Hawaiian Electric

Integrated Grid Planning ("IGP") Stakeholder Council Meeting

June 23, 2021

Agenda

- IGP Workplan and Schedule Update
  - Technical Advisory Panel
- Key Questions and Objectives
- Scenarios and Sensitivities
- Solar and Wind Resource Potential Update
- Discussion and Next Steps

IGP Workplan and Schedule Update

Summary of Workplan Update filed on June 18, 2021

- The Company anticipates filing the revised Inputs & Assumptions deliverable by August 3, 2021 in compliance with the Review Point Guidance.
- The Company further intends to file a revised Grid Needs Assessment deliverable as a Review Point by October 1, 2021 that incorporates stakeholder feedback, including items raised by the Commission in its Review Point Guidance such as planning criteria and modeling methods.
- Upon acceptance of these two major deliverables, the Company will begin the IGP Grid Needs Planning process step with an expected duration that will be dependent in part on the scope of modeling iterations between the various modeling tools.
- As the Company focuses on building consensus on the remaining items highlighted by the Commission, it will also establish a “Parking Lot” for new suggestions or ideas brought to light over the course of working group discussions

Various avenues to receive stakeholder feedback & technical review

STWG

Stakeholder Technical Working Group

Industry stakeholders and subject matter experts. Solicit feedback, provide opportunities for stakeholders to present, vet modeling methods grid needs assessments, etc.

Merged w/ STWG
Distribution Planning
Forecasting Assumptions
Competitive Procurement
Standardized Contract

SC

Stakeholder Council

Represents a broad cross section of stakeholders. Provide guidance on strategic issues.

TAP

Technical Advisory Panel

Technical experts and independent review of technical challenges facing company planning and operations

Public

Public

Community and customer engagement on IGP plans as well as specific projects

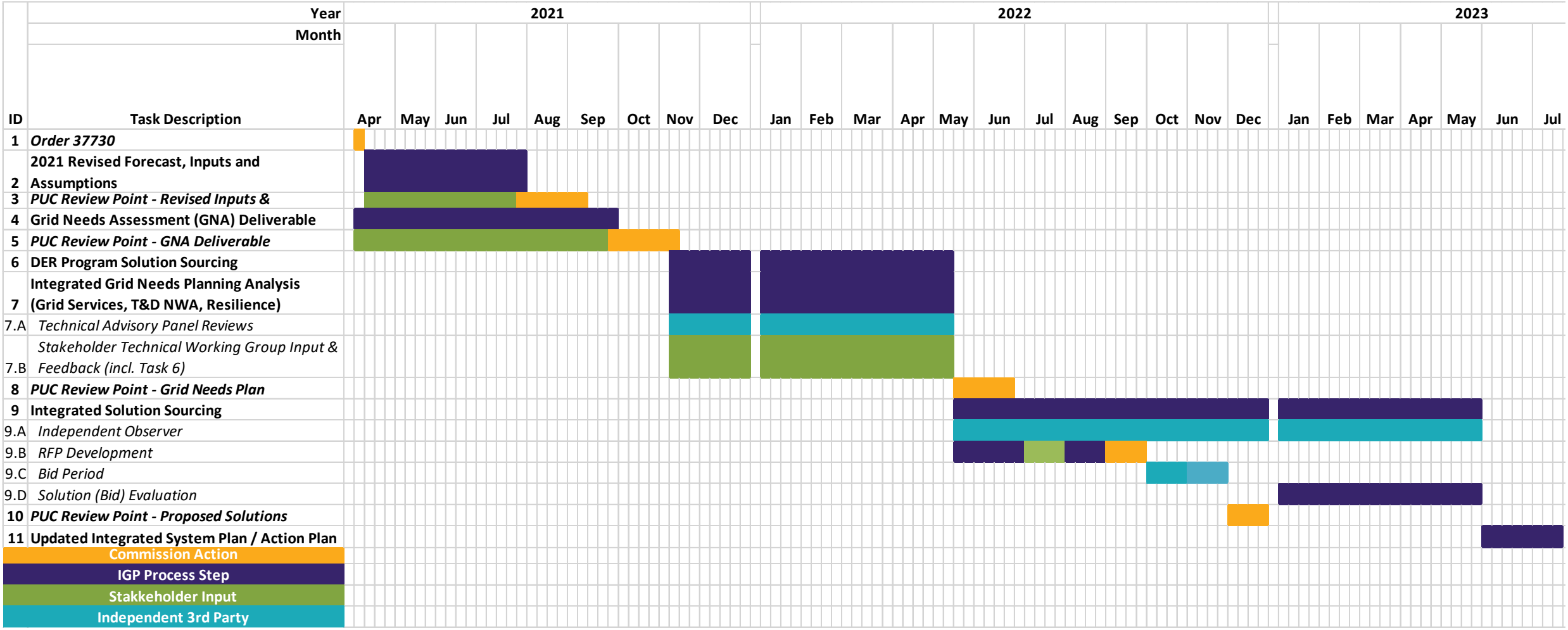
RWG

Resilience Working Group

Define resilience, identify threats and critical customers, provide feedback on resilience solutions

Additional engagement outside of the formal working group process to seek additional clarification and feedback to allow for additional deep dive discussions

IGP Schedule Update

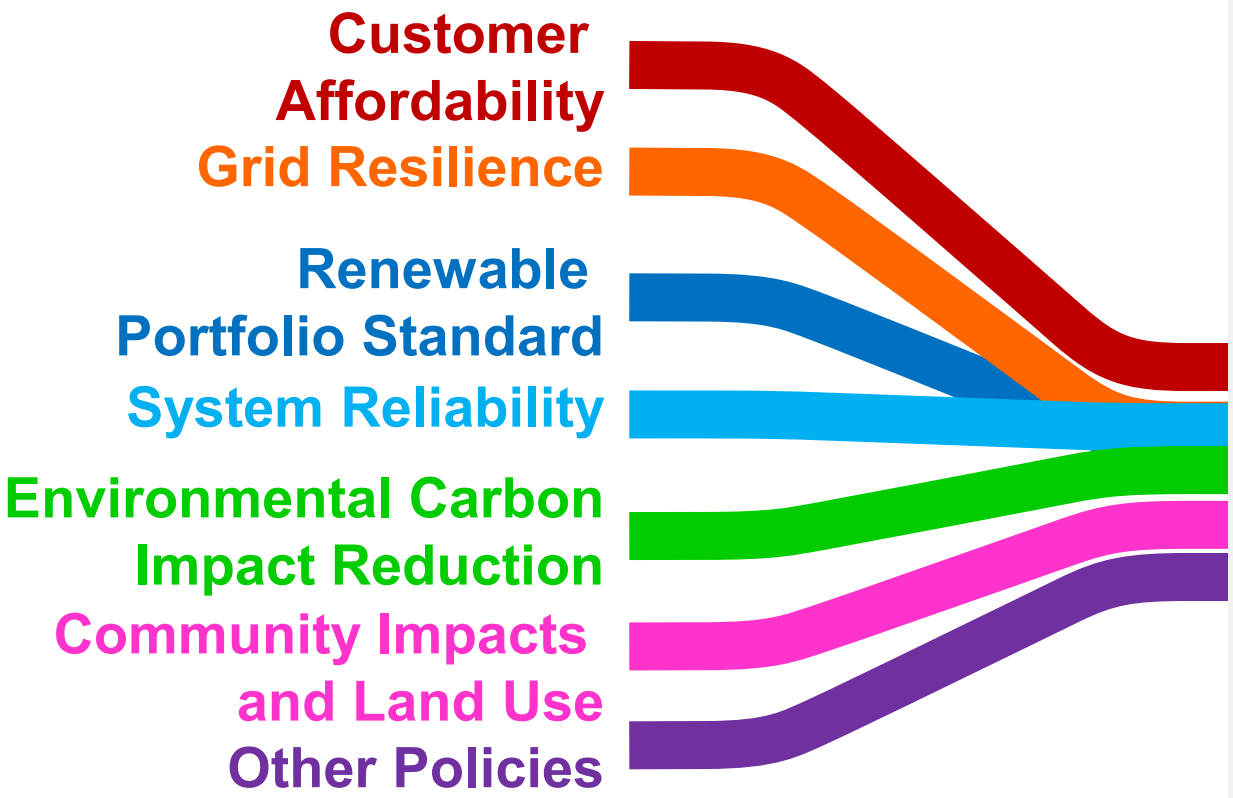


Technical Advisory Panel additions

- Commission requested to add at least one expert on utility systems modeling to the TAP, ideally from Ulupono's list of recommendations
- Company reached out to Jacquelin Cochran; however, she and her colleagues did not have the bandwidth to support
- Will reach out next to Amol Phadke, LBNL
- Rick Rocheleau expressed an interest to step down as Chair of the TAP due to competing work priorities; Rick will remain as a member of the TAP
  - TAP Chair to be selected on a rotational basis every two years per 2018 Workplan
- **Does the Stakeholder Council have any feedback for improving the TAP or its structure?**

IGP Key Questions for Today

Key IGP Objectives and Stakeholder Questions



- **Are the IGP assumptions (and application of assumptions) appropriate, relevant and reasonable for the IGP planning process?**
- **Do the IGP modeling methods, scenarios and plan options robust and ultimately result in a robust action plan?**
- Is Hawaiian Electric reasonably planning for the future of Electrification?
- What are Hawaiian Electric's reliability and resilience needs, and how are these maintained as generators age and retire and intermittent renewable energy resources, and energy storage, increase?
- How can IGP improve the effectiveness of DER resources?
- What improvements should the Utility and development partners consider to engage affected communities to ensure project success?
- How should the IGP and key foundational proceedings such as, Performance Based Regulation (PBR), Distributed Energy Resource (DER) and other dockets be aligned and integrated?

Developed by Stakeholder Council

Review of the top 5 inputs that influence model output

- Range of load and load shapes, not individual layers, is most important
  - Customer adoption of technology: PV, BESS, EV
- Contribution of resources to meet peak customer demand
- Relative technology costs more important than absolute value
- RPS Targets and Planned Renewable Resources
  - DER programs, Grid-scale projects, CBRE, etc.
  - If RPS requirements are binding constraint, then fuel costs are less important; if not, fuel costs are significant
- Generating Unit Retirements

Input needed from the Stakeholder Council

Consensus on Inputs and Forecasts

- Resource technology costs and fuel price forecasts
- Range of load shapes for “bookend” scenarios
- Solar and Wind developable resource potentials
- Continuing discussions with Ulupono, Blue Planet and Solar Parties

Consensus on Other Key Modeling Parameters

- Contribution of resources to meet peak demand
  - Will be discussed at a later Stakeholder Council meeting on Reliability and Resilience
  - Company working with Ulupono, TAP and stakeholders to test different reliability guidelines
- Generating Unit Retirements
  - Other feedback from the Stakeholder Council?

Scenarios and Sensitivities

Scenarios and Sensitivities

- Multiple stakeholder meetings were held across the Forecast Assumptions Working Group, Solution Evaluation & Optimization Working Group, Stakeholder Council, and Technical Advisory Panel to discuss the proposed sensitivity analyses
- A key scenario that emerged from those discussions was a proposal to test the bookends of the load forecast.
- Customer-centric planning from the bottom up is at the root of the high and low bookends.
  - The customer driven bookends will evaluate how the grid needs and system cost changes with higher and lower adoption of distributed energy resources, including, electric vehicles, energy efficiency, and time-of-use rate adoption, driven by customer preferences, market forces and/or policy actions.

Proposed Customer-centric Bookend Scenarios

- Recognizing feedback from the TAP to conduct bookend analyses to test the sensitivity of the models and portfolios against a range of load forecasts, the Company proposed the following approach for a bookend scenario in its March 2021 reply comments on the first review point.

Assumption	Slower Customer Technology Adoption	Base	Faster Customer Technology Adoption
DER	Market Forecast	Market Forecast	+30%
Electric Vehicles	-30%	Market Forecast	+30%
Energy Efficiency	-30%	Market Forecast	+30%
Time-of-Use	None	Managed EV	Managed EV

Current Customer-centric Bookend Scenarios

- Stakeholder input will help to decide the appropriate policy driver for the level of adoption that is assumed in the low and high bookends and allow the Parties to shape the future uptake that they envision.
- The resulting grid needs analysis are net of customer adoption of technologies through various performance-based customer programs and rates that are tailored to meet grid needs and services.

Customer Layer	Slower Customer Technology Adoption	Base	Faster Customer Technology Adoption	High Load
DER	Market Forecast	Continue with same addressable market, updated resource costs, new EDR program and DER docket proposals	Expanded addressable market, updated resource costs, new EDR program and DER docket proposals, smart export rate for export	Market Forecast
Electric Vehicles	Use a lower market saturation	Market Forecast	100% ZEV by 2045	100% ZEV by 2045
Energy Efficiency	EE--	Market Forecast	EE++	EE--
Time-of-Use	None	Managed EV, Consider AMI rollout schedule, KIUC opt-out rate	Managed EV, Consider AMI rollout schedule, KIUC opt-out rate	None

Green Text = Stakeholder Feedback

Additional scenarios and sensitivities previously discussed

Sensitivity	Purpose	Inputs	Status
2. Market DER	Determine the value of the forecasted market uptake DER	Fix DER capacity to 2020 levels in RESOLVE	Modeled as part of the DER Freeze scenarios in the DER docket
3. No Future Transmission Infrastructure	Determine the value of additional DER above the market uptake	Future grid-scale resources allowed to build up to the available transmission capacity DER aggregators will be available as a resource option to meet future grid needs	Planned for IGP as a standalone scenario
4. High Energy Efficiency	Determine the value of higher levels of energy efficiency	Increase the assumed energy efficiency in the market forecast	Planned for IGP as part of the bookend scenario
5. No State ITC for PV	Understand the impact of removing the State investment tax credit for PV	Adjust the DER uptake forecast and PV resource cost assumptions for the removal of the State ITC	Planned for IGP as a standalone sensitivity
6. No Onshore Development	Determine the value of offshore resources, specifically for O‘ahu, if future onshore grid-scale options are limited	The market uptake of DER will continue as forecasted Only offshore wind will be available as a resource option	Planned for IGP as a standalone sensitivity

See Grid Needs Assessment & Solution Evaluation Methodology, March 2021, Appendix E

Additional scenarios and sensitivities previously discussed

Sensitivity	Purpose	Inputs	Status
7. Low Renewable Generation	Understand the impact of low energy production from PV, wind, and PV & wind resources	PV and wind profiles from past weather years Include forecasted forced outage rates and costs to maintain thermal fleet	Planned for IGP as a standalone sensitivity
8. Non Grid-Participating Customer Storage	Determine the value of existing net energy metering customers adopting storage as non-export customer load shift resources	Expand the existing customer storage forecast profiles by adding additional battery capacity	The DER Parties modeled this sensitivity as part of their "Load Shift Scenario" in the DER docket[1]
9. Grid-Participating Customer Storage	Determine the value of additional distributed storage that is able to charge from the grid	Expand paired PV-storage DER resources that can participate in grid services	A version of this sensitivity was modeled in the DER docket as part of the Company's proposal for emergency demand response
10. Unmanaged Electric Vehicle Charging	Understand the value of customers managing their own electric vehicle charging	Load profiles for unmanaged vehicle charging	Planned for IGP as part of the bookend scenario
11. Managed Electric Vehicle Charging	Understand the value of electric vehicle charging that is managed by the utility through time-of-use rates	Load profiles for managed vehicle charging	Planned for IGP as part of the bookend scenario

[1] See DER Parties Program Track Final Proposal, Appendix D, page 3

Revised Assumptions, Planning Criteria, and Modeling Methods

Modeling Case or Input	Deliverable to be Updated	Revision Date	Assumptions to be Updated
Base, Low Bookend, High Bookend	Inputs & Assumptions	August 3	• DER uptake to reflect updated resource costs, EDR program, DER docket proposal • EV uptake to reflect stakeholder feedback (e.g. 100% ZEV by 2045 proposed by Blue Planet) • EE uptake to reflect stakeholder feedback, needs to be aligned with EE as a resource
DER Freeze, EE Freeze, EV Freeze	Inputs & Assumptions	August 3	Revised market uptake frozen at 2021 levels
No Future Transmission	Inputs & Assumptions	August 3	DER aggregator costs updated for NREL ATB
No State ITC for PV	Inputs & Assumptions	August 3	• Revised lower DER uptake below market forecast • Higher capital costs for grid-scale and aggregator PV resources
No Onshore Development	Inputs & Assumptions	August 3	• Offshore wind costs and profiles from NREL O‘ahu Study
Low RE Generation	Inputs & Assumptions	August 3	Lower production profiles for PV and wind
High Fuel Price	Inputs & Assumptions	August 3	Higher fuel forecast to be developed with stakeholder feedback
Resource costs	Inputs & Assumptions	August 3	Resource costs updated to use public data sources in response to Ulupono comments
Energy efficiency supply curves	Inputs & Assumptions	August 3	Dependent on AEG scope and schedule
Base circuit level hosting capacity	Inputs & Assumptions	August 3	Grid upgrades for current market DER forecast
Locational DER and load forecasts from LoadSEER	Inputs & Assumptions	August 3	Circuit level forecasts to identify distribution grid needs
Generating unit retirement schedule	Inputs & Assumptions	August 3	

Revised Assumptions, Planning Criteria, and Modeling Methods

Other Inputs	Deliverable to be Updated	Revision Date	Assumptions to be Updated
High/low circuit level hosting capacity	Grid Needs Assessment	October 1	Grid upgrades for high/low DER forecasts, depending on when forecasts are finalized
Planning criteria review for inertia, FFR, regulating reserve, transmission planning	Grid Needs Assessment	October 1	
Transmission Renewable Energy Zones (REZ)	Grid Needs Assessment	October 1	Updated interconnection costs for PV and wind candidate resources
NREL resource potential updates	Inputs & Assumptions	August 3	Updated resource potential for PV and wind candidate resources in response to Ulupono comments

Criteria Testing Analyses	Deliverable to be Updated	Revision Date	Assumptions to be Updated
“Virtual Inertia”	Inputs & Assumptions	August 3	Removal of inertia constraint to assess impact of IBR providing virtual inertia
ERM target and HDC profile	Grid Needs Assessment	October 1	Revised ERM targets (20%, 10%, 0% using 30% reference) and variable renewable profiles

Feedback from June 2, 2021 regarding treatment of DER in the modeling

- Clarifications/questions raised by stakeholders:
  - Is RESOLVE bias toward grid-scale because of fixed cost treatment (“free” resource)?
  - Is DER being modeled to provide grid services?
  - Programs and tariffs should not be excluded in addressing grid needs
  - Separate sensitivities for the DER layers should be standalone
- Company’s clarifications:
  - Grid-scale is not a free resource, RESOLVE will optimize resource selection using the cost of the resource
  - DERs can be modeled to provide grid services similar to the modeling work in the DER docket. This includes DER layers in the bookends
  - Bookend scenarios are intended to address uncertainty in future customer adoption. Allows evaluation of a range of max and min of system loads and associated grid needs and costs.
    - Evaluating DER layers in isolation meets a use case that may be better suited to program design (i.e., DER docket)
  - The intent of the grid needs assessment modeling is to identify grid needs that can be fulfilled by programs, pricing, procurements, and different types of technology
    - Grid-scale vs distributed, procurement vs program are less relevant at this stage when determining a portfolio of grid needs. Those discussions can be resolved following the grid needs assessment step as part of solution sourcing

Solar and Wind Resource Potential Update

Preliminary updated PV potential results

Original Scenarios

Ulupono Scenarios

Table ES- 1: Summarized installable capacity in MW for Utility-Scale 1-Axis Tracking PV Systems All Scenarios; Lands with Capacity Factors >= 0.10

Island	PV-1-3	PV-1-5	PV-1-HS	PV-2-3	PV-2-5	PV-2-HS	PV-3-3	PV-3-5
Oʻahu	907	1954	9634	1412	2794	13965	561	1008
Molokaʻi	1225	3016	13387	1225	3016	13387	1177	2918
Maui	1038	2669	26728	1038	2669	26728	508	1411
Lānaʻi	697	1478	9599	697	1478	9599	557	1199
Hawaiʻi	12417	29384	117231	15083	35319	129977	13621	31841

DOD Lands Included

Island	PV-Alt-1	PV-Alt-2
Oʻahu	3810	7026
Molokaʻi	10411	10411
Maui	13687	13687
Lānaʻi	9691	9691
Hawaiʻi	76179	89470

Ulupono Switch Scenarios	Utility Scale Solar Selected by Switch (0-15% Slope)	Utility Scale Solar Selected by Switch (0-30% Slope)
Unrestricted (100% Use of B and C Lands)	3,448 MW	3,497 MW
10% Use of B and C Lands	2,313 MW	3,456 MW
Current Use (1.8% Use of B Lands and 1.1% Use of C Lands)	1,898 MW	3,361 MW

Preliminary updated wind potential results

Original Scenarios

Table ES- 1: Summarized installable capacity in MW for Utility-Scale Wind Systems All Scenarios; Lands with Wind Speeds >= 6.5 m/s

Island	WIND-1-20	WIND-1-HS	WIND-2-20	WIND-2-HS	WIND-3-20	WIND-3-HS	WIND-4-20	WIND-4-HS
O'ahu	436	761	640	1147	230	465	333	728
Moloka'i	951	1249	951	1249	688	958	688	958
Maui	634	940	634	940	421	659	421	659
Lāna'i	381	441	381	441	312	368	312	368
Hawai'i	1189	1254	1189	1254	982	1039	982	1039

Cut off at 6.5 m/s (same as original summarizations)

Include all wind speeds (do not cut off at 6.5 m/s)

Ulupono Scenarios

DOD Lands Included

Island	WIND-Alt-1	WIND-Alt-2
O'ahu	186	284
Moloka'i	515	515
Maui	278	278
Lāna'i	305	305
Hawai'i	670	670

Island	WIND-Alt-1	WIND-Alt-2
O'ahu	256	365
Moloka'i	515	515
Maui	767	767
Lāna'i	509	509
Hawai'i	5037	5974

NREL Scenario Legend

		PV								Wind								PV	Wind	PV	Wind
Exclusion Category	Land Category	PV-1-3	PV-1-5	PV-1-HS	PV-2-3	PV-2-5	PV-2-HS	PV-3-3	PV-3-5	WIND-1-20	WIND-1-40	WIND-2-20	WIND-2-40	WIND-3-20	WIND-3-40	WIND-4-20	WIND-4-40	PV-Alt-1	Wind-Alt-1	PV-Alt-2	Wind-Alt-2
Federal Lands	National Guard	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	exclude	exclude	exclude	exclude
	National Park Service	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	exclude	exclude	exclude	exclude
	Other Federal Lands	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	exclude	exclude	exclude	exclude
	U.S. Department of Defense Lands	Exclude	Exclude	Exclude	Include	Include	Include	Include	Include	Exclude	Exclude	Include	Include	Exclude	Exclude	Include	Include	exclude	exclude	include	include
Dept. of Defense	Dept. of Defense Lands	Exclude	Exclude	Exclude	Include	Include	Include	Include	Include	Exclude	Exclude	Include	Include	Exclude	Exclude	Include	Include	exclude	exclude	include	include
Slope	Slope percent > 3%	Exclude	Include	Include	Exclude	Include	Include	Exclude	Include	Include	Include	Include	Include	Include	Include	Include	Include	include	include	include	include
	Slope percent > 5%	Exclude	Exclude	Include	Exclude	Exclude	Include	Exclude	Exclude	Include	Include	Include	Include	Include	Include	Include	Include	include	include	include	include
	Slope percent > 10%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	include	include	include	include
	Slope percent > 15%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	cost addr	include	cost addr	include
	Slope percent > 20%	Exclude	Exclude	Include	Exclude	Exclude	Include	Exclude	Exclude	Exclude	Include	Exclude	Include	Exclude	Include	Exclude	Include	cost addr	exclude	cost addr	exclude
	Slope percent > 30%	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	exclude	exclude	exclude	exclude
	Slope percent > 40%	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	exclude	exclude	exclude	exclude
Setbacks	Road Setback (173m)	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Exclude	Exclude	Exclude	Exclude	include	exclude	include	exclude
	Building Setback (173m)	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Exclude	Exclude	Exclude	Exclude	include	exclude	include	exclude
	Transmission ROW Setback (173m)	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Exclude	Exclude	Exclude	Exclude	include	exclude	include	exclude
Land Study Bureau Agricultural Lands	Class A Land	Include	Include	Include	Include	Include	Include	90% Exc.	90% Exc.	Include	Include	Include	Include	Include	Include	Include	Include	exclude	include	exclude	include
	Class B Land	Include	Include	Include	Include	Include	Include	90% Exc.	90% Exc.	Include	Include	Include	Include	Include	Include	Include	Include	10% Inc	include	10% Inc	include
	Class C Land	Include	Include	Include	Include	Include	Include	90% Exc.	90% Exc.	Include	Include	Include	Include	Include	Include	Include	Include	10% Inc	include	10% Inc	include
Tsunami Evacuations Zones	Tsunami Evacuation Zones	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	Exclude	exclude	exclude	exclude	exclude
	Extreme Tsunami Evacuation Zones	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	Include	include	include	include	include

U.S. Fish and Wildlife Federal lands, State parks, Wetlands, Lava Flow zones, Important Ag Lands, and Urban zones were excluded across all scenarios

- The links below will take you to CARTO apps that will allow you to toggle the two scenarios with Ulupono's proposed changes along with the previous scenarios to see where land availability changes.
- Wind: https://nrel.carto.com/u/gds-member/builder/49af7cb6-fbd7-4278-8ec9-a1663a910f8c/embed
- PV: https://nrel.carto.com/u/gds-member/builder/4d570d92-d17c-4bba-b592-8f4e55446d50/embed

Discussion and Next Steps

- Key questions:
  - Are the IGP assumptions (and application of assumptions) appropriate, relevant and reasonable for the IGP planning process?
  - Do the IGP modeling methods, scenarios and plan options robust and ultimately result in a robust action plan?
- Continue discussions with key Stakeholder Council members involved with vetting inputs and assumptions: Ulupono, Blue Planet, and Solar Parties