# Hawai‘i Natural Energy Institute Research Highlights

*Grid Integration & Energy Efficiency*

## *Development and Verification of AI-Based Microgrid Platform and Business Model*

**OBJECTIVE AND SIGNIFICANCE**: The goal of this project is to demonstrate the capabilities of an advanced control system using artificial intelligence (AI) to optimize energy management of a distributed solar and energy storage based microgrid to reduce costs, and improve resilience of the seawater distribution system at the Hawai‘i Ocean Energy, Science & Technology (HOST) Park. The microgrid control system has been designed with the potential capability to provide energy management across 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 renewable energy, aquaculture and other ocean-based sustainable technologies. The demonstration site is in a section of the Park that includes three sets of pipelines capable of delivering up to 100,000 gallons per minute of cold seawater from depths of 3,000 ft. The innovative green economic development park is administered by the Natural Energy Laboratory of Hawai‘i Authority (NELHA), an agency of the State of Hawai‘i. Interruptions in electrical service have the potential to irreparably damage the businesses that depend on the seawater for their agricultural and production requirements. The proposed microgrid, with AI capability, is intended to reduce utility costs and reduce or eliminate outages of the seawater pumping system.

The Hawai‘i Natural Energy Institute (HNEI) conceived the project, initiated efforts to apply for Korea Institute of Energy Technology, Evaluation and Planning (KETEP) grant funding, and helped form the consortium of United States and Korean participants. In 2018, 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 an AI microgrid that includes photovoltaic panels and battery energy storage systems at the HOST Park.

**PROJECT STATUS/RESULTS**: HNEI supports the microgrid development project by advising on requirements for grid interconnection between the proposed HOST Park microgrid and the Hawai‘i Electric Light Company (HELCO) grid, including 1) the potential applicability and impacts of microgrid service tariffs; 2) functional requirements and use cases for the microgrid; and 3) project team engagement with the engineering, procurement and construction (EPC) and financial contractors.

During 2022, microgrid construction began with clearing of the lava fields and installation of ground-mounted PV array. The battery energy storage system is expected to be installed by end of year, with the microgrid operational by March 31, 2023.

This project has produced a number of works, including the ones listed below:


- 2021, W-H. Park, H. Abunima, M.B. Glick, Y-S. Kim, **Energy Curtailment Scheduling MILP Formulation for an Islanded Microgrid with High Penetration of Renewable Energy**, Energies, Vol. 14, Issue 19, Paper 6038.
- 2020, R-K. Kim, M.B. Glick, K.R. Olson, Y-S. Kim, **MILP-PSO Combined Optimization Algorithm for an Islanded Microgrid Scheduling with Detailed Battery ESS Efficiency Model and Policy Considerations**, Energies, Vol. 13, Issue 8, Paper 1898.
- 2019, J-W. Chang, G-S. Lee, H-J. Moon, M.B. Glick, S-I. Moon, **Coordinated Frequency and State-of-Charge Control with Multi-Battery Energy Storage Systems and Diesel Generators in an Isolated Microgrid**, Energies, Vol. 12, Issue 9, Paper 1614.



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