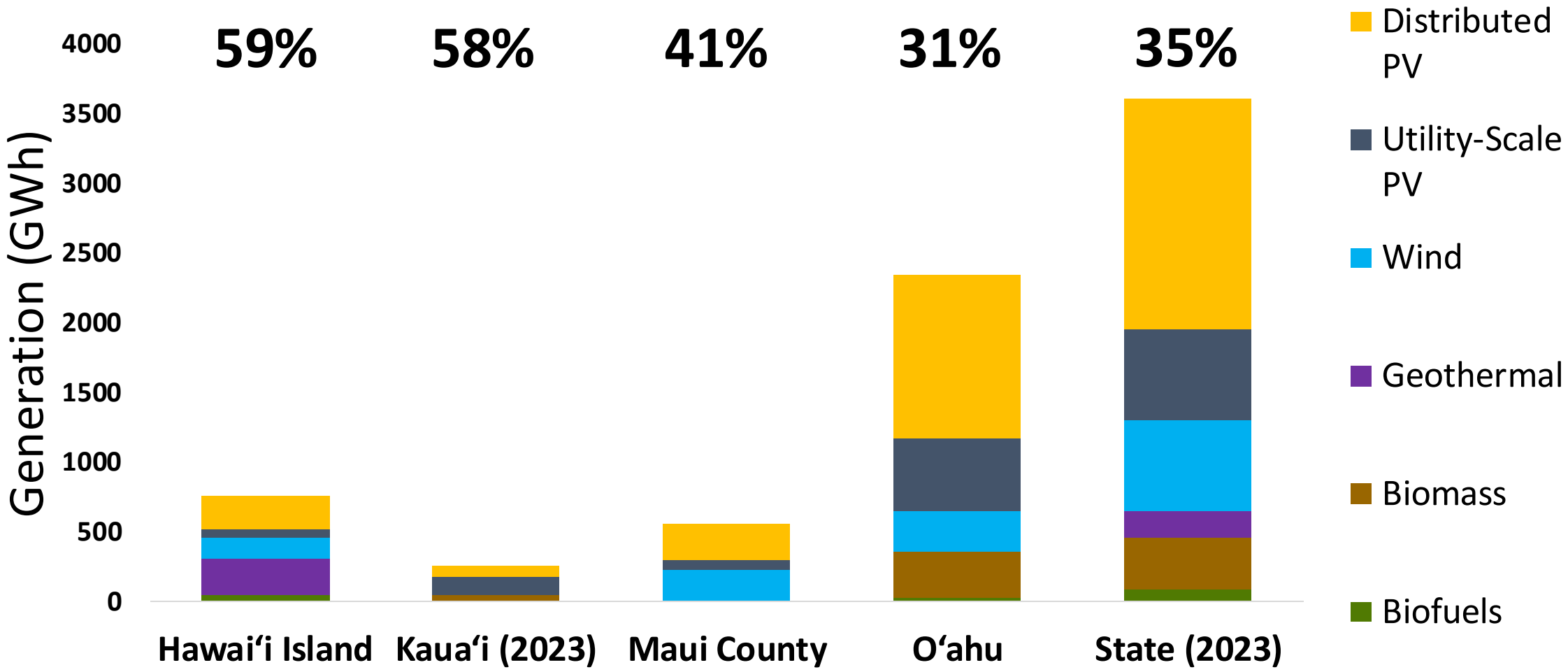
HAWAIʻI ENERGY CONFERENCE 2025

Mark Glick, Chief Energy Officer, Hawaiʻi State Energy Office

RPS and decarbonization policies are driving Hawai'i's energy transition- but solutions must fit needs of the 6 islands where change is taking place.



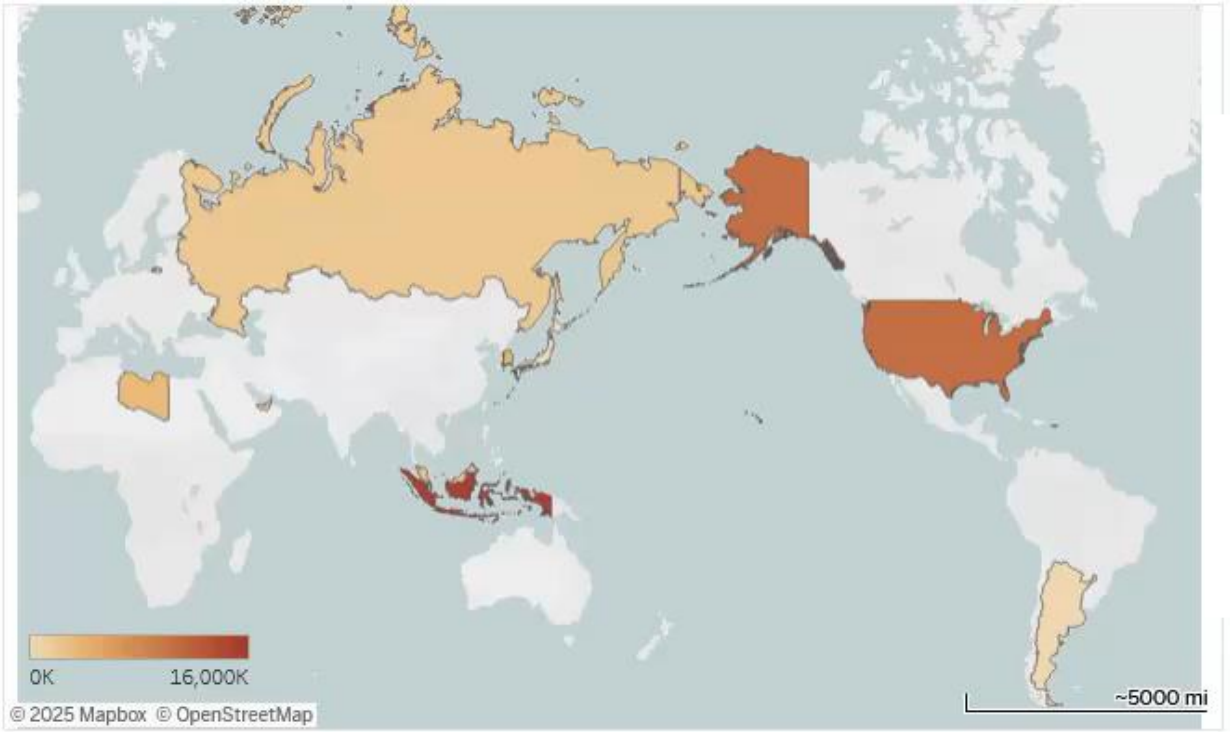
County-specific generation by source (GWh). Data compiled by the Hawai‘i State Energy Office (HSEO), Source Public Utilities Commission (PUC) Docket 2007-0008. 2023 & 2024 Renewable Portfolio Standards (RPS) Annual Status Reports.

Fuel Imports for Electricity Generation

2016-2024

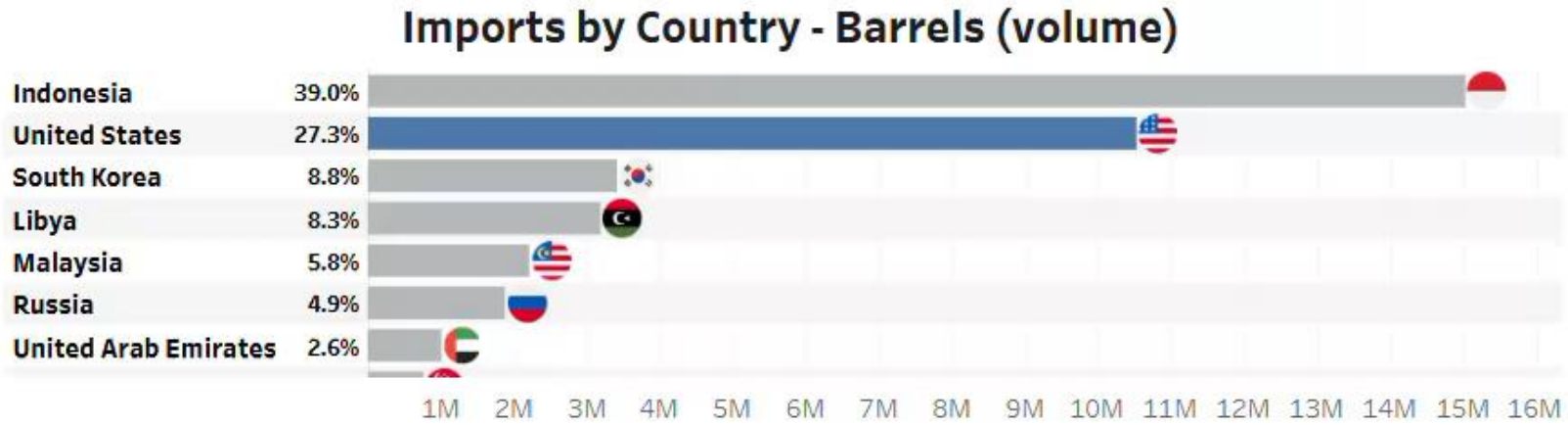
Top Fuel Suppliers

- Libya
- Argentina
- Russia
- Brazil
- Alaska



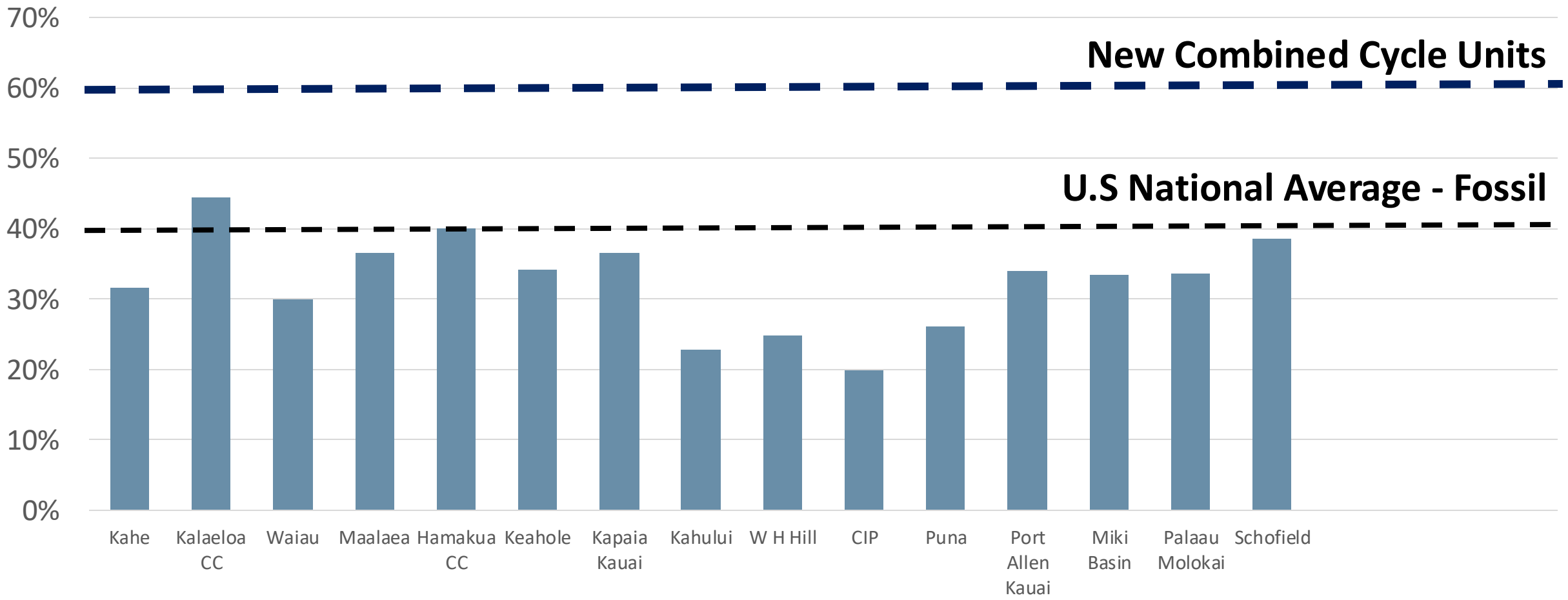
2016

Hawai‘i Fuel Imports Electricity Generation Fuels



Aerial View of Libyan Fuel Depot – Provides Hawai‘i with Crude

Efficiency of Generators – Below National Average



In order of decreasing net generation →

Source: eGRID 2023; US Averages - EIA 2024

Repowering & Resilience Panel

HAWAIʻI ENERGY CONFERENCE 2025

RICK ROCHELEAU, HNEI DIRECTOR; **MICHAEL ANGELO**, CONSUMER ADVOCATE; **SHELEE KIMURA**, PRESIDENT & CEO HAWAIIAN ELECTRIC; **LEO ACUNSION**, CHAIR HAWAI'I PUBLIC UTILITIES COMMISSION

Hawaii's Renewable Energy Challenges: Firm Power Needs

HAWAII ENERGY CONFERENCE
KAHULUI MAUI
MAY 21, 2025

BY
RICHARD ROCHELEAU
HAWAII NATURAL ENERGY INSTITUTE
SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAII AT MANOA, USA

- Includes additional slides for clarity
- Modeling conducted by Telos Energy Inc under contract to HNEI

Challenges to meeting statutory goals in a cost-effective way

GHG reductions 50% below 2005 levels by 2030; RPS, 40% by '30, 70% by '40, 100% by '45

Challenges

- Focus on the low carbon solutions that make sense for the time frame in which we need to act.
- Solar with storage has best potential for widespread deployment in the next decade?
- Models show that solar with storage (with or without wind) can provide up to 70% of our total energy needs with modest curtailment and no loss of reliability if the remaining generation operates flexibly (start-stops and ramp rates).
- How do we do this and keep the cost of electricity affordable - we need to get more creative to reduce the cost of both utility scale and behind-the-meter installations.
- We need to ensure that changes that are equitable and beneficial to all ratepayers and do a better job of educating the general public that proposed solutions benefit them.
- How do we grow the load and maximize use of low carbon generation and worry less about the final 30%.
- **High solar and wind scenarios will still require large amounts of flexible firm *capacity***
- **How do we get stakeholders aligned to make critical decisions in a timely manner**

Scenarios and solar levels used for preliminary assessment

SCENARIOS

1) NO FIRM CAPACITY ADDITIONS
Existing HECO oil fleet

2) 350 MW FIRM CAPACITY ADDITIONS
new CT/IC capacity

.

SOLAR LEVELS

A) 500 GWh of PV+BESS (38% RPS)*
38% RPS approx equivalent to full Stage 1&2 deployment, some CBRE with 800 MW BTM PV and load growth

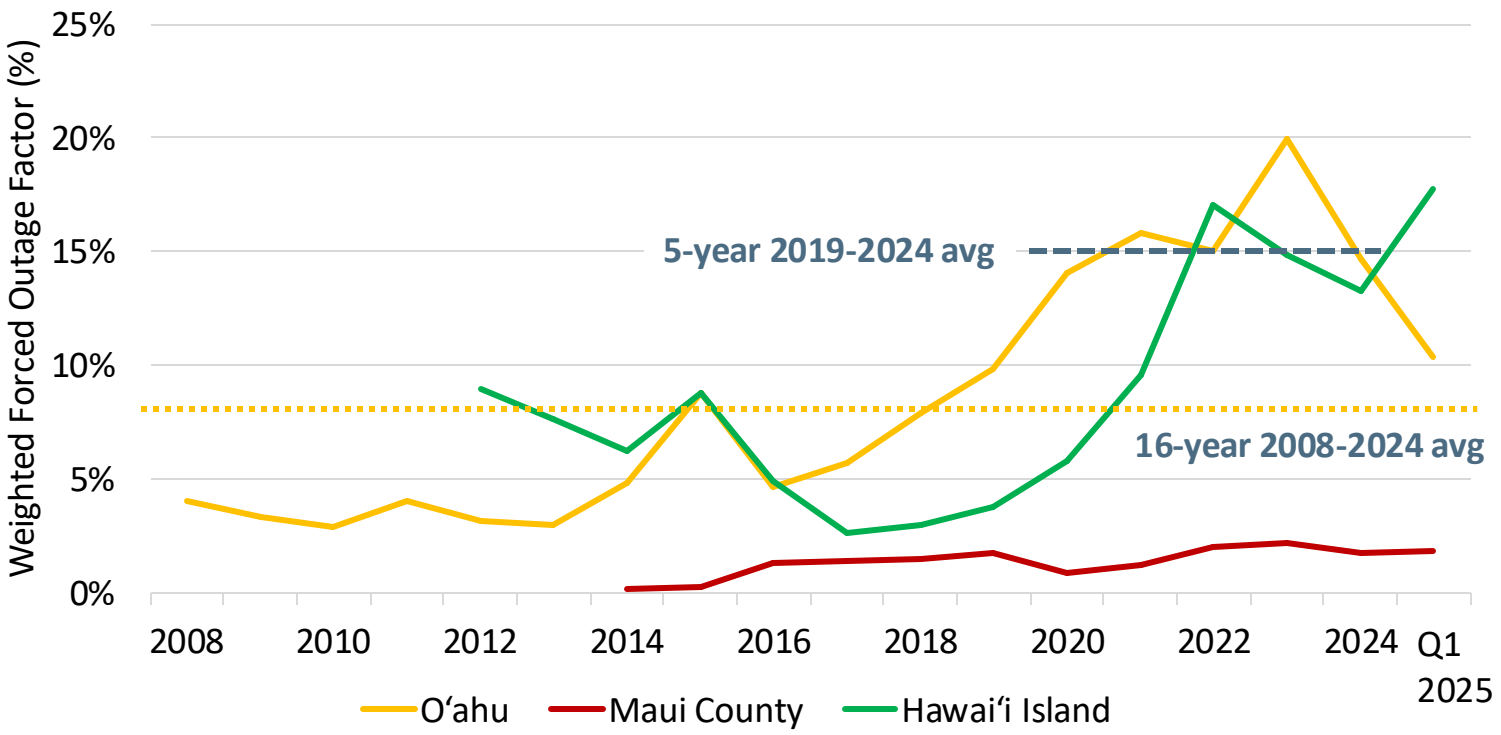
B) 1000 GWh of PV+BESS (44% RPS)

C) 2000 GWh of PV+BESS (56% RPS)

D) 3000 GWh of PV+BESS (68% RPS)

* GWH shown based on existing and planned utility scale systems with or without storage

HECO Outage Rates



Previous analysis (2023)

used three-levels of outage rates

- Low: 12-year FOF (2008-2019)
- Mid: 5-year FOF (2015-2019)
- High: 2019 FOF

Initial Analysis (Current)

Use 2019-2024 average (aligned closely with our "High" FOR previously.

Sensitivity (Current)

Use 2008-2024 average ~8% to evaluate sensitivity of forced outage rate assumptions on reliability. As older units retire, fleetwide WEFOF may decrease.

Oahu Loss of Load Expectation (LOLE) and Firm Capacity Needs for different solar/storage levels and Oahu retirements*

No Firm Capacity Additions

Incremental Retirement	Plant Name	Cumulative Retirement	Total Firm	500 GWh PV+BESS	1000 GWh PV+BESS	2000 GWh PV+BESS	3000 GWh PV+BESS
		0	1630				
	AES	180	1450				
	W3-4	274	1356	0.21	0.037		
	W5-6	382	1248	0.95	0.24	0.014	
	W7	466	1164		0.91	0.10	0.025
	W8	551	1079			0.47	0.12
	K1	635	995				0.37
	K2	720	910				
	K3	805	825				
	K4	889	741				
	K5	1024	606				
	K6	1159	471				
	W9	1210	420				
	W10	1262	368				

~450 MW of Additional Retirements Possible with 350 MW New Firm (~1.3 MW retired per MW added)

350 MW firm capacity additions

Incremental Retirement	Plant Name	Cumulative Retirement	Total Firm	500 GWh PV+BESS	1000 GWh PV+BESS	2000 GWh PV+BESS	3000 GWh PV+BESS
		0	1980				
	AES	180	1800				
	W3-4	274	1706				
	W5-6	382	1598				
	W7	466	1514				
	W8	551	1429				
	K1	635	1345	0			
	K2	720	1260	0.10	0.01		
	K3	805	1175	0.28	0.08		
	K4	889	1091	1.41	0.31	0.04	
	K5	1024	956		1.94	0.29	0.08
	K6	1159	821			1.51	0.36
	W9	1210	770				0.93
	W10	1262	718				

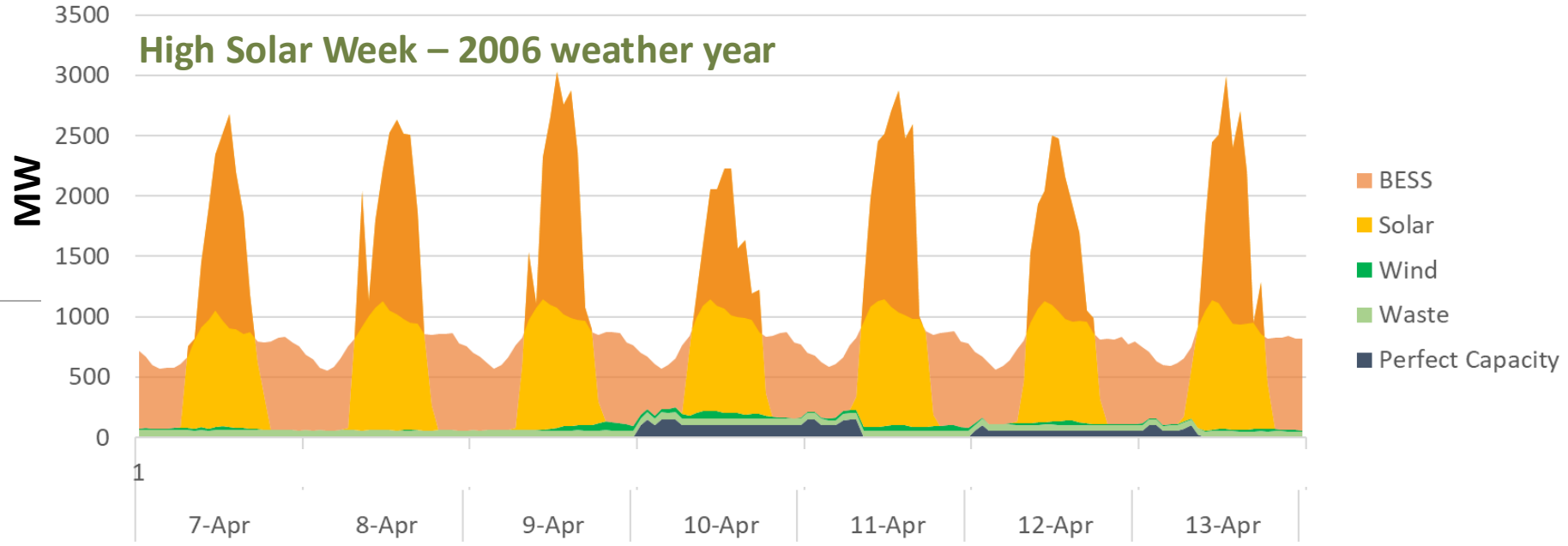
Final results pending maintenance scheduling

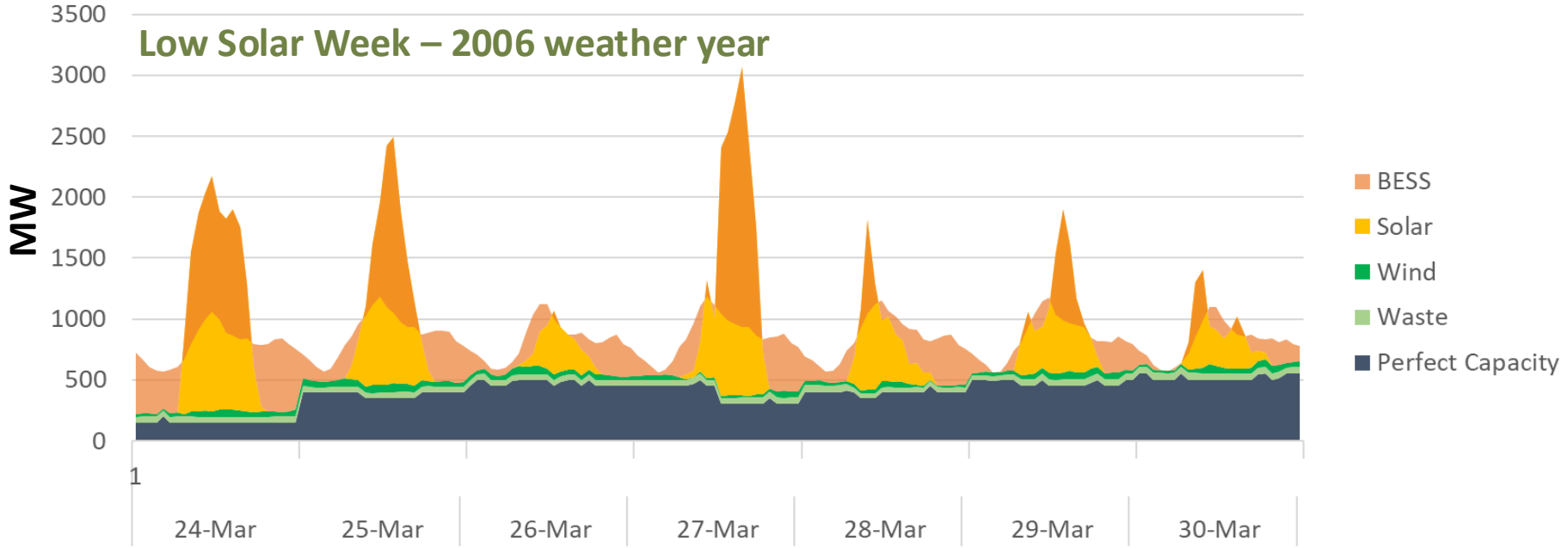
* Stochastic analysis using 26 years of solar data and the 2019-2024 weighted forced outage rate of 15% for existing HECO generation units.

Comparison of unit dispatch for a week with good solar resource vs a low resource week

Even with a large solar and storage buildout, there are multiple events per year requiring large amounts of ‘dispatchable firm” power, sometimes for extended periods

“Dispatchable firm” need driven in large-part by **multi-day** low wind/solar events

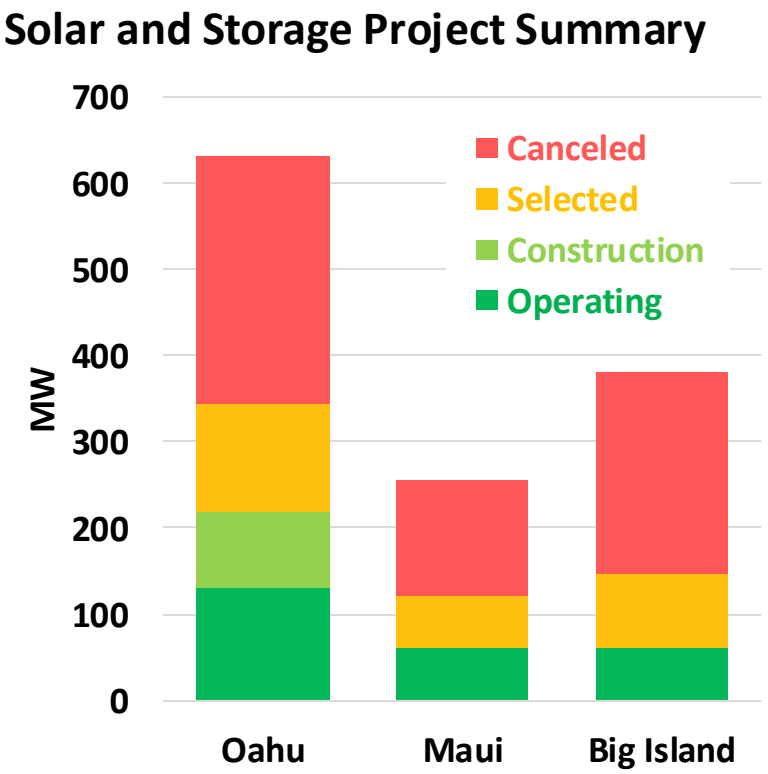




The 2006 low solar week occurred during the “40-days of rain”

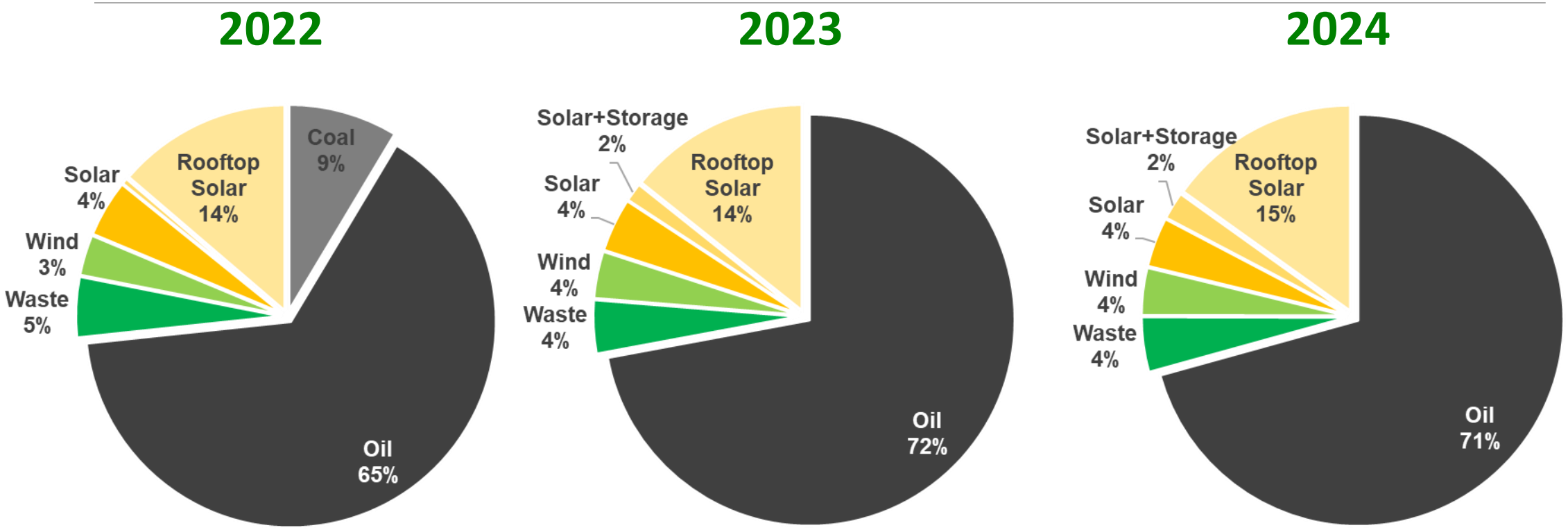
How do we make it easier for developers to get to the end of the project

Over 50% of projects canceled before COD



Name	Stage	Status	Island	Technology	Estimated Completion	Power Rating (MW)	Energy Rating (MWh)	Add'l Renewable Energy (GWh)
Mililani I Solar, LLC	Stage 1	Operating	Oahu	Solar + BESS	2022	39	156	85
AES Waikoloa Solar, LLC	Stage 1	Operating	Big Island	Solar + BESS	2023	30	120	66
Waiawa Solar Power LLC	Stage 1	Operating	Oahu	Solar + BESS	2023	36	144	79
AES Kuihelani	Stage 1	Operating	Maui	Solar + BESS	2024	60	240	131
AES West Oahu Solar, LLC	Stage 1	Operating	Oahu	Solar + BESS	2024	13	50	27
Hale Kuawehi Solar LLC	Stage 1	Operating	Big Island	Solar + BESS	2025	30	120	66
Hoohana Solar 1, LLC	Stage 1	Construction	Oahu	Solar + BESS	2025	52	208	114
Paeahu Solar LLC	Stage 1	Canceled	Maui	Solar + BESS	n/a	15	60	33
Kapolei Energy Storage	Stage 2	Operating	Oahu	BESS (standalone	2024	185	565	405
Kupono Solar	Stage 2	Operating	Oahu	Solar + BESS	2024	42	168	92
Mountain View Solar	Stage 2	Construction	Oahu	Solar + BESS	2025	7	35	15
Waiawa Phase 2 Solar	Stage 2	Construction	Oahu	Solar + BESS	2025	30	240	66
Waena BESS	Stage 2	Construction	Maui	BESS (standalone	2026	40	160	88
Barbers Point Solar	Stage 2	Canceled	Oahu	Solar + BESS	n/a	15	60	33
Kahana Solar	Stage 2	Canceled	Maui	Solar + BESS	n/a	20	80	44
Kamaole Solar	Stage 2	Canceled	Maui	Solar + BESS	n/a	40	160	88
Kaukonahua Solar	Stage 2	Canceled	Oahu	Solar + BESS	n/a	6	25.4	13
Kupehau Solar	Stage 2	Canceled	Oahu	Solar + BESS	n/a	60	240	131
Mahi Solar	Stage 2	Canceled	Oahu	Solar + BESS	n/a	120	480	263
Mehana Solar	Stage 2	Canceled	Oahu	Solar + BESS	n/a	7	26.4	14
Puako Solar PV + Battery Storage	Stage 2	Canceled	Big Island	Solar + BESS	n/a	60	240	131
Pulehu Solar	Stage 2	Canceled	Maui	Solar + BESS	n/a	40	160	88
Waikoloa Village Solar + Storage	Stage 2	Canceled	Big Island	Solar + BESS	n/a	60	240	131
Keahole Battery Energy Storage	Stage 2	Awaiting PUC Appro	Big Island	BESS (standalone	2025	12	12	26
Puuloa Solar	Stage 3	Selected	Oahu	Solar + BESS	2026	6	30	13
Kuihelani Phase 2 Solar	Stage 3	Selected	Maui	Solar + BESS	2027	40	160	88
Mahi Solar and Storage (Rebid)	Stage 3	Selected	Oahu	Solar + BESS	2027	120	480	263
Pulehu Solar & Storage (Rebid, small	Stage 3	Selected	Maui	Solar + BESS	2027	20	80	44
Keamuku Solar	Stage 3	Selected	Big Island	Solar + BESS	2030	86	344	188
Makana La	Stage 3	Canceled	Oahu	Solar + BESS	2027	80	480	175
Puu Hao Solar	Stage 3	Canceled	Maui	Solar + BESS	2027	20	80	44
Puako Solar	Stage 3	Canceled	Big Island	Solar + BESS	2028	60	240	131
Kaiwiki Solar	Stage 3	Canceled	Big Island	Solar + BESS	n/a	55	220	120

New solar and storage resources have not yet displaced the retired coal plant. Oil has made up the difference. New 2024 and 2025 solar/storage capacity expected to improve numbers



Oahu Annual Generation by Resource Type

Hawaii Energy Policy Forum: Addressing the State's Pressing Energy Issues

Topic Selection : Steering committee of 20 persons identified 36 topics which were 'bundled' into eight groups for further consideration and analysis. Steering committee subsequently identified three for initial focus.

Affordability: Analyze cost drivers of renewable energy projects and affordability challenges of meeting the 2040 70% RPS goal. Evaluate opportunities and make recommendations to improve the affordability of meeting RPS goals including utility scale, BTM, use of public buildings and land, and agrivoltaics.

Reliability : Assess gap energy needs for different renewable scenarios and retirement options. Identify ability of emerging non-thermal technologies to reduce gap energy needs and evaluate options and fuels for remaining gap energy requirement.

Building Performance Standards (BPS): Analyze cost and lifetime savings for existing building stock that complies with BPS. Provide policy recommendations for the implementation of BPS.

Other Topics include: Battery recycling; EV Infrastructure, Resilience; Biofuels; Public Education;

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