Maui Energy Storage Study: Comparison of Distributed vs. Central Storage Value

Michael Kintner-Meyer and Frank Tuffner

Pacific Northwest NATIONAL LABORATORY
Proudly Operated by Battelle Since 1965

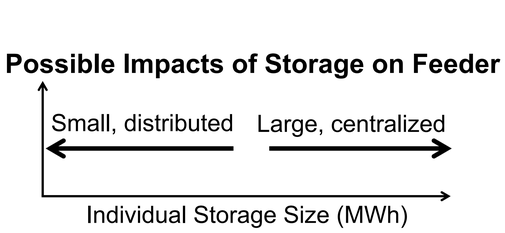
Overview

- 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

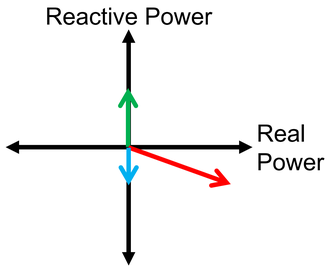
Information from Maui Smart Grid Project (http://www.mauismartgrid.com/)

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?



1. Inverter producing power and maintaining power factor
2. Cloud transient occurs – decreases system voltage
3. Inverter provides reactive power – helps maintain system voltage

Approach

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

GridLAB-D™

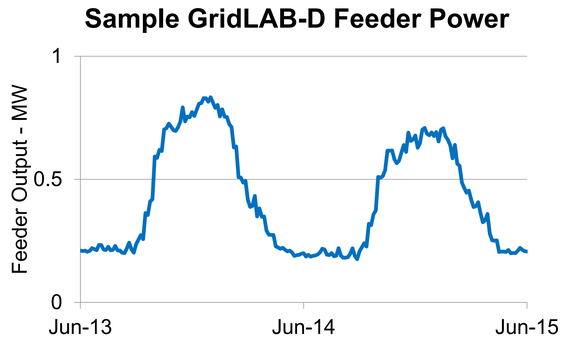
- Department of Energy/OE-funded distribution analysis software
- Models substation to end-use loads
- Examines distribution-level impacts and demand-response scenarios
- Utilized in parallel on the Maui Smart Grid Demonstration Project

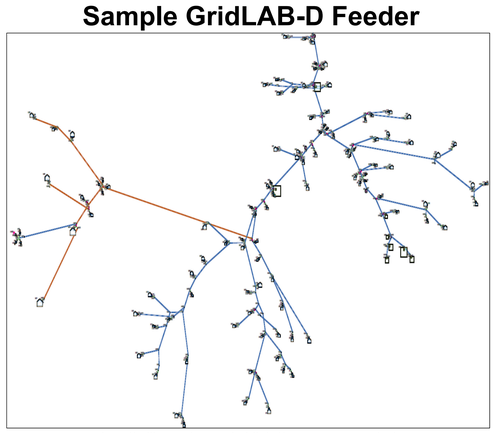
Accomplishments

- Started in June 2012
- Initial feeder set selected

Feeder models

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

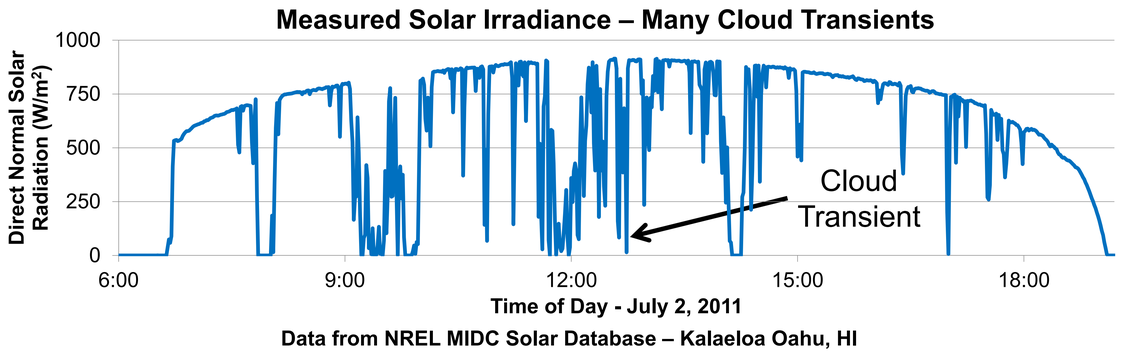




http://rollingturtle.com/gridlabd/taxonomy_graphs/

Solar models

- Validated against NREL SAM software
- Support for cloud transients



Data from NREL MIDC Solar Database – Kalaeloa Oahu, HI

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)

U.S. DEPARTMENT OF ENERGY

For more information, please contact:

Michael Kintner-Meyer
michael.kintner-meyer@pnnl.gov
(509) 375-4306

Frank Tuffner
francis.tuffner@pnnl.gov
(509) 372-6799

PNNL-SA-90806

www.pnnl.gov