Measuring the Value of CSP in the Power System

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Key Points

• CSP with dispatchable thermal energy storage provides and maintains both operational (fuel and emissions) and capacity (reliability) benefits to regional grids

• This is especially true at high penetrations of variable renewable technologies such as PV and wind

• CSP can support additional generation of variable technologies due to its flexibility relative to inflexible baseload coal generation.
PLEXOS Analysis of Operational and Capacity Benefits of CSP in Southwest Balancing Area

Available at http://www.nrel.gov/publications
CAISO Analysis – Operational Value

Lowest solar multiples (lower annual capacity factors) yield the highest operational system value.
C A I S O  A n a l y s i s – C a p a c i t y  V a l u e

C S P  i n t e g r a t e d  w i t h  t h e r m a l  e n e r g y  s t o r a g e  m a i n t a i n s  h i g h  c a p a c i t y  v a l u e

<table>
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<th>Capacity Credit (%)</th>
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<tr>
<td><strong>CSP-TES</strong> (with &gt; 3 Hrs Storage)</td>
<td><strong>PV</strong></td>
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<td><strong>33% RPS Scenario</strong></td>
<td>92.2%</td>
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<tr>
<td><strong>40% RPS Scenario</strong></td>
<td>96.6%</td>
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NREL 2014

Mills and Wiser 2012
CAISO Analysis – Total Valuation

- Relative value of CSP is $48/MWh greater than PV in the 33% scenario and about $63/MWh greater in the 40% scenario.
Average and marginal curtailment rates of PV in base scenario

≈ 23% marginal curtailment at 20% penetration
Marginal curtailment of solar assuming equal energy mix of PV and CSP

No curtailment at 20% Solar Penetration
Marginal curtailment of solar assuming equal energy mix of PV and CSP and additional grid flexibility

- Low curtailment at 30% solar penetration