THE CRYSTAL BALL, Hawai'i's Energy Transition

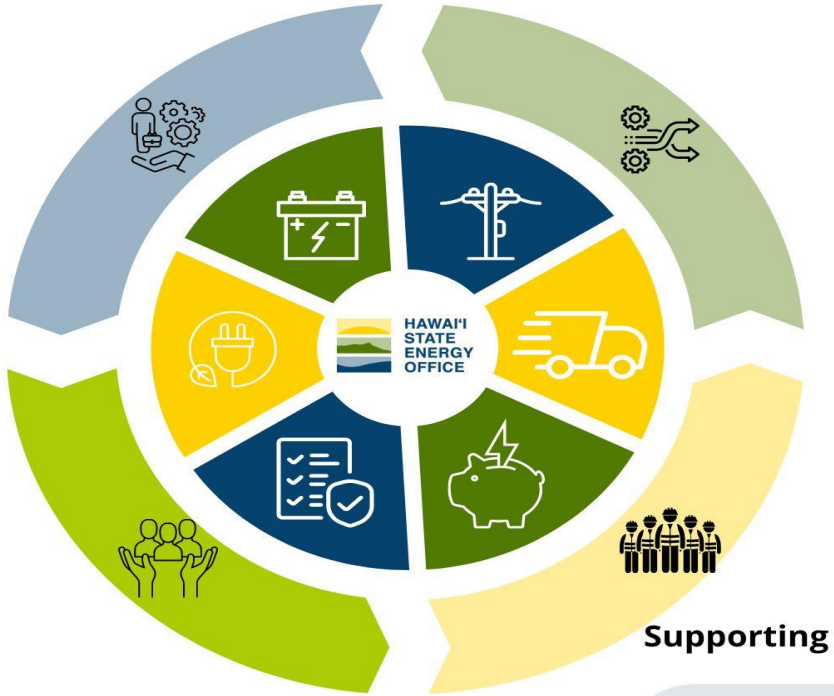
Mark B. Glick, Chief Energy Officer,
Hawai'i State Energy Office

Alaska Wind Working Group Conference

September 8, 2023

HAWAIʻI STATE ENERGY OFFICE

Hawaii State Energy Office



Elements of Energy Transition

- Battery Storage
- Grid Modernization
- Generation & Production
- Transportation
- Governance
- Energy Efficiency

Supporting Elements

- Technical Assistance
- Market Transformation
- Workforce Development
- Community Engagement

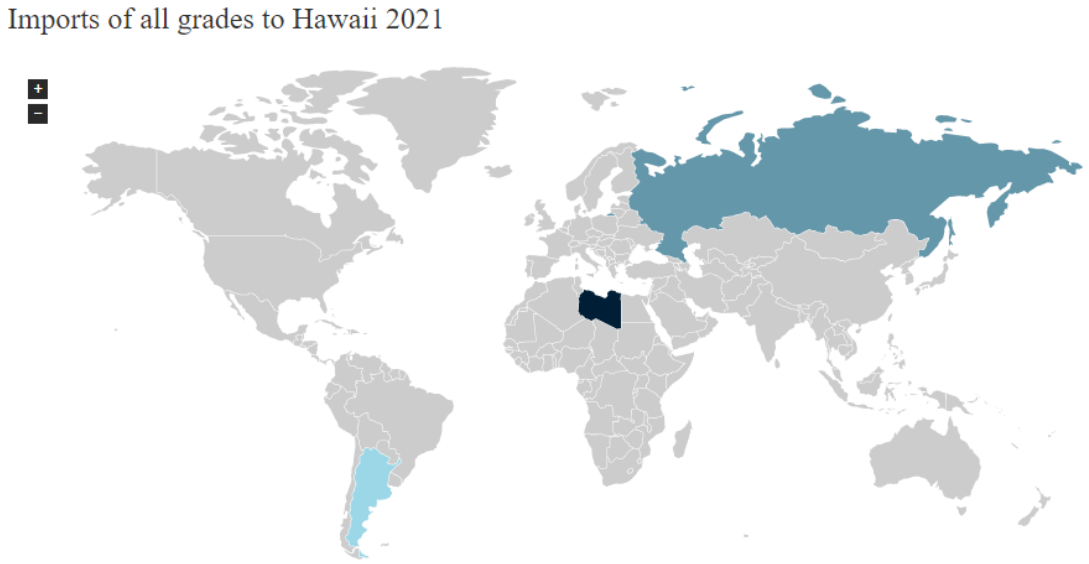
HSEO's statutory purpose is to promote **energy efficiency, renewable energy, and clean transportation** to help achieve a resilient, clean energy economy.

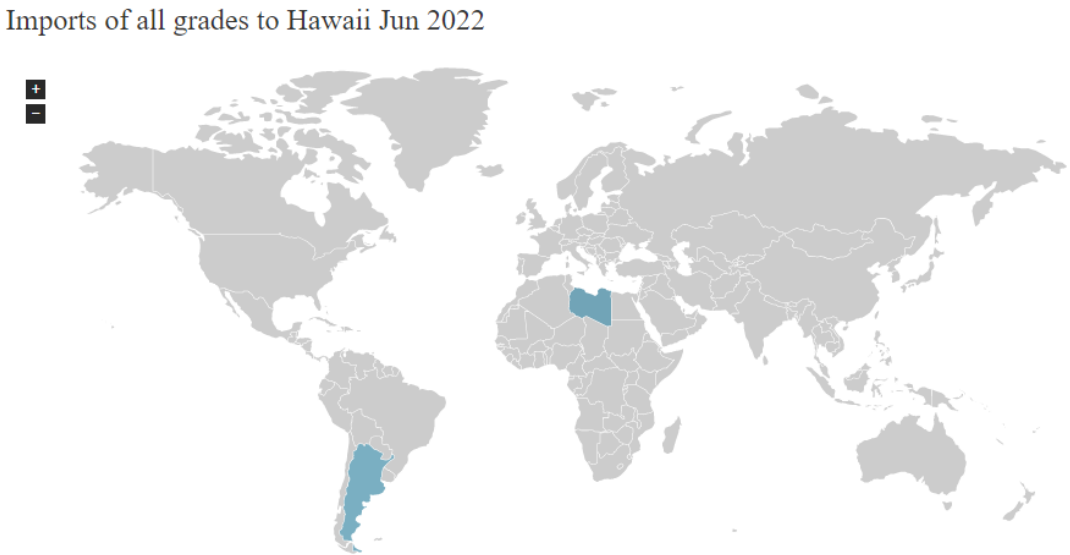
A well-defined policy framework (governance), modernized electrical grid, and energy storage are essential components of any clean energy economic transition.

HAWAI'I STATE ENERGY OFFICE

Urgency to Accelerate Hawai‘i’s Energy Transition

(1) Energy Security; (2) Mitigating Oil Price Volatility





Petroleum imports to Hawai‘i in 2021

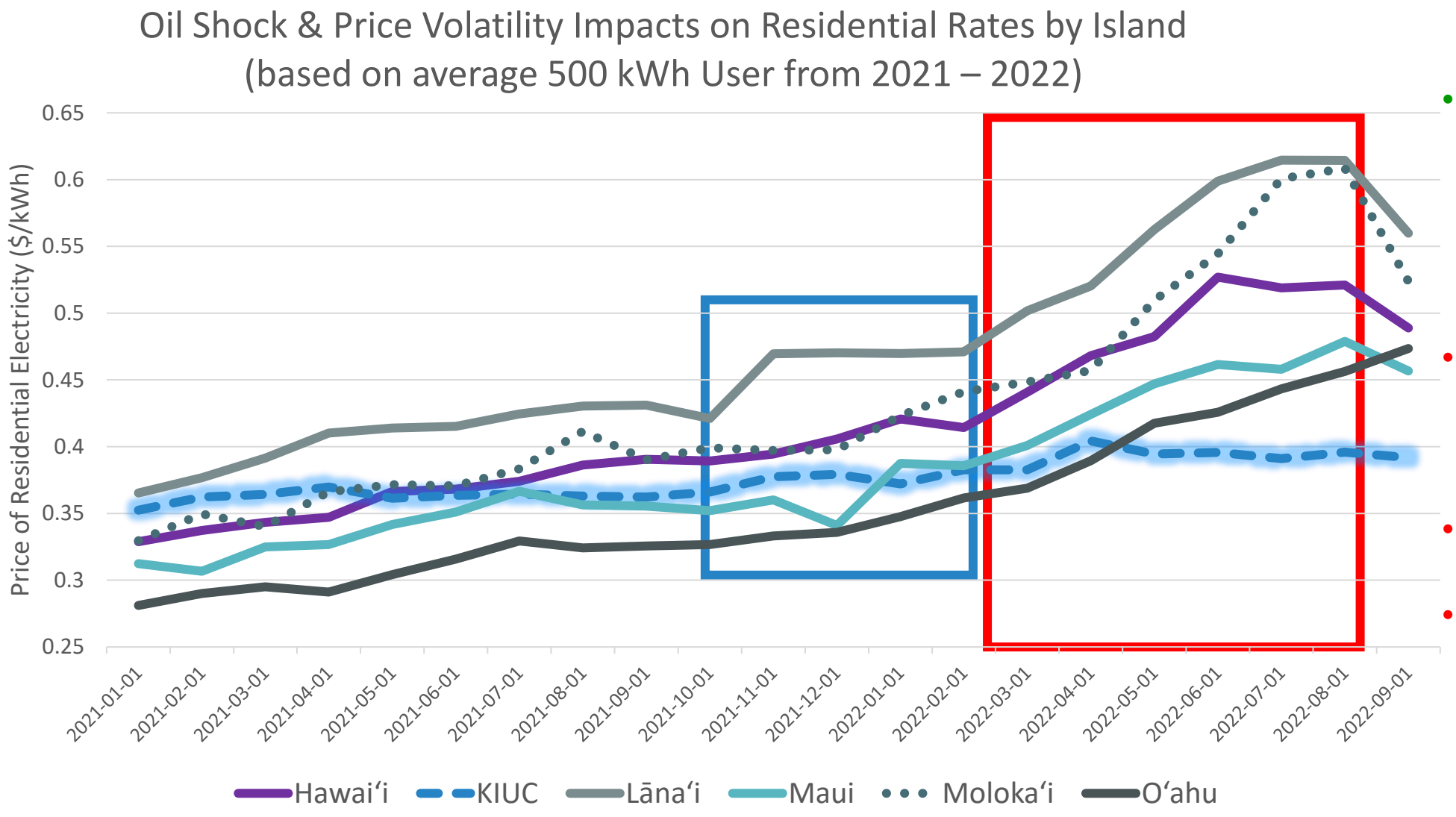
Libya – 64%
Russia – 28%
Argentina – 8%

Imports by Country June 2022

In response to Russia’s invasion of Ukraine in April 2022, Hawai‘i’s only refinery announced suspension of Russian crude oil purchase, shifting oil imports to Argentina and Libya.

HAWAI‘I STATE ENERGY OFFICE

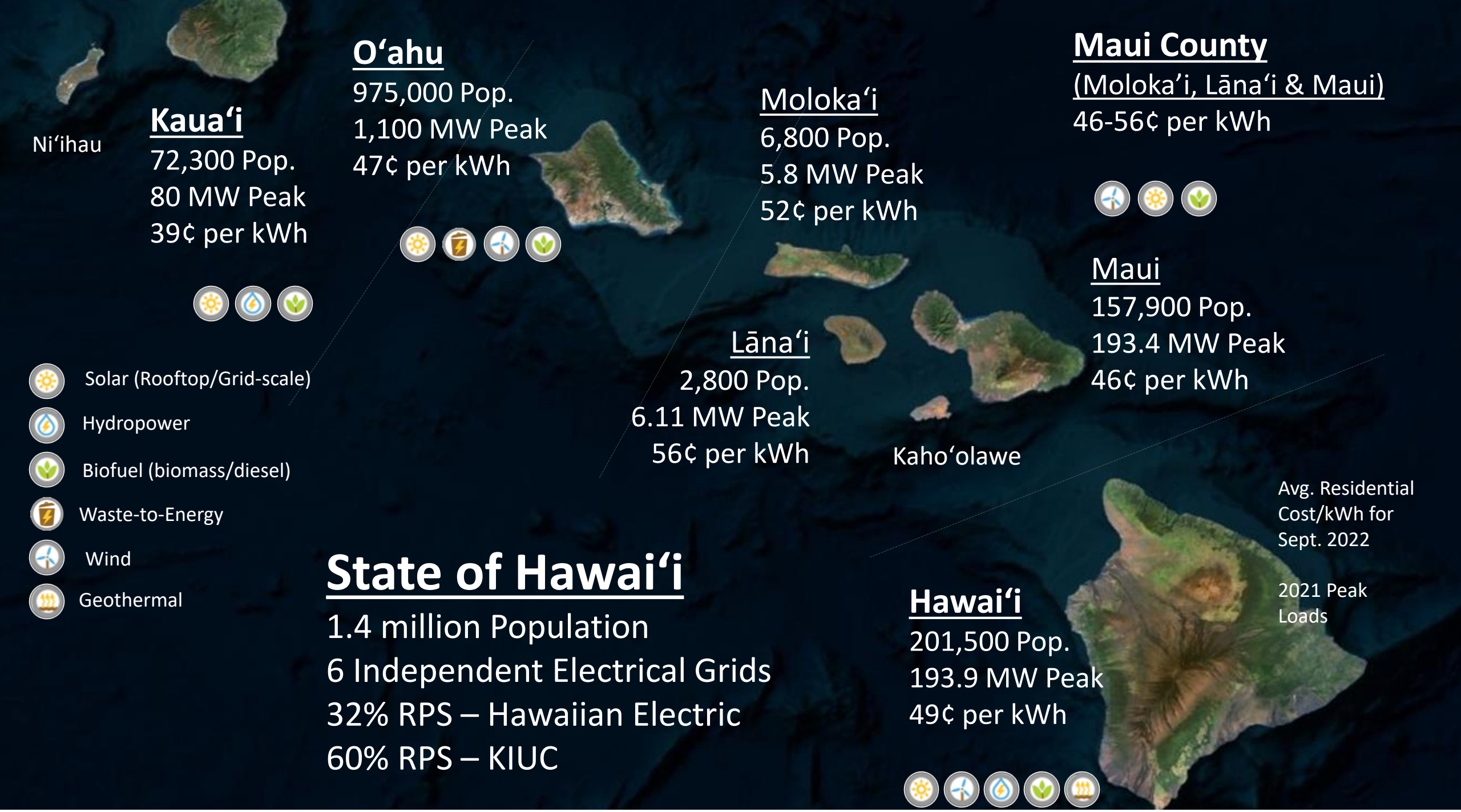
Average Electricity Prices by Island – 2021 to 2022



- Oil spikes on news of Russian military build-up on Ukraine border – Oct-Nov of 2021.
- Russian invasion of Ukraine spurs oil shock in April of 2022.
- O‘ahu costs exceed Kaua‘i energy costs.
- Kaua‘i energy costs plateau.

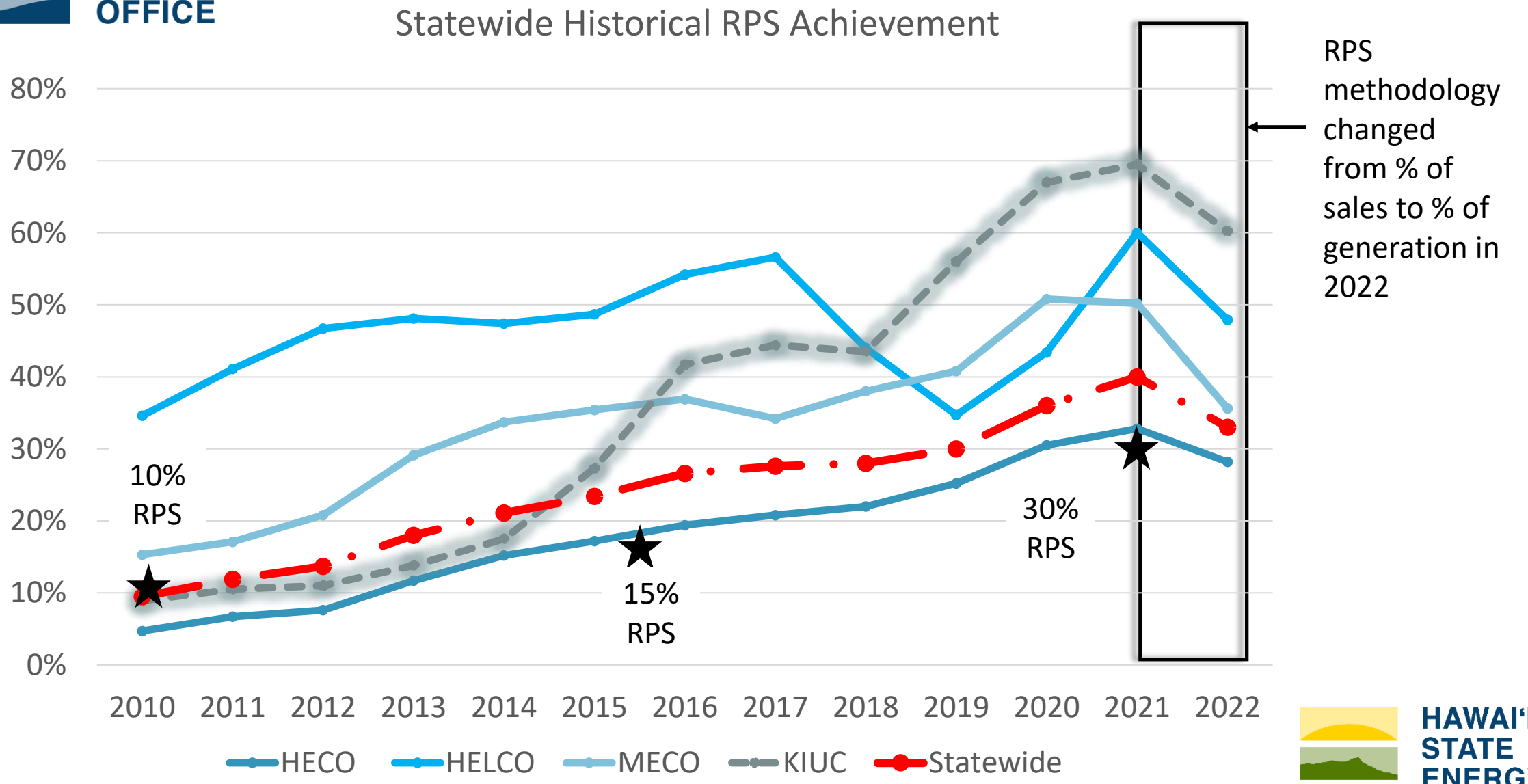
HAWAI‘I STATE ENERGY OFFICE

HAWAI‘I STATE ENERGY OFFICE


Ni‘ihau
Kaua‘i
72,300 Pop.
80 MW Peak
39¢ per kWh
O‘ahu
975,000 Pop.
1,100 MW Peak
47¢ per kWh
Moloka‘i
6,800 Pop.
5.8 MW Peak
52¢ per kWh
Lāna‘i
2,800 Pop.
6.11 MW Peak
56¢ per kWh
Kaho‘olawe
Maui County
(Moloka’i, Lāna‘i & Maui)
46-56¢ per kWh
Maui
157,900 Pop.
193.4 MW Peak
46¢ per kWh
Hawai‘i
201,500 Pop.
193.9 MW Peak
49¢ per kWh
Solar (Rooftop/Grid-scale)
Hydropower
Biofuel (biomass/diesel)
Waste-to-Energy
Wind
Geothermal
State of Hawai‘i
1.4 million Population
6 Independent Electrical Grids
32% RPS – Hawaiian Electric
60% RPS – KIUC
Avg. Residential Cost/kWh for Sept. 2022
2021 Peak Loads

HAWAIʻI STATE ENERGY OFFICE

Progress Towards the RPS



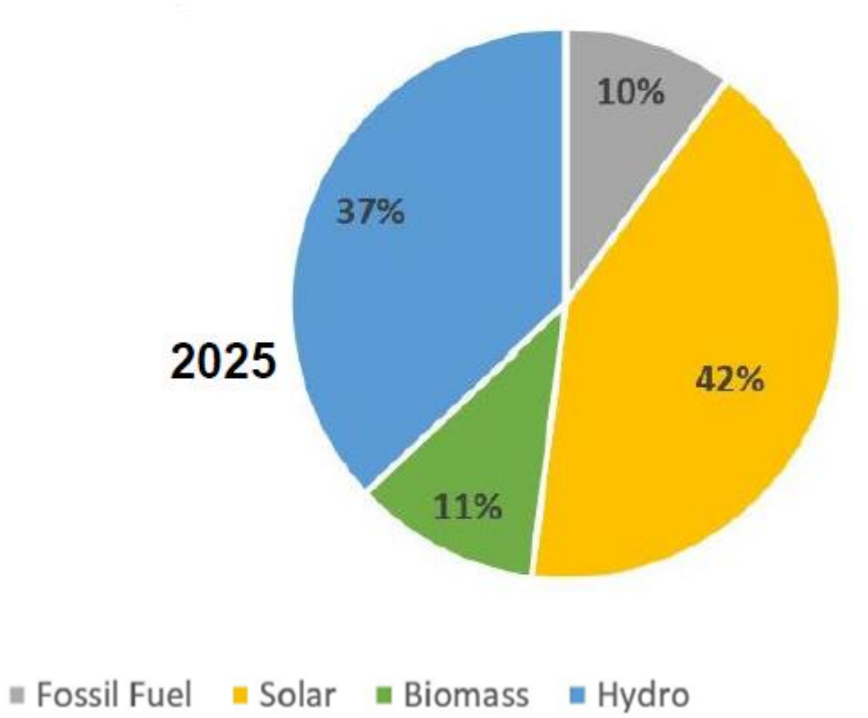
Source: Hawaiʻi PUC Docket No. 2007-0008

HAWAIʻI STATE ENERGY OFFICE

RPS Near Future*

* Assumes projects in development are not delayed past 2025

Kaua‘i Island Electric Cooperative



Source: KIUC WEKP Presentation

Renewable Portfolio Standard (HECO)

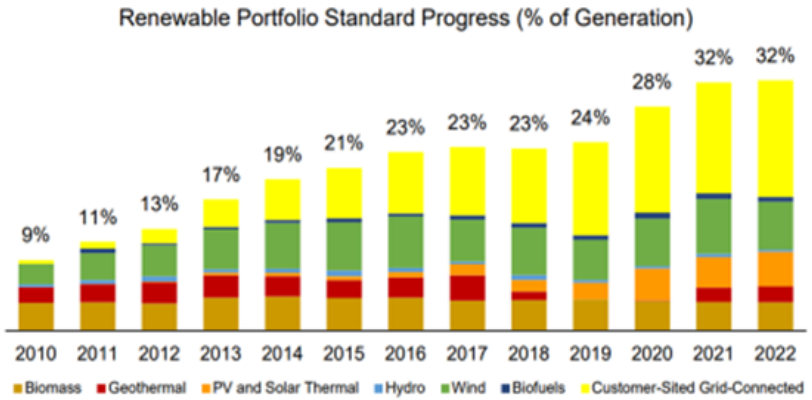


Figure 2: Renewable Portfolio Standards Under Amended Definition

Hawaiian Electric projects to reach 40% RPS by 2025

Source: HECO PUC Filing February 2023

HAWAI‘I STATE ENERGY OFFICE

Threats to Hawai’i’s Energy Transition

- Community Concerns re: Energy Siting of Energy Infrastructure, Exacerbated by Land Use Constraints & Competition
- State and County Government Technology and Resource Constraints
  - Lengthy, unpredictable process for permit approvals
- Utility Interconnection Process
  - Hawai’i PUC is implementing Phase 2 of the Act 201 (SLH 2022) Study
- Supply Chain Challenges
- Battery and PV Panel Waste Stream Management
- Local Workforce & Community Benefits
- Extreme Weather Events

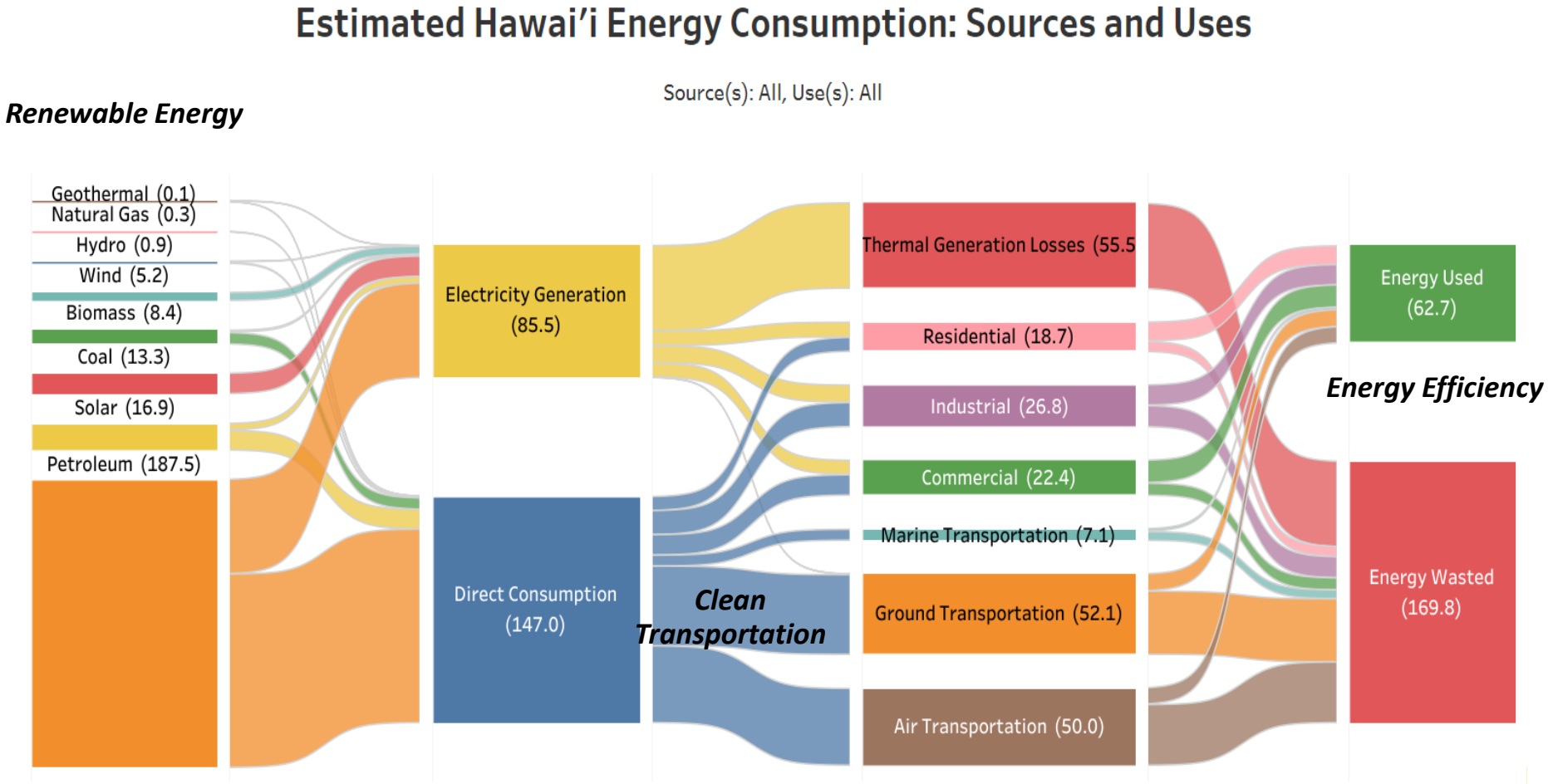
HAWAIʻI STATE ENERGY OFFICE

HSEO: Planning for a Decarbonized Economy

Matching development of RE and total demand across all sectors that creates greatest benefit

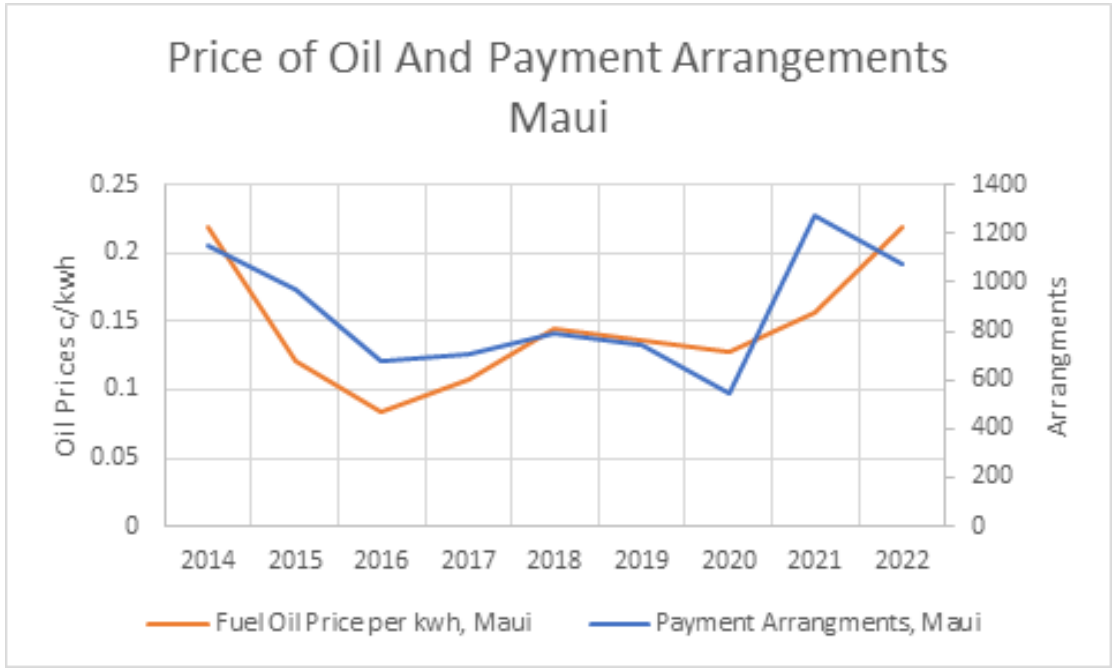
Statutory Goals

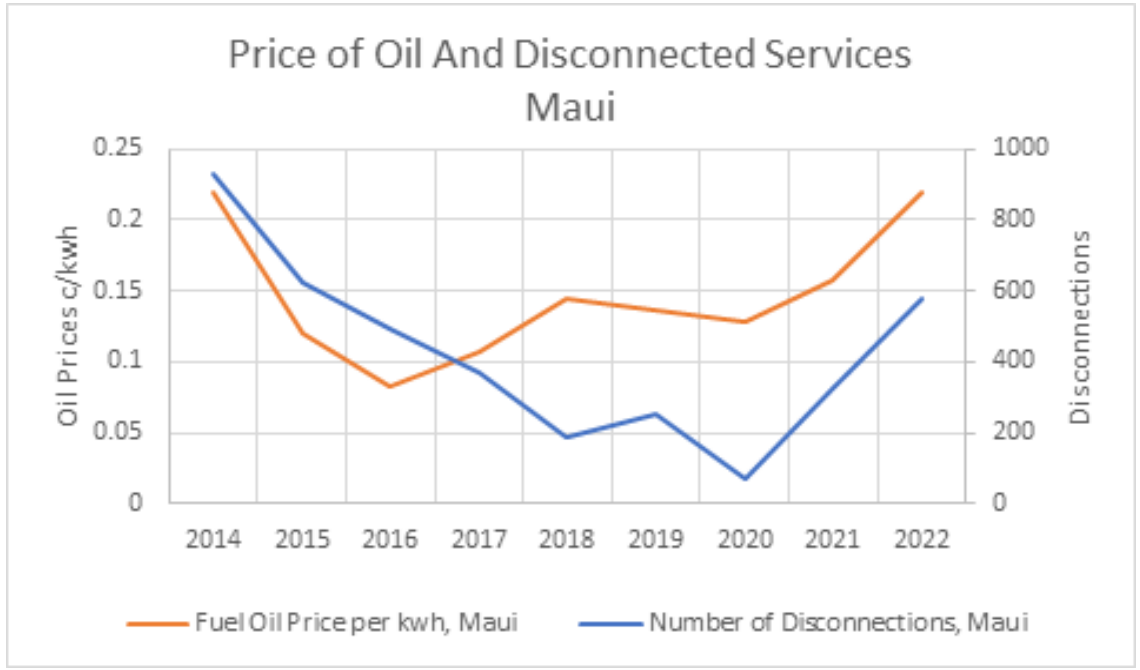
- Promote energy efficiency, renewable energy, and clean transportation
- To achieve a resilient clean energy net-negative carbon economy



HAWAIʻI STATE ENERGY OFFICE

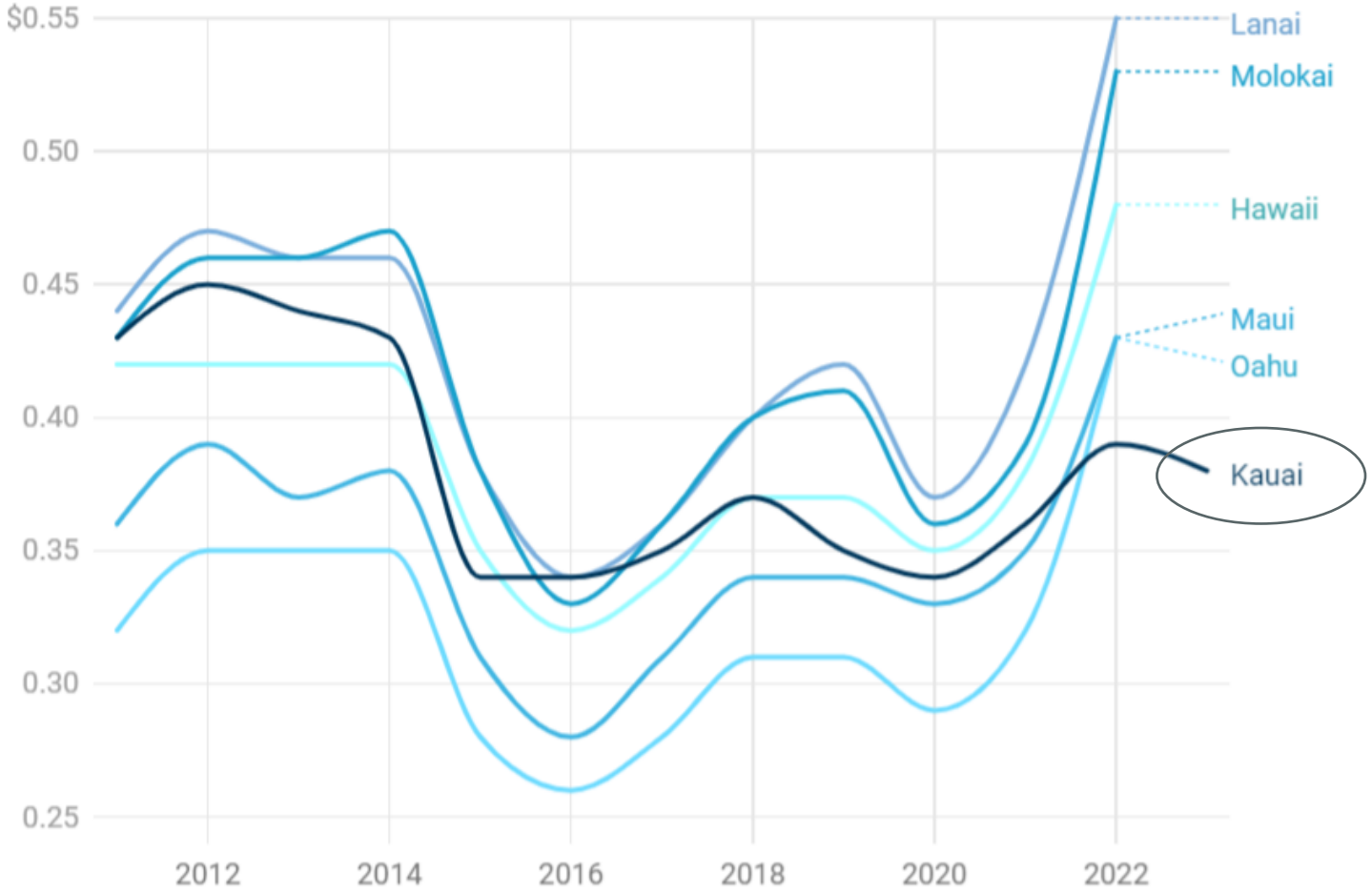
Oil Volatility Impacts Daily Lives





HAWAIʻI STATE ENERGY OFFICE

Average Electricity Prices by Island, 2012 to 2022



Source: State of Hawaii, DBEDT • Get the data • Created with Datawrapper

HAWAIʻI STATE ENERGY OFFICE

Strategic Priorities

- Capitalize on IIJA, IRA and other federal funds
  - Over $450 billion investment in energy and clean transportation
- Identify areas for collaboration to tackle transportation
  - Largest energy user and largest emitter
  - Mix of existing tech and hard-to-decarbonize sectors
  - Multiple agencies at fed, state county levels
- Take the right next steps on the path to decarbonization
- Identify long-term prospects that may benefit the state
  - Sequestration
  - Geothermal Exploration
  - Hydrogen
  - Advanced PV & Long-Duration Storage
- Begin to break free from oil volatility

HAWAIʻI STATE ENERGY OFFICE

HSEO Near-Term Branch Priorities At a Glance…

EERE

1. Act 238 Decarb Study
2. Administer $68.4 million for home efficiency and electric appliances
3. Apply for Zero Energy Code grant funds ($34 million available to Hawai‘i)

RCA

1. Clearpath 2023
2. Administer $15 million in grid resilience and modernization funds
3. Assist DAGS with state fleet decarb

JOBs

1. Expand clean energy wayfinders program with $1 million in federal funds
2. Lead clean energy jobs segment of Hawai‘i Good Jobs Challenge

HAWAI‘I STATE ENERGY OFFICE

HSEO Impact Measures

EERE

- Energy and emissions saved in state buildings
- Renewable fuel tax credit certificates processed
- Hawai‘i Green Business Program participants

RCA

- Number of FEMA mobilizations
- Completion of CEI map tool
- Jobs and apprentices from GRIP
- Vehicle exemptions reviewed

JOBS

- GJH participants employed
- Wayfinders events
- Community capacity impact (survey)
- ALICE households engaged in clean energy programs

HAWAI‘I STATE ENERGY OFFICE

Long Duration Storage

Key Objectives

- Evaluate efficacy of multi-day storage technologies to reduce dispatchable firm capacity needs
- Develop modeling tools and methods required to evaluate long-duration storage considering weather and load uncertainty

Status Update

- Currently developing/testing modeling tools and methods in coordination with HECO, IGP TAP, and others

Future Work

- Initial results indicate that future power system may be *energy limited* with insufficient resources to charge multi-day storage.
- Develop detailed operating practices for long-duration storage technologies

Potential options for long-duration energy storage technologies

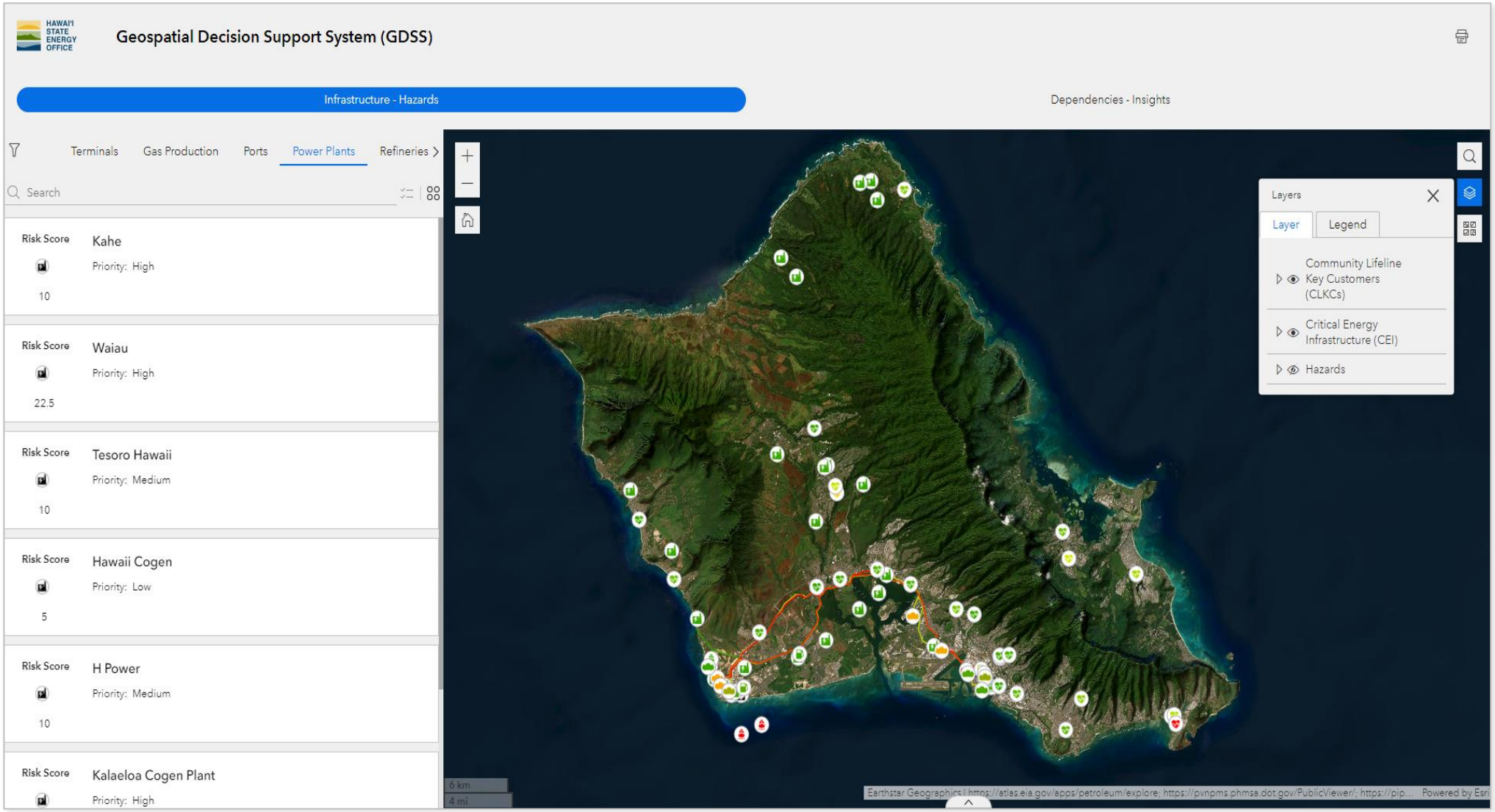
- Hydrogen & Combustion Turbines
- Iron-air and alternative chemistry batteries
- Compressed air energy storage
- Pumped hydroelectric

Grid-Forming Inverter Based Resources

- **Dynamic IBR Case Study: Maui Island (NREL & HECO)**
- 97% of 144.7MW provided by inverter-based resources, with two levels of synchronous condensers for inertia (370 MVA and 124MVA)
- Found instability only in very low short circuit situations, attributed to “only a few devices in the system,”
- Mitigation by inverter specification, pre-operations testing, and legacy inverter upgrades
- Related project on Kauaʻi announced in May 2023 for IBR fault protection schemes (NREL & KIUC)

HAWAIʻI STATE ENERGY OFFICE

Energy Security Planning



HAWAIʻI STATE ENERGY OFFICE

Mahalo

Mark B. Glick,
Hawai‘i Chief Energy Officer
Mark.b.glick@hawaii.gov
808-451-6648

HAWAIʻI STATE ENERGY OFFICE