



Hawai'i Natural Energy Institute Research Highlights

International Support

Asia Pacific Regional Energy System Assessment (APRESA)

OBJECTIVE AND SIGNIFICANCE: In August 2017, HNEI was awarded a grant from the Office of Naval Research (ONR) to support energy system transitions in select locations throughout the Asia-Pacific region under the Asia Pacific Regional Energy System Assessment (APRESA) program. The objective of APRESA is to develop comprehensive energy system assessments in the Asia-Pacific region regarding energy transition strategy, policy, regulation, technology options, demonstrations, implementation plans, and training based on the specific requirements or needs of the targeted jurisdictions and strategic alliances.

BACKGROUND: During the six years of APRESA activities, HNEI established substantive strategic partnerships with national, regional, and local jurisdictions, as well as private and public stakeholders including numerous utilities, universities, and other research and international aid and development entities, such as the World Bank (WB), Asian Development Bank (ADB), Australian Infrastructure Financing Facility for the Pacific (AIFFP), The Asia Foundation (TAF), The Maureen and Mike Mansfield Foundation (TMF), U.S. Agency for International Development (USAID), and U.S. Department of Defense (DOD) organizations in the areas of interest. Based on the programmatic success of these strategic partnerships, ONR has extended the APRESA program for an additional two years through 2024.

Nations with ongoing active engagement and support activities include Vietnam, Thailand, Laos, Indonesia, Papua New Guinea, and the Philippines. New engagements with Pacific Island countries (PIC) include Palau, Cook Islands, the Republic of the Marshall Islands, and the Commonwealth of the Northern Mariana Islands. The criteria for selection of jurisdictions include: 1) those with significant rates of projected demand growth requiring rapid energy system expansion and transformation, 2) strategic trade and geopolitical opportunities to the United States, 3) potential to integrate renewable energy technologies, and 4) a collaborative environment to conduct the work.

In addition to the deep local partnerships formed in these jurisdictions, this program has led to a highly successful collaborative relationship with the U.S.

Agency for International Development (USAID) and its implementing prime contractors throughout the region (e.g., Deloitte, Tetra Tech, Abt Associates, RTI, Chemonics, and Delphos International).

USAID partner country governments need high-quality technical expertise to guide their decision-making and can learn from the experience of more developed countries using their best practices and case studies. With significant experience providing technical expertise in the renewable energy space, HNEI is uniquely positioned to partner with USAID and provide energy intelligence in identifying tailored solutions for jurisdictions in need. This collaborative approach, leveraging the capabilities, resources, and know-how of HNEI and USAID implementing contractors in the Asia-Pacific region is consistent with the U.S.' whole-of-government strategy to grow sustainable and secure energy markets across the region. Achieving self-reliance enables emerging economies to rely less on external aid in times of crisis, promotes more transparent markets that incentivize private investment, and redirects resources from inefficient energy subsidies toward more productive utilization. Low-cost renewable energy has the potential to improve the financial viability of energy sectors, reduce vulnerabilities to malign and climate change influences, and improve a country's overall ability to finance its self-reliance. HNEI's collaborations and interventions under this grant help deliver technical expertise to policymakers in emerging economies that can aid in achieving lower-cost, cleaner energy solutions that catalyze competitive markets and reduce carbon emissions – ultimately enabling their populations to enjoy universal, reliable, and cleaner electricity services.

HNEI is using the remaining APRESA funding to extend the efforts in the current countries and to expand this work to other countries, regions, and DOD facilities of interest, with particular focus on PICs. These efforts are supported by a number of HNEI faculty and staff, including those of the HNEI's GridSTART team focused on advanced grid technologies and enabling policy and regulation.

PROJECT STATUS/RESULTS: A number of select projects initiated under the APRESA award are summarized below. Many of these are also described

in more detail in separate project summaries under the [International Support](#) section.

Innovation System Mapping Project in the Renewable Energy Sector in Vietnam

Under this effort, HNEI provided financial support and guidance, to the National Institute for Science and Technology Policy and Strategy Studies (NISTPASS) to map the innovation opportunities associated with renewable energy (RE) sector development in Vietnam. While the development of renewable energy resources in Vietnam is a government priority, there has been a lack of clarity about the role of many organizations in Vietnam impacting energy development, the relationship between them, and the policies required to foster energy innovation. An objective of this work was to identify which Vietnamese stakeholders in the RE sector would benefit from further policy and institutional support. To meet the aggressive government goals associated with RE innovation, the project is also focused on identifying relevant organizations in the sector and understanding how they interact with each other and as a system.

In April 2023, NISTPASS held a workshop with various Vietnamese groups titled “Mapping Sector Innovation System of Renewable Energy in Vietnam,” which was attended by HNEI and ONR personnel. Incorporating inputs from this workshop, NISTPASS submitted a book titled “Sectoral Innovation System in Renewable Energy: Case of Solar and Wind in Vietnam.” This project is completed, but HNEI has initiated discussions for a small, follow-on planning award to continue work in this area.

Saigon Energy Hub (SEHub) Support

HNEI is collaborating with Ho Chi Minh City’s Institute for Regional and Urban Studies (IRUS) to develop a public renewable demonstration and technology center to raise the community awareness of the needs, the feasibility, and the benefits of energy efficiency and renewable energy. Originally planned for an outdoor public park venue, the project now consists of a number of energy efficiency and renewable energy themed workshops to be conducted at new facilities located at Ho Chi Minh City Union of Science and Technology Association’s Headquarters. A Pre-Feasibility report was submitted

by IRUS, identifying the site, the partners, projected activities, space utilization, equipment and furnishings, timeline and budget, and financing sources.

In September 2023, UH and IRUS personnel met to discuss progress and the upcoming energy-efficient and renewable energy themed workshops, which will continue through July 2024. This work is described in more detail in the “[Saigon Energy Hub \(SEHub\) Support](#)” project summary..

Provincial Electricity Authority of Thailand (PEA) Collaboration

HNEI has developed a capacity-building program focused on topics of renewable energy grid integration, smart grid technologies, microgrid assessment and design, and the development of advanced EV charging applications for engineers from the Provincial Electricity Authority of Thailand (PEA). PEA is a large Thai distribution grid operator with a service territory spanning all of Thailand, except for the Bangkok metropolis and two adjoining provinces (Thailand has 77 total provinces).

Since Spring 2020, HNEI GridSTART has delivered a training program for PEA select engineers. The program accommodates two classes of six engineering interns each year. The program lasts for twelve weeks and includes 40 hours of lectures and team-oriented deep immersion in custom “hands-on mini-project” research, development, and test endeavors tailored to the learning needs of working utility engineers focused on energy distribution systems. Due to COVID-19 travel restrictions, the PEA intern program experienced delays and shifted partially to online learning in 2020-2021. In 2022, with the lifting of travel restrictions, two classes of PEA interns were trained at HNEI in two separate sessions. Each class was divided into sub-groups working on various mini-projects, which included optimizing virtual power plant dispatch and demand response, improving electric vehicle (EV) energy consumption estimation, assessing PV hosting capacity, and designing optimized microgrid systems.

While HNEI GridSTART completed the development of the class curriculum and a mini-project research plan focused on microgrid design and operation, travel to Hawai‘i by the incoming 2023 PEA intern

classes was unexpectedly suspended due to unforeseen circumstances amid the ongoing repercussions and political conditions in Thailand following the contested results of the 2023 national elections. It is anticipated that the PEA intern training at HNEI will resume in 2024. This work is described in more detail in the [“Provincial Electricity Authority of Thailand \(PEA\) Collaboration”](#) project summary.

Waste-to-Bioenergy Conversion for Community PV-BioGrid

With APRESA funding, HNEI contracted Chiang Mai Rajabhat University, Thailand to conduct an assessment of small biomass systems as a firm power option in islanded settings. The study included a resource assessment of potential biomass feedstocks in Thailand, including urban solid wastes and agricultural residues and a technology assessment of available conversion systems. Based on the results, an anaerobic digestion system was selected to integrate into a grid-isolated community dependent largely on PV for electricity. The system has been installed at the University and shake down testing has begun.

Sustainable Aviation Fuel (SAF) Production

APRESA funds have supported Dr. Quang-Vu Bach’s participation in a research program evaluating sustainable aviation fuel production systems for tropical environments. Current activities include evaluation of biomass resources derived from urban solid waste and their suitability as feedstocks for thermochemical gasification systems. The synthesis gas product can be subsequently converted with Fischer-Tropsch synthesis to sustainable aviation fuel. The aviation industry (civilian and military) faces significant greenhouse gas challenges due to dependence on petroleum jet fuels and limited opportunity for electrification.

Additionally, APRESA funding contributed to a sustainable aviation fuel workshop in Bangkok, Thailand in May 2023, which was organized by the Federal Aviation Administration (FAA), the U.S. Trade Development Agency, Energy Technology Center of Thailand, and HNEI. Its goal was to share information on SAF developments in the region and to identify barriers to implementing SAF value chains spanning feedstock production to end use. Participants from various Asia-Pacific countries

attended, representing civil aviation authorities, government policymakers, airlines, SAF feedstock producers, consumers, and technology providers, university researchers, and airport operators jet fuels and limited opportunity for electrification.

Support to the USAID Energy Secure Philippines (ESP) Program

In 2019, HNEI GridSTART collaborated with USAID Clean Power Asia to provide technical and capacity building support to the Philippines Department of Energy (PDOE) for the preparation and presentation of its Department Circular regarding the development and implementation of net energy metering (NEM) programs. HNEI GridSTART continues to support the Philippines’ power sector by delivering both collaborative (APRESA funded) and USAID Energy Secure Philippines (ESP) program funded technical support to the Philippines Energy Regulatory Commission (ERC), distribution utilities (DUs), and other relevant agencies. Specifically, HNEI GridSTART has been assisting them in developing a comprehensive set of rules for an “off-grid” NEM program tailored to small, rural area grid systems in the Philippines. HNEI GridSTART is also collaborating with USAID ESP and the ERC to establish a BESS regulatory framework for the Philippines.

In Summer 2022, HNEI GridSTART submitted reports and documentation on NEM rules for isolated “off-grid” island systems and a BESS regulatory framework in the Philippines to USAID ESP and the ERC. The reports were presented in person in Manila in August 2022, followed by a workshop with the USAID ESP and the ERC in September 2022 to draft BESS regulations for the ERC to promulgate.

In February 2023, HNEI GridSTART conducted a second in-person writing workshop on the ERC’s draft BESS regulation. In June 2023, HNEI GridSTART provided capacity building on microgrids to the ERC and power system resiliency to the DOE. In November 2023, HNEI GridSTART delivered in-person capacity building on power system resiliency to the PDOE to assist DUs. HNEI is also working with USAID ESP to develop and administer a hybrid classroom/hands-on training curriculum to help off-grid DUs optimize NEM uptake, which is planned for delivery in the first half of 2024. This work is

described in more detail in the “[Support to the USAID Energy Secure Philippines \(ESP\) Program](#)” project summary..

USAID Sustainable Energy for Indonesia’s Advancing Resilience (SINAR) Program

The USAID’s Sustainable Energy for Indonesia’s Advancing Resilience (SINAR) program is a five-year initiative to support Indonesia’s transition to a clean energy economy. HNEI GridSTART is providing technical support to the program by helping to build capacity on a range of topics related to advanced energy systems, including financing, procurement, planning, and operations. HNEI GridSTART’s work is also focused on improving the performance of energy utilities, such as PT Perusahaan Listrik Negara (PLN, or State Electricity Company) and strengthening the institutional framework and capacity of the energy sector. This includes helping to develop and implement competitive procurement standards, improve cost recovery mechanisms, and modernize planning and operating practices.

In February 2022, HNEI GridSTART shared Hawai‘i’s renewable energy transformation experience with Indonesia’s Directorate General of Electricity and Ministry of Energy and Mineral Resources in a three-day webinar. Following the webinar, in May 2023, HNEI was invited and traveled to Indonesia and conducted a three-day workshop on small island grid planning for PLN in Bali, as well as a one-day webinar for the SetjenDEN (the National Energy Council of Indonesia) in Jakarta. Discussions with Indonesian stakeholders during that trip have led to ongoing discussions regarding additional capacity building in Hawai‘i, which is planned for 2024. This project is described in more detail in the “[USAID Sustainable Energy for Indonesia’s Advancing Resilience \(SINAR\) Program](#)” project summary.

Électricité du Laos (EDL) and Ministry of Energy and Mines (MEM) Support

HNEI has agreed, pursuant to an October 25, 2021 Letter of Engagement with EDL, to deliver needed technical capacity building support at EDL’s request on the following topics: 1) practical guidance for interconnection of distributed solar PV systems to the distribution grid; 2) training curriculum on topics such as voltage regulation and variation, frequency

limits, voltage dips, voltage unbalance, voltage flicker and harmonics; and 3) standards of practice for installing and operating underground distribution cables. With the lifting of COVID-19 travel restrictions by the Laos government, plans are underway for HNEI to deliver in-person and remote training on these topics starting in 2024.

USAID Southeast Asia’s Smart Power Program (SPP) – Laos

A Letter of Collaboration, initiated by Deloitte Consulting (Deloitte), the prime contractor for the USAID Southeast Asia Smart Power Program (SPP), was signed with HNEI on October 27, 2022. The USAID SPP is a \$40 million, five-year initiative with the goal of mobilizing \$2 billion in blended financing for clean energy infrastructure. The program sets out to drive economic growth and development of Southeast Asia, focusing on creating secure, market-oriented, and environmentally responsible energy sectors. The ultimate vision is to help the region achieve its target of net-zero greenhouse gas emissions by 2050.

Among the initial tasks outlined in the collaboration agreement, HNEI is providing support to Électricité du Laos (EDL) and the Lao Ministry of Energy and Mines (MEM) focused on enhancing power system resilience, implementing demand-side management/demand response (DSM/DR) strategies, and integrating variable renewable energy (VRE) resources into their transmission and distribution systems.

In 2023, HNEI GridSTART delivered updated Feasibility Study Guidelines for wind, solar, and biomass energy projects in Laos. GridSTART also provided an updated Grid Code for Laos that incorporates interconnection standards for inverter-based resources as well as updated interconnection standards for PV systems connected at the distribution level. In addition, HNEI GridSTART conducted two capacity building sessions for EDL and MEM staff focusing on the updated Grid Code and distribution interconnection standards. This work is described in more detail in the “[USAID Southeast Asia’s Smart Power Program \(SPP\) – Laos](#)” project summary.

*Production Cost Estimates for *Millettia pinnata**

Millettia pinnata, also called karanja or pongamia, is indigenous to the Indian subcontinent and Southeast Asia. This leguminous tree bears seed rich in fatty acids (27 to 39 wt%) that when harvested can be processed into oil, nitrogen-rich meal, and lignocellulosic pod fractions that all can play roles in improving the resiliency in both food and energy for island communities in tropics. APRESA funds support an initial cost of production analysis to determine farm gate prices for harvested seed pods based on costs to establishment, maintenance, and harvesting costs for pongamia orchards in Hawai‘i. This analysis framework can be extended to other locations in the tropical Pacific.

Energy Systems Regulatory and Technical Support for Pacific Island Countries

HNEI GridSTART is providing technical and regulatory/policy support to various Pacific Island Countries (PIC), such as the Republic of Palau (Palau), Cook Islands, Commonwealth of the Northern Mariana Islands (CNMI), and Republic of the Marshall Islands (RMI).

In September 2023, HNEI GridSTART hosted two trainings for PIC representatives in Hawai‘i: a three-day training program for the newly appointed Director of Palau’s Energy and Water Administration (PEWA) and utility staff on a variety of energy transition policies and regulations, and a one-day training program for the members of the Cook Islands’ power company, Te Aponga Uira (TAU), including Board members, the Chief Executive Officer, and the Chief Engineer. Topics included Hawai‘i’s energy transition, grid modernization, battery energy storage systems, and a case study on Moloka‘i’s distributed PV integration. Discussions with TAU are ongoing to define further HNEI support across a wide range of energy and regulatory needs.

At the Pacific Power Association’s (PPA) 30th Annual Conference in Saipan, HNEI GridSTART met with a CNMI’s Commonwealth Utilities Corporation (CUC) Board member who expressed interest in HNEI’s support for their renewable integration plans. Follow-up meetings with CUC will be scheduled to identify and prioritize areas of support. GridSTART also met with representatives from RMI’s National Energy Office during the conference, which requested HNEI

to review and comment on RMI’s new energy legislation and regulations. Based in part on interactions with other stakeholders at the PPA conference, HNEI GridSTART is further engaged in discussions to support additional projects in Samoa, Tonga, the Federated States of Micronesia, Nauru, Kiribati, Tuvalu, and Niue. This work is described in more detail in the “[Energy Systems Regulatory and Technical Support for Pacific Island Countries](#)” project summary.

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Contact: Richard Rocheleau, rochelea@hawaii.edu;
Leon Roose, lroose@hawaii.edu;
Scott Turn, sturn@hawaii.edu

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