FINAL TECHNICAL REPORT

Executive Summary

Asia Pacific Regional Energy System Assessment

Office of Naval Research

Grant Award Number N00014-17-1-2923

September 1, 2027 through May 31, 2025

HNEI
Hawai‘i Natural Energy Institute
University of Hawai‘i at Mānoa

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EXECUTIVE SUMMARY

This report summarizes work conducted under Grant Award Number N00014-17-1-2923, the Asia Pacific Regional Energy System Assessment (APRESA), funded by the Office of Naval Research (ONR) to the Hawaiʻi Natural Energy Institute (HNEI) of the University of Hawaiʻi at Mānoa (UH). The overall objective of this multi-year grant was 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. Projects were selected based on the specific requirements or needs of the targeted jurisdictions with a focus on geographic regions/countries of strategic United States (U.S.) interest, including but not limited to Pacific Island nations; Department of Defense (DOD) facilities within the U.S. Indo-Pacific Command (USINDOPACOM) operating area (formerly known as the United States Pacific Command operating area); Association of Southeast Asian Nations (ASEAN) countries of strategic interest; as well as Hawaiʻi, the West Coast, and Alaska. The criteria for selection of jurisdictions included: 1) those with significant rates of projected demand growth requiring rapid energy system expansion and transformation; 2) strategic trade and geopolitical opportunities to the U.S.; 3) potential to integrate renewable energy technologies; and 4) a collaborative environment to conduct the work.

Over the seven years of APRESA activities, HNEI provided engagement and support activities to a range of organizations based in Hawaiʻi and with countries in the Asia Pacific region including Vietnam, Thailand, Laos, Indonesia, Philippines, Cambodia, and several Pacific Island countries (PICs) including the Republic of Palau, the Cook Islands, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Fiji.

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) and DOD organizations in the areas of interest. 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 implementation of prime contractors throughout the region (e.g., Deloitte, Tetra Tech, Abt Associates, RTI, Chemonics, and Delphos International).

A brief summary of results by projects based in Hawai‘i and then by region/country follows.

Hawai‘i: A number of projects based in Hawai‘i were implemented with the intent to support secure energy development in Hawai‘i and allow transition to the broader Asia Pacific region. Projects included:

- The development and enhanced scaling of a dashboard website that tracks multiple global and statewide sustainability goals and targets. This effort supported dashboard launches in several PICs, including Guam, Palau, and the Northern Mariana Islands.
- Indoor air quality was evaluated through field measurement and computational fluid dynamics modeling, and anonymously measured human-based activity with the intent of better understanding space utilization and energy management.
- HNEI provided in-kind and financial support for a global conference to identify potential plans for future hydrogen energy development in island communities.

Vietnam: HNEI established partnerships with several institutions in Vietnam to support their development of a sustainable and resilient energy system. Projects included:

- Support to a community group to develop a workshop platform and eight seminars covering a range of energy themes to raise awareness of renewable energy.
- HNEI provided financial support and delivered training and expertise to support Vietnam’s development of a renewable portfolio standard mechanism and roadmap for implementation.
- HNEI provided technical planning, capacity building, and scenario modeling in support of Vietnam’s Eighth Power Development Plan’s (PDP8) development.
- HNEI supported Vietnam’s National Institute for Science & Technology Policy and Strategy Studies (NISTPASS) to map the innovation opportunities associated with renewable energy sector development in Vietnam.
- HNEI initiated an effort to support the Institute of Energy, Ministry of Industry and Trade to develop grid modeling capabilities.

Thailand: HNEI established collaborations with several Thai universities, utility providers, grid operators, and energy regulatory commission. Projects included:

- HNEI contracted Chiang Mai Rajabhat University to conduct an assessment of small biomass systems as a firm power option in islanded settings including the design, development, and implementation of a bioreactor system to hybridize a community PV grid system and extend hours of electricity availability.

- Technical collaborations with the Electricity Generating Authority of Thailand (EGAT), the Provincial Electricity Authority (PEA), and Chulalongkorn University enabled comprehensive advancements in grid planning, energy production forecasting, microgrid operations, and regulatory standards. These efforts included technical studies for solar and wind integration, production cost modeling (PCM), scenario analysis, development of robust predictive platforms tailored to Thailand's needs, and hands-on training for utility engineers. Work in Thailand assisted in laying the groundwork for regional regulatory modernization, while also facilitating demonstration projects such as the Koh Phaluai microgrid.

Laos: HNEI supported technical capacity building, grid modernization, and policy advancement in the Lao People's Democratic Republic (LPDR). Collaborations with the Ministry of Energy and Mines (MEM) and Électricité du Laos (EDL) introduced new competitive procurement models and guided the launch of Laos' first market-based solar pilot auction. The team also developed, expanded, and institutionalized technical interconnection and performance standards for solar and wind projects, enhancing reliability in the evolving power sector. Hands-on workshops and targeted capacity building directly equipped Lao practitioners with skills in scenario analysis and grid code management and helped to strengthen institutional knowledge and resilience strategies.

Indonesia: HNEI worked with Indonesian energy partners to provide technical training, capacity building, and collaborative research supporting grid modernization and energy transition. Engagements included training for the Ministry of Energy and Mineral Resources (MEMR), collaborative DC microgrid research with the University of Indonesia, and support for the Sustainable Energy for Indonesia's Advancing Resilience (SINAR) program. These efforts included hands-on workshops, capacity building webinars, and benchmarking tours covering grid modernization, microgrid design, battery energy storage systems (BESS), competitive procurement, and distributed resource integration.

Philippines: HNEI's collaboration with the Philippines Department of Energy (DOE) and Energy Regulatory Commission (ERC) facilitated improvements in their Net Metering Program, increased distributed solar adoption, and delivered regulatory frameworks for off-grid net energy metering and BESS. Support of the Energy Secure Philippines (ESP) program delivered advanced regulatory frameworks, practical training, and targeted technical assistance, which directly enhanced the expertise and operational capabilities of Philippine energy institutions, utilities, and the Armed Forces of the Philippines.

Pacific Island Countries (PICs): HNEI provided technical support for PICs, with specific efforts in the Republic of Palau, the Cook Islands (Rarotonga), the Republic of the Marshall Islands (Majuro), the Federated States of Micronesia (Yap), and the Republic of Fiji. The team delivered targeted analysis, regulatory development, and capacity building for projects addressing each island's unique challenges of maximizing use of local energy resources. Activities encompassed training workshops, stakeholder consultations, modeling studies, grid code development, and demonstration projects on hosting capacity and resiliency assessment.

Southeast Asia and Indo-Pacific Region: HNEI established collaborative technical engagement throughout Southeast Asia and the Indo-Pacific region. Projects included:

- Support of the Association of Southeast Asian Nations (ASEAN) Centre for Energy (ACE) allowed for significant contributions to the ASEAN Interconnection Masterplan Study (AIMS) III through technical review.
- HNEI assisted the Southeast Asia Smart Power Program (SPP) regionally across the ten ASEAN Member States through capacity building workshops, and more specifically in Laos and Cambodia. In Laos, HNEI engaged with EDL and MEM to provide updated feasibility study guidelines for energy projects and an updated grid code. In Cambodia, HNEI supported Electricité de Cambodge (EdC), the national utility, by holding a workshop on power system coordination and flexible resource management to enhance local practitioners' technical capacity.
- HNEI participated in various Asia-Pacific Economic Cooperation (APEC) working groups; forums and capacity building events convened by Asian Development Bank and the Department of State's Asia Enhancing Development and Growth through Energy (EDGE) initiative; and sustainable aviation fuel international workshops.
- A literature review and analysis of a tropical oilseed tree was conducted to evaluate its potential as a sustainable bioenergy resource.

This final report describes the work that has been accomplished in each of the areas identified above. Publications produced through these efforts are noted below and available on HNEI's website at https://www.hnei.hawaii.edu/publications/project-reports/apresa/.