National Renewable Energy Laboratory
Innovation for Our Energy Future

Quantifying the Value of Dispatchable CSP: Project Plan Overview

Paul Denholm
NREL
Oct 7, 2011

Background

- The value of dispatchable solar energy via concentrating solar power (CSP) with thermal energy storage is not well quantified
- CSP is either nonexistent or poorly represented in utility simulation tools
- Previous studies have been unable to optimally utilize the CSP resource
  - Western Wind and Solar Integration Study (GE MAPS) and CAISO 33% study (PLEXOS) used “block dispatch” of CSP resource
  - Does not capture day-to-day variability of system dispatch requirements
  - Does not allow CSP to respond to variation in net load resulting from wind and solar
  - Does not consider co-optimization with ancillary services

Analytic Goals

- Quantify the benefits of CSP with thermal storage
  - Examine its ability to provide dispatchable energy and ancillary services
  - Examine how the value changes as a function of penetration of other renewables
  - Explore the relative benefits of wind, PV and CSP at various levels of grid penetration

Sources of System Value

- Energy – value of avoided generation including fuel, O&M, emission
  - TES enables shifting energy to times of maximum value.
  - Also avoids costs associated with non-optimal system dispatch (often called integration costs) needed to address variability and uncertainty of the resource
- Operating Reserves – ability to replace operation of part-load generators (may be reflected in energy depending on analytic methods)
  - CSP w/TES can operate at part-load to provide various ancillary services
- Capacity (Planning Reserve) – ability to displace conventional generators (hardware)
  - CSP w/TES has high capacity value

Project Plan

- Create a series of renewable penetration scenarios based on CA 33% RPS Scenarios
- Incorporate these scenarios including dispatchable CSP into PLEXOS
  - Same model used by CAISO
  - Validate CSP operation in test system
- Examine change in system costs and system operation
  - Change in system costs including fuel use associated with energy and ancillary services
  - Emissions
  - Renewable Curtailment
  - Ability of CSP to replace firm capacity
- How these change with various amounts of CSP/TES

Questions?

Paul Denholm

303-384-7488

paul.denholm@nrel.gov