The Truth About Concentrating Solar Power:
Affordable, Abundant, Reliable and American-Made

EESI-ACEG Briefing, 22 May 2012
Concentrating solar power

Parabolic trough

Linear fresnel

Power tower

Dish engine

Concentrating PV
Abundant

In America, beam or direct solar energy is greatest in the southwest states – AZ, CA, CO, NM, NV, TX and UT.

This map shows the areas (over 87,000 sq miles) in those states where the land is relatively flat and relatively “empty”.

The generation potential of those areas is six times what the US needs today.

So this energy resource is abundant.
CSP works when needed not only when electricity is generated

- Because the sun’s energy is collected in the form of heat, that heat can be stored efficiently and economically in large tanks, similar to thermos bottles.
- The tanks hold a fluid, called a molten salt.
- In the daytime, heat from the solar field is collected in these large tanks, and at night or during long cloudy periods, the heat is transferred from the tanks to make steam to allow the turbine to continue to run and generate electricity.
- That is now being done on a very large scale by CSP plants.
Generation from a CSP plant with thermal energy storage can be shifted to match the utility system load profile.

**Summer**

Solar Plant With Storage vs. Utility System Load
July

**Winter**

Solar Plant With Storage vs. Utility System Load
January

Key:
- Solar
- Demand
- Generation
## Operating CSP plants in the US

<table>
<thead>
<tr>
<th>Name or location*</th>
<th>Utility</th>
<th>State</th>
<th>Size</th>
<th>Technology</th>
<th>Begin operation</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saguaro</td>
<td>APS</td>
<td>Arizona</td>
<td>1 MW</td>
<td>Parabolic trough</td>
<td>2006</td>
<td>Acciona</td>
</tr>
<tr>
<td>Nevada Solar One</td>
<td>NVEnergy</td>
<td>Nevada</td>
<td>64 MW</td>
<td>Parabolic trough</td>
<td>2007</td>
<td>Acciona</td>
</tr>
<tr>
<td>Kimberlinas power plant</td>
<td>PG&amp;E</td>
<td>California</td>
<td>5 MW</td>
<td>Linear Fresnel</td>
<td>2008</td>
<td>Ausra/AREVA</td>
</tr>
<tr>
<td>Sierra Sun tower</td>
<td>SCE</td>
<td>California</td>
<td>5 MW</td>
<td>Power tower</td>
<td>2009</td>
<td>eSolar</td>
</tr>
<tr>
<td>Keahole Solar demo</td>
<td>HELCO</td>
<td>Hawaii</td>
<td>7 MW</td>
<td>Parabolic trough</td>
<td>2009/2011</td>
<td>Sopogy</td>
</tr>
<tr>
<td>Maricopa Solar demo</td>
<td>SRP</td>
<td>Arizona</td>
<td>1 MW</td>
<td>Dish/engine</td>
<td>2010</td>
<td>SES / Tessera Solar</td>
</tr>
<tr>
<td>Cameo hybrid</td>
<td>Xcel</td>
<td>Colorado</td>
<td>2 MW*</td>
<td>Trough add-on to coal</td>
<td>2010*</td>
<td>Abengoa</td>
</tr>
<tr>
<td>Martin Solar Energy Ctr.</td>
<td>FPL</td>
<td>Florida</td>
<td>75 MW</td>
<td>Trough add-on to IGCC</td>
<td>2010</td>
<td>NextEra Energy</td>
</tr>
</tbody>
</table>

| Operation Total | 512 MW |

*Cameo project completed its testing and is no longer operating
## CSP plants under construction in the US

<table>
<thead>
<tr>
<th>Name</th>
<th>Ivanpah</th>
<th>Genesis</th>
<th>Solana</th>
<th>Crescent Dunes</th>
<th>Mojave</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Utility</strong></td>
<td>SCE + PG&amp;E</td>
<td>PG&amp;E</td>
<td>APS</td>
<td>NVE</td>
<td>PG&amp;E</td>
</tr>
<tr>
<td><strong>State</strong></td>
<td>California</td>
<td>California</td>
<td>Arizona</td>
<td>Nevada</td>
<td>California</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>392 MW</td>
<td>250 MW</td>
<td>280 MW</td>
<td>110 MW</td>
<td>280 MW</td>
</tr>
<tr>
<td><strong>Technology</strong></td>
<td>Power Tower</td>
<td>Trough</td>
<td>Trough</td>
<td>Power Tower</td>
<td>Trough</td>
</tr>
<tr>
<td><strong>COD</strong></td>
<td>2012</td>
<td>2012</td>
<td>2013</td>
<td>2013</td>
<td>2014</td>
</tr>
<tr>
<td><strong>Company</strong></td>
<td>Brightsource</td>
<td>NextEra</td>
<td>Abengoa</td>
<td>SolarReserve</td>
<td>Abengoa</td>
</tr>
</tbody>
</table>

**Total CSP under construction: 1,321 MW**
Artist’s rendering of Solana (3 sq. miles)
Power block May 2012
Components
Mirrors, collector assembly
Perimeter fence/grading, pond
Thermal Storage foundation
Steel tanks
Substation/transmission lines
IT controls
Feed water vessels
Pump motors
Heat Transfer Fluid and pumps
Pressure heaters
Thermal Storage Equipment
Receiver tubes
Ball joint assemblies
Water treatment equipment
Collector foundations
Cooling / condensing system
Night HTF pumps
Hydraulic drives
Piping/insulation

Solana supply chain spans the country
Rio Glass advanced manufacturing of mirrors
America wins

There are numerous benefits from harvesting the sun’s energy with CSP plants:

- **Energy security** – we use our own domestic energy
- **Enhances reliability** – by adding another resource to the generation mix
- **Environmental** – generates electricity free of GHG emissions and other harmful emissions
- **Economic benefits** – creates more jobs per MW than conventional sources and supports economic growth
  - Jobs – 5,200 jobs during construction of these five CSP projects – mainly local jobs
  - 313 jobs to operate and maintain those plants – mainly local jobs
  - Several thousand jobs to manufacture the components for those plants in factories across America
- **American-Made** – Solana is over 70% American-Made while Mojave, our second plant is over 90% American-Made.
Affordable

CSP is abundant, reliable (and dispatchable) and American-Made. But is it affordable?

- Thanks to the federal and state incentives, CSP is affordable today.
- If those policies are continued for about 10 more years (many fewer than what was done to support coal, oil and gas), the cost will come down due to improved performance and the learning curve effect, those incentives will no longer be needed and CSP will be a low cost clean energy option.

Conventional sources of electricity generation started out at very high cost and have achieved cost reduction with economies of scale

- Coal, natural gas, and nuclear have required massive increases in scale in order to achieve current favorable costs

Solar PV and wind, by contrast, are continuing to experience significant improvements in their costs with relatively small increases in scale

- The rapid reductions in clean energy's costs are projected to continue and will bring these technologies to parity in a relatively short time

CSP is even earlier on the learning curve and therefore still requires federal support until adequate scale is reached
As we are talking today about wind power, I claim that we cannot afford not to develop CSP because CSP with TES will back up the intermittent wind and PV, allowing the country to use larger amounts of both.

With continued policy support, the outlook for CSP is very strong and positive and America will have another competitive resource to meet its energy needs.
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**ABENGOA SOLAR**  
and  
Chairman, Utility Scale Power Division, SEIA  

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