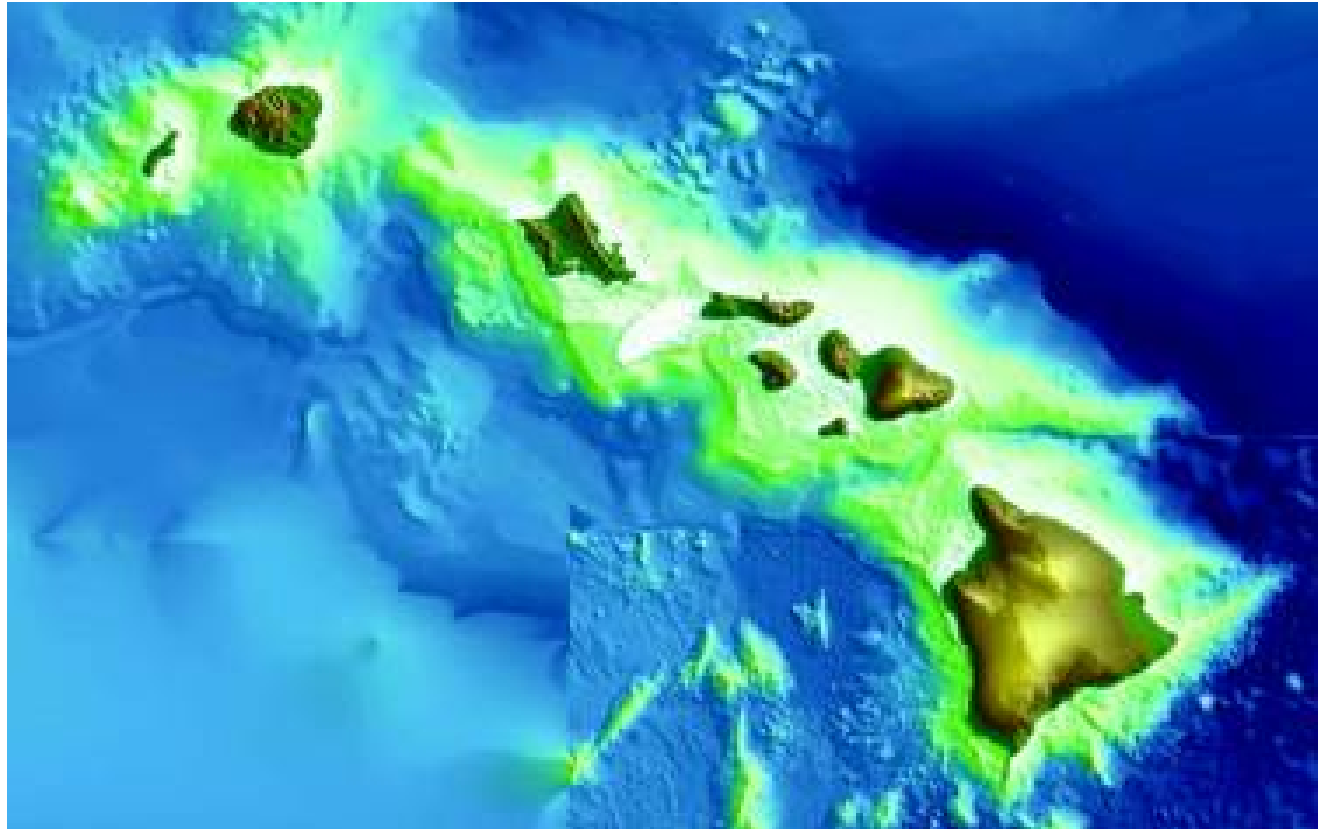


UH-HNEI PV and Energy Storage Programs



Program Objectives

- Evaluate performance and durability of emerging PV
- Evaluate alternative battery technology for a variety of ancillary services
- Support analysis to understand and mitigate impact of intermittency of renewables on the electric grid



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Program Activities

- Establish PV and battery testbeds to support Research, Test and Evaluation (RT&E)
- Develop 1 Hz Data collection, storage (secure server), and analysis capability
- Provide reporting and data access through a University of Hawaii managed website to help support needs of local utilities, academia, and technology community



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Pu'u Wa'a Wa'a PV Test Bed Commissioned July 9th, 2010



Multiple (4) Vendors – 3 kW

Multiple (7) types of PV array with micro inverter

UH College of Engineering (CoE) Test bed Commissioned December 9th, 2010



Mitsubishi – 3 kW

Amorphous **Silicon** PV array with SMA SB3000
central inverter



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CoE Test bed

Commissioned December 9th, 2010



Kyocera – 5 kW

Polycrystalline **Silicon** PV array with SMA SB5000
central inverter



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UH-Maui College Test bed Commissioned April 11th, 2011



Kyocera – 15 kW

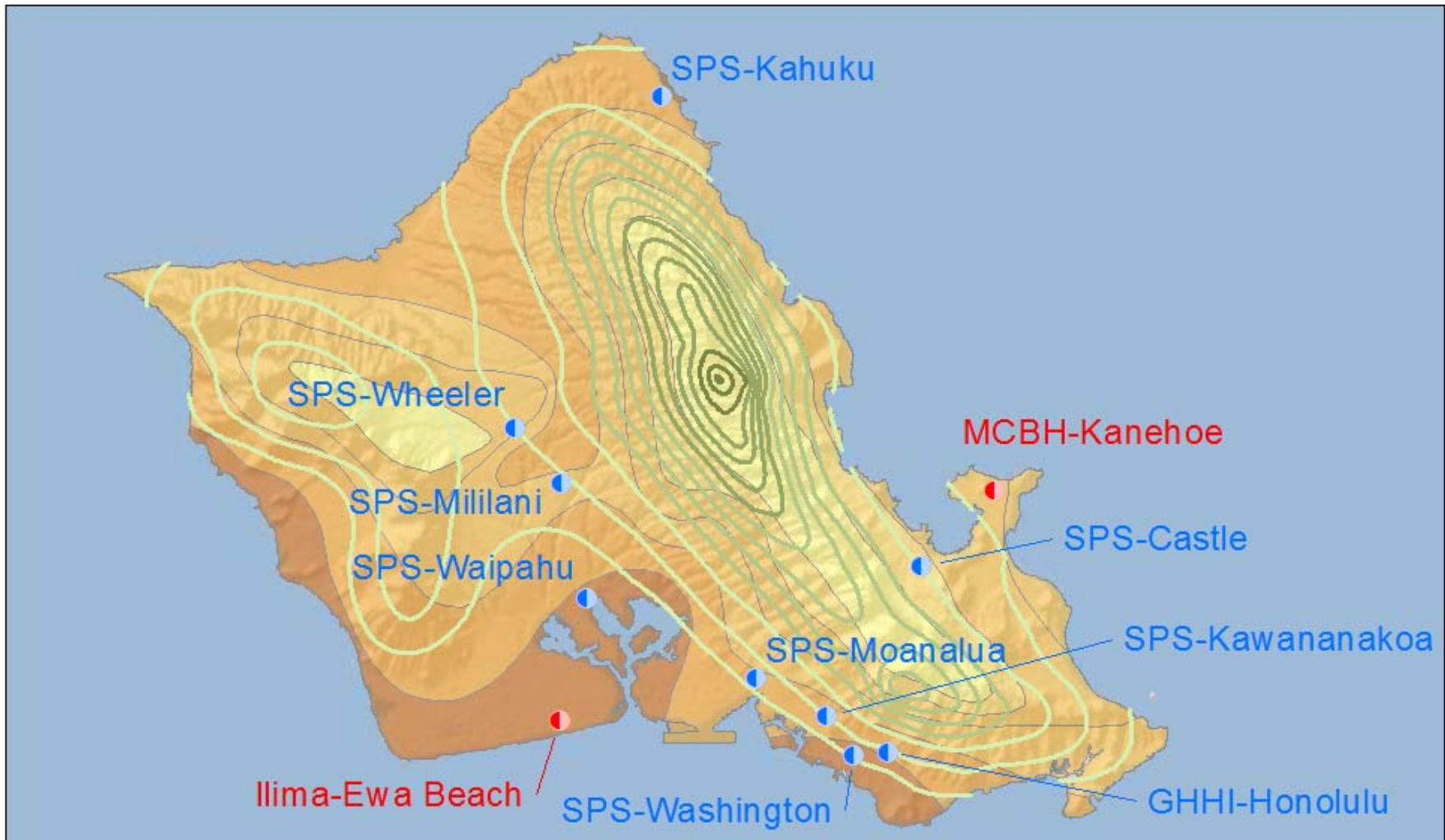
Polycrystalline **Silicon** PV array with 3 SMA SB5000
string inverters



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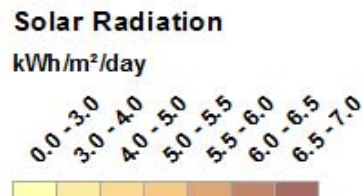
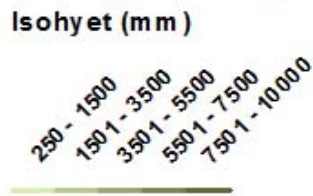
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Average Annual Solar Radiation & Rainfall

Site Locations
 ● Operational
 ● Planned



Oahu
 1:350,000



Author: Jason Balmut
 Date: 11/22/2011

Sources: ESRI Basemaps, Hawai'i Statewide GIS
<http://hawaii.gov/department/gis/data/solrad.txt>
<http://hawaii.gov/geography/hawaii.edu>

Sun Power for Schools (SPS)

- Deployed 1 sample per second DAS systems at the following schools:
 - Wheeler Middle School
 - Castle High School
 - Kahuku Middle / High School
 - Waipahu High School
 - Kawanānakoā Middle School
 - Mililani High School
 - Washington Middle School
 - Moanalua Middle School

Future Installations for 2012

- PV Solar Facility tied to MEDB's facility electrical system
 - 45kW of PV
- PV Panel Testbed System part of MEDB's facility electrical upgrade
 - 15kW of PV
- Micro-grid project for UH-HIMB facility on Coconut island
 - Mix and quantity of renewables and Energy Management System (EMS) to be determined

Data Analysis “Toolbox” – Develop hardware and software tools to enable data collection, secure storage, analysis, and distribution



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Data Acquisition System (DAS)

- On-site “Control” computer to manage controller and I/O modules
 - Module-level Sensor Measurement Units
 - LabVIEW interface for remote operation
- “Host” computer located at UH-HNEI
 - Hosts visualization and Database SW supporting on-site operation
- Database “Server” computer on UH campus
 - Manual uploading process of data to server daily
 - Migrating to fully automated process (2Q12)



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DAS Hardware and Software



NI cRIO-9024

cRio-9022 embedded controller
with NI-9144 Ethernet extension
chassis



NI cRIO-9114



3 x NI 9205

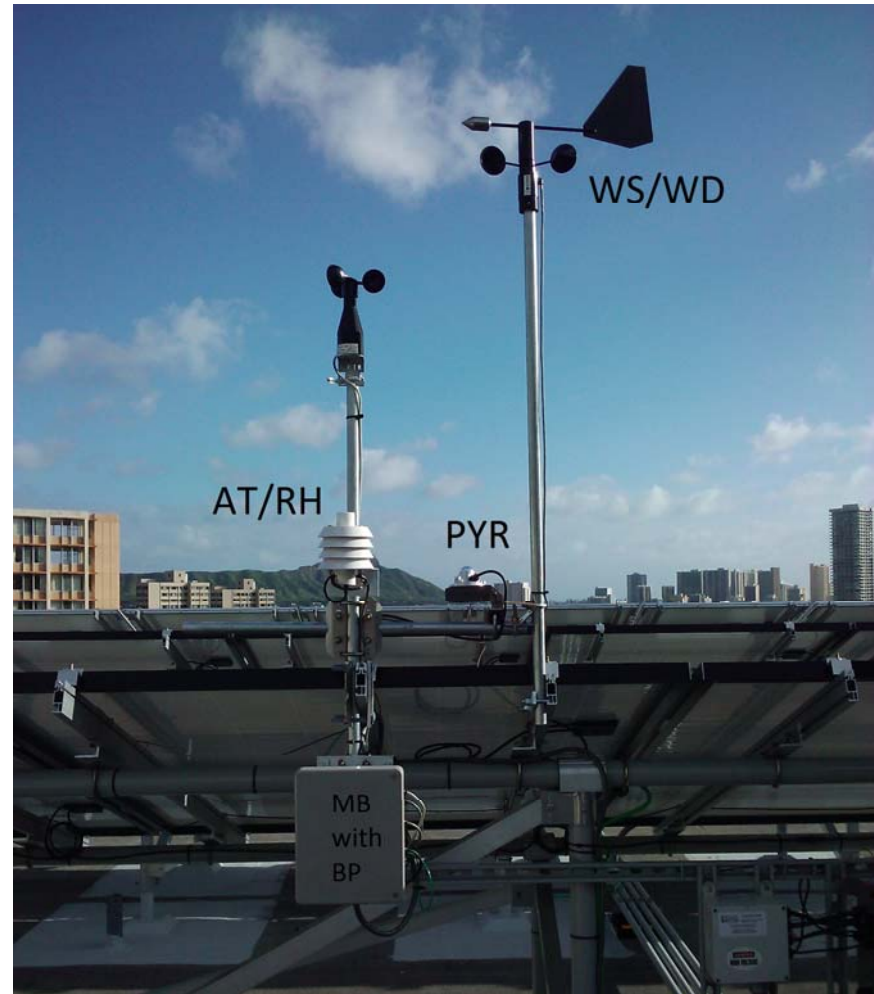
32-Ch ± 200 mV to ± 10 V



~100 Data channels; 1 scan per sec

Weather Station

- Wind Speed (WS)
- Direction (WD)
- Global Solar Radiation (PYR)
- Ambient Temperature (AT)
- Relative Humidity (RH)
- Barometric Pressure (BP)



Grid-connected Battery Projects

- HELCO and Hawi Renewable Development
 - 10.6 MW Wind farm
 - Frequency regulation
 - Wind generation smoothing
- HECO and Waiawa Substation
 - 900 KW distributed PV
 - Power quality management
 - VAR injection
 - LV Tap Changer support
 - Voltage regulation



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Grid-connected Battery Projects



1 MW/250kWhr Grid-scale Battery Energy Storage System (BESS)

Mahalo Nui Loa!



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