Introduction to HNEI

ARL Summer Meeting

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

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Hawaii Natural Energy Institute
Organized Research Unit in the School of Ocean and Earth Science and Technology, University of Hawaii at Manoa

**Alternative Fuels:** Biomass, Biofuels, Hydrogen, Methane Hydrates

**Electrochemical Power Systems**
- Fuels Cells, Batteries

**Renewable Power Generation**
- Ocean Energy
- Photovoltaics

**Energy Efficiency**
- Building Technology

**Grid Integration**
- Grid modeling and analysis
- Transportation systems
- Smart grid development
- Grid-scale storage
Grid Systems Technologies Advanced Research Team

• Interdisciplinary team of faculty, professionals, post-doctoral fellows and students at HNEI (including over 80 years cumulative utility experience)

• Established to develop, test and evaluate advanced grid architectures, enabling policies, and new technologies and methods for effective integration of renewable energy resources and power system optimization

• Funding includes ONR, NavFAC, USDOE, Hitachi, Nissan, and State of Hawaii

• Strong partnerships with Hawaii, national and international organizations
Select Projects

- **Hawaii Grid Integration Studies** - Renewable integration, grid reliability study supporting PUC and HCEI (USDOE, State)

- **Battery Energy Storage** – Evaluate BESS for grid ancillary services (ONR, USDOE, Industry Partners, State)

- **US DOT Electric Vehicle Transportation Center** - FSEC partnership to address EV integration, battery performance (USDOT, State)

- **Maui Smart Grid Project** – Control of distributed resources and energy storage for peak demand reduction (USDOE, Industry partners)

- **Smart Grid Inverter Project** – Development of advanced inverter functionality and communications for SG w hi penetration PV (USDOE, ONR, State)

- **Molokai Renewable Microgrid** – Management of grid scale battery (system stability) and distributed resources (ONR, MECO, HECO)

- **Navy Energy Assurance Project** – Power grid modernization and renewable energy integration action plan to meet Navy needs/goals in Hawaii with a focus on the reliability and power quality to PHNSY (ONR via UH ARL)
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<tbody>
<tr>
<td>Reduce Demand</td>
<td>$17M awarded</td>
<td>SGM in design</td>
<td>projects programmed</td>
<td>projects programmed</td>
<td>33 GWH</td>
<td>31 MW</td>
<td>84 GWH</td>
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<td>Increase renewables</td>
<td>12 MW Solar</td>
<td>11 MW PPV</td>
<td>1.5 MW LFG</td>
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<td>MAC PPA</td>
<td>Housing + DG PPA</td>
<td>@ PMRF</td>
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<td>Culture of</td>
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<td>Energy Conservation Board</td>
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<td>Conservation</td>
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<td>Building Energy Monitor Program</td>
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<td>Strengthen</td>
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<td>HNEI Grid Modernization Study</td>
<td>P-416 PMRF Power Grid Consolidation</td>
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<td>Infrastructure</td>
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<td>P-715 Interconnect STAC to Hickam</td>
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<td>Energy System</td>
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<td>Management and</td>
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<td>P-718 JBPHH Smart Grid</td>
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<td>Measurement</td>
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<td>SCADA &amp; DDC</td>
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<td>Community Partnership</td>
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<td>HECO-DOD EXCOM Energy Partnership</td>
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<td>Energy Awareness</td>
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<td>LNG Study and Potential Terminal Site</td>
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<td>Know Loads Team</td>
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<td>20 MW West Loch PV</td>
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Grid Scale BESS Projects (1-2 MW)

- Design experiments and develop algorithms to assess BESS performance and lifetime for high value grid applications
- Optimize value to grid with minimal battery degradation

Haw‘i 10 MW Wind farm at Upolu Point Hawaii Island
- Frequency regulation and wind smoothing

Cambell Park industrial feeder with high penetration
- Power smoothing, voltage and VAr support, and frequency regulation

Molokai Secure Renewable Microgrid
- Operating reserves, (fault management), frequency regulation, power smoothing, and peak shifting
• **Hawaii Sustainable Energy Research Facility (HISERF) (ONR, USDOE, HECO, NASA, Industry)**
  - Development and testing of fuel cell and battery systems for grid and vehicle applications
  - Development of advanced air filtration for FC operations in harsh environments.

• **Marine Corps Base Hawaii Dual Pressure “Fast-Fill” H2 Fueling Station (USDOE, ONR)**
  - Basis for design of public stations
  - Unattended operation, 50 fills since Nov 2014
  - Supports development of H2 infrastructure in HI

• **Hydrogen Energy Systems for Grid Management (USDOE, ONR, SOHI, Industry)**
  - Demonstrate the use of electrolyzers to mitigate the impacts of intermittent renewable energy
  - Support FC bus fleet on Big Island
  - Evaluate effect off multiple revenue streams on overall hydrogen costs.
Navy Wave Energy Test Site at MCBH
3 grid-connected berths – 30m, 60m, 80m – now complete

Funding Partnership
• Navy: Infrastructure, Developer Support, ARL/HNEI Support
• USDOE: National Marine RE Center at HNEI, Developer Support
• Office of Naval Research: Technology Support
• State of HI: Technology Support

HNEI Role
• Support NAVFAC EA process and deep berths design
• Environmental impacts, incl. acoustic & EMF signature, eco surveys, sediment xport
• Independent evaluation of device power output/durability, incl. wave measurement and forecasting, device/array modeling
• Provide site-dedicated support vessel for developers and researchers
Expected WETS Tenants

Northwest Energy Innovations
1. 18 kW Azura device, 30m
   May 2015 for one year
2. Utility scale device (TBD), 80m,
   Late 2017 for one year

Fred.Olsen/Sound and Sea Tech.
240 kW Lifesaver device, 80m,
Oct 2015 for 6 months

Columbia Power Technologies
Spring 2017 ~ 500kW
StingRAY device, 80m, one year

Ocean Energy, USA, LLC
Oscillating Water Column device, up to 1MW, 60m,
~ August 2016 for 1 year
NWEI Azura Deployment at WETS