER) through the collaboration of the real estate developer and the Company may be the best option.

Additionally, stakeholders seek to maximize the potential participation opportunities for NWAs and grid services in the aggregate. For example, a stakeholder shared that a \$50,000 per year NWA opportunity may not be worth a procurement or program, but it may have potential after being aggregated with other potential grid services opportunities.

## G.3 T&D NON-WIRES ALTERNATIVES

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The definitions of NWA and grid services presented in this section, including the specific wording for each of the terms, are derived from the industry research and stakeholder input and feedback discussed in Section 2.



### G.3.1 NWA DEFINITION

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NWAs generally are non-traditional solutions that may defer, delay, or avoid traditional T&D investments (for example, a new substation or feeder). Non-traditional solutions can include a single solution or a combination of solutions at the grid-scale or distribution level, such as solar photovoltaic (PV), other renewable generation, energy storage, EE, and demand response (including price responsive demand). The following NWA definition was developed in concert with the DPWG:

*An electricity grid project that uses non-traditional transmission and distribution (T&D) solutions, such as distributed generation (DG), energy storage, energy efficiency (EE), demand response (DR), and grid software and controls, to defer or avoid the need for conventional transmission and/or distribution infrastructure investments.*

This definition adapts several aspects developed by Navigant,<sup>55</sup> the US Department of Energy,<sup>56</sup> and others.<sup>57</sup>

### G.3.2 NWA GRID SERVICES

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A wide range of grid services are needed as Hawai'i decarbonizes the electricity sector with ultimately more than half its resources at the edge of the system. Already, DERs have the opportunity to provide bulk system ancillary services, including frequency response, replacement reserves, and regulation on a technology agnostic basis.<sup>58</sup> Additionally, in support of the IGP planning cycle and Commission direction,<sup>59</sup> the Company has identified and defined initial T&D NWA services in technology agnostic terms, building on the work developed for the Demand Response portfolio in Docket No. 2015-0412. An example of where the Company will apply the NWA evaluation process are the projects identified through the distribution planning process, as described in the *Distribution Planning Methodology* report. Using the outline detailed in this report, these projects are candidates to be evaluated for NWA opportunity.

Specifically, these initial NWA services are focused on those with the greatest potential value involving T&D capital deferral services (for example, distribution capacity deferral and reliability services). Capital deferral is the primary focus of the Federal Energy Regulatory Commission for transmission<sup>60</sup> and the leading states' use for distribution, as found in the industry survey discussed in Section 2.

The service descriptions and definitions in Sections 3.2.1 and 3.2.2 are based on IGP stakeholder input and feedback leveraging references from California's Competitive Solicitation Working Group.<sup>61</sup>

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<sup>55</sup> B. Feldman, Non-Wires Alternatives: What's up next in utility business model evolution, UtilityDive, July 12, 2017.

<sup>56</sup> Electricity Advisory Committee, Recommendations on Non-Wires Solutions, US Department of Energy, October 17, 2012.

<sup>57</sup> SEPA, PLMA & E4TheFuture, "Non-wires Alternatives: Case Studies from Leading US Projects", 2018.

<sup>58</sup> See Docket No. 2015-0412, Decision and Order No. 35238, issued on January 25, 2018.

<sup>59</sup> HPUC Order No. 33584, Maui Elec. Co., Ltd., Docket No. 2015-0070, filed March 11, 2016, at 45-46.

<sup>60</sup> E. Watson and K. Colburn, Looking Beyond Transmission, Public Utilities Fortnightly, April 2013.

<sup>61</sup> California Competitive Solicitations Framework Working Group <https://drpwg.org/sample-page/ider/>.

### G.3.3 T&D CAPACITY DEFERRAL

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T&D capacity deferral opportunities involve the potential to defer capital investment that may otherwise be needed to address grid needs that are identified through area capacity analysis and/or hosting capacity analysis. This may include deferring substations, new lines/reconductoring, transformers, and other equipment by reducing forecast loading of the infrastructure to within ampacity/load ratings under normal operating conditions. Loading in this context relates to the current and/or power (bi-directional) carrying capability of specific conductor, transformer, and/or other equipment. Therefore, increases in forecast loading may arise from new loads and/or energy injections from distributed resources (that is, reverse power flow).

The following definition of T&D capacity service was developed with the DPWG to describe these types of opportunities:

*A supply and/or a load modifying service that DERs provide as required via reduction or increase of power or load that is capable of reliably and consistently reducing net loading<sup>62</sup> on desired transmission and/or distribution infrastructure. T&D capacity service can be provided by a single DER and/or an aggregated set of DERs that reduce the net loading on a specific distribution infrastructure location coincident with the identified operational need in response to a control signal from the utility.*

This definition combines both NTAs and NDAs into a single service in recognition of the potential to yield optimized benefits across T&D opportunities from NWA solutions.

### G.3.4 DISTRIBUTION RELIABILITY (BACK-TIE)

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In addition to NWA opportunities under normal grid operating conditions, there are potential opportunities under contingent conditions. Contingent operating conditions involve emergency reconfigurations of the distribution system that result in transferring the load (that is, bi-directional current/power) from one circuit/transformer to another to mitigate an outage. These contingent opportunities arise when combined loading exceeds the emergency ampacity/power rating of the conductor, transformer, and/or other equipment. This is a reliability-oriented service because it enables safe transfer of one circuit/transformer's load to another during an emergency by creating sufficient headroom or reducing the transferring load to within emergency ratings.

The following definition of distribution reliability service was developed in the DPWG:

*A supply and/or load modifying service capable of improving local distribution reliability under abnormal conditions. Specifically, this service reduces contingent loading of grid infrastructure to enable operational flexibility to safely and reliably reconfigure the distribution system to restore customers.*

This type of distribution service is relatively new in the industry; the Company's procurement for this service in the IGP Soft Launch was one of the first, if not the first. In a future IGP cycle, the Company may evaluate a

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<sup>62</sup> Net loading refers to the net amount of bi-direction current on specific grid infrastructure.

wider set of T&D NWA services. For example, voltage support and resiliency services may be identified and defined through the process of documenting the T&D needs and services requirements. Resiliency services are currently being discussed in the Resiliency Working Group and through Docket No. 2018-0163, which is intended to produce a Microgrid Services Tariff.

## G.4 NWA OPPORTUNITY EVALUATION METHODOLOGY

### G.4.1 OVERVIEW

The Company has considered the NWA opportunity evaluation approaches and lessons learned from other states as well as stakeholder feedback to develop a holistic methodology. The multi-state lessons and stakeholder feedback support RMI's recommendation that *"traditional planning processes can better support non-wires solutions if screening criteria are used to determine when alternatives should be considered for a given need."*<sup>63</sup>

The Company intends to use such a common NWA opportunity evaluation framework to identify T&D projects that are most likely to be suitable for NWA solutions. This evaluation methodology is intended to provide greater clarity, certainty, and transparency to the market going forward. Such criteria incorporated into the IGP process will also facilitate systematic consideration of NWAs by T&D planners going forward as directed by the Commission. The goals of this NWA opportunity evaluation methodology are as follows:

- Identify all potential candidate T&D projects that may be cost-effectively deferred through the identified and defined DER services.
- Productively engage the market for NWAs by helping DER aggregators and developers efficiently allocate resources to the best opportunities.
- Further, Commission guidance and stakeholder feedback outlined the following objectives in the development of an NWA opportunity evaluation framework:
- Adopt/adapt leading practices to develop candidate T&D NWA opportunity evaluation.
- During initial NWA opportunity screens, create over-inclusive, rather than overly restrictive, candidate NWA project shortlists.
- Use a simple initial NWA opportunity screen to identify shortlist candidate opportunities and assess sourcing options (procurement, programs, and pricing).
- Remember that not all NWA opportunities make economic sense to source via competitive procurement. Therefore, price signals through rate design and DER programs will also be considered to achieve the most affordable solutions for customers.

These goals and objectives shaped the development of the NWA opportunity evaluation methodology described in Section 4.2. The Company believes that this opportunity screen and prioritization approach will

<sup>63</sup> M. Dyson, J. Prince, et al., "The Non-Wires Solutions Implementation Playbook", Rocky Mountain Institute, 2018.

support development of an NWA market. Recognizing that NWA procurements and use are at a relatively nascent stage of implementation across the industry, the Company expects this evaluation methodology to evolve as the industry collectively gains more NWA experience. This NWA opportunity evaluation methodology is not meant to be an NWA solution evaluation as would be done in a procurement; rather this is an assessment of the potential T&D projects that qualify for an NWA opportunity.

## G.4.2 OPPORTUNITY EVALUATION METHODOLOGY

The Company has developed a three-step methodology that incorporates 1) an initial NWA opportunity screen, 2) an NWA opportunity sourcing evaluation and 3) an action plan. The initial opportunity screen is intended to quickly and simply identify “qualified” and “non-qualified” T&D opportunities based on technical requirements. The opportunity sourcing evaluation in the second step further evaluates and prioritizes the “qualified” opportunities in terms of the grid project avoided cost (economics), timing of need, and performance requirements to support a procurement. This three-step approach, shown in Figure G-3, is based on leading practices from states in the Northeast and from California as well as stakeholder feedback tailored to Hawai‘i’s needs.



**Figure G-3: NWA Opportunity Evaluation Methodology**

This methodology is designed to identify a wider set of potential NWA opportunities than methodologies in other states. Step 1 does not include a dollar threshold, unlike the states in the Northeast; instead, program or pricing options may be considered viable in the Step 2 evaluation. The incorporation of program and pricing options in the Step 2 sourcing evaluation is for those opportunities considered too financially small for procurement. Step 2 methodology also includes a clearly defined minimum dollar threshold for procurements identified by stakeholders that is similar in approach to that of the states in the Northeast. This is a more transparent method than the overly complex California approach<sup>64,65</sup> that also effectively uses the project capital avoided cost as the primary economic threshold. The resulting T&D action plan in Step 3

<sup>64</sup> Pacific Gas & Electric, Request for Approval to Issue Competitive Solicitations for Distributed Energy Resource (DER) Procurement for Electric Distribution Deferral Opportunities. November 15, 2019. CPUC Advice Letter 5688-E.

<sup>65</sup> Southern California Edison, Southern California Edison Company's Request for Approval to Launch the 2020 Distribution Investment Deferral Framework, November 15, 2019 Solicitation. CPUC Advice Letter 4108-E.

is intended to enable a range of potential NWA sourcing options via procurement, programs, and pricing consistent with another RMI recommendation.<sup>66</sup>

### G.4.2.1 Step 1: NWA Opportunity Screen

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The intent of the NWA opportunity screen is to categorize all T&D capital budget projects by applying a technical screen and to identify those T&D projects that are most suitable for further NWA opportunity evaluation. As discussed with stakeholders and identified by other states, certain T&D projects with the greatest NWA opportunity include the following three grid needs categories:

1. Expanding distribution system capacity to meet load and/or hosting capacity needs (that is, new substation, new feeders, reconductoring)
2. Ensuring a reliability requirement for circuit back-tie upgrade deferral
3. Enhancing system resilience<sup>67</sup>

As the Company has identified in the IGP, consistent with best industry practices, these types of T&D needs may be met by new NWA grid services, including T&D capacity deferral service, reliability back-tie service, and resiliency service. The Soft Launch pursued procurement of distribution capacity deferral and reliability back-tie services. The Company's reliability back-tie service is a first for the industry. These three types of T&D needs will form the initial screen.

Conversely, certain T&D projects cannot, or are unlikely to, be deferred or avoided by DER. These "required" projects include those necessary to comply with public works or other customer requests, such as the following:

- Line/pole relocation or undergrounding due to street widening, relocation clauses, or overhead-to-underground conversions
- Emergency and preventative equipment and infrastructure replacement to restore power after outages, avoid outages, avoid catastrophic failures, and ensure public safety
- Replacement of physical apparatus, such as circuit breakers, relays, and transformers, because of asset condition
- Replacement of damaged or failed equipment/poles/conductor
- New customer requests for new physical connection to the electric grid

The Step 1 screen will categorize all T&D opportunities in the Company's capital budget into two groups based on the project type:

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<sup>66</sup> M. Dyson, J. Prince, et al., "The Non-Wires Solutions Implementation Playbook", Rocky Mountain Institute, 2018, page 39.

<sup>67</sup> Reliability scoped to be redundant, such as a second feeder and its associated infrastructure, would be qualified opportunities. However, hardening, or physically strengthening critical infrastructure, would not be considered a qualified opportunity.

- T&D projects with an NWA opportunity involving one or more of the three grid needs categories described earlier in this section.
- T&D projects that address “required” needs outside of the three NWA opportunity categories. This step can be done in conjunction with the Company’s annual capital budgeting process to ensure that consistency is applied across the enterprise. Those T&D projects identified as required in this initial screen will be pursued as utility wires solutions in the appropriate regulatory approval procedure (that is, general rate case or a cost recovery mechanism such as a GO7 application).

Focusing on the most viable NWAs by categorizing opportunities by these specific capital project types is employed in every state currently pursuing NWAs.

### G.4.2.2 Step 2: NWA Opportunity Sourcing Evaluation

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The Company, through the use of NWAs, seeks to expand options for broad participation in support of growing a viable DER market to meet Hawai‘i’s goals. It is also important for all customers to directly benefit from the use of DER. As such, the Company’s approach is to consider a range of competitive market-based procurement, program, and pricing options to expand access for all customers—not just for a few. This approach is different than what California and other states consider in their NWA procurement-focused opportunity evaluations.

While the Company’s methodology adapts aspects of California’s<sup>68</sup> evaluation criteria, it is done here in the context of assessing other sourcing options, such as programs and retail pricing, as well as procurements on the basis of favorable, uncertain, or unfavorable attributes. The implied precision of California’s complex quantitative approach, in practice, does not identify more NWA procurement opportunities than the simpler methods employed in other states. Based on the six mainland states surveyed, NWA opportunities for procurement averaged approximately 1 to 2 percent of all T&D capital projects<sup>69</sup> and about 5 to 10 percent of initially screened distribution upgrade projects.<sup>70</sup>

The Company is adapting elements of the California approach as such elements are useful in considering sourcing options other than procurements. Therefore, the intent of this second step is to evaluate candidate T&D NWA opportunities in greater detail to identify those with the highest likelihood of success and related solution sourcing options. This NWA opportunity sourcing evaluation is technology agnostic, consistent with the Company’s IGP process.

The following three criteria is used to evaluate NWA opportunities:

- **Timing** of the grid need
- **Performance requirements** in relation to operational performance requirements of the identified T&D grid need

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<sup>68</sup> California PUC Decision on the Distribution Investment and Deferral Process (D.18-02-004).

<sup>69</sup> California utilities’ distribution deferral opportunities reports for 2018 and 2019 are consistent with this finding.

<sup>70</sup> P. De Martini and A. De Martini, NWA Opportunity Evaluation Survey of Current Practice, Pacific Energy Institute, March 2020

- **Project economics** in terms of the deferral value of a qualified T&D capital project and any other relevant avoided costs to determine sourcing options

The following criteria were considered to evaluate NWA opportunities but is currently not included in the evaluation due to lack of quality market data, and to broaden the NWA opportunities that can move to Step 3. These criteria may be reassessed with further NWA experience and market responses to future RFPs.

- **Forecast certainty** of the forecasted growth driving the grid need
- **Market assessment** based on the potential for successful NWA procurement versus programs or retail pricing options in the immediate local area related to the grid need

Each grid project will be assessed in relative terms within each criterion. The criteria are further explained below.

## Timing

Timing of the grid need is an important factor. Sufficient lead time is required to allow for a procurement (including contract negotiations) or program development, regulatory approval, and NWA solution deployment by the in-service date, as required by the forecasted operational date, to meet the grid need. Based on the Company's experience with sourcing other grid services, and consistent with stakeholder feedback and industry practice, a starting point of a 2-year lead time is used.

One lesson learned from the industry survey was that the time needed for NWA procurement contract negotiations and subsequent regulatory approval are key factors in the time required. In addition, depending on the complexity of the contingent wires solution in the event the NWA sourcing does not yield a viable solution, more lead time may be needed. The minimum timing threshold may be adjusted as the Company, the market, and the Commission learn from future NWA opportunities.

Timing criteria are defined as follows:

- **Favorable:**
  - o 2-5 year lead time
- **Moderate or Uncertain:**
  - o Greater than 5 year lead time
- **Unfavorable:**
  - o Less than 2 year lead time

Grid needs with lead times greater than 5 years are considered Moderate or Uncertain and will be reassessed during the next IGP cycle.

## Performance Requirements

The performance requirements criterion will be used to determine whether NWA solutions can reasonably meet the performance requirements of the identified grid need (capacity expansion, reliability back-tie, or



resiliency). Projects that target critical needs with high operational risks are more likely to require more stringent performance requirements and contract terms for NWA solutions. In general, opportunities with more lenient requirements are more viable for NWAs. For example, if the opportunity has a smaller peak capacity, shorter duration needs, and fewer calls, then the ability to meet the performance requirements will be considered more favorable for an NWA.

Performance criteria are defined as follows:

- **Favorable:**
  - o Capacity: Up to 5 MW and
  - o Duration: Up to 4 hours
- **Moderate or Uncertain:**
  - o Capacity: > 5 MW and < 10 MW or
  - o Duration: > 4 hours and < 8 hours
- **Unfavorable:**
  - o Capacity: 10 MW and larger
  - o Duration: 8 hours or more

The grid need will be clearly described as illustrated in Figure G-4, along with supporting engineering and operational analyses as provided in the Soft Launch<sup>71</sup> and case examples<sup>72</sup> discussed with the DPWG in August and October 2019.

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<sup>71</sup> DPWG Meeting August 8, 2019 "Review of Soft Launch Opportunity" presentation:

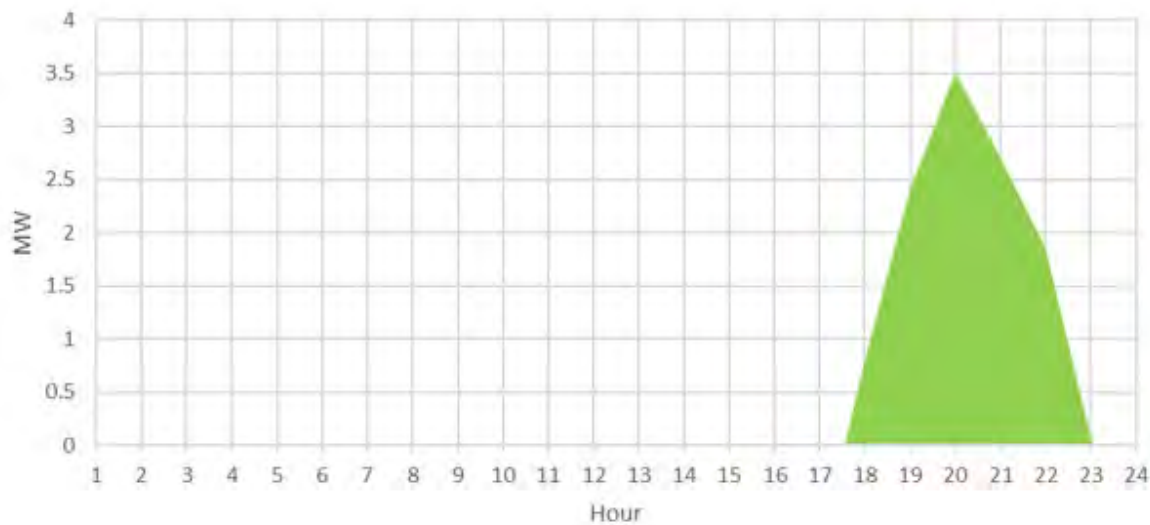
[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20190808\\_dpwg\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20190808_dpwg_meeting_presentation_materials.pdf).

<sup>72</sup> DPWG Meeting October 9, 2019 "Review of T&D NWA Opportunity Identification & Evaluation Process" presentation:

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20191009\\_dpwg\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20191009_dpwg_meeting_presentation_materials.pdf).



### Projected Hourly Needs Summary



| Equipment   | MW Peak | MWH  | Delivery Months | Delivery Hours | Duration (Hr) | Max # of Days |
|-------------|---------|------|-----------------|----------------|---------------|---------------|
| Tsf/Circuit | 3.5     | 11.4 | Jan - Dec       | 5PM - 11PM     | 6             | 365           |

**Figure G-4: Example Engineering Analysis and Performance Requirements**

These performance requirements are intended to provide as complete a picture as possible of the grid need and operational performance required of solutions to transparently inform stakeholders.

### Project Economics

The project economics criterion will be used to evaluate opportunities for procurement, programs, and/or pricing, and to identify opportunities that are unlikely to be cost-effective. The project economics include the deferral value of a qualified T&D capital project and any other relevant avoided costs. Based on stakeholder feedback, projects with an economic value (that is, capital cost) of \$1 million or greater will be seen as favorable in this criteria. Projects with an economic value less than \$1 million may be considered for targeted DER programs to address specific NWA needs consistent with the Company's Advanced Rate Design Strategy.<sup>73</sup>

Project Economic criteria are defined as follows:

- **Favorable:** \$1M and above
- **Moderate or Uncertain:** Between \$500K and \$1M
- **Unfavorable:** Less than \$500K

<sup>73</sup> Hawaiian Electric Companies, Advanced Rate Design Strategy, September 25, 2019.

## Forecast Certainty

Forecast certainty criterion is important to avoid investment in grid needs that may be premature or not required if the forecasted load growth does not materialize. However, this forecast certainty criterion is currently not used to evaluate grid needs because the Company has yet to determine the evaluation metrics for this. The Company may consider qualitative factors in the future such as, but not limited to, the following:

- **Favorable:** If the forecasted load growth is driven by actual electric service requests received, which may signal higher certainty of developer plans driving a grid need.
- **Moderate or Uncertain:**
  - o If the forecasted load growth is driven by conceptual or high-level master plans, which may signal moderate certainty of developer plans.
  - o If the forecasted load growth is driven by spatial allocation of the Company system-wide growth forecast, which may signal moderate certainty of growth in an area.

## Market Assessment

The market assessment criterion is used to assess the following two aspects in terms of procurement/program sourcing options:

- Technical potential based on the number of customers available for behind-the-meter solutions and land availability for ahead-of-the-meter solutions
- Supplier and solution diversity to ensure competitiveness and reliability

The opportunity for a DER-based alternative is dependent on sufficient existing or new customers and/or land availability in the appropriate locations associated with the circuits and/or substation(s) to develop an NWA solution sufficient to meet an identified grid need. Also, as procurements are intended to foster competitive solutions, it is beneficial to identify whether sufficient customers and/or land opportunity exists to support competitive proposals from more than one provider. These factors may be used to evaluate the potential success of an NWA procurement/program and any mitigation measures that may be needed to realize a successful outcome for customers. For instance, as proposed by stakeholders, an NWA program may provide a better outcome for a new residential development than a procurement.<sup>74</sup>

However, currently the Company lacks quality market data to properly assess this criteria. Therefore, this criteria is not used in this evaluation. This criteria may be reassessed based on market response to future RFPs.

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<sup>74</sup> Stakeholder comments on programmatic approach for NWA in DPWG meetings beginning in July 17, 2019 meeting:  
[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20190717\\_dpwg\\_meeting\\_summary\\_notes.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20190717_dpwg_meeting_summary_notes.pdf)

### G.4.2.3 Step 3: Action Plan

The NWA opportunity sourcing evaluation discussed in Section 4.2.2 results in a T&D action plan that assigns specific T&D projects to one of three action plan tracks. The assigned action plan track will provide the path the Company will use to pursue a solution. Competitive procurement is the primary means of sourcing opportunities \$1 million or greater. However, based on stakeholder discussion in the DPWG, the Company sought to expand the potential for NWAs by including the option for programs and pricing for opportunities under \$1 million and for those opportunities that do not lend themselves to procurement, such as new real estate developments. As such, this sourcing approach adapts the California model by explicitly incorporating the option for programs and pricing options in Track 2 to expand the potential for NWA solutions for grid needs less than \$1 million in economic value.<sup>75</sup> The three tracks are as follows:

- **Track 1:** Procurement of favorable NWA opportunities (that is, greater than \$1 million in economic value with in-service need in 2 to 5 years) with performance requirements that can reasonably be met by NWAs.
- **Track 2:** Reassess if factors indicate reevaluating in the future for potential procurement (that is, moderate/uncertain or favorable performance and economic criteria and timing greater than 5 years); or a program or pricing if the economic value is less than \$1 million but greater than \$500K and potential timing of need is favorable (2 to 5 years) for customer adoption.
- **Track 3:** Non-qualified opportunities that have criteria (for example, performance, timing, or economics) that cannot be reasonably met by NWA solutions. In these instances, the wires solution will be implemented.

The action plan will include a summary list of T&D project opportunities evaluated and the proposed course of action on solutions for each grid need. In addition, the supporting evaluation for each NWA opportunity will be discussed.

| Track        | Timing                      | Overall Performance             | Economics          |
|--------------|-----------------------------|---------------------------------|--------------------|
| 1            | Favorable                   | Favorable or Moderate/Uncertain | Favorable          |
| 2 (Pricing)  | Favorable                   | Favorable or Moderate/Uncertain | Moderate/Uncertain |
| 2 (Reassess) | Moderate/Uncertain          | Favorable or Moderate/Uncertain |                    |
| 3            | One or more are Unfavorable |                                 |                    |

**Figure G-5: T&D NWA Opportunity Evaluation**

<sup>75</sup> Note that in the Northeast and California, the utilities employ demand side management programs funded by existing customer public surcharges to mitigate grid needs before pursuing NWA procurements.

Figure G-5 identifies potential distribution opportunities in one of the three tracks described above, along with a corresponding color code—green (favorable), yellow (uncertain), and red (unfavorable)—to highlight the assessment of each criterion to indicate why the opportunity was placed into the given track.

#### G.4.2.4 Contingency Plan

The primary goal of action plans Track 1 and Track 2, as mentioned in section 4.2.3, is to pursue successful deferral of the grid project with a NWA. However, for the Company to meet its obligation to provide electric service, there may be a need to develop a contingency plan based on grid investment or another alternative to ensure that the in-service date and lead time to implement those solutions may be met.

During NWA procurement and/or program implementation, solicitation/program development, NWA deployment/customer adoption, or NWA commercial operation, several scenarios may occur that could cause the NWA solution to not viably solve the grid need. For example, if there are no cost-effective NWA bids that meet the distribution need, or if contracts are not approved by the Commission, implementation of the Company's contingency solution will be needed. This contingency solution may include the wires project originally intended for deferral. For this reason, it will be necessary to continue preliminary engineering solution development activity, such as wires project engineering and other related activity. This challenge was discussed with the IGP TAP on November 16, 2022,<sup>76</sup> which the TAP suggested the Company also assess the risk of a non-performing NWA, and the impact should be considered in identifying NWA opportunities.

As the NWA process and market mature, a framework may need to be developed that covers contingency planning for NWAs similar to what has been developed for competitive bidding of generation.<sup>77</sup> As part of the Competitive Procurement Working Group within the IGP process, the Company is revising the competitive bidding framework to cover procurement of NWAs. Modifications to contingency planning will be covered by those revisions as well as processes and procedures to facilitate the procurement of NWAs.

If NWA bids meet most of the distribution need, but not all of the need required for a full deferral, the Company may develop short lead time mitigation alternatives that supplement the NWA portfolio for the total solution where feasible. Depending on how early in the procurement process the shortcoming is known and the amount that will be insufficient, the Company may initially attempt to use NWAs as a contingency measure to supplement the deficiency or may consider smaller wires solutions and/or operational constraints to temporarily remedy a deficiency. If a cost-effective solution does not exist, the Company may need to pursue the contingency plan's alternative solution. This may include operating solutions, up to pursuing the initial traditional solution. For example, if an NWA solution can resolve a distribution line overload, but the location leaves a portion unmitigated, that smaller remaining portion may still be reconducted to supplement the NWA solution. Such contingency solutions may require the Company to seek expedited approval by the Commission.

<sup>76</sup> See

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/technical\\_advisory\\_panel/20221116\\_tap\\_feedback.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/technical_advisory_panel/20221116_tap_feedback.pdf)

<sup>77</sup> See, Decision and Order No. 23131 filed on December 9, 2006 in Docket No. 03-0372, Instituting a Proceeding to Investigate Competitive Bidding for New Generating Capacity in Hawaii. Available at,

If the NWA provider is unable to install NWAs according to the contract, the Company may develop short lead time mitigation alternatives that supplement the NWA portfolio for the total solution where feasible in accordance to the wire solutions development<sup>78</sup> steps. The supplemental solution would be the least complex solution that addresses the shortcoming. This could include an operating solution, like switching, that uses existing equipment or load balancing. If a cost-effective NWA mitigation solution does not exist, the Company may pursue the contingency solution.

If the NWA fails during field commissioning or underperforms during operations based on commissioning and performance verification protocols agreed to in the contract, the Company will determine emergency limitations, if applicable, and will work with system operations on potential grid reconfiguration or load drop for all scenarios above. The Company will determine the reason for NWA underperformance, assess any equipment damage or outage impacts, assess whether new mitigation is required, and determine expedited solution options. If issues such as these arise and result in adverse impacts on reliability (that is, system average interruption duration index and system average interruption frequency index metrics), then any associated impacts on performance incentives/penalties must also be considered.

The absolute latest a decision can be made for a distribution project intended for deferral is directly after final design is complete and before the scheduling, permitting, and construction of the project begins. This varies depending on the project being deferred, but typically distribution projects that do not require permitting require a project commencement decision to be made at least 12 to 48 months prior to the need date (as described in the *Distribution Planning Methodology* report, Section 5.3). The timing of the contingency decision process may change over time as the Company continues to understand the impact of scheduling traditional and DER solutions in parallel.

Cost recovery of preliminary engineering costs for contingency solutions is another issue that may need to be raised with the Commission in the future. The Company acknowledges that the issue of preliminary engineering costs that are expended to produce contingency or parallel plans to third-party contracted NWA services may be discussed in the performance-based regulation proceeding as part of the discussion on adjustments to the major project interim recovery mechanism.

## G.5 CASE EXAMPLES

The Company shared several identified grid needs with stakeholders at the October 9, 2019, DPWG meeting for the purpose of jointly validating the proposed NWA opportunity evaluation methodology with real examples.<sup>79</sup> These real T&D projects have been identified and scoped by the Company for consideration. These illustrative projects were discussed with stakeholders to refine the NWA opportunity evaluation methodology and to jointly assess each opportunity. For this reason, a representative set of examples that includes projects that are typically screened out of NWA consideration in California and the Northeast were included for the DPWG discussion. As such, this list is not the complete list of potential grid projects, nor

<sup>78</sup> See the Distribution Planning Methodology report, Section 6.

<sup>79</sup> October 9, 2019, DPWG meeting presentation, see slides 19-54

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20191009\\_dpwg\\_meeting\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20191009_dpwg_meeting_presentation_materials.pdf).

does it represent a final list of evaluated NWA opportunities as is found in the California Distribution Deferral Opportunity Report, for example. However, the results of the DPWG's feedback and application of this methodology in the Soft Launch and in the DPWG meetings is consistent with the California and Northeast approaches to identifying viable NWA opportunities for procurement.<sup>80</sup> The following includes example projects discussed during the October 9, 2019 DPWG meeting<sup>81</sup>. Additional example projects discussed during the November 2022 TAP presentation<sup>82</sup> on the NWA opportunity evaluation process are also included.

## G.5.1 STEP 1: NWA OPPORTUNITY SCREEN

Several case example T&D projects were discussed with stakeholders. The projects presented in this section are examples of capital projects that do not represent viable NWA opportunities and, as such, would be screened out in Step 1 of the process. The projects that passed Step 1 screening are discussed under Step 2 in Section 5.2.

### G.5.1.1 Salt Lake Boulevard Overhead Line Relocation

This project involved an overhead (OH) to underground (UG) line conversion and relocation of Salt Lake Boulevard OH lines requested by public works, as illustrated in Figure F-6.

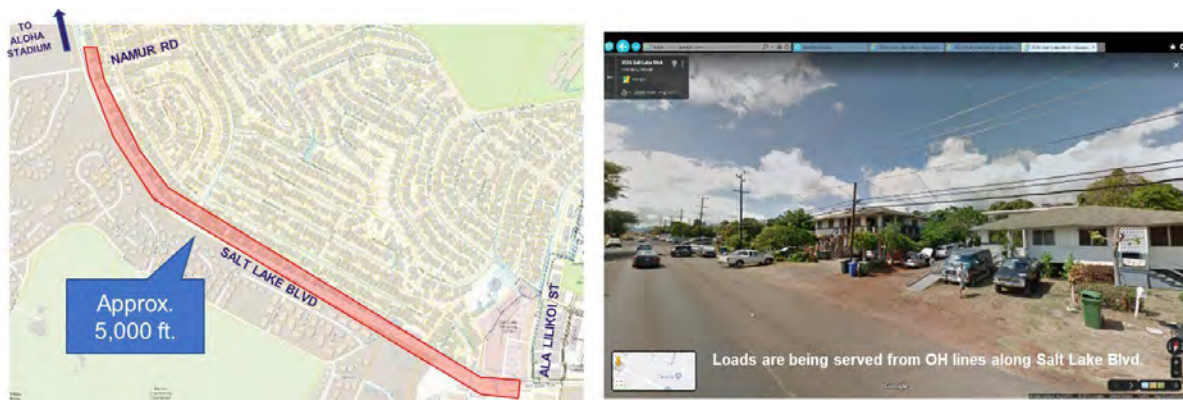


**Figure G-6: Salt Lake Boulevard Overhead Line Relocation**

This project involved relocating a portion of an existing line; therefore, the alternative is to remove that line. This means that downstream loads would need to be removed from the grid. Stakeholder consensus in the meeting was that this type of project is not a feasible NWA opportunity. This type of project requested by public works would be put into the non-qualified category in Step 1.

<sup>80</sup> Note: In 2019, PG&E and SCE identified a combined total of over 800 grid needs that were screened to only 10 projects (6 for SCE and 4 for PG&E) for NWA procurement. This is consistent with the experience in the Northeast.

<sup>81</sup> October 9, 2019, DPWG Meeting Summary Notes

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/distribution\\_planning/20191009\\_dpwg\\_meeting\\_summary\\_notes.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/distribution_planning/20191009_dpwg_meeting_summary_notes.pdf).

<sup>82</sup> November 16, 2022, DPWG Meeting Summary Notes [IGP Technical Advisory Panel Distribution Grid Needs Assessment & Non-Wires Alternatives \(hawaiianelectric.com\)](#)



### G.5.1.2 Waiau-Mililani 46 kV OH to UG Conversion

A customer requested OH to UG conversion projects for betterment in support of the Koa Ridge Development, as shown in Figure G-7. The scope of work includes installation of OH transitions and UG electrical facilities and then removal of existing OH electrical facilities once UG facilities are energized. The total project cost is \$6.5 million, with the developer contributing the majority of the funding through contributions in aid of construction (CIAC). The Company's cost after the customer's contributions is about \$800,000. In-service dates vary between 2020 and 2021.



**Figure G-7: Waiau-Mililani 46 kV OH to UG Conversion**

Stakeholders agreed that this type of customer-requested betterment OH to UG conversion project is not a feasible NWA opportunity. Customer-requested betterment conversion projects will be put into the non-qualified category in Step 1.

### G.5.1.3 Waiau 46 kV GIS Bus Replacement

This project is proposed to replace the existing deteriorated 46 kV air-insulated switchyard with a new 46 kV gas-insulated substation (GIS). This major 46 kV switching station provides service to Waiau, Ewa, Mililani, Pearl City, and Waipahu through eight sub-transmission lines with a total bus load (2018) of 92 MW.

Findings from Black & Veatch's *Waiau 46 kV Substation Engineering Study* dated 2013 are as follows:

- Substation that is well beyond its design life (66+ years in marine environment)
- Bus configuration that creates risk of major outage and is expensive to operate
- Severely corroded steel structure
- Inadequate grounding system creating potential hazard to public
- Aged, obsolete, and unreliable equipment providing unreliable service

- Inadequate housing for modern protective relays

The scope of work includes installing a new 46 kV GIS ring bus (circuit breakers are connected to form a ring, with isolators on both sides of each breaker) and constructing a new 46 kV control house, with provisions for future 138 kV relays, as shown in Figure G-8. The estimated project cost is \$60 million to \$80 million, with an in-service date of September 2024.

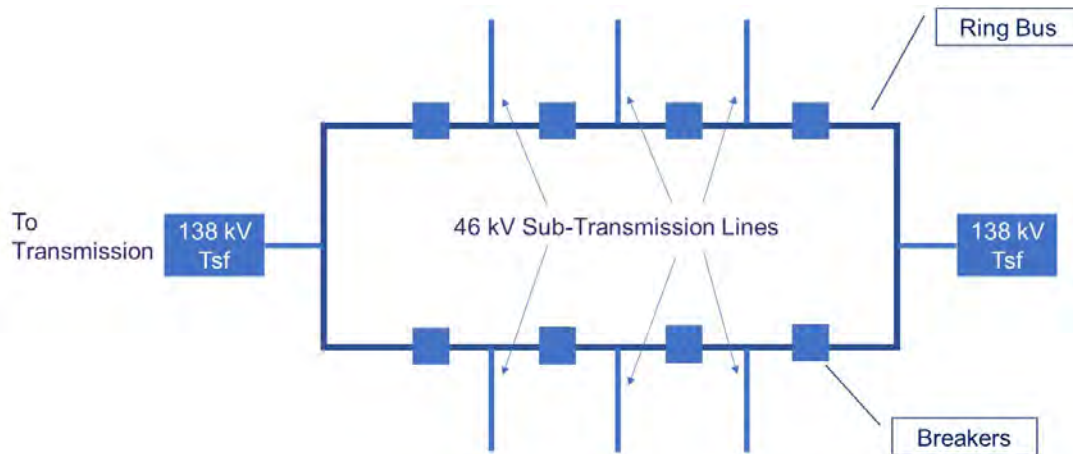


**Figure G-8: Waiau 46 kV GIS Bus**

Stakeholder consensus was that this type of aging infrastructure project is not an NWA opportunity because there is not a viable approach to avoid the ring bus and breaker replacement. Also, the 46 kV substation bus provides system benefits by allowing renewable projects and DER to export renewable energy to other parts of the grid in support of Hawai'i's 100 percent renewable objective. As such, this project would be screened out in Step 1.

The three example projects screened out in Step 1, which include line relocation, line OH to UG conversion, or bus replacement of aging infrastructure, represent projects where the alternative is to remove that section of the line or bus. This means that downstream loads would either result in losing a backup source or need to be removed from the grid.

## G.5.2 STEP 2: NWA OPPORTUNITY SOURCING EVALUATION

The following case example T&D projects that passed Step 1 screening were discussed with the IGP Technical Advisory Panel on November 16, 2022 in the joint application of the Step 2 evaluation criteria.

### G.5.2.1 Koa Ridge

Koa Ridge Development in Central O'ahu near Mililani, built by Castle & Cooke Hawai'i, includes 3,500 new homes, a medical center, commercial and light industrial development, parks, and schools. The developer estimated an additional 40.7 MW of load at the completion of the development. Additional distribution capacity would be needed by 2025 to address the new development growth, as shown in Figure G-9.



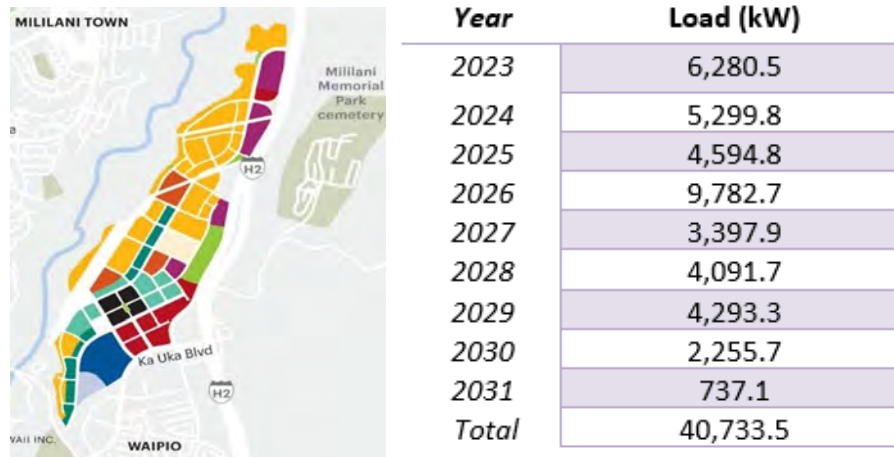


**Figure G-9: Waipio Substation and Koa Ridge Load Forecast**

The load growth will result in an overload of substation transformers under normal and emergency conditions, as presented and discussed with the stakeholders.

The proposed wires T&D project is to install a 10 MVA 46-12 kV transformer and associated equipment at Waipio Substation with an estimated cost of \$2.9 million, with an in-service date of 2025.

The Koa Ridge project is categorized as an expansion of distribution system capacity in Step 1. The following is the assessment for Step 2:

- **Performance Requirements:** Performance requirements are a potential challenge given the long-duration and high-magnitude overloads, and given the results of the Soft Launch (see Section 5.3) it is uncertain if a procurement will be successful (red).
- **Timing:** The in-service date is more than 2 years away (Green).
- **Economic Assessment:** The T&D project cost is greater than \$1 million (Green).

| Transformer                | Timing | Overall Performance                                                                                                         | Economics |
|----------------------------|--------|-----------------------------------------------------------------------------------------------------------------------------|-----------|
| Waipio 1<br>(Normal, Base) | 2025   | <ul style="list-style-type: none"> <li>Capacity: 10.6 MW</li> <li>Duration: 23 hours</li> <li>365 calls per year</li> </ul> | \$ 2.9M   |
| Waipio 1<br>(N-1, Base)    | 2025   | <ul style="list-style-type: none"> <li>Capacity: 11.5 MW</li> <li>Duration: 14 hours</li> <li>365 calls per year</li> </ul> | \$ 2.9M   |

Due to the large performance needs to address the projected overloads with capacity needs greater than 10 MW and duration longer than 8 hours, this Koa Ridge project's overall performance needs is deemed to be unfavorable and placed into Track 3 which indicates a non-qualified NWA opportunity that cannot be reasonably met by NWA solutions and the wires solution is to be implemented.

### G.5.2.2 CEIP 46 Sub-transmission Circuit Reconductoring

The CEIP 46 sub-transmission system serves a large portion of mid-west O’ahu from Ewa to Kapolei. It also serves as the backup in contingency scenarios to the Kahe, Ewa Nui, and Waiau sub-transmission systems. See Appendix A for map of the service area. There are a number of new loads forecasted to be served from the CEIP 46 sub-transmission system. The load for these projects total approximately 53 MW of new load growth. Additional distribution capacity would be needed by 2025 to address the load growth.

The proposed T&D project is to reconductor a section of the CEIP 46 sub-transmission circuit and associated equipment at an estimated cost of \$3.93 million, with an in-service date of 2025

The load growth will result in a contingency overload of the current carrying capacity of the cable/conductor. This project is categorized as ensuring a reliability requirement for circuit back-tie upgrade deferral in Step 1. The following is the assessment for Step 2:

- Performance Requirements: Performance requirements are considered favorable given a potential challenge given its short-duration and low-magnitude overloads (Green).
- Timing: The in-service date is more than 2 years away (Green).
- Economic Assessment: The T&D project cost is greater than \$1 million (Green).

| Transformer        | Timing | Overall Performance                                                                                                            | Economics |
|--------------------|--------|--------------------------------------------------------------------------------------------------------------------------------|-----------|
| CEIP/CEIP 46 (N-1) | 2025   | <ul style="list-style-type: none"> <li>• Capacity: 4.7 MW</li> <li>• Duration: 3 hours</li> <li>• 14 calls per year</li> </ul> | \$ 3.9M   |

Due to all evaluation criteria being favorable this project is placed into Track 1.

### G.5.2.3 Kakaako and Ala Moana Development Areas

New residential/commercial projects have been proposed in the Kakaako and Ala Moana area due to the Transit-Oriented Development (TOD) Special District Design Guidelines, which promote “intense and efficient use of land” near the rail stations, as shown in Figure G-10. The Company received six TOD-related service requests in the Ala Moana area, and two more appeared to be in development per news reports and feedback from the City. The Ala Moana TOD need was previously identified as a Track 2 opportunity because the performance requirements and timing were uncertain. The opportunity would be reconsidered in the next planning cycle based on further information on the need, including refinement of performance requirements, timing of in-service date(s), and scoping and estimation of a wires solution. Since then, several projects have not materialized and the refinement of the forecast shows more growth in the Kakaako area instead.

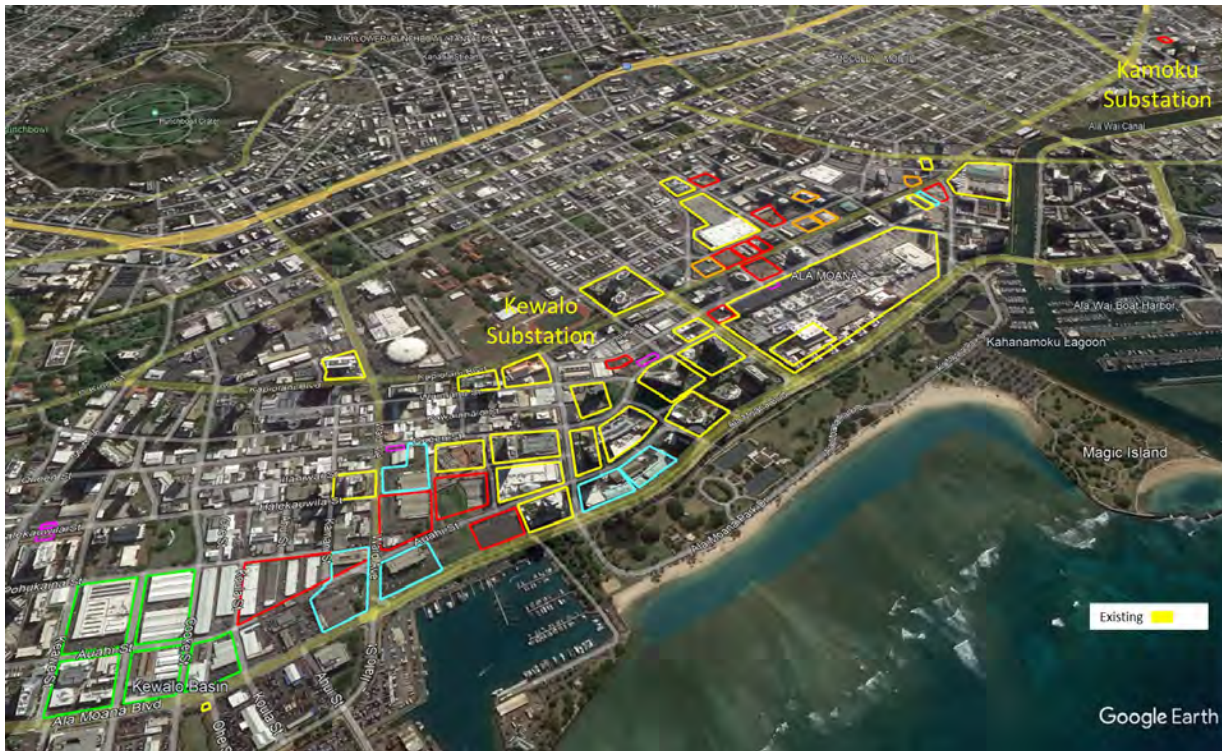


**Figure G-10: Kakaako and Ala Moana Area**

The Kakaako area under development is focused between Kamakee Street and Keawe Street and is served by a 25 kV distribution system fed by the Kewalo Substation (in Kakaako), Kamoku Substation (near Iolani School), and/or Iwilei Substation. With the projected loads based on service requests and developer plans, overloads will occur as illustrated in Figure G-11 and Figure G-12.

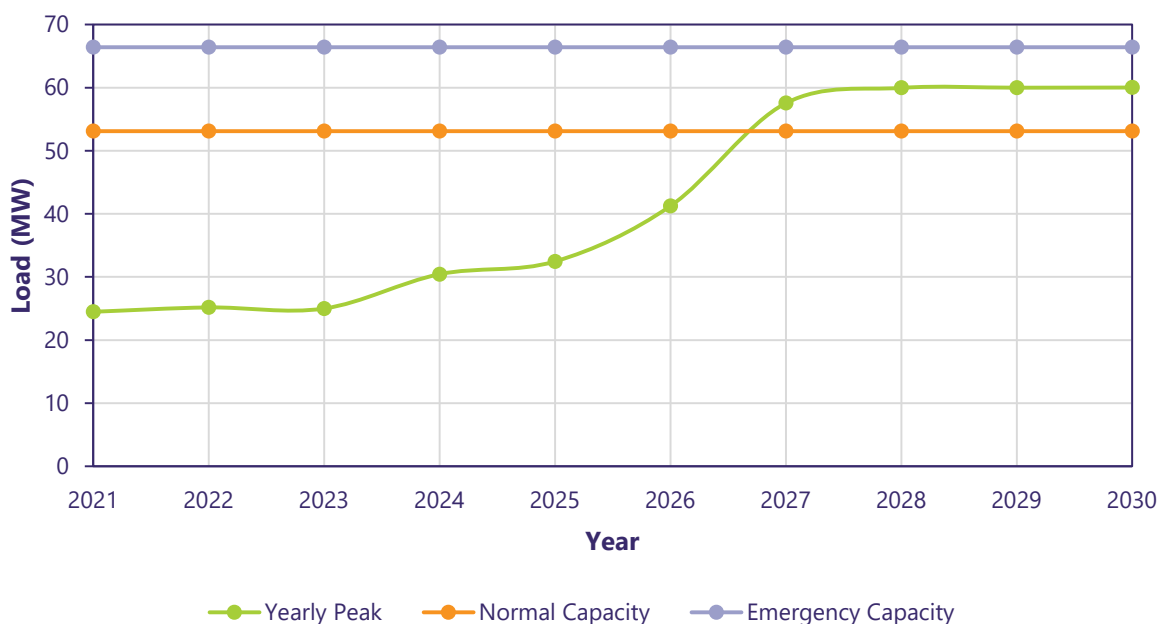


**Figure G-11: Kewalo T3 Yearly Peak Forecast**

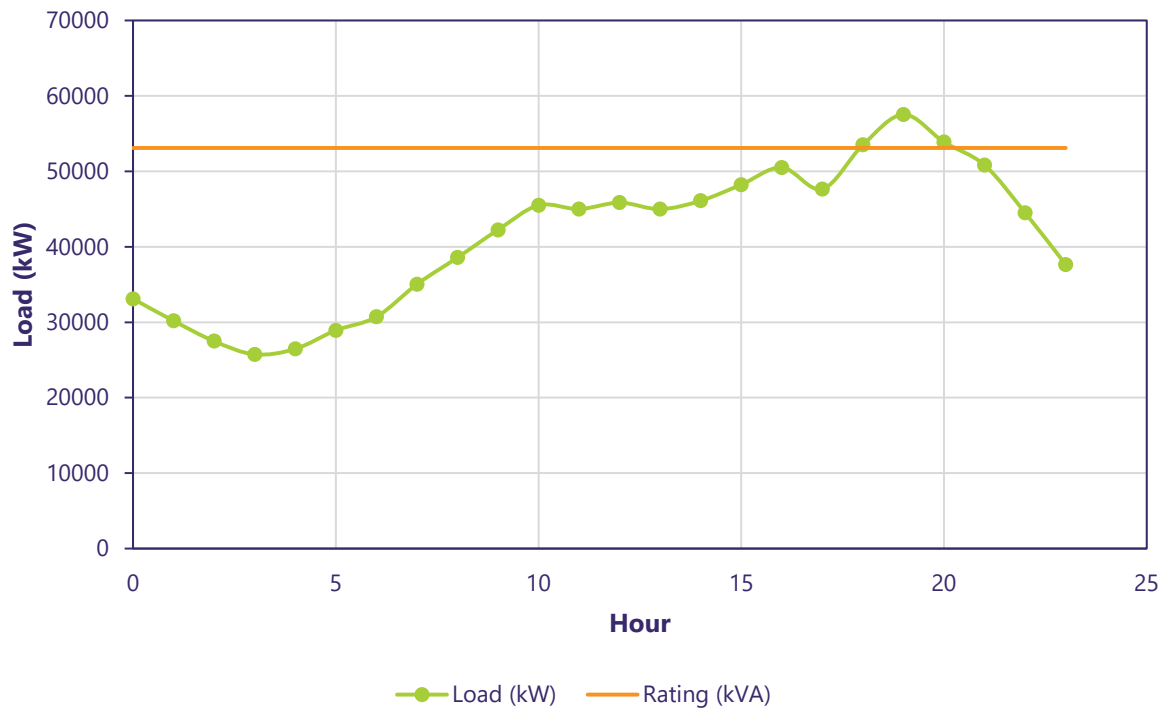


**Figure G-12: Kewalo T3 2027 Peak Day Overload**

The proposed wires T&D project is to install a 50 MVA 138-25 kV transformer at Kewalo Substation and extend new circuits to the Kakaako development area at an estimated cost of \$22 million, with an in-service date of 2026.

The Kewalo T3 project is a qualified NWA opportunity based on the Step 1 criteria. The project is considered expansion of the distribution system capacity.

The following is the assessment from Step 2:

- Performance Requirements: Transformer loading requirements are favorable (Green).
- Timing: The in-service date is more than 2 years away (Green).
- Economic Assessment: The T&D project cost is greater than \$1 million (Green).

| Transformer                 | Timing | Overall Performance                                                                                                             | Economics |
|-----------------------------|--------|---------------------------------------------------------------------------------------------------------------------------------|-----------|
| Kewalo T3<br>(Normal, Base) | 2027   | <ul style="list-style-type: none"> <li>• Capacity: 4.43 MW</li> <li>• Duration: 3 hours</li> <li>• 12 calls per year</li> </ul> | \$ 22M    |

Based on the evaluation criteria this project is placed into Track 1.

### G.5.3 STEP 3: ACTION PLAN

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The following are example steps the Company took to seek NWA solutions for projects that were placed in Track 1. The Company conducted a Soft Launch and several Expression of Interests (EOI) to demonstrate the grid needs assessment, NWA opportunity evaluation, sourcing process, and solution evaluation methods for NWAs by using real-world examples. These examples also allowed the Company to gain experience identifying needs for resource choices while being subjected to an evaluation and construction time line. The lessons learned in the Soft Launch and EOIs are being used to help inform development of the full-scale IGP planning and sourcing effort.

### G.5.4 IGP SOFT LAUNCH RFP – HO’OPILI AND EAST KAPOLEI AREA

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The Company identified two T&D NWA opportunities to source through a competitive procurement as part of the IGP Soft Launch. These two opportunities were effectively identified as Track 1 opportunities to pursue for procurement. The following discussion summarizes the opportunities and results.

Ho’opili is a mixed-use master-planned community developed by D.R. Horton in west O’ahu located north of Ewa Beach and east of Kapolei, as shown in Figure G-13. The plans for this new community include 11,750 new residential homes, 7 community and recreation centers, over 200 acres of commercial farms and community gardens, up to 3 million square feet of commercial space, and 5 Department of Education public schools. In addition to Ho’opili, there are currently over 20 additional customer service requests in the area with completion dates within the next few years. Due to an estimated load growth of 83.4 MVA, overloads under contingency conditions are forecasted to occur in 2022, with normal overload conditions beginning in 2023.



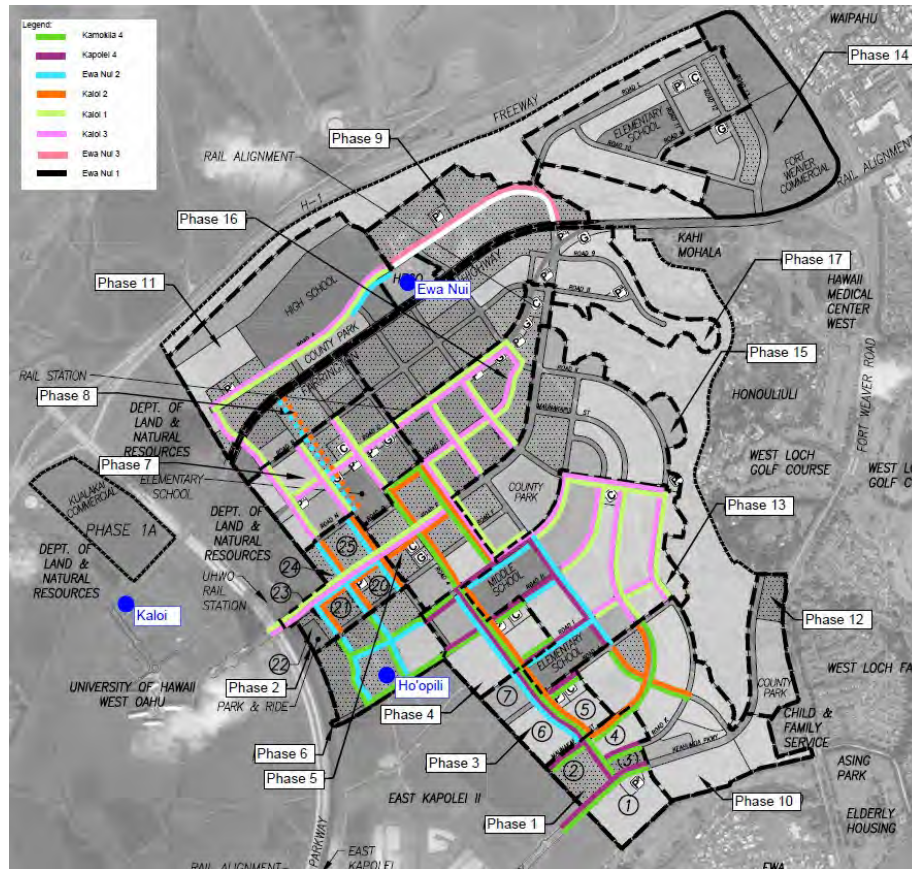


**Figure G-13: Planned Ho'opili Development**

The load growth will result in an overload of substation transformers and distribution circuits under normal and emergency conditions, as shown in Figure G-14 and Figure G-15. From these overloads, two NWA opportunities were identified. The first NWA opportunity was to defer the Kapolei 4 Circuit Extension project with a commercial operation date (COD) of February 1, 2022. The second NWA opportunity was to defer the Ho'opili Substation project with a COD of January 1, 2023.

| Deferral Opportunity | Equipment    | MW Peak | Operational Date | Delivery Months | Delivery Hours | Duration (Hr) | Max # of Days | MWH  |
|----------------------|--------------|---------|------------------|-----------------|----------------|---------------|---------------|------|
| Ho'opili Substation  | Kaloi 1 Tsfc | 4.7     | Jan 2023         | Jan–Dec         | 1PM–11AM       | 10            | 365           | 21.5 |
|                      | Kaloi 3 Ckt  | 0.3     | Aug 2023         | Aug–Oct         | 7PM–9PM        | 2             | 69            | 0.4  |

**Figure G-14: Summary of Normal Overloads**

| Deferral Opportunity        | Equipment      | MW Peak | Operational Date | Delivery Months | Delivery Hours | Duration (Hr) | Max # of Days | MWH  |
|-----------------------------|----------------|---------|------------------|-----------------|----------------|---------------|---------------|------|
| Kapolei 4 Circuit Extension | Kapolei 2 Tsfc | 3.5     | Feb 2022         | Jan–Dec         | 5PM–11PM       | 6             | 365           | 11.4 |
| Ho'opili Substation         | Ewa Nui 2 Ckt  | 5.1     | Jan 2023         | Jan–Dec         | 11AM–12AM      | 13            | 365           | 30.9 |

|  |                |     |          |         |                      |    |     |      |
|--|----------------|-----|----------|---------|----------------------|----|-----|------|
|  | Kaloi 1 Tsf    | 9.7 | Jan 2023 | Jan–Dec | 6AM–8AM,<br>9AM–12AM | 17 | 365 | 62.8 |
|  | Kaloi 3 Ckt    | 2.6 | Jan 2023 | Jan–Dec | 5PM–11PM             | 6  | 365 | 8.5  |
|  | Kamokila 4 Ckt | 1.0 | May 2023 | Jan–Dec | 5PM–10PM             | 5  | 226 | 2.9  |

**Figure G-15: Summary of Contingency Overloads**

Figure G-16 shows the loading of the peak day by month on the Kaloi #1 Transformer in the year 2023. Figure G-17 shows the associated grid need for Kaloi #1 Transformer. These, along with graphic representation for all other overloads, were identified in the RFP, Appendix J, for NWA services for the Ho‘opili Area, dated November 8, 2019.

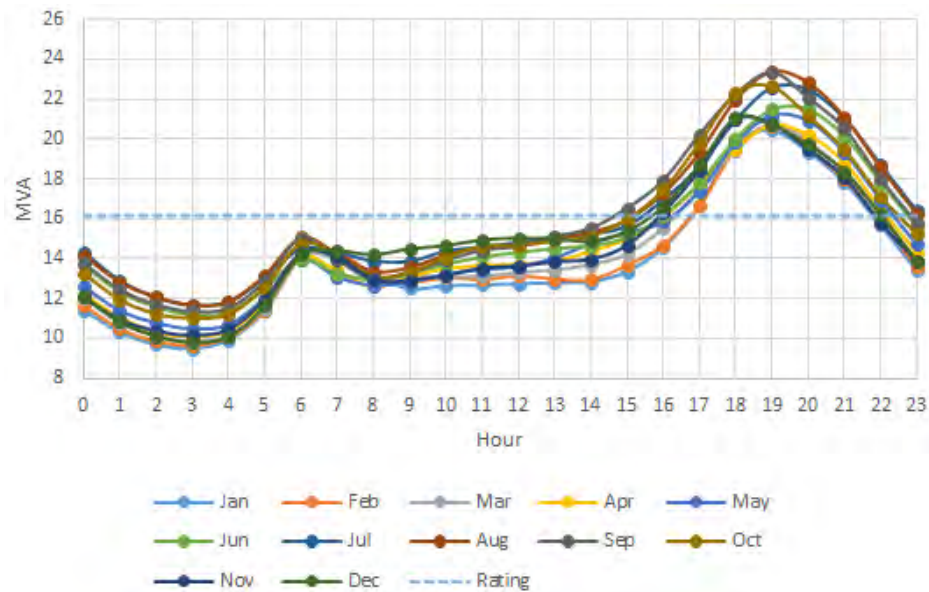


**Figure G-16: Kaloi #1 Transformer Loading – Monthly Peak Day in 2023**

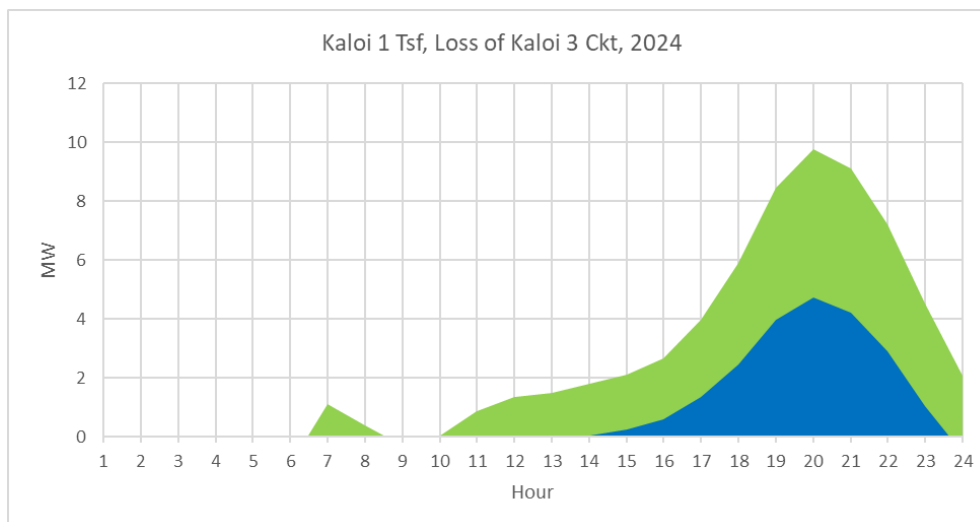


**Figure G-17: Kaloi #1 Transformer Overload**

The most cost-effective T&D project proposed for comparison to an NWA solution is the construction of a new substation site and associated equipment located in the Ho'opili development. This would result in minimal distribution circuit installation costs because of the location of new loads to serve. Estimated costs for this project are approximately \$12.7 million with provisions for up to four 46-12 kV, 10/12.5 MVA distribution transformers to allow for future load growth in the area.

The IGP Soft Launch RFP process resulted in low response from the market. Because of insufficient response to the RFP to meet the performance and operations requirements for either of the deferral opportunities, the Company, in consultation with the Independent Observer, decided not to move forward with the IGP Soft Launch RFP. As a result, the Company is moving forward with the identified traditional solution. As indicated in Hawaiian Electric's *Ho'opili Area Study* dated 2019, the proposed project will allow for the timely installation of critical infrastructure to the electrical system, which will provide necessary capacity to serve projected loads and provide essential reliable power under contingency conditions.

Although a traditional solution will be initially pursued for the Ho'opili area, future NWA opportunities remain to enable Ho'opili's growth. The Company will evaluate the viability of a programmatic DER effort for the Ho'opili and East Kapolei area to reduce longer-term needs for distribution upgrades in the area. The Company will reevaluate options as load grows (around 2024 or 2025) and will determine if future NWA opportunities become available. The Company has also recognized the challenge and need of exploring ways to cost-effectively mitigate the impact of large new real estate development loads.

The Company was one of the first, if not the first, to procure for a distribution reliability (back-tie) service nationally and gained valuable experience while proceeding through the Soft Launch process. The Company will continue to improve the IGP process going forward and will conduct future NWA procurements for distribution opportunity based on lessons learned from the Soft Launch. Some lessons learned that will be applied to the IGP process include the following<sup>83</sup>:

- Leverage the NWA evaluation framework developed by the DPWG to determine opportunities best suited for procurements
- Continue to pursue market solutions to acquire least cost, best fit solutions for customers, but consider tariff and program options to complement procurements
- Continue discussion in examining opportunities to capture multiple services from resources at longer-duration contracts

Pursue standard form RFP for NWAs and streamline the process for short lead time/near-term needs.

### Expression of Interest for NWA Opportunities

In the years 2022 and 2023, EOIs were issued for three T&D NWA opportunities which were identified as Track 1 opportunities based on the NWA methodology. The objective of the EOIs were to identify interested parties who are able to develop cost competitive utility-scale renewable projects or aggregating DER/EE

<sup>83</sup> March 9, 2020, DPWG Presentation Slides

[https://www.hawaiianelectric.com/documents/clean\\_energy\\_hawaii/integrated\\_grid\\_planning/stakeholder\\_engagement/working\\_groups/soft\\_launch/20200309\\_igp\\_soft\\_launch\\_wg\\_presentation\\_materials.pdf](https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/soft_launch/20200309_igp_soft_launch_wg_presentation_materials.pdf)



projects in specific locations to fulfill grid service performance requirements. As part of the EOIs, the performance requirements, net present value (NPV) of the deferral or avoidance cost of the traditional wires solution, and a map of the areas where the NWA projects are required were provided.

The information obtained from responses would help the Company determine if there are viable cost competitive NWA projects, to move forward with issuance of an RFP or alternative means of procurement, subject to approval by the Hawai'i Public Utilities Commission. The following discussions summarizes the opportunities and results.

### Ewa Nui B Transformer NWA

The Company forecasts significant load growth in central O'ahu in the coming years. The load is forecasted to increase by approximately 70 MVA by 2030 triggering overloads beginning in 2026 during a contingency condition. Therefore, the Company has identified a capacity and reliability grid need and issued an EOI in 2/2023 to developers or aggregators who are capable of developing utility-scale renewable projects or aggregating DER/EE in the Central O'ahu area.

The traditional wires solution consists of installing a new 80MVA 138-46kV transformer and associated equipment at Ewa Nui Substation with a new 46kV circuit. This solution is preliminarily estimated to cost \$15.0M.

To address these grid needs, the Company sought capacity (MW) and energy (MWH) annual grid needs shown in Figure G-18 to defer the need for the wires project by five years.

|               | 2026 | 2027 | 2028 | 2029 | 2030 |
|---------------|------|------|------|------|------|
| Capacity (MW) | 7.2  | 9.5  | 12.2 | 15.1 | 16.5 |
| Energy (MWH)  | 8.5  | 15.5 | 31.1 | 65.0 | 87.8 |

**Figure G-18: Annual Grid Needs**

This project is intended to defer a T&D solution to provide capacity to the 46 kV system for five years. The NPV of the deferral value is: \$7.0M.

The Company did not receive any responses to this EOI and will be pursuing the traditional wires solution.

### CEIP 46 Reconductoring NWA

The Company forecasts significant load growth in west O'ahu from Ewa to Kapolei areas in the coming years. The load is forecasted to increase by approximately 53 MVA by 2030 triggering overloads of existing electrical infrastructure beginning in 2025 during a contingency condition. Therefore, the Company has identified a capacity and reliability grid need and issued an EOI in 2/2023 to developers or aggregators who are capable of developing utility-scale renewable projects or aggregating DER/EE in the Ewa and Kapolei areas of O'ahu.

The traditional wires solution consists of installing approximately 520 ft of new 1500KCM cables parallel to existing cables and reconductoring approximately 1.91 miles of 556 conductor to 795 conductor. This solution is preliminarily estimated to cost \$3.93M.

To address this grid need, the Company sought the aggregate NWA amount of 5.71MW/13.9MWH in 2025 for the expected 30-year lifespan of a wires project to avoid the cost of the wires project. Figure G-19 shows the capacity (MW) and energy (MWH) annual grid needs.

|               | 2025 | 2026 | 2027 | 2028 | 2029 |
|---------------|------|------|------|------|------|
| Capacity (MW) | 5.71 | 5.71 | 5.71 | 5.71 | 5.71 |
| Energy (MWH)  | 13.9 | 13.9 | 13.9 | 13.9 | 13.9 |

**Figure G-19: Annual Grid Needs**

This project is intended to avoid a T&D solution to provide capacity to the 46 kV system. The NPV to avoid the wires project is \$4.57M.

The Company did not receive any responses to this EOI and will be pursuing the traditional wires solution.

### Kewalo T4 Transformer NWA

The Company forecasts significant load growth in the Kakaako and Kewalo area in the coming years. The forecasted load growth totals approximately 30 MVA by 2030 triggering normal and contingency overloads of existing electrical infrastructure beginning in 11/2025. Therefore, the Company identified a capacity and reliability grid need and issued an EOI in 3/2023 to developers or aggregators who may be interested and capable of developing utility-scale renewable projects or aggregating DER/EE in the Kakaako and Kewalo areas of O'ahu.

The traditional wires solution consists of installing a 138-25 kV, 50 MVA transformer and associated equipment at Kewalo Substation and four new 25 kV circuits. The solution is preliminarily estimated to cost \$22M.

To address these grid needs, the Company sought aggregate NWA amounts for two scenarios below. Figure G-20 shows the capacity (MW) and energy (MWH) annual grid needs.

1. 2.0MW/3.3MWH in 2025-2026 to defer the wires project by one year; or
2. 2.0MW/3.3MWH in 2025-2026 and 17.7MW/168.5MWH in 2027 to avoid the need for the wires project.

|               | 11/2025 | 2026 | 2027  | 2028  | 2029  | 2030  |
|---------------|---------|------|-------|-------|-------|-------|
| Capacity (MW) | 2.0     | 2.0  | 17.6  | 17.7  | 17.7  | 17.7  |
| Energy (MWH)  | 3.3     | 3.3  | 166.6 | 168.5 | 168.1 | 167.7 |

**Figure G-20: Annual Grid Needs**

The NWA is intended to defer or avoid a T&D solution to provide capacity to the distribution system. The approximate NPV for the two NWA scenarios were:

1. NPV to defer the wires project by one year: \$3.17M.
2. NPV to avoid the wires project: \$25.6M

The Company did not receive any responses to this EOI and will be pursuing the traditional wires solution.

SERVICE LIST  
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