U.S. Department of Energy
Energy Efficiency and Renewable Energy

Concentrating Solar Power
- Barriers and Opportunities -

Presented at the Energy & Nanotechnology Workshop:
Prospects for Solar Energy in the 21st Century

Frank Wilkins
Solar Thermal R&D Team Leader
U.S. Department of Energy
Washington, DC

October 16, 2004

CSP Discussion

- Description of the technology
- Policy challenges
- Potential for cost reduction
- Strategy to overcome deployment barrier

CSP Technology

Video

CSP Characteristics

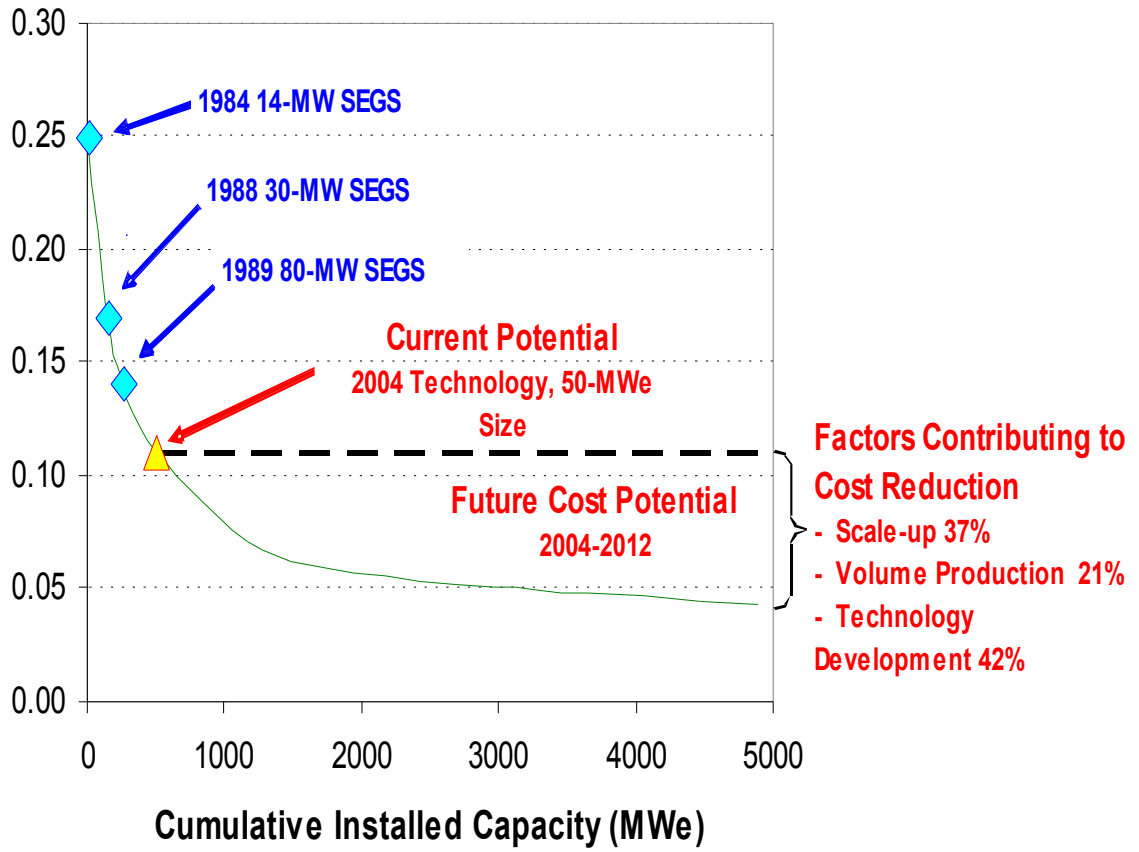
- Best suited for multi-megawatt central power plants.
- Curved mirrors used to focus the sun's rays and to make steam which produces electricity via conventional power equipment.
- Dispatchable power for peaking and intermediate loads through hybridization and/or thermal storage.
- Proven technology with 354 MW operating successfully in California for the past 15 years.
- Rapidly deployed because it uses conventional items such as glass, steel, gears, turbines, etc.
- Water requirements similar to coal-fired plant.

Policy Background

- 2000 – NRC recommended DOE halt R&D citing industry, R&D, and deployment issues
- 2001 - Congress asked DOE to determine the feasibility of deploying 1000 MW of CSP in the Southwest
- FY2002-FY2005 – DOE requests termination of CSP
- 2002 – Feasibility report sent to Congress
- 2003 – Due-diligence study and its review by NRC (with NRC citing deployment issue)
- 2004 – New CSP strategy (with State and WGA deployment partners)

CSP Cost Reduction

- Sargent & Lundy's due-diligence study* evaluated the potential cost reductions of CSP.
- Cost reductions for trough technology will result from scale-up, R&D and deployment.
- Utilities have expressed interest in technology if cost at 7 cents/kWh or less.



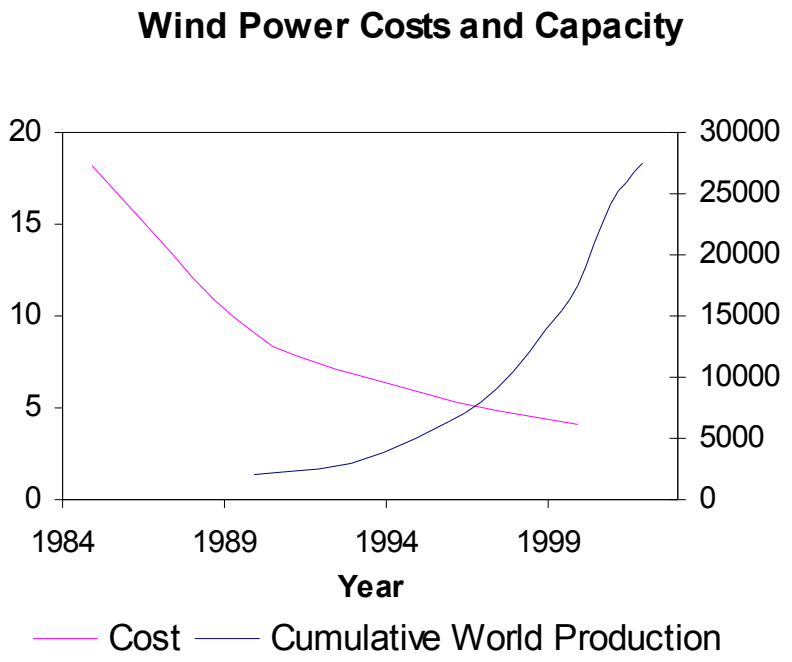
* Sargent and Lundy (2003). Assessment of Parabolic Trough and Power Tower Solar Technology Cost and Performance Impacts. http://www.nrel.gov/docs/fy04osti/34440.pdf

R&D Opportunities

- Thermal Energy Storage
  - Improved Heat Transfer Fluids
    - Low cost fluid with low vapor pressure and higher temperature stability to increase solar operating temperatures (e.g. troughs from 400ºC to 500ºC).
      - » 16% improvement in the annual solar to electric efficiency
      - » 12% reduction in cost of energy
  - Low cost storage at 500ºC
- Advanced Receiver Designs
  - Solar Selective Coatings
    - Cutting thermal emittance in half from 14% at 400ºC to 7%, while maintaining solar absorptance at 95%
      - » 15% improvement in the annual solar to electric efficiency
      - » 15% reduction in cost

Deployment and Cost

Cost reduction realized by wind power is a good example for CSP.



- Initial cost of wind power was high but decreased as installed capacity increased.
- The same trend will occur for CSP.

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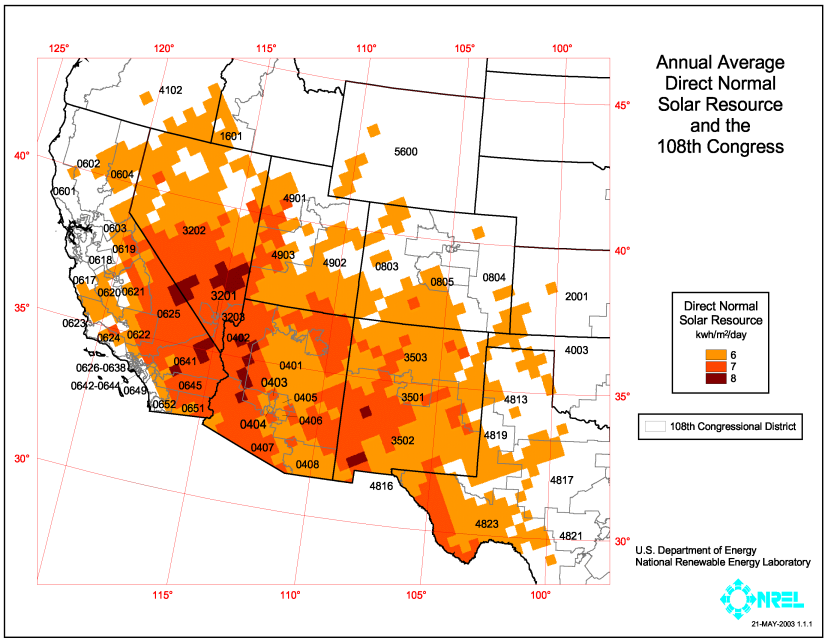
SW 1000 MW Strategy

Resource Availability:

State	Solar Capacity (MW)	Land Area (Sq Mi)
AZ	1,652,000	12,790
CA	742,305	5,750
NV	619,410	4,790
NM	1,119,000	9,157
Total	4,132,715	32,487



The table and map represent land that has no primary use today, exclude land with slope > 1%, and do not count sensitive lands.

Solar Energy Resource ≥ 7.0 kWhr/m²/day (includes only excellent and premium resource)

Current total generation in the four states is 83,500 MW.

Benefits to the States

Economy

- Create new jobs in rural areas
- Reduce cash outflow for energy
- Increase capital investment in the state
- Increase state GSP

Environment

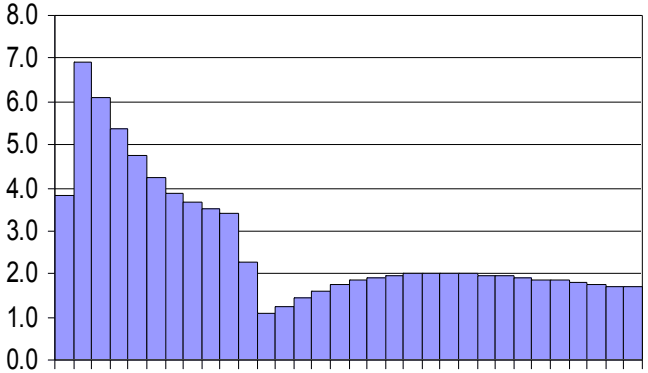
- Reduce air pollutants
- Reduce greenhouse gas emissions

Energy

- Produce clean power in the state
- Hedge against NG and hydro price increases and volatility
- Hedge against regulation of CO_2
- Reduce or mitigate transmission problems

Economic Benefits

- At it's peak, installation of 1000 MW of CSP power plants would create nearly 7,000 new jobs (direct and indirect).
- These jobs can readily be created in rural areas.
- In addition to CSP plants, manufacturing and assembly plants can be expected.
- 1000 MW would add $300M/yr to gross state product



* Based on UNLV Center for Business and Economic Research study on the potential impact of constructing and operating solar power generation facilities in Nevada.

Other Benefits to States

Environment

- Reduce air pollutants
- Improve air quality
- Improve public health
- Reduce haze and increase tourism
- Reduce greenhouse gas emissions

Energy

- Produce clean power in the state **(equivalent of 150,000 homes receiving all their energy from solar)**
- Hedge against natural gas and hydro power price increases and volatility
- Hedge against regulation of carbon emissions
- Reduce or mitigate transmission problems

Impact on Ratepayers

An estimate of the cost to develop the CSP solar energy resource under a renewable portfolio standard.

- The investment to build 1000 MW of CSP plants could come from private money – not from the federal or state's treasury.
- The incremental energy cost required of ratepayers if:
  - 500 MW in CA - 5 cents/month
  - 200 MW in NM - 69 cents/month
  - 150 MW in AZ - 35 cents/month
  - 150 MW in NV - 64 cents/month

SW Activities

- In June, Governors Schwarzenegger (CA) and Richardson (NM) included the 1000 MW of CSP power as part of the Western Governors' Association Clean Energy Initiative.
- Arizona is installing 1 MW plant.
- Nevada is developing 50 MW CSP plant.
- New Mexico formed a Task Force to identify a large-scale CSP plant.
- California formed a task force to develop a new solar strategy

Summary

- The solar energy resource in the Southwest U. S. is enormous and largely untapped.
- Electricity generation from solar energy can provide clean energy as well as be an engine for economic development.
- Both R&D and deployment are necessary to reduce cost.
- Deployment strategy designed to change policy.

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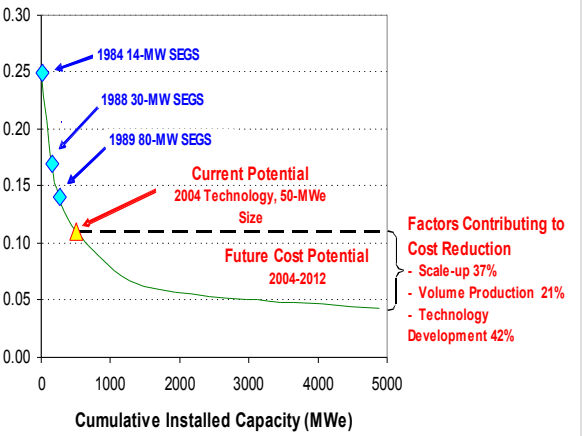

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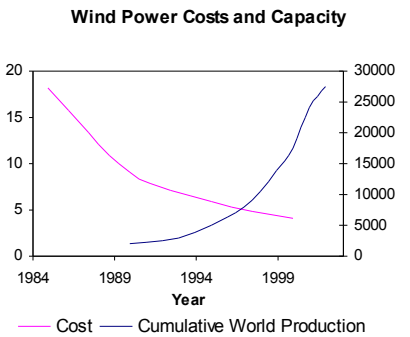

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Reverse the two axis

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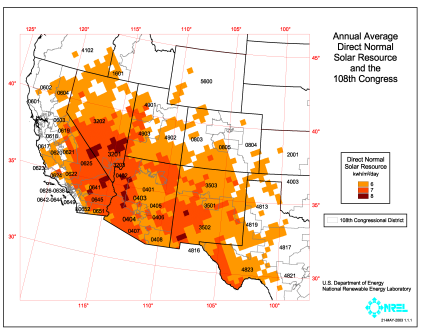

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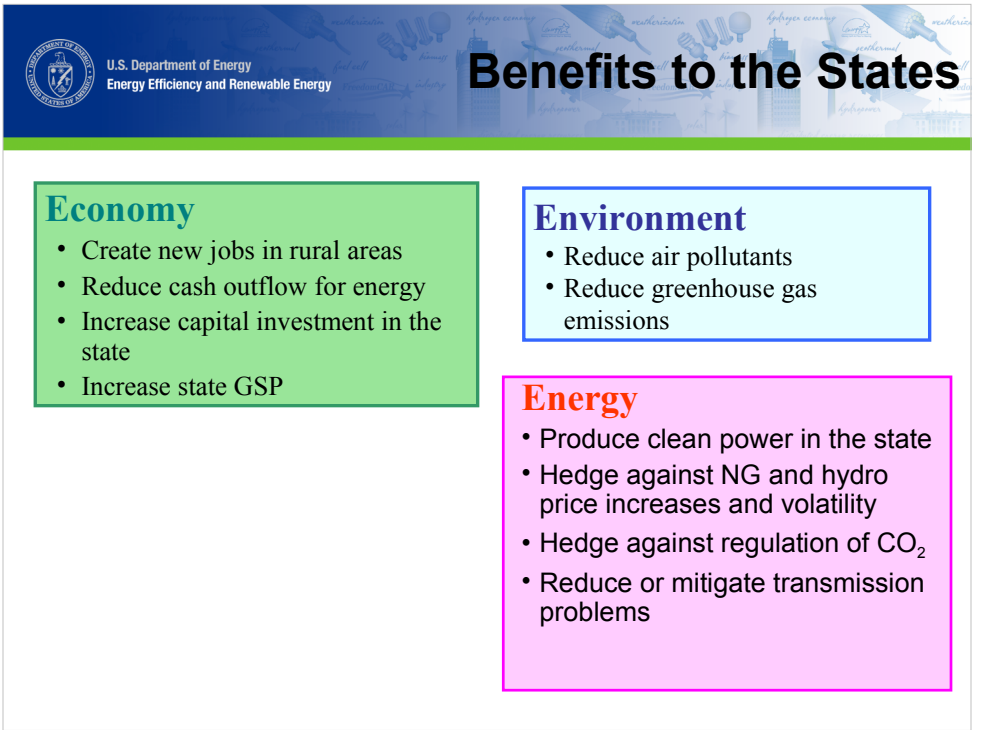

Is there a chart for hydropower fluctuations?

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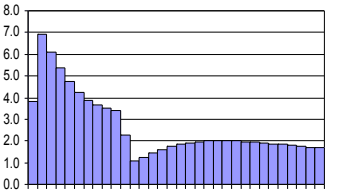

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