Hawaii Sustainable Energy Project – NREL Support

DOE OE Smart Grid Peer Review

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Hawaii Sustainable Energy Project– NREL

Objective

Provide technical support to Hawaii to reach goal of 70% renewable and energy efficiency

Funding Summary ($K)

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<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
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Technical Scope

Provide technical support to Lanai (MECO and C&C) to help reach goal of 100% renewable energy.

Provide Kauai and KIUC with technical support regarding integration of renewable energy.

Provide technical support for Hawaii in the areas of grid integration of distributed and renewable energy and smart grid applications.
Needs and Challenges

This project addresses the Smart Grid Program Goals to develop technologies to modernize the electric grid, enhance security and reliability of the energy infrastructure, and facilitate recovery from disruptions to energy supply by:

• Integration of renewable energy
• Integration of energy storage
• Integration of combined heat and power – increase system efficiency and reduce peak demand
• Integration of energy efficiency measures

The diversification of supply can help increase system reliability.
Impacts and Benefits

Project Smart Grid value streams

**Capacity** – examining reduction in peak-loads with implementation of CHP and renewable energy

**Power quality & reliability** – examining impact of high levels of PV on electric power system reliability

**Energy efficiency** – examining customer benefit of local voltage regulation to reduce power consumption (Microplanet conservation voltage reduction system installed at C&C laundry site)

**Operational efficiency** – examining the impacts of adding utility control over PV systems and energy storage to island power system operations

**Clean technology** – examining impacts of integrating high levels for renewable energy into the electric power system
Technical Approach

**Project Teams:** This project works with the relevant utilities, system integrators, and owners to implement Hawaii’s renewable energy and energy efficiency goals.

**Lanai**
NREL and Sandia provide support to Lanai partners (MECO and Castle & Cooke) for achieving 100% renewable energy on the Hawaiian island of Lanai.
- FY08-09 conducted scenarios to reach 100% Renewable Energy were developed and modeled in FY08 and FY09.
- FY09, a 1.5MW PV system was brought on line and is operating at 50% capacity. In FY10 a 880kW Combined Heat and Power (CHP) system was installed.
- FY10 – evaluated energy storage options for PV system. Installed new irradiance sensors.

**Kauai**
Working with Sandia and local utility (KIUC)
Needs help with models for integrating high levels of renewables
- FY10 – developing PV models for integration studies
Lanai 100% RE studies

Support was provided for Lanai including evaluation of several renewable scenarios using modeling and simulation.

Additional studies were conducted to determine what renewable options would make the most economic sense and a set of scenarios to achieving 100% renewables were developed.

This graph shows a sample HOMER run. Colored areas show the most economical system. As a function of wind speed (x-axis) and diesel price (y-axis).
Innovation for Our Energy Future

PV reduces fuel usage and generator run time

Scenario 2: Base Case + 30%* PV

Still need Aux generator – could use energy storage or load control

PV reduces fuel usage and generator run time

* 30% of Peak Load not Energy
Scenario 2: Base Case + 90%* PV

PV reduces fuel usage and generator run time.

Still need Aux generator – could use energy storage or load control.

Excess PV must be dumped or stored.

May need Storage for inter-hour ramps.

* 90% of Peak Load not Energy.
Prior-Year Progress & Accomplishments

88% RE Study Summary

- **PV+Battery** can reduce the use of diesel fuel but COE is higher
  - PV can provide 88% of the remaining load with RE with 16 MW and 10 battery modules
  - LCOE at 2.95 x Base Case
- **Concentrating Solar Power+Thermal Storage**
  - Can provide up to 88% of the remaining load with RE
  - LCOE at 1.86 x Base Case
  - CSP = 4MW Generator/ 28MW CSP array
- **Wind+Battery**
  - Wind can provide 88% of the remaining load with RE with 7 (1.5MW) MW wind turbines and 6 (1.2MW) battery modules
  - LCOE = 1.1 x Base Case
- **Getting to 100% RE with Solar or Wind & batteries alone is difficult**
  - Should consider biodiesel generator in the system mix
- **Examining Wind Options and Solar/Wind Hybrid Options**
In FY10, we are examining the impact of the next phase of photovoltaics on the electric power system on Lanai.

Produced updated resource data maps. (see next slide)

Adding additional data collection and monitoring sites for both solar irradiance and power.

Planning on island-wide interconnection study for 500-800kW PV
FY10 Progress & Milestones

Lanai – Solar and Wind

Kauai – Solar and Wind
FY10 Progress & Milestones

Discussing with MECO/HECO on island-wide interconnection requirements study (IRS) to install 500-800kW more distributed PV

Installed new 3sec. Irradiance sensors on Lanai for help with island-wide integration study

- 3sec. Solar sensors
- 1.2MW PV system, 1 sec. solar sensors
- 900kW CHP plant
Variability of four sites significantly reduced from single site.
A new 880kW combined heat and power (CHP) system became operational in FY10. This will integrate distributed generation and renewable energy into the system design on the distribution system to reduce peak power demand on the grid or improve asset utilization.

Figure shows an estimated load duration curve for Lanai demonstrating a 10% peak load reduction that includes both the CHP and battery system.
**FY11 Planned Research**

**Lanai**
- Completing 100% PE Roadmap
- Complete island-wide integration study

**Kauai**
- Completing models for detailed PV integration studies (short circuit, etc.)
Interactions & Collaborations

- Sandia National Laboratories – collaborative support on Lanai projects

- Maui Electric Company (MECO)

- Hawaiian Electric Company (HECO)

- Kauai Island electric Cooperative (KIUC)

- Castle & Cooke

- PV system integrators
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