



*Innovation for Our Energy Future*

# Hawaii Sustainable Energy Project – NREL Support



**DOE OE Smart Grid  
Peer Review**

**Ben Kroposki, PhD, PE**

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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)

FY09	FY10	FY11
300K	300K	300K

## 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.



Older Diesel Engines on Lanai used for Peaking



New CHP system at Manele Bay

# Impacts and Benefits

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## 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 projects works with the relevant utilities, system integrators, and owners to implement Hawaii 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

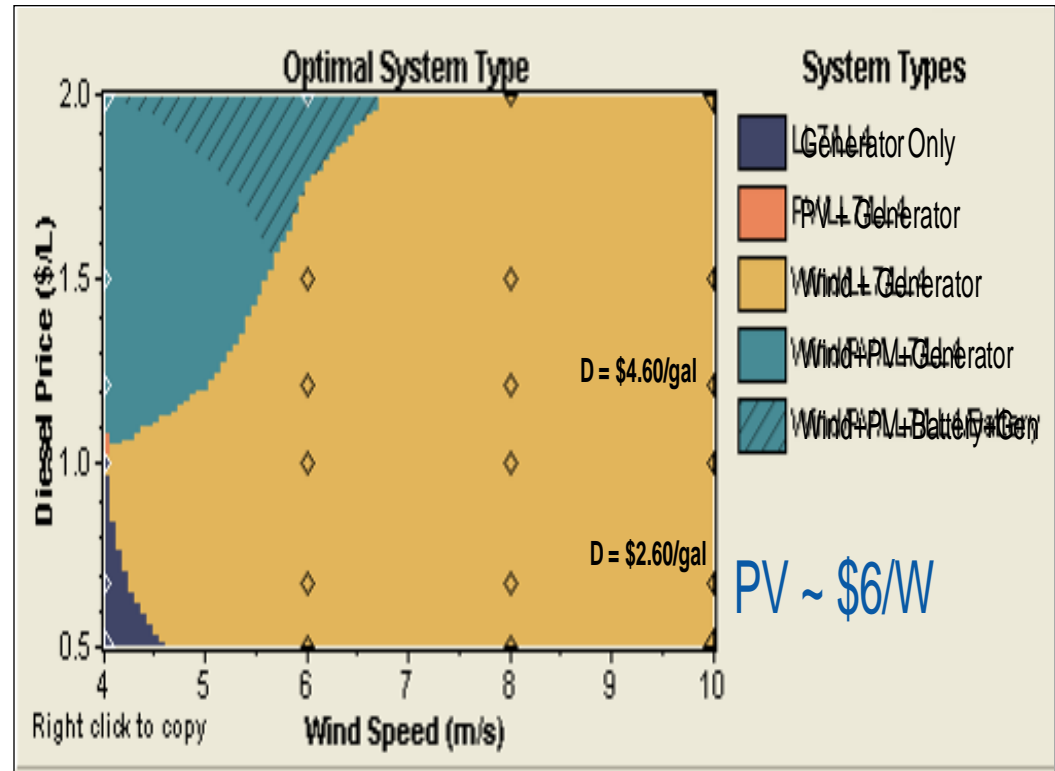
- FY10 – developing PV models for integration studies

# Prior-Year Progress & Accomplishments

## 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.

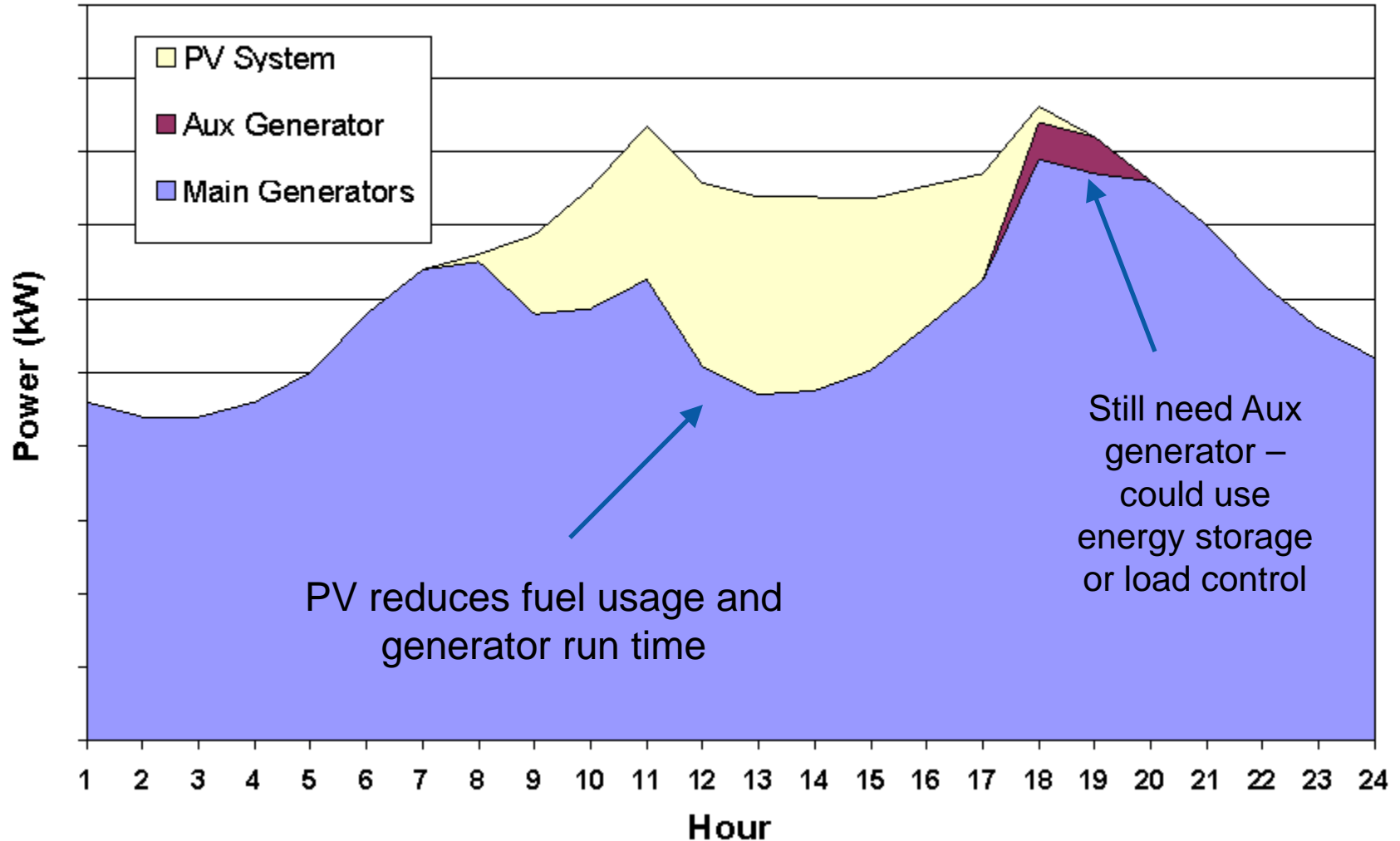


This graph shows a sample HOMER run. Colored areas show the most economical system. As a function of wind speed (x-axis) and diesel price (y-axis)

# Prior-Year Progress & Accomplishments

Scenario 2: Base Case +  
30%\* PV

## Lanai - Generation Profile

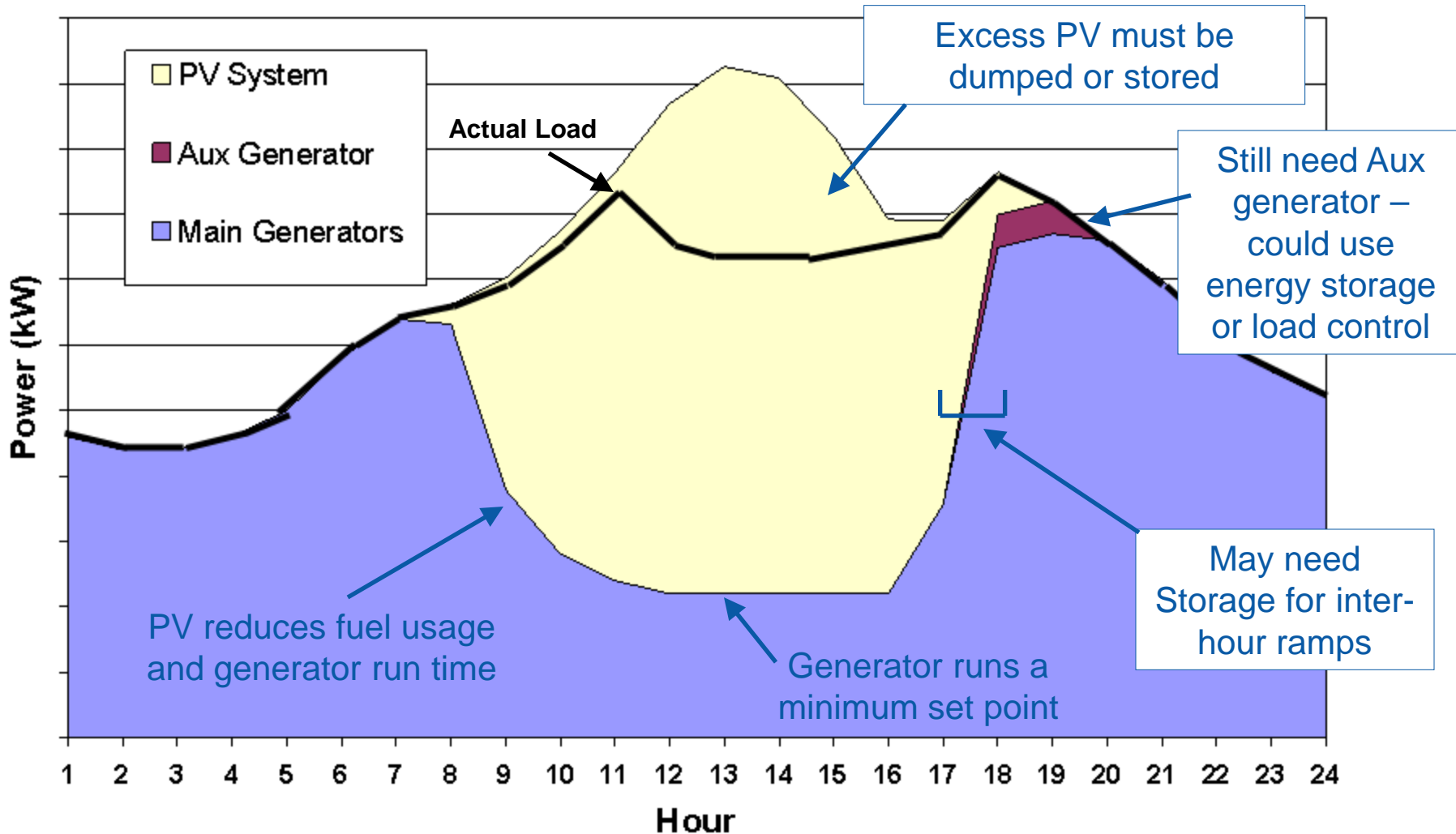


\* 30% of Peak Load not Energy

# Prior-Year Progress & Accomplishments

Scenario 2: Base Case +  
90%\* PV

## Lanai - Generation Profile



\* 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**

# FY10 Progress & Milestones

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.

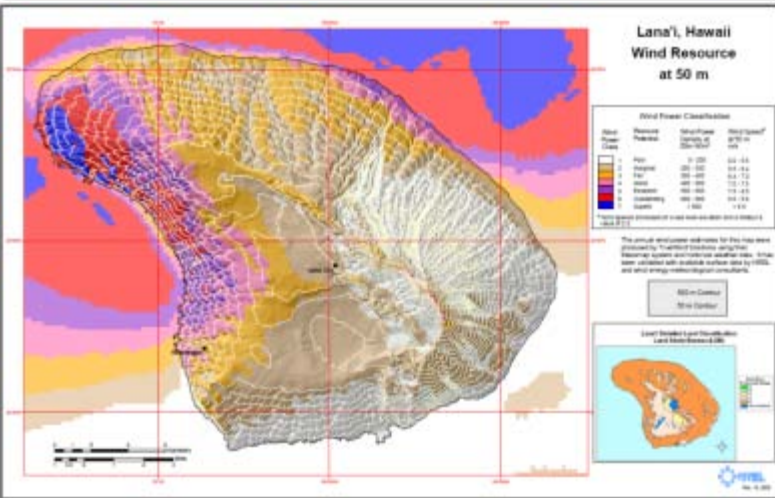
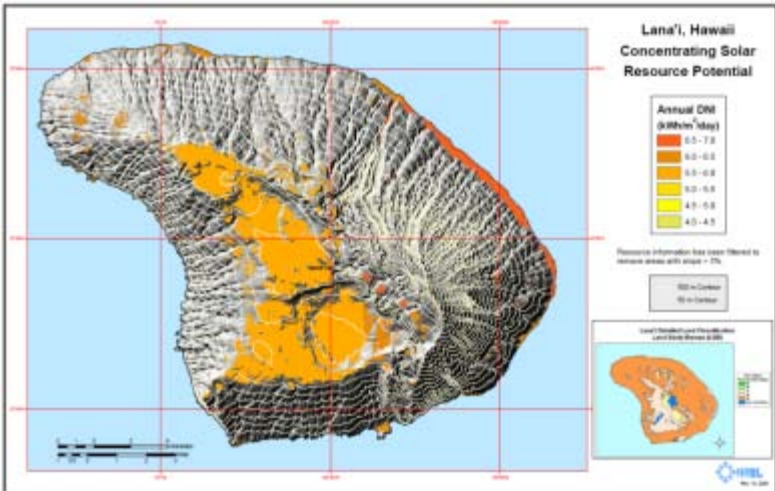
Planning on island-wide interconnection study for 500-800kW PV

Examining possible locations for more PV

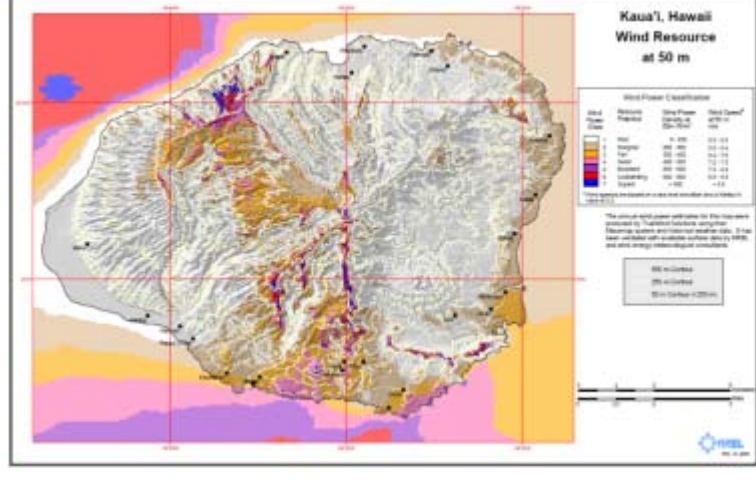
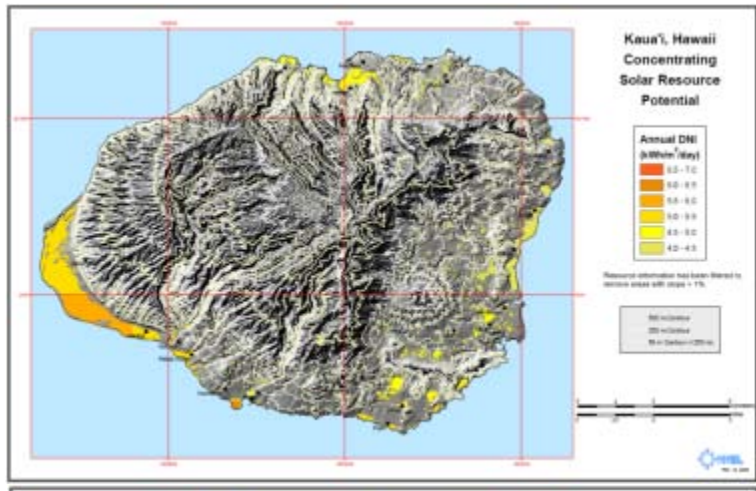


# FY10 Progress & Milestones

## Lanai – Solar and Wind



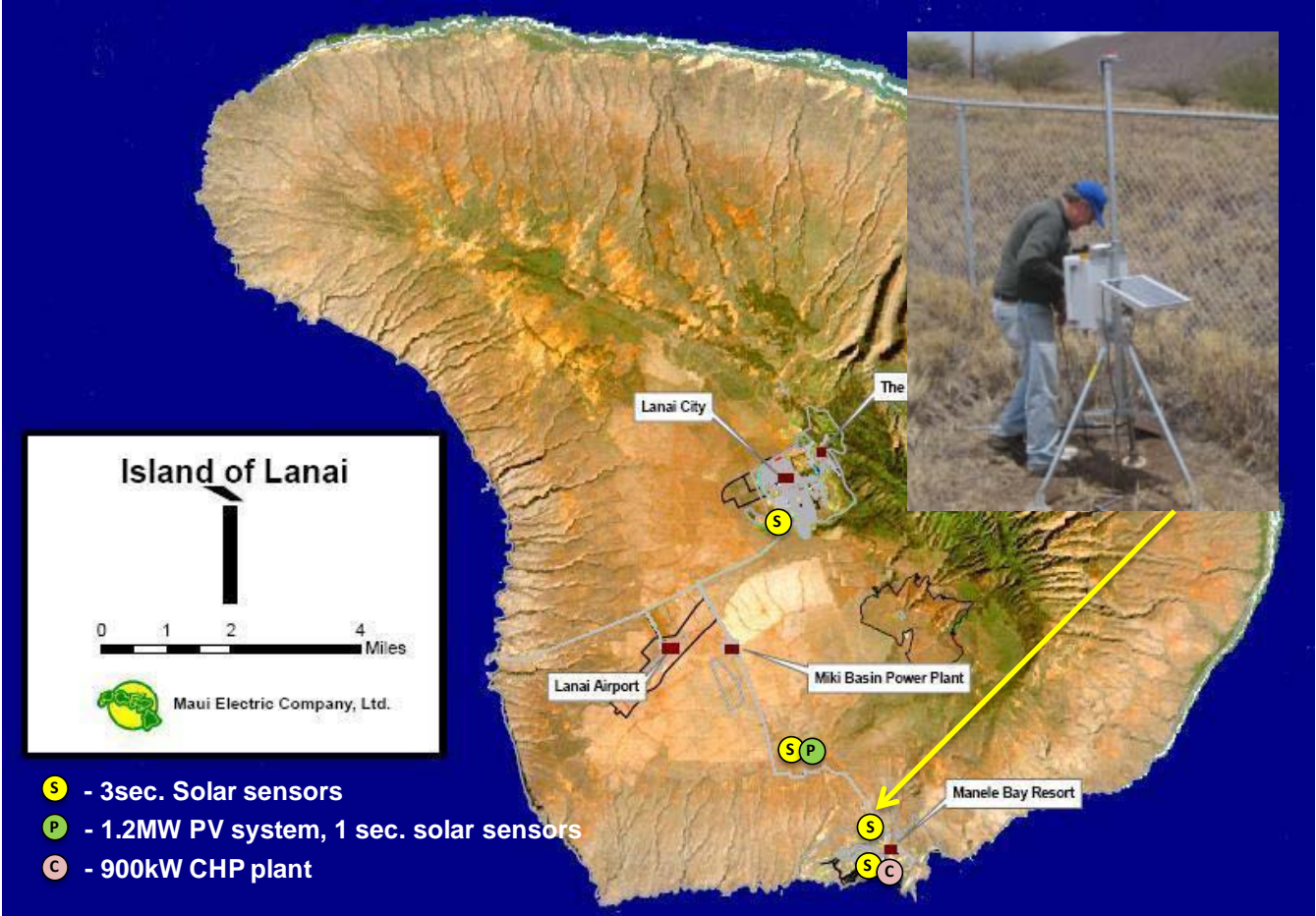
## Kauai – Solar and Wind



# FY10 Progress & Milestones

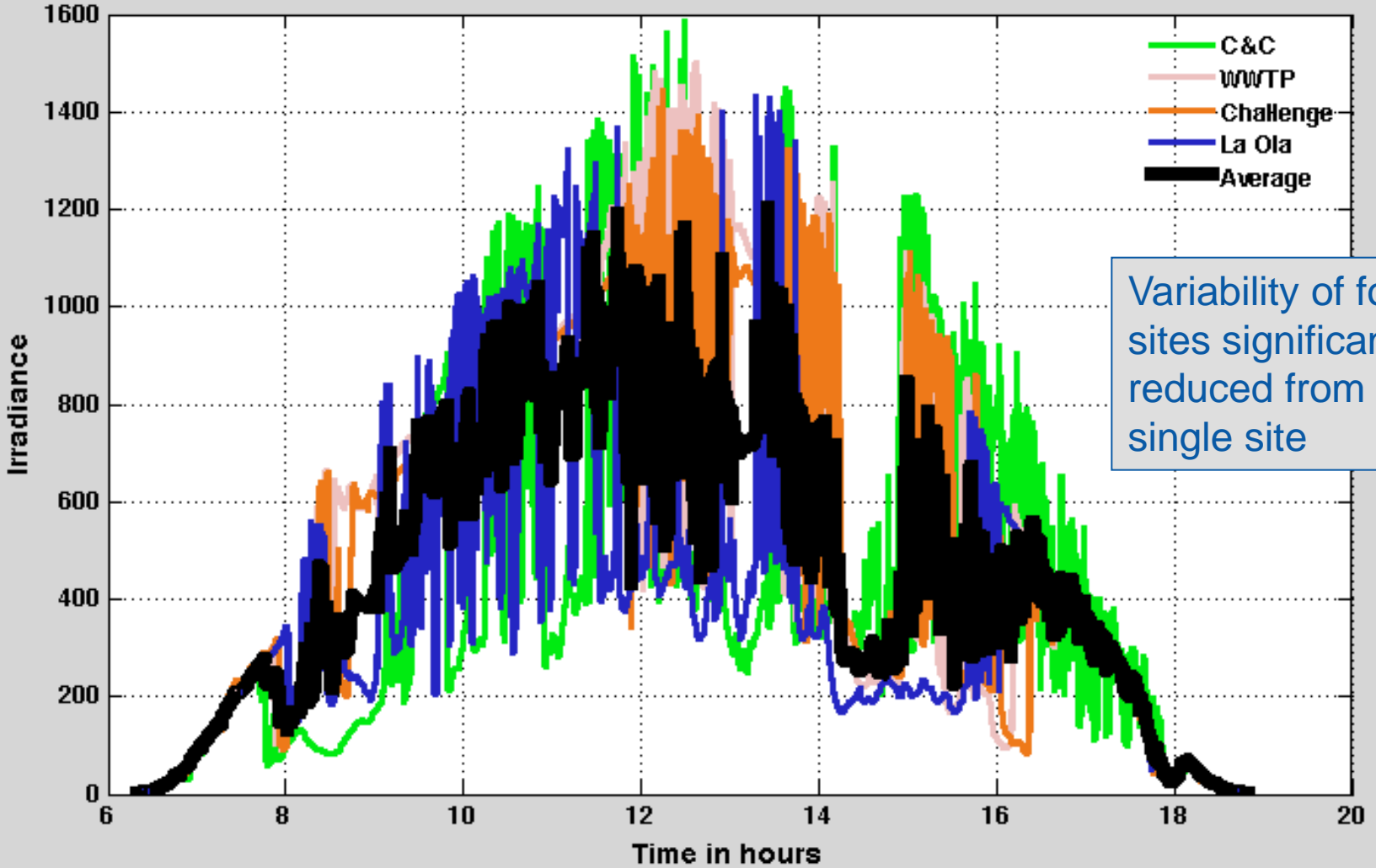
Discussing with MECO/HECO on island-wide interconnection requirements study (IRS) to install 500-800kW more distributed PV

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



# FY10 Progress & Milestones

Irradiance from 4 sensor at Lanai



Variability of four sites significantly reduced from single site

# FY10 Progress & Milestones

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.

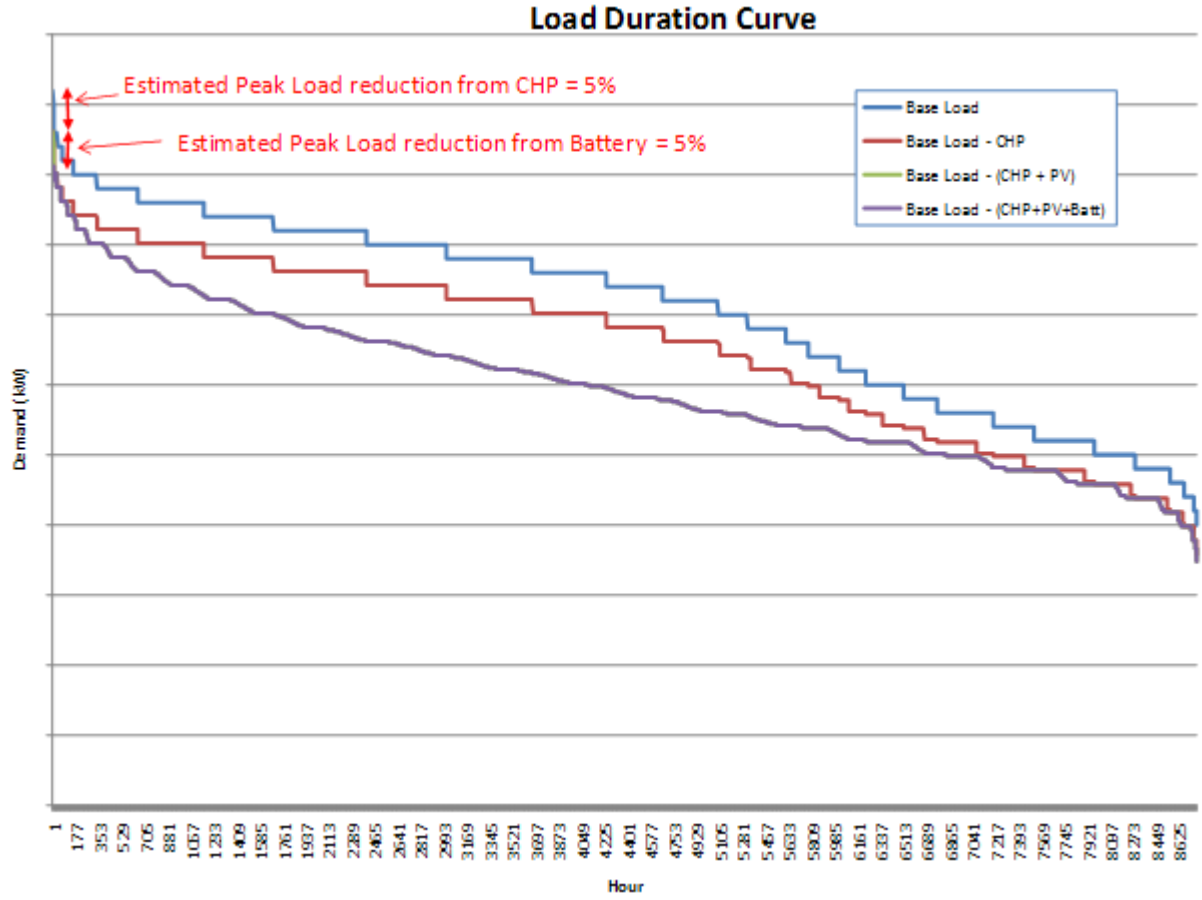


Figure shows an estimated load duration curve for Lanai demonstrating a 10% peak load reduction that includes both the CHP and battery system.

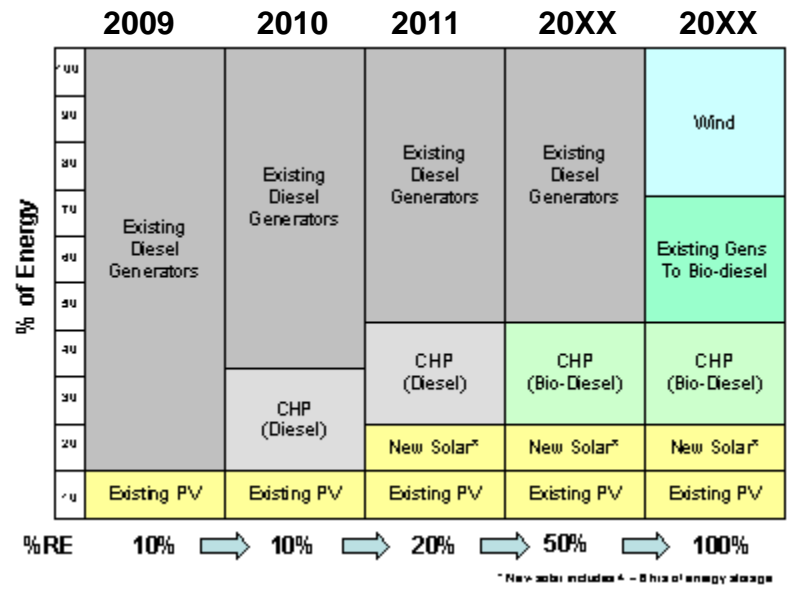
# FY11 Planned Research

## Lanai

Completing 100% PE Roadmap

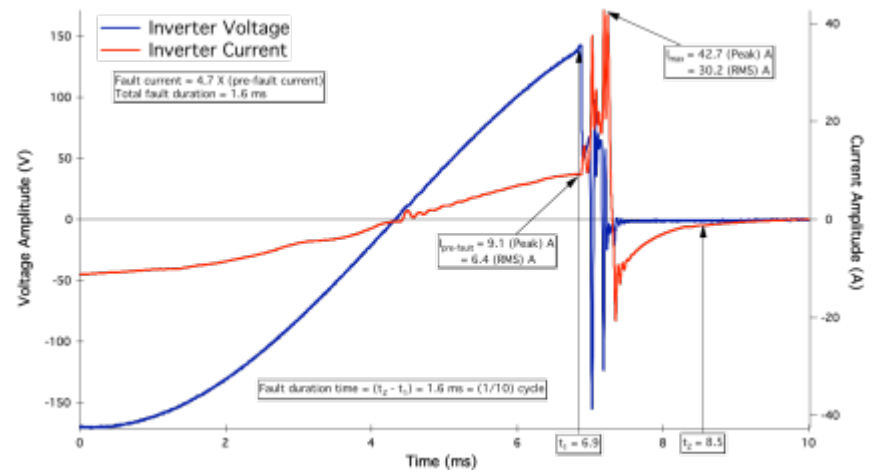
Complete island-wide integration study

## Lanai 100% RE Roadmap - DRAFT



## Kauai

Completing models for detailed PV integration studies (short circuit, etc.)







# Contact Information

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**Principal Investigator:**

Ben Kroposki, PhD, PE

National Renewable Energy Laboratory

Golden, CO 80401

Phone: 303-275-2979

Email: [Benjamin.Kroposki@nrel.gov](mailto:Benjamin.Kroposki@nrel.gov)

