http://www.gwpc.org/sites/default/files/event-sessions/Lausten_Mark.pdf

Solar Energy Technologies Program

Concentrating Solar Power Water Needs and Alternative Cooling Method Impacts

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Office of Energy Efficiency and Renewable Energy
Solar Energy Technologies Program (SETP)
Concentrating Solar Power Program Area

Overview

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- Technology
- Water Usages
- Impacts of Alternatives
- CSP Market Projections and State / Regional freshwater consumption impact.

The Value of CSP

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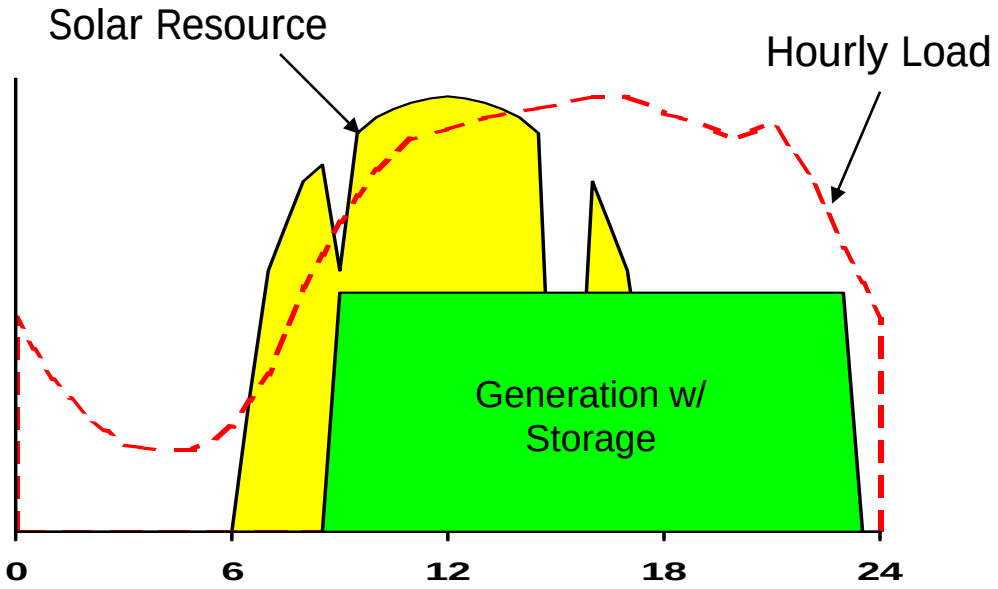
- Dispatchable
- Large scale
- Energy input from CSP is 100% renewable, will not emit GHG
- CSP integrates with grid
- Market ready: 1 GW of CSP in USA in the next three years.
- Renewable Energy Storage that is Low-cost High efficiency



Concentrating Solar Power Technology

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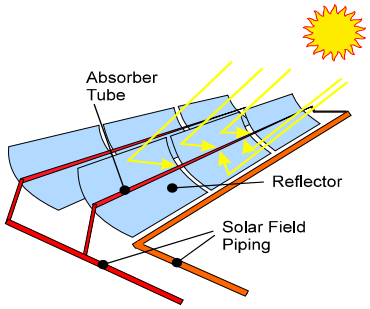
Steam Turbine Generator
Dispatchable, Integrates with Storage

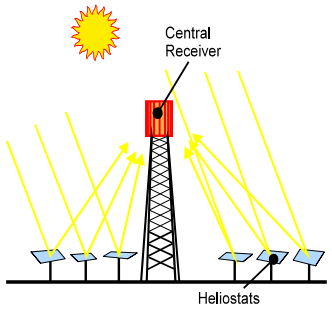
Stirling Engine-Alternator
High Efficiency, no Storage

Trough



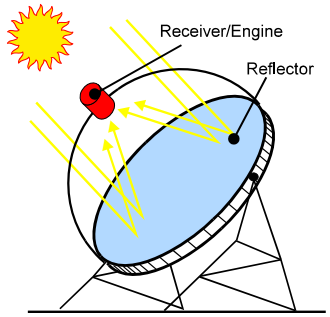
- Most cost effective 250+MW
- 75 suns concentration
- Operating temp: 400C
- Annual efficiency: 14%

Towers



- Most cost effective 250+MW
- 800 suns concentration
- Operating temp: 560C
- Annual efficiency: 18%

Dishes



- Modular 30 kW units
- 3000 suns concentration
- Operating temp: 800C
- Annual efficiency: 23%

CSP Water Requirements

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- Mirror washing
- Hotel Use
- Steam cycle cooling

  Accounts for 90% of water consumption
- Comparison to other traditional power generation technologies:

  850 gal / MWh CSP

  600 gal / MWh Coal

  250 gal / MWh CC Nat gas.

Evaporative cooling - most efficient and cost effective

1400 acre-ft per year for a 250 MW CSP trough power plant

To produce the same amount of energy:

500 acre-ft for combined cycle natural gas plants

1000 acre-ft per year for coal fired power plants

Alternative Cooling Methods – Dry cooling

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90% Less Water

6 % loss in production

20% reduced capacity at hottest hours

10% capital cost increase

1-2 ¢ / kWh increase in cost of power

Thermal Storage:

- Collect peak solar resource
- Produce electricity during cooler hours
- Capacity still reduced during hottest hours

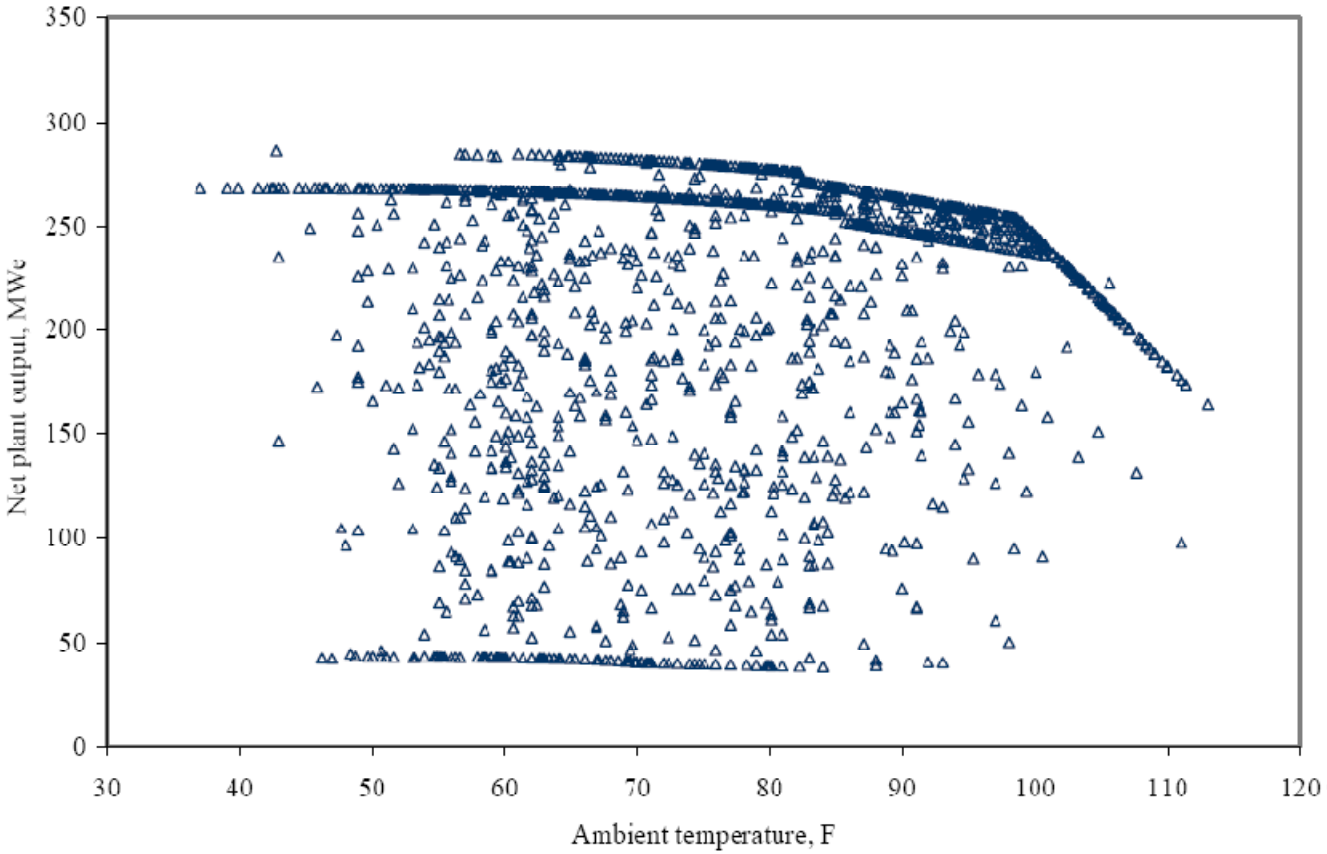

Figure 5 Net Plant Output as a Function of Ambient Temperature; Dry Heat Rejection

Alternative Cooling Methods – Hybrid cooling

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80% Water Reduction
2% loss in productivity

50% Water Reduction
1% loss in productivity

89% Water Reduction
4% loss in productivity

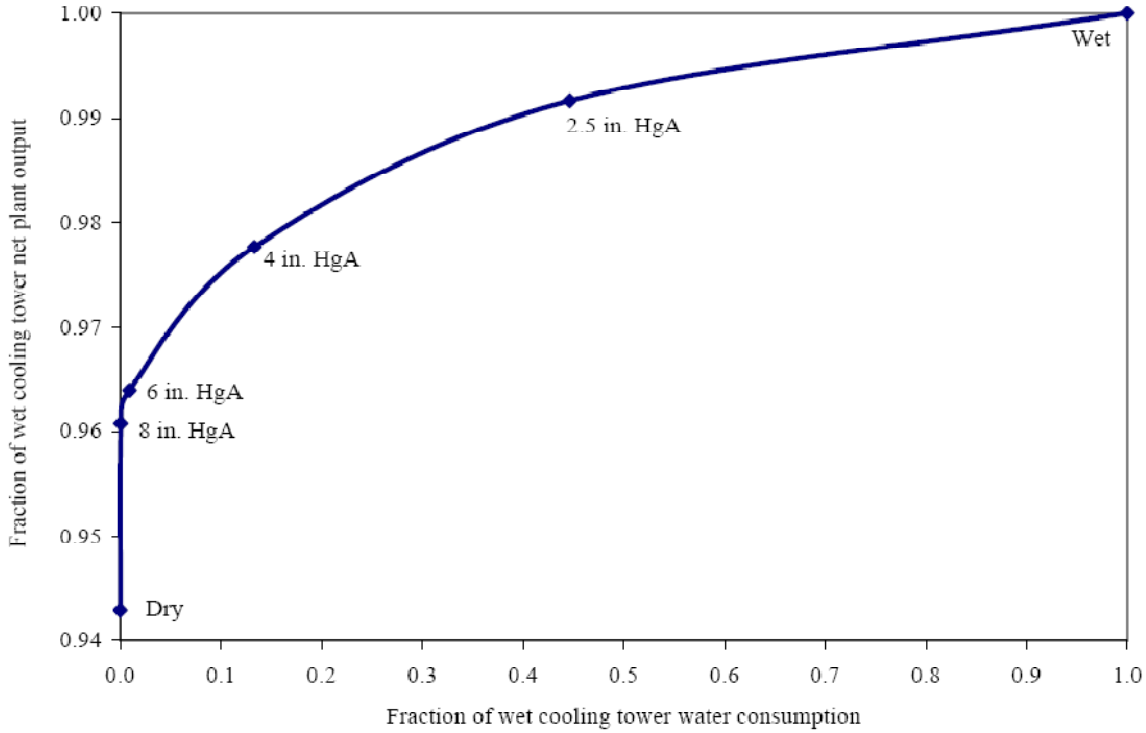


Figure 6 Net Plant Output as a Function of Wet Cooling Tower Water Consumption

Similar economic impact as Dry Cooling

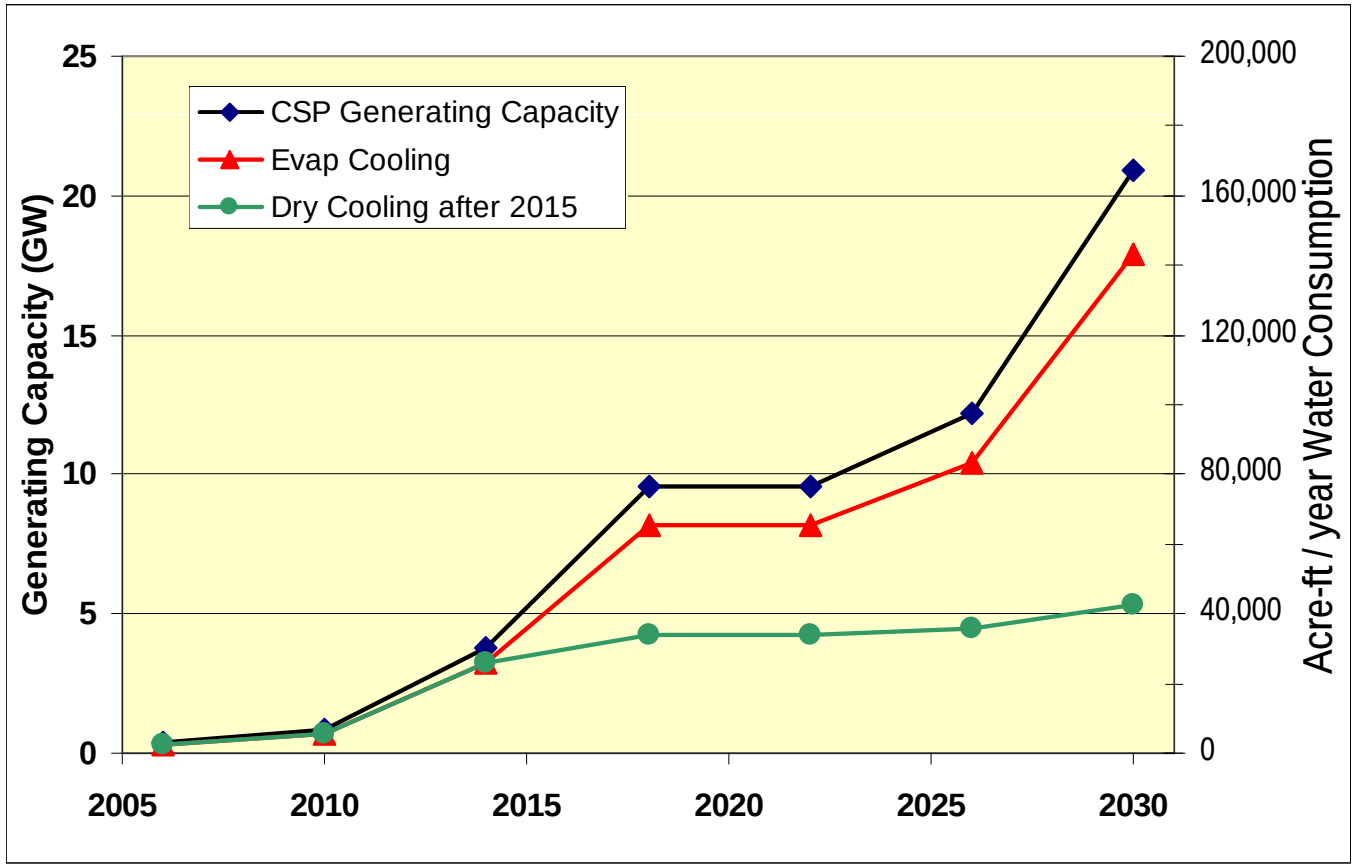
Higher Capacity at Peak Demand Periods

CSP Market Growth

NREL modeling projects limited growth of CSP Market in the next 20 years.

Growth projections based on BLM applications do not consider market forces.

The CSP market will struggle to be a significant contribution to GHG reduction without significant near term growth to establish the industry.



Market Growth – Local Water Impact

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Majority of CSP Growth will likely be in CA and NV
but also TX, AZ, CO and NM

2020 Projected Growth 10 GW CSP nationally

CA 6 GW = 35,000 acre-ft/yr if evaporative cooled

25,000 acre-ft / yr	Traditional fossil generation
3,500 acre-ft / yr	If all dry cooling
4-10,000 acre-ft / yr	If all hybrid cooling

NV 1.5 GW = 9,000 acre-ft / yr
TX 0.8 GW = 5000 acre-ft/yr
AZ 0.8 GW = 5000 acre-ft/yr
NM 0.8 GW = 6000 acre-ft/yr

Thank You

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Further Resources:

www1.eere.energy.gov/solar/pdfs/csp_water_study.pdf

www.solareis.anl.gov

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