

Hawai'i's End-to-End Energy Transformation and Lessons For Pacific Island Countries



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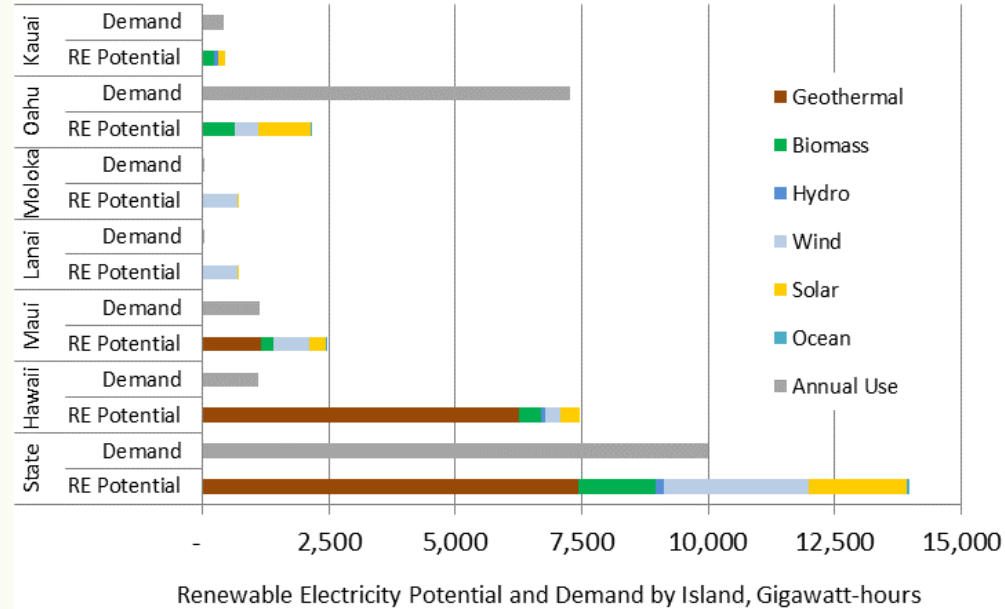


PACIFIC ISLANDS CLIMATE COLLABORATIVE – 2022 FORUM

MARCH 22 – 23, 2022 AT 12:00 – 2:00PM HST

DAY 2, SESSION 3: CLIMATE SOLUTIONS EXPO

Opportunity for Sustainability in Hawaii is Abundant



Source: National Renewable Energy Laboratory, Hawaii Clean Energy Initiative Scenario Analysis, 2012; and DBEDT

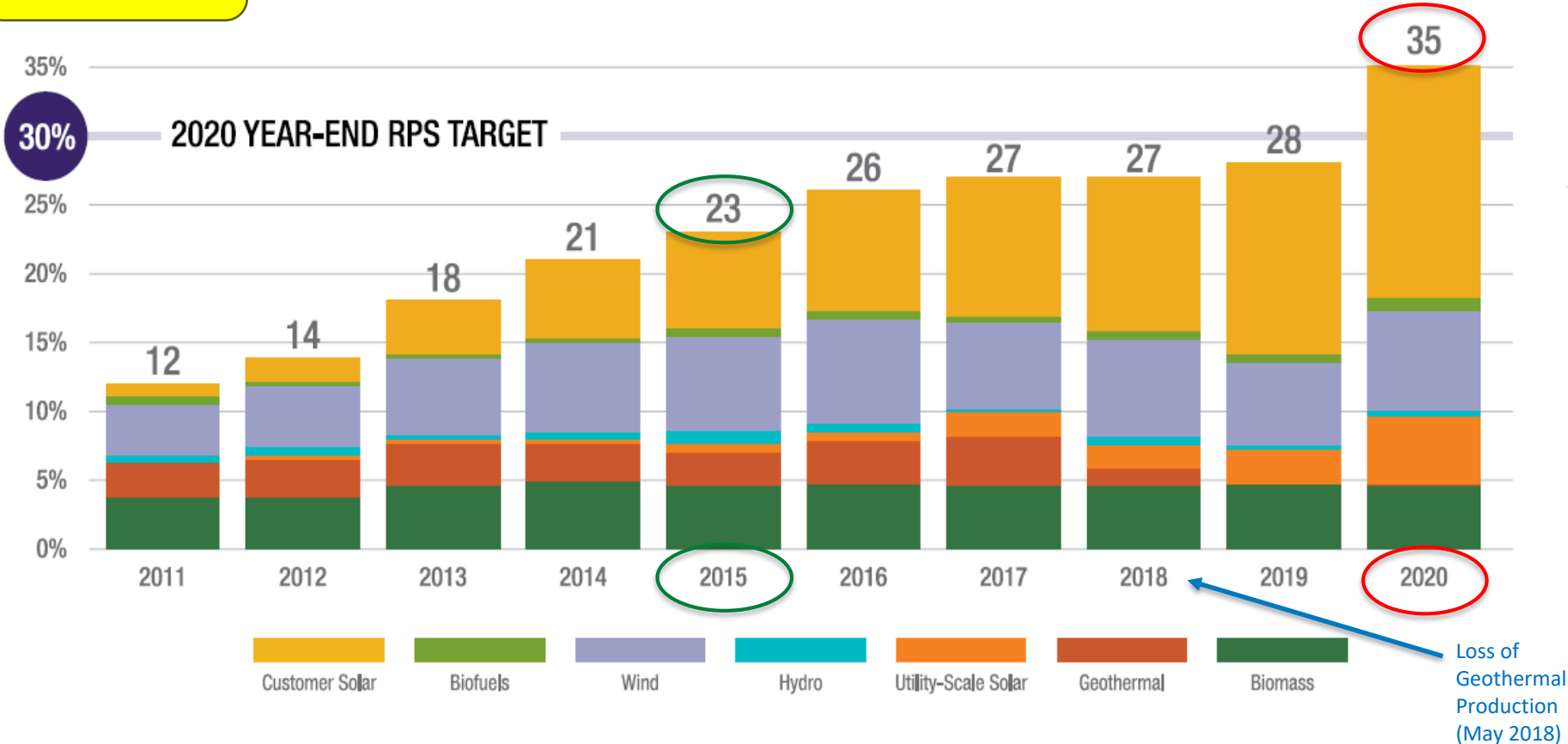


Progress Toward A Clean Energy Future

Hawaiian Electric Companies

2008
Hawaii Clean
Energy Initiative

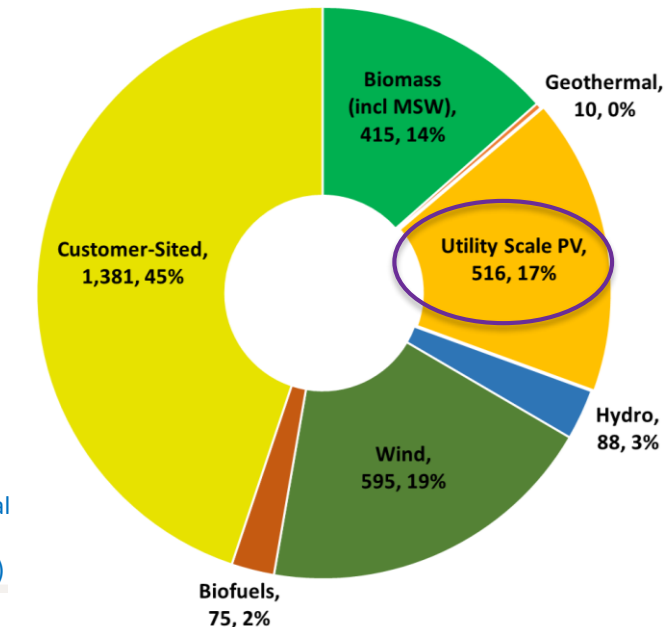
RENEWABLE PORTFOLIO STANDARD PROGRESS



Hawaii RPS Goals

2015 - 15%
2020 - 30%
2030 - 40%
2040 - 70%
2045 - 100%

2020 State Renewable Energy Generation (GWh, %)



Source: Hawaiian Electric Sustainability Report 2020-2021, HPUC Dkt 2007-0008 RPS Reports

Hawai'i Natural Energy Institute (HNEI)

University of Hawai'i at Mānoa

Organized Research Unit in the School of Ocean and Earth Science and Technology
Founded in 1974, established in Hawai'i statute in 2007 (HRS 304A-1891)

- Conduct RDT&E to accelerate and facilitate the use of resilient alternative energy technologies and reduce Hawai'i's dependence on fossil fuels.
- Diverse staff includes engineers, scientists, lawyers; students and postdoctoral fellows; visiting scholars

Areas of Interest

- **Grid Integration (Grid**START**)**
- **Policy and Innovation**
- **Renewable Power Generation**
- **Electrochemical Power Systems**
- **Building Efficiency**
- **Alternative Fuels**
- **Transportation**

Core Functions

- **State Energy Policy Support**
- **Research & Development**
- **Testing and Evaluation**
- **Analysis**
- **Workforce Development**

Established to develop and test advanced grid architectures, new technologies and methods for effective integration of renewable energy resources, power system optimization and resilience, and enabling policies

- Serves to integrate into the operating power grid other HNEI technology areas: energy efficiency, renewable power generation, biomass and biofuels, fuel cells and hydrogen
- Strong and growing partnerships with Hawai'i, national and international organizations including Asia-Pacific nations

Expertise & Focus:

- | | |
|---|--|
| ➤ <i>Energy Policy and Regulation</i> | ➤ <i>Power Systems Operation</i> |
| ➤ <i>Renewable Energy Grid Integration</i> | ➤ <i>Power Systems Engineering and Standards</i> |
| ➤ <i>Smart Grid Planning & Technologies</i> | ➤ <i>Communications Design and Testing</i> |
| ➤ <i>Power Systems Planning</i> | ➤ <i>Project Management and Execution</i> |
| ➤ <i>RE Resource Procurement</i> | |

Lead for many public-private demonstration projects

Core Team Members:

❖ Richard Rocheleau	Director, HNEI
❖ Leon Roose *	Specialist & Chief Technologist
❖ Mark Glick *	Specialist, Energy Policy
❖ Marc Matsuura *	Senior Smart Grid Program Manager
❖ Damon Schmidt *	Senior Energy Regulatory/Policy Analyst
❖ James Maskrey *	Energy Efficiency Program Manager
❖ Jonathan Kobayashi	Power System Engineer
❖ Silas Oliviera de Toledo	Power System Engineer
❖ Brian Griswold	Junior Power System Engineer
❖ Kevin Davies	Assistant Researcher – Power systems
❖ Saeed Sepasi	Assistant Researcher – Power systems
❖ Dax Mathews	Renewable Energy Resources Forecasting
❖ Ai Oyama	Research Technical Writer/Translation Specialist
❖ Sharon Chan	GIS Specialist
❖ Quynh Tran	Post-Doctoral Fellow

*Team members combine
for 75+ years of utility and
regulatory experience*

- * Prior electric utility company senior management
- * Prior Administrator of the Hawaii State Energy Office

Sampling of Sponsors & Partners:



Coconut Island DC Microgrid

Background:

- ❖ Grid**START** is developing a DC-based microgrid on Coconut Island, home to the University of Hawai'i's Hawai'i Institute of Marine Biology (HIMB), located in Kāne'ohe Bay, O'ahu.



Key project goals:

- ❖ Adoption of innovative energy efficient and reliable clean energy technologies
- ❖ Establishment of a research platform to study resilient DC microgrid technologies (e.g., microgrid controller, energy storage, DC powered appliances, etc.) in a tropical coastal environment
- ❖ Development of solar powered DC all-electric land (E-car) and sea (E-boat) transportation solutions

International partnerships:

- ❖ Okinawa Institute of Science and Technology (OIST), Japan
- ❖ PUES Corporation (PUES), Japan
- ❖ University of Indonesia (UI), Indonesia

OIST & PUES

A DC-powered e-car, e-boat, and portable emergency power source using a novel swappable battery energy storage system



UI

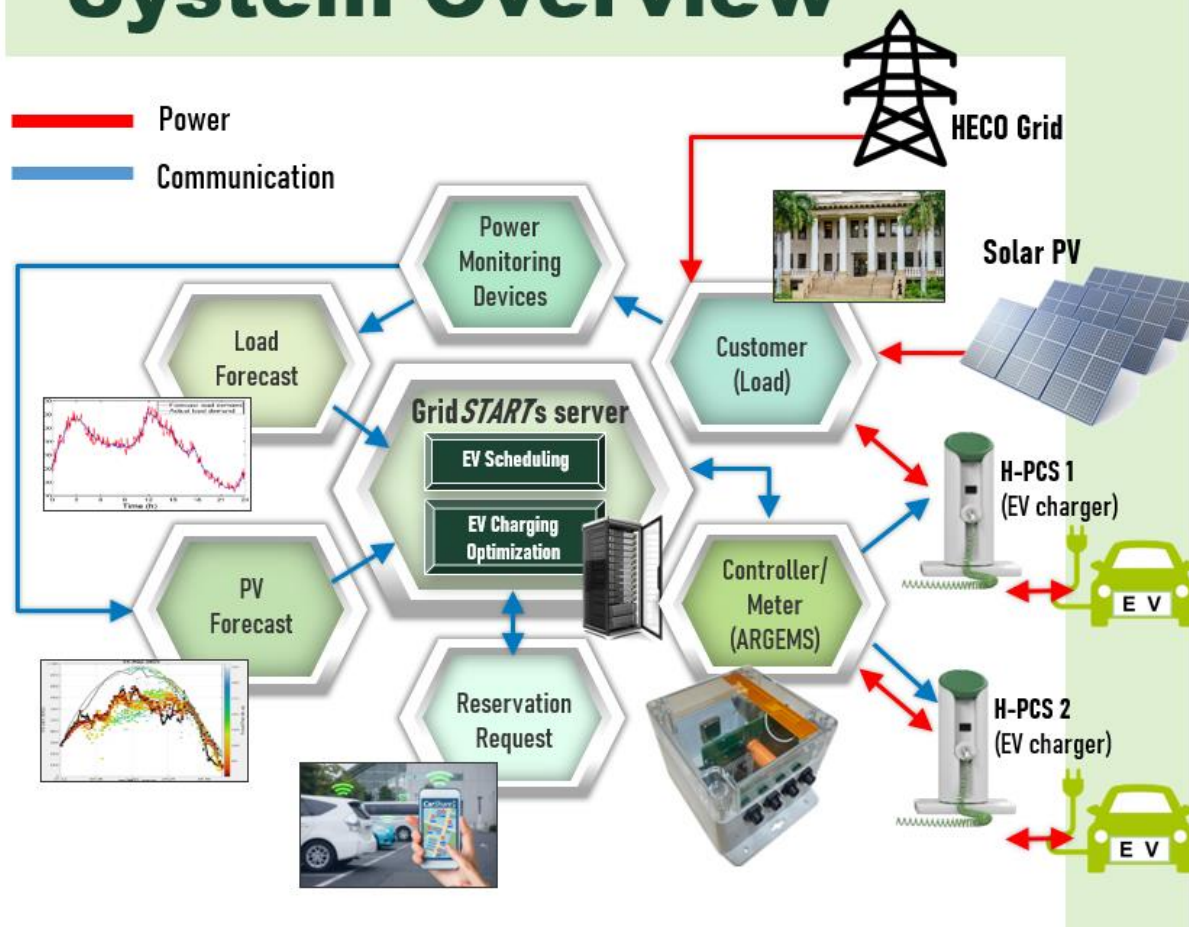
A new version of a UI designed DC-DC converter (DCON), which transforms the voltage of the PV and BESS 48 V DC bus to the 200 - 350 volts required by the various DC microgrid loads



Background:

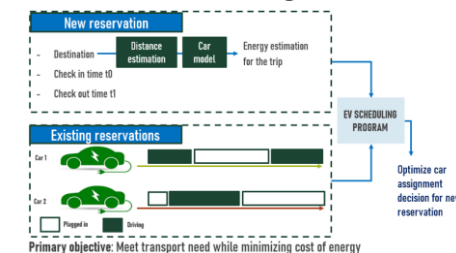
- Grid**START** is collaborating with IKS Co., Ltd. (IKS) on technology development, test, and demonstration of advanced control of two bidirectional electric vehicle (EV) chargers (H-PCS) on the campus of the University of Hawai'i at Mānoa (UH).
- The H-PCS was developed by IKS with support from Hitachi Limited as part of the earlier JUMPSmart Maui smart grid demonstration project, where Grid**START** was one of the partners.
- Two EVs will be used by designated university personnel in a car-sharing system accessed via an Grid**START** developed secure smartphone/web-based car scheduling application made available to the drivers.
- Not only will the EVs be used for energy research and results dissemination, but the project experience will also allow the UH administration to evaluate the practical use of EVs as part of their vehicle fleet.

System Overview

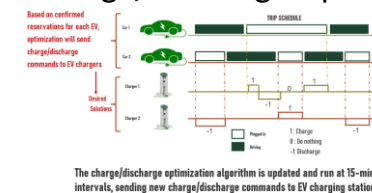


GridSTART Algorithms

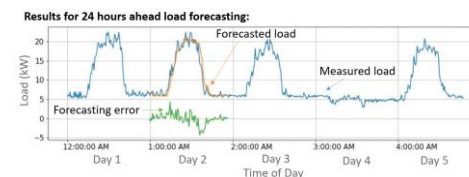
EV Use Scheduling



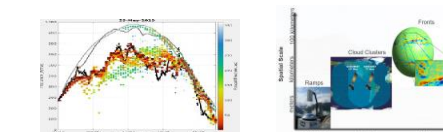
Charge/Discharge Optimization



Load Forecasting



Solar PV Forecasting



Technical Support for Development of Bess Technical Standards for Thailand

Background:

- ❖ Despite the emergence of BESS applications in Thailand, there is still a lack of regulations to ensure the quality and safety of BESS installations, operations, and decommissioning.
- ❖ The Office of Energy Regulatory Commission of Thailand (OERC) expressed its interest to USAID Clean Power Asia (CPA) to develop regulations that address the engineering, performance, and safety of the installation and operation of BESS (BESS Technical Standards) as well as relevant electrical grid connection codes for BESS.
- ❖ Under USAID CPA and ONR APRESA funding, HNEI Grid**START** delivered technical assistance to OERC by developing BESS Technical Standards and providing recommendations on electrical grid connection codes relevant to BESS.

BESS Technical Standards and Best Practices:

- ❖ IEC Standard 62933 on Electrical Energy Storage Systems (2018)
- ❖ NFPA Standard 855 on the Installation of Stationary Energy Storage Systems (2020)
- ❖ New York Battery Energy Storage Guidebook (2020)
- ❖ California Safety Inspection Checklist AS/NZS Standard 5139 on Electrical Installations – Safety of Battery Systems for Use with Power Conversion Equipment (2019)

BESS Interconnection Codes:

- ❖ NERC Reliability Guideline BPS-Connected Inverter-Based Resource Performance (2018)
- ❖ NERC Reliability Guideline Improvements to Interconnection Requirements for BPS-Connected Inverter-Based Resources (2019)
- ❖ IEEE P2800 Standard for Interconnection and Interoperability of Inverter-Based Resources (IBR) Interconnecting with Associated Transmission Electric Power Systems (forthcoming)
- ❖ EGAT code (2019)



Enhancing Customer Participation in the Philippines' Net-Metering Framework

Background:

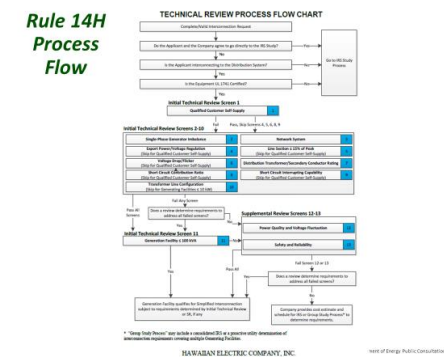
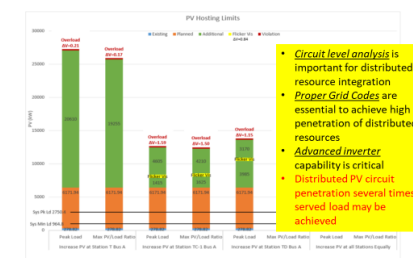
- ❖ Grid**START** provided technical and capacity building support in collaboration with USAID Clean Power Asia (CPA) to assist the Philippines Department of Energy (PDOE) to prepare its Department Circular (DC) for Promulgating Policies to Enhance Customers' Participation in the Philippines' Net-Metering Framework.
- ❖ These policies include among others the revision of the existing 100 kW system size cap, enumerating compensation mechanisms to inform decision making by the Energy Regulatory Commission (ERC), and simplifying and streamlining net-metering interconnection and tools.

Objective and Significance:

Grid**START** is supporting PDOE by developing and delivering:

- ❖ Guidelines for distribution utilities on distribution impact study screening criteria
 - Identification of technical requirements and stream-lined processes based on industry best practices
 - Recommendations for distribution grid code improvements to accommodate higher distributed PV penetrations
- ❖ Capacity building for distribution utilities via webinars, workshops, in-person trainings, and expert consultations in events hosted by relevant Philippines energy stakeholders
 - Delivered expert in-person training and messaging support at the request of the PDOE in public consultation meetings held in several major Philippines cities in October 2019 to engage stakeholder input to proposed net-metering program changes
 - In collaboration with USAID CPA, NREL, and PDOE, Grid**START** delivered a series of virtual training sessions from July through October 2020 for distribution utilities in the Philippines

Circuit Level PV Hosting Capacity



Mahalo!

(Thank you)



For more information, contact:

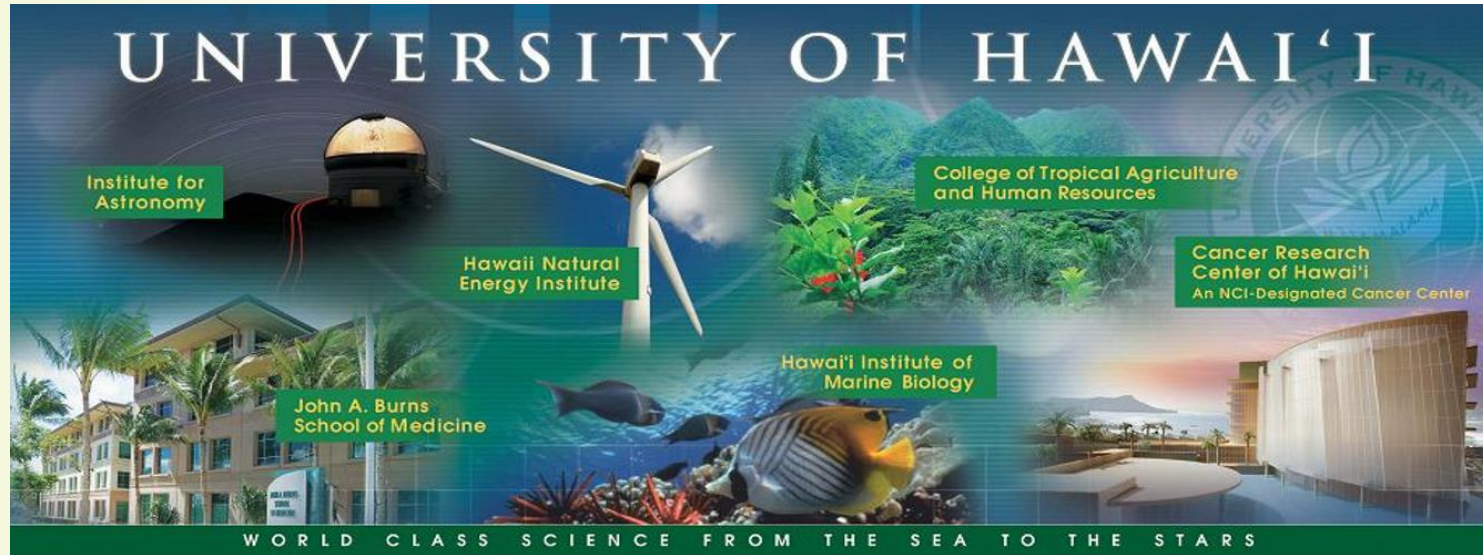


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- Established in 1907
- Statewide system with 3 universities and 7 community colleges
- Over 50,000 students
- University of Hawai'i at Mānoa is the largest and main research campus
 - 14,000 undergraduate students
 - 6,000 graduate students
- ***School of Ocean and Earth Science and Technology*** is the largest research unit on the Mānoa campus

~\$100 million extramural funding per year



Marc M. Matsuura

Sr. Smart Grid Program Manager



Mr. Matsuura joined the Hawai'i Natural Energy Institute (HNEI), University of Hawai'i at Mānoa, in 2013 as its Senior Smart Grid Program Manager. He is a founding member of HNEI's **GridSTART** (Grid System Technologies Advanced Research Team), a research team focused on energy transition enabling policy and regulation, advanced grid architectures, grid modernization technologies, and novel methods to achieve the reliable grid integration of RE resources, power system optimization and energy resilience goals.

Prior to joining HNEI, he was with the Hawaiian Electric Company for 21 years. His career at Hawaiian Electric included positions of leadership in the areas of transmission and distribution (T&D) engineering, T&D standards and technical services, system operation, transmission planning, smart grid planning, and system integration. Marc is a licensed professional electrical engineer in Hawaii. He holds a B.S. in Electrical Engineering and an M.B.A. from the University of Hawai'i at Mānoa.



Leon R. Roose

Chief Technologist



Mr. Roose is a tenured faculty member of the Hawai'i Natural Energy Institute (HNEI), University of Hawai'i at Mānoa, where he formed and leads HNEI's **GridSTART** (Grid System Technologies Advanced Research Team), a research team focused on energy transition enabling policy and regulation, advanced grid architectures, grid modernization technologies, and novel methods to achieve the reliable grid integration of RE resources, power system optimization and energy resilience goals.

He served in numerous leadership roles at the Hawaiian Electric Company for 19 years prior including management of renewable energy planning and integration, generation resource planning and competitive procurement, negotiation and administration of all power purchase agreements for the utility, transmission and distribution system planning, smart grid planning and projects, system relaying and protection, and fuel purchase and supply to all utility generating plants. He is a licensed attorney, worked in private law practice in Hawai'i and was formerly Associate General Counsel at Hawaiian Electric. He holds a B.S. in Electrical Engineering and a J.D. from the University of Hawai'i at Mānoa.