

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

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Pacific Northwest
NATIONAL LABORATORY

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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)

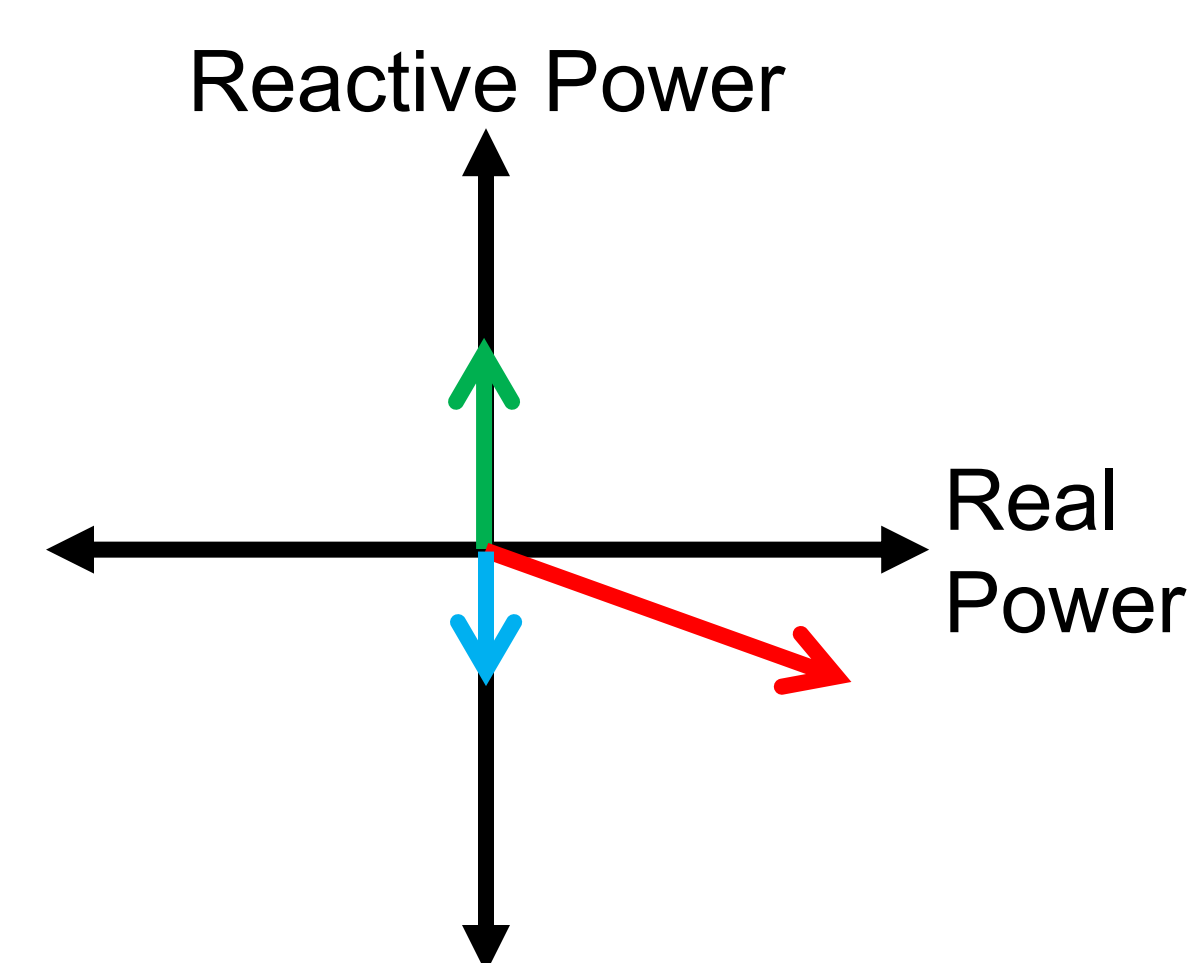
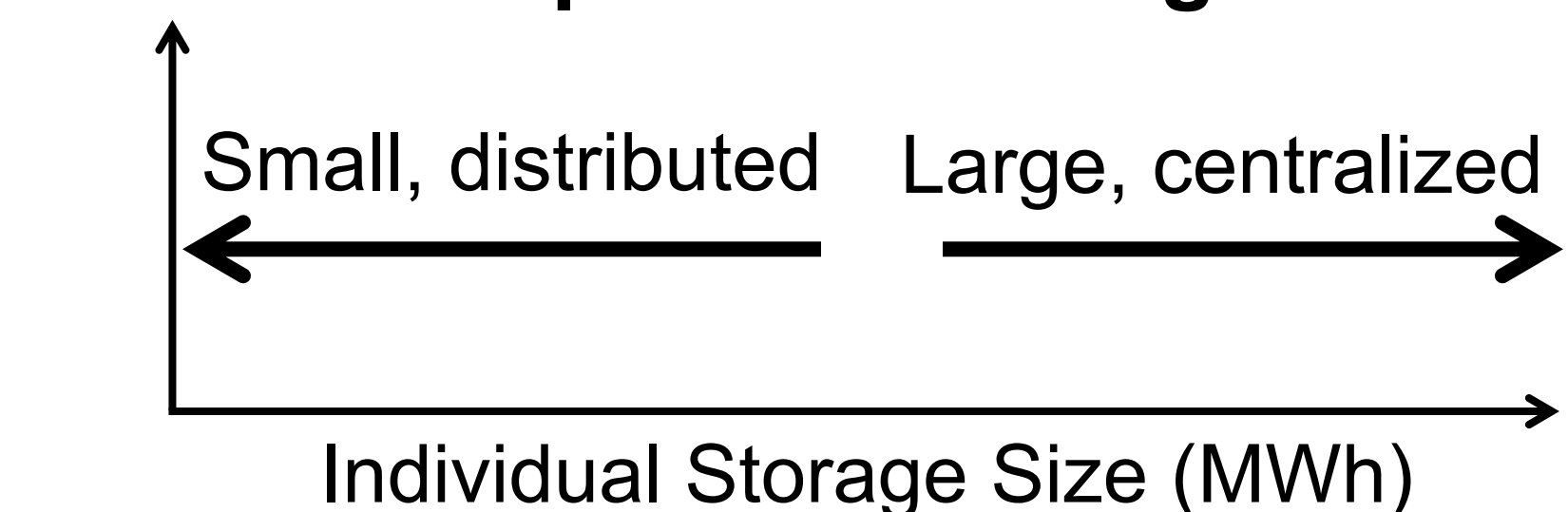


Information from Maui Smart Grid Project (<http://www.mauismartgrid.com/>)

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?

Possible Impacts of Storage on Feeder



- Inverter producing power and maintaining power factor
- Cloud transient occurs – decreases system voltage
- 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

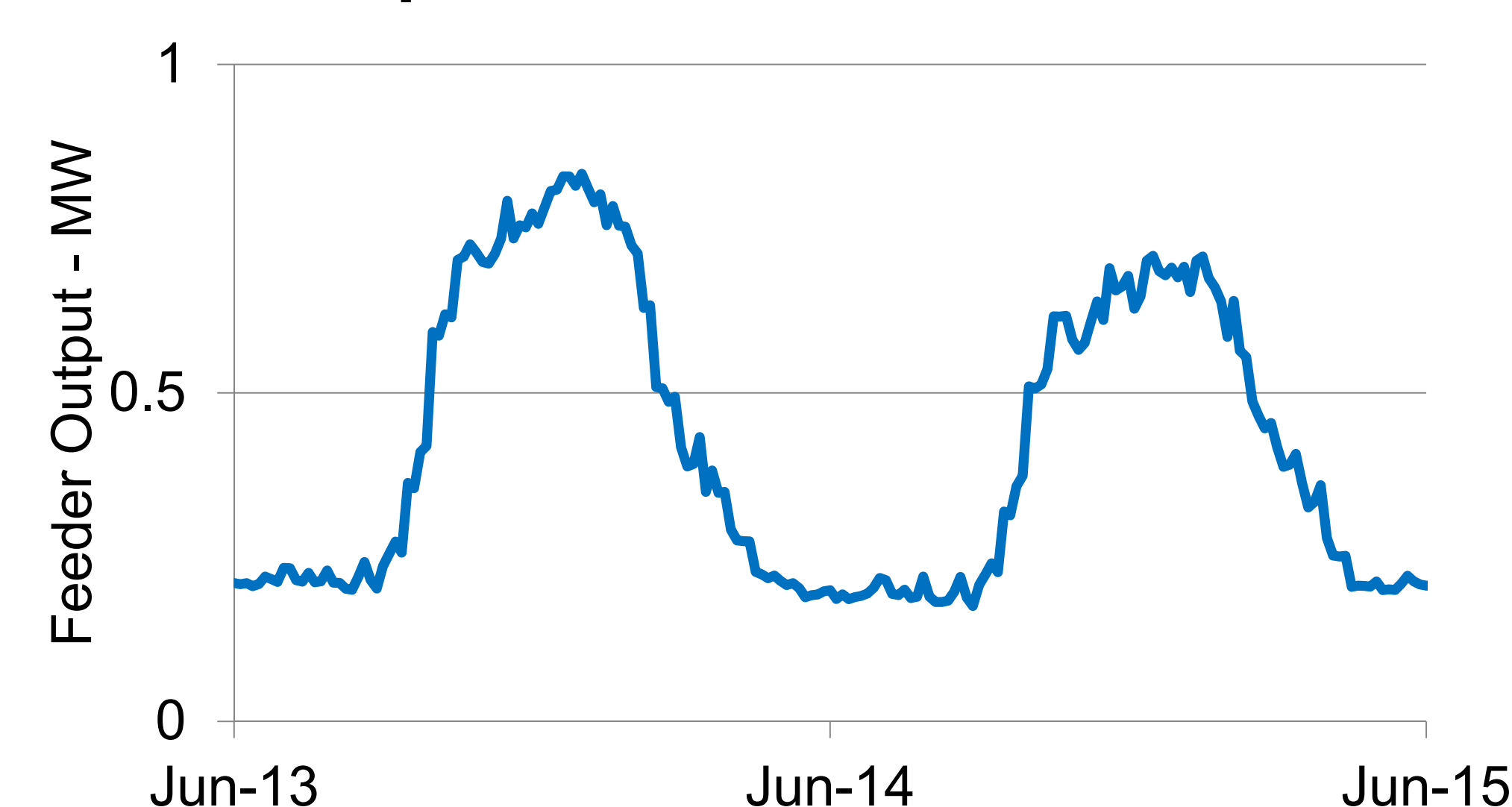
Accomplishments

- Started in June 2012
- Initial feeder set selected

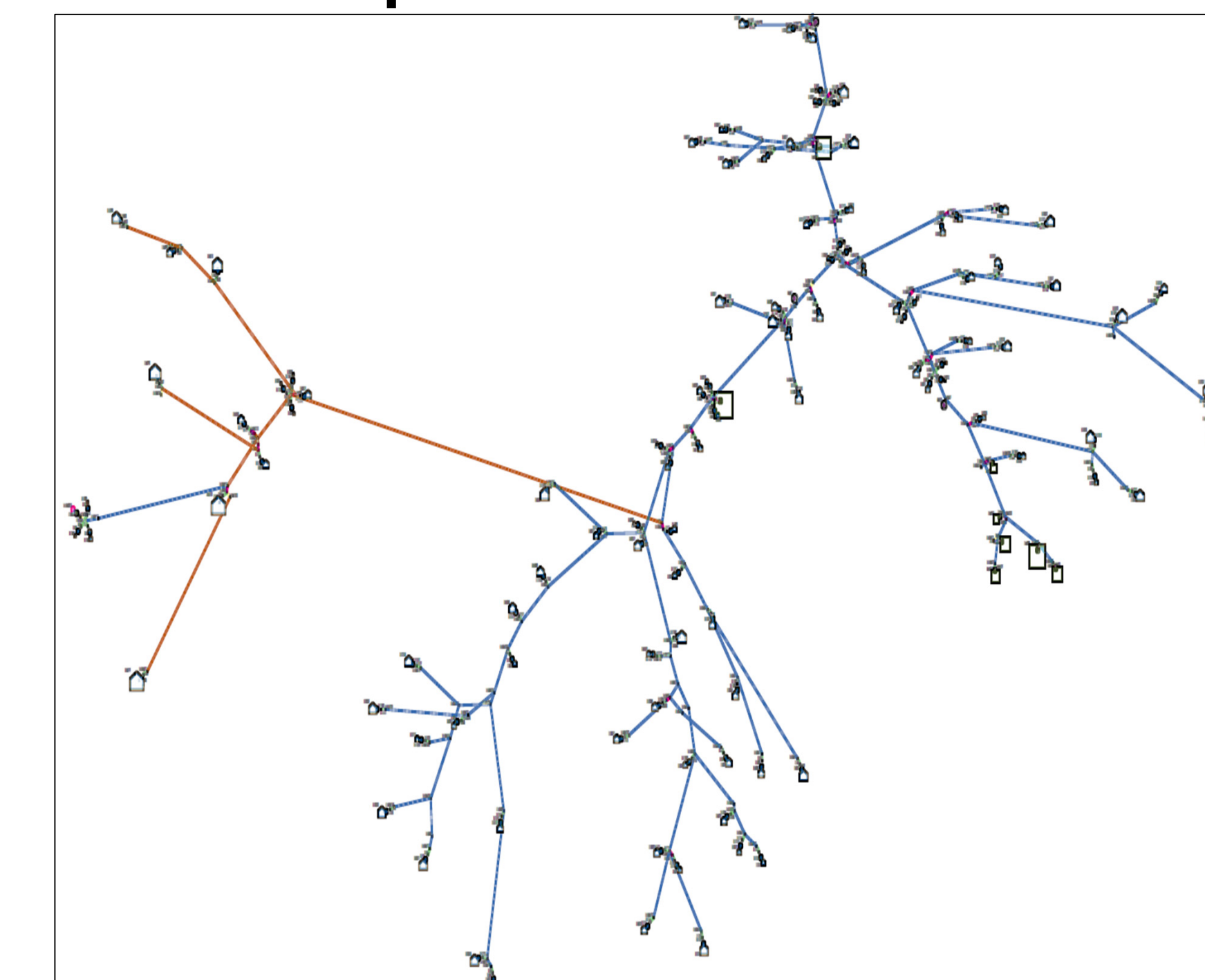
Feeder models

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

Sample GridLAB-D Feeder Power



Sample GridLAB-D Feeder

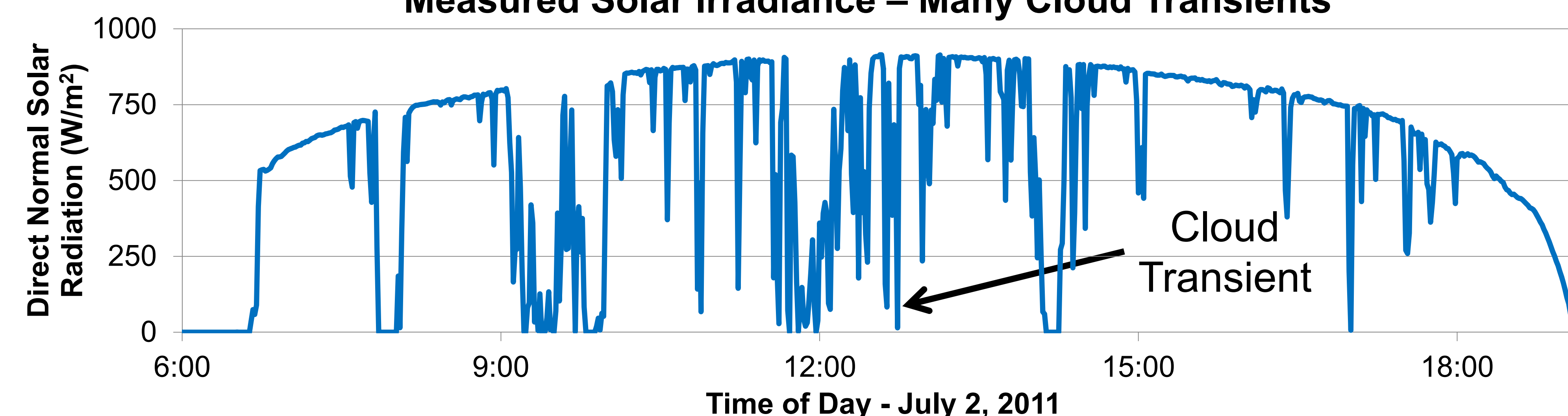


http://rollingturtle.com/gridlabd/taxonomy_graphs/

Solar models

- Validated against NREL SAM software
- Support for cloud transients

Measured Solar Irradiance – Many Cloud Transients



Data from NREL MIDC Solar Database – Kalaheo 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)



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