Hawaii Natural Energy Institute

Rick Rocheleau, Director

-photo courtesy of NWEI
Select HNEI Research Activities (2013-2014)

- Wave Energy Test Site at MCBH (USDOE, Navy, ONR, BT)
  - $9 million award from Navy to UH announced 7/21/14
  - Navy funded infrastructure; DOE and Navy funding of technology developers
  - HNEI to provide variety of support services (EA assistance, independent data analysis, real time wave forecasting, environmental monitoring, marine support services).

- Programmatic EIS (BT, USDOE)
  - Provide information/guidance to aid in the planning, permitting and addressing of environmental impacts and community concerns
  - Comment period on Draft PEIS ended 7/18/14. Final PEIS will address comments received.

- Integrated hydrogen/transportation systems (USDOE, ONR, BT)
  - Fast-fill high-pressure fueling station opening at MCBH (August 2014)
  - Big Island H2 infrastructure with 3 fuel cell buses (1stQ 2015)

- Energy Efficiency (ONR, USDOE, HIDOEd)
  - Testing of advanced building designs for maximum comfort w minimal energy
  - Analysis of HI DOEd structures to maximize comfort w minimal investment/energy

- Grid-scale Demonstration Programs
  - Demonstration of grid and distribution scale BESS, 2x1MW, 1x2MW, (ONR, USDOE)
  - Smart-grid demonstration programs - integrated demand response (USDOE, ONR)
  - Advanced inverters with smart grid communications - USDOE, BT

- Energy modeling/assessment
  - Assessment of LNG for electricity and transportation (USDOE)
  - Integrated EV charging (Tier 2, DOT Univ Trans Center w UCF)
  - Grid models to quantify impacts of central and distributed renewable generation (BT, USDOE)
Transmission vs. Distribution: Separate but connected challenges

**Generation/Transmission**
- Optimal dispatch of generation resources to minimize production cost
- Total system generation must balance with load (second by second)
  - Intermittency of both central and distributed renewables impacts balance
  - Renewable penetration (wind, solar) reduces dispatchable generation available to balance load changes
- Reserves required for intermittency and contingency events (loss of load/generation, line faults)

**Distribution Circuit/Substation**
- Issues can include reverse flow, over/undervoltage, dynamic response
- Distributed renewables (e.g. PV) impacts both circuit and system
- Circuit issues must be solved at the circuit level
Preliminary/Key Results: Grid Analysis

- Dispatch models show that retirement of old, slow thermal units allows more wind and PV with reduced curtailment –up to 50% of total electricity
- Retirements without availability of fast-response generation decreases system reliability (more outages per year)
  - Additional renewables can also reduce risk somewhat but increases curtailment - where is the optimum?
- High PV penetration of distribution circuits can effect stability at both the circuit and the system level
- Many mitigation strategies can help (smart inverters, storage, demand response, energy efficiency, flexible fast-acting thermal units) but details are important
- Day to day variability of renewable resource limits impact of time of day usage to reduce curtailment