January 29, 2021

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: Adequacy of Supply
Maui Electric Company, Limited

The following information is respectfully submitted in accordance with paragraph 5.3a of General Order No. 7, which states:

> *The generation capacity of the utility's plant, supplemented by electric power regularly available from other sources, must be sufficiently large to meet all reasonably expectable demands for service and provide a reasonable reserve for emergencies. A Statement shall be filed annually with the Commission within 30 days after the close of the year indicating the adequacy of such capacity and the method used to determine the required reserve capacity which forms the basis for future requirements in generation, transmission, and distribution plant expansion programs required under Rule 2.3h.1.*

2021 Adequacy of Supply Report Summary

- Maui Electric Company, Limited's ("Maui Electric" or the "Company") 2021 Adequacy of Supply employs a new Energy Reserve Margin criteria, developed to review adequacy of supply in all hours of the year vs. during the peak hour of the day or peak day of the year and incorporate the reliability contribution of variable and energy-limited resources, such as energy storage and duration limited grid services, such as demand response resources.
- For the island of Maui, Energy Reserve Margin criteria shortfalls occur in 2021 and 2022. Energy Reserve Margin is satisfied from 2023 through 2025 with the addition of planned generation and storage resource additions. New resources planned for Maui are anticipated to meet energy reserve margin targets to mitigate the retirement of Kahului Power Plant.
- For the island of Lanai, Energy Reserve Margin shortfalls occur from 2021 through 2025.

- For the Island of Molokaʻi, Energy Reserve Margin is satisfied for the next five years 2021 through 2025.
- The peak load experienced on Maui in 2020 was 185.3 MW-net and was served by Maui Electric's total capability of 246.3 MW-net not including variable generation sources such as wind and solar. This represents a reserve margin of approximately 33% over the 2020 net system peak.
- The peak load experienced on Lanaʻi in 2020 was 6.14 MW-gross, and was served by Lanaʻi's total capability of 9.40 MW-gross, not including variable generation sources. This represents a reserve margin of approximately 53% over the 2020 system peak.
- The peak load experienced on Molokaʻi in 2020 was 5.80 MW-gross, and was served by Molokaʻi's capability of 12.01 MW-gross not including variable generation sources. This represents a reserve margin of approximately 107% over the 2020 system peak.

1.0 Maui's Peak Demand and System Capability in 2020

Maui's 2020 system peak occurred on Thursday, January 2, 2020, at approximately 6:40 p.m. and was 185.3 MW (net) or 189.4 MW (gross). During the peak, wind resources provided approximately 35.7 MW and there was no solar output.

At the time of the system peak, Maui had a generating reserve margin of approximately 33% over the 2020 system peak based on firm generation resources.[1] This calculation does not include any variable generation wind and solar resources.

1.1 Rider M

At the time of system peak, Maui had in place nine load management contracts totaling approximately 4.2 MW under Rider M, which reduced the evening peak by approximately 2.1 MW-net.

2.0 Criteria to Evaluate Maui Electric's Adequacy of Supply

Maui Electric's capacity planning criteria are applied to determine the adequacy of supply – whether or not there is enough generating capacity on the system. Maui Electric's capacity planning criteria take into account that the Company must provide for its own backup generation since, as an island utility, it cannot import emergency power from a neighboring utility.

The function of a planning criteria is to establish guidelines to manage the risk of insufficient generation capability from a diverse mix of generating resources available to

[1] Refer to Attachment 2, Table A2 for additional details.

the system in long-range generation expansion studies. Resource plan development is evaluated based on a consistent guideline 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.

With the increasing quantities of variable renewable wind and solar resources, and future energy storage additions to the system, a capacity planning criteria was developed to address the dynamic nature of energy provided by wind, PV and limited duration storage.[2] For the purposes of this adequacy of supply report, Maui Electric used its Energy Reserve Margin planning criteria. The previous planning criteria is also presented, however, as discussed further below, calculations for the previous criteria rely mainly on capacity contribution from traditional firm capacity thermal generators, since variable generation and limited duration resources do not translate accurately to criteria that focus on an annual system peak.

2.1 Energy Reserve Margin:

The Energy Reserve Margin is the percentage of system load in which the system capacity must exceed the system load in each hour. With the increasing quantities of variable renewable wind and solar resources, Maui Electric has recently developed this capacity planning criteria to account for current and future variable generation resources by addressing the dynamic nature of energy provided by wind, PV and limited duration storage. The hourly evaluation of available energy allows for better integration of resources with possible rapid fluctuations in generating capabilities. The Energy Reserve Margin for Maui is 30%, to maintain reliability, and provide reasonable reserve for emergencies. Details of the Energy Reserve Margin, purpose, concept, and structure are discussed at length in Attachment 3.

2.2 Maui Electric’s Previous Capacity Planning Rule

Rule 1:

New generation will be added to prevent the violation of the rule listed below where “units” mean all units and firm capacity suppliers physically connected to the system, and “available unit” means an operable unit not on scheduled maintenance.

[2] Refer to Hawaiian Electric’s Integrated Grid Planning Technical Advisory Panel documents from December 17, 2020. https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/technical-advisory-panel and its Solution Evaluation and Optimization Working Group documents from May 22, 2020 https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/working-groups/solution-evaluation-and-optimization-documents

The total capability of the system must at all times be equal to or greater than the summation of the following:

a. the capacity needed to serve the estimated system peak load less the total amount of interruptible load;

b. the capacity of the unit scheduled for maintenance; and

c. the capacity that would be lost by the forced outage of the largest available unit in service.

Reserve Margin:

Consideration will be given to maintaining a peak firm reserve margin of approximately 20 percent based on Reserve Ratings.

2.3 Other Considerations in Determining the Timing of Unit Additions

The need for new generation is not based solely on the application of the criteria previously mentioned. As capacity needs become imminent, it is essential that Maui Electric broaden its consideration to ensure timely installation of generation capacity necessary to meet its customers’ energy needs.

Other near-term considerations may include:

1. the current condition and rated capacity of existing units;
2. the preferred mix of generation resources to meet varying daily and seasonal demand patterns at the lowest reasonable capital and operating costs;
3. required power purchase obligations and contract terminations;
4. the uncertainties surrounding Non-Utility Generation resources;
5. transmission system considerations;
6. meeting environmental compliance standards; and
7. system stability considerations for Maui Electric’s isolated system.

In the application of Maui Electric’s capacity planning criteria that are used to determine its adequacy of supply, the inputs drive the results. Key inputs are described in the following sections.

3.0 Key Inputs to the 2021 Adequacy of Supply Analysis

3.1 Period Under Review

This adequacy of supply review covers the period 2021 to 2025.

3.2 May 2020 Updated Peak Forecast

In May 2020 a sales and peak forecast ("May 2020 S&P forecast") was developed which was subsequently approved by the Company for future planning purposes and used for this analysis.

The sales and peak forecasts used for the analysis herein is the result of detailed analysis of the impacts of the Covid-19 pandemic and anticipated recovery. In 2020, the Covid-19 pandemic resulted in unprecedented disruptions to global travel, local resident behavior, economic activity and as a result, electricity consumption. State and county emergency orders beginning with stay-at-home orders and mandatory post-arrival travel quarantines in March 2020 basically shut down the Hawaiʻi economy, especially the tourism industry. Electricity usage was severely impacted, although in different ways depending on the sector. Several economic updates were issued in the following months by the University of Hawaiʻi Economic Research Organization ("UHERO"), with the outlook rapidly changing as new emergency orders went into effect.

The Company's future forecast was informed by multiple types of data to provide numerous sources of insight into this unprecedented time. Customer information was analyzed including available customer-level consumption data from before and after the governments' emergency orders went into effect, customers' public announcements regarding closures and reopening plans, feedback from customers to their Hawaiian Electric account managers, distribution circuit data from before and after emergency orders went into effect, and customer billing data. Local economists, organizations and businesses in Hawai'i discussed impacts to the local economy and their perspectives on recovery in multiple public forums. Information from other utilities on Covid-19 related impacts to electricity consumption and methods for projecting recovery was also considered.

The forecast is the result of the above described contributing factors and reflects the Company's most current outlook for customer energy demand for the next five years

In addition, a high weather peak scenario forecast was used in the analysis to show asymmetric risks associated with unusual events that could occur in future years. Maui Electric has in past years experienced significantly higher peak loads than forecasted primarily due to unusually high temperature and humidity conditions. To evaluate the potential risk associated with higher peaks due to unusual conditions such as high temperature and humidity, a high weather peak scenario forecast was created.

Figure 1 and Table 1 below illustrate Maui's historical system peaks and compares them to the forecasts used in 2020 and 2021 analyses. A comparison between recorded and forecasted peaks shows the volatility of recorded system peaks from year to year.

Maui Electric's May 2020 Updated forecast includes peaks that are lower than its 2019 forecast driven primarily by an updated outlook on sales.

Maui Electric's May 2020 Updated forecast assumes that annual system peaks occur in August. The actual annual peak month can vary from year to year.

For both the recorded and forecast data, Table 1 includes the peak reduction benefits of energy efficiency programs and naturally occurring conservation.

Figure 1: Recorded Peaks and Future Year Projections

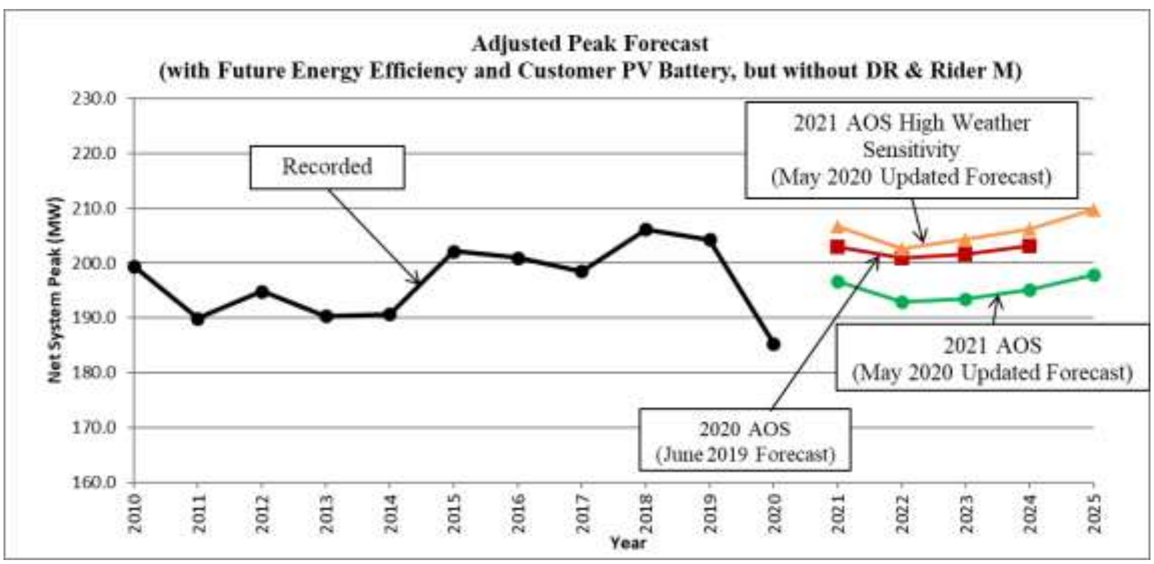

Table 1: Recorded Peaks and Future Year Projections
Net System Peak[3] (MW)
(with Future Energy Efficiency and Customer battery, but without DR & Rider M)

Year	Actual Net-to-System	June 2019 Peak Forecast	Difference	May 2020 Updated Peak Forecast	May 2020 Updated High Weather Sensitivity Peak Forecast
2010	199.4				
2011	189.9				
2012	194.8				
2013	190.3				
2014	190.7				
2015	202.2				
2016	201.0				
2017	198.5				
2018	206.2				
2019	204.3				
2020	185.3				
2021		202.9	-6.3	196.6	206.7
2022		200.9	-8.0	192.9	202.7
2023		201.7	-8.2	193.5	204.3
2024		203.2	-8.1	195.1	206.2
2025				197.8	209.7

3.3 Projected Peak Reduction Benefits of Demand Response Programs

Maui Electric is committed to pursuing demand response (“DR”) programs designed to provide cost-effective resource options as identified in the Hawaiian Electric Companies Integrated Demand Response Portfolio Plan.[4]

In 2015, the Hawaiian Electric Companies submitted to the Commission for approval a DR Portfolio Application in Docket 2015-0412. In 2016, Maui Electric filed an application seeking to expand its Fast DR Program from 0.2 MW to 5.0

[3] The June 2019 peak forecast and the May 2020 updated peak forecast include ~3 MW of standby load.
[4] Refer to Docket No. 2007-0341.

MW ("Fast DR Expansion Application").[5] A Revised DR Portfolio filing was filed on February 10, 2017, which provided modified approval requests and DR program design and targets following consistent with the DR Portfolio used in PSIP Update Report filing on December 23, 2016. On January 25, 2018 the Commission issued Decision and Order No. 35238, approving the Companies' Revised DR Portfolio tariff structure framework.

On August 22, 2019, the Hawaiian Electric Companies issued Request for Proposal No. 103119-02 "Grid Services from Customer-sited Distributed Energy Resources". Final selections were made on January 9, 2020 where aggregators were selected that would offer grid services to the islands. For the purposes of the analysis, Maui Electric's adequacy of supply was calculated with forward looking peak reduction benefit from DR for Maui. The DR impacts in Table 2 lists the peak reductions forecasted for each year.

Table 2 – DR Peak Reduction

Year	DR Peak Reduction Impacts (MW-Net)
2021	7.6
2022	9.2
2023	10.8
2024	10.8
2025	8.4

3.4 Planned Maintenance Schedules for the Generating Units on the System

Planned overhaul and maintenance outages reduce generating unit availabilities. The schedules for planned overhaul and maintenance outages change frequently due to unforeseeable findings during outage inspections or to changes in priorities due to unforeseeable problems or circumstances. When major revisions to planned and/or maintenance outages occur, the Planned Maintenance Schedule is revised. The Planned Maintenance Schedule used in this analysis was updated on December 11, 2020.

Maui Electric schedules three days of maintenance for combustion turbine engine replacements; Maui Electric intends to undertake these three-day outages at times that present a low degree of risk, such as during the weekend, when loads are

[5] See Application filed in Docket No. 2016-0232.

expected to be relatively low. As a result, potential shortfalls that occur during these three days of combustion turbine replacement, in isolation, do not warrant any longer-term mitigation measures to be implemented. In order to identify the additional risk to the system this short-term maintenance can present, however, the analysis provides results with and without the three-day combustion turbine maintenance.

3.5 Reductions of Firm Generating Capacity

3.5.1 Kahului Power Plant

Maui Electric is planning to convert two of its Kahului Power Plant generating units to synchronous condensers and retire two units in the 2024 timeframe.[6] For the purposes of this analysis, Kahului unit 3 is assumed to be unavailable from January 2024 and Kahului unit 4 is assumed to be unavailable from April 2024 due to their conversion from generators to synchronous condensers. Kahului units 1 and 2 are assumed to retire at the end of November 2024.

3.6 Non-Firm Resource Additions

Maui Electric’s renewable RFP phase 1 projects AES Kuihelani Solar (Docket No. 2018-0436) and Paeahu Solar (Docket No. 2018-0433) were approved by the Commission and are assumed to begin operation in 2023. Pulehu Solar (Docket No. 2020-0141), Kahana Solar (Docket No. 2020-0142) and Waena Battery Energy Storage Project (Docket No. 2020-0132) are pending approval by the Commission. Maui Electric intends to submit an additional application for an RFP project on Maui in 2021

These projects can provide additional energy and capacity on the Maui system. These projects were not included in the calculation of Rule 1 but are included in Energy Reserve Margin calculations.

4.0 Results of Analysis

4.1 Description of Scenarios

In energy planning, uncertainty is an important aspect. Therefore, a range of forecasts was considered in the analysis.

For Energy Reserve Margin analysis, two scenarios were analyzed, both scenarios include the contributions from existing variable renewable resources

[6] See Docket No. 2020-0167, Maui Electric’s Switchyard/Synchronous Condenser Project

- without planned generation and storage projects described in Section 3.6.
- with all planned generation and storage projects.
- with all planned generation and storage projects and a high weather forecast scenario was examined as a proxy of the peaks recovering faster from Covid-19 than forecasted.

Although the Energy Reserve Margin criteria will be used for future planning purposes, analyses using the company's previous planning criteria are shown to provide a reference point and added perspective regarding adequacy of supply of the system.

Various Rule 1 planning scenarios were included to evaluate the generating system reliability and potential resource capacity shortfalls using the previous planning criteria. Descriptions of the scenarios are provided below:

- Forecast Scenario
- High Peaks forecast

4.2 Energy Reserve Margin

The results of the Energy Reserve Margin criteria analysis are shown in Table 3. A 30% Energy Reserve Margin target was used for Maui.

Energy Reserve Margin criteria shortfalls occur in 2021 and 2022. Energy Reserve Margin is satisfied from 2023 through 2025 with the addition of planned generation and storage resource additions. However, without these anticipated projects, the Energy Reserve Margin is not achieved from 2023 and the system is at risk of having energy shortfalls.

The Energy Reserve Margin shortfall in 2021 is significantly larger than shortfalls in 2022 and 2023 due to a higher forecasted peak in 2021, and the maintenance of Maalaea unit 14 combustion turbine coincidently landing on the peak day of the year. Future 2021 peaks are highly uncertain, as such Maui Electric plans to adjust maintenance schedules throughout the year, to the extent possible, to mitigate shortfalls.

Table 3: Maui Energy Reserve Margin Shortfall Hours

Number of Hours Below Energy Reserve Margin Target (Pass/Fail 30% Criteria)			
Year	**Without** Future Generation and Storage Projects	**With** Future Generation and Storage Projects	**With** Future Generation and Storage Projects and High Peak Forecast
2021	138 (FAIL)	138 (FAIL)	238 (FAIL)
2022	46 (FAIL)	46 (FAIL)	153 (FAIL)
2023	28 (FAIL)	0 (PASS)	0 (PASS)
2024	355 (FAIL)	0 (PASS)	0 (PASS)
2025	539 (FAIL)	0 (PASS)	0 (PASS)

Table 4: Maui Estimated Energy Reserve Margin

Lowest Estimated Energy Reserve Margin Percentage			
Year	**Without** Future Generation and Storage Projects	**With** Future Generation and Storage Projects	**With** Future Generation and Storage Projects and High Peak Forecast
2021	10%	10%	4%
2022	22%	22%	14%
2023	24%	42%	40%
2024	6%	54%	52%
2025	12%	46%	48%

4.3 Rule 1

The Rule 1 forecast scenario used below only includes the capabilities of Maui Electric's generating units when calculating the reserve capacity shortfalls and reserve margin.

Examination of variable wind generation contribution to total firm capacity was performed in a scenario as a consideration due to the large amount of total wind capacity on the Maui system. Currently, the Maui system includes 72 MW of variable wind generation. For the purposes of Rule 1 calculations, an approximate capacity value of 2.1 MW was used for existing wind resources based on a probability level of wind output during daily peak events.

Table 5 shows the reserve capacity shortfall, in MW, in the amount needed to satisfy Rule 1 of the capacity planning criteria. The analysis shows that Rule 1 is violated in the forecast case for 2021, 2022, 2024 and 2025. Also included in Table 5 is the result for Rule 1 of the scenario that includes 2.1 MW toward total system firm capacity from existing wind facilities and a scenario that includes the impacts of combined wind capacity, DR, and with and without three-day combustion turbine engine replacement maintenance. Appendix 1 shows Maui's projected reserve margin analyses.

Table 5 Maui Division Rule 1 Analysis

Year	Forecast Scenario (MW)	Wind Capacity Scenario (MW)	Wind Capacity and DR Scenario (MW)	Wind Capacity and DR Scenario Excluding Three Day Maintenance (MW)
2021	-11.5	-9.4	-1.8	-1.8
2022	-5.5	-3.4	5.8	5.8
2023	4.3	6.5	17.3	17.3
2024	-23.0	-20.9	-10.0	-8.1
2025	-34.9	-32.8	-24.3	-24.3

The potential risk associated with higher peaks due to unusual conditions such as high temperature and humidity are reflected in the results of the high weather peak forecast. Table 6 shows the Rule 1 analysis for the high weather peaks.

Table 6: Maui Division Rule 1 Analysis – High Weather Peaks Forecast

Year	Forecast Scenario (MW)	Wind Capacity Scenario (MW)	Wind Capacity and DR Scenario (MW)	Wind Capacity and DR Scenario Excluding Three Day Maintenance (MW)
2021	-22.3	-20.2	-12.6	-12.6
2022	-16.0	-13.9	-4.7	-4.7
2023	-7.4	-5.3	5.2	5.2
2024	-35.1	-33.0	-22.1	-19.2
2025	-45.6	-43.5	-35.0	-35.0

5.0 Mitigation Measures

To avoid near-term reserve capacity shortfalls, Maui Electric has taken a portfolio approach, considering a variety of mitigation measures.

5.1 Temporary Distributed Generation

Maui Electric's application to purchase and install approximately 4.95 MW of temporary distributed generation ("Temp DG") remains suspended.[7] However, the Company believes Temp DG is the lowest risk alternative to supplemental DR capacity in the near-term. Temp DG units can be operational in six months or less, and provide a high level of dependable capacity, relative to the other options available to Maui Electric.

Should the Company decide to pursue Temp DG units as a solution, leasing the units may be the preferred option (versus buying and later selling the units as originally proposed in the Temp DG application). Leasing removes the uncertainty of the future sale price of the units and may also alleviate stakeholder concerns regarding the permanence of the units.

5.2 Refinement of Maintenance Schedule

Maui Electric's normal maintenance scheduling practices are performed by the Maui Electric Generation Division. Scheduling involves many different operational factors. Maintenance scheduling can be expected to be adjusted numerous times over the year due to changing operational factors. In the event of reserve capacity shortfalls, rearranging maintenance schedules, to the extent possible, may provide some level of mitigation

5.3 Call for Conservation

Maui Electric may request voluntary customer curtailment of demand during capacity reserve shortfall conditions. However, because this is strictly voluntary, and the Company has no direct control in the implementation of this measure, it should not be considered as dependable as other measures such as demand response. Also, the potential benefit of this option is likely to reduce over time, as increased customer participation in demand response programs becomes more common.

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[7] See Order No. 34437 Suspending the Docket, filed on March 9, 2017 in Docket No. 2016-0234.

6.0 Lanaʻi Division

6.1 Peak Demand and System Capability in 2021-2025

Lanaʻi's 2020 system peak of 6,140 kW (gross) occurred on March 6, 2020 (6:25 p.m.). The total system capability of Lanaʻi was 9,400 kW-gross at the time of the system peak resulting in a reserve margin of approximately 53% over the 2020 system peak.

At times during 2020, Lanaʻi received energy from Lanai Sustainability Research, LLC ("LSR"), a PV independent power producer. Since the power purchase contract with LSR is not for firm capacity, it is not reflected in Lanaʻi's total firm generating capability.

On July 9, 2019, Maui Electric's combined heat and power system, located at the Manele Bay Four Seasons Resort, incurred engine damage. For the purposes of this analysis the CHP unit was not included. The total system capability for Lanaʻi was reduced to 9,400 kW to reflect no CHP operation.

Maui Electric developed and adopted its peak forecast in May 2020 that was used in this analysis for Lanaʻi.

6.2 Lanaʻi Division Capacity Planning Criteria

6.2.1 Energy Reserve Margin

The Energy Reserve Margin is the percentage of system load in which the system capacity must exceed the system load in each hour. Lanaʻi must meet or exceed a 60% Energy Reserve Margin.

6.2.2 Previous Lanaʻi Planning Criteria

The following criterion is used to determine the timing of an additional generating unit for the Lanaʻi Division and the Molokaʻi Division:

> New generation will be added to prevent the violation of any one of the rules listed below where "units" mean all units and firm capacity suppliers physically connected to the system, and "available unit" means an operable unit not on scheduled maintenance.
>
> 1. The sum of the normal top load ratings of all units must be equal to or greater than the system peak load to be supplied.

2. With no unit on maintenance, the sum of the reserve ratings of all units minus the reserve rating of the largest available unit must be equal to or greater than the system peak to be supplied.

3. With a unit on maintenance:

   a) The sum of the reserve ratings of all units minus the reserve rating of the largest available unit must be equal to or greater than the daytime peak load to be supplied.

   b) The sum of the reserve ratings of all units must be equal to or greater than the evening peak load to be supplied.

6.3 Lana‘i Division Results of Analysis

6.3.1 Energy Reserve Margin Results

The results of the Energy Reserve Margin criteria analysis are shown in Table 7. A 60% Energy Reserve Margin target was used for Lana‘i.

Table 7: Lana‘i Energy Reserve Margin Shortfall Hours

Number of Hours Below Energy Reserve Margin Target (Pass/Fail 60% Criteria)	
Year	Lanai
2021	234 (FAIL)
2022	1 (FAIL)
2023	328 (FAIL)
2024	7 (FAIL)
2025	1 (FAIL)

Table 8: Lana‘i Estimated Energy Reserve Margin

Lowest Estimated Energy Reserve Margin Percentage	
Year	Lanai
2021	20%
2022	50%
2023	20%
2024	40%
2025	50%

In 2021 and 2023 the larger 2,200 kW units on Lana‘i are taken offline for maintenance resulting in larger shortfalls for those years. Future loads and available resources for the island are uncertain. If the system load on Lana‘i increases significantly, mitigation measures and additional resources may be needed to maintain reasonable reserves for emergencies. Mitigation measures may include aggressive maintenance to maximize the availability of units, restoration of the combined heat and power operation and calls for voluntary load reductions when generation shortfalls are anticipated

6.3.2 Previous Planning Criteria Results

Table 10: Shows the criteria shortfalls in negative values for the Lana‘i daytime and evening peak criteria described in Section 6.2.2.

Table 10: Daytime and Evening Peak Criteria Analysis

Year	Daytime Peak Criteria (Gross kW)	Evening Peak Criteria (Gross kW)
2021	-600	600
2022	700	600
2023	-600	500
2024	500	500
2025	1,400	500

7.0 Molokaʻi Division

7.1 Peak Demand and System Capability in 2020 – 2024

Molokaʻi's 2020 system recorded peaks of 5,800 kW (gross) on October 14 (6:27 p.m.), October 15 (6:27 p.m.) and October 19 (6:48 p.m. The total system capability on Molokaʻi was 12,010 kW-gross at the time of the system peak, resulting in a reserve margin of approximately 107% over the 2020 system peak.

Maui Electric developed and adopted its peak forecast in March 2020 that was used in this analysis for Molokaʻi.

7.2 Molokaʻi Division Capacity Planning Criteria

Molokaʻi Division's capacity planning criteria are identical to those of the Lanaʻi Division. See Section 6.2 above, Lanaʻi Division Capacity Planning Criteria.

7.3 Molokaʻi Division Results of Analysis

7.3.1 Energy Reserve Margin Results

The results of the Energy Reserve Margin criteria analysis are shown in Table 11. A 60% Energy Reserve Margin target was used for Molokaʻi.

Table 11: Molokaʻi Energy Reserve Margin Shortfall Hours

Number of Hours Below Energy Reserve Margin Target (Pass/Fail 60% Criteria)	
Year	Molokai
2021	0 (PASS)
2022	0 (PASS)
2023	0 (PASS)
2024	0 (PASS)
2025	0 (PASS)

Table 12: Moloka‘i Estimated Energy Reserve Margin

Lowest Estimated Energy Reserve Margin Percentage	
Year	Molokai
2021	140%
2022	140%
2023	140%
2024	150%
2025	130%

7.3.2 Moloka‘i’s Peaks Criteria Results

Table 13 shows the capacity surplus for the Moloka‘i daytime and evening peak criteria described in Section 7.2.

Table 13: Daytime and Evening Peak Criteria Analysis

Year	Daytime Peak Criteria (Gross kW)	Evening Peak Criteria (Gross kW)
2021	6,700	7,100
2022	5,900	7,100
2023	6,000	7,200
2024	6,900	7,200
2025	5,800	7,200

7.4 Reductions in Peak Demand: Moloka‘i’s Rider M

At the time of system peak, Moloka‘i had in place one load management contract totaling approximately 365 kW under Rider M, which reduced evening peak by approximately 358 kW.

8.0 Conclusion

Maui Division’s Energy Reserve Margin criteria shortfalls occur in 2021 and 2022, Energy Reserve Margin is satisfied from 2023 through 2025 with the addition of planned generation and storage resource additions. New resources planned for Maui are anticipated to meet energy reserve margin targets to mitigate the retirement of Kahului Power Plant.

Lana‘i’s Division’s Energy Reserve Margin shortfalls occur from 2021 through 2025

Moloka‘i’s Energy Reserve Margin is satisfied for the next five years 2021 through 2025.

Sincerely,

/s/ Kevin M. Katsura

Kevin M. Katsura
Director
Regulatory Non-Rate Proceedings

Attachments

c: Division of Consumer Advocacy (with Attachments)

Table A1:
Maui Division Projected Reserve Margins

Year	System Capability at Annual Peak Load (Net MW) [A] (I)	Equivalent Wind Capacity (Net MW) [B] (II)	System Peak (Net MW) [C] (III)	Interruptible Load (Net MW) [D] (IV)	Reserve Margin (%) [A+B - (C-D)] / (C-D)
2021	246	2	197	8	31%
2022	246	2	193	9	35%
2023	246	2	194	11	36%
2024	222	2	195	11	22%
2025	210	2	198	8	12%

Notes:

I. System Capability includes:
- Maui Electric central station units at total capability in 2020 was 246.3 MW-net.
- Planned retirement of the units at the Kahului Power Plant (35.9 MW-net) in 2024.

II. Equivalent Wind Capacity:
- Combined equivalent wind capacity value of the wind farms on Maui is 2.1 MW-net.

III. System Peaks:
- The 2021-2025 annual forecasted system peaks are based on Maui Electric's May 2020 Update Forecast.
- The forecasted System Peaks for 2021-2025 include the estimated peak reduction benefits of third-party energy efficiency programs.
- The Maui Electric annual forecasted system peak is expected to occur in the month of August.

IV. Interruptible Load:
- As discussed in Section 3.2, the DR programs make up the interruptible load impacts.

Table A2:

Maui Unit Ratings Installed

As of December 31, 2020

Units	Gross (MW)		Net (MW)	
	Reserve	NTL[I]	Reserve	NTL[I]
M1	2.50	2.50	2.50	2.50
M2	2.50	2.50	2.50	2.50
M3	2.50	2.50	2.50	2.50
X1	2.50	2.50	2.50	2.50
X2	2.50	2.50	2.50	2.50
M4	5.60	5.60	5.51	5.51
M5	5.60	5.60	5.51	5.51
M6	5.60	5.60	5.51	5.51
M7	5.60	5.60	5.51	5.51
M8	5.60	5.60	5.48	5.48
M9	5.60	5.60	5.48	5.48
M10	12.50	12.50	12.34	12.34
M11	12.50	12.50	12.34	12.34
M12	12.50	12.50	12.34	12.34
M13	12.50	12.50	12.34	12.34
M14/15/16[II]	58.00	58.00	56.78	56.78
M17/18/19[II]	58.00	58.00	56.78	56.78
Maalaea GS	212.10	212.10	208.42	208.42
K1	5.90	5.00	5.62	4.71
K2	6.00	5.00	5.77	4.76
K3	12.70	11.50	12.15	10.98
K4	13.00	12.50	12.38	11.88
Kahului GS	37.60	34.00	35.92	32.33
Hana 1[III]	1.00	1.00	0.97	0.97
Hana 2[III]	1.00	1.00	0.97	0.97
Maui System	251.70	248.10	246.28	242.69

Notes:

(I) NTL = Normal Top Load

(II) The NTL rating for long-term capacity planning purposes for each of the two Maalaea Dual Train Combined Cycle units, Maalaea Unit 14/15/16 and Maalaea Unit 17/18/19**,** is 56.78 MW (net). Maui Electric performed capability tests on Maalaea Unit 14/15/16 and Maalaea Unit 17/18/19, respectively. Maalaea Unit 14/15/16 resulted in a net NTL rating of 56.27 MW (0.51 MW lower than the rated NTL) and M17/18/19 resulted in a net NTL of 56.20 MW (0.58 MW lower than the rated NTL). With consideration that the capabilities of these units can vary depending on ambient weather conditions, it was determined that the rated NTL of 56.78 MW (net) is acceptable.

(III) Units located at Hana Substation No. 41.

1. Capacity Planning Criteria

Increasing quantities of variable renewable resources, and planned energy storage additions to the system have driven the need to develop a capacity planning criteria that better accounts for the dynamic nature of such resources. The Energy Reserve Margin capacity planning criteria was developed and adopted by the Company in order to plan for our Island's future generation capability needs.

1.1 Energy Reserve Margin

Reliability planning criteria for utilities adequacy of supply evaluation varies among different jurisdictions, and includes criteria such as, but not limited to, loss of largest unit, loss of load expectation, expected unserved energy, loss of load probability, and reserve margin percentages. An Energy Reserve Margin, similar to a capacity reserve margin, was selected to establish guidelines that minimize the risk of insufficient generation capability from a diverse mix of generating resources. The Energy Reserve Margin can be summarized as the percentage by which the system capacity must exceed the system load in each hour. Using an Energy Reserve Margin planning criteria is intended to provide enough energy resources for safe and reliable service to customers and to serve future system needs.

1.2 Definitions

1.2.1 Available Unit

Unit which is capable of providing service, whether or not it is actually in service, regardless of the capacity level that can be provided.

1.2.2 Normal Net Capability Rating: (N1, N2, N3... NN)

a. For applicable firm capacity units such as steam units, combustion turbines, and internal combustion engines, this is the maximum net load the units are capable of carrying continuously on a day-to-day basis. This is the maximum net load to which the unit is normally dispatched.

b. Firm capacity provided by other suppliers is represented as generating units with normal net capability ratings, consistent with the intent of these definitions and applicable power purchase agreements.

1.2.3 Hourly Dependable Capacity

The Hourly Dependable Capacity ("HDC") is the minimum expected capacity from variable generation resources based on empirical data. In order to calculate an hourly variable renewable resource output with greater dependability for capacity planning purposes, a portion of the variance in the form of standard deviation is removed from historical average hourly production. These empirically derived values, also known as the Hourly Dependable Capacity, have a high probability of being exceeded by the amount of energy actually available to the system from a variable renewable resource in any given hour.

The number of standard deviations deducted is 2 for all solar resources, and 1 for all wind resources. The HDC (MW) is calculated for each hour as follows:

$$HDC_{hr} = \chi - N * \sigma,$$

where
χ = the mean,
σ = a standard deviation,
N = the number of standard deviations

1.2.4 Shifted Load

The energy charged and discharged by energy storage systems in each hour. Energy storage systems that shifts load include but are not limited to utility scale batteries and batteries paired with renewable resources. Shifted load may include customer owned energy storage systems that have the ability shift load per the terms of their particular tariff or distributed energy program.

1.2.5 Interruptible Load

The reduction of customer loads to support system capacity needs, for example, demand response programs that can reduce system load when needed, or tariffs that allow changes in load.

1.2.6 Energy Reserve Margin Target

The Energy Reserve Margin is the percentage of system load in which the system capacity must exceed the system load in each hour. The Energy Reserve Margin target for each island is listed in the table below.

Table A3: Energy Reserve Margin Targets

Island	Energy Reserve Margin
O‘ahu	30%
Hawai‘i	30%
Maui	30%
Moloka‘i	60%
Lana‘i	60%

Energy Reserve Margin targets are derived from an assessment of historical data. Identified at risk hours were evaluated to determine minimum Energy Reserve Margins for planning purposes. The loss of largest unit, multiple forced outages, and unplanned maintenance were some of the largest contributing factors for hours considered to be at-risk. Energy Reserve Margin targets plan for the loss of largest unit and an additional hourly reserve for emergencies.

The size of generating units on each island are contributing factors to energy reserve margin targets. For instance, on Moloka‘i and Lana‘i, the largest generating units on the island have the capability to produce roughly 60% of each island’s average daily energy usage. For comparison to the current planning criteria described above, which is to meet the peak load with the loss of the largest available unit, the 60% energy reserve margin target for Moloka‘i and Lana‘i is to plan for resources that can generate enough energy throughout the day to meet the island’s energy load without the largest available unit.

1.3 Generation Addition Rule

New generation will be added to prevent the violation of the rule listed below. Available units include available Hawaiian Electric and independent power producer units and facilities. The sum of the amount net capability ratings of all available units minus planned maintenance, plus Hourly Dependable Capacity, plus shifted load by energy storage, plus interruptible loads must be equal to or greater than the system hourly load multiplied by the quantity of one plus the Energy Reserve Margin.

$$\Sigma (N_i - \text{Maintenance} + \text{Hourly Dependable Capacity} + \text{Shifted Load} + \text{Interruptible Load}) \geq \text{System Hourly Load} * (1 + \text{Energy Reserve Margin})$$

The rule above, applies to resource planning in long-range generation expansion studies. The timing of generating resource additions should be examined using these rules as guides, with due consideration given to short-term operating conditions, equipment procurement, construction, financial and regulatory constraints.