

**Innovation, Investment, Research and
Development: CleanEnergy Technology Trends
and Economic Development**

**International Collaboration on AI-Based Microgrid
Platforms, Renewable Integration & Energy Policy**



Hawaii Natural Energy Institute

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Hawaii Natural Energy Institute (HNEI)

School of Ocean and Earth Science and Technology
University of Hawaii at Manoa

- Founded as organized research unit in 1974, established in statute in 2007 - complements the state statute for the Energy Resources Coordinator and its delegate, the Hawaii State Energy Office
- 4 major funding sources; UHM, Barrel Tax, Extramural, Applied Research Laboratory– alternative energy via HNEI recognized as core competency for the UH ARL
- Diverse staff including engineers, scientists, lawyers; students and postdoctoral fellows seeking solutions to renewable generation & transportation fuels, grid integration, and innovation
- Combines research excellence with deep experience
 - ❖ Policy team -former PUC Commissioner & State Energy Administrator
 - ❖ HNEI's GridSTART team has >120 years cumulative utility experience
 - ❖ Both current PUC Commissioners came from HNEI

Strategic Focus

Hawaii Innovation Initiative

- Research, Development, Testing & Evaluation
- Analysis
- Policy Guidance
- Workforce Development



Programs & Alliances to Replicate and Expand

- Asia Pacific Regional Energy Systems Analysis (APRESA) supported by the Office of Naval Research - to develop resilient renewable energy systems in the Asia Pacific
- Islanded Grid Resource Center 2.0 in collaboration with Maine's Island Institute & the Renewable Energy Assistance Project of Alaska



APRESA

HNEI is engaged with the governments and their consultants in Vietnam, Thailand, Japan and Korea on cooperative endeavors to incorporate large-scale energy efficiency, renewable energy, and advanced grid service policies.



Examples include:

- *Renewable Energy Outreach, Education & Training*, for the Center of



USAID
TỬ NHÂN DÂN MỸ

an Studies, Ho Chi Minh City



t, Vietnam Low Emission Energy Program, with

Mission Innovation with Korea

- Outgrowth of 2015 MOU between State of Hawaii and the Korea Institute of Energy Technology Evaluation and Planning (KETEP) on August 24, 2015 to cooperate in the development of green energy technology
- HNEI responded to a KETEP solicitation and received an award to conduct a feasibility study on Korean microgrid platforms in three potential Hawaii sites under KETEP's International Energy Collaborative Research and Development Program.
- On the most promising of the 3 sites, HNEI formed a six-party alliance to apply for KETEP Mission Innovation grant funding
- KETEP granted an award to the alliance in October for a project that officially began on Nov. 1, 2018 and concludes in June of 2021.

ENCORED



SEOUL
NATIONAL
UNIVERSITY



Hawaii-Korea Microgrid Project Overview

Deployment and Operation of “Smart” Microgrid Featuring Distributed Resources with Resilience in Off-grid Events

- Apply big data / reinforcement learning based prediction and optimization algorithms
- Development of system scalability through local EMS interworking
- Design & deploy power trading model and service



AI-Based
Cloud EMS

- Microgrid system design & on-site engineering for PV, ESS, Control system
- Install & operate AI-based cloud/local EMS
- Analysis of empirical results on economical value and system stability



Microgrid System
Operation



- Coordinated control for DG, diesel back-up generator, PV+ESS to maximize off-grid operation time
- Real-time Simulator (RTDS) based system simulation and algorithm verification
- Includes microgrid optimal design methodology



Off-Grid
Operation



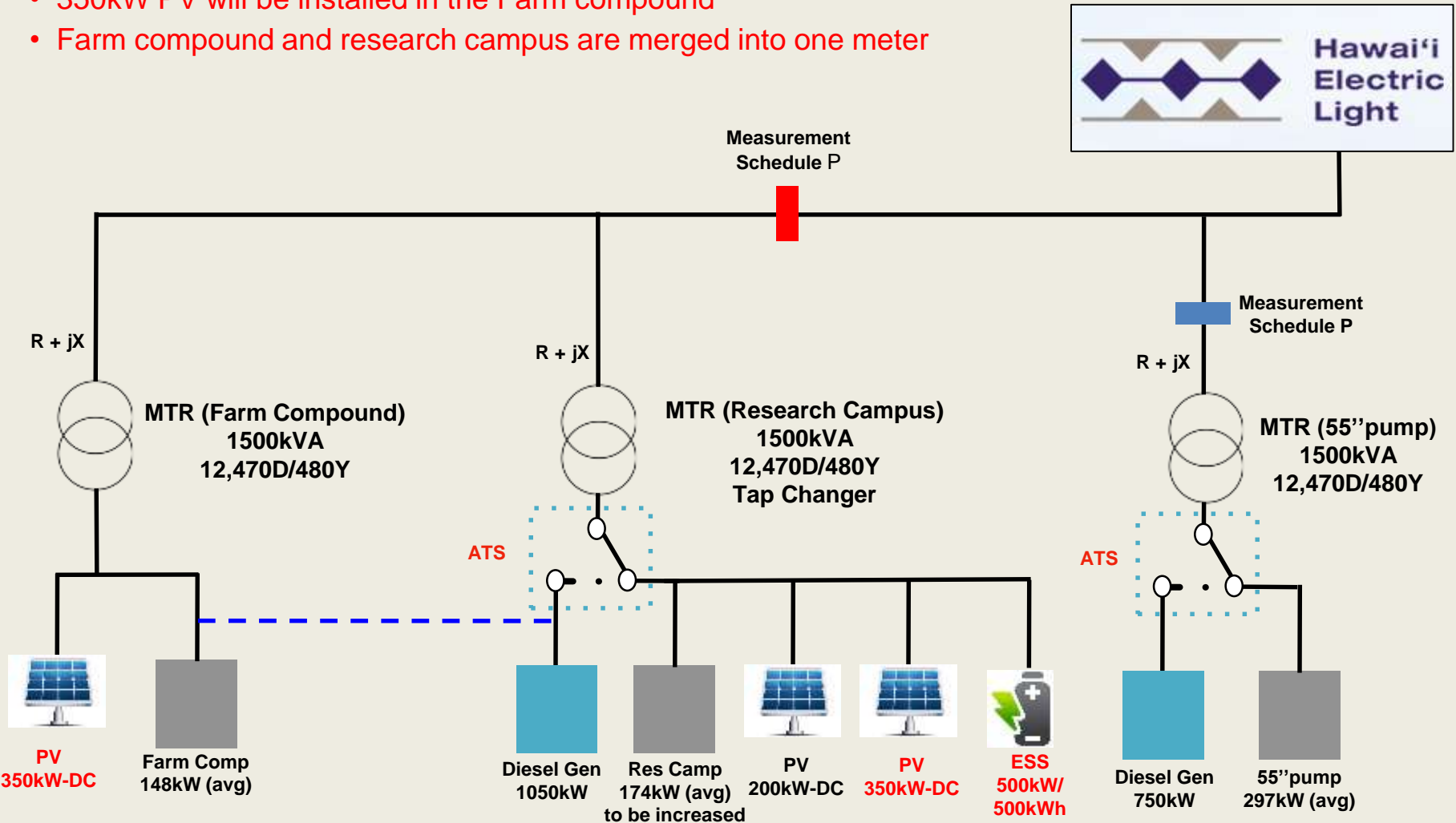
Business Model

- Integration of law and regulation in Hawaii
- Guidelines for microgrid business models
- Creation of a replicable, localized new energy service model

Supporting Hawaii's drive for 100% renewable energy through deployment of locally optimized microgrid operation technology

Proposed System Configuration - Case1

- 350kW PV and 500kW/500kWh ESS will be installed in the research campus
- 350kW PV will be installed in the Farm compound
- Farm compound and research campus are merged into one meter

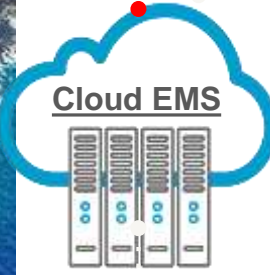
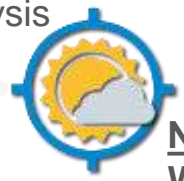


Featured Innovations

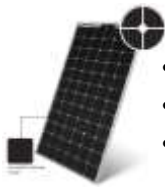
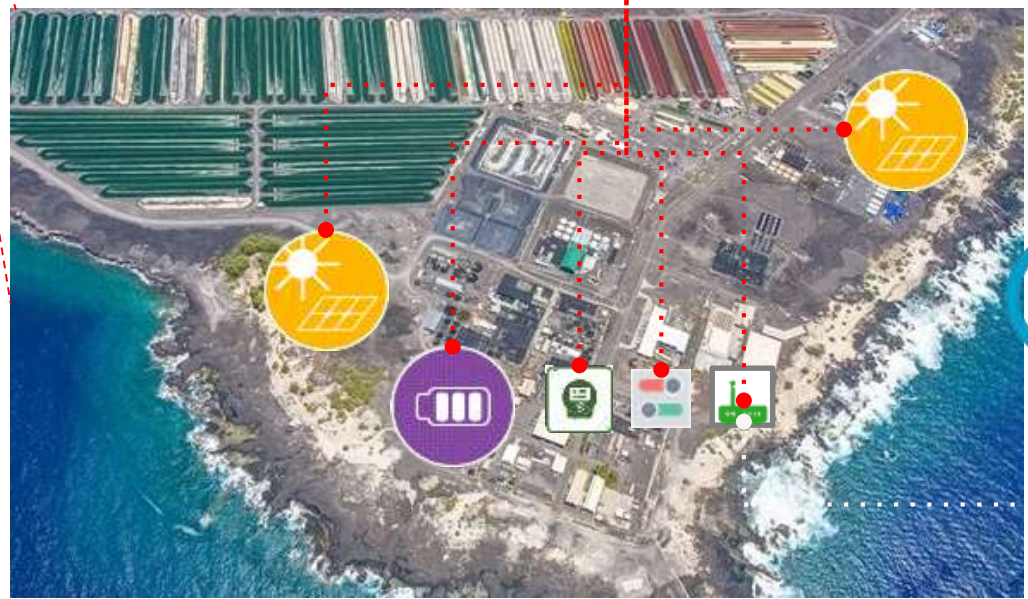
- Coordination control
- Frequency control
- Black start
- Automatic synchronizing



- Optimal Generation Planning (cost or CO₂ emission)
- Monitoring distributed energy resources and analysis field data
- Peak monitoring and estimation
- Cost analysis



- Big data collection/preprocessing/analysis
- Load and solar forecasting with reinforcement deep learning
- Optimal generation plan based on reinforcement deep learning



Solar

- 700~1,000kW
- N-Type
- Bifacial module (+ 5~30%)



ESS

- 500kW PCS
- 500kWh Battery
- 98.7% efficiency



Smart meter & Gateway

- Wireless connection
- Low power consumption
- Real-time data transmission

Thank you!

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