Sandia National Laboratories

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Sandia National Laboratories Energy Hawaii Initiative

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Sandia National Laboratories

NELHA ES Conference

September 12-13, 2016

Program Sponsor: DOE/OE Stationary Energy Storage Program - Dr. Imre Gyuk

U.S. DEPARTMENT OF ENERGY NNSA

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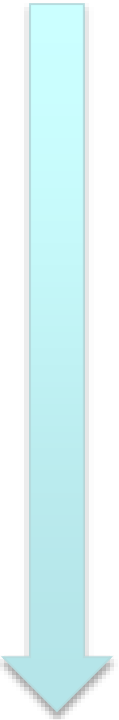
Outline

- Overview of Sandia's ES Project Group (Industry Acceptance)
- Hawaii Specific Active Projects
- NELHA Collaboration
- Potential Projects

Six Sandia Thrust Areas to Meet Grid Challenges

- **Materials and Systems Development**
  - Leading the **development** of next-generation technologies
  - Improving current **technology** (flow batteries, flywheels, etc.)
- **Power Electronics**
  - **Developing** and testing new wide-bandgap power-electronic devices
- Component and systems analysis and safety
  - Analysis from battery cells through MW size ES systems
  - ES system testing protocols
  - ES system safety R&D
- ***Industry Acceptance (IA)***
  - ***ES System Field deployments and commissioning***
  - ***State-Initiated Demonstrations***
  - ***Technical support***
- **Grid Analytics and Policy**
  - Providing **assessments** of the impact of storage placement
- **Outreach -** Leading publications and meetings to **help** educate the Grid Energy community

Nanoscopic



Macroscopic

SNL Industry Acceptance – ES Projects Team

MISSION STATEMENT: Encourage investment in Energy Storage though field deployments by insuring systems are safe, reliable, cost effective, functional, understood by the public.

APPROACH: - Work with national and international entities that include the DOD, State Energy offices, Other National Labs**, Utilities, project developers, installers, integrators, Universities and Consumers to:

- Conduct grid and system Analysis
- Develop Energy Storage Projects
- Support State and International renewable/resiliency/Energy Storage initiatives
- Develop public information programs concerning energy storage

** Partnering relationship with sister Labs – PNNL, ORNL, NREL

SNL Industry Acceptance – ES Projects Team

Capabilities

- Grid analysis & modeling
  - ES applications, sizing, technologies
  - using commercial and Sandia developed analysis tools (PYOMO, PLEXOS,PSLF)
- Project Development and Implementation
  - Request for Information and Proposals (RFI & RFP)
  - project designs and specifications
  - Data Acquisition Systems (DAS) design and implementation
  - Technical support during the construction of ESS'
  - ESS commissioning/testing plan development and implementation.
  - Start-up, commissioning and testing support.
- System Analysis
  - Remote monitoring and data acquisition
  - Analysis of operational test data
  - System optimization algorithms**.**
- Policy, regulatory and state support through CESA resources
  - Webinars, Papers,

DOE-OE/SNL Demonstration Projects 2016

Stock Image source: http://www.devarticles.com/c/a/Web-Services/Cooking-With-Web-Services-PHP-and-GD/3/

Ongoing Hawaii Projects

HECO project

In May, 2014, HECO issued an RFP for one or more large-scale energy storage systems able to store 60 to 200 megawatts for up to 30 minutes. HECO approached DOE OE / SNL to assist in the selection, commissioning and long term analysis of energy storage systems. SNL has and is providing technical consulting, system evaluation, and analysis services.

Agreed upon technical support includes but is not be limited to:

1 Assist HECO in developing RFP selection criteria and reviewing proposals

2 Assist HECO in determining optimum deployment sites and technology types

3 Work with HECO and the selected companies in developing commissioning documents for systems > 20MW, including system acceptance best practices, safety and commissioning

4 Perform long term monitoring and data analysis of deployed systems

5 Publish analysis results

Completed or in-process tasks:

- NDA with HECO in place.
- Provided guidance on the selection criteria.
- Participated in the final review of those proposals and provide HECO with an opinion of the feasibility and value of the top ten.
- Conducted production cost modeling of the Oahu grid to evaluate the benefits of energy storage for arbitrage and contingency reserves
- Modeled behind the meter PV generation variability using Sandia's Wavelet Variability Model (WVM)

Ongoing Hawaii Projects

NELHA Collaboration
Sandia National Laboratories is collaborating with National Energy Lab of Hawaii Authority (NELHA) in its effort to incorporate Electrical Energy Storage in its renewable energy, microgrid and innovative energy projects. SNL has and is providing technical consulting, system evaluation, and analysis services.

Agreed upon technical support includes but is not be limited to:

- Providing technical expertise in the development of RFPs for distributed energy and energy storage projects
- Evaluate proposed energy storage systems for Technical Readiness Level (TRL), functionality, and applicability to project deliverables
- Perform technical reviews of project design documentation including complete system design, installation design, and data acquisition design
- Witness and/or verify installation and operation of systems including control algorithms and software, data acquisition system operation and remote access
- Verify start-up and commissioning of complete systems
- Remotely access, monitor and analyze system operation and performance data for up to one year post commissioning
- Participate in education, outreach and technology transfer as requested by NELHA and agreed upon by SNL

Completed or in-process tasks:
- Provided support to NELHA during the installation and commissioning of the 10KW Aquion system. Presently evaluating system operation.
- Developing remote access to NELHA Data Acquisition System (DAS). This will allow SNL access to system(s) operation
- Part of team to develop a UET (Vanadium Flow battery) project. DOE/Sandia will contribute cost share to project
- Identification of additional ES Project for FY17/18.

Potential Hawaii Projects

Honolulu Authority for Rapid Transportation (HART)

- The train will have the capacity for regenerative braking. 70% will be used by accelerating trains with 30% being lost to heat. Project will capture this 30% using energy storage. HART is looking at a wayside energy storage system that was pioneered in Pennsylvania by Viridity with grant from Pennsylvania energy authority. LA Metro is also using it as are a few other cities and internationally. HART, who will be the largest utility user in the state, is installing 2,000kVa transformers in each of 16 substations = about a 30 MW system. Peaks will be in morning and evening commute (6-8:30 a.m., 4-6 p.m.) which dovetails with residential electricity peaks. In order to move forward, they would like to do a feasibility study to understand if ES would work on their system and to understand the benefits

Ikehu Molokai Energy Storage Project

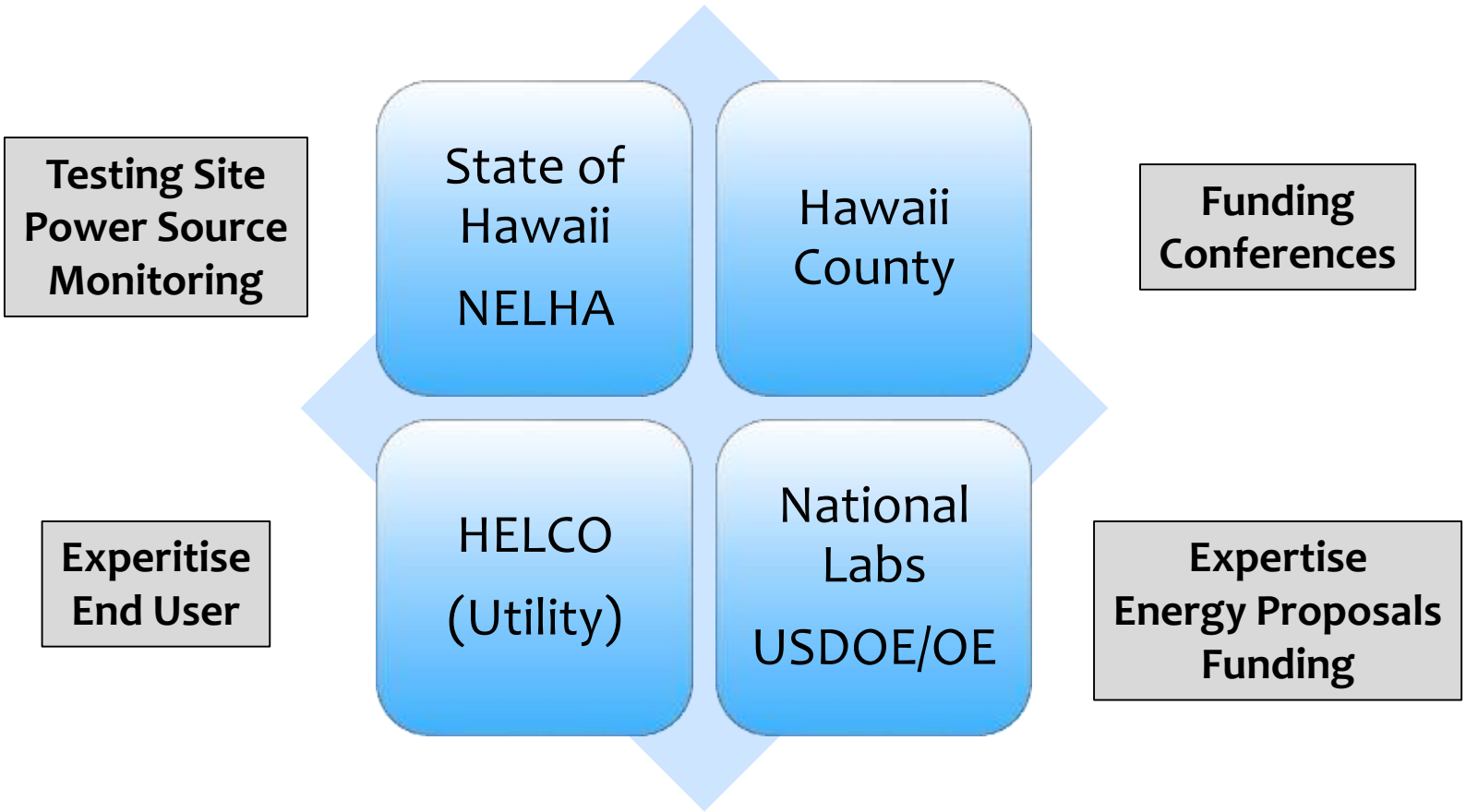
- Two phase project: Phase 1 will add 6 MW PV and 6 mW/6 mWh energy storage resources to achieve 40% renewables penetration on the Molokai island grid, allowing retirement of a portion of the island's diesel generation; Phase 2 aims to achieve 100% renewable generation on Molokai. Partners include Princeton Energy Group in collaboration with HECO/MECO and the Hawaii Energy Agency, with support from DOE/OE.

NELHA Energy Storage Program

Why an Energy Storage Test Bed at NELHA?

Hawaii Policy	- State's overdependence on oil - Aggressive Clean Energy Policy – 100% by 2045 - Abundance of natural renewable resources (sun, wind, bio, geo, hydro, ocean)
Demonstration Needs	- Motivated customers - User Demand (Utility, Commercial, Residential, Military) for real world demonstrations in industrial setting - 100-150 MW storage deployment needed in next few years - High percentage of renewables needing to be integrated on grids
Roll Out	- High electrical rates between $0.20 and $0.40/kWh - Government private partnerships - Master permit

Testing and Validation of Electrical Energy Storage

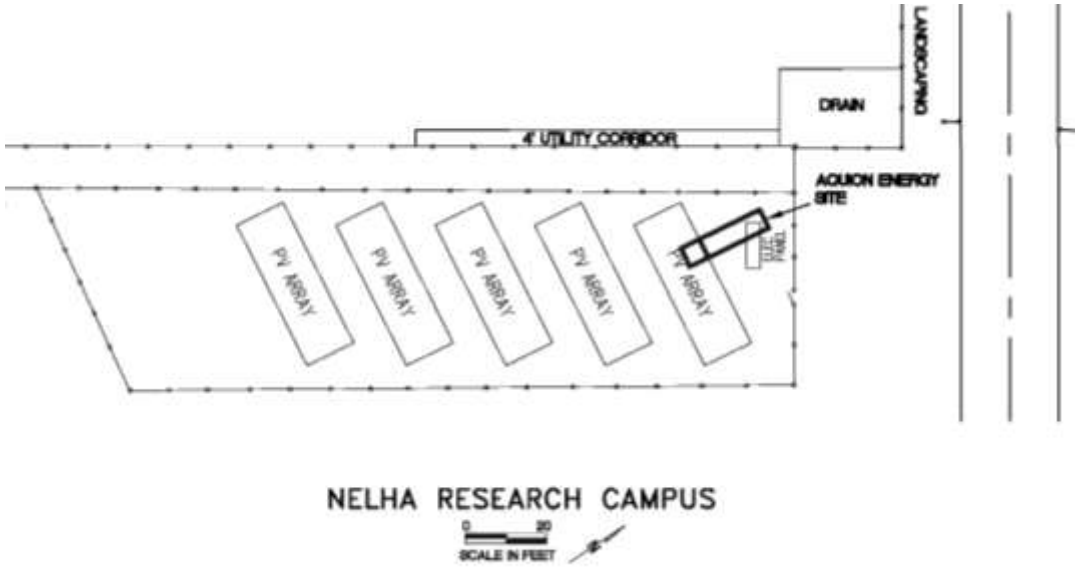


Initial Partners 2014/2015

Government	National Labs	Private
• State of Hawaii • County of Hawaii • US DOE – Office of Electricity	• Sandia National Laboratories • National Renewable Energy Laboratory	• Hawaiian Electric Company • Makai Ocean Engineering • Aquion Energy Inc.

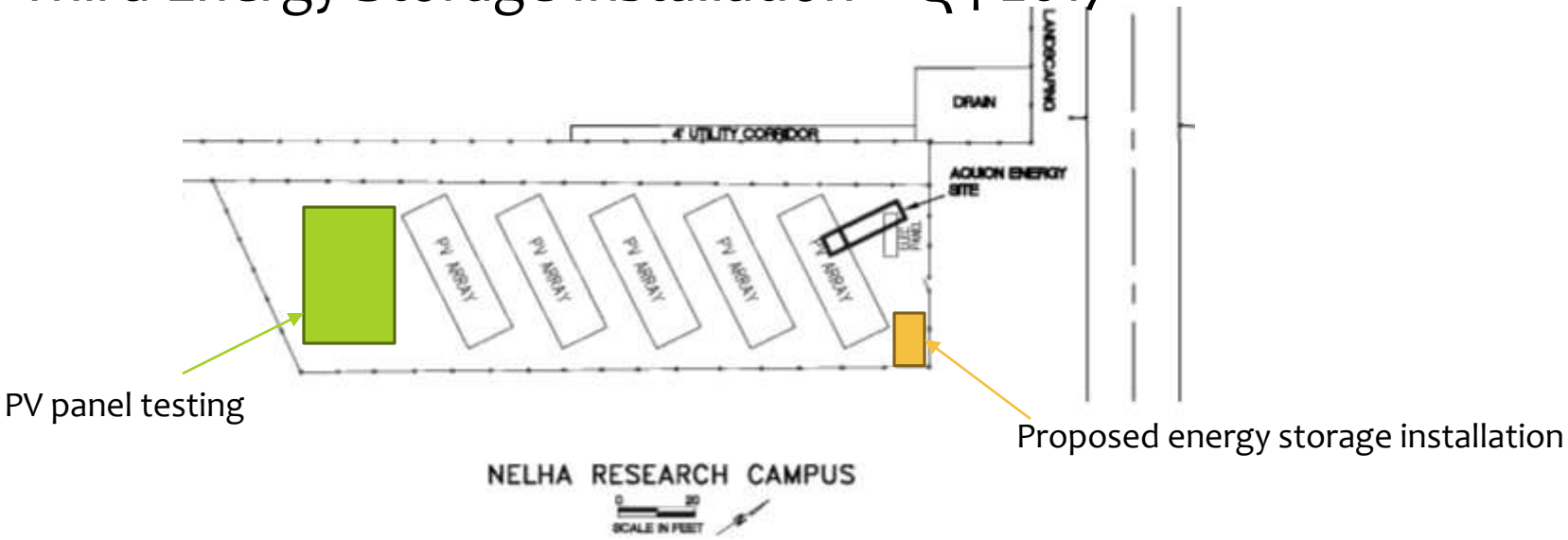
First Installation: Aquion Battery (Generation 1)

- Lease and Evaluation Agreement – Executed Oct 15, 2014
- Installation March 2015
- One M100 Battery Module
- Minimum 21.9kWh based on C/20 standard discharge rate
- Local Partner: Renewable Energy Services



In the works… for the RC Energy Storage Test Bed

- Energy Storage Battery Pilot – Q1 2017
  - UET Vanadium Flow Battery
  - Partners include HELCO, NELHA, UET, DOE/Sandia
- PV panel – Subtropical coastal marine environment long term testing - Q2 2017
- Third Energy Storage Installation – Q4 2017



Innovation : Something to Consider

One of the first gasoline powered cars ~1891 by Henry Nadig of Allentown, Pa.

Courtesy of American Automobile Museum, Allentown, Pa.

Innovation: Something to Consider

*Quotes about the Nadig in 1891**

- Blasted as a "**dangerous device**" – backfiring caused fires
- Car **not allowed** on the **streets** during the day as it "frightened" the horses
- Constable served notice; drivers/operators could be **arrested** for creating a "**public nuisance**"
- "Shouts of 'Get a horse!' were followed by the grand insult of the day – "***Cabbages***" that were thrown at the hapless Nadig."

** Whelan, Frank "Did Auto Age First Dawn in the Valley? Allentown Mechanic Built One of Country's First Gas-powered Cars" Sept, 14, 1989 The Morning Call*

Thanks

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