OBJECTIVE AND SIGNIFICANCE: HNEI GridSTART is collaborating with the Electricity Generating Authority of Thailand (EGAT), the utility responsible for generation and transmission of power throughout Thailand, to conduct a renewable energy (RE) integration study for the country and enhance the professional capacity of its engineers in advanced study methods and tools.

BACKGROUND: The collaboration is pursuant to a Memorandum of Understanding (MOU) executed by HNEI and EGAT (see Figure 1) that is focused on a range of research, development and capability enhancements of mutual interest and benefit.

Activities include constructing a high-fidelity production cost model of the Thai power grid and assessing the operational and economic impact of high penetration solar photovoltaic (PV) scenarios over a five to ten year planning horizon. Focus is on determining Thai-grid appropriate flexibility measures and evaluating their effectiveness in mitigating RE grid impacts. After a calibrated model of the Thai power grid is developed, GridSTART and EGAT will jointly conduct modeling with personnel visits to Thailand and Hawaii, empowering EGAT engineers to conduct such analyses and more on its own going forward.

High levels of RE pose grid challenges due to its intermittency and variability and the limited capability of legacy power systems to flexibly respond by changes in unit commitment and dispatch to balance system net load. To maintain generation load balance and frequency control, conventional generation may need to ramp more quickly over a wider-range to effectively balance short-term load changes and the variability and uncertainty of RE resource production. The production cost of dispatched generation may also increase due to less efficient operation and the need for increased operating reserves. Symptoms of increased frequency and voltage variability may appear when reliable grid operation is at risk, with possible degradation in power quality and other detrimental consequences. Thailand’s current level of PV and wind resources have yet to give rise to serious operational and economic concerns. However, the market for RE additions in Thailand is rapidly growing, and EGAT is prudent in its effort to swiftly build the knowledge, tools and capacity to study and evaluate high penetration RE scenarios consistent with Thai energy policy and plans for increased RE penetration.

PROJECT STATUS/RESULTS: GridSTART and EGAT built and calibrated a high-fidelity production cost model of the Thai power grid in PLEXOS. In May 2019, HNEI held a multi-day workshop in Bangkok focused on model build, tuning and calibration, and presented model validation results.

Development of time series PV and wind data sets for all existing RE plants and future high penetration RE scenarios (including large additions of distributed PV) are nearly complete. Applying the model to assess flexibility counter-measures to grid impacts of high RE and will be underway before year-end 2019.

Funding Source: Office of Naval Research, APRESA
Contact: Leon Roose, lroose@hawaii.edu, (808) 956-2331

Last Updated: November 2019
OBJECTIVE AND SIGNIFICANCE: The project objective is to foster collaboration around smart grids, particularly distribution systems and microgrids with solar photovoltaics (PV) and energy storage. University of Hawaii (UH) is among an esteemed group of institutions from the U.S. and India including Washington State University (WSU), Massachusetts Institute of Technology (MIT), Texas A&M University, General Electric, ABB, numerous U.S. DOE laboratories, and peer organizations in India including five Indian Institute of Technology (IIT) campuses. This project is an important opportunity to highlight Hawaii’s challenges and solutions as a “postcard from the future” with respect to renewable energy, while inviting input from international leaders in smart grid research and technology development.

BACKGROUND: HNEI GridSTART has several specific roles and objectives in the larger project:

- To provide models and data from distribution circuits with high distributed PV penetration as a basis to explore advanced devices, controls and distribution system operation (See Figure 1);
- To operate these models on HNEI GridSTART hardware-in-the-loop (HIL) equipment linked in real time to devices and controls at, for instance, WSU and the National Renewable Energy Laboratory (NREL) as a means to provide realistic testing in a controlled environment;
- To provide streams of PV data and corresponding multi-horizon PV forecasts from HNEI’s solar forecasting system (contact Dr. Dax Matthews) to validate both the solar PV forecasts and optimal controls that use the forecasts; and
- To provide outreach and workforce development addressing smart grid technologies and applications and renewable energy grid integration.

PROJECT STATUS/RESULTS: As of year two of the five year project, UH researchers and postdoctoral fellows have:

- Created tools to integrate Hawaii distribution circuit models for real-time simulation (Fig. 1);
- Co-authored a paper on PV/load disaggregation, submitted to IEEE Transactions journal;
- Hosted two professors from IIT as part of a U.S.-India Partnership to Advance Clean Energy (PACE) fellowship;
- Presented parts of two webinars to the team; and
- Prepared an exhibit attended by approximately 1,000 Hawaii K-12 students (See Figure 2).

Figure 1. Overview of HNEI’s data and models from the area of South Kihei, Maui (presented at 2019 UI-ASSIST annual meeting)

Figure 2. Poster and part of display presented to K-12 students at the 2019 SOEST Open House on the UH Manoa campus

Funding Source: U.S. Department of Energy (subaward from Washington State University); in-kind cost share from UH faculty salary and fringe

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Last Updated: November 2019
OBJECTIVE AND SIGNIFICANCE: Under this project, HNEI, in collaboration with the National Renewable Energy Laboratory (NREL) is advising and guiding Vietnam’s Ministry of Industry and Trade (MOIT) and other Vietnamese stakeholders with the design of a Renewable Energy Portfolio Standard (RPS) mechanism and roadmap for its implementation. The project offers a replicable structure and framework for evaluating best practices for renewable policy development in this rapidly growing economic region.

BACKGROUND: This effort, conducted in support of the US AID funded V-LEEP involved analysis and development of a design and implementation roadmap for an RPS to increase deployment of renewable energy projects in Vietnam. Based on research of the Vietnam power sector and power market reforms and other announced changes, HNEI and NREL assessed international RPS models, identified best practices applicable to Vietnam and prepared a draft RPS roadmap. That was followed by public and private sector consultations to seek input on findings and approaches in support of Vietnam’s renewable energy development system (REDS) action plan.

PROJECT STATUS/RESULTS: Key outcomes of this effort included the following work products presented to the V-LEEP Program leadership team:

- A report of international leading practices for RPS policies co-authored with NREL: https://www.nrel.gov/docs/fy19osti/72798.pdf
- A written administrative and monitoring structure for a Vietnam RPS featuring a planning and reporting strategy and accounting, enforcement, flexibility mechanisms and cost recovery components largely based on Hawaii’s structure and experience.
- Outreach, advisory meetings and discussions of all V-LEEP work products above with MOIT and other national executive branch agencies and jurisdictions, utilities, and energy stakeholders during the week of 13-18 March 2019 in Hanoi and Ho Chi Minh City, and subsequent mission report.

The mission report and draft Vietnam RPS implementation roadmap of the project findings will help inform HNEI’s broader role in supporting EREA on Vietnam’s energy transition under a bilateral Memorandum of Understanding executed on October 25, 2019.

Funding Source: Office of Naval Research, APRESA

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Last Updated: November 2019
OBJECTIVE AND SIGNIFICANCE: The goal of this active project is to upgrade and improve the resilience of the electrical system for the deep seawater delivery facilities at the Hawaii Ocean Energy, Science & Technology (HOST) Park. An advanced control system for an AI-based microgrid incorporating distributed solar and energy storage is under development to optimize energy management, reduce costs, and improve resilience of the HOST Park seawater distribution system. The microgrid control system will be designed with the capability to provide comprehensive energy management of the entire 900-acre HOST Park where more than 40 companies operate business/pilot sites.

BACKGROUND: HOST Park is a unique outdoor demonstration site for emerging renewable energy, aquaculture and other ocean-based sustainable technologies. Three sets of pipelines are capable of delivering up to 100,000 gallons per minute of seawater cold sea water from depths of 3,000 ft. The innovative green economic development park is administered by The Natural Energy Laboratory of Hawaii (NELHA), a self-sufficient State of Hawaii agency. Interruptions in electrical service have the potential to irreparably damage the businesses that depend on the seawater for their agricultural and production requirements This project is intended to reduce utility costs and protect the seawater pumping system from potential outages through the installation of an AI-based renewable microgrid. The Hawaii Natural Energy Institute (HNEI) initiated efforts to apply for Korea Institute of Energy Technology Evaluation and Planning (KETEP) grant funding and assembled a consortium of United States and Korean entities to pursue the microgrid development project with NELHA. KETEP awarded the project team a grant of KrW 1,940 million, approximately USD 1.73 million via the Korea Ministry of Trade, Industry, and Energy as part of their International Energy Collaborative Research and Development Program. The project entails a detailed design, deployment, testing and evaluation of a microgrid that includes photovoltaic (PV) panels and energy storage systems (ESS) at the HOST Park research campus seawater pump stations. The project period is November 1, 2018 through April 30, 2021.

PROJECT STATUS/RESULTS: To date, HNEI has supported the microgrid development project by clarifying requirements for grid interconnection between the proposed HOST Park microgrid and the HELCO grid; developing functional requirements and use cases for the microgrid; and supporting the project team in regulatory proceedings by the Hawaii Public Utilities Commission to establish a microgrid services tariff and process under which microgrids can be interconnected to Hawaii’s electrical grids.

Funding Source: KETEP (subcontract with Encored, Inc.)

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Last Updated: April 2020
ADDITIONAL PROJECT RELATED LINKS

PAPERS AND PROCEEDINGS:

PRESENTATIONS:
1. 2019, M.B. Glick, Smart Grid and Microgrid for Archipelagic Communities - Power Play of Policy-Industry-Capacity-Infrastructure, Presented at the 5th ASEAN Smart Grid Congress, Johor, Malaysia, December 4.