Maui Energy Storage Study: Comparison of Distributed vs. Central Storage Value
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Overview
- Collaborative project with the National Renewable Energy Laboratory (NREL) and Sandia National Laboratory (SNL)
- Maui, Hawaii feeders with significant penetrations of photovoltaic distributed generation
  - PV capacity is 22% of peak load and >100% of daytime minimum load

Questions
- What are the impacts of centralized versus decentralized storage on a heavy-solar distribution feeder?
- What benefits can four-quadrant inverters provide a heavy-solar distribution feeder?

Possible Impacts of Storage on Feeder
- Small, distributed
- Large, centralized
- Individual Storage Size (MWh)
- Reactive Power
- Real Power

Approach
- Construct feeder models for Maui systems of interest
- Simulate feeders using GridLAB-D
  - Centralized vs. distributed storage solution
  - Rapid cloud transients
  - Four-quadrant inverter controls
  - Transmission network influences

GridLAB-D™
- Department of Energy/OE-funded distribution analysis software
- Models substation to end-use loads
- Examines distribution-level impacts and demand-response scenarios
- Utilized in parallel on the Maui Smart Grid Demonstration Project

Accomplishments
- Started in June 2012
- Initial feeder set selected

Feeder models
- Process to extract and populate
- Calibrate against distribution-level SCADA data

Solar models
- Validated against NREL SAM software
- Support for cloud transients

Battery models
- Simple efficiency-based storage models
- Inverter interface and explicit state-of-charge tracking

Next Steps
- Integrate NREL and SNL components into study models (January 2013)
- Provide final report on role of distributed energy storage systems (April 2013)

Measured Solar Irradiance – Many Cloud Transients

Sample GridLAB-D Feeder Power

Sample GridLAB-D Feeder

Information from Maui Smart Grid Project (http://www.mauismartgrid.com)