Hawai‘i Natural Energy Institute Research Highlights

Grid Integration & Renewable Power Generation

Advanced Real-Time Grid Energy Monitor System (ARGEMS)

OBJECTIVE AND SIGNIFICANCE: The objective of this project is to develop a low-cost device and system that can provide enhanced situational awareness allowing tighter, localized coordination of distributed energy resources (DERs) such as rooftop solar photovoltaics (PV). This is important for Hawai‘i because as power generation and ancillary services become more decentralized and variable, there will be a need for enhanced measurement, data analytics, and distributed controls near the grid edge. Field devices such as advanced meters, line sensors, and secondary reactive power (var) controllers are all part of Hawaiian Electric Companies' Grid Modernization Strategy, and this project has the potential to provide significant advancements in these areas beyond the commercial state of the art.

BACKGROUND: Grid edge technology has the potential to relieve voltage constraints with local context-aware volt/var control, identify and help mitigate local thermal violations through energy and load shifting, provide data for more refined and readily updated PV hosting capacity analysis, identify power quality issues such as harmonic distortion from increasing amounts of power electronic devices, and assist in fault location and anomaly detection, such as pending transformer failure and unmetered loads. This system offers a high-tech, flexible research-to-commercialization platform that can be programmed to support these use cases and more. It offers high-fidelity voltage and current measurement, numerous communications options, low-latency event-driven messaging, precise GPS-based timing, backup power supply, and powerful processing capabilities for real-time data analysis, all within a small weather resistant enclosure.

PROJECT STATUS/RESULTS: ARGEMS devices have been successfully deployed at the UH Mānoa campus, Arizona State University, Chulalongkorn University (Thailand), and in Okinawa, Japan. The latest version is shown in Figure 1 and examples of analysis and visualization are shown in Figure 2.

The system is currently patent pending (via UH's Office of Technology Transfer) and commercial pathways are being explored. Discussions regarding potential use cases and demonstrations have been initiated with utilities in Hawai‘i, Alaska, and Thailand. Assembly is now performed commercially. Costs are expected to be competitive with traditional distribution service transformer monitors.

The project has enabled and fostered new collaborations and funded research and it has been featured in educational and outreach activities. It has supported research on distributed volt/var control (DURA project led by Arizona State University) and optimal electric vehicle scheduling and charging (vehicle to grid demonstration, with Hitachi). Fourteen (14) undergraduate students and six international interns have been involved. It has been shared with the public through ThinkTech Hawai‘i, SOEST's Open House, and UH Sea Grant's Voices of the Sea.

Figure 1. ARGEMS devices ready for research collaboration.

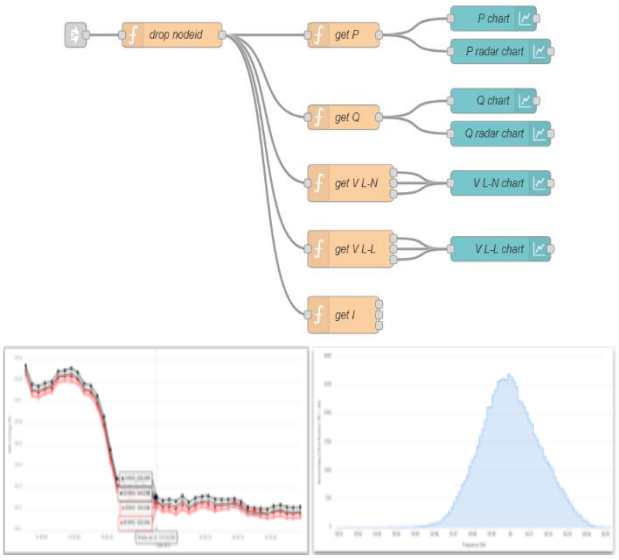

Figure 2. Analysis and visualization of real-time data.

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Contact: Kevin Davies, kdavies@hawaii.edu

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