

Session 4: The Dynamics of our Future Energy Landscape
Advanced Electrification in the Pacific Region

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Hawaii Natural Energy Institute**

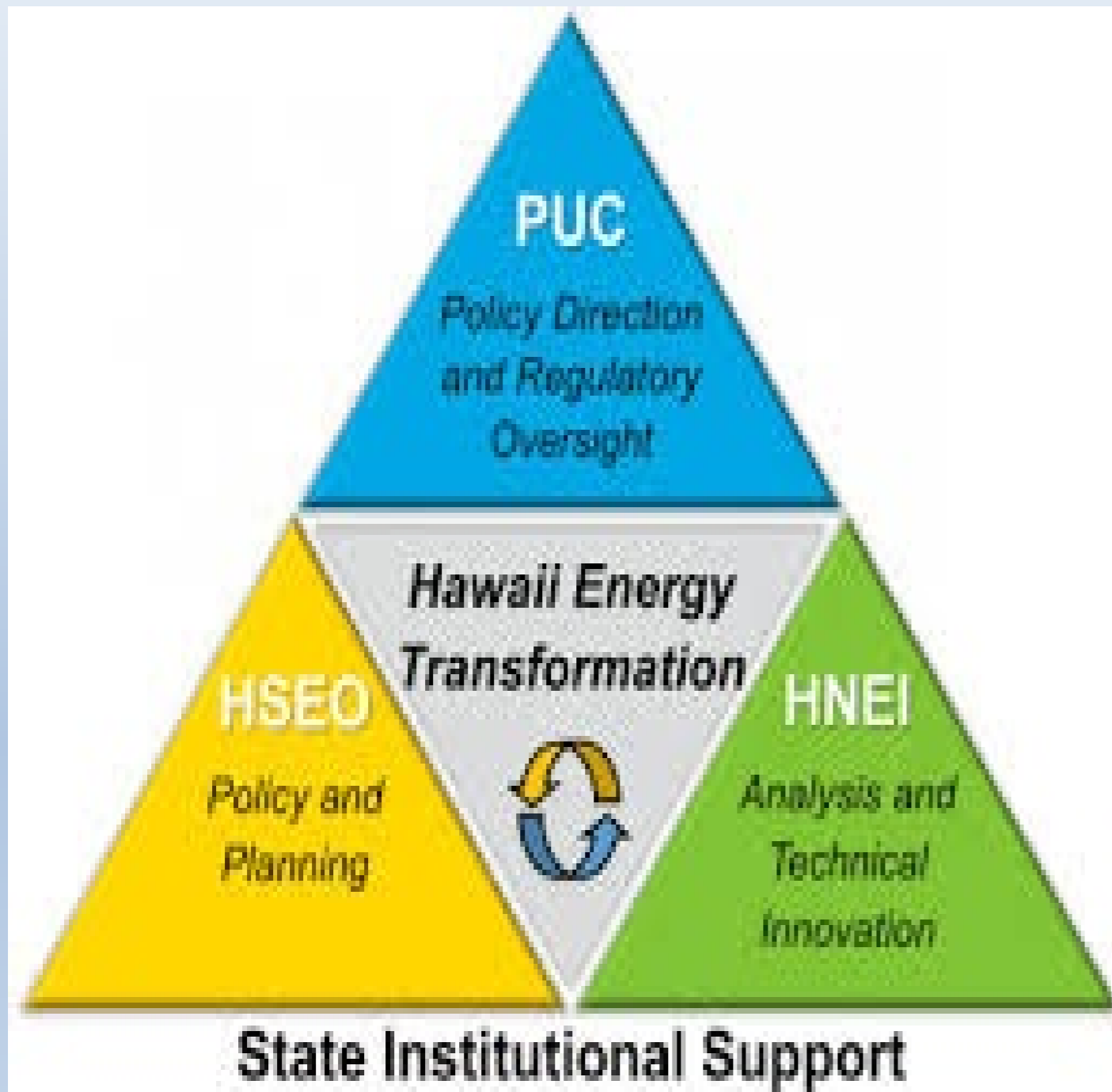


**UNIVERSITY
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MĀNOA**

2022 Isolated Power Systems (IPS) Connect Conference
Cordova Center, Cordova, Alaska
July 28, 2022

Hawaii Natural Energy Institute (HNEI)

School of Ocean and Earth Science and Technology, University of Hawaii at Manoa



- Founded as an organized research unit in 1974 - established in statute in 2007 to serve as the Hawaii's lead on energy resource and technology development.
- HNEI, along with the Hawaii State Energy Office and Public Utilities Commission, helps drive Hawaii's energy transition.
- Diverse staff including engineers, scientists, lawyers; students and postdoctoral fellows, combining research excellence & deep experience, with two of the three current Hawaii Public Utility Commissioners serving at HNEI at the time of their appointment by the Governor.



Hawaii Natural Energy Institute

Hawaii's Energy Transition

A 30-Year Journey...

- **1974** – *Energy Offices throughout US & HNEI established*
- **2001** - *First RPS (voluntary)*
- **2004** - *Initial mandatory RPS (20% RE by 2020)*
- **2008-2009** - HCEI goals set and codified into binding commitments (25% by 2020 - 40% RPS by 2030)
- **2010** – *Food and Energy Security Act 73*
- **2015** - Gov Ige signed Act 97 (30% by 2020, 100% by 2045)



Energy Statutory Policy - Hawaii

- **Act 97 (2015) HRS §269-92 Renewable portfolio standards (RPS).** Hawaii was the first state in the nation to adopt a legally binding RPS (a) Each electric utility company that sells electricity for consumption in the State shall establish a renewable portfolio standard of one hundred per cent of its net electricity sales by December 31, 2045. Interim RPS goals for 2030 is 40% and 70% for 2040.
- **Statutory authority: Develop programs to encourage private and public exploration, research, and development of indigenous energy resources that will benefit the state.**
196-1 | Energy Resources: Findings and declaration of necessity 196-4 | Energy Resources: Powers and duties 226-18 | Objectives and policies for facility systems --energy
- **Community-Based Renewable Energy:** Community-based renewable energy (CBRE) was established by Act 100, Session Laws of Hawaii 2015, which directed the PUC to establish a community-based renewable energy tariff (HRS Section 269-27.4). The details of the tariffs and programs is addressed in PUC Docket No. 2015-0389.
- **Energy Efficiency Portfolio Standards:** Hawaii's Energy Efficiency Portfolio Standard (EEPS), HRS Section 269-96, requires the reduction of electricity consumption by 4,300 gigawatt-hours by 2030. A Public Benefits Fee surcharge is collected via utility customers' electricity bills to support energy efficiency programs in Hawaiian Electric Company's service territory through the public benefits fee administrator, Hawaii Energy. Kauai Island Utility Cooperative directly supports energy efficiency for the island of Kauai.



Energy Regulatory Policy - Hawaii

- Community-Based Renewable Energy (CBRE) – Docket No. [2015-0389](#)
- Competitive Bidding to Acquire Dispatchable and Renewable Generation – Docket No. [2017-0352](#)
- Decoupling – Docket No. [2013-0141](#)
- Demand Response (DR) – Docket No. [2015-0412](#)
- Distributed Energy Resources (DER) – Docket No. [2014-0192](#)
- Distributed Energy Resource Policies – Docket No. [2019-0323](#)
- Electrification of Transportation (EoT) – Docket No. [2018-0135](#)
- Energy Efficiency – Docket No. [2007-0323](#)
- Green Energy Market Securitization (GEMS) Program – Docket No. [2014-0135](#)
- Grid Modernization – Docket No. [2018-0141](#)
- Integrated Grid Planning (IGP) – Docket No. [2018-0165](#)
- Microgrid – Docket No. [2018-0163](#)
- Performance-Based Regulation (PBR) – Docket No. [2018-0088](#)



The Hawaii Energy Policy Forum

Members of the Hawaii Energy Policy Forum commit to:

Create Value Through Action

Create value through action when we:

- Leverage existing resources and relationships to achieve greater impacts;
- Set milestones and deliverables and hold ourselves accountable by achieving and sharing results;
- Evaluate our performance on an ongoing basis;
- Adapt to changing needs.

Serve the Greater Good

Serve the greater good when we:

- Place higher-level societal goals over personal and organizational agendas;
- Take a holistic view of energy policy in harmony with other state policy objectives;
- Weigh carefully economic, environmental and equity impacts;
- Increase participation of underserved communities.

Enable Collaboration

Enable collaboration when we:

- Create opportunities to connect and share information and data;
- Create a framework for dialogue to understand competing positions on issues;
- Promote partnerships on projects.

Foster Openness, Trust, and Respect

Foster openness, trust, and respect when we:

- Encourage frank discussions from all perspectives;
- Participate actively with integrity and empathy;
- Identify areas of agreement and seek understanding when addressing competing interests;
- Report differing viewpoints accurately;
- Maintain transparency in Forum processes, information and work products;
- Acknowledge contributions and successes.

Support Factual Information Sharing & Education

Support factual information sharing and education when we:

- Ask the right questions to identify and prioritize stakeholder needs;
- Establish clear, consistent, and realistic expectations and objectives;
- Gather reliable quality data and information of best practices;
- Conduct analysis and research and support;
- Vet statements, positions and qualify facts and information;
- Present all sides, identify trade-offs and choices, and clarify complexities;
- Share information tailored to diverse audiences in a timely manner;
- Diversify the mechanisms by which we deliver information to the public.



Hawaii Natural Energy Institute

“The Hawaii Clean Energy Initiative”

An Energy Transformation Partnership



Hawaii Natural Energy Institute

100% RPS by 2045



- **The architects of Act 97 (2015) – Administrator, Hawaii State Energy Office, House Energy & Environment Chair Chris Lee and Senate Energy Chair Mike Gabbard, speaking at the State Capitol shortly after passage.**
 - **Act 97 (2015) makes Hawaii the first state to set a 100% RPS.**



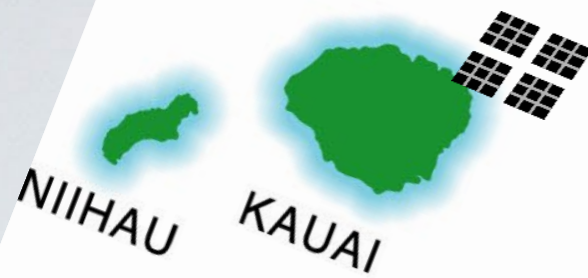
Affecting Change on Six Isolated Grids

RPS Targets

30% by 2020

70% by 2040

100% by 2045



NIIHAU
KAUAI
80MW

1200MW



OAHU

5MW



MOLOKAI



LANAI

5MW



KAHOOLAWE



MAUI

200MW



HAWAII'
(Big Island)

190MW

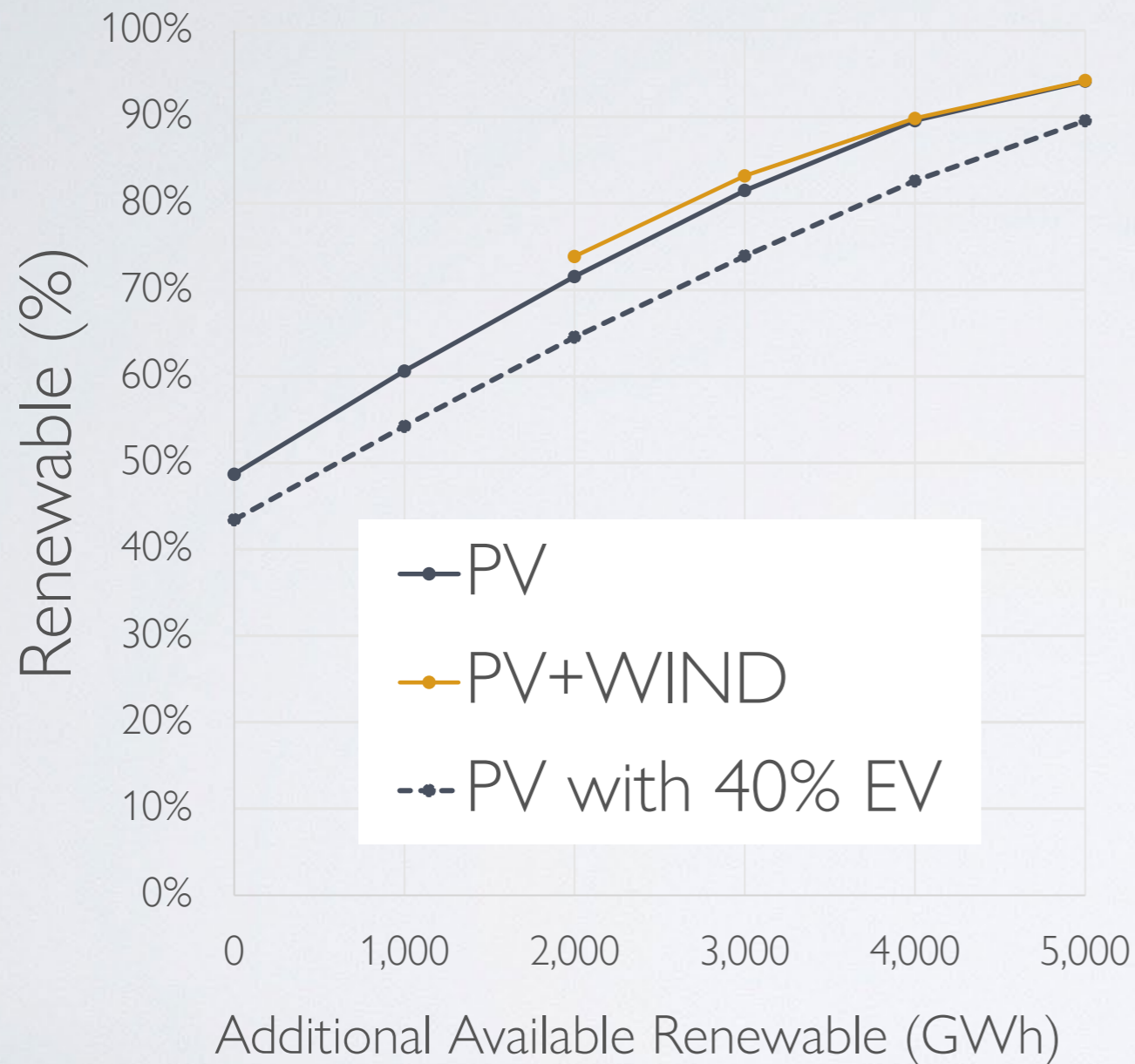
FORMIDABLE CHALLENGES

- >70% of energy use on Oahu
- No interconnections between islands
- Resource and population not co-located
- Land availability, community acceptance, and permitting remain significant hurdles

Meeting RPS goals requires innovation and community commitment

Hawaii's Viable Path to 100% Renewable

Total Renewable Utilization



- Additional solar or solar plus wind can get us to 70% without significant curtailment.
 - Reaching 70% renewables will require an additional 2000GWh (800MW) of solar plus storage (beyond Stage 2) using ~ 6000 acres of land.
 - Converting 40% of our light duty vehicles to EV will require an additional 900 GWh per year.
- At 70%, system still needs a minimum of 650MW of “firm” capacity to cover seasonality and multi-day low wind and solar events.
- As variable renewable increases, “firm” capacity needs decrease modestly but use of those systems decreases significantly with big effect on the “firm” generation needs.

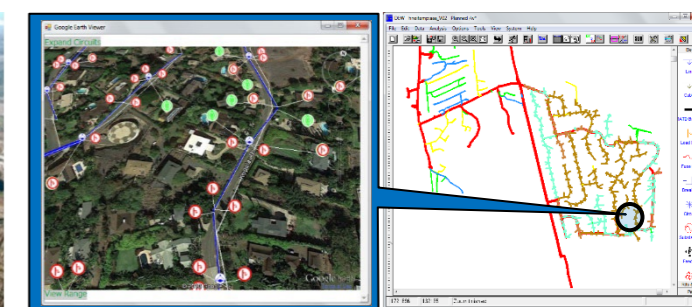


Representative Projects (Research, Demonstration, Test & Evaluation)

Smart Grid Optimization & Controls

HNEI develops algorithms and technologies to control and manage power to stabilize the grid, increase resiliency and manage cost

- Bi-directional EV Charging Optimization
- Advanced Conservation Voltage Reduction for Energy Cost Reduction
- Molokai High-speed BESS for Contingency Response
- Smart Grid Distributed PV Inverter Controls
- Maui Smart Grid Demand Reduction
- High Resolution Solar Forecasting
- Grid-edge Sensing and Controls Technology



Resilient Renewable Energy Microgrids

HNEI is developing, installing and testing technologies for renewable energy microgrids in Hawaii and the Pacific region

- Coconut Island DC Hybrid Microgrid
- NELHA Host Park Microgrid Plan Development
- JBPHH Infrastructure Modernization and Renewable Integration Project
- Navy Marianas Infrastructure Modernization and Renewable Integration Project
- USMC Okinawa Renewable Energy and Conservation Voltage Reduction Demonstration



Recent PV Plus Storage PPAs in Hawaii

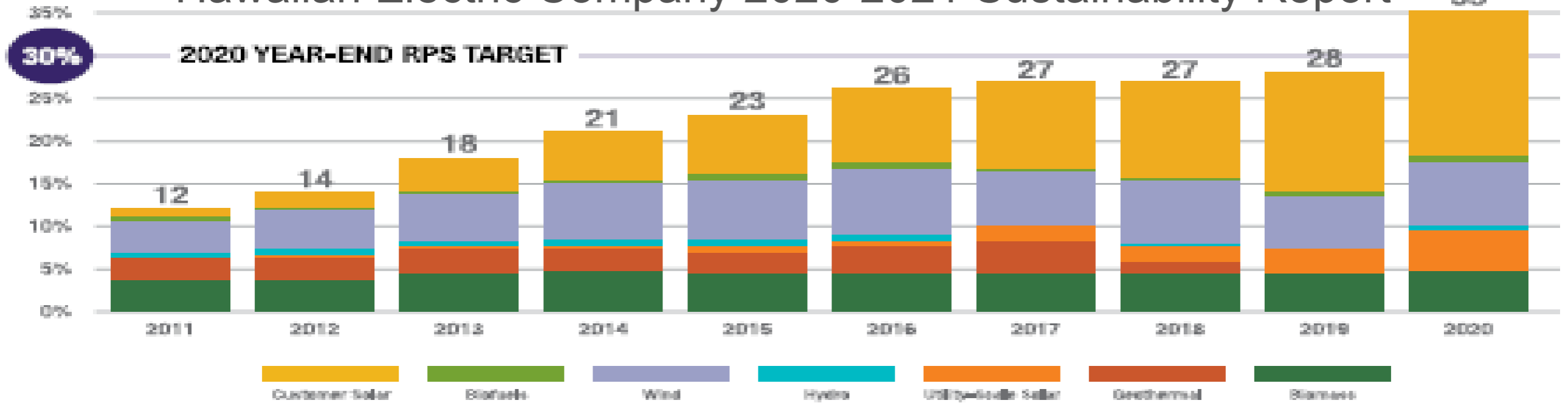
Project name	Island	Developer	Size	Storage	Cost per KWh
Waikoloa Solar	Hawaii	AES	30 MW	120 MWh	\$0.08
Hale Kuawehi	Hawaii	Innergex	30 MW	120 MWh	\$0.09
Kuihelani Solar	Maui	AES	60 MW	240 MWh	\$0.08
Paeahu Solar	Maui	Innergex	15 MW	60 MWh	\$0.12
Hoozana	Oahu	174 Power Global	52 MW	208 MWh	\$0.10
Mililani I Solar	Oahu	Clearway	39 MW	156 MWh	\$0.09
Waiawa Solar	Oahu	Clearway	36 MW	144 MWh	\$0.10

- Fuel oil has ranged in past 5 years from **\$0.14** to **\$0.25** per KWh

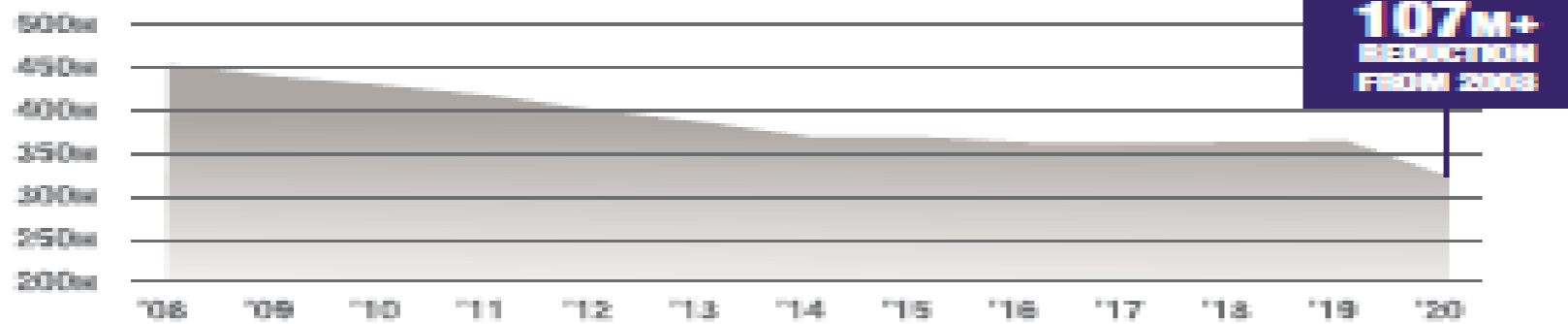


RENEWABLE PORTFOLIO STANDARD PROGRESS

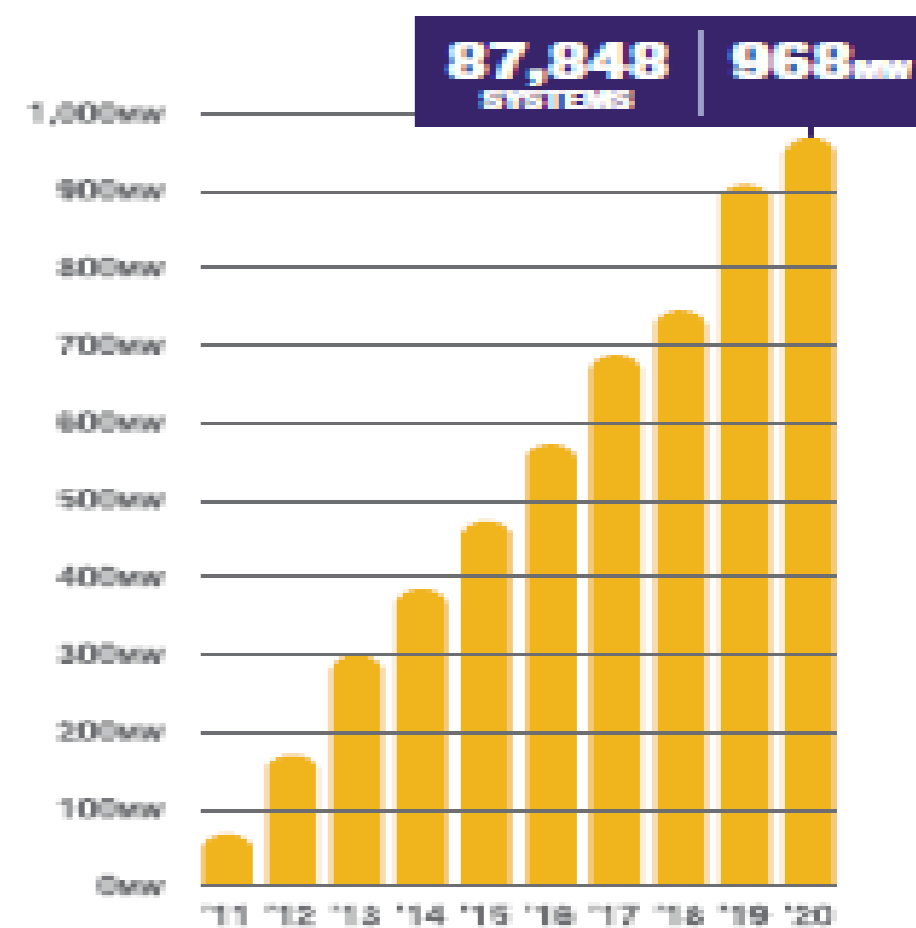
Hawaiian Electric Company 2020-2021 Sustainability Report



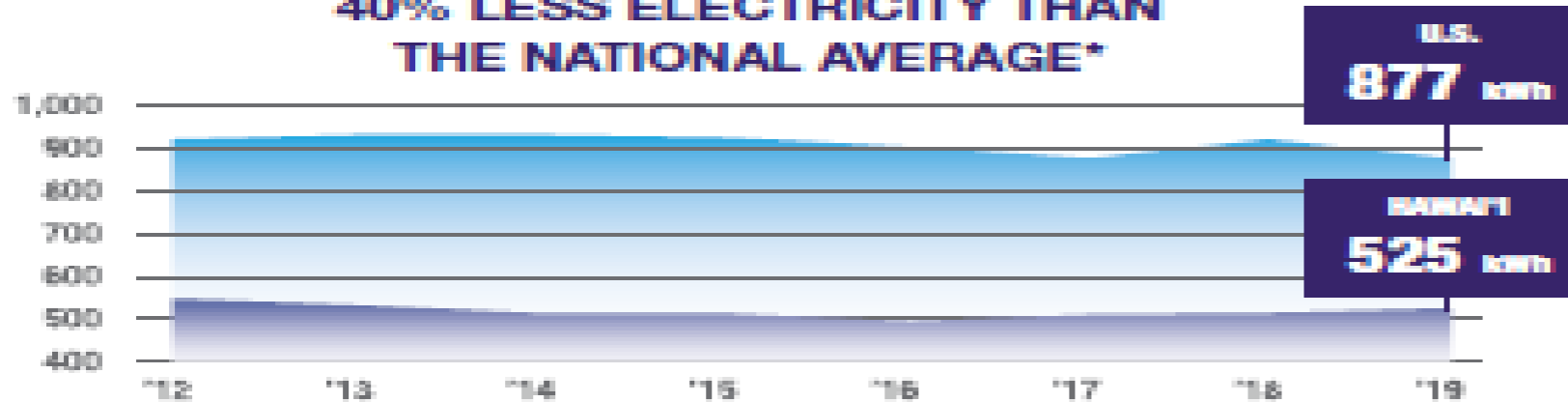
LESS OIL USED FOR POWER GENERATION *(in millions of gallons)*



CUMULATIVE SOLAR INSTALLATIONS

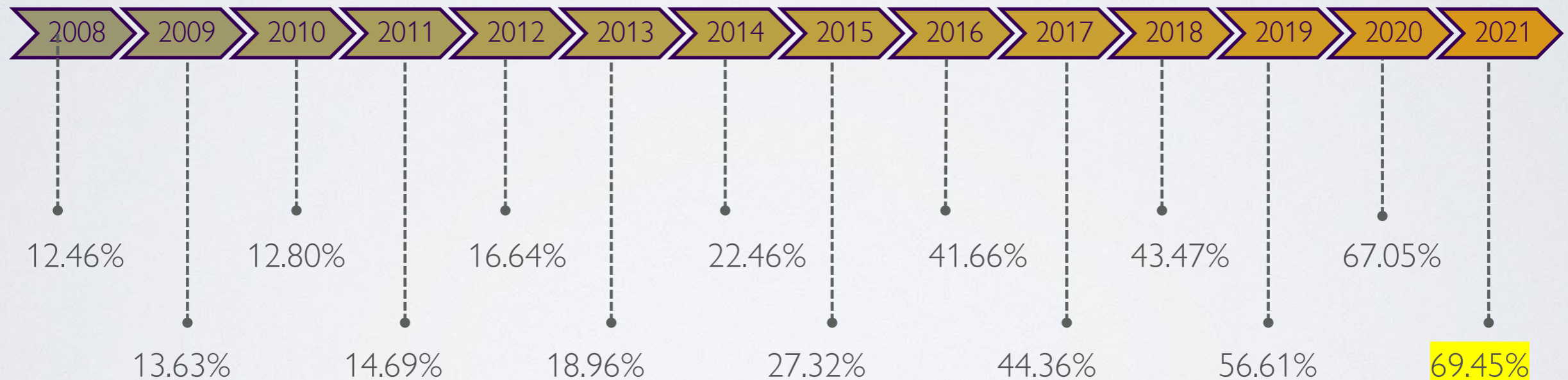


AVERAGE HAWAII HOME USES 40% LESS ELECTRICITY THAN THE NATIONAL AVERAGE*



Kauai Island Utility Cooperative's ("KIUC's") 2021 Annual RPS Status Report

- KIUC's RPS percentage of **69.45%** surpassing the 30% by 2020 RPS requirement by 39.5 percentage points and the 40% by 2030 RPS requirement by 29.5 percentage points.



FACT SHEET: Mission Innovation

The White House

November 29, 2015

- 20 countries (*when announced*) – now 24 countries + European Commission
- Representing 80 percent of global clean energy R&D budgets
- Commit to double their respective R&D investments over five years.



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Republic of Korea

Ministry of Trade, Industry, and Energy (MOTIE)

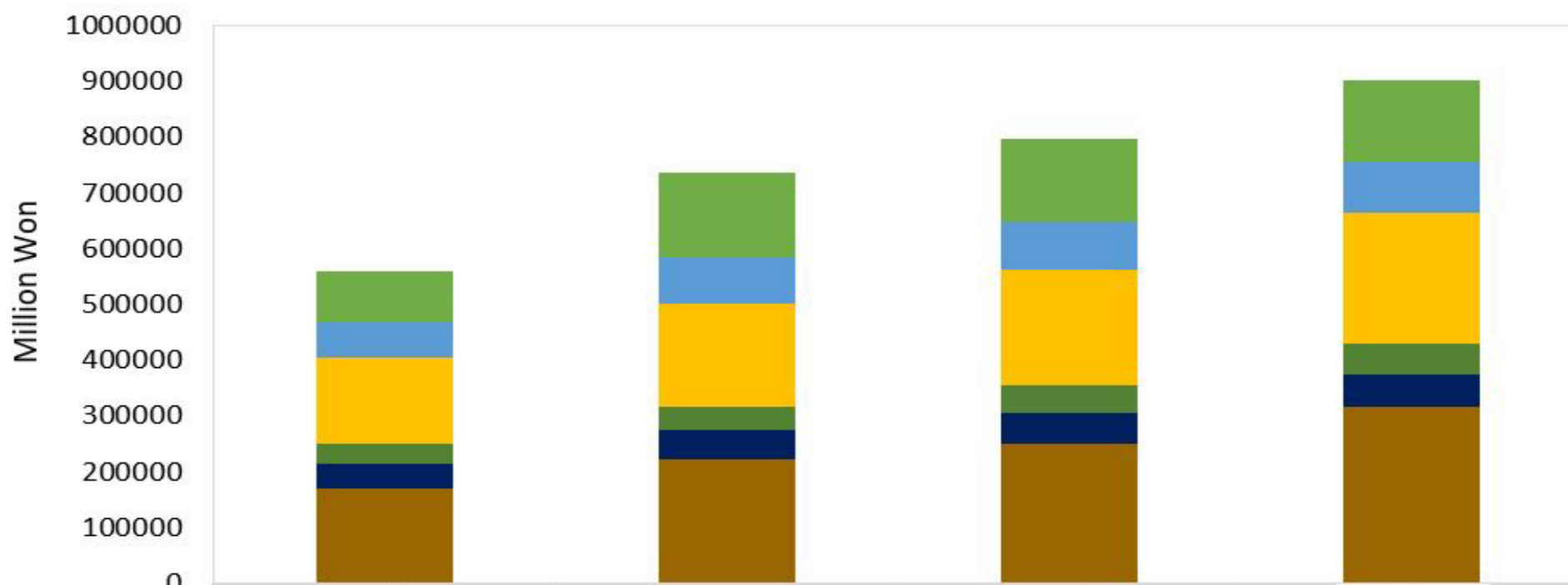
Progress towards doubling public investment

Country-determined baseline year: FY 2016

Doubling target year: FY 2021

Baseline funding amount: USD \$490 million

Doubling target amount: USD \$980 million



	Baseline	First year	Second year	Third year
Energy efficiency	90097	150136	151289	146733
Carbon capture, use and storage	65966	83669	85122	90458
Renewables	152219	186025	207410	236484
Nuclear fission and fusion	37038	41733	48882	52935
Hydrogen and fuel cells	44333	51143	54319	58387
Other power and storage technologies	170882	223940	251944	317883
Other cross-cutting technologies/research	0	0	0	0
Unallocated	0	0	0	0
TOTAL	560535	736646	798966	902880

Call for International Energy Joint R&D Projects launched by South Korea

South Korea is launching a new [international joint research competition](#), specifically dedicated to... boost collaboration between MI member countries and South Korea. Funding: up to \$1 million/1 billion KRW per year (up to 3 years). Deadline: **14 September, 2018**

This call will support R&D cooperation among South Korean companies, universities and research institutes and their foreign partners. Projects proposals are expected to promote international technology cooperation, stimulate national energy technology competitiveness and create new energy market by laying the foundation for overseas market entry.

To apply:

- Funding amount : up to \$1 million/ 1 billion KRW per year (up to 3 years)
 - Participation is open to any MI member countries' organization (e.g. industry, university, research institute)
 - Leading organization must be Korean SMEs or Mid-tier companies*
-

Mission Innovation with Korea

- In August of 2015, State of Hawaii and the Korea Institute of Energy Technology Evaluation and Planning (KETEP) signed an MOU to cooperate in the development of green energy technology.
- In 2017, HNEI responded to a KETEP solicitation and received an award to conduct a feasibility study on Korean microgrid platforms in three potential Hawaii sites under KETEP's International Energy Collaborative Research and Development Program.
- On the most promising of the 3 sites, HNEI formed a six-party alliance in summer of 2018 to apply for KETEP Mission Innovation grant funding
- The international Alliance wins KETEP grant award that is expected to be installed and operational by the end of 2022.

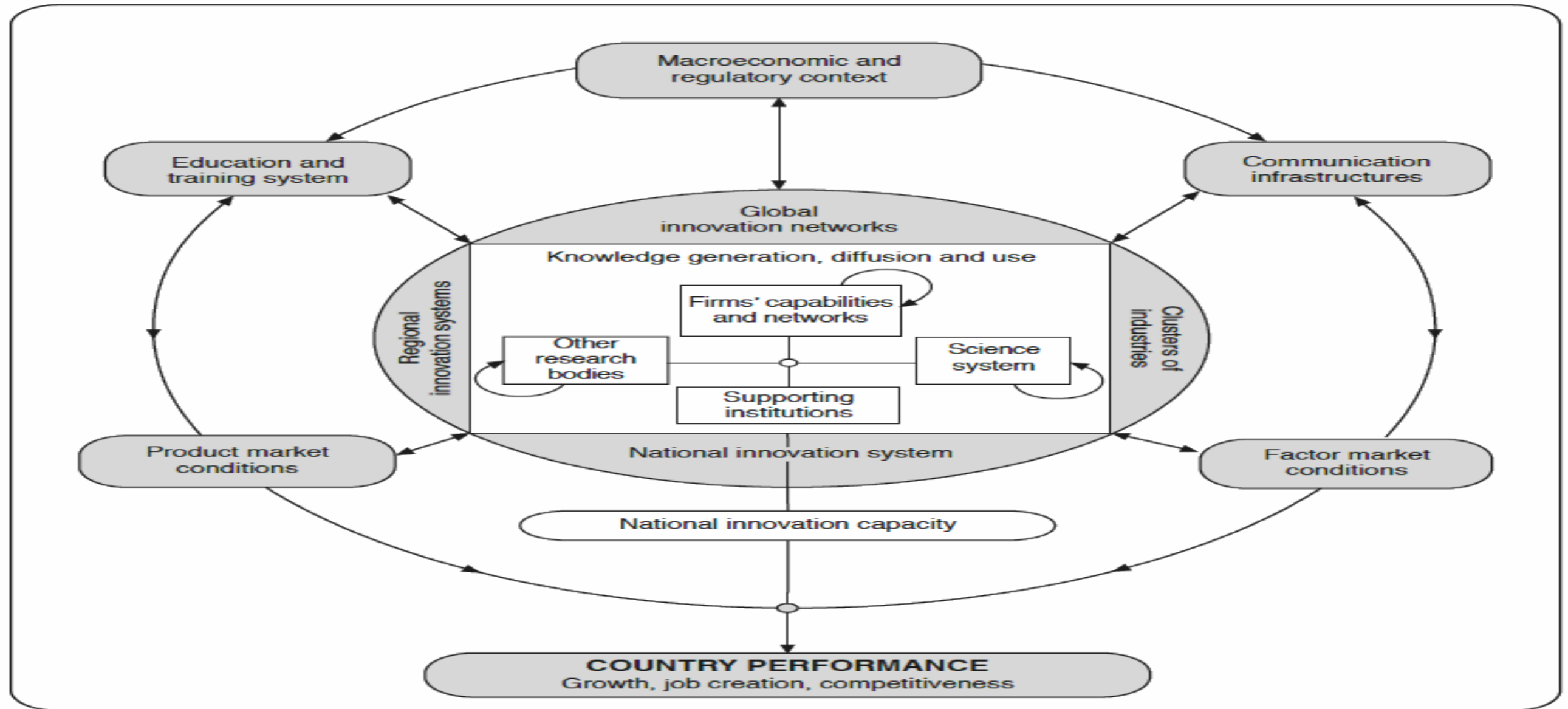
ENCORED



SEOUL
NATIONAL
UNIVERSITY



International: Vietnam National Institute for Science and Technology Policy and Strategy Studies (NISTPASS)

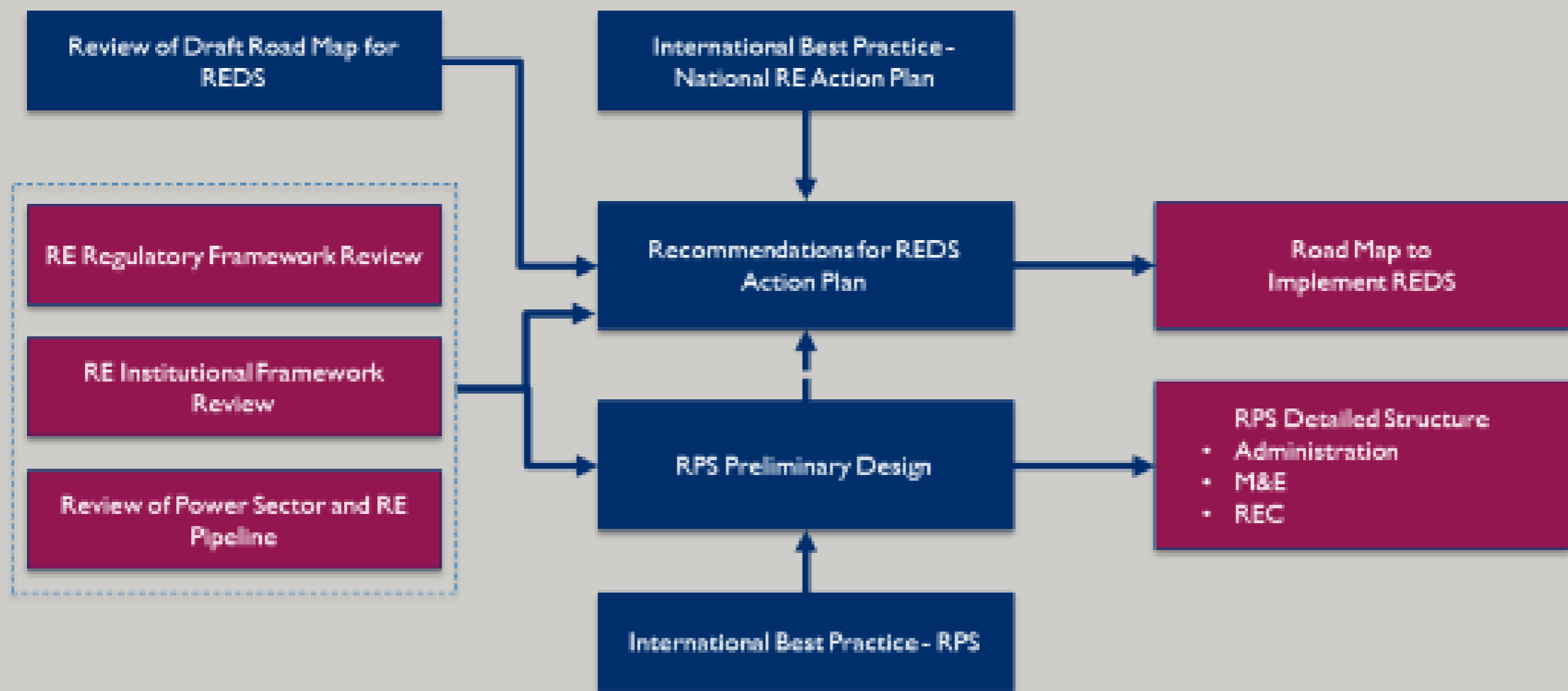


HNEI is supporting a comprehensive investigation of opportunities in building an innovation economy based on the supply side investments made by Vietnam in wind and solar development.



Vietnam Low Emission Energy Program (V-LEEP) RPS Development

Approach to Support REDS Action Plan and RE Portfolio Standards

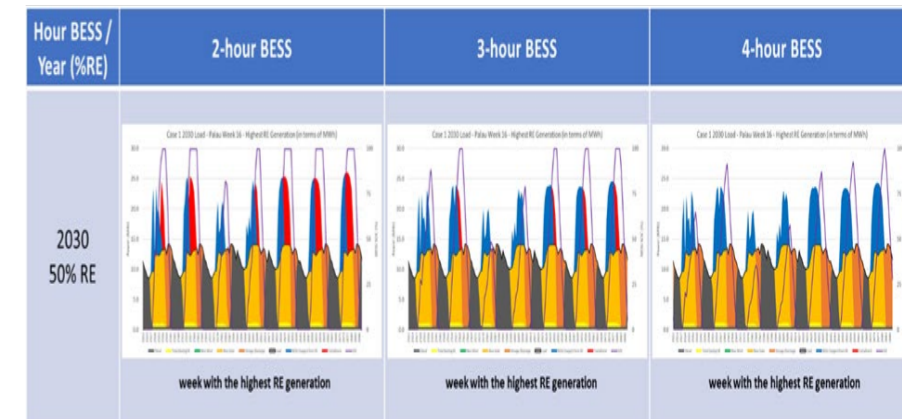


With the National Renewable Energy Laboratory (NREL), HNEI advised Vietnam's Ministry of Industry and Trade (MOIT) and other Vietnamese stakeholders on the design of a Renewable Energy Portfolio Standard (RPS) mechanism and roadmap for its implementation. The project In was a featured element of the Renewable Energy Development Strategy 2016 - 2030 adopted by the government of Vietnam in 2015.

**Examples of International Engagements
Enabled by ONR APRESA Funding**

ASIA-PACIFIC Region:

- ❖ Developing Renewable Energy Storage Systems for Pacific Island Countries (World Bank)
- ❖ ASEAN Interconnection Masterplan Study (AIMS) III Support
- ❖ ASEAN Centre For Energy (ACE) Capacity Building on PLEXOS Production Cost Modeling Analyses
- ❖ Recommendations on Methodology for Vietnam Power Development Plan
- ❖ Vietnam PDP-8 Renewable Energy Integration modeling support
- ❖ Capacity Building Internships for Provincial Electricity Authority of Thailand (PEA) utility engineers
- ❖ Development of Battery Energy Storage System (BESS) Technical Standards for Thailand OERC
- ❖ Thailand Renewable Integration Study and Capacity Building for the Electricity Generating Authority of Thailand (EGAT)
- ❖ Solar PV Forecasting for Thailand with Chulalongkorn University
- ❖ Technical Support for Enhancing Customer Participation in the Philippines' Net-Metering Framework
- ❖ Capacity Building Workshops on Implementing DPV Interconnections in the Philippines
- ❖ Laos Transmission and Distribution Grid Interconnection Codes for Inverter-based Resources
- ❖ Laos Solar Pilot Auction Technical Performance Requirements
- ❖ USAID Program support in ASEAN Region, Vietnam, Indonesia, Philippines, Papua New Guinea



Thank you!

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HNEI