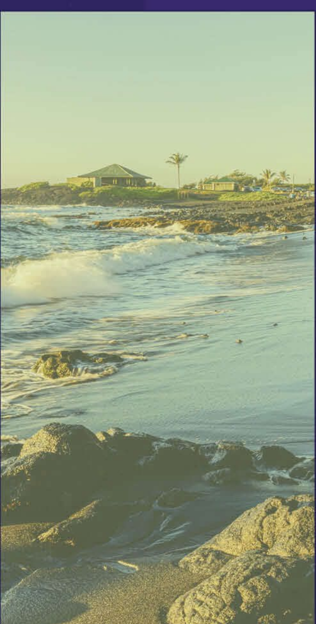
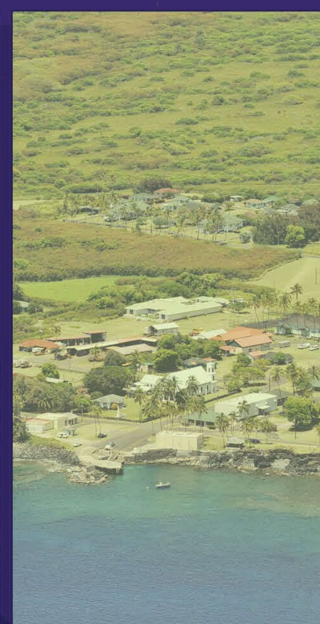
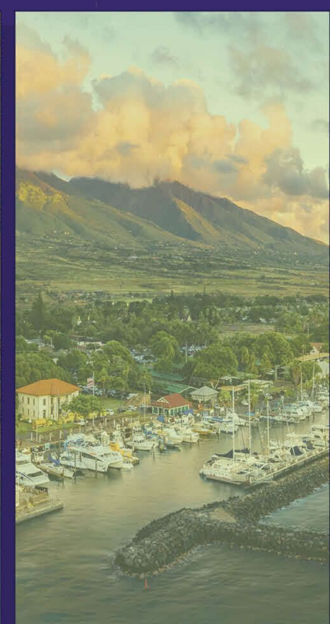
Hawai'i Powered

Integrated Grid Plan

Action Plan Annual Update



Hawaiian Electric

2025

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1 IGP Action Plan Summary and Status

The Integrated Grid Plan provides a short-term action plan and long-term strategy to meet the energy needs of our customers up to and beyond 2045. The short-term action plan includes immediate actions that must be taken to achieve our 2030 goals and set a path toward 2045 net-zero decarbonization. In meeting these goals, the action plan provides foundational actions that retain the flexibility to realize the benefits of technological advances, respond to changing customer and community needs, and adapt to evolving environmental conditions.

This section provides an update to the Action Plan provided in the May 2023 IGP Final Report.

1.1 Key Finding and Recommendation: Stabilize Utility Rates and Advance Energy Equity

To stabilize rates and advance energy equity, we will need to:

- Pursue the least costly pathway, which maximizes solar, wind and energy storage
- Provide at least $3,000 per megawatt in community benefits packages per year to host communities of large-scale projects
- Keep rates lower than the status quo of fossil fuel reliance
- Examine forms of relief for LMI customers
- Pursue federal funding to expand customer access to renewable technologies and reduce the cost of grid modernization

Actions we can take within the next five years to stabilize rates:

1. Use competitive procurements to the extent possible for all types of renewable generation as a means to attract lowest pricing possible for customers
2. Pursue federal funding with up to 50% match for climate adaptation program and Phase 2 grid modernization
3. Work with stakeholders to address affordability through the Energy Equity docket

1.1.1 Use competitive procurements to the extent possible for all types of renewable generation as a means to attract lowest pricing possible for customers

Competitive procurements through Requests For Proposals ("RFP") continue to be the preferred vehicle for the acquisition of all types of large-scale generation and storage. On May 2, 2025, we filed a draft IGP RFP for O'ahu and Hawai'i Island along with our Reply Statement of Position, completing the procedural steps in the IGP RFP docket.

1.1.2 Pursue federal funding with up to 50% match for climate adaptation program and Phase 2 grid modernization

Hawaiian Electric pursued federal funds (Grid Resilience and Innovative Partnerships ("GRIP") Round 1, Topic Area 1) in April 2023 to match customer funds requested as part of Docket No. 2022-0135 "Climate Adaptation T&D Resilience Program" in the application filed on June 30, 2022. Hawaiian Electric received notification from the U.S. Department of Energy ("DOE") of successful selection for award on October 17, 2023, and is currently engaged in negotiations with DOE. Hawaiian Electric subsequently received approval for the cost-matching funds from the Hawai'i Public Utilities Commission ("PUC") in Docket No. 2022-0135 (see Decision and Order No. 40566 issued on January 31, 2024). The award amount approved by both the DOE and the PUC was $95 million each, resulting in a total of $190 million of funding to implement high-priority resilience investments in utility infrastructure primarily for wildfire risk mitigation.

However, Hawaiian Electric was not awarded by the DOE for any GRIP Round 2 grants in 3 topic areas that were submitted.

1.1.3 Work with stakeholders to address affordability through the Energy Equity docket

Feedback from the Commission's draft report in Docket No. 2022-0250 (the "Energy Equity Docket") was incorporated into the draft IGP RFP filed on May 2, 2025.

1.2 Key Finding and Recommendation: Grow the Marketplace for Customer-scale and Large-scale Renewable Generation

To grow a thriving, competitive marketplace for customer-scale and large-scale renewable generation, we will need:

- Greater customer participation in energy generation and storage
- Widespread adoption of energy efficiency
- Rapid development of low-cost renewables and transmission

Actions we can take to begin increasing customer participation:

1. Implement new distributed energy resources (DER) programs to use deployed advanced metering infrastructure (AMI): Smart DER Tariff and bring-your-own-device options, targeting 1,186 MW of private rooftop solar capacity by 2030
2. Implement community-based renewable energy projects for low- and moderate-income customers and the Tranche 1 procurement
3. Implement advanced rate designs and conduct time-of-use (TOU) study to use deployed AMI
4. Procure energy efficiency and other grid services to meet grid needs and reduce supply-side requirements
5. Review lessons learned from the Phase 2 Tranche 1 community-based renewable energy procurement, and propose changes, if necessary, for a more robust program

Actions we can take to start developing low-cost renewables and transmission:

6. Update key assumptions based on current market conditions (i.e., fuel forecasts) during and following the Stage 3 request for proposals (RFP)
7. Complete Stage 3 procurement and work with stakeholders to execute the projects that are selected
8. Complete Land Request for Information to identify potential sites for large-scale renewable generation and development of REZs in concert with communities
9. Issue an additional competitive procurement for renewable dispatchable generation after Stage 3 and determine market for long lead renewable resources (i.e., offshore wind and other technologies to achieve commercial operations by 2035) and REZs for each island
10. Continue finding solutions to improve the interconnection process, including working with State and county agencies

1.2.1 Implement new distributed energy resources (DER) programs to use deployed advanced metering infrastructure (AMI): Smart DER Tariff and bring-your-own-device options, targeting 1,186 MW of private rooftop solar capacity by 2030

Smart Renewable Energy (also known as Smart DER) and Bring Your Own Device ("BYOD") Level 1 programs initiated on April 1, 2024 for all islands in Docket No. 2019-0323. With the start of the new programs, all interim DER programs were closed at the end of March 2024. The BYOD Level 1 program is similar to Battery Bonus where there is no control signal dispatched from the utility and the battery is responding every day on a scheduled dispatch.

The Commission hosted a Technical Conference on April 4, 2024 to discuss controllability and the path required to activate BYOD Level 2 and Level 3 programs. Pending Commission Order, we will work diligently to create more customer options for grid services participation.

On March 21, 2025, the Commission ordered the modification to BYOD Level 1 to modify certain parameters and updating the name to BYOD Plus. The new program launched on May 15, 2025. The BYOD Plus program is operationally similar to BYOD Level 1 but instead modifies certain incentive and enrollment parameters. We will continue to implement the DER programs developed collaboratively through Docket No. 2019-0323.

Through the IGP, DERs represent another opportunity for customers to access renewable energy options. Since the time DERs first launched in the early 2000's, there have been periods of rapid uptake as well as federal and local tax incentives that have bolstered the market for many years. As DERs continue to be a resource option in the resource portfolio, we will consider more thorough analysis of the current and future DER market opportunities, especially on the island of O'ahu where the market potential is a key factor with respect to the feasibility of some of the IGP scenarios.

1.2.2 Implement community-based renewable energy projects for low- and moderate-income customers and the Tranche 1 procurement

Community-Based Renewable Energy (also known as Shared Solar) commenced a Phase 2 of the program on April 9, 2020 in Docket No. 2015-0389. This led to the development and procurement of dedicated low-and-moderate-income ("LMI") and Tranche 1 projects, as well as small projects. Dedicated LMI project subscriber organizations commit to subscribing LMI customers defined by the Federal Housing and Urban Development ("HUD"), geographic location by zip code, or by participating in comparable programs as defined by Tariff Rule 29. Further, commercial subscribers can participate if they are a 501(c)(3) organization or government entity. Seven such projects were awarded capacity for a combined total of 23 MW across O'ahu, Maui and Hawai'i Island with guaranteed commercial operations by the end of 2025. However, three projects (8.5 MW) subsequently withdrew.

We procured five additional projects with a combined capacity of over 14 MW across O'ahu, Hawai'i Island and Moloka'i for Tranche 1 projects which are open to any eligible customer on those islands. These projects were planned to achieve guaranteed commercial operations in 2026 but only the two Moloka'i projects remain in development.

1.2.3 Implement advanced rate designs and conduct time-of-use (TOU) study to use deployed AMI

The Advanced Rate Design (ARD) Time-of-Use Rate Pilot was undertaken from February 1, 2024 to January 31, 2025 in Docket No. 2019-0323. This one-year study included randomly selected customers on O'ahu and Hawai'i islands who had AMI meters and were served on residential Schedule R or commercial Schedules G and J. Customers on all five islands who have AMI meters and who are currently served on Schedules R, G, or J could elect to be served on these time-of-use rates, although such opt-in customers were not included in the study population. All customers served on these time-of-use rates had the option to return to non-time-of-use rate schedules at any time. These TOU rates were closed to new enrollments as of February 1, 2025, although customers who were served on these rates prior to that date may continue to take service on these rates. We filed its Final Pilot Study Report on May 1, 2025. On May 21, 2025, the Commission ordered the Parties in the Docket No. 2019-0323 to file final briefs on the ARD TOU Study including any recommendations for the future of ARD TOU rates by June 18, 2025, and ordered the ARD Track of Docket No. 2019-0323 closed after the filing of those final briefs, unless otherwise ordered by the Commission.

1.2.4 Procure energy efficiency and other grid services to meet grid needs and reduce supply-side requirements

In Docket No. 2022-0041, the Commission issued Decision and Order No. 40082 on July 12, 2023, approving the third procurement of an aggregator on O'ahu with modifications to the contract. Hawaiian Electric filed an amendment to the Grid Services Purchase Agreement ("GSPA") on December 29, 2023. Subsequently, the Commission closed the docket on January 26, 2024. Prior to commencement of operations under the contract, the contract was terminated.

In Docket No. 2017-0352, one GSPA contract remains active and is working to catch up on their customer enrollment.

We are focused on the implementation of currently available grid service programs and working with the Commission on potential upcoming grid service procurements.

Currently, we do not administer Energy Efficiency ("EE") programs for electric utility customers in Hawai'i, however, we support collaboration with Hawai'i Energy, the Commission's third party administrator that promotes EE savings across the state.

1.2.5 Review lessons learned from the Phase 2 Tranche 1 community-based renewable energy procurement, and propose changes, if necessary, for a more robust program

Community-Based Renewable Energy (also known as Shared Solar) will incorporate Phase 2 Tranche 1 lessons learned in Docket No. 2015-0389, following the final award of projects and prior to the commencement of Tranche 2. Since the final award of Tranche 1 projects on February 22, 2023, we have gathered feedback from customers, developers and stakeholders on ways to expand the number of projects available, increase subscription opportunities, and reduce administrative burden.

In their 2024 Inclinations, the Commission noted that the current Phase 2 program has enrolled only a fraction of the program cap and developers have struggle to meet the program's requirements and schedules. The Commission intends to study whether the CBRE program should be restructured to replace Subscriber Organizations with utility managed, on-bill customer enrollment among other modifications for simplified interconnection, flat export rate, focus on lower income communities, and guaranteed bill discount.

1.2.6 Update key assumptions based on current market conditions (i.e., fuel forecasts) during and following the Stage 3 request for proposals (RFP)

We have continued to update assumptions since the inputs and assumptions were approved for the first IGP cycle. The analyses contained in Section 2 use the 2023 fuel price forecast from the Energy Information Administration Annual Energy Outlook and 2024 conservative resource cost forecast from the National Renewable Energy Laboratory Annual Technology Baseline.

The update to use the conservative resource cost forecast is intended to better reflect market pricing in the planning models. Hawaiian Electric experienced project delays and price increases due to external supply chain disruptions such as the COVID-19 pandemic that resulted in numerous amendments to project applications. Current events in Federal policy are also creating uncertainty in project pricing. Uncertainty around trade tariffs and the Federal investment tax credit may potentially increase project pricing further.

1.2.7 Complete Stage 3 procurement and work with stakeholders to execute the projects that are selected

Hawaiian Electric selected 16 renewable energy projects in December 2023 and January 2024 from the Stage 3 RFPs on O'ahu, Hawai'i Island, and Maui. 5 projects have subsequently withdrawn, and contract negotiations are ongoing to produce long-term contracts for approximately 302 megawatts (MW) of variable generation, 660 MW of firm generation, and 1.1 gigawatt-hours (GWh) of storage. Estimated completion dates for the projects range from 2026 to 2033.

1.2.8 Complete Land Request for Information to identify potential sites for large-scale renewable generation and development of REZs in concert with communities

Hawaiian Electric completed a Land Request For Information ("RFI") in April 2023 and in October 2024. The responses to the Land RFI continues to provide us initial input into the land being made available by developers. Furthermore, the Governor's Executive Order and 2024 Commission Inclinations support the designation of two Renewable Energy Zones on Oahu by Q2 2026.

1.2.9 Issue an additional competitive procurement for renewable dispatchable generation after Stage 3 and determine market for long lead renewable resources (i.e., offshore wind and other technologies to achieve commercial operations by 2035) and REZs for each island

On June 27, 2025, the Companies filed a revised draft IGP RFP to procure additional Renewable Dispatchable Generation ("RDG") resources for O'ahu and Hawai'i Island:

- O'ahu: 750 GWh annually of renewable energy to be in service no later than November 1, 2030 and 81 MW of firm capacity to be in service no later than December 1, 2033. A stability target of 350 MW of Grid Forming resources was also included for no later than November 1, 2030.

- Hawai'i Island: 435 GWh annually of renewable energy to be in service no later than November 1, 2030 in this round and 30 MW of firm capacity to be in service no later than December 1, 2032. A stability target of 115 MW of Grid Forming resources was also included for no later than November 1, 2030.

In its previous action plan update, we were intending to utilize the next RFP (i.e., IGP Long-Term RFP) to seek long-term resources that require extended project development time or long-lead infrastructure to complete, as it would minimize the risk of initiating and building infrastructure that is not utilized for renewable energy development. On O'ahu, the IGP Long-Term RFP was informed by the installation of 400 MW of offshore wind in 2035. However, potential issues will need to be resolved for an actual project to move forward. Recent Federal policy introduced a moratorium on new offshore wind and community concerns were raised in a neighborhood board meeting held last year to discuss the concept of offshore wind.[1]

In alignment with the Governor's Executive Order and PUC Inclinations 2024, the Companies intend to work with State Agencies to designate two REZs on Oahu by Q2 2026 – ahead of the originally intended process.

1.2.10 Continue finding solutions to improve the interconnection process, including working with State and county agencies

Hawaiian Electric continues to improve the information provided in the most recent draft RFP. Standardized interconnections with standard equipment and design templates have been created and Company specifications were updated. In addition, preliminary information such as injection capacities and preferred interconnection locations were made available prior to issuance of the RFP. The IGP RFP will also incorporate a Preliminary Interconnection Report process, which will provide bidders with more information on their potential interconnection locations based on their potential project sizes and locations, and the Company will also make its Subject Matter Experts available to meet with developers on their specific proposals ahead of their bid submittals.

[1] *See* https://www.civilbeat.org/2024/06/new-project-seeks-to-build-offshore-wind-farms-in-kaiwi-channel/

1.3 Key Finding and Recommendation: Create a Modern and Resilient Grid

To create a resilient grid with enough capacity to meet the State's policy goals, we will need:

- Investment of $59.4 million in distribution upgrades over the next 10 years
- Investment of $1.33 billion through 2035 to expand or create new transmission interconnection points between renewable projects
- Initial investment of $190 million to improve the resilience of the transmission and distribution grid

Near-term actions to upgrade the distribution system:

1. Issue expressions of interest for qualified distribution non-wires alternatives opportunities
2. Prepare extraordinary project recovery mechanism requests to implement distribution upgrades needed to support electrification and expansion of private rooftop solar hosting capacity, and other requests to support expanded distribution capacity for new housing and commercial developments

Near-term actions to develop REZs:

3. Continue community engagement to determine feasibility of developing REZs
4. Create a transmission siting and routing process in collaboration with communities, State, county, landowners, and project developers

Near-term actions to improve grid resilience:

5. Pending Public Utilities Commission approval, implement and execute a 5-year, $190 million climate adaptation program to harden our grid and implement other resilience measures
6. Develop resilience modeling and performance target levels of resilience to inform future hardening and other resilience investments
7. Leverage an energy transition initiative partnership program and Resilience Working Group to identify other microgrid opportunities
8. Execute North Kohala microgrid and RFP, apply lessons learned, and pursue additional microgrid opportunities to enhance community resilience
9. Complete rollout of AMI and obtain approval of phase 2 grid modernization to enhance system reliability and resilience

1.3.1 Issue expressions of interest for qualified distribution non-wires alternatives opportunities

Hawaiian Electric issued the following Non-Wires Alternatives ("NWA") RFP/Expressions of Interest ("EOIs") since 2023:

- North Kohala Energy Storage RFP[2]
- Kakaʻako/Kewalo Non-Wires Alternative EOI[3]
- CEIP Non-Wires Alternative EOI[4]
- ʻEwa Nui Non-Wires Alternative EOI[5]
- Waikoloa EOI[6]

All the EOIs and the North Kohala RFP did not produce a viable NWA.

1.3.2 Prepare extraordinary project recovery mechanism requests to implement distribution upgrades needed to support electrification and expansion of private rooftop solar hosting capacity, and other requests to support expanded distribution capacity for new housing and commercial developments

We are continuing to monitor the timing and need for circuit upgrades to increase DER hosting capacity. Examples of recent projects that were initiated or installed since the previous update:

- Line extension and infrastructure installation to serve new developments.
- Installation of new substation equipment to increase capacity.
- Reconductor distribution circuits to increase capacity and mitigate voltage issues.
- Install voltage regulators to mitigate voltage issues.
- Reconductor subtransmission lines to increase capacity.

[2] See https://www.hawaiianelectric.com/clean-energy-hawaii/selling-power-to-the-utility/competitive-bidding-for-system-resources/north-kohala-energy-storage-rfp

[3] See https://www.hawaiianelectric.com/clean-energy-hawaii/selling-power-to-the-utility/competitive-bidding-for-system-resources/competitive-bidding-archived-rfp-information/updated-non-wires-alternative-eoi-kakaako-and-kewalo

[4] *See* https://www.hawaiianelectric.com/clean-energy-hawaii/selling-power-to-the-utility/competitive-bidding-for-system-resources/competitive-bidding-archived-rfp-information/oahu-non-wires-alternative-utility-scale-or-distributed-energy-resource-grid-services-eois

[5] *See* https://www.hawaiianelectric.com/clean-energy-hawaii/selling-power-to-the-utility/competitive-bidding-for-system-resources/competitive-bidding-archived-rfp-information/oahu-non-wires-alternative-utility-scale-or-distributed-energy-resource-grid-services-eois

[6] *See* https://www.hawaiianelectric.com/documents/clean_energy_hawaii/selling_power_to_the_utility/competitive_bidding/20240405_waikoloa_eoi.pdf

- Install line sensors to actively monitor power flow to utilize cable to a greater capacity.
- Install switches to facilitate isolating subtransmission lines to allow for faster restoration.

Hawaiian Electric is evaluating whether to package future projects and upgrades together as part of an application for cost recovery to the Commission. An example is to include voltage regulators in the Grid Mod Phase 2 application, as it aligns with the field device strategy and the further additions of DERs.

In addition, the following projects were initiated or are in-progress to increase capacity primarily due to load forecast increases:

1. Kewalo T4 (Docket No. 2023-0212) – A new transformer and associated equipment is being installed to serve the load growth in the Kaka'ako and Kewalo areas.
2. Waikoloa T2 (Docket No. 2024-0137) – A new transformer and associated equipment is being installed to serve the load growth in the Waikoloa area on Hawaii Island.
3. Waipi'o Tsf 3 (Docket No. 2023-0303) – A new transformer and associated equipment is being installed to serve the load growth because of the Koa Ridge development.
4. Auiki Substation (Docket No. 2018-0185) – A new substation and associated equipment is being constructed to serve the load growth in the DoT harbors area.
5. Kulanihakoi Substation (Docket No. 2020-0182) – A new substation was energized to serve the Ho'opili expansion.

1.3.3 Continue community engagement to determine feasibility of developing REZs

The Commission hosted a series of five public meetings between October 2023 and February 2024 regarding equity issues related to the RFP process, pursuant to Order No. 40290 in the Energy Equity Docket (Docket No. 2022-0250). The REZ concept was discussed in these meetings.

In connection with our draft IGP RFP filing on April 30, 2024 referenced in Section 1.2.9 above, we hosted a virtual community meeting on March 11, 2024 and a more developer-focused meeting on March 20, 2024. Community feedback in response to the posted draft RFP was accepted during the meetings, via e-mail and is continuing to be accepted through our online feedback survey.

1.3.4 Create a transmission siting and routing process in collaboration with communities, State, county, landowners, and project developers

As described in 1.2.9 above, we plan to initiate major transmission upgrades to support larger tranches of large-scale development by first obtaining input from the market in the initial stages of the long-term RFP process. It is within this process that we will develop grid solutions to enable multiple developments sited in similar areas of the islands.

In alignment with the Governor's Executive Order and PUC Inclinations 2024, we intend to work with State Agencies to designate two REZs on Oahu by Q2 2026.

1.3.5 Pending Public Utilities Commission approval, implement and execute a 5-year, $190 million climate adaptation program to harden our grid and implement other resilience measures

Hawaiian Electric is currently implementing its five-year, $190 million, Climate Adaptation T&D Resilience Program. Hawaiian Electric was successful in obtaining U.S. Department of Energy matching funds for roughly 50% of the program cost as part of the GRIP Round 1, Topic Area 1, federal funding opportunity.

Since the August 2023 Maui Windstorm and Wildfires, the Climate Adaptation T&D Resilience Program has been transformed into a vehicle to implement our Wildfire Mitigation Immediate Action Plan (IAP) and our 2025-2027 Wildfire Safety Strategy. This includes measures to harden the grid (e.g., pole replacements, conductor replacements, replacement of equipment with fire-safe alternatives), enhanced vegetation management practices, and situational awareness investments such as weather stations and cameras.

The 2025-2027 Wildfire Safety Strategy is currently under review in Docket No. 2025-0156 and cost recovery of the strategy is currently under review in Docket No. 2025-0263.

1.3.6 Develop resilience modeling and performance target levels of resilience to inform future hardening and other resilience investments

Hawaiian Electric has contracted with the Pacific Northwest National Laboratory ("PNNL") to develop resilience performance models leveraging PNNL's Electric Grid Resilience and Assessment System ("EGRASS") framework. Originally developed for Puerto Rico following the aftermath of Hurricane Maria, EGRASS is a modeling framework used to "assess the impact on infrastructure as a result of natural hazard, estimate the probability of failure for different components of the electrical infrastructure, such as towers, transmission lines and substations, and analyze the associated risk and impact of their failures on system reliability."[7] This model will provide key insights to inform storm hardening priorities and cost-benefit analysis of hardening alternatives. To date, we have been able to develop wind fragility models of our transmission systems and are now developing a model to simulate the time to restore the transmission system after a major storm or hurricane.

In 2024, Hawaiian Electric also developed a wildfire risk model to enable quantitative risk-informed decision making for wildfire mitigation planning efforts. This model was used to develop and prioritize wildfire mitigation projects to be implemented as part of the 2025-2027 Wildfire Safety Strategy by estimating the wildfire risk associated with each circuit and the cost effectiveness of mitigation options.

1.3.7 Leverage an energy transition initiative partnership program and Resilience Working Group to identify other microgrid opportunities

In April 2021, we were selected as a recipient of the DOE's Energy Transitions Initiative Partnership Project ("ETIPP"), which provided National Lab support to develop a community-informed map of potential hybrid microgrid locations on O'ahu. The project is in its final stages and we plan to make these maps and deliverables available publicly. The data and information from this project will also be used to assess potential microgrid locations.

[7] *See* https://www.pnnl.gov/news-media/strengthening-puerto-ricos-power-grid

1.3.8 Execute North Kohala microgrid and RFP, apply lessons learned, and pursue additional microgrid opportunities to enhance community resilience

In October 2021, Hawaiian Electric filed a draft RFP with the Commission for the BESS portion of the microgrid, seeking a 5 megawatt (MW) / 30 megawatt-hours (MWh) standalone energy storage system for integration with a microgrid controller system owned and operated by Hawaiian Electric. The final RFP was approved and opened to bidders on March 24, 2023. Proposals were due by May 31, 2023. On August 29, 2023, the RFP was closed without an award. Following a comprehensive evaluation process, Hawaiian Electric concluded that the proposals did not meet the criteria set forth in the RFP. On March 6, 2024, the Commission closed the docket, Docket No. 2022-0012. Since then, Hawaiian Electric has applied to several grant opportunities[8] to support funding for this project and is awaiting to hear back from the latest grant application.

1.3.9 Complete rollout of AMI and obtain approval of phase 2 grid modernization to enhance system reliability and resilience

On February 28, 2022, in Docket No. 2018-0141, the Commission ordered the us to deploy Advanced Metering Infrastructure ("AMI") to all customers, excluding opt-outs, by Q3 2024. As of the end of May 2024, we have deployed more than 430,000 AMI meters and are on-track to complete the project by the Commission's deadline.

While we were unsuccessful in pursuit of round one DOE IIJA grant funding for Grid Modernization Strategy ("GMS") Phase 2, the DOE encouraged us to apply GMS Phase 2 for IIJA grant funding during the second-round funding opportunity. We applied for IIJA grant funding on May 23, 2024, seeking the maximum award size of $100.0 million for any one individual award.

On May 31, 2024, we filed an updated and supplemented application in Docket No. 2019-0327, requesting PUC approval for the Companies' matching portion of an IIJA project to implement GMS Phase 2. This $115.2M request seeks approval to implement an Advanced Distribution Management System ("ADMS"), field devices ("Field Devices"), expansion of Supervisory Control and Data Acquisition ("SCADA"), expansion of the Private LTE ("PLTE") network, and Operational Technology ("OT") Cybersecurity Monitoring ("Cybersecurity"). We were notified that we were not awarded GRIP Round 2 funding, and are currently re-scoping GMS Phase 2 and plan to file another updated and supplemented PUC application for updated project costs in the second quarter of 2025.

[8] The Companies have submitted a Notice of Intent for the Hazard Mitigation Grant Program through HiEMA (July 2024) and concept paper under the DOE Energy Improvements in Rural or Remote Areas program (DOE-FOA-0003428, February 2025)

1.4 Key Finding and Recommendation: Secure Reliability through Diverse Energy Sources and Technologies

Creating a reliable clean energy grid will require:

- Developing renewable firm generation that is modern and flexible
- Adoption of emerging technologies

Near-term actions to secure reliability:

1. Continue to monitor the condition of an aging generation fleet and prepare contingency plans as necessary; manage prudent and essential capital investments in generating units that could potentially be retired or deactivated in the near future, balanced with ensuring short-term reliability
2. Acquire new firm generation and solar, wind and energy storage projects through the Stage 3 procurement to facilitate deactivation and retirement of existing fossil-fuel generation through 2035
3. Complete a resource adequacy study to review reliability planning methods and renewable resource accreditation methodologies

Near-term actions to adopt emerging technologies:

4. Continue to require grid-forming technology for inverter-based resources, including for large-scale standalone wind and solar when technology is commercially available
5. Continue to monitor and evaluate the performance of new solar and storage projects, including continued assessment of system security risks as more renewable systems are brought online
6. Continue to monitor and invest in advanced technologies to operate the high inverter-based grids and seek new grid technologies to improve the reliability of the grid
7. Implement IEEE 2800-2022 in future large-scale inverter-based resource projects
8. Continue engagement with the DER industry to improve inverter performance to address system security concerns
9. Continue evaluating advanced equipment for providing system stability (e.g., grid-forming STATCOM)
10. Develop interconnection standards for grid interface of electric vehicles to get ahead of potential system security risks seen today with rooftop solar systems

1.4.1 Continue to monitor the condition of an aging generation fleet and prepare contingency plans as necessary; manage prudent and essential capital investments in generating units that could potentially be retired or deactivated in the near future, balanced with ensuring short-term reliability

Hawaiian Electric continues to maintain and make appropriate investments in generating units, completing necessary maintenance outages and overhauls on each unit. Similarly, we continue to make capital investments in existing generating units and completed more than 53 capital projects in 2024.

Generating units are monitored continuously by operators and notifications of maintenance needs are made as necessary. In addition to continuous monitoring by operators, we manage and maintain existing generating units by executing a maintenance basis program which includes preventative and predictive maintenance with engineering oversight. Electrical, boiler, and turbine subject matter experts ("SMEs") also monitor equipment and help specify maintenance needs. Through this comprehensive system, all critical components receive maintenance based on monitoring (predictive maintenance technologies such as vibration monitoring) and/or time. When corrective needs are identified, they are planned into the units' maintenance schedules. This maintenance basis is executed by a team of maintenance personnel, planners, engineers, and SMEs.

We continue to develop the Waena BESS (Docket No. 2020-0132) and Waiau Repowering (Docket No. 2025-0211) projects, in addition to developing contingency plans on Maui, Hawaiʻi Island, and Oʻahu. As part of the contingency planning, we are also evaluating critical spares and making investments in long-term lead items such as spare transformers.

1.4.2 Acquire new firm generation and solar, wind and energy storage projects through the Stage 3 procurement to facilitate deactivation and retirement of existing fossil-fuel generation through 2035

As described in Section 1.2.7 above, projects were selected from the Stage 3 RFPs for Oʻahu, Maui, and Hawaiʻi Island in December 2023 and January 2024. These projects, once in service, will help to facilitate the deactivation and retirement of existing fossil fuel resources at Waiau and Māʻalaea Power Plants, by providing additional renewable capacity and energy.

1.4.3 Complete a resource adequacy study to review reliability planning methods and renewable resource accreditation methodologies

E3, a consultant to Hawaiian Electric, recently completed an independent resource adequacy study that examined different capacity planning criteria and resource accreditation methodologies. The study found that the different criteria and methodologies could produce resource portfolios with similar installed capacity, reliability, and cost. Possible next steps were also outlined for the Commission's consideration regarding reliability standards. The study was filed as an exhibit to our April 8, 2024 letter providing comments on Commission Order No. 40651 in Docket No. 2018-0165.

Based on the feedback from the Commission in Order No. 41022, we will plan to continue to refine the resource accreditation methodology for variable resources, incorporate any reliability standard modifications based on the recommendations of the Hawaiʻi Electric Reliability Administrator, and prepare to evaluate more or less stringent LOLE standards as part of the next IGP cycle.

1.4.4 Continue to require grid-forming technology for inverter-based resources, including for large-scale standalone wind and solar when technology is commercially available

We have continued to require grid-forming ("GFM") technology for the battery energy storage system ("BESS") inverter component in the Stage 3 and IGP RFP resource procurements. An improvement made starting in the Stage 3 RFP is more specific GFM requirements, particularly regarding short-term overcurrent capability and alignment with certain performance requirements from IEEE 2800-2022. In the preliminary analysis from the Stage 3 RFP portfolio evaluation, it is observed that the GFM component of the selected Stage 3 portfolio improves system stability. We will continue to require GFM technology for the BESS inverter component in future resource procurements.

We have yet to receive a proposal with commercially available GFM technology for a large-scale standalone wind or solar plant.

In addition, we have also been working with existing project owners to explore the option of retrofitting existing grid-following ("GFL") BESS inverters with GFM technology to improve overall system stability.

1.4.5 Continue to monitor and evaluate the performance of new solar and storage projects, including continued assessment of system security risks as more renewable systems are brought online

Several new solar and storage projects went into service since the last action plan update: on Maui, AES Kuihelani in May 2024, and on Hawai'i Island, Hale Kuawehi Solar in March 2025. While we are continuing to gain operational experience with these new projects, the management of these resources is expected to become more complex as more projects are added in the near future. Further, there are notable differences in capabilities and performance depending on project, requiring detailed analyses and monitoring of project pre- and post-COD. As noted in Section 1.4.9 below, future contingency resources may also be needed for system security.

1.4.6 Continue to monitor and invest in advanced technologies to operate the high inverter-based grids and seek new grid technologies to improve the reliability of the grid

We continue to monitor and evaluate advanced technologies that support the planning, operation, and integration of high inverter-based grid systems. To improve the reliability of its grids with increasing inverter-based renewable energy and storage systems, we are currently working with research and industry partners in various research projects to develop and evaluate new grid solutions and operational support tools needed to manage the variability and uncertainty of photovoltaic and energy storage systems. This is being done through collaborative engagements that leverage industry expertise and external funding (e.g., federal grants) to lower costs to customers.

In June 2024, we commissioned a project with the Electric Power Research Institute ("EPRI") to collaborate with other utilities on modifications to EPRI's software tool called Flexible Energy Scheduling Tool for Integrating Variable generation ("FESTIV") to coordinate and schedule generating resources to meet operating reserve needs and maintain reliability on the utility grid with high penetrations of renewable energy inverter-based grid systems and energy storage.

In November 2024, we executed another project with EPRI to evaluate an asset management tool to assess the health, performance, and risk of substation circuit breakers. The objective is to find the highest-risk circuit breakers for condition-based maintenance or proactive replacement, avoiding the risk of extended outage and potential failure.

We continue to explore opportunities to expand the use of radio frequency ("RF") sensors on substation insulators to overhead distribution and transmission power lines for early fault detection ("EFD") to maintain or improve advanced grid reliability and resilience. The technology uses waveform analytics to detect, locate, and report on anomalies in power lines such as arc faults, equipment degradation, broken strands on conductor, down conductors, loose tie wire, and vegetation contact.

1.4.7 Implement IEEE 2800-2022 in future large-scale inverter-based resource projects

In the Stage 3 RFP contract performance standards, we partially adopted IEEE 2800-2022 standard and merged it with our existing RDG project performance standards, and generated the latest version of RDG project performance standard. These requirements have also been included in the IGP RFP performance standards.

1.4.8 Continue engagement with the DER industry to improve inverter performance to address system security concerns

We have been working with NREL to perform DER inverter testing to better understand DER inverter ride-through capability and characteristics, such as momentary cessation. Meanwhile, we have been sharing the findings of the inverter testing results with industry and are participating in the IEEE 1547 revision working group, proposing a new category of inverter performance requirements for isolated systems, such as Hawai'i. Currently, the proposal is under review by the standard revision working group.

1.4.9 Continue evaluating advanced equipment for providing system stability (e.g., grid-forming STATCOM)

Currently, we believe that system stability needs can be met by continuing to require GFM technology in the near-term resource procurements and GFM resource MW headroom and MWh energy reserve during daily operation. Project withdrawals have continued to hinder the ability to increase the amount of GFM resources and thus, GFM headroom. It should be noted as well that active management of these resources continues to grow in complexity with the continued addition of resources. Such increased complexities may lead to the addition of future contingency resources (e.g., GFM STATCOM, standalone FFR) to supplement the security of the system.

1.4.10 Develop interconnection standards for grid interface of electric vehicles to get ahead of potential system security risks seen today with rooftop solar systems

We have worked with EPRI to understand how existing EV chargers perform under fault conditions. Electromagnetic Transient ("EMT") models were created in this process to incorporate the aggregated behaviors of EV chargers on the system for future analyses. A key takeaway was that EV chargers' behaviors under fault conditions vary and have the potential to mitigate impact to the system if standard requirements are developed. We will continue to analyze these behaviors and anticipate developing standard requirements in the future.

2 Exploratory Look At Executive Order No. 25-01 and Commission's Inclinations Near Term RPS and GHG Goals

This section of the Action Plan Annual Update provides a high-level initial assessment of the potential impacts to the Companies' resource plans in response to guidance provided by Governor Josh Green and the Public Utilities Commission. On Oʻahu, significant resource mix changes that will likely significantly increase costs to customers will be needed to address this new policy guidance through expansive use of biodiesel, DER, or other renewable resources assuming that Oʻahu remains land-constrained. On Hawaiʻi Island, Maui, Molokaʻi, and Lānaʻi, the resource mix to meet these new policy goals were in alignment with the IGP preferred plans.

- Governor Josh Green's Executive Order No. 25-01 Accelerating Hawaiʻi's Transition Toward 100 Percent Renewable Energy ("Governor's EO") which calls for an acceleration of our renewable energy progress, including a 100% renewable portfolio standard for Maui and Hawaiʻi Island, 70% reduction in greenhouse gas ("GHG") emissions for Oʻahu by 2035, and the addition of at least 50,000 new distributed renewable energy installations before 2030 across the State.[9]
- The Commission's 2024 Inclinations on the Future of Energy in Hawaiʻi ("PUC Inclinations") that provides new policy guidance for the Companies' resource plans including the expedited replacement of old, inflexible fossil fuel generation with more efficient and reliable technologies that support the transition to 100% renewable energy, expanded interconnection of renewable utility-scale and distributed energy resources to limit oil-based generation to no more than 40% on each island by 2030, and increased integration of new DER of approximately 400 MW by end of 2030.[10]

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[9] *See* https://governor.hawaii.gov/wp-content/uploads/2025/01/2501085_Executive-Order-No.-25-01.pdf

[10] *See* https://puc.hawaii.gov/wp-content/uploads/2025/01/Hawaii-PUC-Energy-Inclinations-White-Paper-FINAL.12.31.24_signed.pdf

These documents provide intermediate goals for RPS and GHG emissions reductions in the 2030 and 2035 timeframe, in addition to existing laws for RPS and GHG emissions.

Table 2-1 summarizes the RPS and GHG emissions goals that the Companies must plan for in the near and long term. It also includes guidance provided by executive orders issued at the Federal level that may restrict the availability of offshore wind. The modeling analyses contained herein examines meeting these goals on an island-by-island basis even though existing laws for GHG emissions are defined at the State level, with a focus on years 2030 and 2035.

Table 2-1: Summary of RPS and GHG goals.

Zone	2030	2035	2040	2045
Statewide	40% RPS 50% GHG reduction[11]		70% RPS	100% RPS Net-zero emissions
O‘ahu	60% RPS 50% GHG reduction No Offshore Wind	70% GHG reduction No Offshore Wind	No Offshore Wind	No Offshore Wind
Hawai‘i Island	60% RPS 50% GHG reduction	100% RPS		
Maui County	60% RPS (each island) 50% GHG reduction (each island)	100% RPS		

Governor’s EO	**President’s EO**	**PUC Inclinations**	**GHG Law**	**RPS Law**

Table 2-2 through Table 2-6 provides a comparison of the 2025 IGP Plan to the new resource additions needed to address the interim RPS, GHG, and DER goals, a sensitivity where biogenic emissions were included in the GHG accounting, and a sensitivity where higher resource costs were considered. These new

[11] While statewide emissions targets in H.R.S. 225P-5 include all industries, they are assumed to be Company targets for modeling purposes. The total GHG emissions contained in this section were estimated using the emission factors and the global warming potentials based on the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4), consistent with the 2023 IGP Final Report.

resources are in addition to planned projects from the Stage 3 RFP and planned RFPs for IGP RFP Round 1 and Round 2.

- The 2025 IGP Plan for O'ahu, Hawai'i Island, and Maui does not list any resource additions because the new resource additions that were selected by RESOLVE in the 2023 IGP Final Report for the 2030 and 2035 timeframe have already been re-purposed into the IGP RFP Round 1, IGP RFP Round 2, and Long-Term RFP targets for capacity and energy.
- When not including biogenic emissions, biodiesel can still be used as part of the resource portfolio to reduce GHG emissions.
    - If under a high resource cost scenario where Federal investment tax credits and production tax credits for renewable technologies are removed, the resource portfolio will reduce the buildout of PV, wind, and BESS and instead rely upon biodiesel generation further, resulting in overall resource plan cost increases of 30% - 77%.
    - Lower cost renewable fuels could be used to decrease resource plan costs.
- When including biogenic emissions in the GHG accounting, the resource additions are the same as when not including biogenic emissions on Hawai'i Island, Maui, Moloka'i, and Lāna'i. In fact, the 2030 and 2035 RPS and GHG goals can be met with just planned resources from planned RFPs on Maui and Hawai'i Island.[12] On land-constrained O'ahu, there is a dramatic shift in the resource build as the capacities for non-emitting DER (due to lack of availability of other non-emitting resources or negative emissions technologies that are currently commercially available on O'ahu) and standalone BESS increase significantly because biodiesel is assumed to have a similar emissions profile as fossil fuel when including biogenic emissions.
    - If under a high resource cost scenario and biogenic emissions are included, the resource portfolio shifts on Maui, Moloka'i, and Lāna'i from PV to wind but the overall amount of new renewable energy being added is similar. The resource portfolio for Hawai'i Island remains similar under the high resource cost scenario, with wind and standalone storage as the selected resources. O'ahu remains largely the same due to the limited resource options available. Again, overall resource plan cost increases range from 30% - 77%.
- On O'ahu, given the limited resource options under the land-constrained scenario that lead to high levels of DER expansion selected by RESOLVE above forecasted DER levels, distribution upgrades and other resources and reserves for stability may be needed, which will require further analysis. The high DER adoption levels may similarly require a high level of incentives that significantly reduce the expected payback period and expand the market for a new DER system. Other negative emissions

[12] Planned RFPs include the CBRE Phase 2 Tranche 2 RFP. In the PUC Inclinations, the Commission noted that the CBRE program has attracted only a fraction of the program cap and developers have struggled to meet the program's requirements. Among other issues, the Commission intends to study whether the program should be restructured to replace subscriber organizations with utility managed enrollment. Therefore, the capacity and energy provided by the CBRE Phase 2 Tranche 2 RFP placeholders will need to be replaced by a successor program or new resource to meet the RPS and GHG goals.

technology may also be needed to achieve greater levels of GHG reduction beyond the 70% by 2035 goal set by the Governor's EO.

Additional resources needed to achieve the RPS, GHG, and DER goals set by the Governor's Executive Order and the PUC Inclinations are not included in the 2025 IGP Plan in Section 3. The analyses contained in Section 2 are intended to be a high-level exploratory look at what may be required to achieve the proposed RPS, GHG, and DER goals and assess the divergence of these pathways from the established IGP preferred plans. Hawaiian Electric emphasize that this exploratory analysis is currently bounded in its application by the following considerations. The preliminary analysis: (1) does not impose a limitation on the build limit of the DER resource based on market potential, (2) is not currently supported by any study of the existing and future market potential for new DERs, and (3) does not take into account the potential loss of attractive state and federal tax incentives that could significantly impact the affordability of DERs and inhibit the growth of new DER in the resource mix. To the extent that the resource plans developed in this new analysis suggest a significant departure from the prior IGP preferred plans, the Companies propose that these interim RPS, GHG, and DER goals, qualifying zero emissions resources including negative emissions technologies, and resulting resource plans be re-assessed holistically with stakeholders as part of the second cycle of IGP.

2.1 Summary of O'ahu Results

Table 2-2 describes the new resources, incremental to the IGP Plan, that were selected on O'ahu to meet the 2030 and 2035 RPS and GHG goals.

- On O'ahu, when biogenic emissions are not included in the GHG accounting, the RESOLVE model selects storage and DER while continuing to rely on biodiesel generation, up to 25% of total generation, to meet the 2030 and 2035 RPS and GHG goals. Under a high resource cost scenario, the selection of storage and DER is reduced and instead, biodiesel generation is further increased, with costs by increasing by 30%.
- Recognizing the DER goals in the Governor's EO and PUC Inclinations, if the RPS and GHG goals were to be substantially met with DER instead of biodiesel, a substantial amount of DER would need to be added at a higher cost than utilizing biodiesel generation. The tradeoffs between DER, biodiesel generation, and other resource options to meet these policy goals can be examined in more detail in the upcoming IGP cycle.
- When biogenic emissions are included in the GHG accounting, RESOLVE selects similar amounts of storage and DER as it does under a high resource cost scenario. However, the high resource cost scenario sees costs increase by 65%.

Table 2-2: New O'ahu resources selected after IGP RFP R1 and R2 to meet 2030 and 2035 RPS and GHG goals

	O'ahu RPS and GHG Analyses Future Installed Capacity after IGP RFP R1 and R2 (Cumulative MW)					
Year	Resource	2025 IGP Plan[13]	Without Biogenic Without Future Firm		With Biogenic Without Future Firm	
			2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost
2030	Standalone Storage (4hrs)	---	85 MW	23 MW	202 MW	204 MW
	Paired DER w/ 2hr Storage	---	0 MW	0 MW	790 MW	762 MW
2035	Standalone Storage (4hrs)	---	126 MW	23 MW	400 MW	428 MW
	Paired DER w/ 2hr Storage	---	437 MW	0 MW	2,164 MW	1,981 MW

[13] Capacities shown are incremental to planned resource additions through the IGP RFP. IGP RFP Round 1 seeks 750 GWh of renewable energy equivalent to 363 MW of hybrid solar and 81 MW of firm capacity. IGP RFP Round 2 seeks 232 GWh of renewable energy equivalent to 11 MW of standalone solar and 99 MW of onshore wind.

2.2 Summary of Hawaiʻi Island Results

Table 2-3 describes the new resources, incremental to the IGP Plan, that were selected on Hawaiʻi Island to meet the 2030 and 2035 RPS and GHG goals.

- On Hawaiʻi Island, when biogenic emissions are not included in the GHG accounting, the RESOLVE model selects small amounts of storage and onshore wind. Under a high resource cost scenario, these capacities are slightly reduced and costs increase by 33%. The incremental resources are the same if biogenic emissions are included in the GHG accounting.
- If considering just the minimum amount of new, incremental resources that are needed to meet the 2030 and 2035 RPS and GHG goals, no future resources would be required as the planned resources from the Stage 3 RFP, CBRE Phase 2 Tranche 2 RFP,[14] and IGP RFP are enough to meet them.

Table 2-3: New Hawaiʻi Island resources selected after IGP RFP R1 to meet 2030 and 2035 RPS and GHG goals

	Hawaiʻi Island RPS and GHG Analyses Future Installed Capacity after IGP RFP R1 (Cumulative MW)					
Year	Resource	2025 IGP Plan[15]	Without Biogenic		With Biogenic	
			2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost
2030	Standalone Storage (4hrs)	---	5 MW	1 MW	5 MW	1 MW
	Onshore Wind	---	15 MW	12 MW	15 MW	12 MW
2035	Standalone Storage (4hrs)	---	5 MW	1 MW	5 MW	1 MW
	Onshore Wind	---	15 MW	12 MW	15 MW	12 MW

[14] In the PUC Inclinations, the Commission noted that the CBRE program has attracted only a fraction of the program cap and developers have struggled to meet the program's requirements. Among other issues, the Commission intends to study whether the program should be restructured to replace subscriber organizations with utility managed enrollment. Therefore, the capacity and energy provided by the CBRE Phase 2 Tranche 2 RFP placeholders will need to be replaced by a successor program or new resource to meet the RPS and GHG goals.

[15] Capacities shown are incremental to planned resource additions through the IGP RFP. IGP RFP Round 1 seeks 435 GWh of renewable energy equivalent to 30 MW of onshore wind and 115 MW of hybrid solar as well as 30 MW of firm capacity.

2.3 Summary of Maui County Results

Table 2-4 describes the new resources, incremental to the IGP Plan, that were selected on Maui to meet the 2030 and 2035 RPS and GHG goals.

- On Maui, when biogenic emissions are not included in the GHG accounting, the RESOLVE model selects large amounts of hybrid solar and relatively smaller amounts of storage and onshore wind. Under a high resource cost scenario, the hybrid solar capacity is significantly reduced and replaced by increased capacities of onshore wind, with costs increasing by 57%. The incremental resources are the same if biogenic emissions are included in the GHG accounting.
- If considering just the minimum amount of new, incremental resources that are needed to meet the 2030 and 2035 RPS and GHG goals, no future resources would be required as the planned resources from the Stage 3 RFP, CBRE Phase 2 Tranche 2 RFP,[16] and IGP RFP are enough to meet them. However, biodiesel would provide a significant share of the total generation so new resources could still be added to reduce resource plan costs and biogenic emissions.

[16] In the PUC Inclinations, the Commission noted that the CBRE program has attracted only a fraction of the program cap and developers have struggled to meet the program's requirements. Among other issues, the Commission intends to study whether the program should be restructured to replace subscriber organizations with utility managed enrollment. Therefore, the capacity and energy provided by the CBRE Phase 2 Tranche 2 RFP placeholders will need to be replaced by a successor program or new resource to meet the RPS and GHG goals.

Table 2-4: New Maui resources selected after IGP RFP R2 to meet 2030 and 2035 RPS and GHG goals

	Maui RPS and GHG Analyses Future Installed Capacity after IGP RFP R2 (Cumulative MW)					
			Without Biogenic		With Biogenic	
Year	Resource	2025 IGP Plan[17]	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost
2030	Standalone Storage (4hrs)	---	3 MW	6 MW	3 MW	6 MW
	Hybrid Solar w/ 4hr Storage	---	180 MW	0 MW	180 MW	0 MW
	Onshore Wind	---	14 MW	94 MW	14 MW	94 MW
2035	Standalone Storage (4hrs)	---	11 MW	14 MW	11 MW	14 MW
	Hybrid Solar w/ 4hr Storage	---	257 MW	0 MW	257 MW	0 MW
	Onshore Wind	---	14 MW	101 MW	14 MW	102 MW

Table 2-5 describes the new resources, in place of the IGP Plan resources, that were selected on Molokaʻi to meet the 2030 and 2035 RPS and GHG goals.

- On Molokaʻi, when biogenic emissions are not included in the GHG accounting, the RESOLVE model selects hybrid solar and storage. Under a high resource cost scenario, the hybrid solar and storage are replaced by onshore distributed wind, with costs increasing by 30%. The incremental resources are the same if biogenic emissions are included in the GHG accounting.
- If considering just the minimum amount of new, incremental resources that are needed to meet the 2030 and 2035 RPS and GHG goals, the hybrid solar capacity selected by RESOLVE could be reduced to less than half of what was selected by RESOLVE. However, biodiesel would provide a significant share of the total generation so new resources could still be added to reduce resource plan costs and biogenic emissions.

[17] Capacities shown are incremental to planned resource additions through the IGP RFP. IGP RFP Round 2 seeks 230 GWh of renewable energy equivalent to 40 MW of onshore wind and 25 MW of hybrid solar.

Table 2-5: New Moloka'i resources selected to meet 2030 and 2035 RPS and GHG goals

	Molokai RPS and GHG Analyses Future Installed Capacity (Cumulative MW)					
Year	Resource	2025 IGP Plan	Without Biogenic		With Biogenic	
			2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost
2030	Standalone Storage (4hrs)	0.5 MW	0.5 MW	0.6 MW	0.5 MW	0.6 MW
	Hybrid Solar w/ 4hr Storage	11.5 MW	10.2 MW	0 MW	10.2 MW	0 MW
	Onshore Wind	0 MW	0 MW	3.5 MW	0 MW	3.5 MW
2035	Standalone Storage (4hrs)	0.6 MW	0.5 MW	0.8 MW	0.5 MW	0.8 MW
	Hybrid Solar w/ 4hr Storage	13.8 MW	11.1 MW	0 MW	11.1 MW	0 MW
	Onshore Wind	0 MW	0 MW	4.5 MW	0 MW	4.5 MW

Table 2-6 describes the new resources, in place of the IGP Plan resources, that were selected on Lānaʻi to meet the 2030 and 2035 RPS and GHG goals.

- On Lānaʻi, when biogenic emissions are not included in the GHG accounting, the RESOLVE model selects hybrid solar and storage. Under a high resource cost scenario, a more diverse portfolio is selected including hybrid solar, storage, standalone solar, and onshore distributed wind, with costs increasing by 77%. The incremental resources are the same if biogenic emissions are included in the GHG accounting.
- If considering just the minimum amount of new, incremental resources that are needed to meet the 2030 and 2035 RPS and GHG goals, the hybrid solar capacity selected by RESOLVE could be reduced. However, biodiesel would provide a significant share of the total generation so new resources could still be added to reduce resource plan costs and biogenic emissions.

Table 2-6: New Lānaʻi resources selected to meet 2030 and 2035 RPS and GHG goals

	Lanai RPS and GHG Analyses Future Installed Capacity (Cumulative MW)					
			Without Biogenic		With Biogenic	
Year	Resource	2025 IGP Plan	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost	2025 AP Update Base Resource Cost	2025 AP Update High Resource Cost
2030	Standalone Storage (4hrs)	0.6 MW	0.5 MW	1.6 MW	0.5 MW	1.6 MW
	Hybrid Solar w/ 4hr Storage	21.0 MW	20 MW	1.4 MW	20 MW	1.4 MW
	Standalone Solar	0 MW	0 MW	5.2 MW	0 MW	5.3 MW
	Onshore Wind	0 MW	0 MW	3.8 MW	0 MW	3.8 MW
2035	Standalone Storage (4hrs)	0.6 MW	0.5 MW	2.1 MW	0.5 MW	2.1 MW
	Hybrid Solar w/ 4hr Storage	21.3 MW	21.3 MW	4.2 MW	21.3 MW	4.3 MW
	Standalone Solar	0 MW	0 MW	7.4 MW	0 MW	7.4 MW
	Onshore Wind	0 MW	0 MW	3.8 MW	0 MW	3.8 MW

3 2025 IGP Plan

This section provides a comparison of the 2025 IGP Plan to the new resource additions needed to address the interim RPS, GHG, and DER goals, the biogenic emissions sensitivity, and the resource cost sensitivity. Descriptions of the resource changes in the 2025 IGP Plan are also provided with summary tables of the 2024 IGP Plan, the 2025 IGP Plan, and description of changes made in the 2025 IGP Plan. The 2025 IGP Plan began with the 2024 IGP Plan that was filed on June 28, 2024 and was updated with changes in scope and timing for planned projects from previous RFPs, as well as, the placeholders for the IGP RFPs.

Additional resources needed to achieve the RPS, GHG, and DER goals set by the Governor's Executive Order and the PUC Inclinations are not included in the 2025 IGP Plan below. The analyses contained herein are intended to be an initial, exploratory look at the pathways to achieve these interim RPS, GHG, and DER goals and assess the how different these pathways are compared to the established IGP preferred plans. To the extent that the resource plans developed in this new analysis suggest a significant departure from the prior IGP preferred plans, the Companies propose that these interim RPS, GHG, and DER goals and resulting resource plans be re-assessed holistically with stakeholders as part of the second cycle of IGP.

3.1 O‘ahu

Table 3-1: O‘ahu Resource Plan

O‘ahu Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2025	Install 1.7 MW KHLS	~~Install 1.7 MW KHLS~~ Install 52 MW 208 MWh Ho‘ohana Solar Install 7 MW 35 MWh Mountain View Solar	Install 52 MW 208 MWh Ho‘ohana Solar Install 7 MW 35 MWh Mountain View Solar	Updated CBRE Ph 1 PV project (KHLS) COD from 1/2025 to 1/2026 Updated Ho‘ohana Solar COD from 11/2024 to 6/2025 Updated Mountain View Solar COD from 12/2024 to 10/2025
2026	Remove 15 MW Load Build Remove 26 MW Load Reduce Install 6 MW LMI Kaukonahua Standalone Solar Install 6 MW 30 MWh Pu‘uloa Solar S3 RFP	Remove 15 MW Load Build Remove 26 MW Load Reduce Install 6 MW LMI Kaukonahua Standalone Solar Install 6 MW 30 MWh Pu‘uloa Solar S3 RFP Install 1.7 MW KHLS Install 30 MW 240 MWh Waiawa Ph 2 Solar	Remove 15 MW Load Build Remove 26 MW Load Reduce Install 6 MW LMI Kaukonahua Standalone Solar Install 6 MW 30 MWh Pu‘uloa Solar S3 RFP Install 1.7 MW KHLS Install 30 MW 240 MWh Waiawa Ph 2 Solar	Updated CBRE Ph 1 PV project (KHLS) COD from 1/2025 to 1/2026 Updated Waiawa Ph 2 Solar COD from 11/2024 to 1/2026
2027	Install 30 MW Par Hawai‘i Renewable Combined Heat and Power S3 RFP Install 120 MW 480 MWh Mahi Solar and Storage S3 RFP Install 80 MW 480 MWh Makana Lā Solar S3 RFP	~~Install 30 MW Par Hawai‘i Renewable Combined Heat and Power S3 RFP~~ Install 120 MW 480 MWh Mahi Solar and Storage S3 RFP ~~Install 80 MW 480 MWh Makana Lā Solar S3 RFP~~	Install 120 MW 480 MWh Mahi Solar and Storage S3 RFP	Removed Par Hawai‘i Renewable Combined Heat and Power due to withdrawal Removed Makana Lā Solar due to withdrawal
2028	Install 99 MW Pu‘uloa Energy 1 S3 RFP	Install 99 MW Pu‘uloa Energy 1 S3 RFP	Install 99 MW Pu‘uloa Energy 1 S3 RFP	

Oʻahu Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2029	Install 75 MW of CBRE Ph 2 RFP PV Install 84.2 MW Waiau 11-12, Waiau Repower S3 RFP Remove 108.1 MW Waiau 5-6 IGP RFP: First Round - Install 589 GWh Renewable Energy + 270 MW GFM (285 MW hybrid solar)	~~Install 75 MW of CBRE Ph 2 RFP PV~~ Install 84.2 MW Waiau 11-12, Waiau Repower S3 RFP Remove 108.1 MW Waiau 5-6 ~~IGP RFP: First Round - Install 589 GWh Renewable Energy + 270 MW GFM (285 MW hybrid solar)~~	Install 84.2 MW Waiau 11-12, Waiau Repower S3 RFP Remove 108.1 MW Waiau 5-6	Updated First Round IGP RFP COD to 11/2030[18] Removed CBRE Ph 2 RFP, to be replaced by successor program per PUC Inclinations
2030		IGP RFP: First Round - Install ~~589~~ 750 GWh Renewable Energy + ~~270~~ 350 MW GFM (~~285~~ 363 MW hybrid solar)	IGP RFP: First Round - Install 750 GWh Renewable Energy + 350 MW GFM (363 MW hybrid solar)	Updated First Round IGP RFP COD to 11/2030[18] Updated First Round IGP RFP target for Makana Lā Solar withdrawal
2031	Remove 30 MW Kahuku Wind Install 84.2 MW Waiau 13-14, Waiau Repower S3 RFP Remove 169.1 MW Waiau 7-8	Remove 30 MW Kahuku Wind Install 84.2 MW Waiau 13-14, Waiau Repower S3 RFP Remove 169.1 MW Waiau 7-8	Remove 30 MW Kahuku Wind Install 84.2 MW Waiau 13-14, Waiau Repower S3 RFP Remove 169.1 MW Waiau 7-8	
2032	Remove 1 MW Kapolei Sustainable Energy Park Remove 69 MW Kawailoa Wind IGP RFP: First Round - Install 50 MW Firm IGP RFP: Second Round - Install 232 GWh Renewable Energy (11 MW Standalone Solar, 99 MW Onshore Wind) IGP RFP: Second Round - Replace prior RFP withdrawals or shortfall from First Round IGP RFP	Remove 1 MW Kapolei Sustainable Energy Park Remove 69 MW Kawailoa Wind ~~IGP RFP: First Round - Install 50 MW Firm~~ ~~IGP RFP: Second Round - Install 232 GWh Renewable Energy~~ ~~(11 MW Standalone Solar, 99 MW Onshore Wind)~~ ~~IGP RFP: Second Round - Replace prior RFP withdrawals or shortfall from First Round IGP RFP~~	Remove 1 MW Kapolei Sustainable Energy Park Remove 69 MW Kawailoa Wind	Updated First Round Firm IGP RFP COD to 12/2033[18] Updated Second Round IGP RFP COD to 12/2033[18]

[18] IGP RFP CODs were updated as noted in Docket No. 2024-0258 after the analysis for this report was already underway. Updated CODs are shown in the resource plan.

Oʻahu Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2033	Remove 5 MW Kalaeloa Solar Two Remove 5 MW Kalaeloa Renewable Energy Park Remove 164.9 MW Kahe 1-2 Remove 60 MW Load Build 3 Remove 60 MW Load Reduce 3 208 MW KPLP Biodiesel Conversion S3 RFP Install 84.2 MW Waiau 15-16, Waiau Repower S3 RFP	Remove 5 MW Kalaeloa Solar Two Remove 5 MW Kalaeloa Renewable Energy Park Remove 164.9 MW Kahe 1-2 Remove 60 MW Load Build 3 Remove 60 MW Load Reduce 3 208 MW KPLP Biodiesel Conversion S3 RFP Install 84.2 MW Waiau 15-16, Waiau Repower S3 RFP IGP RFP: First Round - Install ~~50~~ 81 MW Firm IGP RFP: Second Round - Install 232 GWh Renewable Energy (11 MW Standalone Solar, 99 MW Onshore Wind) IGP RFP: Second Round - Replace prior RFP withdrawals or shortfall from First Round IGP RFP	Remove 5 MW Kalaeloa Solar Two Remove 5 MW Kalaeloa Renewable Energy Park Remove 164.9 MW Kahe 1-2 Remove 60 MW Load Build 3 Remove 60 MW Load Reduce 3 208 MW KPLP Biodiesel Conversion S3 RFP Install 84.2 MW Waiau 15-16, Waiau Repower S3 RFP IGP RFP: First Round - Install 81 MW Firm IGP RFP: Second Round - Install 232 GWh Renewable Energy (11 MW Standalone Solar, 99 MW Onshore Wind) IGP RFP: Second Round - Replace prior RFP withdrawals or shortfall from First Round IGP RFP	Updated First Round Firm IGP RFP COD to 12/2033[18] Updated Second Round IGP RFP COD to 12/2033[18] Updated IGP RFP: First Round target for Par Hawaiʻi withdrawal IGP RFP energy target for expiring wind PPAs (99 MW) could be met by other resources due to new onshore wind setbacks
2034				
2035				
2036	LT RFP: Install 2,230 GWH Renewable Energy (400 MW Offshore Wind and 140 MW 560 MWh Standalone BESS)	LT RFP: Install 2,230 GWH Renewable Energy ~~(400 MW Offshore Wind and 140 MW 560 MWh Standalone BESS))~~	LT RFP: Install 2,230 GWH Renewable Energy	Offshore wind was removed in the analysis due to Federal Executive Order. The LT RFP energy target could be met by other resources including the development of REZ.
2037	Remove 171.5 MW Kahe 3-4	Remove 171.5 MW Kahe 3-4	Remove 171.5 MW Kahe 3-4	
2038				
2039	Remove 27.6 MW Waianae Solar	Remove 27.6 MW Waianae Solar	Remove 27.6 MW Waianae Solar	

Oʻahu Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2040	Remove 24 MW Nā Pua Makani Wind Install 12 MW 48 MWh Standalone BESS Install 28 MW Recovered PV Potential Install 24 MW Recovered Wind Potential	Remove 24 MW Nā Pua Makani Wind Install 12 MW 48 MWh Standalone BESS Install 28 MW Recovered PV Potential Install 24 MW Recovered Wind Potential	Remove 24 MW Nā Pua Makani Wind Install 12 MW 48 MWh Standalone BESS Install 28 MW Recovered PV Potential Install 24 MW Recovered Wind Potential	Recovered Wind Potential (24 MW) could be met by other resources due to new onshore wind setbacks
2041	Remove 109.6 MW Clearway Projects	Remove 109.6 MW Clearway Projects	Remove 109.6 MW Clearway Projects	
2042				
2043				
2044	Remove 20 MW West Loch Solar	Remove 20 MW West Loch Solar	Remove 20 MW West Loch Solar	
2045	Install 182 MW 728 MWh Standalone BESS Install 1,310 MW 2,619 MWh Aggregated DER BESS Install 1,310 MW Aggregated DER Install 129 MW Recovered PV Potential Biodiesel Conversion on all firm units	Install 182 MW 728 MWh Standalone BESS Install 1,310 MW 2,619 MWh Aggregated DER BESS Install 1,310 MW Aggregated DER Install 129 MW Recovered PV Potential Biodiesel Conversion on all firm units	Install 182 MW 728 MWh Standalone BESS Install 1,310 MW 2,619 MWh Aggregated DER BESS Install 1,310 MW Aggregated DER Install 129 MW Recovered PV Potential Biodiesel Conversion on all firm units	
2046	Remove 269.5 MW Kahe 5-6	Remove 269.5 MW Kahe 5-6	Remove 269.5 MW Kahe 5-6	
2047				
2048				
2049				
2050	Install 127 MW 508 MWh Standalone BESS Install 947 MW 1,894 MWh Aggregated DER BESS Install 947 MW Aggregated DER	Install 127 MW 508 MWh Standalone BESS Install 947 MW 1,894 MWh Aggregated DER BESS Install 947 MW Aggregated DER	Install 127 MW 508 MWh Standalone BESS Install 947 MW 1,894 MWh Aggregated DER BESS Install 947 MW Aggregated DER	

3.2 Hawai‘i Island

Table 3-2: Hawai‘i Island Resource Plan

Hawai‘i Island Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2025	Return 58 MW Hamakua Energy On Standby 15.5 MW Puna Steam	Remove 0.75 MW Waiau Hydro Remove 1.25 MW Pana‘ewa D24 Install 0.75 MW CBRE Ka Lae Energy Install 30 MW 120 MWh Waikoloa Solar Install 30 MW 120 MWh Hale Kuawehi Solar Return 58 MW Hamakua Energy On Standby 15.5 MW Puna Steam	Remove 0.75 MW Waiau Hydro Remove 1.25 MW Pana‘ewa D24 Install 0.75 MW CBRE Ka Lae Energy Install 30 MW 120 MWh Waikoloa Solar Install 30 MW 120 MWh Hale Kuawehi Solar Return 58 MW Hamakua Energy On Standby 15.5 MW Puna Steam	Hamakua Energy expected to return to normal service by end of 2025 Puna Steam on standby
2026	Remove 3.17 MW Load Build Remove 4 MW Load Reduction Install 3.4 MW 13.7 MWh LMI Nā‘ālehu Solar Install 3.4 MW 13.7 MWh LMI Kalaoa Solar A Install 3.4 MW 13.7 MWh LMI Kalaoa Solar B	Remove 3.17 MW Load Build Remove 4 MW Load Reduction ~~Install 3.4 MW 13.7 MWh LMI Nā‘ālehu Solar~~ Install 3.4 MW 13.7 MWh LMI Kalaoa Solar A Install 3.4 MW 13.7 MWh LMI Kalaoa Solar B	Remove 3.17 MW Load Build Remove 4 MW Load Reduction Install 3.4 MW 13.7 MWh LMI Kalaoa Solar A Install 3.4 MW 13.7 MWh LMI Kalaoa Solar B	Added CBRE LMI awarded projects Removed Nā‘ālehu Solar due to withdrawal
2027	Remove 20.5 MW Tawhiri	Remove 20.5 MW Tawhiri	Remove 20.5 MW Tawhiri	
2028	Remove 33.8 MW Hill5-6 Remove 12.1 MW Wailuku Hydro PGV capacity increase to 46 MW Install 60 MW 240 MWh Puako Solar S3 RFP Install 55 MW 220 MWh Kaiwiki Solar S3 RFP	Remove 33.8 MW Hill5-6 Remove 12.1 MW Wailuku Hydro PGV capacity increase to 46 MW ~~Install 60 MW 240 MWh Puako Solar S3 RFP~~ ~~Install 55 MW 220 MWh Kaiwiki Solar S3 RFP~~	Remove 33.8 MW Hill5-6 Remove 12.1 MW Wailuku Hydro PGV capacity increase to 46 MW	Updated Wailuku Hydro's status from continuing operation thru the planning horizon to expiring on 5/2028[19] Removed Stage 3 awarded projects

[19] Wailuku Hydro PPA expiration date based on the third amendment to the power purchase contract filed on June 13, 2025.

Hawai'i Island Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2029	Install 12.5 MW 50 MWh CBRE PV Phase 2 T2 RFP Hybrid Solar IGP RFP: First Round - Install 134 GWh Renewable Energy (30 MW onshore wind)	~~Install 12.5 MW 50 MWh CBRE PV Phase 2 T2 RFP Hybrid Solar~~ ~~IGP RFP: First Round - Install 134 GWh Renewable Energy (30 MW onshore wind)~~		Updated First Round IGP RFP COD and revised the energy target for withdrawn Stage 3 PV+BESS projects[20] Removed CBRE Ph 2 RFP, to be replaced by successor program per PUC Inclinations
2030	Install 86 MW 344 MWh Keamuku Solar S3 RFP Biodiesel Conversion 60 MW Hamakua Firm Renewable Energy Install 7.5 MW 30 MWh Hamakua Firm Renewable Energy Battery IGP RFP: First Round - Install 60 MW Firm	Install 86 MW 344 MWh Keamuku Solar S3 RFP Biodiesel Conversion 60 MW Hamakua Firm Renewable Energy Install 7.5 MW 30 MWh Hamakua Firm Renewable Energy Battery IGP RFP: First Round - Install 435 GWh Renewable Energy (30 MW onshore wind) ~~IGP RFP: First Round - Install 60 MW Firm~~	Install 86 MW 344 MWh Keamuku Solar S3 RFP Biodiesel Conversion 60 MW Hamakua Firm Renewable Energy Install 7.5 MW 30 MWh Hamakua Firm Renewable Energy Battery IGP RFP: First Round - Install 435 GWh Renewable Energy (30 MW onshore wind + 115 MW Paired PV)	Updated First Round IGP RFP COD and revised the energy target for withdrawn Stage 3 PV+BESS projects[20]
2031	Remove 10.25 MW Kanoelehua CT1 Remove 13.8 MW Keāhole CT2	Remove 10.25 MW Kanoelehua CT1 Remove 13.8 MW Keāhole CT2	Remove 10.25 MW Kanoelehua CT1 Remove 13.8 MW Keāhole CT2	
2032	IGP RFP: Second Round to replace possible Stage 3 RFP withdrawals	IGP RFP: First Round - Install 30 MW Firm ~~IGP RFP: Second Round to replace possible Stage 3 RFP withdrawals~~	IGP RFP: First Round - Install 30 MW Firm	Revised First Round IGP RFP Firm target to 30 MW[21]
2033		IGP RFP: Second Round to replace possible Stage 3 RFP withdrawals	IGP RFP: Second Round to replace possible Stage 3 RFP withdrawals	Updated Second Round IGP RFP COD to 12/2033

[20] IGP RFP CODs were updated as noted in Docket No. 2024-0258 after the analysis for this report was already underway. Updated CODs are shown in the resource plan.

[21] The firm capacity target of 60 MW identified for the First Round IGP RFP, to be in service by December 1, 2031, has been updated to 30 MW by December 1, 2032 based on recent updates to outage data and additional planning considerations. Modeling for this analysis assumed 60 MW as the change to the firm target occurred after analysis was underway.

Hawaiʻi Island Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2034				
2035				
2036				
2037				
2038				
2039				
2040	Install 1 MW 4 MWh Standalone BESS Install 20 MW 80 MWh Hybrid Solar AggA Install 1 MW Wind New AggA	Install 1 MW 4 MWh Standalone BESS Install 20 MW 80 MWh Hybrid Solar AggA Install 1 MW Wind New AggA	Install 1 MW 4 MWh Standalone BESS Install 20 MW 80 MWh Hybrid Solar AggA Install 1 MW Wind New AggA	
2041				
2042				
2043				
2044				
2045	Install 2 MW 8 MWh Standalone BESS Biodiesel Conversion on all firm units	Install 2 MW 8 MWh Standalone BESS Biodiesel Conversion on all firm units	Install 2 MW 8 MWh Standalone BESS Biodiesel Conversion on all firm units	
2046				
2047				
2048				
2049				
2050	Install 15 MW 60 MWh Hybrid Solar AggA Install 2 MW Wind New AggA	Install 15 MW 60 MWh Hybrid Solar AggA Install 2 MW Wind New AggA	Install 15 MW 60 MWh Hybrid Solar AggA Install 2 MW Wind New AggA	

3.3 Maui

Table 3-3: Maui Resource Plan

Maui Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2025	Remove 2.42 MW Load Reduce Grid Service Remove 0.1 MW Load Build Grid Service Install 2.5 MW 10.9MWh LMI Makawao Solar + Battery Install 2.5 MW 10.9MWh LMI Pi'iholo Road Solar + Battery Resume in-service SMRR and Kuia Solar	Remove 2.42 MW Load Reduce Grid Service Remove 0.1 MW Load Build Grid Service ~~Install 2.5 MW 10.9MWh LMI Makawao Solar + Battery~~ ~~Install 2.5 MW 10.9MWh LMI Pi'iholo Road Solar + Battery~~ Resume in-service SMRR and Kuia Solar	Remove 2.42 MW Load Reduce Grid Service Remove 0.1 MW Load Build Grid Service Resume in-service SMRR and Kuia Solar	Makawao Solar withdrawn Updated Pi'iholo Road Solar COD
2026	Remove 4.73 MW Load Reduce Grid Service Remove 1.88 MW Load Build Grid Service Install 40 MW 160 MWH Waena BESS Remove 30 MW Kaheawa Wind Power 1 Install 30 MW Kaheawa Wind 1	Remove 4.73 MW Load Reduce Grid Service Remove 1.88 MW Load Build Grid Service Install 40 MW 160 MWH Waena BESS Remove 30 MW Kaheawa Wind Power 1 Install 30 MW Kaheawa Wind 1	Remove 4.73 MW Load Reduce Grid Service Remove 1.88 MW Load Build Grid Service Install 40 MW 160 MWH Waena BESS Remove 30 MW Kaheawa Wind Power 1 Install 30 MW Kaheawa Wind 1	
2027	Remove 49.36 MW Mā'alaea 10-13 Install 40 MW 160 MWh Kuihelani Phase 2 Solar Install 20 MW 80 MWh Pūlehu Solar & Storage Install 40 MW 'Ūkiu Energy ICE	Remove 11.3 MW Kahului 3 ~~Remove 49.36 MW Mā'alaea 10-13~~ Install 40 MW 160 MWh Kuihelani Phase 2 Solar Install 20 MW 80 MWh Pūlehu Solar & Storage Install 40 MW 'Ūkiu Energy ICE Install 2.5 MW 10.9MWh LMI Pi'iholo Road Solar + Battery	Remove 11.3 MW Kahului 3 Install 40 MW 160 MWh Kuihelani Phase 2 Solar Install 20 MW 80 MWh Pūlehu Solar & Storage Install 40 MW 'Ūkiu Energy ICE Install 2.5 MW 10.9MWh LMI Pi'iholo Road Solar + Battery	Updated Kahului 3 deactivation schedule from 12/2028 to 6/2027 Updated Mā'alaea 10-13 deactivation schedule Updated Pi'iholo Road Solar COD to 9/2027
2028	Remove 9.47 MW Kahului 1-2 Remove 23 MW Kahului 3-4	Remove 9.47 MW Kahului 1-2 ~~Remove 23 MW Kahului 3-4~~ Remove 11.5 MW Kahului 4 Remove 12.34 MW Mā'alaea 13	Remove 9.47 MW Kahului 1-2 Remove 11.5 MW Kahului 4 Remove 12.34 MW Mā'alaea 13	Updated Kahului 3 deactivation schedule Updated Mā'alaea 13 deactivation schedule from 1/2027 to 9/2028

Maui Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2029	Install 12.5 MW CBRE Phase 2 RFP Paired PV	Remove 12.34 MW Mā'alaea 12 ~~Install 12.5 MW CBRE Phase 2 RFP Paired PV~~	Remove 12.34 MW Mā'alaea 12	Updated Mā'alaea 12 deactivation schedule from 1/2027 to 10/2029 Removed CBRE Ph 2 RFP, to be replaced by successor program per PUC Inclinations
2030	Remove 33 MW Mā'alaea 4-9 Remove 7.5 MW Mā'alaea 1-3	Remove 33 MW Mā'alaea 4-9 Remove 7.5 MW Mā'alaea 1-3 Remove 12.34 MW Mā'alaea 11	Remove 33 MW Mā'alaea 4-9 Remove 7.5 MW Mā'alaea 1-3 Remove 12.34 MW Mā'alaea 11	Updated Mā'alaea 11 deactivation schedule from 1/2027 to 2/2030
2031		Remove 12.34 MW Mā'alaea 10	Remove 12.34 MW Mā'alaea 10	Updated Mā'alaea 10 deactivation schedule from 1/2027 to 4/2031
2032	IGP RFP Second Round - 176 GWh Energy Target (40 MW Onshore Wind) IGP RFP: Second Round - Replace prior RFP withdrawals	~~IGP RFP Second Round - 176 GWh Energy Target (40 MW Onshore Wind)~~ ~~IGP RFP: Second Round - Replace prior RFP withdrawals~~		
2033	Remove 21 MW Kaheawa Wind Power 2 Remove 21 MW Auwahi Wind	Remove 21 MW Kaheawa Wind Power 2 Remove 21 MW Auwahi Wind IGP RFP Second Round – ~~176~~ 230 GWh Energy Target (40 MW Onshore Wind, 25 MW Hybrid Solar) IGP RFP: Second Round - Replace prior RFP withdrawals	Remove 21 MW Kaheawa Wind Power 2 Remove 21 MW Auwahi Wind IGP RFP Second Round - 230 GWh Energy Target (40 MW Onshore Wind, 25 MW Hybrid Solar) IGP RFP: Second Round - Replace prior RFP withdrawals	Updated Second Round IGP RFP Energy Target for Puu Hao withdrawal and moved COD to 12/2033
2034				
2035				
2036	LT RFP: 391 GWh Energy Target (192 MW Hybrid Solar)	LT RFP: 391 GWh Energy Target (192 MW Hybrid Solar)	LT RFP: 391 GWh Energy Target (192 MW Hybrid Solar)	
2037				
2038				
2039				
2040	Remove 5.74 MW SMRR PV Install 18 MW Onshore Wind (AggC) Install 43 MW 172 MWh Hybrid Solar Battery (AggC)	Remove 5.74 MW SMRR PV Install 18 MW Onshore Wind (AggC) Install 43 MW 172 MWh Hybrid Solar Battery (AggC)	Remove 5.74 MW SMRR PV Install 18 MW Onshore Wind (AggC) Install 43 MW 172 MWh Hybrid Solar Battery (AggC)	

Maui Resource Plan				
Year	**2024 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2041				
2042				
2043				
2044				
2045	Install 8 MW 32 MWh Hybrid Solar Battery (AggB) Install 66 MW 264 MWh Hybrid Solar Battery (AggC) Install 41 MW Onshore Wind (AggC) Biodiesel Conversion on all firm units	Install 8 MW 32 MWh Hybrid Solar Battery (AggB) Install 66 MW 264 MWh Hybrid Solar Battery (AggC) Install 41 MW Onshore Wind (AggC) Biodiesel Conversion on all firm units	Install 8 MW 32 MWh Hybrid Solar Battery (AggB) Install 66 MW 264 MWh Hybrid Solar Battery (AggC) Install 41 MW Onshore Wind (AggC) Biodiesel Conversion on all firm units	
2046				
2047				
2048				
2049				
2050	Install 57 MW 228 MWh Hybrid Solar Battery (AggB) Install 57 MW 228 MWh Hybrid Solar Battery (AggC)	Install 57 MW 228 MWh Hybrid Solar Battery (AggB) Install 57 MW 228 MWh Hybrid Solar Battery (AggC)	Install 57 MW 228 MWh Hybrid Solar Battery (AggB) Install 57 MW 228 MWh Hybrid Solar Battery (AggC)	

3.4 Moloka‘i

Table 3-4: Moloka‘i Resource Plan

Moloka‘i Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2025		Install 0.25 MW 1 MWh Kualapu‘u Community Based Renewable Energy (CBRE Phase 2) Install 2.2 MW 10.1 MWh Pala‘au Community Based Renewable Energy (CBRE Phase 2)	Install 0.25 MW 1 MWh Kualapu‘u Community Based Renewable Energy (CBRE Phase 2) Install 2.2 MW 10.1 MWh Pala‘au Community Based Renewable Energy (CBRE Phase 2)	Replaced CBRE Phase 2 Placeholder with actual projects
2026				

Moloka'i Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2027	Install 2.75 MW 11 MWh Hybrid Solar Storage Install 2.75 MW Hybrid Solar (CBRE Phase 2)	~~Install 2.75 MW 11 MWh Hybrid Solar Storage~~ ~~Install 2.75 MW Hybrid Solar (CBRE Phase 2)~~		Replaced CBRE Phase 2 Placeholder with actual projects
2028				
2029	Installed 0.4 MW 1.6 MWh Standalone BESS Installed 3 MW 12 MWh Hybrid Solar Storage Installed 3 MW Hybrid Solar	Installed 0.4 MW 1.6 MWh Standalone BESS Installed 3 MW 12 MWh Hybrid Solar Storage Installed 3 MW Hybrid Solar	Installed 0.4 MW 1.6 MWh Standalone BESS Installed 3 MW 12 MWh Hybrid Solar Storage Installed 3 MW Hybrid Solar	
2030	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 8.5 MW 34.0 MWh Hybrid Solar Storage Installed 8.5 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 8.5 MW 34.0 MWh Hybrid Solar Storage Installed 8.5 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 8.5 MW 34.0 MWh Hybrid Solar Storage Installed 8.5 MW Hybrid Solar	
2031				
2032				
2033				
2034				
2035	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.3 MW 9.2 MWh Hybrid Solar Storage Installed 2.3 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.3 MW 9.2 MWh Hybrid Solar Storage Installed 2.3 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.3 MW 9.2 MWh Hybrid Solar Storage Installed 2.3 MW Hybrid Solar	
2036				
2037				
2038				
2039				
2040	Installed 1.1 MW 4.4 MWh Hybrid Solar Storage Installed 1.1 MW Hybrid Solar	Installed 1.1 MW 4.4 MWh Hybrid Solar Storage Installed 1.1 MW Hybrid Solar	Installed 1.1 MW 4.4 MWh Hybrid Solar Storage Installed 1.1 MW Hybrid Solar	
2041				
2042				

Moloka‘i Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2043				
2044				
2045	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.6 MW 10.4 MWh Hybrid Solar Storage Installed 2.6 MW Hybrid Solar Biodiesel Conversion on all firm units	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.6 MW 10.4 MWh Hybrid Solar Storage Installed 2.6 MW Hybrid Solar Biodiesel Conversion on all firm units	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 2.6 MW 10.4 MWh Hybrid Solar Storage Installed 2.6 MW Hybrid Solar Biodiesel Conversion on all firm units	
2046				
2047				
2048				
2049				
2050	Installed 1.2 MW 4.8 MWh Hybrid Solar Storage Installed 1.2 MW Hybrid Solar	Installed 1.2 MW 4.8 MWh Hybrid Solar Storage Installed 1.2 MW Hybrid Solar	Installed 1.2 MW 4.8 MWh Hybrid Solar Storage Installed 1.2 MW Hybrid Solar	

3.5 Lāna‘i

Table 3-5: Lāna‘i Resource Plan

Lāna‘i Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2025				
2026				
2027	Install 15.8 MW 63.2 MWh Hybrid Solar Storage Install 15.8 MW 63.2 MWh Hybrid Solar (CBRE RFP)	~~Install 15.8 MW 63.2 MWh Hybrid Solar Storage~~ ~~Install 15.8 MW 63.2 MWh Hybrid Solar~~ ~~(CBRE RFP)~~		Removed CBRE Phase 2 placeholder due to withdrawal of Lāna‘i Solar
2028				

Lāna‘i Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2029	Installed 0.6 MW 2.4 MWh Standalone BESS Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	Installed 0.6 MW 2.4 MWh Standalone BESS Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	Installed 0.6 MW 2.4 MWh Standalone BESS Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	
2030	Installed 4.9 MW 19.6 MWh Hybrid Solar Storage Installed 4.9 MW Hybrid Solar	Installed 4.9 MW 19.6 MWh Hybrid Solar Storage Installed 4.9 MW Hybrid Solar	Installed 4.9 MW 19.6 MWh Hybrid Solar Storage Installed 4.9 MW Hybrid Solar	
2031				
2032				
2033				
2034				
2035	Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	Installed 0.3 MW 1.2 MWh Hybrid Solar Storage Installed 0.3 MW Hybrid Solar	
2036				
2037				
2038				
2039				
2040	Installed 1 MW 4 MWh Hybrid Solar Storage Installed 1 MW Hybrid Solar	Installed 1 MW 4 MWh Hybrid Solar Storage Installed 1 MW Hybrid Solar	Installed 1 MW 4 MWh Hybrid Solar Storage Installed 1 MW Hybrid Solar	
2041				
2042				
2043				
2044				
2045	Installed 0.2 MW 0.8 MWh Standalone BESS Installed 1.5 MW 6.0 MWh Hybrid Solar Storage Installed 1.5 MW Hybrid Solar Biodiesel Conversion on all firm units	Installed 0.2 MW 0.8 MWh Standalone BESS Installed 1.5 MW 6.0 MWh Hybrid Solar Storage Installed 1.5 MW Hybrid Solar Biodiesel Conversion on all firm units	Installed 0.2 MW 0.8 MWh Standalone BESS Installed 1.5 MW 6.0 MWh Hybrid Solar Storage Installed 1.5 MW Hybrid Solar Biodiesel Conversion on all firm units	
2046				
2047				

Lānaʻi Resource Plan				
Year	**2023 IGP Plan**	**2025 IGP Plan - Redline**	**2025 IGP Plan**	**Description of Changes**
2048				
2049				
2050	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 0.9 MW 3.6 MWh Hybrid Solar Storage Installed 0.9 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 0.9 MW 3.6 MWh Hybrid Solar Storage Installed 0.9 MW Hybrid Solar	Installed 0.1 MW 0.4 MWh Standalone BESS Installed 0.9 MW 3.6 MWh Hybrid Solar Storage Installed 0.9 MW Hybrid Solar	

4 Appendices

4.1 Executive Order and Inclinations Analysis Forecasts and Data Tables

The analyses presented in Section 2 use Hawaiian Electric's 2023 fuel price forecast that is based on the Brent forecast provided by the Energy Information Administration ("EIA") Annual Energy Outlook ("AEO"). This is an update to the fuel price forecast approved by the Commission that was based on the 2021 EIA AEO.

Table 4-1: 2023 EIA AEO Fuel Price Forecast

$ Per	Hawaiian Electric					Hawai'i Electric Light					Maui Electric				Molokai	Lanai
MMBTU	LSFO	Diesel	ULSD	ULSD	Biodiesel	IFO	Diesel	ULSD	Naphtha	Biodiesel	IFO	Diesel	ULSD	Biodiesel	ULSD	ULSD
2030	$20.41	$24.04	$24.80	$25.80	$37.86	$17.33	$25.68	$26.56	$26.69	$37.86	$16.78	$25.46	$26.09	$37.86	$27.04	$31.37
2031	$21.00	$24.72	$25.51	$26.52	$38.82	$17.84	$26.41	$27.31	$27.43	$38.82	$17.27	$26.19	$26.83	$38.82	$27.80	$32.23
2032	$21.68	$25.48	$26.29	$27.33	$39.85	$18.41	$27.22	$28.15	$28.26	$39.85	$17.83	$27.01	$27.67	$39.85	$28.66	$33.19
2033	$22.30	$26.19	$27.03	$28.09	$40.88	$18.95	$27.99	$28.95	$29.04	$40.88	$18.34	$27.77	$28.46	$40.88	$29.47	$34.10
2034	$23.01	$26.99	$27.85	$28.94	$41.98	$19.54	$28.85	$29.83	$29.91	$41.98	$18.93	$28.63	$29.33	$41.98	$30.37	$35.11
2035	$23.76	$27.84	$28.72	$29.84	$43.13	$20.19	$29.76	$30.77	$30.83	$43.13	$19.55	$29.55	$30.27	$43.13	$31.32	$36.18
2036	$24.47	$28.64	$29.54	$30.69	$44.24	$20.78	$30.61	$31.65	$31.69	$44.24	$20.13	$30.40	$31.15	$44.24	$32.22	$37.18
2037	$25.19	$29.45	$30.38	$31.55	$45.35	$21.39	$31.49	$32.55	$32.58	$45.35	$20.73	$31.28	$32.04	$45.35	$33.14	$38.21
2038	$25.89	$30.25	$31.20	$32.40	$46.46	$21.99	$32.34	$33.43	$33.44	$46.46	$21.31	$32.13	$32.92	$46.46	$34.03	$39.22
2039	$26.60	$31.06	$32.04	$33.26	$47.59	$22.60	$33.21	$34.33	$34.33	$47.59	$21.90	$33.01	$33.81	$47.59	$34.95	$40.25
2040	$27.35	$31.91	$32.91	$34.16	$48.77	$23.23	$34.11	$35.26	$35.25	$48.77	$22.52	$33.91	$34.74	$48.77	$35.90	$41.31
2041	$28.12	$32.78	$33.81	$35.08	$49.98	$23.89	$35.05	$36.23	$36.20	$49.98	$23.15	$34.85	$35.70	$49.98	$36.88	$42.42
2042	$28.88	$33.65	$34.71	$36.01	$51.20	$24.54	$35.99	$37.19	$37.15	$51.20	$23.79	$35.78	$36.66	$51.20	$37.86	$43.52
2043	$29.66	$34.54	$35.62	$36.95	$52.46	$25.20	$36.94	$38.17	$38.11	$52.46	$24.43	$36.73	$37.63	$52.46	$38.86	$44.65
2044	$30.50	$35.49	$36.59	$37.96	$53.78	$25.91	$37.95	$39.22	$39.14	$53.78	$25.12	$37.75	$38.67	$53.78	$39.93	$45.85
2045	$31.32	$36.42	$37.56	$38.96	$55.12	$26.61	$38.96	$40.26	$40.17	$55.12	$25.80	$38.76	$39.70	$55.12	$40.99	$47.04
2046	$32.31	$37.54	$38.71	$40.14	$56.61	$27.45	$40.15	$41.49	$41.38	$56.61	$26.62	$39.96	$40.93	$56.61	$42.24	$48.44
2047	$33.22	$38.57	$39.77	$41.24	$58.05	$28.22	$41.26	$42.63	$42.50	$58.05	$27.37	$41.06	$42.06	$58.05	$43.40	$49.74
2048	$34.21	$39.70	$40.93	$42.43	$59.59	$29.07	$42.47	$43.88	$43.72	$59.59	$28.20	$42.27	$43.30	$59.59	$44.67	$51.16
2049	$35.27	$40.89	$42.16	$43.69	$61.20	$29.97	$43.74	$45.20	$45.01	$61.20	$29.07	$43.56	$44.62	$61.20	$46.01	$52.66
2050	$36.22	$41.97	$43.27	$44.85	$62.75	$30.77	$44.91	$46.40	$46.20	$62.75	$29.86	$44.72	$45.81	$62.75	$47.23	$54.04

The High Resource Cost Sensitivity presented in Section 4.2.3 uses the 2024 National Renewable Energy Laboratory ("NREL") Annual Technology Baseline ("ATB"). This is an update to the resource cost forecast approved by the Commission that was based on the 2021 NREL ATB for most technologies and U.S. Department of Energy studies for distributed wind on Lānaʻi and Molokaʻi.

Table 4-2: High Resource Capital Cost based on Conservative Forecast from NREL ATB, $/kW

Technology	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Paired Grid-Scale PV (Single axis tracking)	2,133.8	2,116.2	2,096.6	2,074.9	2,051.0	2,024.9	2,032.8	2,040.0	2,046.3	2,051.9	2,056.6
Grid-Scale PV (Single axis tracking)	2,312.4	2,293.2	2,271.9	2,248.4	2,222.6	2,194.3	2,202.9	2,210.6	2,217.5	2,223.5	2,228.7
Wind On-Shore	2,009.6	2,040.9	2,072.6	2,104.7	2,137.2	2,170.0	2,203.2	2,236.8	2,270.7	2,305.0	2,339.7
Distributed Wind	6,386.7	6,394.0	6,398.1	6,399.0	6,396.4	6,390.2	6,380.2	6,366.4	6,348.4	6,326.1	6,299.3
Combined Cycle 1x1	2,445.6	2,484.7	2,524.3	2,566.3	2,606.9	2,648.0	2,689.7	2,731.8	2,774.5	2,817.6	2,863.5
Combined Cycle 2x1	2,055.5	2,088.6	2,122.2	2,156.1	2,190.5	2,225.2	2,260.4	2,296.2	2,332.3	2,368.8	2,405.8
Combustion Turbine	1,813.0	1,839.5	1,866.3	1,893.3	1,920.6	1,948.1	1,975.8	2,004.0	2,032.2	2,060.7	2,089.4
Internal Combustion Engine	3,152.3	3,198.4	3,244.9	3,291.9	3,339.3	3,387.1	3,435.4	3,484.4	3,533.4	3,582.9	3,632.7
Standalone Storage 4-Hour	2,558.6	2,600.2	2,642.4	2,685.1	2,728.4	2,772.3	2,816.7	2,861.7	2,907.3	2,953.5	3,000.2
Paired Grid-Scale PV (Single axis tracking) paired with 4-Hour Storage	4,494.9	4,515.6	4,534.9	4,552.7	4,568.8	4,583.2	4,632.1	4,680.8	4,729.2	4,777.3	4,825.2
Paired Residential PV paired with 2-Hour Storage	9,111.4	9,276.5	9,443.9	9,613.7	9,785.9	9,960.5	10,077.8	10,194.8	10,311.3	10,427.4	10,542.9

Technology	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Paired Grid-Scale PV (Single axis tracking)	2,060.4	2,063.3	2,065.2	2,066.1	2,065.9	2,064.5	2,062.0	2,058.3	2,053.2	2,046.8
Grid-Scale PV (Single axis tracking)	2,232.8	2,235.9	2,238.0	2,238.9	2,238.7	2,237.2	2,234.5	2,230.4	2,225.0	2,218.0
Wind On-Shore	2,374.7	2,410.1	2,445.9	2,482.0	2,518.5	2,555.3	2,592.5	2,630.0	2,667.9	2,706.1
Distributed Wind	6,267.9	6,231.6	6,190.1	6,143.4	6,091.1	6,033.1	5,969.0	5,898.7	5,821.9	5,738.2
Combined Cycle 1x1	2,907.7	2,952.4	2,997.6	3,043.4	3,089.6	3,136.3	3,183.6	3,234.0	3,282.3	3,331.1
Combined Cycle 2x1	2,443.4	2,481.2	2,519.4	2,558.1	2,597.2	2,637.1	2,677.1	2,717.5	2,758.3	2,799.9
Combustion Turbine	2,118.2	2,147.3	2,176.6	2,206.1	2,236.1	2,266.0	2,296.1	2,326.3	2,356.7	2,387.3
Internal Combustion Engine	3,682.9	3,733.5	3,784.5	3,835.8	3,887.9	3,939.8	3,992.1	4,044.7	4,097.6	4,150.7

Technology	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Standalone Storage 4-Hour	3,047.4	3,095.3	3,143.7	3,192.8	3,242.4	3,292.5	3,343.3	3,394.6	3,446.5	3,499.0
Paired Grid-Scale PV (Single axis tracking) paired with 4-Hour Storage	4,872.6	4,919.7	4,966.3	5,012.4	5,057.9	5,102.9	5,147.2	5,190.8	5,233.6	5,275.7
Paired Residential PV paired with 2-Hour Storage	10,657.8	10,771.8	10,885.1	10,997.3	11,108.5	11,218.6	11,327.3	11,434.6	11,540.4	11,644.6

4.2 Technical Analysis of Section 2

This section provides the supporting technical analyses for new resource additions on O'ahu, Hawai'i Island, Maui, Moloka'i and Lāna'i that are needed to meet the 2030 and 2035 RPS and GHG goals proposed by the Governor's EO and PUC Inclinations. The resource additions were analyzed in scenarios where only non-biogenic emissions were included, non-biogenic and biogenic emissions were included, and under high resource costs.

4.2.1 Impacts of Governor Green's and PUC's Guidance on Near Term Resource Plans

Starting with the 2024 IGP Plan[22] and planning assumptions developed in the first IGP cycle, the RESOLVE model was refreshed with the current scope and timing of planned projects and RFPs. The models were then updated with the Governor's and Commission's RPS and GHG goals in 2030 and 2035 shown in Section 2, Table 2-1.

The portfolio developed by RESOLVE was then analyzed in PLEXOS, consistent with the same process flow established in the IGP process. PLEXOS was used to perform a more detailed analysis of the commitment and dispatch of generating units at an hourly level and to confirm that the economic dispatch of the portfolio would continue to meet the 2030 and 2035 RPS and GHG goals. A sensitivity analysis was performed if the portfolio did not meet the RPS or GHG goals in 2030 and 2035 where additional non-emitting DER or PV+BESS resources were added until the goals were achieved. Conversely, if the portfolio exceeded the RPS and GHG goals in 2030 and 2035, future resources selected by RESOLVE or other planned resources were removed to examine how sensitive an island's RPS or GHG emissions profile was to the addition of new resources and to better define the minimum amount of new resources that were needed to meet the goals. Once the RPS and GHG goals were met, the portfolios were checked against the Governor's and Inclination goals for new DER additions.

The analyses contained in this section are intended to be an initial, exploratory look at the pathways to achieve these interim RPS, GHG, and DER goals and assess how different these pathways are compared to the established IGP preferred plans. To the extent that the resource plans developed in this new analysis suggest a significant departure from the prior IGP preferred plans, the Companies propose that these interim RPS, GHG, and DER goals and resulting resource plans be re-assessed holistically with stakeholders as part of the second cycle of IGP.

4.2.1.1 O'ahu

The accelerated timeline of the RPS and GHG targets is expected to result in increased resource needs over the next 10 years. Limits on the expected types and quantities of resources available to the O'ahu system due to Federal executive orders (offshore wind) and land use concerns due to competing end uses (onshore

[22] The 2024 IGP Plan was provided in the 2024 IGP Action Plan Annual Update at https://hawaiipowered.com/igpreport.

large-scale renewables under the land-constrained scenario) in the future means we may need to pursue the remaining resource options available to us, namely biofuel and DER.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets increases resource needs through 2035, above what is being sought in the IGP RFPs (Table 4-3). Though initial results show that RESOLVE selects firm biofuel generators, they also suggest that the operating characteristics and costs of the generic biofuel generator may be more optimistic and not representative of recently procured firm Stage 3 projects and current market conditions (Table 4-4). When future firm biofuel generators are excluded from selection, RESOLVE selects aggregated DER (Table 4-5).
- **Model Comparison:** RESOLVE increases biofuel usage to meet RPS and GHG targets. PLEXOS isn't forced to meet those targets and instead economically dispatches the RESOLVE portfolio. As a result, PLEXOS did not meet the RPS and GHG targets and the portfolio needs more resources (Table 4-6). Given this result and acknowledging the increased emphasis on DER in both the Governor's EO and PUC Inclinations, additional aggregated DER was added to the portfolio to meet the RPS and GHG targets.
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan initially developed by RESOLVE did not meet the RPS and GHG targets when analyzed in PLEXOS. As a result, future aggregated DER was incrementally added to determine the minimum amount needed by 2030 and 2035 for O'ahu to meet the RPS and GHG goals.
    - **2030:** Approximately 550 MW of aggregated DER, in total, are needed by 2030 to meet RPS and GHG targets (Figure 4-1, Table 4-8). This exceeds the 400 MW of DER noted in the PUC Inclinations. Assuming a representative 5 kW DER system, 550 MW of aggregated DER is equivalent to 110,000 new DER systems which would also exceed the 50,000 systems noted in the Governor's EO.
    - **2035:** Approximately 1,800 MW of aggregated DER, in total, are needed by 2035 to meet RPS and GHG targets (Figure 4-2, Table 4-8). Additional variable renewable resources can further reduce biofuel consumption (Table 4-7).
- **Biofuel Usage:** Without biogenic emissions, RPS and GHG goals can be met with economic dispatch and large amounts of DER or increased biofuel usage and less DER (Table 4-7). The cost of building additional DER beyond the DER targets provided in the Governor's EO and PUC Inclinations may outweigh the cost of burning more biofuels. A more detailed examination of the tradeoffs to meet these goals will be done in the upcoming IGP cycle.

Key Assumptions

Key assumptions in this analysis to meet the 2030 and 2035 RPS and GHG goals are summarized below.

1. **RPS Targets:** O'ahu RPS must reach 60% by 2030.

2. **GHG Targets:** O'ahu must reduce GHG emissions (compared to 2005) by 50% by 2030, and 70% by 2035.

3. **Fuel Price:** Fuel price forecast was updated to the 2023 Energy Information Administration ("EIA") Annual Energy Outlook ("AEO").

4. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels are not considered in the GHG emission accounting.

5. **Stage 3 Planned Resources:** The Makana Lā Solar and Par Hawai'i projects have withdrawn from the Stage 3 RFP.

6. **IGP RFP First Round Targets:** The expected energies from the withdrawn Stage 3 RFP projects have been added to the IGP RFP First Round targets.

7. **IGP RFP GCODs:** Assumed GCODs for IGP RFP First Round RFPs are 12/1/2029 and 12/1/2032 for variable resources and firm resources respectively. Assumed GCOD for the IGP RFP Second Round RFP is 12/1/2032.[23]

8. **Recovered Onshore Wind:** Contracts for existing onshore wind resources are not expected to be renewed due to changes in land use regulations for wind turbine setbacks and community feedback.[24]

9. **Offshore Wind:** Development of offshore wind resources has been put on indefinite hold by Federal executive order.[25]

10. **Renewable Firm:** After the IGP RFP, renewable firm is not expected to be built until 2035 at the earliest due to the long development timelines for firm projects. No future renewable firm is selected after the Stage 3 projects in "woFtrFm" scenarios.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenario

- **Oa_LC_woBiogenic**
    - Updated resource assumptions.

[23] After the analysis was underway, the IGP RFP GCODs were updated as noted in Docket No. 2024-0258. The First Round GCOD for variable resources was updated from December 1, 2029 to November 1, 2030. The First Round GCOD for firm resources and Second Round GCOD were updated from December 1, 2032 to December 1, 2033.

[24] *See* https://www.civilbeat.org/2024/12/wind-turbines-down-threatening-renewable-energy-goals/

[25] *See* https://www.whitehouse.gov/presidential-actions/2025/01/temporary-withdrawal-of-all-areas-on-the-outer-continental-shelf-from-offshore-wind-leasing-and-review-of-the-federal-governments-leasing-and-permitting-practices-for-wind-projects/

    - Updated RPS and GHG targets.
    - Biogenic emissions don't count towards GHG targets or GHG reduction.
- **Oa_LC_woBiogenic_woFtrFm**
    - Oa_LC_woBiogenic scenario used as basis for this scenario (Table 4-3).
    - Future firm biofuel ineligible for selection by RESOLVE.

Results

Shown below are the resource capacities for the "Oa_LC_woBiogenic" scenario in 2030 and 2035, grouped by resource type and procurement (Table 4-3). This scenario is restricted to choosing between biofuel generators, aggregated DER, and standalone BESS for future resources due to the assumed land-constrained nature of the O'ahu system. RESOLVE builds 48 MW of standalone BESS in 2030 and 294 MW of firm biofuel in 2035.

Table 4-3: O'ahu RESOLVE results summary, year 2030 and 2035.

Oa_LC_woBiogenic	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Biofuel Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm Biofuel	0 MW	81 MW
Future Aggregated DER	0 MW	0 MW
Future Firm Biofuel	0 MW	294 MW
Total	**2,693 MW**	**2,804 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	48 MW / 193 MWh	48 MW / 193 MWh
Future Aggregated DBESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**891 MW / 3,696 MWh**	**891 MW / 3,696 MWh**
NPV (MM 2018$, 2030-2050)	**22,486**	

The 294 MW of future firm biofuel selected by RESOLVE in 2035 is a large amount of firm resources considering the recently awarded Stage 3 biofuel projects are planned to be in operation before 2035. Diving deeper into these results, Table 4-4 compares the capacity factor of the future firm biofuel with the Stage 3 biofuel projects.

Table 4-4: O'ahu RESOLVE biofuel capacity factor comparison, year 2035.

Oa_LC_woBiogenic	Future Firm Biofuel	Stage 3 RFP Firm Projects
Generator Type	2x1 Combined Cycle	2x1 Combined Cycle, CT, ICE
Capacity Factor (%)	73%	0% - 30%

The large difference in capacity factors shows that RESOLVE prefers to build and run less expensive generic combined cycle biofuel generators instead of dispatching the planned Stage 3 biofuel projects it will already have on the grid. The generic combined cycle firm units selected by RESOLVE run at a higher capacity factor due to their lower operating cost compared to the Stage 3 projects. This suggests that the operating characteristics and costs of generic biofuel generators assumed by RESOLVE may not fully reflect all of the costs of a new firm generator in Hawai'i. It may also not be a realistic scenario to assume new future biofuel generation that displaces more certain planned biofuel projects that were already selected through a competitive procurement process. Because the model already has available biofuel capacity it can dispatch and utilize to meet the RPS and GHG goals, subsequent analysis assumed that future biofuel generation was not allowed to be selected.

Shown below are the resource capacities for the "Oa_LC_woBiogenic_woFtrFm" scenario in 2030 and 2035, grouped by resource type and procurement (Table 4-5). In addition to the land-constrained assumption, this scenario removes future biofuel generators from consideration. Instead of 294 MW of future firm biofuel, RESOLVE builds 437 MW of aggregated DER in 2035.

Table 4-5: O'ahu RESOLVE results summary, year 2030 and 2035, without future firm.

Oa_LC_woBiogenic_woFtrFm	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Biofuel Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm Biofuel	0 MW	81 MW
Future Aggregated DER	0 MW	437 MW
Future Firm Biofuel	0 MW	0 MW
Total	**2,693 MW**	**2,947 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	85 MW / 340 MWh	126 MW / 504 MWh
Future Aggregated DBESS	0 MW / 0 MWh	437 MW / 873 MWh
Total	**928 MW / 3,843 MWh**	**1,406 MW / 4,880 MWh**
NPV (MM 2018$, 2030-2050)	**22,754**	

Preventing RESOLVE from building future firm generators increases the NPV (2030-2050, 2018$) by approximately 1% from $22,486MM to $22,754MM (Table 4-3, Table 4-5). Since costs associated with the generic firm resources may not be representative of real-world costs as demonstrated by the Stage 3 firm projects, the "without future firm" scenario represents a more realistic plan.

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **Oa_30LC_woBiogenic_woFtrFm**
    - Oa_LC_woBiogenic_woFtrFm scenario used as basis for this scenario, year 2030 (Table 4-5).
- **Oa_35LC_woBiogenic_woFtrFm**
    - Oa_LC_woBiogenic_woFtrFm scenario used as basis for this scenario, year 2035 (Table 4-5).

Results

Table 4-6 below shows how the RESOLVE and PLEXOS models use biofuels differently and how that affects the RPS and GHG levels.

Table 4-6: O'ahu RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Oa_LC_woBiogenic_woFtrFm (RESOLVE)	8.7%	**-50%**	**60%**	---
Oa_30LC_woBiogenic_woFtrFm (PLEXOS)	0.2%	**-41%**	**49%**	---
2035				
Oa_LC_woBiogenic_woFtrFm (RESOLVE)	25.0%	**-70%**	**81%**	437 MW, DER
Oa_35LC_woBiogenic_woFtrFm (PLEXOS)	15.8%	**-60%**	**68%**	437 MW, DER

RESOLVE utilizes a higher share of biofuel generation to meet RPS and GHG targets. The 2030 PLEXOS results show that when PLEXOS isn't forced to meet those targets, it falls short of both the 2030 RPS and GHG goals and additional resources will be needed. The 2035 PLEXOS results show the GHG reduction target will still not be met because fossil fuels are lower cost than biofuel. Given this observation and the increased emphasis on DER in both the Governor's EO and PUC Inclinations, aggregated DER was added to the portfolio in the following sensitivity analysis to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Given the differences between the RESOLVE and PLEXOS models and the increased emphasis on DER in both the Governor's EO and PUC Inclinations, these scenarios add aggregated DER using the RESOLVE cases with no future firm generation added.

2030 Scenarios

- **Oa_30LC_woBiogenic_woFtrFm**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2030, used as the basis for this sensitivity analysis (Table 4-5).
- **Oa_30LC_woBiogenic_woFtrFm_w400Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-5).
  - Add 400 MW aggregated DER.
- **Oa_30LC_woBiogenic_woFtrFm_w450Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-5).
  - Add 450 MW of aggregated DER.
- **Oa_30LC_woBiogenic_woFtrFm_w500Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-5).
  - Add 500 MW of aggregated DER.
- **Oa_30LC_woBiogenic_woFtrFm_w550Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-5).
  - Add 550 MW of aggregated DER.

2035 Scenarios

- **Oa_35LC_woBiogenic_woFtrFm**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2035, used as the basis for this sensitivity analysis Table 4-5).
- **Oa_35LC_woBiogenic_woFtrFm_w1700Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2035 (Table 4-5).
  - Add 1,700 MW aggregated DER.
- **Oa_35LC_woBiogenic_woFtrFm_w1800Agg**
  - RESOLVE-added resources for "woFtrFm" scenario, year 2035 (Table 4-5).
  - Add 1,800 MW aggregated DER.

- **Oa_35LC_woBiogenic_woFtrFm_w1900Agg**
    - RESOLVE-added resources for "woFtrFm" scenario, year 2035 (Table 4-5).
    - Add 1,900 MW aggregated DER.

Results

Figure 4-1 below shows the RPS and GHG in 2030 based on the results from several different simulations in both RESOLVE and PLEXOS. In RESOLVE, the model must meet the RPS and GHG targets through a combination of least-cost dispatch and build out of new generating resources. RESOLVE also considers only a set of representative days as it solves for these requirements. As a result, the portfolio created by RESOLVE meets the RPS and GHG targets when modeled in RESOLVE. This result is represented by the green triangle in Figure 4-1.

In PLEXOS, no requirements for RPS and GHG targets are enforced and the model is dispatching the RESOLVE portfolio to minimize cost. PLEXOS also models the full 8,760 hours in the year. When the resource portfolio from RESOLVE is modeled in PLEXOS, the RPS and GHG targets aren't met. This result is represented by the blue triangle in Figure 4-1 and serves as the starting point for the sensitivity analyses. Due to these model differences between RESOLVE and PLEXOS, additional resources may need to be added to the RESOLVE resource plan to achieve the RPS and GHG targets.

Approximately 550 MW of aggregated DER is needed by 2030 to meet both targets. For this scenario, the RPS target is a more binding constraint than the GHG target in 2030 as the 50% GHG reduction target is achieved first and additional resources are needed to meet the 60% RPS target (Figure 4-1).

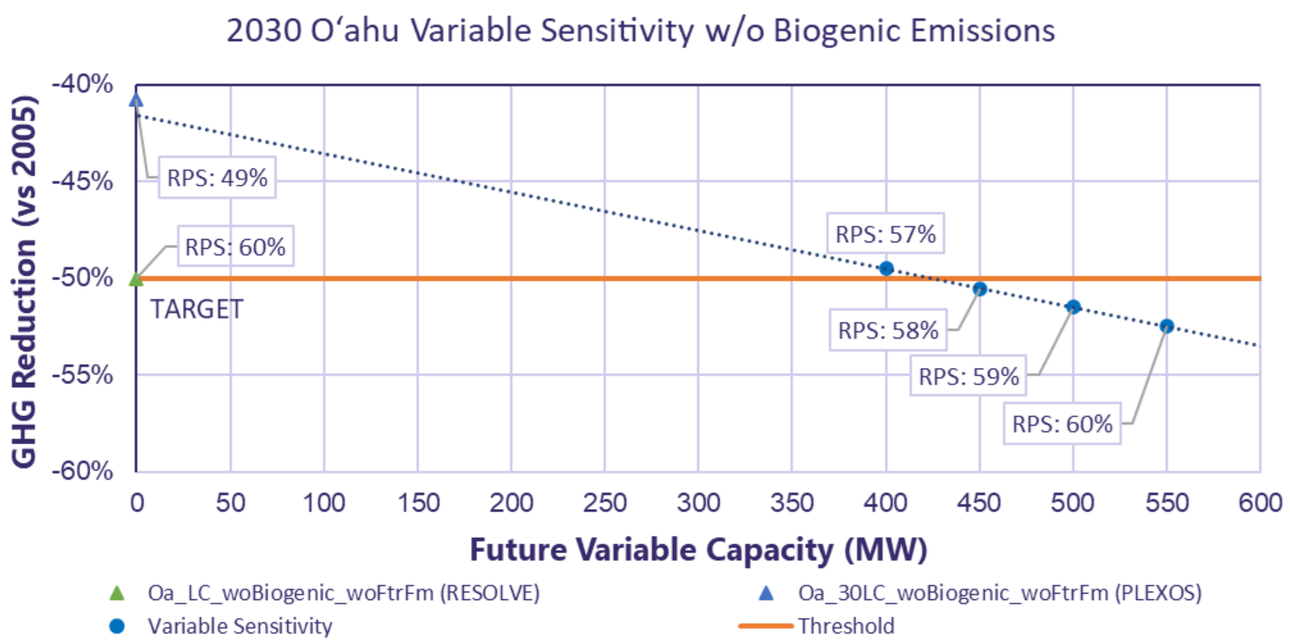

Figure 4-1: O'ahu RPS and GHG (w/o biogenic emissions) in 2030 with incremental addition of aggregated DER capacity.

Similarly, a total of approximately 1,800 MW of aggregated DER is needed by 2035 to meet the 70% GHG reduction target (Figure 4-2). In 2035, the GHG target is a more binding constraint than the RPS target as the

60% RPS target was met earlier in 2030 and additional resources are needed to meet the 70% GHG reduction target (Figure 4-2).

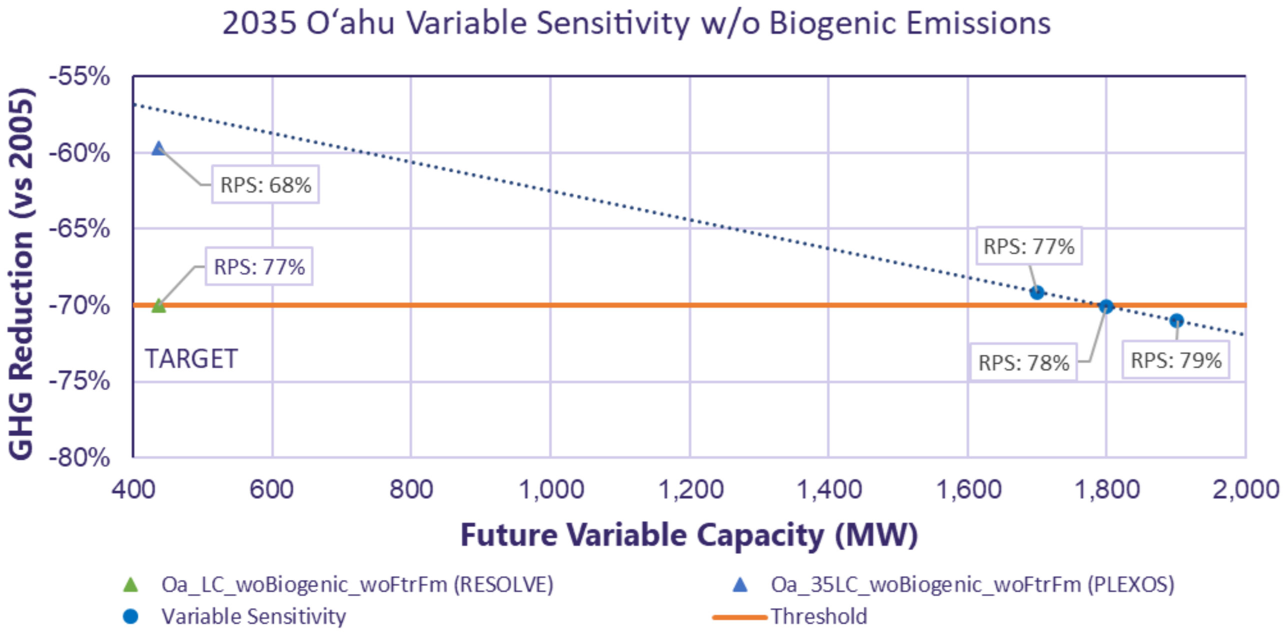

Figure 4-2: O'ahu RPS and GHG (w/o biogenic emissions) in 2035 with incremental addition of aggregated DER capacity.

Table 4-7 below expands on Table 4-6 to show how adding aggregated DER lowers biofuel usage. Comparing the RESOLVE and PLEXOS results shows that, without biogenic emissions, RPS and GHG goals can be met with economic dispatch and large amounts of DER or increased biofuel usage and less DER. The cost of building additional DER beyond the DER targets may outweigh the cost of burning more biofuels. A more detailed cost analysis will be done in the upcoming IGP cycle.

Table 4-7: Expanded O'ahu RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Oa_LC_woBiogenic_woFtrFm (RESOLVE)	8.7%	**-50%**	**60%**	---
Oa_30LC_woBiogenic_woFtrFm (PLEXOS)	0.2%	**-41%**	**49%**	---
Oa_30LC_woBiogenic_woFtrFm_w400Agg	0.3%	**-49%**	**57%**	400 MW, DER
Oa_30LC_woBiogenic_woFtrFm_w450Agg	0.3%	**-51%**	**58%**	450 MW, DER
Oa_30LC_woBiogenic_woFtrFm_w500Agg	0.1%	**-52%**	**59%**	500 MW, DER
Oa_30LC_woBiogenic_woFtrFm_w550Agg	0.04%	**-52%**	**60%**	550 MW, DER
2035				
Oa_LC_woBiogenic_woFtrFm (RESOLVE)	25.0%	**-70%**	**81%**	437 MW, DER
Oa_35LC_woBiogenic_woFtrFm (PLEXOS)	15.8%	**-60%**	**68%**	437 MW, DER
Oa_35LC_woBiogenic_woFtrFm_w1700Agg	3.1%	**-69%**	**77%**	1,700 MW, DER
Oa_35LC_woBiogenic_woFtrFm_w1800Agg	2.6%	**-70%**	**78%**	1,800 MW, DER
Oa_35LC_woBiogenic_woFtrFm_w1900Agg	2.1%	**-71%**	**79%**	1,900 MW, DER

Table 4-8 below shows the resources needed in 2030 and 2035 to meet the RPS and GHG targets in those years. The future aggregated DER added in 2030 exceeds the 400 MW target noted in the PUC Inclinations. Assuming a representative 5 kW DER system, the 550 MW aggregated DER represents 110,000 systems, which is above the 50,000 installations target in the Governor's EO.

Table 4-8: O'ahu PLEXOS results summary, year 2030 and 2035.

	Oa_30LC_woBiogenic_w550Agg	Oa_35LC_woBiogenic_woFtrFm_w1800Agg
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm	0 MW	81 MW
Future Aggregated DER	550 MW 110,000 Installations (5 kW)	1,800 MW 3,600,000 Installations (5 kW)
Future Firm	0 MW	0 MW
Total	**3,243 MW**	**4,310 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	85 MW / 340 MWh	126 MW / 504 MWh
Future Aggregated DBESS	550 MW / 1,100 MWh	1,800 MW / 3,600 MWh
Total	**1,478 MW / 4,943 MWh**	**2,769 MW / 7,607 MWh**
RPS (%)	**60%**	**78%**
GHG Reduction (%)	**-52%**	**-70%**

4.2.1.2 Hawai'i Island

The accelerated timeline of the RPS and GHG targets does not significantly affect the resource plan over the next 10 years. Hawai'i Island is expected to exceed both the RPS and GHG targets before planned resources are added through the IGP RFP.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** By 2030, RESOLVE selects approximately 15 MW of future onshore wind and 5 MW of future 4-hr standalone storage, in addition to the planned projects and RFPs (Table 4-9).
- **Model Comparison:** Due to the high levels of RPS and GHG reduction achieved through planned resources, the model results from RESOLVE and PLEXOS are very similar (Table 4-10).
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan initially developed by RESOLVE is near 100% RPS by 2030. Capacity of future resources was reduced to determine the impact to RPS and GHG.
  - **2030:** RESOLVE builds 15 MW of onshore wind and 5 MW of standalone storage above what is being sought in the IGP RFP. However, PLEXOS analysis indicates that removal of these RESOLVE-selected resources as well as the IGP RFP resources (115 MW of hybrid solar and 30 MW of onshore wind) could still meet both RPS and GHG targets (Figure 4-3, Table 4-12).
  - **2035:** RPS and GHG goals can be satisfied with the installation of planned resources and the conversion of all existing firm units to biofuels (Figure 4-4, Table 4-12). Additional variable renewable resources can further reduce biofuel consumption (Table 4-11).

Key Assumptions

Key assumptions in this analysis to meet the 2030 and 2035 RPS and GHG goals are summarized below.

1. **RPS Targets:** Hawai'i Island RPS must reach 60% by 2030, and 100% by 2035.
2. **GHG Targets:** Hawai'i Island must reduce GHG emissions (compared to 2005) by 50% by 2030.
3. **Fuel Price:** Fuel price forecast was updated to the 2023 EIA AEO.
4. **Biogenic Emissions:** Biogenic CO2 emissions from biofuels are not considered in the GHG emission accounting.
5. **Stage 3 Planned Resources:** The Puako Solar and Kaiwiki Solar projects have withdrawn.
6. **IGP RFP First Round:** The expected energies from the withdrawn Stage 3 projects have been added to the IGP RFP First Round targets with an expected GCOD of 12/1/2029.[26]
7. **Renewable Firm:** After the IGP RFP, renewable firm is not expected to be built until 2035 at the earliest due to the long development times of firm projects.
8. **Biofuel Conversion:** Existing firm generation is assumed to operate on biofuel starting in 2035.

[26] After the analysis was underway, the IGP RFP First Round GCOD was updated to November 1, 2030 as noted in Docket No. 2024-0258.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenario

- **Hi_Base_woBiogenic**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions don't count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-9 are the system resource capacities for each scenario in 2030 and 2035 grouped by resource type and procurement. The model selects 15 MW of onshore wind and 5 MW of standalone storage in 2030. By 2035, existing firm Kanoelehua CT1 and Keāhole CT2 are removed from service and planned resources including Keamuku Solar and the IGP RFP are added, resulting in no additional resources selected by RESOLVE.

Table 4-9: Hawai'i Island RESOLVE results summary, year 2030 and 2035.

Hi_Base_woBiogenic	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	15 MW	15 MW
Future Firm	0 MW	0 MW
Total	**482 MW**	**603 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	5 MW / 20 MWh	5 MW / 20 MWh
Total	**180 MW / 720 MWh**	**266 MW / 1,064 MWh**
NPV (MM 2018$, 2030-2050)	**1,399**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **Hi_30Base_woBiogenic**

- RESOLVE-added resources for year 2030 (Table 4-9).

- **Hi_35Base_woBiogenic**
  - RESOLVE-added resources for year 2035 (Table 4-9).

Results

Table 4-10 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-10: Hawai'i Island RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Hi_Base_woBiogenic (RESOLVE)	0.0%	**-95%**	**98%**	15 MW, Onshore Wind
Hi_30Base_woBiogenic (PLEXOS)	0.5%	**-98%**	**98%**	15 MW, Onshore Wind
2035				
Hi_Base_woBiogenic (RESOLVE)	0.2%	**-100%**	**100%**	15 MW. Onshore Wind
Hi_35Base_woBiogenic (PLEXOS)	1.7%	**-100%**	**100%**	15 MW, Onshore Wind

With the resource plan described in Table 4-9, both the RESOLVE and PLEXOS results meet the RPS and GHG targets in 2030 and 2035, achieving similar levels of RPS and GHG reduction overall at nearly 100% with similar biodiesel generation, as shown above in Table 4-10. Given this observation, the following sensitivity analysis reduces the amount of future generation that is added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Given the high levels of RPS and GHG reduction, RESOLVE-added and other future planned resources were removed to test the sensitivity of the RPS and GHG reduction to new resource additions.

2030 Scenarios

- **Hi_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-9).
- **Hi_30Planned_woBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-9).
  - Remove future onshore wind and future BESS.

- **Hi_30Planned_woBiogenic_woIGPPV**
    - RESOLVE-added resources for year 2030 (Table 4-9).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar.
- **Hi_30Planned_woBiogenic_woIGP**
    - RESOLVE-added resources for year 2030 (Table 4-9).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar and IGP onshore wind.

2035 Scenarios

- **Hi_35Base_woBiogenic**
    - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-9).
- **Hi_35Planned_woBiogenic**
    - RESOLVE-added resources for year 2035 (Table 4-9).
    - Remove future onshore wind and future BESS.
- **Hi_35Planned_woBiogenic_woIGPPV**
    - RESOLVE-added resources for year 2030 (Table 4-9).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar.
- **Hi_35Planned_woBiogenic_woIGP**
    - RESOLVE-added resources for year 2030 (Table 4-9).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar and IGP onshore wind.

Results

Figure 4-3 below shows the RPS and GHG in 2030 based on the results from several different simulations in both RESOLVE and PLEXOS. The x-axis represents the amount of future variable capacity in terms of megawatts of hybrid solar, where 0 MW corresponds to all planned resources through the IGP RFP being installed without the addition of any future RESOLVE-selected resources. Since 30 MW IGP onshore wind and 15 MW future onshore wind were installed, they were converted to 60 MW and 30 MW of equivalent hybrid solar, respectively, assuming a capacity factor of 0.25 for hybrid solar and 0.50 for onshore wind. This conversion was only done for graphical representation, but these resources were modeled as wind in RESOLVE and PLEXOS.

The portfolio created by RESOLVE in the green triangle exceeds RPS and GHG goals. The RPS and GHG reduction calculated in RESOLVE is verified through the more detailed hourly dispatch in PLEXOS, as shown by the blue triangle. As evident in Figure 4-3 below, both RPS and GHG goals can be met without the 15 MW of future onshore wind and 5 MW of future standalone storage. In fact, both RPS and GHG goals can still be achieved if the planned 115 MW of hybrid solar and 30 MW of onshore wind were to withdraw from the IGP RFP.

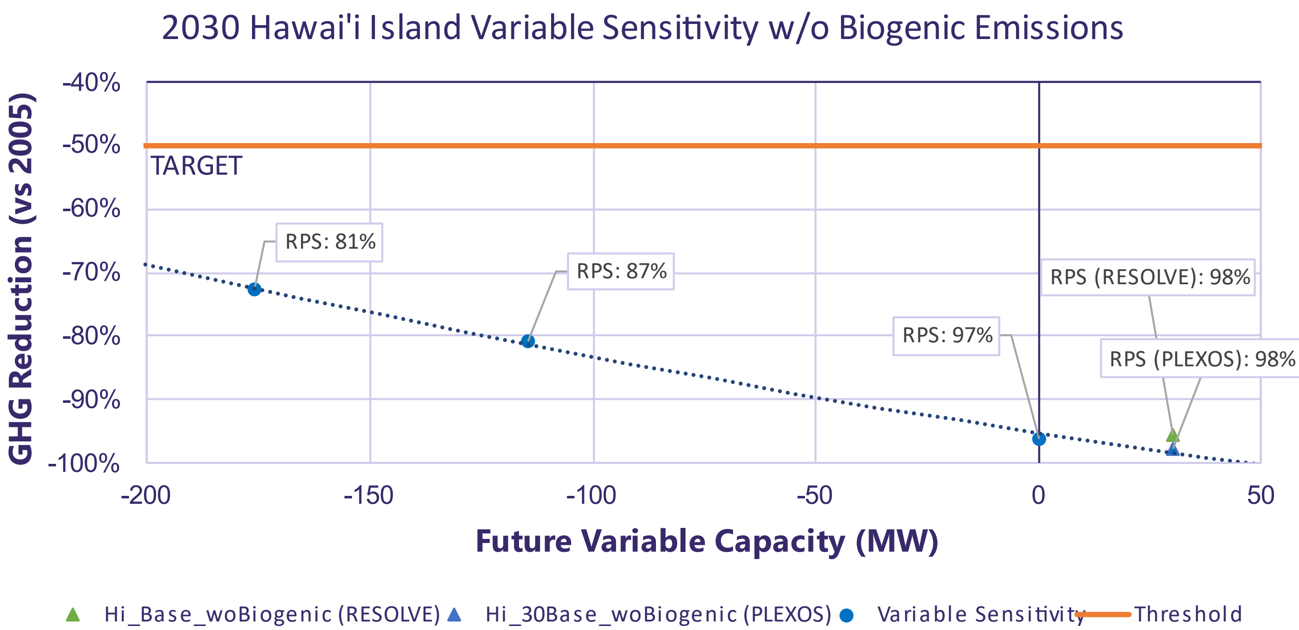

Figure 4-3: Hawai'i Island RPS and GHG (w/o biogenic emissions) in 2030 with incremental addition of future hybrid solar capacity.

Under the accelerated goal of 100% RPS in 2035, all existing firm units are converted to biofuels in 2035. Figure 4-4 show the GHG Reduction versus capacity of equivalent future hybrid solar in 2035. Note that the data point for RPS (PLEXOS) has been offset on the x-axis by 5 MW for graphical illustrative purposes, but the future variable capacity is the same as the data point for RPS (RESOLVE).

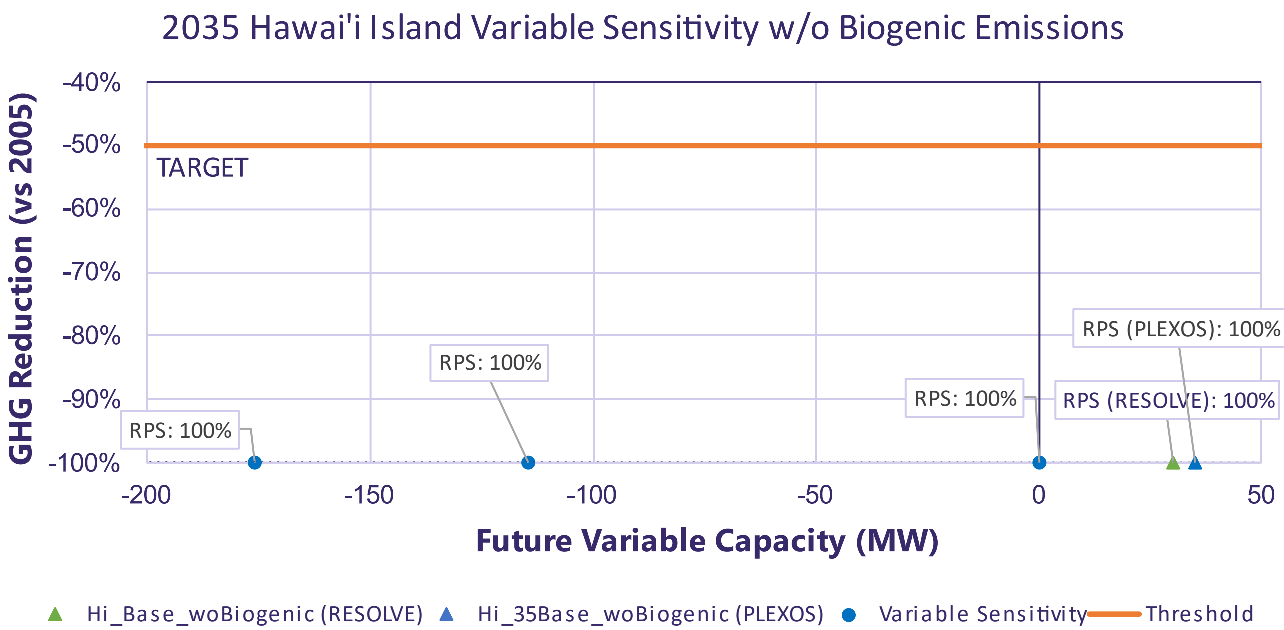

Figure 4-4: Hawai'i Island RPS and GHG (w/o biogenic emissions) in 2035 with incremental addition of future hybrid solar capacity.

Table 4-11 below expands on Table 4-10 to show how adding or removing future resources affects biofuel usage. Biofuel consumption is minimal in the portfolio created by RESOLVE, but reliance on biofuels may increase if future renewable generation is reduced. Without any future RESOLVE-added resources and without the IGP RFP hybrid solar and onshore wind, biofuel generation will be approximately 17% of total generation.

Table 4-11: Expanded Hawai'i Island RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Hi_Base_woBiogenic (RESOLVE)	0.0%	-95%	98%	15 MW, Onshore Wind
Hi_30Base_woBiogenic (PLEXOS)	0.5%	-98%	98%	15 MW, Onshore Wind
Hi_30Planned_woBiogenic (PLEXOS)	0.8%	-96%	97%	0
Hi_30Planned_woBiogenic_woIGPPV (PLEXOS)	5.2%	-81%	87%	-115 MW, Hybrid Solar
Hi_30Planned_woBiogenic_woIGP (PLEXOS)	7.7%	-73%	81%	-115 MW, Hybrid Solar -30 MW, Onshore Wind
2035				
Hi_Base_woBiogenic (RESOLVE)	0.2%	-100%	100%	15 MW, Onshore Wind
Hi_35Base_woBiogenic (PLEXOS)	1.7%	-100%	100%	15 MW, Onshore Wind
Hi_35Planned_woBiogenic (PLEXOS)	3.7%	-100%	100%	0
Hi_35Planned_woBiogenic_woIGPPV (PLEXOS)	9.9%	-100%	100%	-115 MW, Hybrid Solar
Hi_35Planned_woBiogenic_woIGP (PLEXOS)	17.1%	-100%	100%	-115 MW, Hybrid Solar -30 MW, Onshore Wind

Table 4-12 below shows the resources plan through the IGP RFPs, in 2030 and 2035, and their corresponding RPS and GHG results.

Table 4-12: Hawai'i Island PLEXOS results summary, year 2030 and 2035.

	Hi_30Planned_woBiogenic	Hi_35Planned_woBiogenic
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	0 MW	0 MW
Future Firm	0 MW	0 MW
Total	**467 MW**	**588 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**175 MW / 700 MWh**	**261 MW / 1,044 MWh**
RPS (%)	**97%**	**100%**
GHG (%)	**-96%**	**-100%**

4.2.1.3 Maui

The accelerated timeline of the RPS and GHG targets do not significantly affect the resource plan over the next 10 years. Maui will exceed both the RPS and GHG targets before planned resources are added through the IGP RFP.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** By 2030, RESOLVE selects approximately 14 MW of future onshore wind, 180 MW of future hybrid solar, and 3 MW of future 4-hr standalone storage, in addition to the planned projects and RFPs (Table 4-13).
- **Model Comparison:** Due to the high levels of RPS and GHG reduction achieved through planned resources, the model results from RESOLVE and PLEXOS are very similar.
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE is near 100% RPS by 2030. Capacity of future resources were reduced to determine the impact to RPS and GHG.
  - **2030:** 60 MW of hybrid solar from Stage 3 could withdraw and still satisfy both the RPS and GHG goals (Figure 4-5).
  - **2035:** RESOLVE builds 257 MW hybrid solar above what is being sought in the IGP RFP. RPS and GHG goals can be satisfied with the planned resources and the conversion of all existing firm to biofuels. Additional hybrid solar can further reduce biofuel consumption (Figure 4-6).

Key Assumptions

Key assumptions in this analysis to meet the 2030 and 2035 RPS and GHG goals are summarized below.

1. **RPS Targets:** Maui RPS must reach 60% by 2030 and 100% by 2035.
2. **GHG Targets:** Maui must reduce GHG emissions by 50% by 2030.
3. **Fuel Price:** Fuel price forecast was updated to the 2023 EIA AEO.
4. **Biogenic Emissions:** Biogenic CO2 emissions from biofuels are not considered in the GHG emission accounting.
5. **Existing Firm Retirement and Removal from Service:** Retirement and removal dates for the existing firm generation were updated.
   a. K1 and K2 retires December 2028. K3 retires July 2027. K4 retires February 2028.
   b. M1-9 removed January 2030. M10 removed April 2031. M11 removed February 2030. M12 removed October 2029. M13 removed September 2028.
6. **Stage 3 Planned Resources:** Pu’u Hao Solar has withdrawn from the Stage 3 RFP.

7. **IGP RFP Second Round Target:** The expected energies from the withdrawn Stage 3 projects have been added to the IGP RFP First Round targets with an expected GCOD of December 1, 2032.[27]

8. **Biofuel Conversion:** Existing firm generation is assumed to operate on biofuel starting in 2035.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **Ma_Base_woBiogenic**
    - Updated resource assumptions.
    - Updated RPS and GHG targets.
    - Biogenic emissions don’t count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-13 are the system resources capacities for each scenario in 2030 and 2035 grouped by resource type and procurement. The model selects 180 MW of future hybrid solar, 14 MW of future onshore wind, and 3 MW of standalone BESS in 2030. By 2035, more existing firm is retired, the PPA’s for existing wind have expired, and replacement energy is acquired through the IGP RFP Second Round. The model increases the amount of future hybrid solar to a cumulative total of 257 MW. The cumulative capacity of future onshore wind remains at 14 MW and standalone BESS increases to 11 MW.

[27] After the analysis was underway, the IGP RFP Second Round GCOD was updated to December 1, 2033 as noted in Docket No. 2024-0258.

Table 4-13: Maui RESOLVE results summary, year 2030 and 2035.

Ma_Base_woBiogenic	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ukiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	180 MW	257 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	14 MW	14 MW
Future Firm	0 MW	0 MW
Total	**588 MW**	**676 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	183 MW / 732 MWh	268 MW / 1072 MWh
Total	**358 MW / 1432 MWh**	**468 MW / 1872 MWh**
NPV (MM 2018$, 2030-2050)	**2,149**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **Ma_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-13).
- **Ma_35Base_woBiogenic**

   - RESOLVE-added resources for year 2035 (Table 4-13).

Results

Table 4-14 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-14: Maui RESOLVE / PLEXOS Scenario Comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Ma_Base_woBiogenic (RESOLVE)	0.00%	**-93%**	**96%**	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_30Base_woBiogenic (PLEXOS)	0.03%	**-94%**	**94%**	180 MW Hybrid Solar 14 MW Onshore Wind
2035				
Ma_Base_woBiogenic (RESOLVE)	2.0%	**-100%**	**100%**	257 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Base_woBiogenic (PLEXOS)	3.3%	**-100%**	**100%**	257 MW Hybrid Solar 14 MW Onshore Wind

With the resource plan described in Table 4-13, both the RESOLVE and PLEXOS results meet the RPS and GHG targets in 2030 and 2035, achieving similar levels of RPS and GHG reduction overall at nearly 100% with similar biodiesel generation, as shown above in Table 4-14. Given this observation, the following sensitivity analysis reduces the amount of future generation that is added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Given the high levels of RPS and GHG reduction, RESOLVE-added and other future planned resources were removed to test the sensitivity of the RPS and GHG reduction to new resource additions.

2030 Scenarios

- **Ma_30Base_woBiogenic**
   - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-13).

- **Ma_30Planned_woBiogenic**
    - Remove future hybrid solar, future onshore wind, and future BESS.
- **Ma_30Planned_woBiogenic_woPulehuKuihelani2**
    - Remove Future hybrid solar, future onshore wind, and future BESS.
    - Remove 60MW Stage 3 hybrid solar (Pulehu Solar and Kuihelani Ph2 Solar).

2035 Scenarios

- **Ma_35Base_woBiogenic**
    - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-13).
- **Ma_35Base_woBiogenic_w180HS**
    - RESOLVE-added resources year 2035 (Table 4-13).
    - Reduce future hybrid solar from 257 MW to 180 MW.
- **Ma_35Planned_woBiogenic**
    - Remove future hybrid solar, future onshore wind, and future BESS.
- **Ma_35Planned_woBiogenic _woIGPRFP**
    - Remove future hybrid solar, future onshore wind, and future BESS.
    - Remove IGP RFP resources.

Results

Figure 4-5 below shows the RPS and GHG in 2030 based on the results from several different simulations in both RESOLVE and PLEXOS. The x-axis represents the amount of future variable capacity in terms of megawatts of hybrid solar, where 0 MW corresponds to all planned resources through the IGP RFP being installed without the addition of any future RESOLVE-selected resources. The 14 MW future onshore wind was converted to approximately 28 MW of equivalent hybrid solar assuming a capacity factor of 0.25 for hybrid solar and 0.50 for onshore wind. This conversion was only done for graphical representation, but these resources were modeled as wind in RESOLVE and PLEXOS.

The portfolio created by RESOLVE in the green triangle exceeds RPS and GHG goals. The RPS and GHG reduction calculated in RESOLVE is verified through the more detailed hourly dispatch in PLEXOS, as shown by the blue triangle. Both RPS and GHG goals can be met without the RESOLVE-added resources. In fact, the RPS and GHG goals can still be achieved if 60 MW of hybrid solar were to withdraw from Stage 3. Note that the data point for Ma_Base_woBiogenic (RESOLVE) and Ma_Base_wo30Biogenic (PLEXOS) have been offset on the x-axis for graphical illustrative purposes. The future variable capacity is the same for both data points.

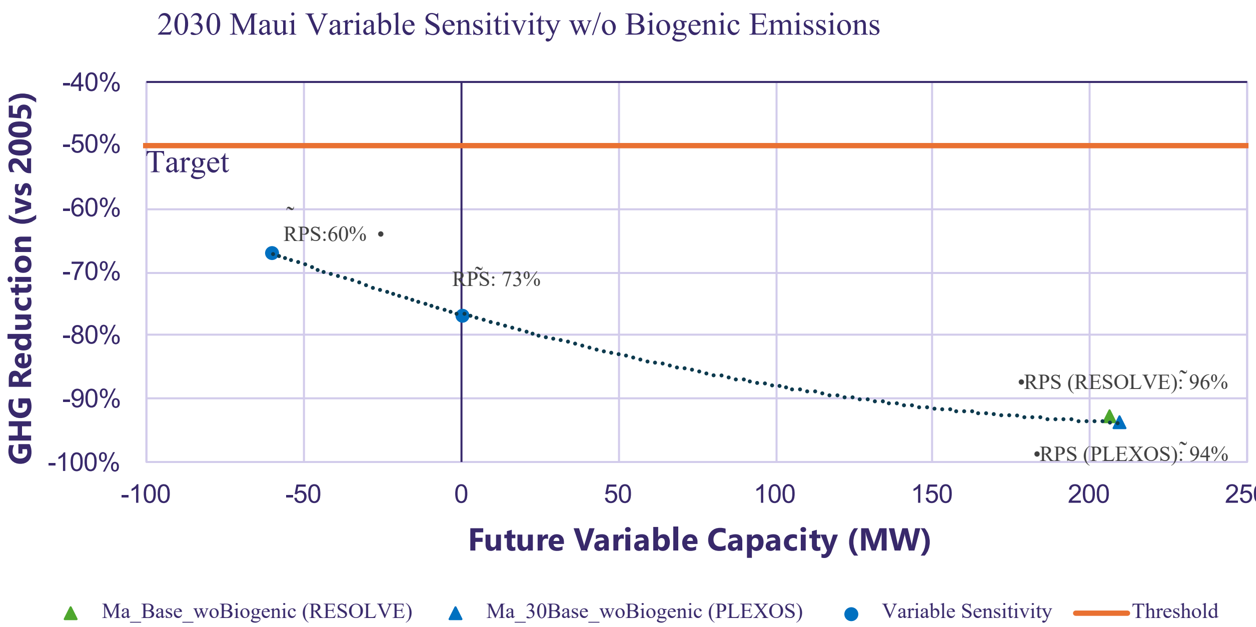

Figure 4-5: Maui RPS and GHG (w/o biogenic emissions) in 2030 with incremental hybrid solar capacity.

Under the accelerated goal of 100% RPS in 2035, all existing firm are converted to biofuels. Figure 4-6 shows the GHG Reduction versus capacity of equivalent future hybrid solar in 2035. The IGP RFP resources are modeled as 40 MW onshore wind and 25 MW hybrid solar. To represent a scenario without the IGP RFP resources and other future resources, the 40 MW IGP onshore wind was converted to 80 MW of equivalent hybrid solar and shown in Figure 4-6 as a total of 105 MW of hybrid solar removed from the resource plan.

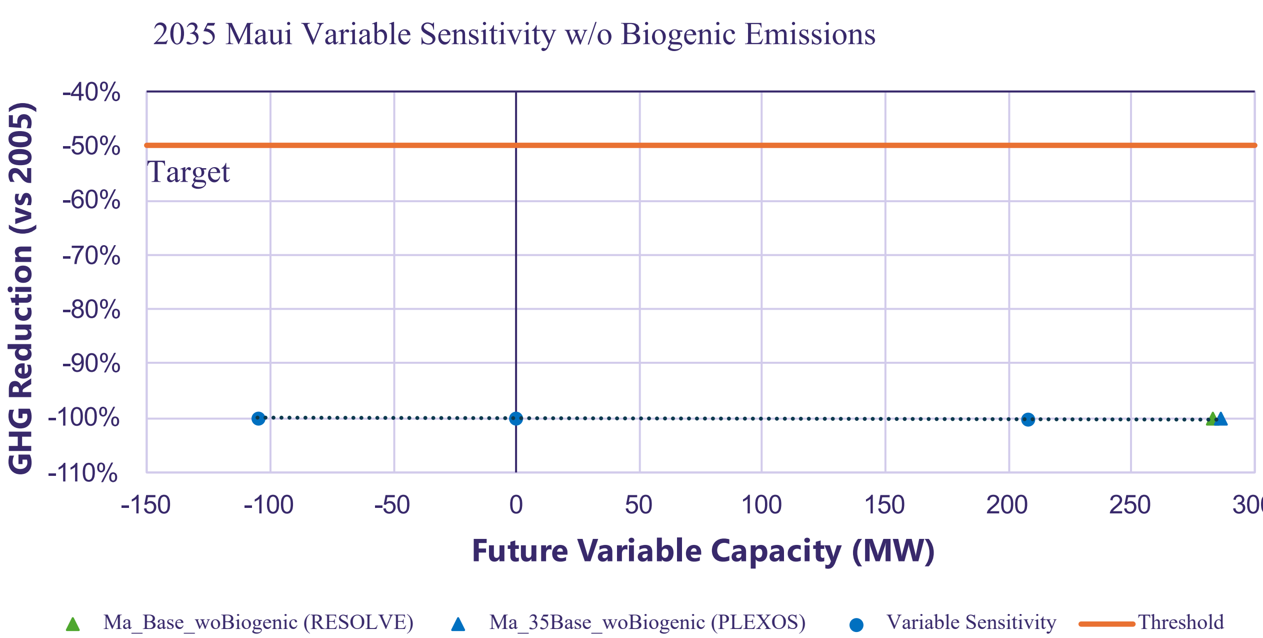

Figure 4-6: Maui RPS and GHG (w/o biogenic emissions) in 2035 with incremental hybrid solar capacity.

Table 4-15 below expands on Table 4-14 to show how adding or removing future resources affects biofuel usage. Biofuel consumption is minimal in the portfolio created by RESOLVE, but reliance on biofuels can increase without variable renewable resources. As an example, the energy target for the IGP RFP is equivalent to 105 MW of hybrid solar. A scenario without any future RESOLVE-added resources and without the IGP RFP hybrid solar and onshore wind results in biofuel generation of almost 40% of total generation. Non-biogenic emissions from biofuels is negligible resulting in effectively 100% reduction in GHG remissions relative to 2005 levels.

Table 4-15: Expanded Maui RESOLVE / PLEXOS Scenario Comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Ma_Base_woBiogenic (RESOLVE)	0.00%	**-93%**	**96%**	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_30Base_woBiogenic (PLEXOS)	0.03%	**-94%**	**94%**	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_30Planned_woBiogenic (PLEXOS)	0.07%	**-77%**	**73%**	0
Ma_30Planned_woBiogenic_ woPulehuKuihelani2 (PLEXOS)	0.3%	**-67%**	**60%**	-60 MW Stage 3 Hybrid Solar
2035				
Ma_Base_woBiogenic (RESOLVE)	2.0%	**-100%**	**100%**	257 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Base_woBiogenic (PLEXOS)	3.3%	**-100%**	**100%**	257 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Base_woBiogenic_w180HS (PLEXOS)	6.1%	**-100%**	**100%**	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Planned_woBiogenic (PLEXOS)	25.9%	**-100%**	**100%**	0
Ma_35Planned_woBiogenic _woIGPRFP (PLEXOS)	40.8%	**-100%**	**100%**	-25 MW IGP Hybrid Solar -40 MW IGP Onshore Wind

Table 4-16 below shows the resources plan through the IGP RFPs, in 2030 and 2035, and their corresponding RPS and GHG results.

Table 4-16: Maui PLEXOS results summary, year 2030 and 2035.

	Ma_30Planned_woBiogenic	Ma_35Planned_woBiogenic
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ukiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	0 MW	0 MW
Future Firm	0 MW	0 MW
Total	**394 MW**	**405 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**175 MW / 700 MWh**	**200 MW / 800 MWh**
RPS (%)	**73%**	**100%**
GHG Reduction (%)	**-77%**	**-100%**

4.2.1.4 Molokaʻi

The accelerated timeline of our RPS and GHG targets is expected to result in increased resource needs over the next 10 years.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** By 2030, RESOLVE selects approximately 10 MW of future hybrid solar and 0.5 MW of future 4-hr standalone storage, in addition to planned projects (Table 4-17).

- **Model Comparison:** The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 10% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources (Table 4-18).
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE exceeded the RPS and GHG targets when analyzed in PLEXOS. As a result, future resources selected by RESOLVE were incrementally removed to determine the minimum amount of new resources needed by 2030 and 2035 for the island to meet the RPS and GHG goals.
    - **2030:** At a minimum, approximately 4.4 MW of future hybrid solar, in total, are needed by 2030 to meet RPS and GHG targets (Figure 4-7, Table 4-19).
    - **2035:** The same 4.4 MW of future hybrid solar being sought in 2030 should allow the Molokaʻi system to meet the 2035 RPS and GHG targets (Figure 4-8, Table 4-20). Additional variable renewable resources can further reduce biofuel consumption (Table 4-19).

Key Assumptions

Key assumptions in this analysis to meet the 2030 and 2035 RPS and GHG goals are summarized below.

1. **RPS Targets:** Molokaʻi RPS must reach 60% by 2030 and 100% by 2035. As a result, all firm generators are assumed to switch to biofuel in 2035.
2. **GHG Targets:** Molokaʻi must reduce GHG emissions (compared to 2005) by 50% by 2030.
3. **Fuel Price:** Fuel price forecast was updated to the 2023 EIA AEO.
4. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels are not considered in the GHG emission accounting.
5. **Biofuel Conversion:** Existing firm generation is assumed to operate on biofuel starting in 2035.

Capacity Expansion

After incorporating updated resource assumptions and recent government policy changes, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **Mo_Base_woBiogenic**
    - Updated resource assumptions.
    - Updated RPS and GHG targets.
    - Biogenic emissions don't count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-17 are the system resources capacities in 2030 and 2035 grouped by resource type and procurement. In 2030, the model builds 10.2 MW of future hybrid solar and 0.5 MW of future 4-hour standalone storage. In 2035, the model builds an additional 0.9 MW of future hybrid.

Table 4-17: Molokaʻi RESOLVE results summary, year 2030 and 2035.

Mo_Base_woBiogenic	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	10.2 MW	11.1 MW
Total	**28.1 MW**	**29.0 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	10.2 MW / 40.8 MWh	11.1 MW / 44.4 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**13.2 MW / 53.9 MWh**	**14.1 MW / 57.5 MWh**
NPV (MM 2018$, 2030-2050)	**87.9**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **Mo_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-17).
- **Mo_35Base_woBiogenic**
  - RESOLVE-added resources for year 2035 (Table 4-17).

Results

Table 4-18 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-18: Moloka'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Mo_Base_woBiogenic (RESOLVE)	0.0%	**-87%**	**85%**	10.2 MW Hybrid Solar
Mo_30Base_woBiogenic (PLEXOS)	0.0%	**-90%**	**89%**	10.2 MW Hybrid Solar
2035				
Mo_Base_woBiogenic (RESOLVE)	12.3%	**-100%**	**100%**	11.1 MW Hybrid Solar
Mo_35Base_woBiogenic (PLEXOS)	9.2%	**-100%**	**100%**	11.1 MW Hybrid Solar

The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 10% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources. Given this observation, the following sensitivity analysis reduces the amount of future generation that is added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Using the resource plan developed by RESOLVE, the 2030 and 2035 buildout was tested in PLEXOS to determine the minimum amount of future variable resource is needed to achieve the RPS and GHG targets.

2030 Scenarios

- **Mo_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-17).
- **Mo_30Base_woBiogenic_w4.4HS**
  - RESOLVE-added resources for year 2030 (Table 4-17).
  - Future hybrid solar reduced to 4.4 MW.
- **Mo_30Base_woBiogenic_w0HS**
  - RESOLVE-added resources for year 2030 (Table 4-17).
  - Future hybrid solar reduced to 0.0 MW.

2035 Scenarios

- **Mo_35Base_woBiogenic**

- RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-17).

- **Mo_35Base_woBiogenic_w4.4HS**
  - RESOLVE-added resources for year 2035 (Table 4-17).
  - Future hybrid solar reduced to 4.4 MW.
- **Mo_35Base_woBiogenic_w0HS**
  - RESOLVE-added resources for year 2035 (Table 4-17).
  - Future hybrid solar reduced to 0.0 MW.

Results

Figure 4-7 below shows the future hybrid solar capacity needed by 2030 to meet the 60% RPS target and 50% GHG reduction target. Approximately 4.4 MW of future hybrid solar is needed to meet both targets. For this scenario, the RPS target is the binding constraint while the GHG target is non-binding as the 50% GHG target is achieved first, and additional resources are needed to meet the 60% RPS target.

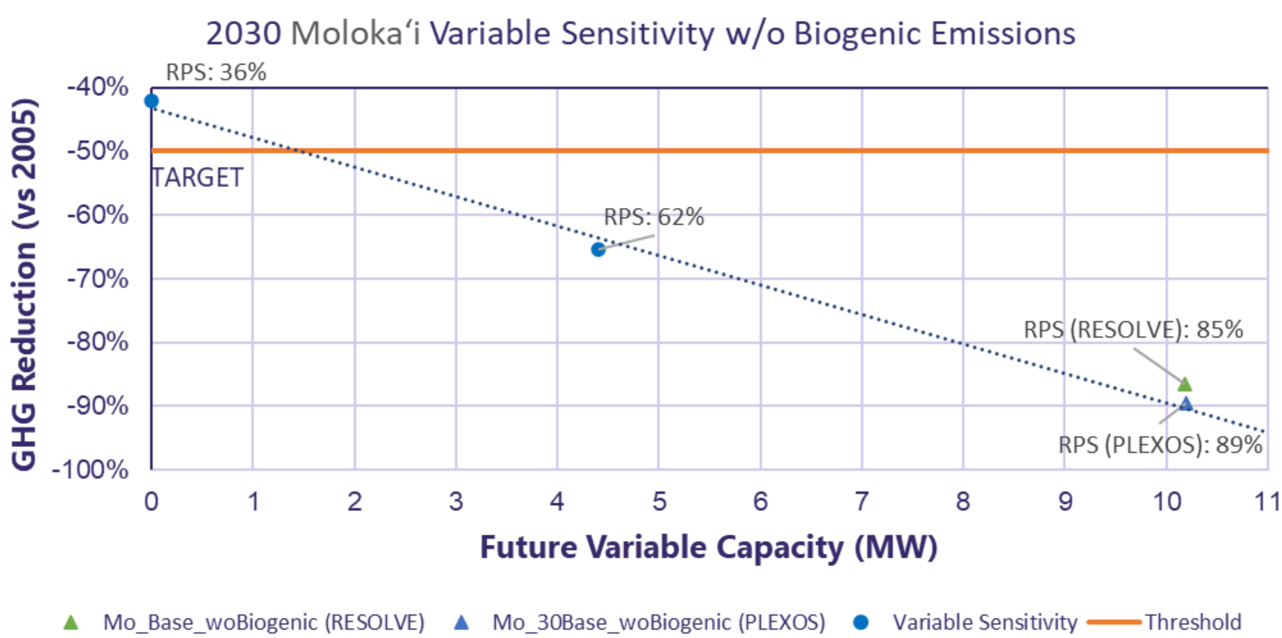

Figure 4-7: Molokaʻi RPS and GHG (w/o biogenic emissions) in 2030 with incremental addition of future hybrid solar capacity.

Figure 4-8 below shows the future hybrid solar capacity needed by 2035 to meet the 100% RPS target and 50% GHG reduction target. Since all the firm generators switch to biofuel in 2035 to achieve the 100% RPS target for Molokaʻi, and since we are not including biogenic emissions in the GHG analysis, we could achieve our 2035 targets without any incremental future hybrid solar in 2035.

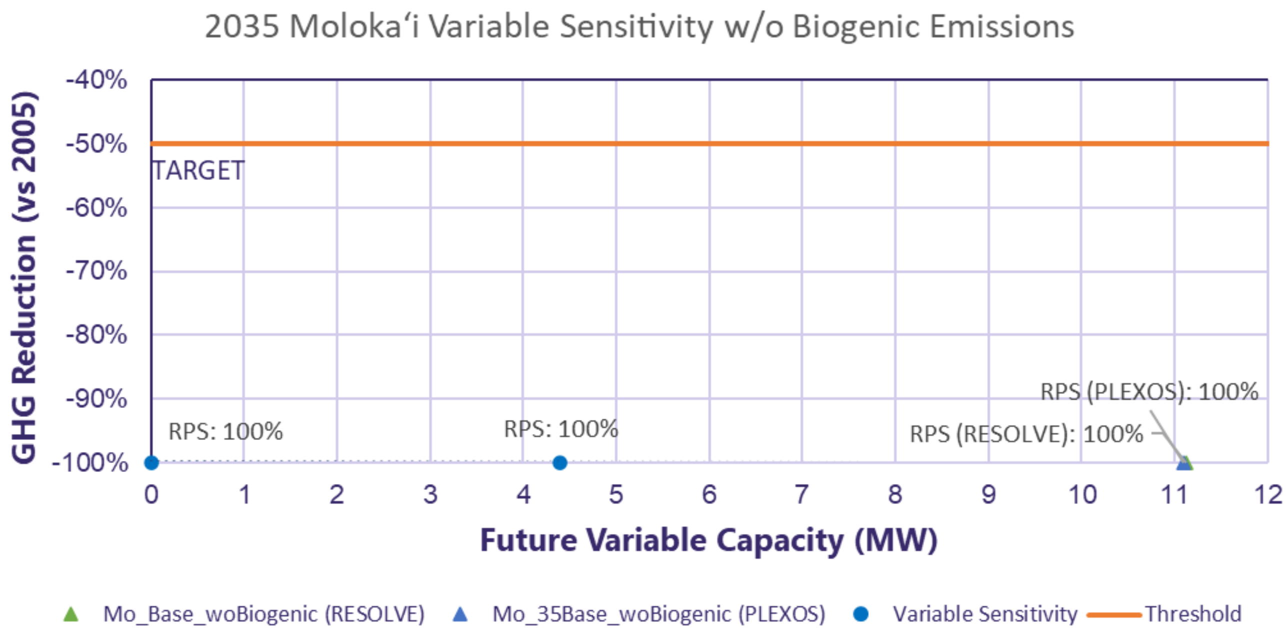

Figure 4-8: Moloka'i RPS and GHG (w/o biogenic emissions) in 2035 with incremental addition of future hybrid solar capacity.

Table 4-19 below expands on Table 4-18 to show how adding aggregated DER affects biofuel usage.

Table 4-19: Expanded Moloka'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Mo_Base_woBiogenic (RESOLVE)	0.0%	-87%	85%	10.2 MW Hybrid Solar
Mo_30Base_woBiogenic (PLEXOS)	0.0%	-90%	89%	10.2 MW Hybrid Solar
Mo_30Base_ woBiogenic_w4.4HS (PLEXOS)	0.0%	-65%	62%	4.4 MW Hybrid Solar
Mo_30Base_ woBiogenic_w0HS (PLEXOS)	0.0%	-42%	36%	0 MW Hybrid Solar
2035				
Mo_Base_woBiogenic (RESOLVE)	12.3 %	-100%	100%	11.1 MW Hybrid Solar
Mo_35Base_woBiogenic (PLEXOS)	9.2%	-100%	100%	11.1 MW Hybrid Solar
Mo_35Base_ woBiogenic_w4.4HS (PLEXOS)	36.3%	-100%	100%	4.4 MW Hybrid Solar
Mo_35Base_ woBiogenic_w0HS (PLEXOS)	61.0%	-100%	100%	0 MW Hybrid Solar

Since 4.4 MW of future hybrid solar is needed to achieve the 2030 targets, it is assumed that the 4.4 MW of future hybrid solar will also be in-service in 2035. Table 4-20 below shows the 2030 and 2035 scenarios that meet the RPS and GHG metrics.

Table 4-20: Moloka'i PLEXOS results summary, year 2030 and 2035.

	Mo_30Base_woBiogenic_w4.4HS	Mo_35Base_woBiogenic_w4.4HS
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	4.4 MW	4.4 MW
Total	**22.3 MW**	**22.3 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	4.4 MW / 17.6 MWh	4.4 MW / 17.6 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**7.4 MW / 30.7 MWh**	**7.4 MW / 30.7 MWh**
RPS (%)	**62%**	**100%**
GHG Reduction (%)	**-65%**	**-100%**

4.2.1.5 Lāna'i

The accelerated timeline of our RPS and GHG targets is expected to result in increased resource needs over the next 10 years.

Summary of Results

Using the latest RPS and GHG targets, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** By 2030, RESOLVE selects approximately 20 MW of future hybrid solar and 0.5 MW of future 4-hr standalone storage (Table 4-21).
- **Model Comparison:** The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 6% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources.
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE exceeded the RPS and GHG targets when analyzed in PLEXOS. As a result, future resources were incrementally

removed to determine the minimum amount of needed by 2030 and 2035 for the island to meet the RPS and GHG targets.

- **2030:** At a minimum, approximately 13.2 MW of future hybrid solar, in total, are needed by 2030 to meet RPS and GHG targets (Figure 4-19, Table 4-24).
- **2035:** The same 13.2 MW of future hybrid solar being sought in 2030 should allow the Lānaʻi system to meet the 2035 RPS and GHG targets (Figure 4-20, Table 4-24). Additional variable renewable resources can further reduce biofuel consumption (Table 4-23).

Key Assumptions

Key assumptions in this analysis to meet the 2030 and 2035 RPS and GHG goals are summarized below.

1. **RPS Targets:** Lānaʻi RPS must reach 60% by 2030 and 100% by 2035. As a result, all firm generators are assumed to switch to biofuel in 2035.
2. **GHG Targets:** Lānaʻi must reduce GHG emissions (compared to 2005) by 50% by 2030.
3. **Fuel Price:** Fuel price forecast was updated to the 2023 EIA AEO.
4. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels are not considered in the GHG emission accounting.
5. **Planned Resource:** The Lānaʻi Solar project has withdrawn from the Lānaʻi RFP.[28]
6. **Biofuel Conversion:** Existing firm generation is assumed to operate on biofuel starting in 2035.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **La_Base_woBiogenic**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions don't count towards GHG targets or GHG reduction.

Results

Shown below are the generating resources capacities in 2030 and 2035, grouped by resource type and procurement (Table 4-21). In 2030, RESOLVE selected 20 MW of future hybrid solar and 0.5 MW of future 4-hour standalone storage. In 2035, RESOLVE selected an additional 1.3 MW of future hybrid solar.

[28] On October 25, 2024, the Company filed a letter of Notice of Withdrawal of LānaʻI Solar in Docket No. 2015-0389.

Table 4-21: Lāna'i RESOLVE results summary, year 2030 and 2035.

La_Base_woBiogenic	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0 MW	0 MW
Future Hybrid Solar	20 MW	21.3 MW
Total	**30.4 MW**	**31.7 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	20 MW / 80.1 MWh	21.3 MW / 85.4 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.2 MWh
Total	**20.5 MW / 82.2 MWh**	**21.8 MW / 87.4 MWh**
NPV (MM 2018$, 2030-2050)	**84.3**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **La_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-21).
- **La_35Base_woBiogenic**
  - RESOLVE-added resources for year 2035 (Table 4-21).

Results

Table 4-22 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-22: Lāna‘i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
La_Base_woBiogenic (RESOLVE)	0.0%	**-89%**	**92%**	20 MW Hybrid Solar
La_30Base_woBiogenic (PLEXOS)	0.0%	**-89%**	**93%**	20 MW Hybrid Solar
2035				
La_Base_woBiogenic (RESOLVE)	6.6%	**-100%**	**100%**	21.3 MW Hybrid Solar
La_35Base_woBiogenic (PLEXOS)	5.5%	**-100%**	**100%**	21.3 MW Hybrid Solar

The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 5% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources. Given this observation, the following sensitivity analysis reduces the amount of future generation is that added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Using the resource plan developed by RESOLVE, the 2030 and 2035 buildout were tested in PLEXOS to determine the minimum amount of future variable resource needed to achieve the RPS and GHG targets.

2030 Scenarios

- **La_30Base_woBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-21).
- **La_30Base_woBiogenic_Hybrid-7**
  - RESOLVE-added resources for year 2030 (Table 4-21).
  - Future hybrid solar is reduced to 15.4 MW.
- **La_30Base_woBiogenic _Hybrid-6**
  - RESOLVE-added resources for year 2030 (Table 4-21).
  - Future hybrid solar is reduced to 13.2 MW.
- **La_30Base_woBiogenic _Hybrid-5**
  - RESOLVE-added resources for year 2030 (Table 4-21).
  - Future hybrid solar is reduced to 11 MW.

2035 Scenarios

- **La_35Base_woBiogenic**
  - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-21).
- **La_30Base_woBiogenic_Hybrid-7**
  - RESOLVE-added resources for year 2035 (Table 4-21).
  - Future hybrid solar is reduced to 15.4 MW.
- **La_30Base_woBiogenic _Hybrid-6**
  - RESOLVE-added resources for year 2035 (Table 4-21).
  - Future hybrid solar is reduced to 13.2 MW.
- **La_30Base_woBiogenic _Hybrid-5**
  - RESOLVE-added resources for year 2035 (Table 4-21).
  - Future hybrid solar is reduced to 11 MW.

Results

Figure 4-9 below shows the future hybrid solar capacity needed by 2030 to meet the 60% RPS target and 50% GHG reduction target. Approximately 13.2 MW of future hybrid solar is needed to meet both targets. For this scenario, the GHG target is the binding constraint while the RPS target is non-binding as the 60% RPS target is achieved first, and additional resources are needed to meet the 50% GHG target.

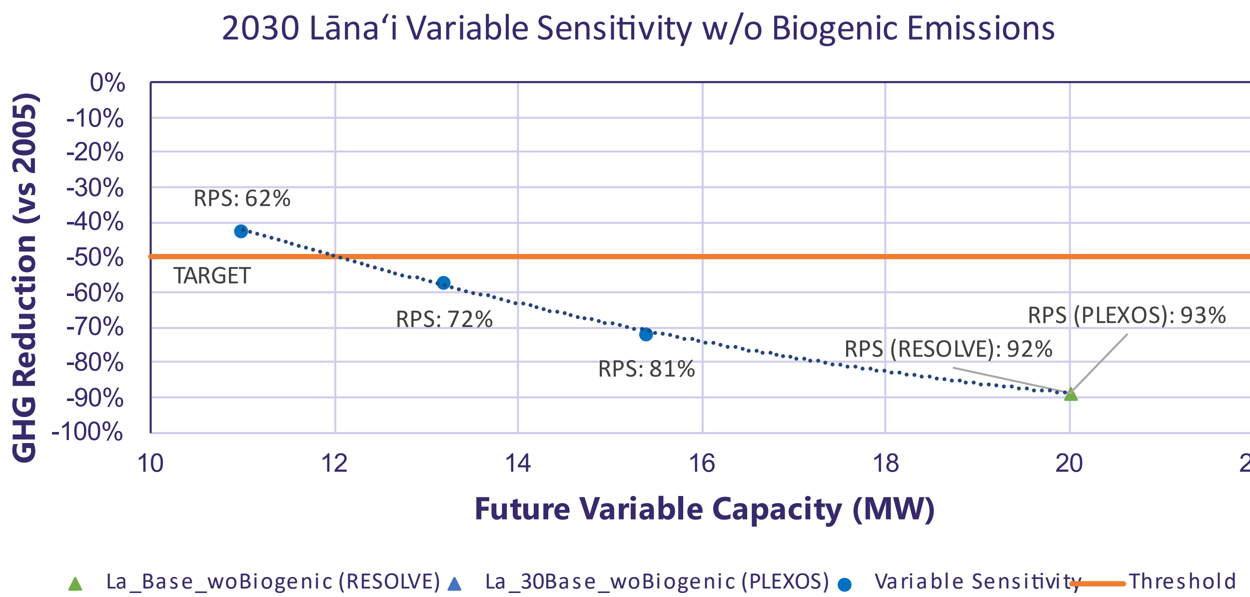

Figure 4-9: Lānaʻi RPS and GHG (w/o biogenic emissions) in 2030 with incremental addition of future hybrid solar capacity.

Figure 4-10 below shows the future hybrid solar capacity needed by 2035 to meet the 100% RPS target and 50% GHG reduction target. Since all firm generators switch to biofuel in 2035 to achieve the 100% RPS target for Lānaʻi, and since we are not including biogenic emissions in the GHG analysis, we could achieve our 2035 targets without any incremental future hybrid solar in 2035.

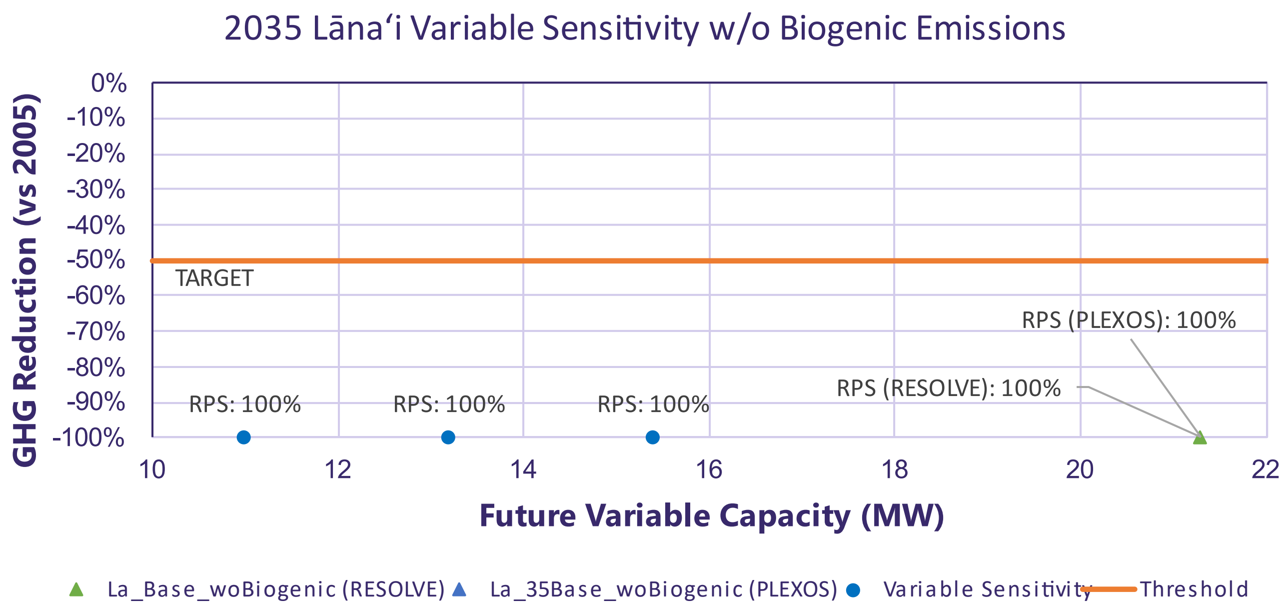

Figure 4-10: Lānaʻi RPS and GHG (w/o biogenic emissions) in 2035 with incremental addition of future hybrid solar capacity.

Table 4-23 below expands on Table 4-22 to show how adding future variable resources affects biofuel usage.

Table 4-23: Expanded Lāna'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
La_Base_woBiogenic (RESOLVE)	0.0%	**-89%**	**92%**	20 MW Hybrid Solar
La_30Base_woBiogenic (PLEXOS)	0.0%	**-89%**	**93%**	20 MW Hybrid Solar
La_30Base_woBiogenic_Hybrid-7	0.0%	**-72%**	**81%**	15.4 MW Hybrid Solar
La_30Base_woBiogenic_Hybrid-6	0.0%	**-57%**	**72%**	13.2 MW Hybrid Solar
La_30Base_woBiogenic_Hybrid-5	0.0%	**-42%**	**57%**	15.4 MW Hybrid Solar
2035				
La_Base_woBiogenic (RESOLVE)	6.6%	**-100%**	**100%**	21.3 MW Hybrid Solar
La_35Base_woBiogenic (PLEXOS)	5.5%	**-100%**	**100%**	21.3 MW Hybrid Solar
La_35Base_woBiogenic_Hybrid-7	18.7%	**-100%**	**100%**	15.4 MW Hybrid Solar
La_35Base_woBiogenic_Hybrid-6	28.3%	**-100%**	**100%**	13.2 MW Hybrid Solar
La_35Base_woBiogenic_Hybrid-5	38.4%	**-100%**	**100%**	11 MW Hybrid Solar

Since 13.2 MW of future hybrid solar is needed to achieve the 2030 targets, it is assumed that the 13.2 MW of future hybrid solar will also be in-service in 2035. Table 4-24 below shows the 2030 and 2035 scenarios that meet the RPS and GHG targets.

Table 4-24: Lāna'i PLEXOS results summary, year 2030 and 2035.

	La_30Base_woBiogenic_Hybrid-6	La_35Base_woBiogenic_Hybrid-6
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0 MW	0 MW
Future Hybrid Solar	13.2 MW	13.2 MW
Total	**23.6 MW**	**23.6 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	13.2 MW / 52.8 MWh	13.2 MW / 52.8 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**13.7 MW / 54.8 MWh**	**13.7 MW / 54.8 MWh**
RPS (%)	**72%**	**100%**
GHG Reduction (%)	**-57%**	**-100%**

4.2.2 Biogenic Emissions Sensitivity

In its order accepting the IGP Final Report, the PUC directed the Companies to report biogenic emissions alongside non-biogenic emissions.[29] In its subsequent order in the IGP docket, the PUC provided further direction to present its methods and assumptions used to develop lifecycle emissions estimates and noted that it will pay close attention to emissions from different fuels and projects involving combustion, including biogenic emissions.

While we reported the emissions associated with its preferred plans in its Final Report, biogenic emissions were excluded. In response to Commission information requests regarding its emissions calculations, we also discussed that it was appropriate to separately report CO_2 emissions from biomass combustion and that CH_4 and N_2O emissions from biomass combustion are not of biogenic origin and should be reported with fossil-fuel based CH_4 and N_2O emissions.[30]

[29] *See* Order 40651 Accepting the 2023 Final IGP Report and Providing Guidance.

[30] *See* Response to Commissions' Information Request PUC-HECO-IRs 45-47 filed in Docket No. 2018-0165 on January 10, 2024.

This is consistent with reporting by the State Department of Health in their Hawaiʻi Greenhouse Gas Emissions Inventory for 2020 and 2021.[31] In that report, the emissions for biomass and biofuel are discussed where it was noted that:[32]

- Biodiesel and biomass release CO_2 emissions when combusted;
- Because biodiesel and biomass CO_2 emissions are biogenic, they should be estimated separately from fossil fuel CO_2 emissions and not be included in emissions totals; and
- CH_4 and N_2O are also emitted from biomass sources and these emissions are included in emissions totals.

Notwithstanding the above, accounting for biogenic emissions in meeting the GHG emissions reduction goals can affect the timing, type, and quantity of resources selected by the RESOLVE model. Therefore, the modeling results contained in this section are a separate sensitivity analysis to show the potential impact to the resource plans when including these emissions.

4.2.2.1 Oʻahu

Meeting near term RPS and GHG reduction goals will drive near term resource additions. Accounting for biogenic emissions will further increase the amount of new resources that will need to be added.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets increases resource needs through 2035 above what is being sought in the IGP RFPs (Table 4-25). Resource needs are greater when biogenic emissions are considered. RESOLVE prefers aggregated DER over biofuels in the near-term. Both biofuel and fossil fuel generators operate at low levels to meet GHG targets.
- **Model Comparison:** When biogenic emissions are included, RESOLVE does not rely on biofuels to meet GHG targets. Instead, both RESOLVE and PLEXOS use fossil fuels and biofuels at low levels and utilize additional aggregated DER capacity to meet RPS and GHG targets (Table 4-26).
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE exceeds the RPS and GHG targets when analyzed in PLEXOS. As a result, future resources were incrementally removed to determine the minimum amount of future resources needed by 2030 and 2035 for the island to meet the RPS and GHG goals.
    - **2030:** Approximately 650 MW of aggregated DER, in total, are needed to meet RPS, GHG targets (Figure 4-11**,** Table 4-28). This exceeds the 400 MW of DER noted in the PUC Inclinations. Assuming a representative 5 kW DER system, 650 MW of aggregated DER is

[31] *See* https://health.hawaii.gov/cab/files/2024/05/2020-and-2021-Inventory_Final-Report_5-29-24.pdf

[32] The Hawaiʻi Greenhouse Gas Emissions Inventory for 2020 and 2021 references the 2006 Intergovernmental Panel on Climate Change ("IPCC") Guidelines for National Greenhouse Gas Inventories as guidance.

equivalent to 130,000 new DER systems which would also exceed the 50,000 systems noted in the Governor's EO.

  - **2035:** Approximately 2,100 MW of aggregated DER, in total, are needed to meet GHG metrics (Figure 4-12**,** Table 4-28). Additional variable renewable resources can further reduce biofuel consumption (Table 4-27).

- **Biogenic Emission Comparison:** The scenarios with biogenic emissions require more future resources. Large amounts of aggregated DER will need to be installed much sooner if biogenic emissions are included in order to comply with the updated RPS and GHG targets as well as the new DER goals. Accounting for biogenic emissions increases NPV (2030-2050, 2018$) by approximately 2% from $22,754MM to $23,249MM (Table 4-53).

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated in Section 4.2.1.1 with the exception that in this case, biogenic CO2 emissions from biofuels are now accounted for in the GHG emissions totals. Also, based on the O'ahu results presented in Section 4.2.1.1, firm biodiesel generators were excluded from selection in RESOLVE.

Capacity Expansion

After incorporating updated resource and policy changes, the following scenario was tested in RESOLVE.

Capacity Expansion Scenarios

- **Oa_LC_wBiogenic_woFtrFm**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions count towards GHG targets or GHG reduction.
  - Future firm biofuel ineligible for selection by RESOLVE.

Results

Shown below in Table 4-25 are the resource capacities for the "Oa_LC_wBiogenic_woFtrFm" scenario in 2030 and 2035 grouped by resource type and procurement. RESOLVE was restricted to choosing between aggregated DER and standalone BESS for future resources due to the land-constrained nature of the O'ahu system. Firm biodiesel was not available for selection based on previous results from Section 4.2.1.1. When biogenic emissions are included, RESOLVE builds 202 MW of standalone BESS and 790 MW of aggregated DER in 2030, and cumulative totals of 400 MW of standalone BESS and 2,164 MW of aggregated DER in 2035. RESOLVE builds aggregated DER instead of increasing the usage of biofuel generators because burning biofuels produces biogenic emissions at rates similar to fossil fuels.

Table 4-25: O'ahu RESOLVE results summary, year 2030 and 2035, w/ biogenic emissions, w/o future firm.

Oa_LC_wBiogenic_woFtrFm	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm	0 MW	81 MW
Future Aggregated DER	790 MW	2,164 MW
Future Firm	0 MW	0 MW
Total	**3,483 MW**	**4,674 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	202 MW / 810 MWh	400 MW / 1,602 MWh
Future Aggregated DBESS	790 MW / 1,581 MWh	2,164 MW / 4,328 MWh
Total	**1,835 MW / 5,894 MWh**	**3,407 MW / 9,433 MWh**
NPV (MM 2018$, 2030-2050)	**23,249**	

Large amounts of aggregated DER will need to be installed much sooner if biogenic emissions are included in order to comply with the updated RPS and GHG targets as well as the new DER goals. Accounting for biogenic emissions increases NPV (2030-2050, 2018$) by approximately 2% from $22,754MM to $23,249MM (Table 4-53).

Model Comparison

The resource plan developed by RESOLVE was analyzed in PLEXOS, which performs a more detailed hourly simulation.

- **Oa_30LC_wBiogenic_woFtrFm**
    - RESOLVE-added resources for year 2030 (Table 4-25).
- **Oa_35LC_wBiogenic_woFtrFm**

- RESOLVE-added resources for year 2035 (Table 4-25).

Results

Table 4-26 below shows how the RESOLVE and PLEXOS models use biofuel to meet their RPS and GHG targets.

Table 4-26: O'ahu RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Oa_LC_wBiogenic_woFtrFm (RESOLVE)	2.0%	**-50%**	**67%**	790 MW, DER
Oa_30LC_wBiogenic_woFtrFm (PLEXOS)	0.01%	**-53%**	**64%**	790 MW, DER
2035				
Oa_LC_wBiogenic_woFtrFm (RESOLVE)	1.9%	**-70%**	**87%**	2,164 MW, DER
Oa_35LC_wBiogenic_woFtrFm (PLEXOS)	0.6%	**-71%**	**83%**	2,164 MW, DER

Both RESOLVE and PLEXOS need aggregated DER to meet RPS and GHG targets. Biofuel usage in both models is very low because of the need to limit the biogenic emissions from biofuels, and therefore, the models rely on non-emitting renewable resources like aggregated DER. As a result, aggregated DER will be used in the following sensitivity analysis to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Given the increased emphasis on DER in both the Governor's EO and the PUC Inclination and the selection of future aggregated DER in Section 4.2.1.1, Future Aggregated DER capacity was adjusted to determine portfolio compliance with the RPS and GHG goals.

2030 Scenarios

- **Oa_30LC_wBiogenic_woFtrFm**
    - RESOLVE-added resources for "woFtrFm" scenario, year 2030, used as the basis for this sensitivity analysis (Table 4-25).
- **Oa_30LC_wBiogenic_w600Agg**
    - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-25).
    - Reduce aggregated DER to 600 MW.
- **Oa_30LC_wBiogenic_w650Agg**
    - RESOLVE-added resources for "woFtrFm" scenario, year 2030 (Table 4-25).
    - Reduce aggregated DER to 650 MW.
- **Oa_30LC_wBiogenic_w700Agg**

- RESOLVE-added resources for “woFtrFm” scenario, year 2030 (Table 4-25).
- Reduce aggregated DER to 700 MW.

2035 Scenarios

- **Oa_35LC_wBiogenic**
    - RESOLVE-added resources for “woFtrFm” scenario, year 2035 (Table 4-25).
- **Oa_35LC_withBiogenic_w2000Agg**
    - RESOLVE-added resources for “woFtrFm” scenario, year 2035 (Table 4-25).
    - Reduce aggregated DER to 2,000 MW.
- **Oa_35LC_withBiogenic_w2100Agg**
    - RESOLVE-added resources for “woFtrFm” scenario, year 2035 (Table 4-25).
    - Reduce aggregated DER to 2,100 MW.
- **Oa_35LC_withBiogenic_w2200Agg**
    - RESOLVE-added resources for “woFtrFm” scenario, year 2035 (Table 4-25).
    - Reduce aggregated DER to 2,200 MW.

Results

Figure 4-11 below shows the RPS and GHG in 2030 based on the results from several different simulations in both RESOLVE and PLEXOS for the cases where biogenic emissions are included. The portfolio created by RESOLVE and modeled in RESOLVE is represented by the green triangle. The portfolio created by RESOLVE and modeled in PLEXOS is represented by the blue triangle. As shown, approximately 650 MW of aggregated DER is needed to meet both targets. For this scenario, the GHG target is a more binding constraint than the RPS target in 2030 as the 60% RPS target is achieved first, and additional resources are needed to meet the 50% GHG reduction target (Figure 4-11).

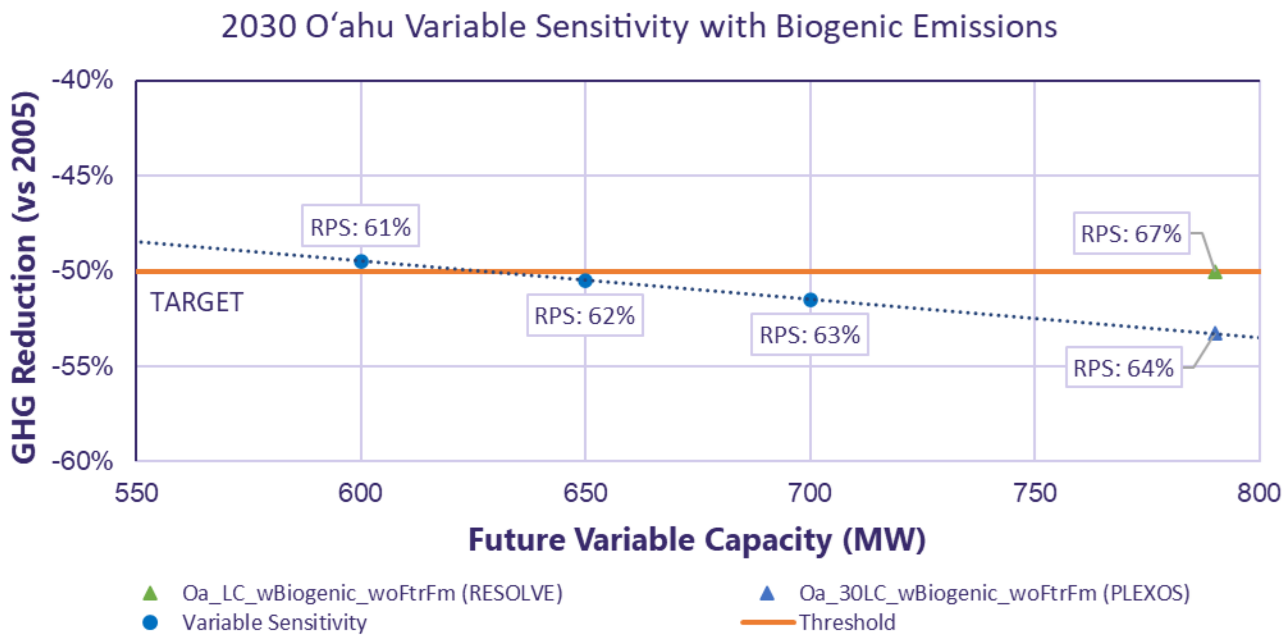

Figure 4-11: O‘ahu RPS and GHG (w/ biogenic emissions) in 2030 with incremental addition of aggregated DER capacity.

Similarly, as shown below in Figure 4-12, a total of approximately 2,100 MW of aggregated DER is needed by 2035 to meet the 70% GHG reduction target. For this scenario, the GHG target is a more binding constraint than the RPS target in 2035 as the 60% RPS target was met earlier in 2030 and additional resources are needed to meet the 70% GHG reduction target (Figure 4-12).

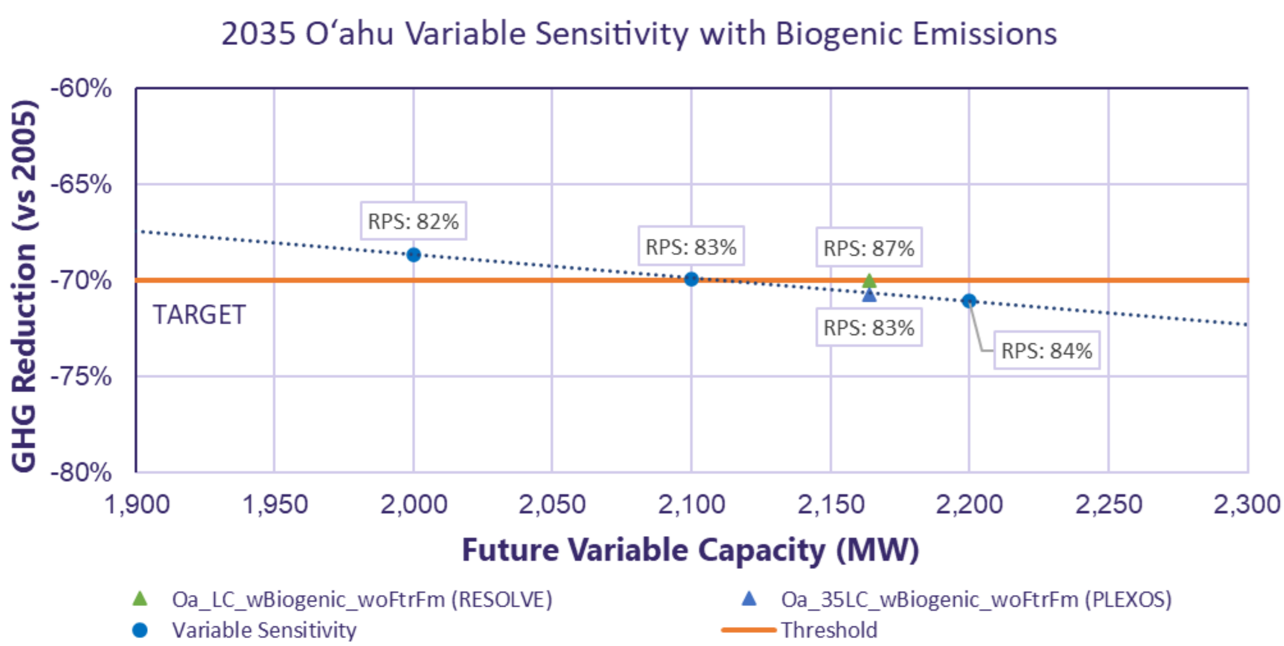

Figure 4-12: O‘ahu RPS and GHG (w/ biogenic emissions) in 2035 with incremental addition of aggregated DER capacity.

Table 4-27 below expands on Table 4-26 and shows how different models and adding aggregated DER affects biofuel usage. If biogenic emissions are included, biofuels cannot be used instead of fossil fuels to reduce GHG. Given this and O'ahu's land-constrained nature, aggregated DER is the only type of generation that can contribute to meeting both RPS and GHG targets.

Table 4-27: Expanded O'ahu RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Oa_LC_wBiogenic_woFtrFm (RESOLVE)	2.0%	**-50%**	**67%**	790 MW, DER
Oa_30LC_wBiogenic_woFtrFm (PLEXOS)	0.01%	**-53%**	**64%**	790 MW, DER
Oa_30LC_wBiogenic_woFtrFm_w600Agg	0.04%	**-49%**	**61%**	600 MW, DER
Oa_30LC_wBiogenic_woFtrFm_w650Agg	0.03%	**-50%**	**62%**	650 MW, DER
Oa_30LC_wBiogenic_woFtrFm_w700Agg	0.03%	**-51%**	**63%**	700 MW, DER
2035				
Oa_LC_wBiogenic_woFtrFm (RESOLVE)	1.9%	**-70%**	**87%**	2,164 MW, DER
Oa_35LC_wBiogenic_woFtrFm (PLEXOS)	0.6%	**-71%**	**83%**	2,164 MW, DER
Oa_35LC_wBiogenic_woFtrFm_woFtrFm_w2000Agg	0.7%	**-69%**	**82%**	2,000 MW, DER
Oa_35LC_wBiogenic_woFtrFm_woFtrFm_w2100Agg	0.6%	**-70%**	**83%**	2,100 MW, DER
Oa_35LC_wBiogenic_woFtrFm_woFtrFm_w2200Agg	0.5%	**-71%**	**84%**	2,200 MW, DER

Table 4-28 below shows the 2030 and 2035 scenarios with biogenic emissions that meet the RPS and GHG targets in those years. The future aggregated DER added in 2030 exceeds the 400 MW noted in the PUC Inclinations. Assuming a representative 5 kW DER system, the 650 MW aggregated DER represents 130,000 systems, which is above the 50,000 installations target in the Governor's EO.

Table 4-28: O'ahu PLEXOS results summary, year 2030 and 2035, w/ biogenic emissions.

	Oa_30LC_wBiogenic_w650Agg	Oa_35LC_withBiogenic_w2100Agg
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm	0 MW	81 MW
Future Aggregated DER	650 MW 130,000 Installations (5 kW)	2,100 MW 4,200,000 Installations (5 kW)
Future Firm	0 MW	0 MW
Total	**3,343 MW**	**4,610 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	202 MW / 808 MWh	400 MW / 1,600 MWh
Future Aggregated DBESS	650 MW / 1,300 MWh	2,100 MW / 4,200 MWh
Total	**1,695 MW / 5,611 MWh**	**3,343 MW / 9,303 MWh**
RPS (%)	**62%**	**83%**
GHG Reduction (%)	**-50%**	**-70%**

Table 4-29 compares the PLEXOS scenarios that meet the RPS and GHG targets with biogenic emissions to the ones that meet those targets without biogenic emissions, assuming that additional firm generation is not available by 2035. As shown below, when biogenic emissions are included in the GHG accounting, significantly more aggregated DER will be needed to comply with the updated RPS and GHG targets, as well as, the new DER goals.

Table 4-29: O'ahu PLEXOS Comparison, year 2030 and 2035, w/ biogenic emissions vs w/o biogenic emissions.

Scenario	Biogenic Emissions Included in GHG	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030					
Oa_30LC_woBiogenic_woFtrFm_w550Agg	Excluded	0.04%	**-52%**	**60%**	550 MW, DER
Oa_30LC_wBiogenic_woFtrFm_w650Agg	Included	0.03%	**-50%**	**62%**	650 MW, DER
2035					
Oa_35LC_woBiogenic_woFtrFm_w1800Agg	Excluded	2.6%	**-70%**	**78%**	1,800 MW, DER
Oa_35LC_wBiogenic_woFtrFm_w2100Agg	Included	0.6%	**-70%**	**83%**	2,100 MW, DER

4.2.2.2 Hawai'i Island

Hawai'i Island can satisfy the RPS and GHG goals relying mostly on variable renewable resources. Including biogenic emissions in the GHG reduction analysis does not affect the resources selected by RESOLVE.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** The resource plan developed by RESOLVE is unaffected by the inclusion of biogenic emissions to meet the RPS and GHG goals (Table 4-30).
- **Model Comparison:** Including biogenic emissions does not affect the resources selected by RESOLVE. Both RESOLVE and PLEXOS models are able to reach RPS and GHG goals with the installation of planned resources and the conversion of all existing firm units to biofuels.
- **Variable Renewable Sensitivities (PLEXOS):** The same sensitivities as Section 4.2.1.2 were tested. While GHG emissions are higher with the inclusion of biogenic emissions, emissions reductions still exceed the target.
  - **2030:** RESOLVE builds 15 MW onshore wind and 5 MW standalone storage above what is being sought in the IGP RFP. However, PLEXOS analysis indicates that removal of these RESOLVE-selected resources as well as the IGP RFP resources (115 MW of hybrid solar and 30 MW of onshore wind) could still meet both RPS and GHG targets (Figure 4-13**,** Table 4-32).
  - **2035:** RPS and GHG goals can be satisfied with the installation of planned resources and the conversion of all existing firm units to biofuels (Figure 4-14). Additional variable renewable resources can further reduce biofuel consumption and the biogenic GHG emissions (Figure 4-14, Table 4-32).

- **Biogenic Emission Comparison:** The 2035 results show that, when the firm generators convert to biofuel to meet the 100% RPS target, only about 2% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources (Table 4-31). Including biogenic emissions has a minimal impact on the GHG reduction levels. Accounting for biogenic emissions does not impact the resource plan and consequently NPV is unaffected (Table 4-56).

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated above in Section 4.2.1.2 with the exception that in this case, biogenic CO2 emissions from biofuels are now accounted for in the GHG emission totals.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenario was tested in RESOLVE.

Capacity Expansion Scenarios

- **Hi_Base_wBiogenic**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-30 are the resource capacities in 2030 and 2035 grouped by resource type and procurement. The model selects the same amount of future onshore wind and future standalone storage as previously.

Table 4-30: Hawai'i Island RESOLVE results summary, year 2030 and 2035, w/ biogenic emissions.

Hi_Base_wBiogenic	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	15 MW	15 MW
Future Firm	0 MW	0 MW
Total	**482 MW**	**603 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	5 MW / 20 MWh	5 MW / 20 MWh
Total	**180 MW / 720 MWh**	**266 MW / 1,064 MWh**
NPV (MM 2018$, 2030-2050)	**1,399**	

Accounting for biogenic emissions does not impact the resource plan and consequently NPV is unaffected (Table 4-56).

Model Comparison

The resource plan developed by RESOLVE was analyzed in PLEXOS, which performs a more detailed hourly simulation.

- **Hi_30Base_wBiogenic**
    - RESOLVE resources for year 2030 (Table 4-30).

- **Hi_35Base_wBiogenic**
    - RESOLVE resources for year 2035 (Table 4-30).

Results

Table 4-31 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-31: Hawai'i Island RESOLVE / PLEXOS Scenario Comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Hi_Base_wBiogenic (RESOLVE)	0.0%	**-95%**	**98%**	15 MW, Onshore Wind
Hi_30Base_wBiogenic (PLEXOS)	0.5%	**-97%**	**98%**	15 MW, Onshore Wind
2035				
Hi_Base_wBiogenic (RESOLVE)	0.2%	**-100%**	**100%**	15 MW, Onshore Wind
Hi_35Base_wBiogenic (PLEXOS)	1.7%	**-98%**	**100%**	15 MW, Onshore Wind

With the resource plan described in Table 4-30, both RESOLVE and PLEXOS results meet the RPS and GHG targets for 2030 and 2035. Because the 2030 RPS and GHG targets are far exceeded, the following sensitivity analysis evaluates impacts to RPS and GHG reduction when renewable resources are removed.

Variable Renewable Sensitivities

Given the high levels of RPS and GHG reduction, RESOLVE-added and other future planned resources were removed to test the sensitivity of the RPS and GHG reduction to new resource additions.

2030 Scenarios

- **Hi_30Base_wBiogenic**
    - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-30).
- **Hi_30Planned_wBiogenic**
    - RESOLVE-added resources for year 2030 (Table 4-30).
    - Remove future onshore wind and future BESS.
- **Hi_30Planned_wBiogenic_woIGPPV**
    - RESOLVE-added resources for year 2030 (Table 4-30).

    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar.

- **Hi_30Planned_wBiogenic_woIGP**
    - RESOLVE-added resources for year 2030 (Table 4-30).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar and IGP onshore wind.

2035 Scenarios

- **Hi_35Base_wBiogenic**
    - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-30).
- **Hi_35Planned_wBiogenic**
    - RESOLVE-added resources for year 2035 (Table 4-30).
    - Remove future onshore wind and future BESS.
- **Hi_35Planned_wBiogenic_woIGPPV**
    - RESOLVE-added resources for year 2035 (Table 4-30).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar.
- **Hi_35Planned_wBiogenic_woIGP**
    - RESOLVE-added resources for year 2035 (Table 4-30).
    - Remove future onshore wind and future BESS.
    - Remove IGP hybrid solar and IGP onshore wind.

Results

Because RESOLVE built the same resource portfolio when including biogenic emissions and when excluding biogenic emissions, Figure 4-13 is essentially unchanged as the prior sensitivity analyses in Section 4.2.1.2.

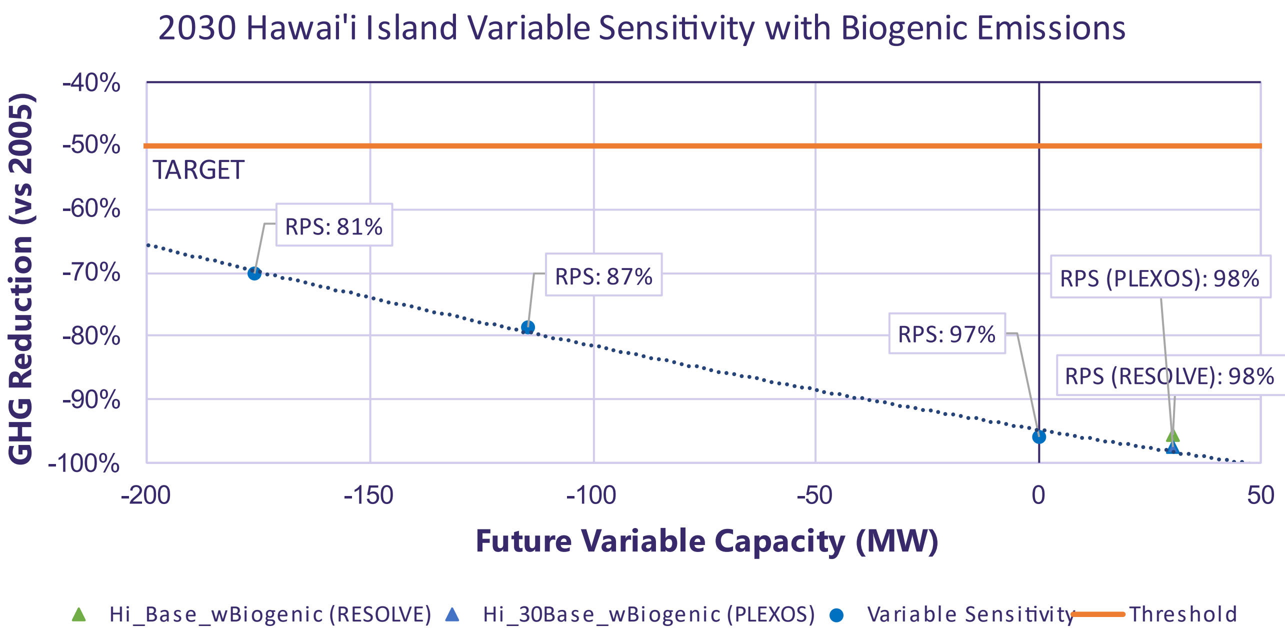

Figure 4-13: Hawai'i Island RPS and GHG (w/ biogenic emissions) in 2030 with incremental equivalent hybrid solar capacity.

Under the accelerated goal of 100% RPS in 2035, all existing firm are converted to biofuels. Figure 4-14 shows the GHG reduction from biofuels versus capacity of future hybrid solar.

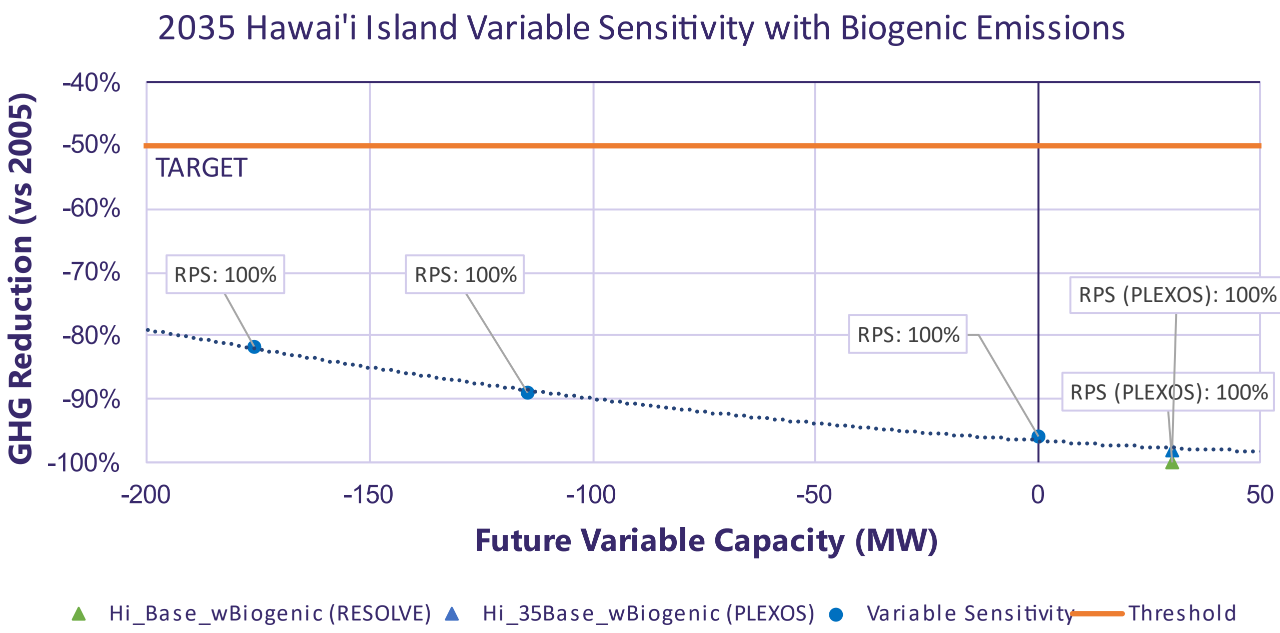

Figure 4-14: Hawai'i Island RPS and GHG (w/ biogenic emissions) in 2035 with incremental equivalent hybrid solar capacity.

Table 4-32 below expands on Table 4-31 and shows how adding and removing future resources affects biofuel usage. If biogenic emissions are included, biofuels cannot be used instead of fossil fuels to reduce GHG.

Table 4-32: Expanded Hawai'i Island RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Hi_Base_wBiogenic (RESOLVE)	0.0%	-95%	98%	15 MW, Onshore Wind
Hi_30Base_wBiogenic (PLEXOS)	0.5%	-97%	98%	15 MW, Onshore Wind
Hi_30Planned_ wBiogenic (PLEXOS)	0.8%	-96%	97%	0
Hi_30Planned_wBiogenic_woIGPPV (PLEXOS)	5.2%	-79%	87%	-115 MW, Hybrid Solar
Hi_30Planned_wBiogenic_woIGP (PLEXOS)	7.7%	-70%	81%	-115 MW, Hybrid Solar -30 MW, Onshore Wind
2035				
Hi_Base_wBiogenic (RESOLVE)	0.2%	-100%	100%	15 MW, Onshore Wind
Hi_35Base_wBiogenic (PLEXOS)	1.7%	-98%	100%	15 MW, Onshore Wind
Hi_35Planned_ wBiogenic (PLEXOS)	3.7%	-96%	100%	0
Hi_35Planned_wBiogenic_woIGPPV (PLEXOS)	9.9%	-89%	100%	-115 MW, Hybrid Solar
Hi_35Planned_wBiogenic_woIGP (PLEXOS)	17.1%	-82%	100%	-115 MW, Hybrid Solar -30 MW, Onshore Wind

Table 4-33 below shows the resources plan through the IGP RFPs, in 2030 and 2035, and their corresponding RPS and GHG results.

Table 4-33: Hawai'i Island PLEXOS results summary, year 2030 and 2035, w/ biogenic emissions.

	Hi_30Planned_wBiogenic	Hi_35Planned_wBiogenic
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	0 MW	0 MW
Future Firm	0 MW	0 MW
Total	**467 MW**	**588 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**175 MW / 700 MWh**	**261 MW / 1,044 MWh**
RPS (%)	**97%**	**100%**
GHG (%)	**-96%**	**-96%**

Table 4-34 compares the PLEXOS planned scenarios with biogenic emissions to the ones without biogenic emissions, all scenarios are well within the RPS and GHG targets.

Table 4-34: Hawai'i Island PLEXOS comparison, year 2030 and 2035, w/ biogenic emissions vs w/o biogenic emissions.

Scenario	Biogenic Emissions Included in GHG	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030					
Hi_30Planned_woBiogenic	Excluded	0.8%	**-96%**	**97%**	0
Hi_30Planned_wBiogenic	Included	0.8%	**-96%**	**97%**	0
2035					
Hi_35Planned_woBiogenic	Excluded	3.7%	**-100%**	**100%**	0
Hi_35Planned_wBiogenic	Included	3.7%	**-96%**	**100%**	0

4.2.2.3 Maui

Maui can satisfy the RPS and GHG goals relying mostly on variable renewable resources. Including biogenic emissions in the GHG reduction analysis does not affect the resources selected by RESOLVE.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** The resulting resource plan developed by RESOLVE is unaffected by the inclusion of biogenic emissions (Table 4-35).
- **Model Comparison:** Due to the high levels of RPS and GHG reduction achieved through planned resources, the model results from RESOLVE and PLEXOS are very similar.
- **Variable Renewable Sensitivities (PLEXOS):** The same sensitivities as Section 4.2.1.3 were tested. While GHG emissions are higher with the inclusion of biogenic emissions, emissions reductions still exceed the target.
    - **2030:** 60 MW of hybrid solar from Stage 3 could be missing and still satisfy both RPS and GHG targets (Figure 4-17**,** Table 4-37).
    - **2035:** RESOLVE builds 257 MW hybrid solar above what is being sought in the IGP RFP. The additional hybrid solar built by RESOLVE reduces biofuel consumption and the subsequent GHG emissions (Figure 4-18, Table 4-37).
- **Biogenic Emission Comparison:** The 2035 results show that, when the firm generators convert to biofuel to meet the 100% RPS target, only about 3% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources (Table 4-36). Including biogenic

emissions has a minimal impact on the GHG reduction levels. Accounting for biogenic emissions does not impact the resource plan and consequently NPV is virtually unaffected (Table 4-59).

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated above in Section 4.2.1.3 with the exception that in this case, biogenic CO2 emissions from biofuels are now accounted for in the GHG emission totals.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenario was tested in RESOLVE.

Capacity Expansion Scenarios

- **Ma_Base_wBiogenic**
    - Updated resource assumptions.
    - Updated RPS and GHG targets.
    - Biogenic emissions count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-35 are the resource capacities in 2030 and 2035 grouped by resource type and procurement. The model selects the same amount of hybrid solar and onshore wind as previously.

Table 4-35: Maui RESOLVE results summary, year 2030 and 2035, w/ biogenic emissions.

Ma_Base_wBiogenic	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ūkiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	180 MW	257 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	14 MW	14 MW
Future Firm	0 MW	0 MW
Total	**588 MW**	**676 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	183 MW / 732 MWh	268 MW / 1072 MWh
Total	**358 MW / 1432 MWh**	**468 MW / 1872 MWh**
NPV (MM 2018$, 2030-2050)	**2,149**	

Accounting for biogenic emissions does not impact the resource plan and consequently NPV is unaffected (Table 4-59).

Model Comparison

The resource plan developed by RESOLVE was analyzed in PLEXOS, which performs a more detailed hourly simulation.

- **Ma_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-35).
- **Ma_35Base_wBiogenic**
  - RESOLVE-added resources year 2035 (Table 4-35).

Results

Table 4-36 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-36: Maui RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Ma_Base_wBiogenic (RESOLVE)	0.00%	**-93%**	**96%**	180 MW, Hybrid Solar 14 MW, Onshore Wind
Ma_30Base_wBiogenic (PLEXOS)	0.03%	**-94%**	**94%**	180 MW, Hybrid Solar 14 MW, Onshore Wind
2035				
Ma_Base_wBiogenic (RESOLVE)	2.0%	**-97%**	**100%**	257 MW, Hybrid Solar 14 MW, Onshore Wind
Ma_35Base_wBiogenic (PLEXOS)	3.3%	**-96%**	**100%**	257 MW, Hybrid Solar 14 MW, Onshore Wind

With the resource plan described in Table 4-35, both RESOLVE and PLEXOS results meet the RPS and GHG targets for 2030, as well as the RPS target for 2035. Because the 2030 RPS and GHG targets are far exceeded, the following sensitivity analysis evaluates impacts to RPS and GHG reduction when renewable resources are removed.

Variable Renewable Sensitivities

Given the high levels of RPS and GHG reduction, RESOLVE-added and other future planned resources were removed to test the sensitivity of the RPS and GHG reduction to new resource additions.

2030 Scenarios

- **Ma_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-35).
- **Ma_30Planned_wBiogenic**
  - Remove future hybrid solar, future onshore wind, and future BESS.

- **Ma_30Planned_wBiogenic _woPulehuKuihelani2**
  - Remove future hybrid solar, future onshore wind, and future BESS.
  - Remove 60 MW Stage 3 hybrid solar (Pulehu Solar and Kuihelani Ph2 Solar).

2035 Scenarios

- **Ma_35Base_wBiogenic**
  - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-35).
- **Ma_35Base_wBiogenic_w180HS**
  - RESOLVE-added resources year 2035 (Table 4-35).

    Reduce future hybrid solar from 257 MW to 180 MW.
- **Ma_35Planned_wBiogenic**
  - Remove future hybrid solar, future onshore wind, and future BESS.
- **Ma_35Planned_wBiogenic_woIGPRFP**
  - Remove future hybrid solar, future onshore wind, and future BESS.
  - Remove IGP RFP resources.

Results

Because RESOLVE built very similar resource portfolios when including biogenic emissions and when excluding biogenic emissions, Figure 4-15 is essentially unchanged as the prior sensitivity analyses in Section 4.2.1.3.

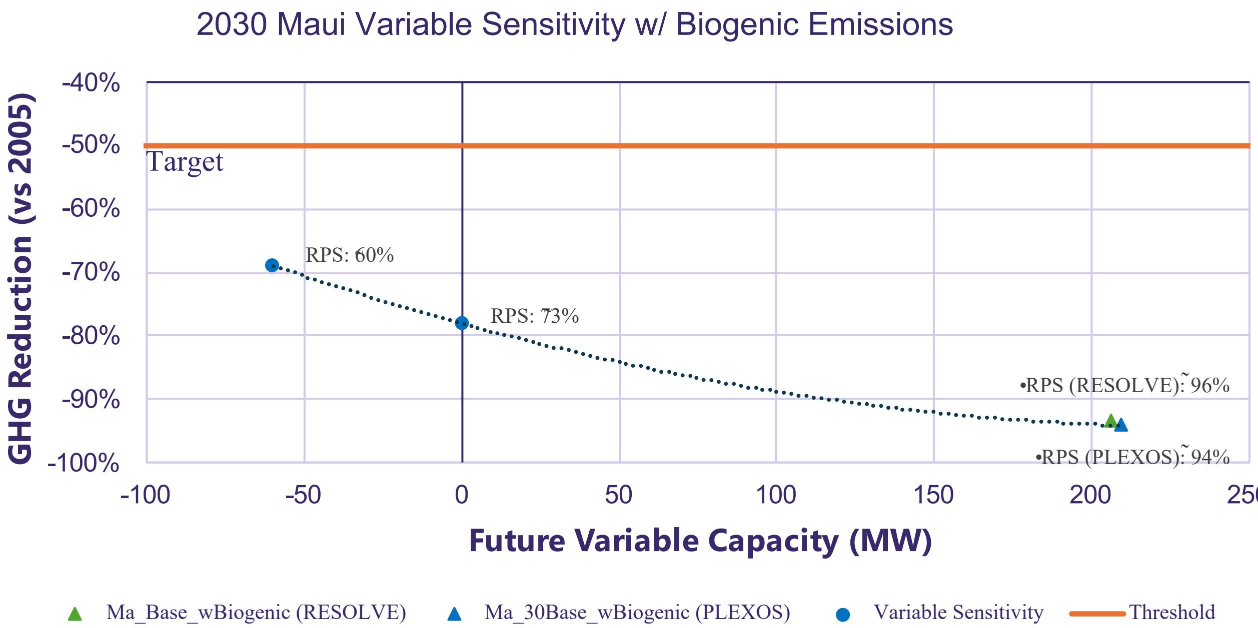

Figure 4-15: Maui RPS and GHG (w/ biogenic emissions) in 2030 with incremental hybrid solar capacity.

Under the accelerated goal of 100% RPS in 2035, all existing firm are converted to biofuels. Figure 4-16 shows the GHG reduction versus capacity of equivalent future hybrid solar. Both RPS and GHG emissions goals will be met before planned resources are added through the IGP RFP. In the resource plan developed by RESOLVE, generation from biofuels accounts for 2% of total generation. Without the IGP RFP and future RESOLVE resources, generation from biofuels increases to over 40%. When accounting for biogenic emissions, this equates to a 65% reduction in GHG emissions exceeding the target of 50%.

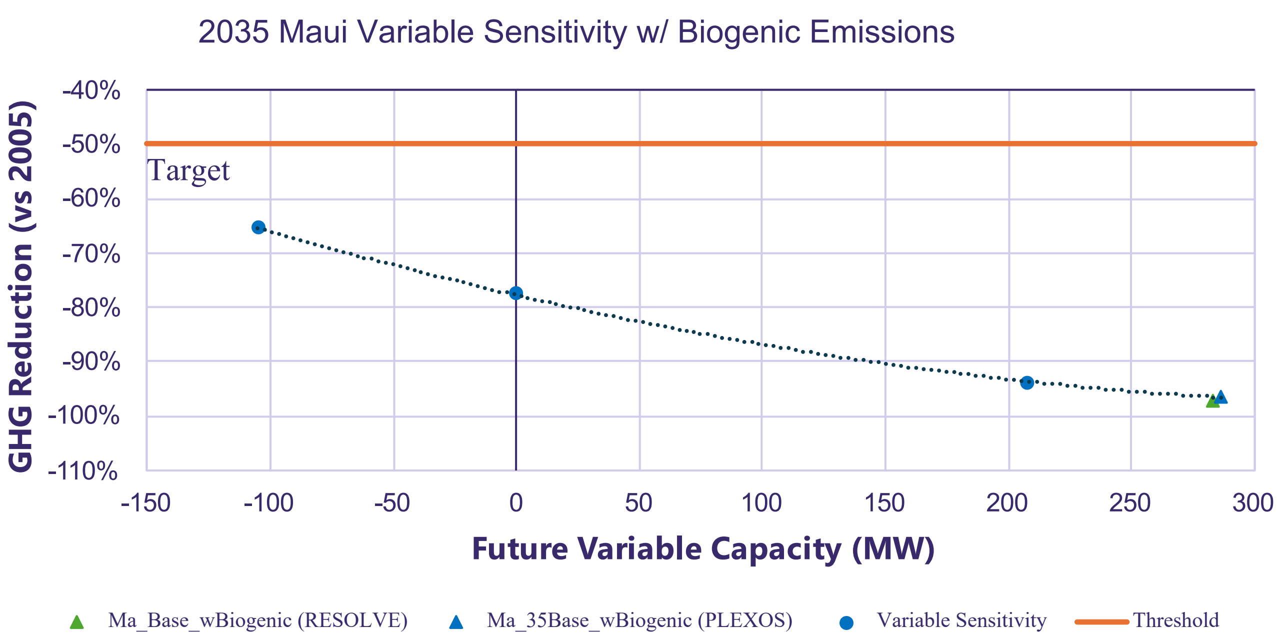

Figure 4-16: Maui RPS and GHG (w/ biogenic emissions) in 2035 with incremental hybrid solar capacity.

Table 4-37 below expands on Table 4-36 and shows how adding and removing future resources affects biofuel usage.

Table 4-37: Expanded Maui RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Ma_Base_wBiogenic (RESOLVE)	0.00%	-93%	96%	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_30Base_wBiogenic (PLEXOS)	0.03%	-94%	94%	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_30Planned_wBiogenic (PLEXOS)	0.07%	-78%	73%	0
Ma_30Planned_wBiogenic_ woPulehuKuihelani2 (PLEXOS)	0.3%	-69%	60%	-60 MW Stage 3 Hybrid Solar
2035				
Ma_Base_wBiogenic (RESOLVE)	2.0%	-97%	100%	257 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Base_wBiogenic (PLEXOS)	3.3%	-96%	100%	257 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Base_wBiogenic_w180HS (PLEXOS)	6.1%	-94%	100%	180 MW Hybrid Solar 14 MW Onshore Wind
Ma_35Planned_wBiogenic (PLEXOS)	25.9%	-78%	100%	0
Ma_35Planned_wBiogenic_woIGPRFP (PLEXOS)	40.8%	-65%	100%	-25 MW IGP Hybrid Solar -40 MW IGP Onshore Wind

Table 4-38 below shows the resources plan through the IGP RFPs, in 2030 and 2035, and their corresponding RPS and GHG results.

Table 4-38: Maui PLEXOS results summary, year 2030 and 2035, w/ biogenic emissions.

	Ma_30Planned_wBiogenic	Ma_35Planned_wBiogenic
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ūkiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	0 MW	0 MW
Future Firm	0 MW	0 MW
Total	**394 MW**	**405 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**175 MW / 700 MWh**	**200 MW / 800 MWh**
RPS (%)	**73%**	**100%**
GHG Reduction (%)	**-78%**	**-78%**

Table 4-39 compares the PLEXOS scenarios with biogenic emissions to the ones without biogenic emissions, and all scenarios are well within the RPS and GHG targets.

Table 4-39: Maui PLEXOS comparison, year 2030 and 2035, w/ biogenic emissions vs w/o biogenic emissions.

Scenario	Biogenic Emissions Included in GHG	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030					
Ma_30Planned_woBiogenic	Excluded	0.07%	**-77%**	**73%**	0
Ma_30Planned_wBiogenic	Included	0.07%	**-78%**	**73%**	0
2035					
Ma_35Planned_woBiogenic	Excluded	25.9%	**-100%**	**100%**	0
Ma_35Planned_wBiogenic	Included	25.9%	**-78%**	**100%**	0

4.2.2.4 Moloka'i

While reducing GHG emissions will drive our future resource acquisitions, 2030 and 2035 resource needs are the same if biogenic emissions are included in our GHG reduction analysis.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** The resulting resource plan developed by RESOLVE is unaffected by the inclusion of biogenic emissions (Table 4-40).
- **Model Comparison:** The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 10% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources (Table 4-41).
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE exceeded the RPS and GHG targets when analyzed in PLEXOS. As a result, future resources selected by RESOLVE were incrementally removed to determine the minimum number of new resources needed by 2030 and 2035 for the island to meet the RPS and GHG goals.
    - **2030:** At a minimum, approximately 4.4 MW of future hybrid solar, in total, are needed by 2030 to meet RPS and GHG targets (Figure 4-17**,** Table 4-43).
    - **2035:** The same 4.4 MW of future hybrid solar being sought in 2030 should allow the Moloka'i system to meet the 2035 RPS and GHG targets (Figure 4-18, Table 4-43). Additional variable renewable resources can further reduce biofuel consumption (Table 4-42).

- **Biogenic Emission Comparison:** Whether or not we include biogenic emissions in the GHG calculation does not change the number of resources needed on Molokaʻi to reach the 2030 and 2035 RPS and GHG targets. In 2035, however, when the firm generators convert to biofuel to meet the 100% RPS target, including biogenic emissions has a significant impact on the GHG reduction levels.

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated above in Section 4.2.1.4 with the exception that in this case, biogenic CO2 emissions from biofuels are now accounted for in the GHG emission totals.

Capacity Expansion

After incorporating updated resource assumptions and recent government policy changes, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **Mo_Base_wBiogenic**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions count towards GHG targets or GHG reduction.

Results

Shown below in Table 4-40 are the resource capacities in 2030 and 2035 grouped by resource type and procurement. In 2030, the model builds 10.0 MW of future hybrid solar and 0.5 MW of future 4-hour standalone storage. In 2035, the model builds an additional 1.3 MW of future hybrid solar and an additional 0.1 MW of future 4-hour standalone storage.

Table 4-40: Moloka'i RESOLVE results summary, year 2030 and 2035, w/ biogenic emissions.

Mo_Base_wBiogenic	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	10.2 MW	11.1 MW
Total	**28.1 MW**	**29.0 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	10.2 MW / 40.8 MWh	11.1 MW / 44.4 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**13.2 MW / 53.9 MWh**	**14.1 MW / 57.5 MWh**
NPV (MM 2018$, 2030-2050)	**87.9**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **Mo_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-40).
- **Mo_35Base_wBiogenic**
  - RESOLVE-added resources for year 2035 (Table 4-40).

Results

Table 4-41 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-41: Moloka'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Mo_Base_wBiogenic (RESOLVE)	0.0%	-87%	85%	10.2 MW Hybrid Solar
Mo_30Base_wBiogenic (PLEXOS)	0.0%	-90%	89%	10.2 MW Hybrid Solar
2035				
Mo_Base_wBiogenic (RESOLVE)	12.3%	-89%	100%	11.1 MW Hybrid Solar
Mo_35Base_wBiogenic (PLEXOS)	9.2%	-91%	100%	11.1 MW Hybrid Solar

The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 10% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources. Given this observation, the following sensitivity analysis reduces the amount of future generation that is added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Using the resource plan developed by RESOLVE, the 2030 and 2035 buildout was tested in PLEXOS to determine the minimum amount of future variable resource is needed to achieve the RPS and GHG targets.

2030 Scenarios

- **Mo_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-40).
- **Mo_30Base_wBiogenic_w4.4HS**
  - RESOLVE-added resources for year 2030 (Table 4-40).
  - Future hybrid solar reduced to 4.4 MW.
- **Mo_30Base_wBiogenic_w0HS**
  - RESOLVE-added resources for year 2030 (Table 4-40).
  - Future hybrid solar reduced to 0.0 MW.

2035 Scenarios

- **Mo_35Base_wBiogenic**

- RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-40).

- **Mo_35Base_wBiogenic_w4.4HS**
  - RESOLVE-added resources for year 2035 (Table 4-40).
  - Future hybrid solar reduced to 4.4 MW.
- **Mo_35Base_wBiogenic_w0HS**
  - RESOLVE-added resources for year 2035 (Table 4-40).
  - Future hybrid solar reduced to 0.0 MW.

Results

Figure 4-17 below shows the future hybrid solar capacity needed by 2030 to meet the 60% RPS target and 50% GHG reduction target. Approximately 4.4 MW of future hybrid solar is needed to meet both targets. For this scenario, the RPS target is the binding constraint while the GHG target is non-binding as the 50% GHG target is achieved first, and additional resources are needed to meet the 60% RPS target.

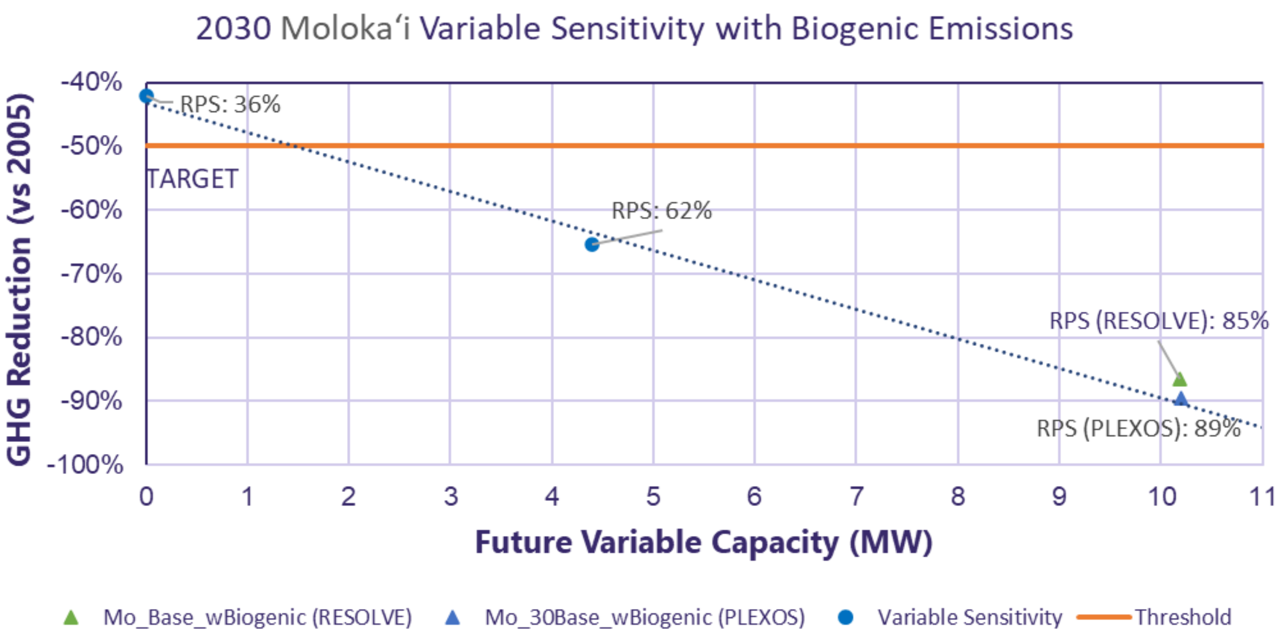

Figure 4-17: Moloka'i RPS and GHG (w/ biogenic emissions) in 2030 with incremental addition of future hybrid solar capacity.

Figure 4-18 below shows the future hybrid solar capacity needed by 2035 to meet the 100% RPS target and 50% GHG reduction target. Since all the firm generators switch to biofuel in 2035 to achieve the 100% RPS target for Moloka'i, and since we are including biogenic emissions in the GHG analysis, we could achieve our 2035 targets without any incremental future hybrid solar in 2035.

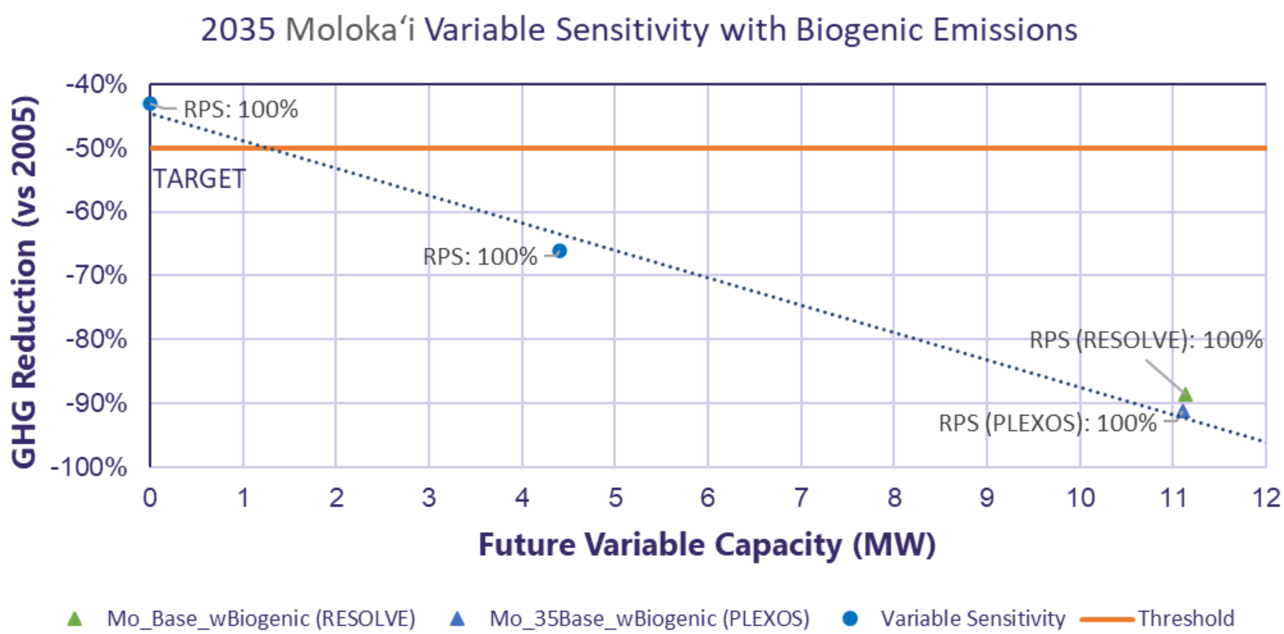

Figure 4-18: Moloka'i RPS and GHG (w/ biogenic emissions) in 2035 with incremental addition of future hybrid solar capacity.

Table 4-42 below expands on Table 4-41 and shows how different models and adding future hybrid solar affects biofuel usage. If biogenic emissions are included, biofuels can't be used instead of fossil fuels to reduce GHG.

Table 4-42: Expanded Moloka'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
Mo_Base_wBiogenic (RESOLVE)	0.0%	**-87%**	**85%**	10.2 MW Hybrid Solar
Mo_30Base_wBiogenic (PLEXOS)	0.0%	**-90%**	**89%**	10.2 MW Hybrid Solar
Mo_30Base_ wBiogenic_w4.4HS (PLEXOS)	0.0%	**-65%**	**62%**	4.4 MW Hybrid Solar
Mo_30Base_ wBiogenic_w0HS (PLEXOS)	0.0%	**-42%**	**36%**	0 MW Hybrid Solar
2035				
Mo_Base_wBiogenic (RESOLVE)	12.3%	**-89%**	**100%**	11.1 MW Hybrid Solar
Mo_35Base_wBiogenic (PLEXOS)	9.2%	**-91%**	**100%**	11.1 MW Hybrid Solar
Mo_35Base_ wBiogenic_w4.4HS (PLEXOS)	36.3%	**-66%**	**100%**	4.4 MW Hybrid Solar
Mo_35Base_ wBiogenic_w0HS (PLEXOS)	61.0%	**-43%**	**100%**	0 MW Hybrid Solar

Since 4.4 MW of future hybrid solar is needed to achieve the 2030 targets, it is assumed that the 4.4 MW of future hybrid solar will also be in-service in 2035. Table 4-43 below shows the 2030 and 2035 scenarios that meet the RPS and GHG metrics.

Table 4-43: Moloka'i PLEXOS results summary, year 2030 and 2035, w/ biogenic emissions.

	Mo_30Base_wBiogenic_w4.4HS	Mo_35Base_wBiogenic_w4.4HS
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	4.4 MW	4.4 MW
Total	**22.3 MW**	**22.3 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	4.4 MW / 17.6 MWh	4.4 MW / 17.6 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**7.4 MW / 30.7 MWh**	**7.4 MW / 30.7 MWh**
RPS (%)	**62%**	**100%**
GHG Reduction (%)	**-65%**	**-66%**

Table 4-44 highlights the impact that including biogenic emissions in the GHG calculation can have on the results. The minimum number of new resources needed by 2030 and 2035 for the island to meet the RPS and GHG goals remains the same regardless if biogenic emissions are considered a GHG emission. In 2035, however, when the firm generators convert to biofuel to meet the 100% RPS target, including biogenic emissions as a GHG emissions has a significant impact on the GHG reduction levels.

Table 4-44: Moloka'i PLEXOS comparison, year 2030 and 2035, w/ biogenic emissions vs w/o biogenic emissions.

Scenario	Biogenic Emissions Included in GHG	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030					
Mo_30Base_ woBiogenic_w4.4HS (PLEXOS)	Excluded	0.0%	**-65%**	**62%**	4.4 MW Hybrid Solar
Mo_30Base_ wBiogenic_w4.4HS (PLEXOS)	Included	0.0%	**-65%**	**62%**	4.4 MW Hybrid Solar
2035					
Mo_35Base_ woBiogenic_w4.4HS (PLEXOS)	Excluded	36.3%	**-100%**	**100%**	4.4 MW Hybrid Solar
Mo_35Base_ wBiogenic_w4.4HS (PLEXOS)	Included	36.3%	**-66%**	**100%**	4.4 MW Hybrid Solar

4.2.2.5 Lāna'i

While reducing GHG emissions will drive our future resource acquisitions, 2030 and 2035 resource needs are the same if biogenic emissions are included in our GHG reduction analysis.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** The resulting resource plan developed by RESOLVE is unaffected by the inclusion of biogenic emissions (Table 4-45).
- **Model Comparison:** The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 6% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources.
- **Variable Renewable Sensitivities (PLEXOS):** The resource plan developed by RESOLVE exceeded the RPS and GHG targets when analyzed in PLEXOS. As a result, future resources were incrementally removed to determine the minimum amount of needed by 2030 and 2035 for the island to meet the RPS and GHG targets.
  - **2030:** At a minimum, approximately 13.2 MW of future hybrid solar, in total, are needed by 2030 to meet RPS and GHG targets (Figure 4-19, Table 4-48).
  - **2035:** The same 13.2 MW of future hybrid solar being sought in 2030 should allow the Lāna'i system to meet the 2035 RPS and GHG targets (Figure 4-20, Table 4-48). Additional variable renewable resources can further reduce biofuel consumption (Table 4-47).

- **Biogenic Emission Comparison:** Whether or not we include biogenic emissions in the GHG calculation does not change the number of resources needed on Lānaʻi to reach the 2030 and 2035 RPS and GHG targets. In 2035, however, when the firm generators convert to biofuel to meet the 100% RPS target, including biogenic emissions has a significant impact on the GHG reduction levels.

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated above in Section 4.2.1.5 with the exception that in this case, biogenic CO2 emissions from biofuels are now accounted for in the GHG emission totals.

Capacity Expansion

After incorporating updated resource and policy assumptions, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **La_Base_wBiogenic**
  - Updated resource assumptions.
  - Updated RPS and GHG targets.
  - Biogenic emissions count towards GHG targets or GHG reduction.

Results

Shown below are the generating resources capacities in 2030 and 2035, grouped by resource type and procurement (Table 4-45). In 2030, RESOLVE selected 20 MW of future hybrid solar and 0.5 MW of future 4-hour standalone storage. In 2035, RESOLVE selected an additional 1.3 MW of future hybrid solar.

Table 4-45: Lānaʻi RESOLVE results summary, year 2030 and 2035, w/ biogenic emissions.

La_Base_wBiogenic	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0.0 MW	0.0 MW
Future Hybrid Solar	20 MW	21.3 MW
Total	**30.4 MW**	**31.7 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	20 MW / 80.1 MWh	21.3 MW / 85.2 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.2 MWh
Total	**20.5 MW / 82.2 MWh**	**21.8 MW / 87.4 MWh**
NPV (MM 2018$, 2030-2050)	**84.3**	

Model Comparison

In RESOLVE, the portfolio must meet the RPS and GHG targets. It does this through a combination of least-cost dispatch and build out of new generating resources over a set of representative days. When the resource plan from RESOLVE is modeled in PLEXOS, no requirements for RPS and GHG targets are enforced. PLEXOS is used as a check to confirm that the RPS and GHG targets continue to be met when modeling every hour over the course of a year.

- **La_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 (Table 4-45).
- **La_35Base_wBiogenic**
  - RESOLVE-added resources for year 2035 (Table 4-45).

Results

Table 4-46 below shows how the results from RESOLVE and PLEXOS models compare in terms of meeting the RPS and GHG targets, and biofuel consumption.

Table 4-46: Lāna'i RESOLVE / PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
La_Base_wBiogenic (RESOLVE)	0.0%	-89%	92%	20 MW Hybrid Solar
La_30Base_wBiogenic (PLEXOS)	0.0%	-89%	93%	20 MW Hybrid Solar
2035				
La_Base_wBiogenic (RESOLVE)	6.6%	-91%	100%	21.3 MW Hybrid Solar
La_35Base_wBiogenic (PLEXOS)	5.5%	-92%	100%	21.3 MW Hybrid Solar

The 2030 results show that we are expected to exceed the 2030 RPS and GHG targets. The 2035 results show that, even with our firm generators on biofuels, only about 5% of the total generation is expected to come from biofuels with the rest coming from variable renewable sources. Given this observation, the following sensitivity analysis reduces the amount of future generation is that added to determine the minimum amount that would be needed to meet the RPS and GHG targets.

Variable Renewable Sensitivities

Using the resource plan developed by RESOLVE, the 2030 and 2035 buildout were tested in PLEXOS to determine the minimum amount of future variable resource needed to achieve the RPS and GHG targets.

2030 Scenarios

- **La_30Base_wBiogenic**
  - RESOLVE-added resources for year 2030 used as the basis for this sensitivity analysis (Table 4-45).
- **La_30Base_wBiogenic_Hybrid-7**
  - RESOLVE-added resources for year 2030 (Table 4-45).
  - Future hybrid solar is reduced to 15.4 MW.
- **La_30Base_wBiogenic _Hybrid-6**
  - RESOLVE-added resources for year 2030 (Table 4-45).
  - Future hybrid solar is reduced to 13.2 MW.
- **La_30Base_wBiogenic _Hybrid-5**
  - RESOLVE-added resources for year 2030 (Table 4-45).
  - Future hybrid solar is reduced to 11 MW.

2035 Scenarios

- **La_35Base_wBiogenic**
  - RESOLVE-added resources for year 2035 used as the basis for this sensitivity analysis (Table 4-45).
- **La_30Base_wBiogenic_Hybrid-7**
  - RESOLVE-added resources for year 2035 (Table 4-45).
  - Future hybrid solar is reduced to 15.4 MW.
- **La_30Base_wBiogenic _Hybrid-6**
  - RESOLVE-added resources for year 2035 (Table 4-45).
  - Future hybrid solar is reduced to 13.2 MW.
- **La_30Base_wBiogenic _Hybrid-5**
  - RESOLVE-added resources for year 2035 (Table 4-45).
  - Future hybrid solar is reduced to 11 MW.

Results

Figure 4-19 below shows the future hybrid solar capacity needed by 2030 to meet the 60% RPS target and 50% GHG reduction target. Approximately 13.2 MW of future hybrid solar is needed to meet both targets. For this scenario, the GHG target is the binding constraint while the RPS target is non-binding as the 60% RPS target is achieved first, and additional resources are needed to meet the 50% GHG target.

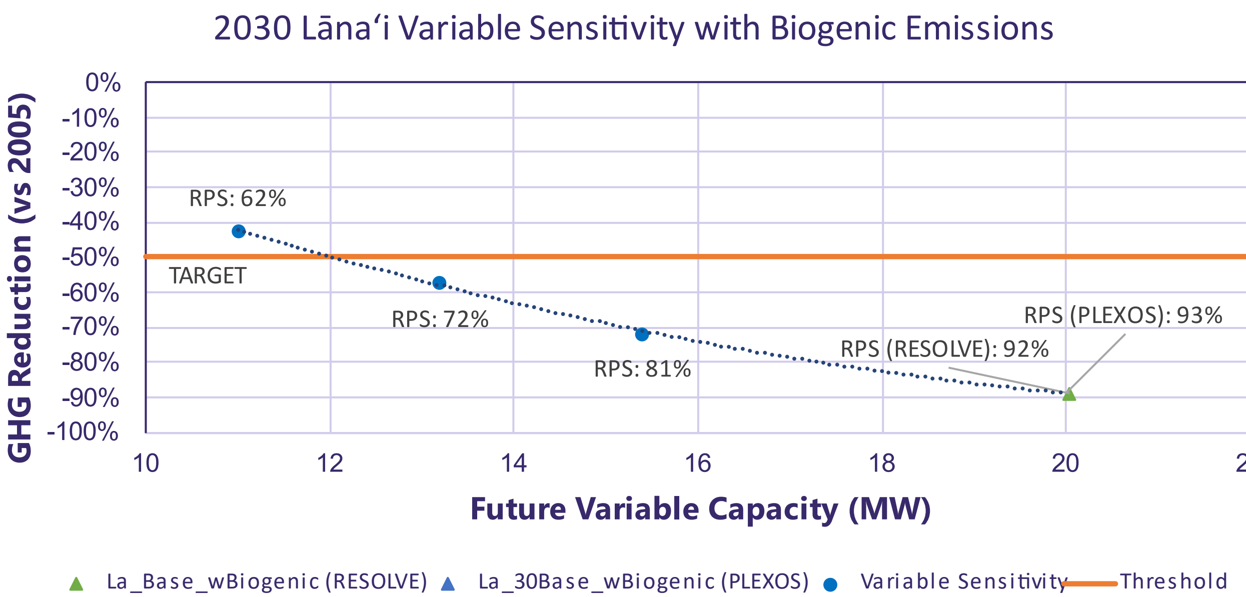

Figure 4-19: Lānaʻi RPS and GHG (w/ biogenic emissions) in 2030 with incremental addition of future hybrid solar capacity.

Figure 4-20 below shows the future hybrid solar capacity needed by 2035 to meet the 100% RPS target and 50% GHG reduction target. Since all firm generators switch to biofuel in 2035 to achieve the 100% RPS target for Lānaʻi, and since we are including biogenic emissions in the GHG analysis, we could achieve our 2035 targets without any incremental future hybrid solar in 2035.

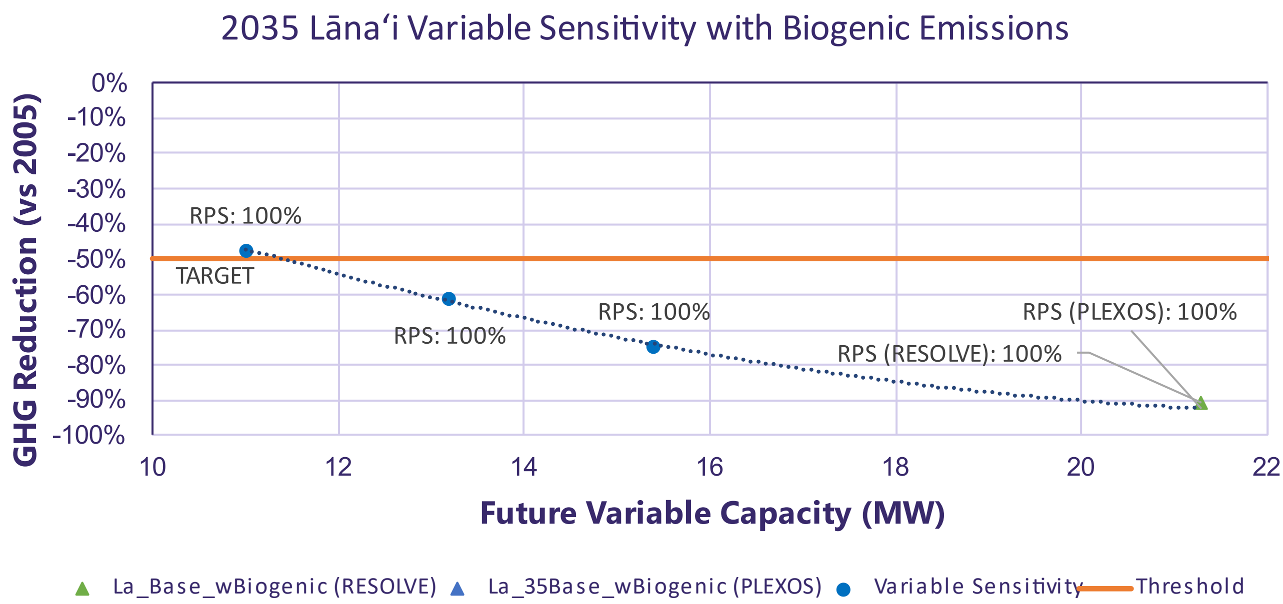

Figure 4-20: Lānaʻi RPS and GHG (w/ biogenic emissions) in 2035 with incremental addition of future hybrid solar capacity.

Table 4-47 below expands on Table 4-46 to show how adding future variable resources affects biofuel usage.

Table 4-47: Expanded Lānaʻi RESOLVE / PLEXOS Scenario Comparison, year 2030 and 2035, w/ biogenic emissions.

Scenario	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030				
La_Base_wBiogenic (RESOLVE)	0.0%	**-89%**	**92%**	20 MW Hybrid Solar
La_30Base_wBiogenic (PLEXOS)	0.0%	**-89%**	**93%**	20 MW Hybrid Solar
La_30Base_wBiogenic_Hybrid-7	0.0%	**-72%**	**81%**	15.4 MW Hybrid Solar
La_30Base_wBiogenic_Hybird-6	0.0%	**-57%**	**72%**	13.2 MW Hybrid Solar
La_30Base_wBiogenic_Hybrid-5	0.0%	**-42%**	**62%**	15.4 MW Hybrid Solar
2035				
La_Base_wBiogenic (RESOLVE)	6.6%	**-91%**	**100%**	21.3 MW Hybrid Solar
La_35Base_wBiogenic (PLEXOS)	5.5%	**-92%**	**100%**	21.3 MW Hybrid Solar
La_35Base_wBiogenic_Hybrid-7	18.7%	**-75%**	**100%**	15.4 MW Hybrid Solar
La_35Base_wBiogenic_Hybrid-6	28.3%	**-61%**	**100%**	13.2 MW Hybrid Solar
La_35Base_wBiogenic_Hybrid-5	38.4%	**-47%**	**100%**	11 MW Hybrid Solar

Since 13.2 MW of future hybrid solar is needed to achieve the 2030 targets, it is assumed that the 13.2 MW of future hybrid solar will also be in-service in 2035. Table 4-48 below shows the 2030 and 2035 scenarios that meet the RPS and GHG targets.

Table 4-48: Lāna'i PLEXOS results summary, year 2030 and 2035, w/ biogenic emissions.

	La_30Base_wBiogenic_Hybrid-6	La_35Base_wBiogenic_Hybrid-6
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0 MW	0 MW
Future Hybrid Solar	13.2 MW	13.2 MW
Total	**23.6 MW**	**23.6 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	13.2 MW / 52.8 MWh	13.2 MW / 52.8 MWh
Future Standalone BESS	0.5 MW / 2.0 MWh	0.5 MW / 2.0 MWh
Total	**13.7 MW / 54.8 MWh**	**13.7 MW / 54.8 MWh**
RPS (%)	**72%**	**100%**
GHG Reduction (%)	**-57%**	**-61%**

Table 4-49 highlights the impact that including biogenic emissions in the GHG calculation can have on the results. The minimum number of new resources needed by 2030 and 2035 for the island to meet the RPS and GHG goals remains the same whether biogenic emissions are considered a GHG emission. In 2035, however, when the firm generators convert to biofuel to meet the 100% RPS target, including biogenic emissions as a GHG emissions has a significant impact on the GHG reduction levels.

Table 4-49: Lāna'i PLEXOS scenario comparison, year 2030 and 2035, w/ biogenic emissions vs w/o biogenic emissions.

Scenario	Biogenic Emissions Included in GHG	Share of Total Generation from Biofuels (%)	GHG Reduction (%, relative to 2005 levels)	RPS (%)	Added Future Generation (Cumulative MW)
2030					
La_30Base_woBiogenic_Hybrid-6	Excluded	0.0%	**57%**	**72%**	13.2 MW Hybrid Solar
La_30Base_wBiogenic_Hybrid-6	Included	0.0%	**57%**	**72%**	13.2 MW Hybrid Solar
2035					
La_35Base_woBiogenic_Hybrid-6	Excluded	28.3%	**100%**	**100%**	13.2 MW Hybrid Solar
La_35Base_wBiogenic_Hybrid-6	Included	28.3%	**61%**	**100%**	13.2 MW Hybrid Solar

4.2.3 High Resource Cost Sensitivity

Hawaiian Electric has competitively procured large-scale generating resources through its RFPs as a means of testing the market for the best pricing. However, over the course of these procurements, project delays and price increases due to external supply chain disruptions such as the COVID-19 pandemic, resulting in numerous amendments to project applications.

In addition to external supply chain disruptions outside of our control, there are potential policy changes at the Federal level that may affect the investment tax credit ("ITC") and production tax credits for new renewable resources as well as potential tariffs on the materials needed to develop new renewable projects that would cause further price increases.

In an effort to quantify the impact of higher resource costs under these uncertain conditions, we have developed this sensitivity analysis for a high resource cost forecast using the same process as the first IGP cycle. Underlying resource costs were sourced from the latest 2024 National Renewable Energy Laboratory Annual Technology Baseline ("NREL ATB")[33] and the conservative forecast was used for overnight capital costs, grid connection costs, and operations and maintenance expenses which is the upper range of the provided ATB data. NREL generally defines the conservative scenario as one where there are lower levels of R&D investment with minimal technology advancement. The ATB data was then adjusted using the same EIA location adjustment factors to bring the resource costs from generic U.S. mainland costs to Hawai'i specific costs. No assumption was made to estimate cost increases due to tariffs due to the difficulty in determining a reasonable and persistent number to assume.

Table 4-50 provides a comparison of the IGP resource costs that were approved for the first cycle in the IGP column and resource costs developed for this high resource cost sensitivity in the High Resource Cost column. Unless noted otherwise, the levelized costs are calculated based on typical capacity factors for resources on O'ahu. Resource costs in the IGP columns included a 10% Federal ITC while the resource costs in the High Resource Cost column have the Federal investment tax credit removed, which was previously expected to be 30% through the Inflation Reduction Act for clean technologies that have zero emissions or can prove net-zero emissions through a lifecycle analysis.

Table 4-50: Resource cost comparison

Levelized Cost of Selected Resources (cents/kWh)	2030		2035	
	IGP	High Resource Cost	IGP	High Resource Cost
Grid-Scale PV	5.8	9.3	6.2	8.8
Grid-Scale PV paired with Grid-Scale Storage (4hrs)	8.1	21.5	8.6	22.1
Wind On-Shore	2.5	3.5	2.7	3.8

[33] *See* https://atb.nrel.gov/electricity/2024/data

Levelized Cost of Selected Resources (cents/kWh)	2030		2035	
	IGP	High Resource Cost	IGP	High Resource Cost
Small/Distributed Wind On-Shore (Moloka'i)	15.9	11.1	16.9	11.2
Small/Distributed Wind On-Shore (Lāna'i)	19.9	14.0	21.2	14.0
Residential PV paired with Residential Storage (2hrs)	28.4	50.8	30.1	55.8
2x1 combined cycle (10% capacity factor, fuel cost not included)	18.6	22.5	20.4	24.4
2x1 combined cycle (50% capacity factor, cost of fuel not included)	3.7	4.5	4.1	4.9

Resource costs are an important assumption that drives resource selection in the RESOLVE model. While the resources shown in this analysis are not meant to be prescriptive, changes in resource build out due to changes in resource cost can illustrate different pathways to meet the RPS, GHG, and DER goals.

4.2.3.1 O'ahu

Meeting near term RPS and GHG reduction goals will drive near term resource additions. However, changing resource costs may change which type of resources RESOLVE selects. If resource costs increase, RESOLVE may also prefer to build fewer new resources and increase the usage of O'ahu's existing/planned biofuel generators instead.

Summary of Results

Using the latest RPS and GHG targets, adjusting current scope and timing of planned projects and RFPs, and increasing the costs for planned and future resources, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):**
  - **Without Biogenic Emissions:** Meeting the new RPS and GHG targets with higher resource costs results in 0 MW of future aggregated DER being selected by 2035 (Table 4-51).
  - **With Biogenic Emissions:** Meeting the new RPS and GHG targets with higher resource costs results in 1,981 MW of future aggregated DER being selected by 2035 (Table 4-52).
- **High Resource Cost Comparison:**
  - **Without Biogenic Emissions:** Higher resource costs result in 0 MW of aggregated DER being selected by 2035 rather than approximately 437 MW of aggregated DER using the base resource cost (Oa_LC_woBiogenic_woFtrFm). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 30% higher, from $22,754MM to $29,433MM (Table 4-53).
  - **With Biogenic Emissions:** Higher resource costs result in approximately 1,981 MW of aggregated DER being selected by 2035 rather than approximately 2,164 MW of aggregated DER using the base resource cost (Oa_LC_wBiogenic_woFtrFm). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 65% higher, from $23,249MM to $38,073MM (Table 4-53).

Key Assumptions

The key assumptions used for the Resource Cost Sensitivity are the same as those stated above in Section 4.2.1.1 with the following exceptions:

1. **Resource Cost:** The 2024 NREL ATB Conservative Resource Costs were used, and the Federal ITC was removed in the "HiResCst" scenarios.
2. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels are not included in the GHG emission accounting except in "wBiogenic" scenarios.

Capacity Expansion Sensitivity

After incorporating updated resource costs, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenarios

- **Oa_LC_woBiogenic_woFtrFm_HiResCst**
  - Oa_LC_woBiogenic_woFtrFm scenario in Section 4.2.1.1 used as basis for this sensitivity analysis.
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3 and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
- **Oa_LC_wBiogenic_woFtrFm_HiResCst**
  - Oa_LC_wBiogenic_woFtrFm scenario in Section 4.2.2.1 used as basis for this sensitivity analysis.
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3 and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

Results

Shown below in Table 4-51 are the resource capacities for the Oa_LC_woBiogenic_woFtrFm_HiResCst scenario in 2030 and 2035 grouped by resource type and procurement. In addition to the land-constrained assumption, this scenario removes future biofuel generators from consideration. When biogenic emissions aren't included, the model only builds 23 MW of standalone BESS in 2030.

Table 4-51: O'ahu RESOLVE results summary, year 2030 and 2035, high resource cost.

Oa_LC_woBiogenic_woFtrFrm_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm	0 MW	81 MW
Future Aggregated DER	0 MW	0 MW
Future Firm	0 MW	0 MW
Total	**2,693 MW**	**2,384 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	23 MW / 92 MWh	23 MW / 92 MWh
Future Aggregated DBESS	0 MW / 0 MWh	0 MW / 0 MWh
Total	**866 MW / 3,595 MWh**	**866 MW / 3,595 MWh**
NPV (MM 2018$, 2030-2050)	**29,433**	

Shown below in Table 4-52 are the resource capacities for the Oa_LC_wBiogenic_woFtrFm_HiResCst scenario in 2030 and 2035 grouped by resource type and procurement. In addition to the land-constrained assumption, this scenario removes future biofuel generators from consideration. When biogenic emissions are included, the model builds 204 MW of standalone BESS and 762 MW of aggregated DER in 2030, and cumulative totals of 428 MW of standalone BESS and 1,981 MW of aggregated DER in 2035.

Table 4-52: O'ahu RESOLVE results summary, year 2030 and 2035, high resource cost, w/ biogenic emissions.

Oa_LC_wBiogenic_woFtrFrm_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	1,340 MW	798 MW
Existing PV (incl. Stage 1-2)	472 MW	461 MW
Existing Wind (incl. Stage 1-2)	123 MW	24 MW
CBRE	86 MW	86 MW
Stage 3 Mahi / Pu'uloa	126 MW	126 MW
Stage 3 Firm Pu'uloa / Kalaeloa / Waiau	183 MW	560 MW
IGP Hybrid Solar	363 MW	363 MW
IGP Standalone Solar	0 MW	11 MW
IGP Onshore Wind	0 MW	0 MW
IGP Firm	0 MW	81 MW
Future Aggregated DER	762 MW	1,981 MW
Future Firm	0 MW	0 MW
Total	**3,455 MW**	**4,365 MW**
Existing BESS (incl. Stage 1-2)	354 MW / 1,541 MWh	354 MW / 1,541 MWh
Stage 3 BESS	126 MW / 510 MWh	126 MW / 510 MWh
IGP BESS	363 MW / 1,452 MWh	363 MW / 1,452 MWh
Future BESS	204 MW / 815 MWh	428 MW / 1,713 MWh
Future Aggregated DBESS	762 MW / 1,524 MWh	1,981 MW / 3,961 MWh
Total	**1,809 MW / 5,842 MWh**	**3,252 MW / 9,177 MWh**
NPV (MM 2018$, 2030-2050)	**38,073**	

Table 4-53 compares RESOLVE results for the resource cost sensitivity scenarios both with and without biogenic emissions. Results include added generating resources in 2030 and 2035 as well as the RESOLVE system cost from 2030-2050 (NPV).

Table 4-53: O'ahu RESOLVE resource cost sensitivity, with and without biogenic emissions.

Scenario	Resource Cost Forecast	Total Added Future Generation (2030, Cumulative MW)	Total Added Future Generation (2035, Cumulative MW)	NPV 2030-2050, 2018$
Without Biogenic Emissions				
Oa_LC_woBiogenic_woFtrFm	Base	---	437 MW, DER Agg.	**22,754**
Oa_LC_woBiogenic_woFtrFm_HiResCst	High	---	---	**29,433**
With Biogenic Emissions				
Oa_LC_wBiogenic_woFtrFm	Base	790 MW, DER Agg.	2,164 MW, DER Agg.	**23,249**
Oa_LC_wBiogenic_woFtrFm_HiResCst	High	762 MW, DER Agg.	1,981 MW, DER Agg.	**38,073**

In a high resource cost scenario, fewer resources are built and more biofuels are burned to achieve a least-cost portfolio.

- Without biogenic emissions, the high resource cost scenario increases system cost by roughly 30%.
- With biogenic emissions, the high resource cost scenario increases system cost by roughly 65%.

4.2.3.2 Hawai'i Island

The accelerated timeline of the RPS and GHG targets do not significantly affect the resource plan over the next 10 years. Hawai'i Island will exceed both the RPS and GHG targets. Changing resource costs does not appear to change which type of resources RESOLVE selects.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets with higher resource costs results in approximately 12 MW of future onshore wind being selected by 2035 (Table 4-54, Table 4-55).
- **High Resource Cost Comparison (RESOLVE):** Higher resource costs result in approximately 12 MW of future onshore wind being selected by 2035 rather than approximately 15 MW of future onshore wind using the base resource cost, regardless of whether biogenic emissions are considered (Hi_Base_woBiogenic, Hi_Base_wBiogenic). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 33% higher, from $1,399MM to $1,864MM (Table 4-56).

Key Assumptions

The key assumptions used for the Resource Cost Sensitivity are the same as those stated above in Section 4.2.1.2 with the following exceptions:

1. **Resource Cost:** The 2024 NREL ATB Conservative Resource Costs were used, and the Federal ITC was removed in the "HiResCst" scenarios.

2. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels aren't considered a GHG emission except in "wBiogenic" scenarios.

Capacity Expansion Sensitivity

After incorporating updated resource costs, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenarios

- **Hi_Base_woBiogenic_HiResCst**
  - Hi_Base_woBiogenic scenario in Section 4.2.1.2 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3, and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
- **Hi_Base_wBiogenic_HiResCst**
  - Hi_Base_wBiogenic scenario in Section 4.2.2.2 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3, and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

Results

Shown below in Table 4-54 are the resource capacities for the Hi_Base_woBiogenic_HiResCst scenario in 2030 and 2035 grouped by resource type and procurement. When biogenic emissions are not included, the model builds 12 MW of onshore wind and 1 MW of standalone storage in 2030.

Table 4-54: Hawai'i Island RESOLVE results summary, year 2030 and 2035, high resource cost.

Hi_Base_woBiogenic_HiResCst	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	12 MW	12 MW
Future Firm	0 MW	0 MW
Total	**479 MW**	**600 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	1 MW / 4 MWh	1 MW / 4 MWh
Total	**176 MW / 704 MWh**	**262 MW / 1,048 MWh**
NPV (MM 2018$, 2030-2050)	**1,864**	

Shown below in Table 4-55 are the resource capacities for the Hi_Base_wBiogenic_HiResCst scenario in 2030 and 2035 grouped by resource type and procurement. Including biogenic emissions does not affected the types or amounts of resources selected by RESOLVE.

Table 4-55: Hawai'i Island RESOLVE results summary, year 2030 and 2035, high resource cost, w/ biogenic emissions.

Hi_Base_wBiogenic_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	124 MW	99 MW
PGV	46 MW	46 MW
Hamakua Energy	58 MW	0 MW
Existing PV (incl. Stage 1-2)	60 MW	60 MW
Existing Wind (incl. Stage 1-2)	11 MW	11 MW
Existing Hydro	3 MW	3 MW
CBRE	20 MW	20 MW
Stage 3 Keamuku	0 MW	86 MW
Stage 3 Firm Hamakua Firm Renewable Energy	0 MW	58 MW
IGP Hybrid Solar	115 MW	115 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	30 MW	30 MW
IGP Firm	0 MW	60 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	12 MW	12 MW
Future Firm	0 MW	0 MW
Total	**479 MW**	**600 MW**
Existing BESS (incl. Stage 1-2)	60 MW / 240 MWh	60 MW / 240 MWh
Stage 3 BESS	0 MW / 0 MWh	86 MW / 344 MWh
IGP BESS	115 MW / 460 MWh	115 MW / 460 MWh
Future BESS	1 MW / 4 MWh	1 MW / 4 MWh
Total	**176 MW / 704 MWh**	**262 MW / 1,048 MWh**
NPV (MM 2018$, 2030-2050)	**1,864**	

Table 4-56 compares RESOLVE results for the resource cost sensitivity scenarios both with and without biogenic emissions. Results include added generating resources in 2030 and 2035 as well as the RESOLVE system cost from 2030-2050 (NPV).

Table 4-56: Hawai'i Island RESOLVE resource cost sensitivity, with and without biogenic emissions.

Scenario	Resource Cost Forecast	Total Added Future Generation (2030, Cumulative MW)	Total Added Future Generation (2035, Cumulative MW)	NPV 2030-2050, 2018$MM
Without Biogenic Emissions				
Hi_Base_woBiogenic	Base	15 MW, Onshore Wind	15 MW, Onshore Wind	**1,399**
Hi_Base_woBiogenic_ HiResCst	High	12 MW, Onshore Wind	12 MW, Onshore Wind	**1,864**
With Biogenic Emissions				
Hi_Base_wBiogenic	Base	15 MW, Onshore Wind	15 MW, Onshore Wind	**1,399**
Hi_Base_wBiogenic_HiResCst	High	12 MW, Onshore Wind	12 MW, Onshore Wind	**1,864**

In a high resource cost scenario, slightly fewer resources are built to achieve a least-cost portfolio, than under a base resource cost scenario. In a high resource cost scenario, the inclusion of biogenic emissions did not alter the resource plan nor the NPV. Both with and without biogenic emissions, the high resource cost scenario resulted in an NPV (2030-2050, 2018$) that was approximately 33% higher, from $1,399MM to $1,864MM.

4.2.3.3 Maui

The accelerated timeline of the RPS and GHG targets do not significantly affect the resource plan over the next 10 years. Maui will exceed both the RPS and GHG targets. However, changing resource costs may change which type of resources RESOLVE selects.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets with higher resource costs results in approximately 100 MW of future onshore wind being selected by 2035 (Table 4-57, Table 4-58).
- **High Resource Cost Comparison (RESOLVE):** Higher resource cost results in approximately 100 MW of future onshore wind being selected by 2035 rather than approximately 260 MW of hybrid solar and 15 MW onshore wind using the base resource cost, regardless if biogenic emission are considered (Ma_Base_woBiogenic, Ma_Base_wBiogenic). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 57% higher, from $2,149MM to $3,382 MM (Table 4-59).

Key Assumptions

The key assumptions used for the Biogenic Emissions Sensitivity are the same as those stated in Section 4.2.1.3 with the following exceptions:

1. **Resource Cost:** The 2024 NREL ATB Conservative Resource Costs were used, and the Federal ITC was removed in the "HiResCst" scenarios.
2. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels aren't considered in the GHG emission accounting except in "wBiogenic" scenarios.

Capacity Expansion

After incorporating updated resource costs, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenarios

- **Ma_Base_woBiogenic_HiResCst**
  - Ma_Base_woBiogenic scenario in Section 4.2.1.3 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3 and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
- **Ma_Base_wBiogenic_HiResCst**
  - Ma_Base_wBiogenic scenario in Section 4.2.2.3 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3 and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

Results

Shown below in Table 4-57 are the system resources capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are not considered a GHG emission. In 2030, the model builds 94 MW of future onshore wind. In 2035, the model builds an additional 7 MW of future onshore wind.

Table 4-57: Maui RESOLVE results summary, year 2030 and 2035, high resource cost.

Ma_Base_woBiogenic_HiResCst	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ūkiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	94 MW	101 MW
Future Firm	0 MW	0 MW
Total	**488 MW**	**506 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	6 MW / 25 MWh	14 MW / 55 MWh
Total	**181 MW / 725 MWh**	**214 MW / 855 MWh**
NPV (MM 2018$, 2030-2050)	**3,382**	

Shown below in Table 4-58 are the system resources capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are considered a GHG emission. Including biogenic emissions does not significantly affect the types or amounts of resources selected by RESOLVE.

Table 4-58: Maui RESOLVE results summary, year 2030 and 2035, high resource cost, w/ biogenic emissions.

Ma_Base_wBiogenic_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	131 MW	119 MW
Existing PV (incl. Stage 1-2)	66 MW	66 MW
Existing Wind (incl. Stage 1-2)	42 MW	0 MW
CBRE	15 MW	15 MW
Stage 3 KWP 1, Kuihelani Ph 2, Pulehu	95 MW	95 MW
Stage 3 Firm Ūkiu	45 MW	45 MW
IGP Hybrid Solar	0 MW	25 MW
IGP Standalone Solar	0 MW	0 MW
IGP Onshore Wind	0 MW	40 MW
IGP Firm	0 MW	0 MW
Future Hybrid Solar	0 MW	0 MW
Future Solar	0 MW	0 MW
Future Onshore Wind	94 MW	102 MW
Future Firm	0 MW	0 MW
Total	**488 MW**	**507 MW**
Existing BESS (incl. Stage 1-2)	115 MW / 460 MWh	115 MW / 460 MWh
Stage 3 BESS	60 MW / 240 MWh	60 MW / 240 MWh
IGP BESS	0 MW / 0 MWh	25 MW / 100 MWh
Future BESS	6 MW / 25 MWh	14 MW / 55 MWh
Total	**181 MW / 725 MWh**	**214 MW / 855 MWh**
NPV (MM 2018$, 2030-2050)	**3,383**	

Table 4-59 compares RESOLVE results for the resource cost sensitivity scenarios both with and without biogenic emissions. Results include added generating resources in 2030 and 2035, the share of total generation that comes from biofuels, and the RESOLVE system cost from 2030-2050 (NPV).

Table 4-59: Maui RESOLVE resource cost sensitivity, with and without biogenic emissions.

Scenario	Resource Cost Forecast	Total Added Future Generation (2030, Cumulative MW)	Total Added Future Generation (2035, Cumulative MW)	NPV (MM 2018$, 2030-2050)
Without Biogenic Emissions				
Ma_Base_woBiogenic	Base	180 MW Hybrid Solar 14 MW Onshore Wind	257 MW Hybrid Solar 14 MW Onshore Wind	**2,149**
Ma_Base_woBiogenic_HiResCst	High	94 MW Onshore Wind	101 MW Onshore Wind	**3,382**
With Biogenic Emissions				
Ma_Base_wBiogenic	Base	180 MW Hybrid Solar 14 MW Onshore Wind	257 MW Hybrid Solar 14 MW Onshore Wind	**2,149**
Ma_Base_wBiogenic_HiResCst	High	94 MW Onshore Wind	102 MW Onshore Wind	**3,383**

In a high resource cost scenario, fewer resources are built, than under a base resource cost scenario, and the resource selected shifts to onshore wind instead of hybrid solar. In a high resource cost scenario, the inclusion of biogenic emissions did not significantly alter the resource plan nor the NPV. Both with and without biogenic emissions, the high resource cost scenario resulted in an NPV (2030-2050, 2018$) that was approximately 57% higher, from $2,149MM to $3,382MM.

4.2.3.4 Moloka'i

While achieving our RPS and GHG goals will drive our future resource acquisitions, the costs of the various options available to achieve these goals will impact the 2030 and 2035 resource needs.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets with higher resource costs results in approximately 5 MW of future onshore wind being selected by 2035 (Table 4-60, Table 4-61).
- **High Resource Cost Comparison (RESOLVE):** Higher resource cost results in approximately 5 MW of future onshore wind being selected by 2035 rather than approximately 11 MW of hybrid solar using the base resource cost, regardless if biogenic emission are considered (Mo_Base_woBiogenic, Mo_Base_wBiogenic). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 30% higher, from $88MM to $115MM (Table 4-62).

Key Assumptions

The key assumptions used for the Resource Cost Sensitivity are the same as those stated above in Section 4.2.1.4 with the following exceptions:

1. **Resource Cost:** The 2024 NREL ATB Conservative Resource Costs were used, and the Federal ITC was removed in the "HiResCst" scenarios.
2. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels aren't considered a GHG emission except in "wBiogenic" scenarios.

Capacity Expansion

After incorporating updated resource assumptions and recent government policy changes, the following scenario was tested in RESOLVE.

Capacity Expansion Scenario

- **Mo_Base_woBiogenic_HiResCst**
  - Mo_Base_woBiogenic scenario in Section 4.2.1.4 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
- **Mo_Base_wBiogenic_HiResCst**
  - Mo_Base_wBiogenic scenario in Section 4.2.2.4 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.
  - Resource costs for planned CBRE, Stage 3, and IGP RFP resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

Results

Shown below in Table 4-60 are the system resources capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are not considered a GHG emission. In 2030, the model builds 3.5 MW of future onshore wind and 0.6 MW of future 4-hour standalone storage. In 2035, the model builds an additional 1.0 MW of future onshore wind and an additional 0.2 MW of future 4-hour standalone storage..

Table 4-60: Moloka'i RESOLVE results summary, year 2030 and 2035, high resource cost.

Mo_Base_woBiogenic_HiResCst	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	0.0 MW	0.0 MW
Future Onshore Wind	3.5 MW	4.5 MW
Total	**21.4 MW**	**22.4 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	0.0 MW / 0.0 MWh	0.0 MW / 0.0 MWh
Future Standalone BESS	0.6 MW / 2.4 MWh	0.8 MW / 3.2 MWh
Total	**3.1 MW / 13.5 MWh**	**3.3 MW / 14.3 MWh**
NPV (MM 2018$, 2030-2050)	**115.3**	

Shown below in Table 4-61 are the system resources capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are considered a GHG emission. Including biogenic emissions does not affected the types or amounts of resources selected by RESOLVE.

Table 4-61: Moloka'i RESOLVE results summary, year 2030 and 2035, high resource cost, w/ biogenic emissions.

Mo_Base_wBiogenic_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	15.2 MW	15.2 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	2.7 MW	2.7 MW
Future Hybrid Solar	0.0 MW	0.0 MW
Future Onshore Wind	3.5 MW	4.5 MW
Total	**21.4 MW**	**22.4 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	2.5 MW / 11.1 MWh	2.5 MW / 11.1 MWh
Future Hybrid BESS	0.0 MW / 0.0 MWh	0.0 MW / 0.0 MWh
Future Standalone BESS	0.6 MW / 2.4 MWh	0.8 MW / 3.2 MWh
Total	**3.1 MW / 13.5 MWh**	**3.3 MW / 14.3 MWh**
NPV (MM 2018$, 2030-2050)	**115.3**	

Table 4-62 highlights the impact that higher resource costs may have on the results for both the case where biogenic emissions are included and the case where biogenic emissions are excluded, respectively.

Table 4-62: Moloka'i RESOLVE resource cost sensitivity, with and without biogenic emissions.

Scenario	Resource Cost Forecast	Total Added Future Generation (2030, Cumulative MW)	Total Added Future Generation (2035, Cumulative MW)	NPV 2030-2050, 2018$MM
Without Biogenic Emissions				
Mo_Base_woBiogenic	Base	10.2 MW Hybrid Solar	11.1 MW Hybrid Solar	**87.9**
Mo_Base_woBiogenic_HiResCst	High	3.5 MW Onshore Wind	4.5 MW Onshore Wind	**115.3**
With Biogenic Emissions				
Mo_Base_wBiogenic	Base	10.2 MW Hybrid Solar	11.1 MW Hybrid Solar	**87.9**
Mo_Base_wBiogenic_HiResCst	High	3.5 MW Onshore Wind	4.5 MW Onshore Wind	**115.3**

In a high resource cost scenario, fewer resources are built, than under a base resource cost scenario, and the resource selected shifts to onshore wind instead of hybrid solar. In a high resource cost scenario, the inclusion of biogenic emissions did not alter the resource plan nor the NPV. Both with and without biogenic emissions, the high resource cost scenario resulted in an NPV (2030-2050, 2018$) that was 30% higher, from $88MM to $115MM.

4.2.3.5 Lānaʻi

While achieving our RPS and GHG goals will drive our future resource acquisitions, the costs of the various options available to achieve these goals will impact the 2030 and 2035 resource needs.

Summary of Results

Using the latest RPS and GHG targets and adjusting current scope and timing of planned projects and RFPs, the following conclusions were drawn.

- **Capacity Expansion (RESOLVE):** Meeting the new RPS and GHG targets with higher resource costs results in approximately 7 MW of standalone solar, 4 MW of hybrid solar, 4 MW of onshore wind and 2 MW of standalone BESS being selected by 2035 (Table 4-63, Table 4-64).
- **High Resource Cost Comparison (RESOLVE):** Higher resource cost results in approximately 7 MW of standalone solar, 4 MW of hybrid solar, 4 MW of onshore wind and 2 MW of standalone BESS being selected by 2035 rather than 21 MW of hybrid solar and 0.5 MW of standalone BESS using the base resource cost, regardless of biogenic emissions accounting (La_Base_woBiogenic, La_Base_wBiogenic). The higher resource cost also resulted in an NPV (2030-2050, 2018$) that was approximately 77% higher, from $84MM to $149MM (Table 4-65).

Key Assumptions

The key assumptions used for the Resource Cost Sensitivity are the same as those stated above in Section 4.2.1.5 with the following exceptions:

1. **Resource Cost:** The 2024 NREL ATB Conservative Resource Costs were used, and the Federal ITC was removed in the "HiResCst" scenarios.
2. **Biogenic Emissions:** Biogenic CO_2 emissions from biofuels aren't considered a GHG emission except in "wBiogenic" scenarios.

Capacity Expansion

After incorporating updated resource costs, the following scenarios were tested in RESOLVE.

Capacity Expansion Scenario

- **La_Base_woBiogenic_HiResCst**
  - La_Base_woBiogenic scenario in Section 4.2.1.5 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

- **La_Base_wBiogenic_HiResCst**
  - La_Base_wBiogenic scenario in Section 4.2.2.5 used as basis for this sensitivity analysis
  - Resource costs for future candidate resources changed to 2024 NREL ATB Conservative scenario without Federal ITC.

Results

Shown below in Table 4-63 are the system resource capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are not considered a GHG emission. In 2030, the model builds 5.2 MW of standalone solar, 1.4 MW of hybrid solar, 3.8 MW of onshore wind, and 1.6 MW of standalone BESS. In 2035, the model builds an additional 2.2 MW of standalone solar, 2.8 MW of hybrid solar, and 0.5 MW of standalone BESS.

Table 4-63: Lānaʻi RESOLVE results summary, year 2030 and 2035, high resource cost.

La_Base_woBiogenic_HiResCst	2030	2035
GHG Emissions	Without biogenic emissions	Without biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0.0 MW	0.0 MW
Future Standalone Solar	5.2 MW	7.4 MW
Future Hybrid Solar	1.4 MW	4.2 MW
Future Onshore Wind	3.8 MW	3.8 MW
Total	**20.8 MW**	**25.8 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	1.4 MW / 5.7 MWh	4.2 MW / 16.7 MWh
Future Standalone BESS	1.6 MW / 6.4 MWh	2.1 MW / 8.5 MWh
Total	**3.0 MW / 12.0 MWh**	**6.3 MW / 25.2 MWh**
NPV (MM 2018$, 2030-2050)	**149.1**	

Shown below in Table 4-64 are the system resource capacities in 2030 and 2035 grouped by resource type and procurement, for the case where biogenic emissions are considered a GHG emission. When biogenic emissions are included, the model builds very similar types and amounts of resources selected in 2030 and 2035.

Table 4-64: Lāna'i RESOLVE results summary, year 2030 and 2035, high resource cost, w/ biogenic emissions.

La_Base_wBiogenic_HiResCst	2030	2035
GHG Emissions	With biogenic emissions	With biogenic emissions
Existing Firm	10.4 MW	10.4 MW
Existing PV (incl. Stage 1-2)	0 MW	0 MW
Existing Wind (incl. Stage 1-2)	0 MW	0 MW
CBRE	0.0 MW	0.0 MW
Future Standalone Solar	5.3 MW	7.4 MW
Future Hybrid Solar	1.4 MW	4.3 MW
Future Onshore Wind	3.8 MW	3.8 MW
Total	**20.9 MW**	**25.8 MW**
Existing BESS (incl. Stage 1-2)	0 MW / 0 MWh	0 MW / 0 MWh
CBRE BESS	0 MW / 0 MWh	0 MW / 0 MWh
Future Hybrid BESS	1.4 MW / 5.7 MWh	4.3 MW / 17.2 MWh
Future Standalone BESS	1.6 MW / 6.5 MWh	2.1 MW / 8.5 MWh
Total	**3.1 MW / 12.2 MWh**	**6.4 MW / 25.7 MWh**
NPV (MM 2018$, 2030-2050)	**149.3**	

Table 4-65 highlights the impact that higher resource costs may have on the results for both the case where biogenic emissions are included and the case where biogenic emissions are excluded, respectively.

Table 4-65: Lāna'i RESOLVE resource cost sensitivity, with and without biogenic emissions.

Scenario	Resource Cost Forecast	Total Added Future Generation (2030, Cumulative MW)	Total Added Future Generation (2035, Cumulative MW)	NPV 2030-2050, 2018$MM
Without Biogenic Emissions				
La_Base_woBiogenic	Base	20 MW Hybrid Solar	21.3 MW Hybrid Solar	**84.3**
La_Base_woBiogenic_HiResCst	High	5.2 MW Standalone Solar 1.4 MW Hybrid Solar 3.8 MW Onshore Wind	7.4 MW Standalone Solar 4.2 MW Hybrid Solar 3.8 MW Onshore Wind	**149.1**
With Biogenic Emissions				
La_Base_wBiogenic	Base	20 MW Hybrid Solar	21.3 MW Hybrid Solar	**84.3**
La_Base_wBiogenic_HiResCst	High	5.3 MW Standalone Solar 1.4 MW Hybrid Solar 3.8 MW Onshore Wind	7.4 MW Standalone Solar 4.3 MW Hybrid Solar 3.8 MW Onshore Wind	**149.3**

In a high resource cost scenario, more resources are built than under the base resource cost scenario, and less hybrid solar is selected in favor of a mix of standalone solar, onshore wind, and standalone BESS. The inclusion of biogenic emissions in a high resource cost scenario slightly altered the resource plan and NPV due to binding GHG constraints in future years. Both with and without biogenic emissions, the high resource cost scenario results in an NPV (2030-2050, 2018$) that was 77% higher, from $84MM to $149MM.