Concentrating Solar Power

Overview for CSP PEER Reviewers

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CSP Technologies and Market

- **With Storage**
  - Parabolic trough
  - Power tower
  - Linear Fresnel

- **Without Storage**
  - Dish/Engine

- **Market**
  - Utility-scale power

CSP Goals and Priorities

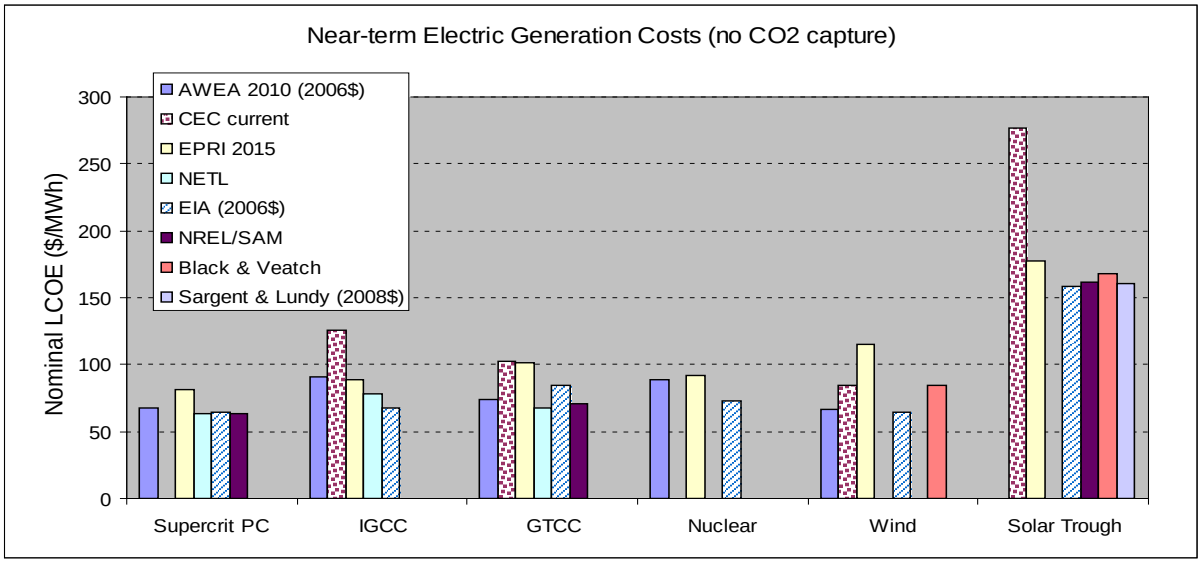
- **Vision:**
  - Inexpensive power generated from CSP technologies is transmitted throughout the country to provide a significant percentage of the country's electrical power, reducing the country's emission of CO^2 while creating millions of jobs.
- **Goals**:
  - Competitive in intermediate power market by 2015
  - Low cost thermal storage supporting the intermediate power market goal.
- **Priorities**:
  - Lower cost through R&D
  - Develop low cost storage options
  - Lower cost by helping reduce barriers to deployment of projects

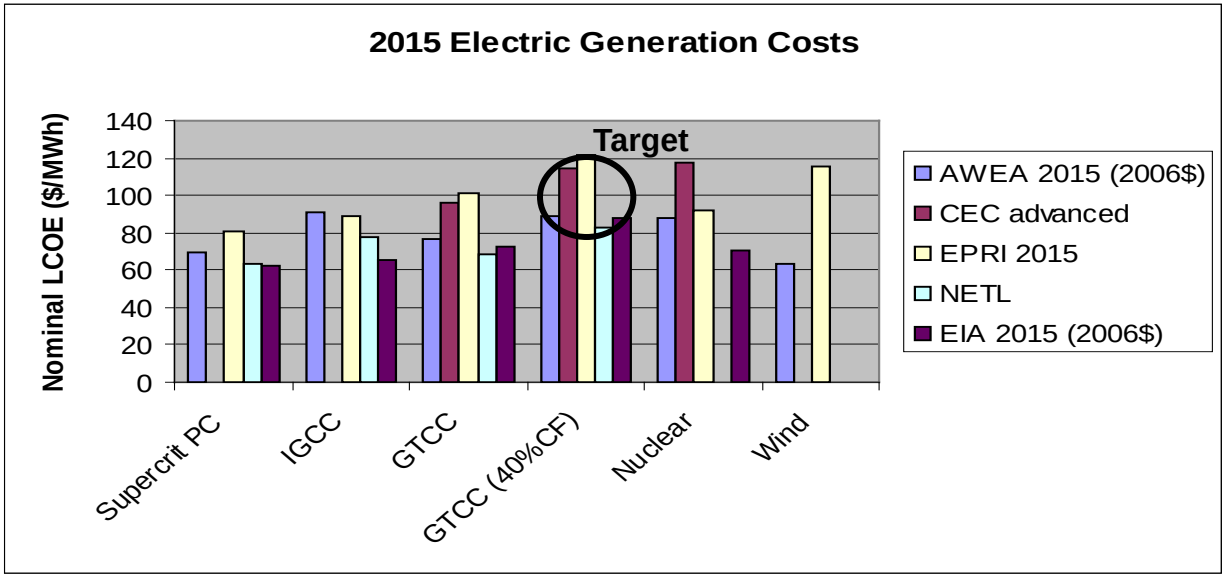
CSP Priorities, Strategies, and Issues

Priority 1 – lower cost of technology through R&D

- Urgency – CSP market (utilities) requires a reduction in cost of CSP power
- Strategy
  - Solicitations released through Golden resulting in cost shared R&D contracts with industry (concept development through demonstration)
  - Lab support to industry; increase staff and upgrade facilities at SNL and NREL
  - Analysis; keep track of goals (moving targets) and cost of technology (also moving with commodity prices), downselect best technology options
- Issues
  - Funding is insufficient to adequately address all CSP options
  - Lab staff must be rebuilt
  - Facilities must be upgraded, new capabilities added if necessary
  - Lack of long-term research activities

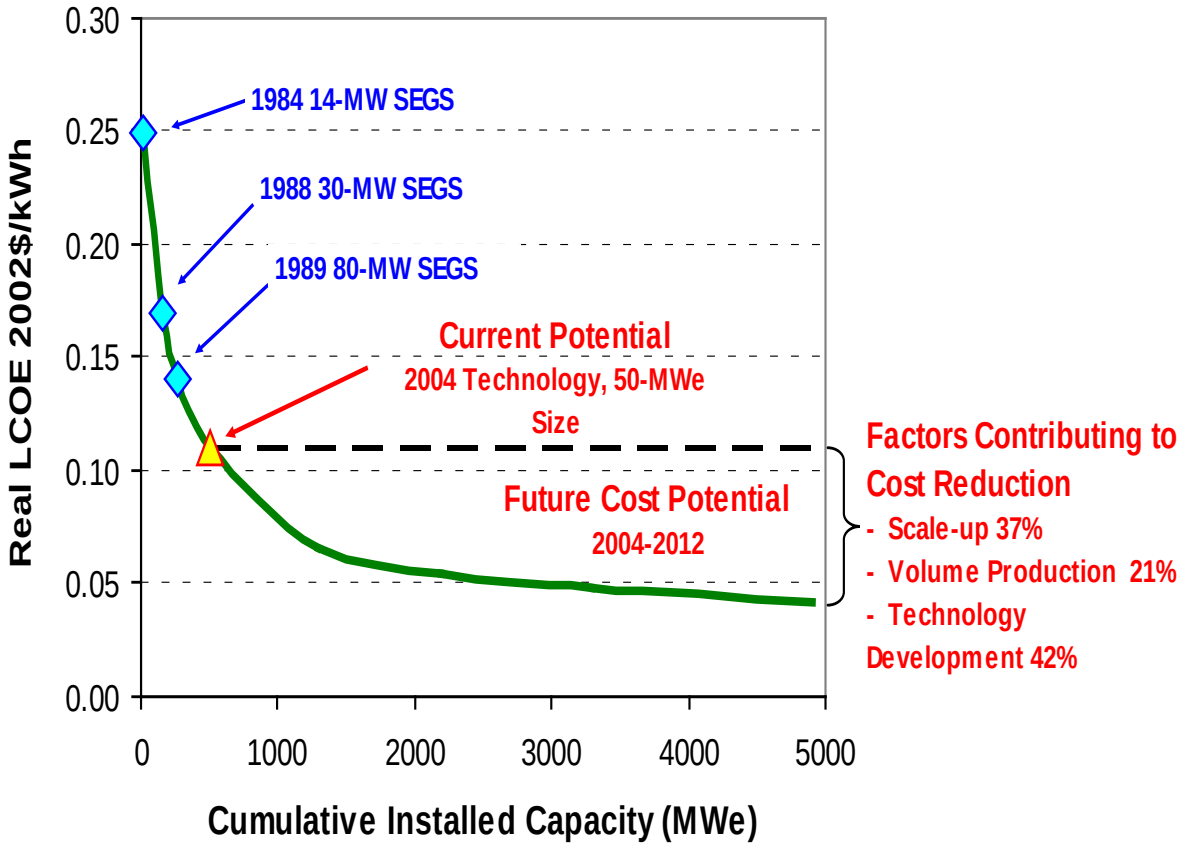
CSP Market Competition





CSP Cost Reduction

- Sargent & Lundy's due-diligence study* evaluated the potential cost reductions of CSP.
- Cost reductions for CSP technology will result from R&D and deployment.



* Sargent and Lundy (2003). Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Impacts. http://www.nrel.gov/docs/fy04osti/34440.pdf

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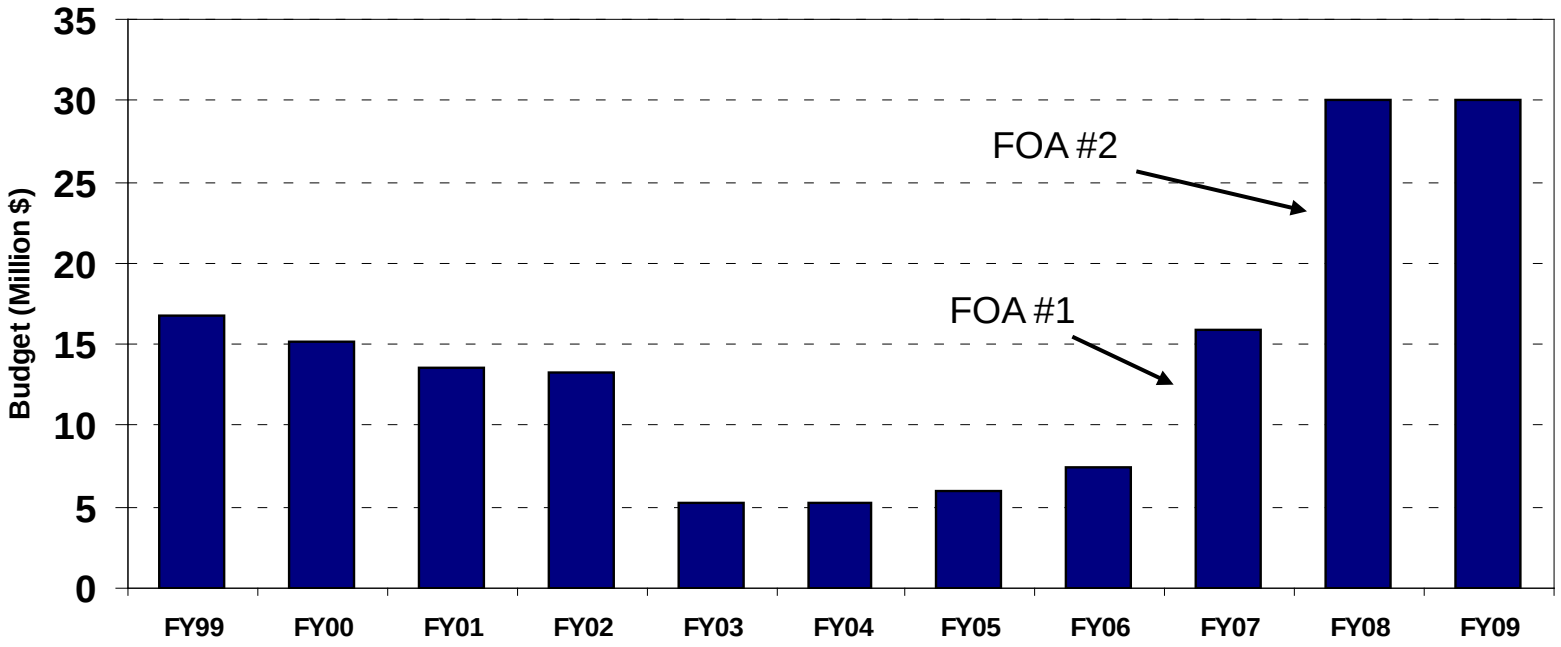
DOE Funding for Concentrating Solar Power



CSP Priorities, Strategies, and Issues

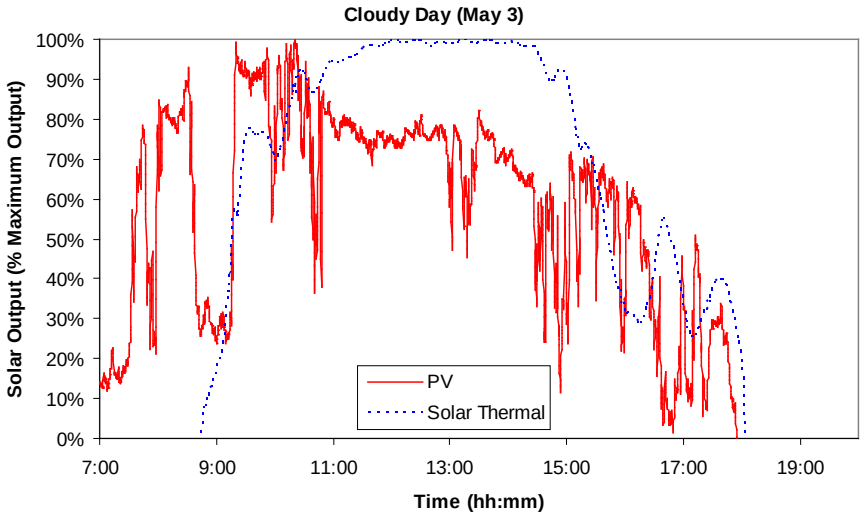
Priority 2 – develop low-cost storage options

- Urgency – storage mitigates solar intermittency, provides stability to grid, and enables dispatchability
- Strategy
  - Build long term plan with industry and lab input
  - Solicitations released through Golden resulting in cost shared R&D contracts with industry (concept development through demonstration)
  - Develop facilities needed to test storage concepts
- Issue
  - Timeliness: new activity requires new lab staff and new facilities – all must come up learning curve fast

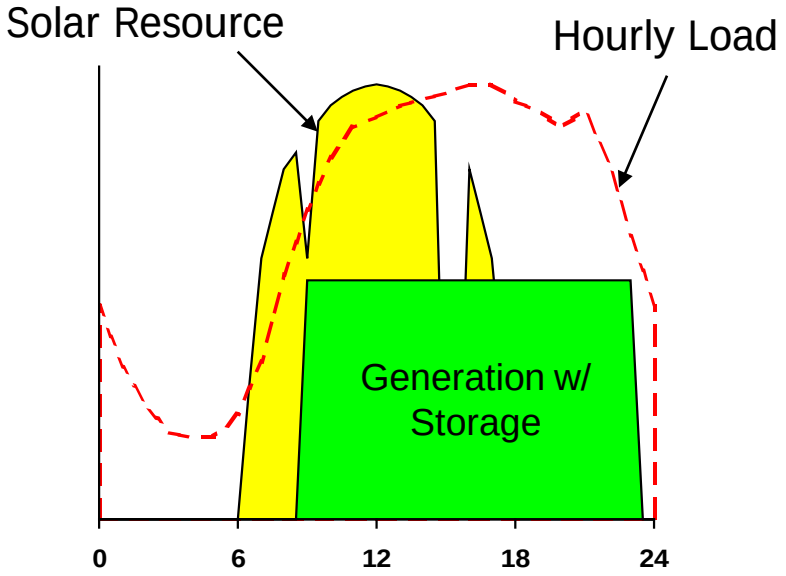
Storage: Meeting Peak Power Demand

Storage provides

- decoupling of energy collection and generation, helping grid stability
- higher value because power production can match utility needs
- additional energy with slightly lower cost
- opportunity to firm PV and wind power



Short term storage from thermal Inertia



Multi-hour storage

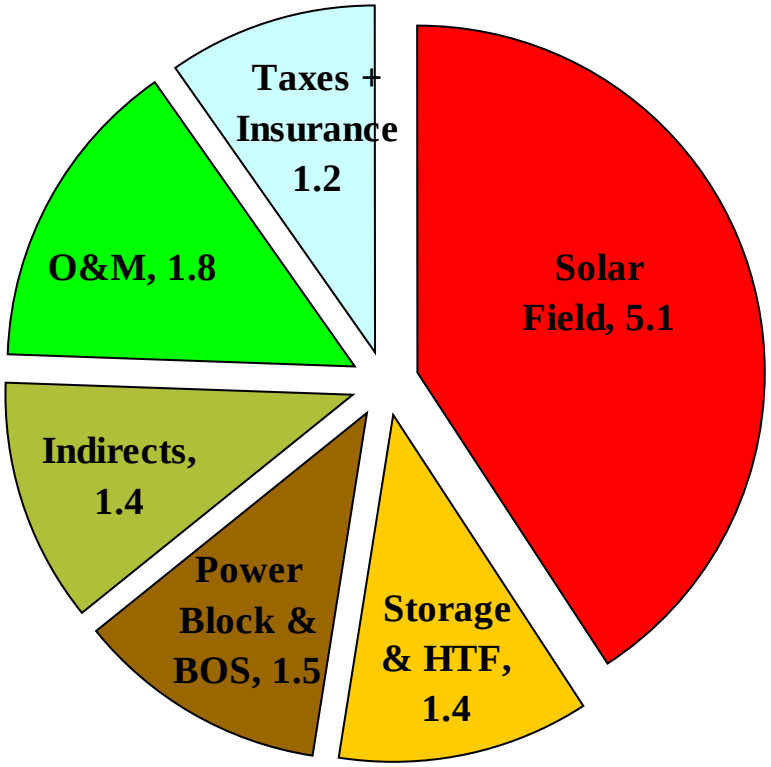
CSP Priorities, Strategies, and Issues

Priority 3 – lower cost by helping reduce barriers to the deployment of projects

- Urgency – cost reduction requires plants being built, operating plants need to demonstrate the viability of the technology
- Strategy
  - Complete the programmatic environmental impact statement (PEIS) with BLM to make access to public land easier
  - Work with the Western Governors' Association and Western States to get support for land designated suitable for solar projects and their access to transmission
  - Provide resource assessment analysis to industry
- Issue
  - DOE can influence, but does not have direct control over deployment of projects

Addressing Cost Barrier

Baseline 100 MWe trough system
with 6 hours thermal storage
40% capacity factor
12.4 ¢/kWh



R&D is targeting technical obstacles in CSP systems to improve performance and reduce costs

Line Focus

- Optimize receiver and concentrator designs for higher temps, increase component suppliers, evaluate new heat transfer fluids, and create advanced evaluation capabilities.

Point Focus

- Improve engine reliability and system manufacturability, and develop next-generation dish system designs. Test new tower receiver panel and explore low cost heliostat options.

Storage

- Develop advanced heat transfer fluids for more efficient operation at high temperatures, and test innovative designs for low-cost storage using sensible and latent heat options .

CSP R&D Contracts

- **CSP FOA* (Nov 2007):** 12 awards
  - Storage (2)
  - Troughs (5)
  - Dishes (2)
  - Linear Fresnel (2)
  - Tower (1)

- **Storage/HeatTransferFluid FOA (Sep 2008):** 15 awards
  - Storage (14)
    - Molten salt
    - Thermocline
    - Phase change materials
    - Thermochemical
  - Heat transfer fluids (1)

FOA – Funding Opportunity Announcement

DOE is also targeting barriers to CSP deployment

Land Access

- Co-leading with the Bureau of Land Management a programmatic environmental impact statement to make suitable federal land available for solar project development.

Transmission Access

- Working with DOE's Office of Electricity, Western Governors' Association, and States to identify best location for transmission corridors.

Resource Assessment

- Improving satellite data, obtaining ground data from additional sites, forecasting .

DOE & BLM: identifying land for CSP deployment

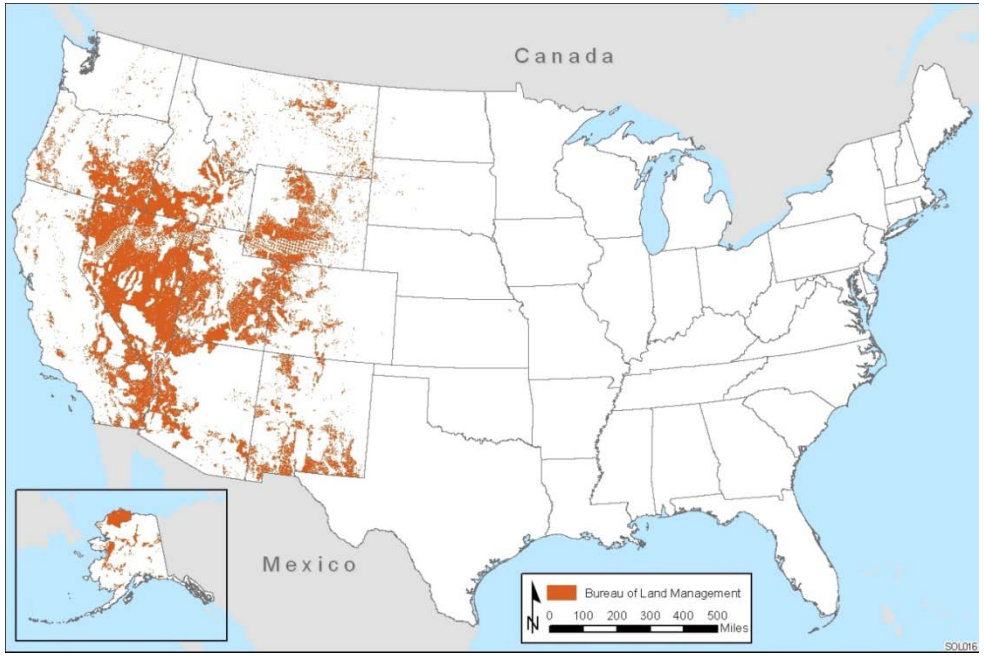
Approach: a programmatic environmental impact statement (PEIS)

- BLM manages 119 million acres in the 6 Southwestern states where the solar resource is most intense (CA, NV, NM, AZ, CO, and UT)

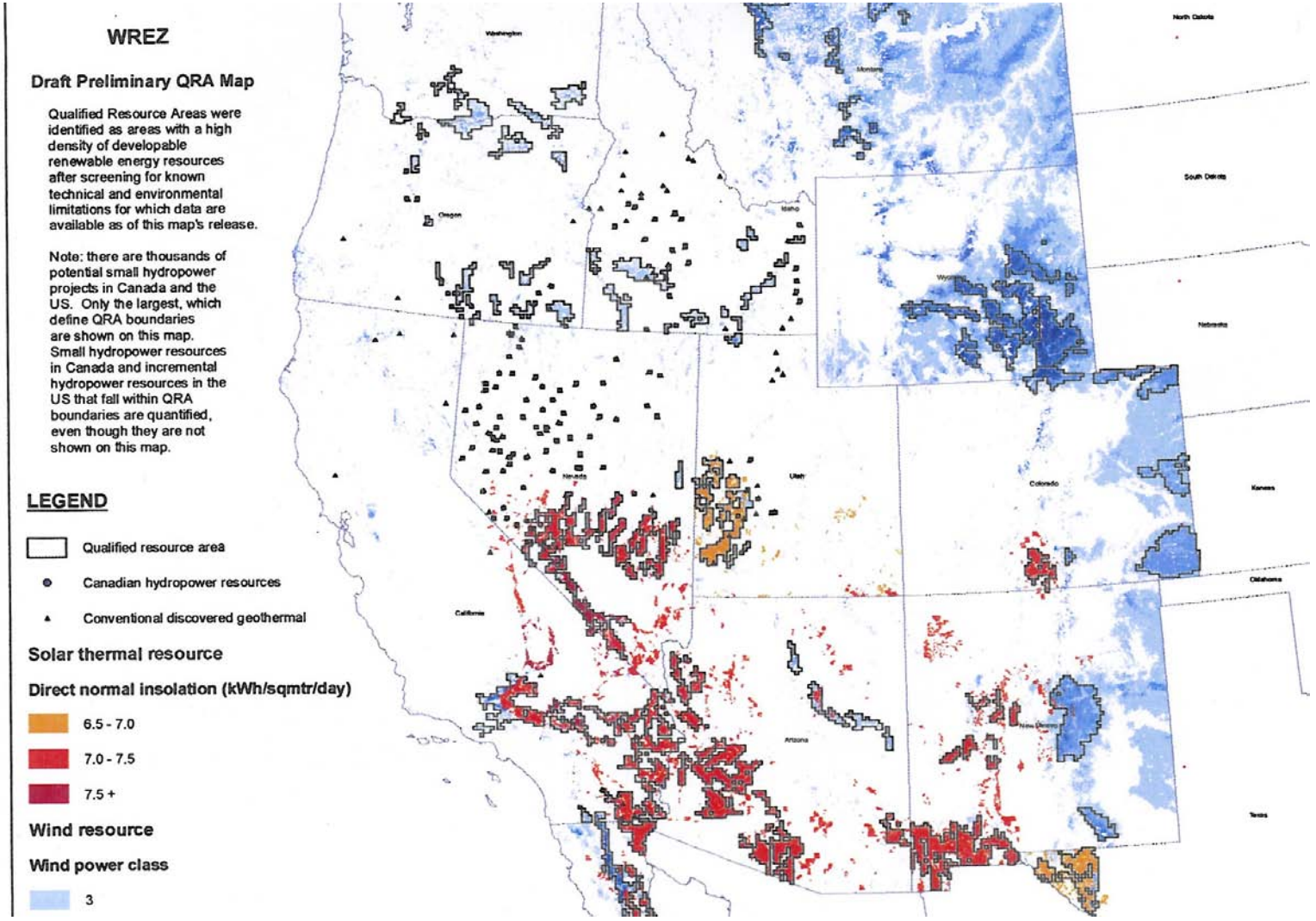
- Identification of land that is appropriate for solar deployment from technical and environmental perspectives

- Streamline evaluation and processing of solar projects

- Identification of additional transmission corridors crossing BLM-managed land

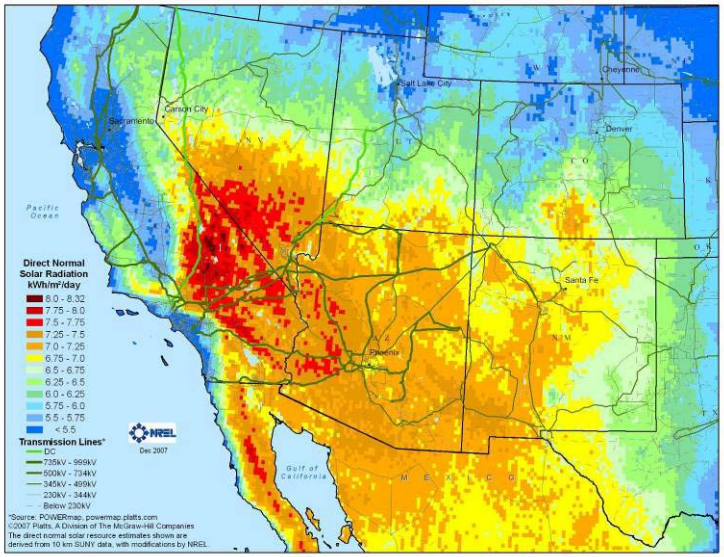


Western Governors' Association
Renewable Energy Zones & Transmission

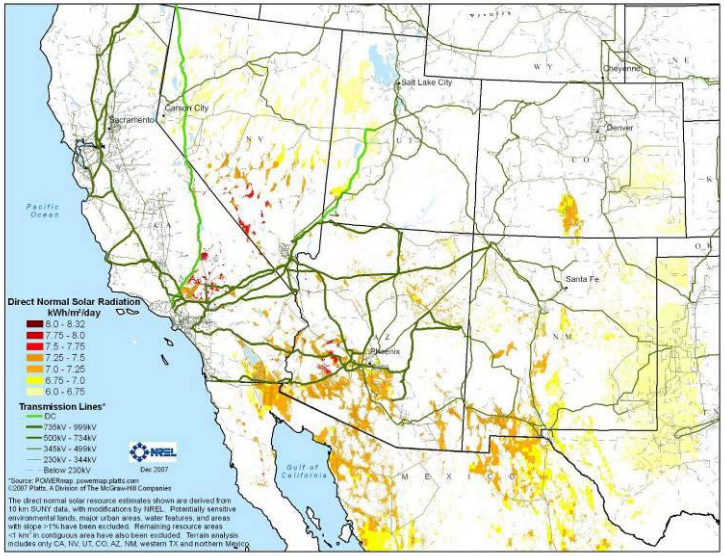


Solar Resource

- Maps



Unfiltered Resource



Solar > 6.0 kwh/m^2-day, Land & slope exclusions

- Improved GIS data
- Data from additional ground sites
- Forecasting

CSP Funding Distribution: FY 2009

R&D Activities

27 contracts - $12 M
(stage-gate reviews)

$13M
Including $1M facilities

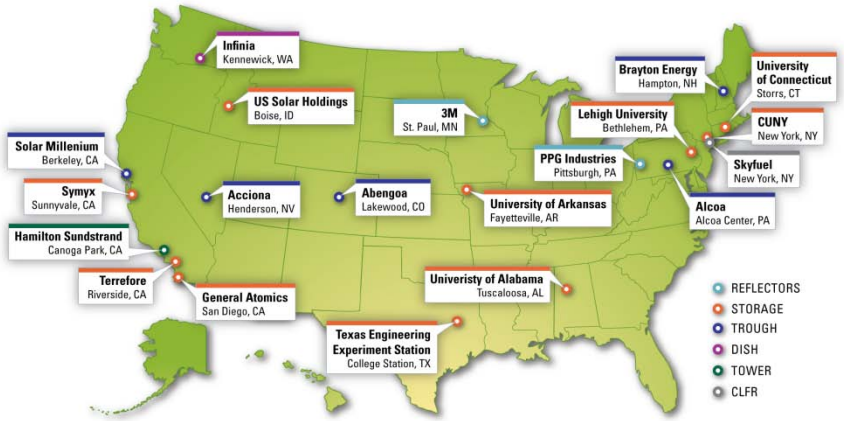
Sandia National Laboratories

NREL

Deployment

$2M

Argonne – PEIS
WGA – renewable zones



Other: $3M (SBIR, recision,…)