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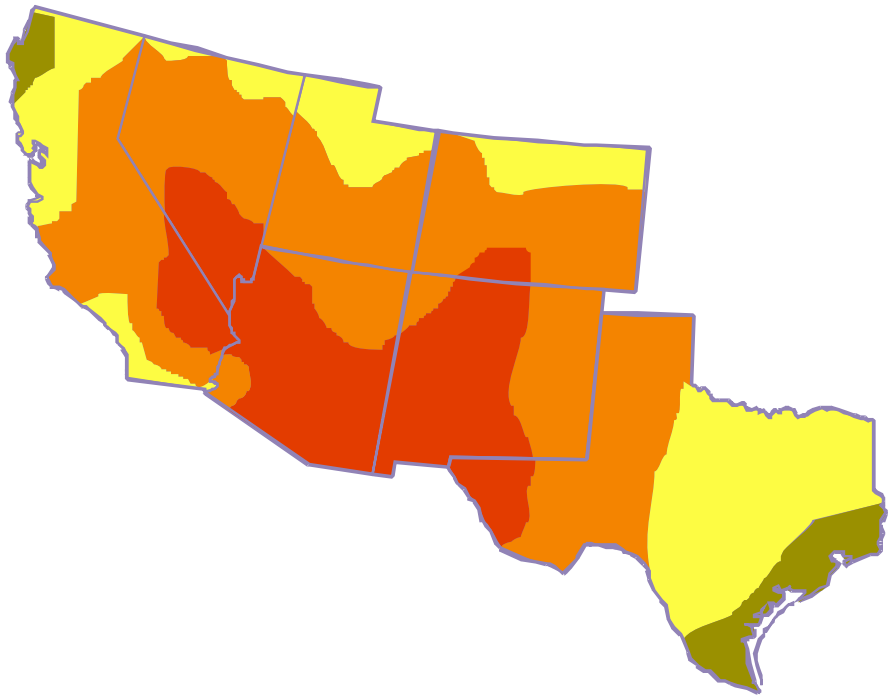
Concentrating Solar Power Program Peer Review



Frank Wilkins
Concentrating Solar Power Program

November 2001

Peer Review

- Expectations
  - Objective analysis of program
  - Assistance in guiding the program
- Format
  - Last peer review done by NRC identified several weaknesses
    - no strategy for development
    - no market for the technology
    - lack of private sector input
    - further R&D would not lead to deployment
  - This review formatted to address NRC defined weaknesses

Peer Review

Actions following review:

- Oral report to CSP Management Team
  - DOE
  - Sandia & NREL
  - Industry
- Written Report to DOE
- Align FY 2002 CSP program with recommendations

Peer Review Context

- FY 2002 Congressional guidance (9/31/01)
  - Continue deployment of 1.0 MW dish system and associated 25 kW dish activities
  - Rpt to Congress on initiative to fulfill goal of 1,000MW supplying SW by 2006 from troughs, power towers, and dishes (due 3/1/02)
  - Address resource opportunities and electric power needs of the SW

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Peer Review Agenda

- Wednesday
  - Program Overview (emphasis on strategy)
  - Market Opportunities
  - Technology Development Activities
    - Distributed Power
    - Dispatchable Power
- Thursday
  - Management of program
  - Research Activities
    - Advanced Component & System Activities
    - Test facilities
  - Tour of facilities
- Friday
  - Review panel working session
  - Presentation to CSP Management Team

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CSP Overview

- Mission & Goals
- Program Strategy
- FY 2001 Activities Summary
- Budget & Spending

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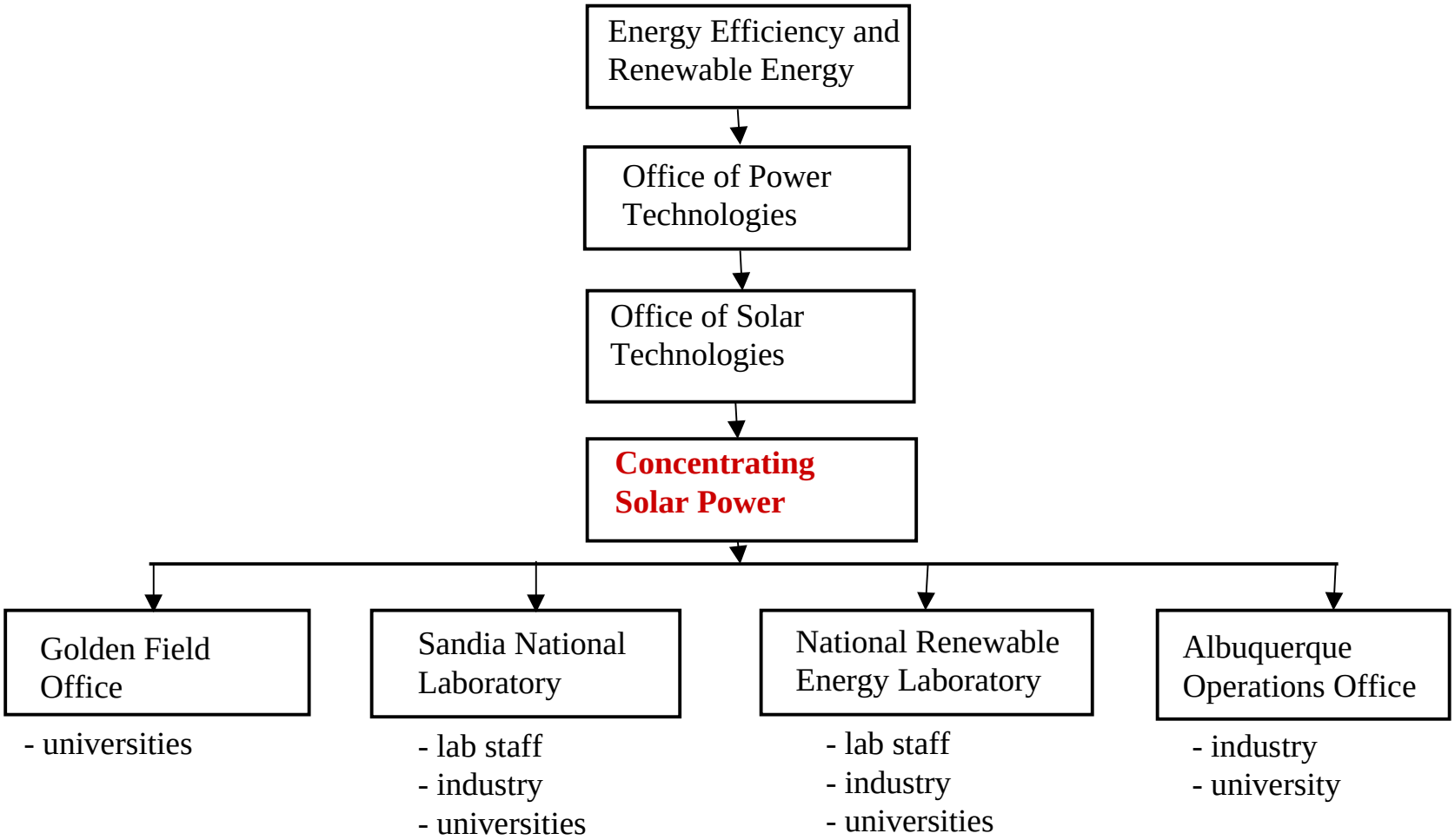
DOE Structure



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Concentrating Solar Power Program

Mission: convert the U.S. solar resource into low cost electricity

Goals:

- 1,000 MW by 2006
- 20,000 MW by 2020

Strategy:

- focus on Southwest as best initial market potential
- emphasize value and security
- work with SW States to identify their energy needs and solar potential
- identify technologies (near and long term) that can fulfill those needs
- work with industry and labs to develop those technologies

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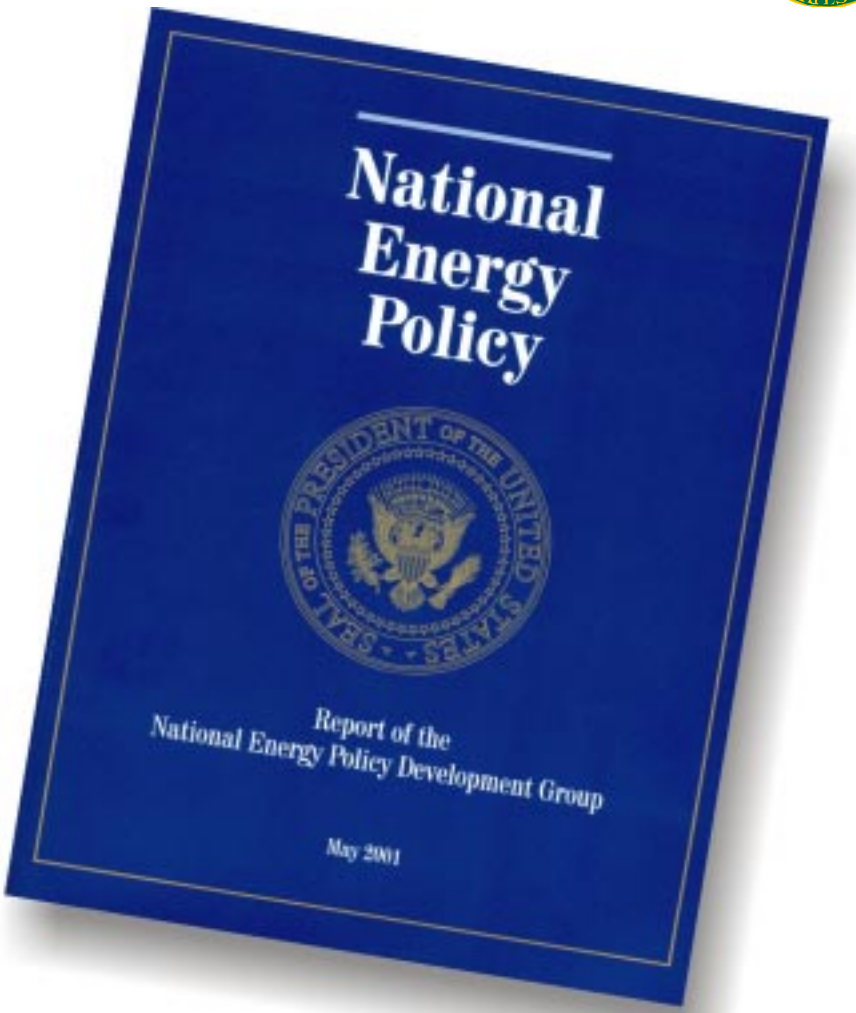
National Energy Policy Plan emphasizes…

- "…looking to technology to help us meet the goals of increasing electricity generation while protecting the environment…"
- "…working with the National Governor's Association and regional governor associations to determine how to better serve the needs of diverse areas of the country…"



In Oct 2001, Sec. Abraham announced…

- DOE's overarching mission is national security
- Priorities include:
  - Ensuring energy security
  - Increasing supply of energy by increased domestic production
  - Directing R&D at ideas and innovations that are relatively immature
  - Finding new sources of energy
  - Enhancing homeland defense against threats posed by terrorism

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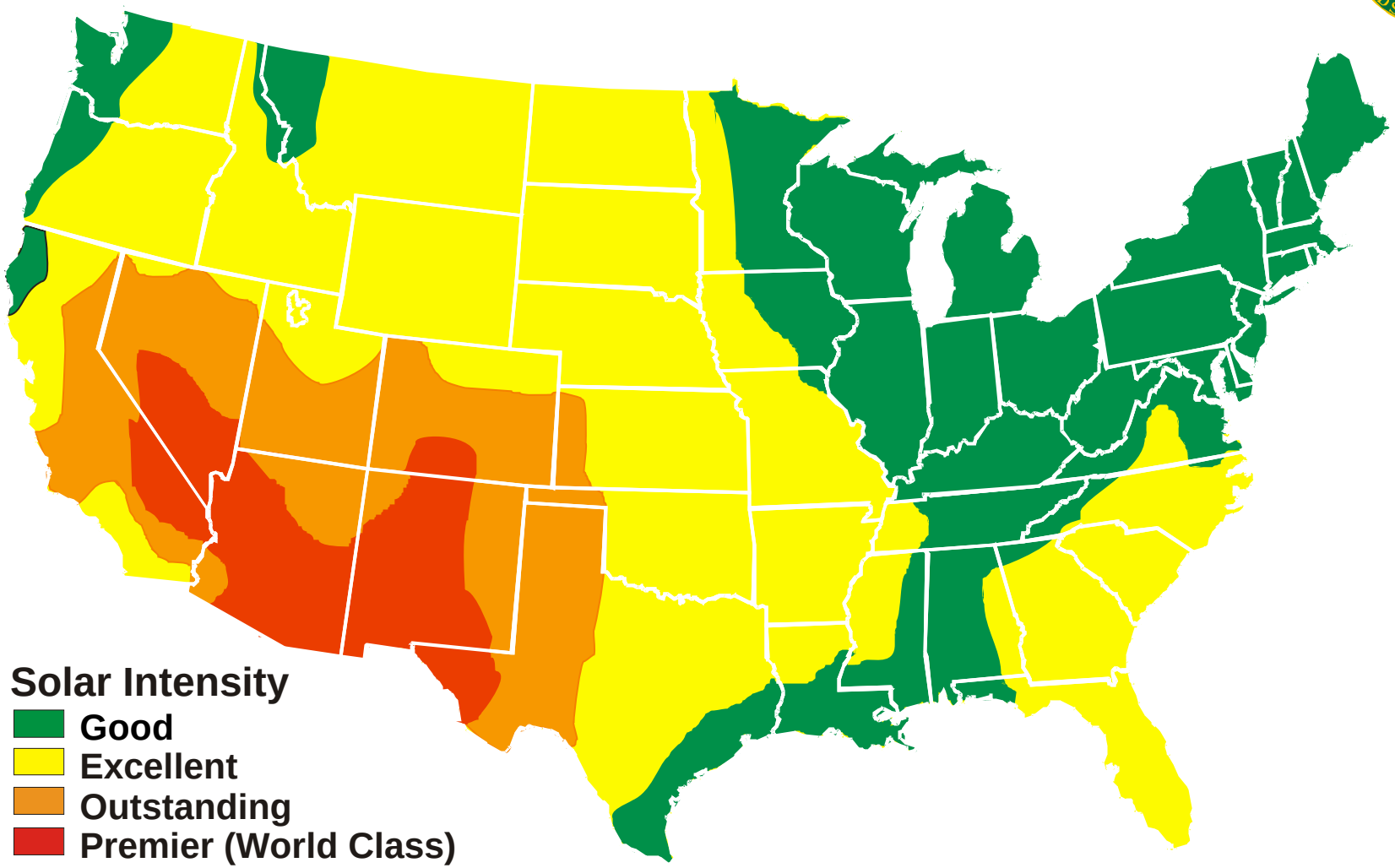
The SW solar resource is the nation's best.



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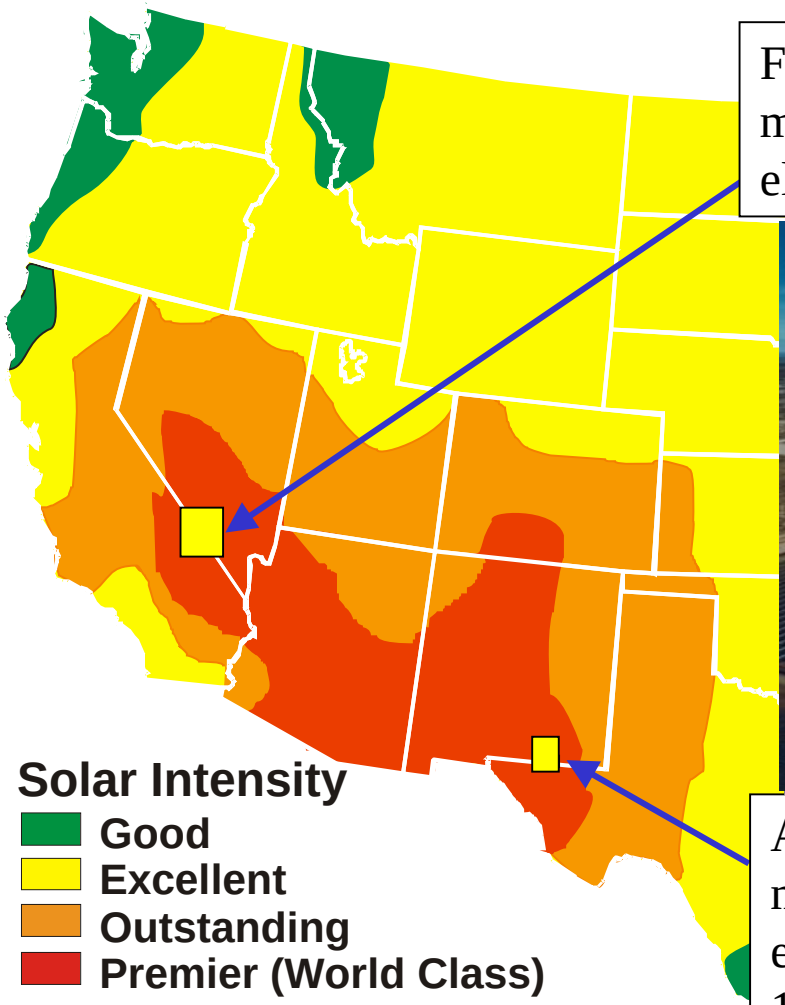
Solar energy could power the nation...



For example, a solar project 100 miles by 100 miles in the Southwest can produce as much electricity as the entire U.S. generated in 1999.

As an example, a solar project 39 miles by 39 miles in the Southwest can produce as much electricity as generated by natural gas in the U.S. in 1999.

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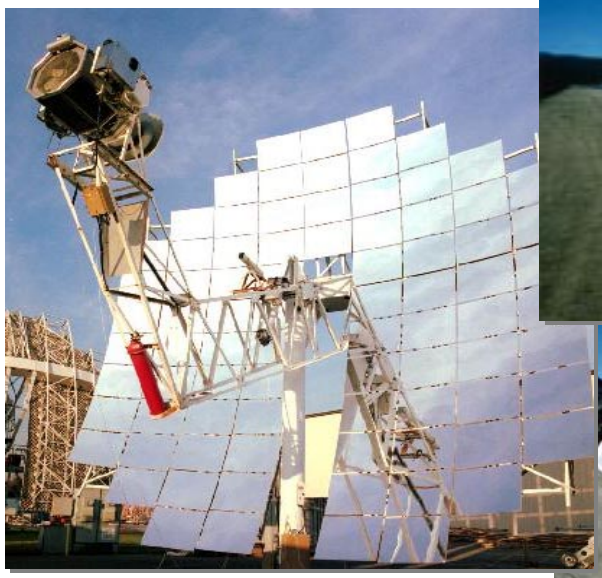
…using technology that can bring jobs into the region and result in the export of energy…



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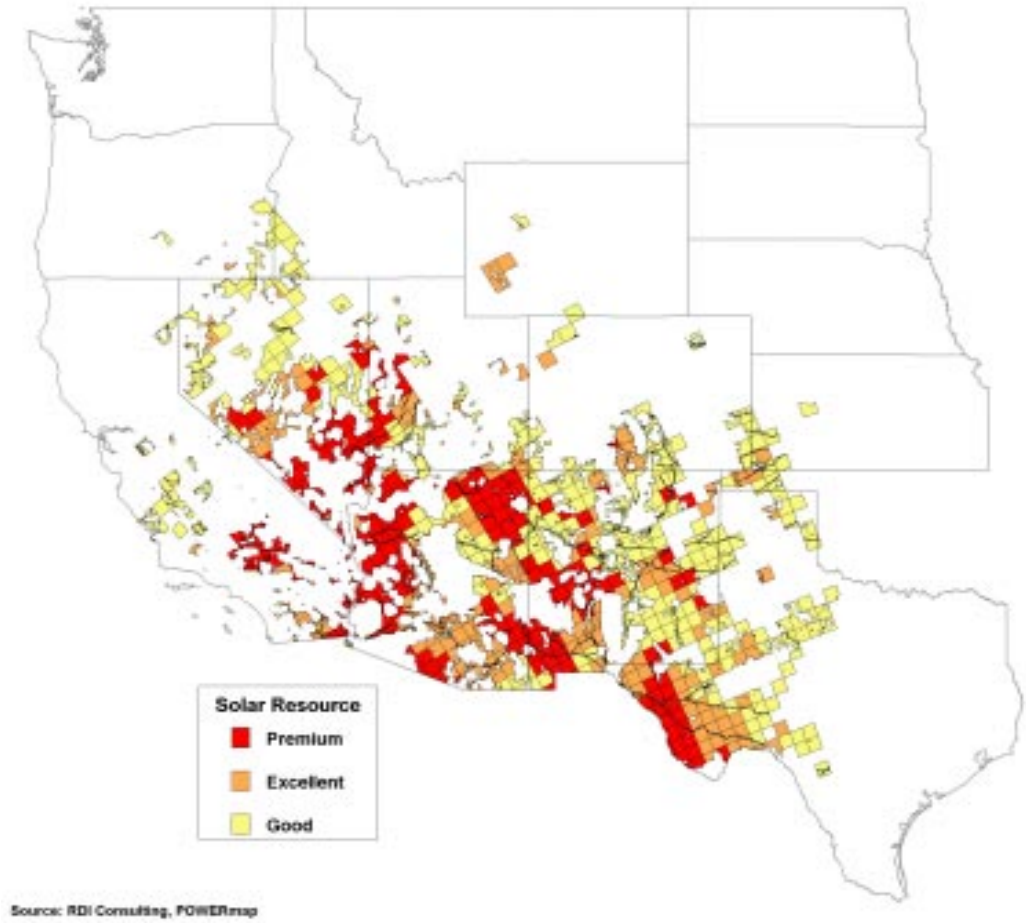
…and available land (shown on map).



Land not considered available:

Urbanized Areas - Cropland- Military Bases -National Wilderness Areas - Fish & Wildlife Service Land - National Park Service and Forest Service Lands -Lakes - Railroads, Highways and Waterways -Rugged or mountainous land (all above with a buffer)

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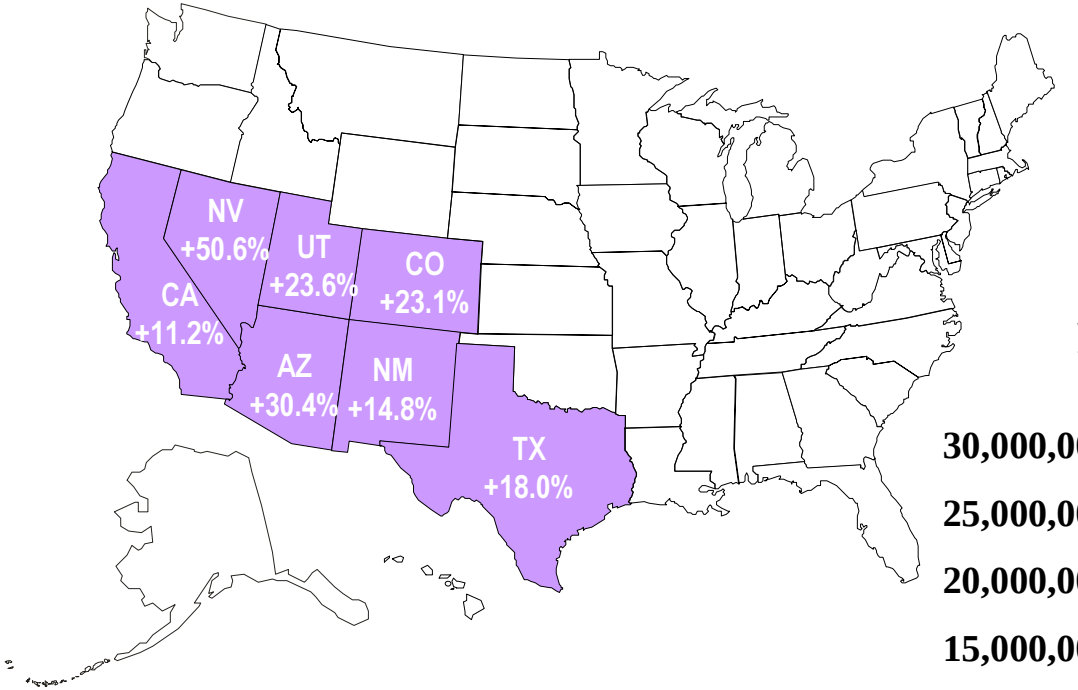
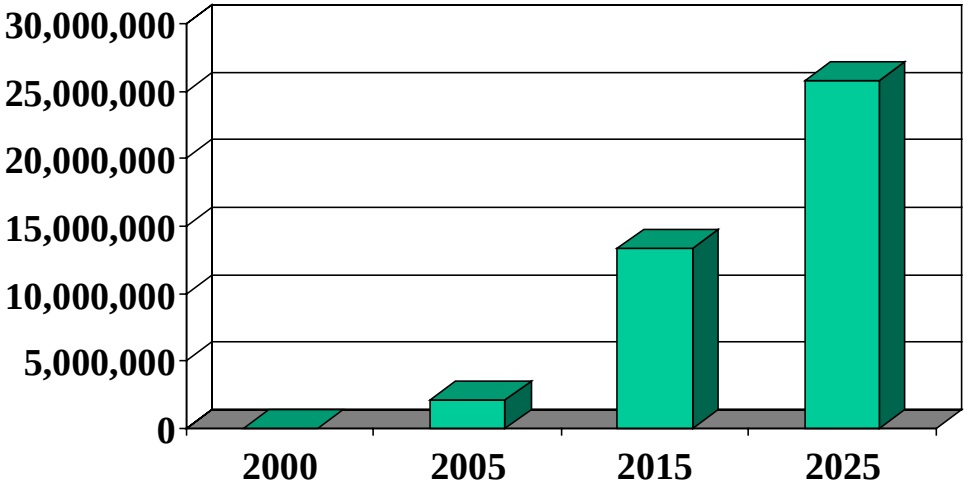
Solar is where power is needed, …

Percentage Change in population from April 1, 1990 through July 1, 1999



The SW is the fastest growing region of the country.

Population Growth, Southwest U.S.



Source: US Census Bureau, 2000

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…it is modular enough to power a city, …

- March Air Force Base, CA (7000 acres) is closing. It could produce more electricity than the city of Oceanside, CA (pop. 156,538) consumes in a year – if solar were part of its reuse plan.

• The Red River Army Depot, TX (19,000 acres) is closing. It's solar resource could produce more electricity than the city of Brownsville, TX (pop. 147,701) consumes in a year.

Source: Data for this information came from the U.S. Census Bureau and the Energy Information Administration

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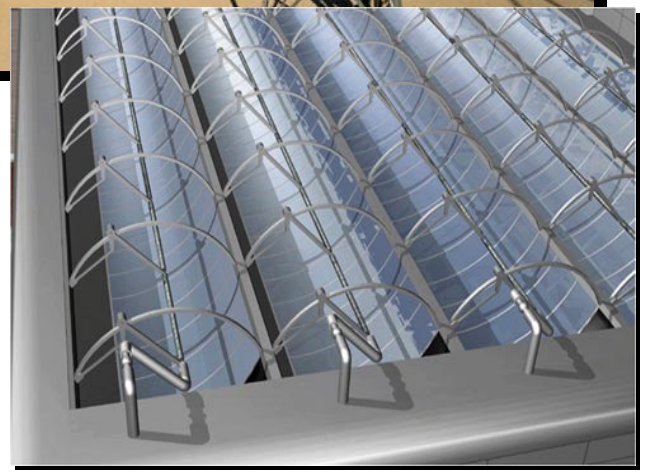
…or a building…..



- A 25 kW dish concentrator system covers about the equivalent of nine parking spaces and can produce enough electricity for over 4 households.

- A roof integrated solar system can provide heat, hot water, electricity, and drive an A/C system for a commercial building, hospital, or school.

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…while enhancing energy security.

Distributed energy "power parks" utilizing solar technology and, for example, micro-turbines would lessen potential for terrorism and supply disruption by:

- placing smaller energy generation plants near the consumer
- minimizing length of transmission
- maximizing the utilization of local energy (solar) resources
- providing independence from imported fuels that could be disrupted

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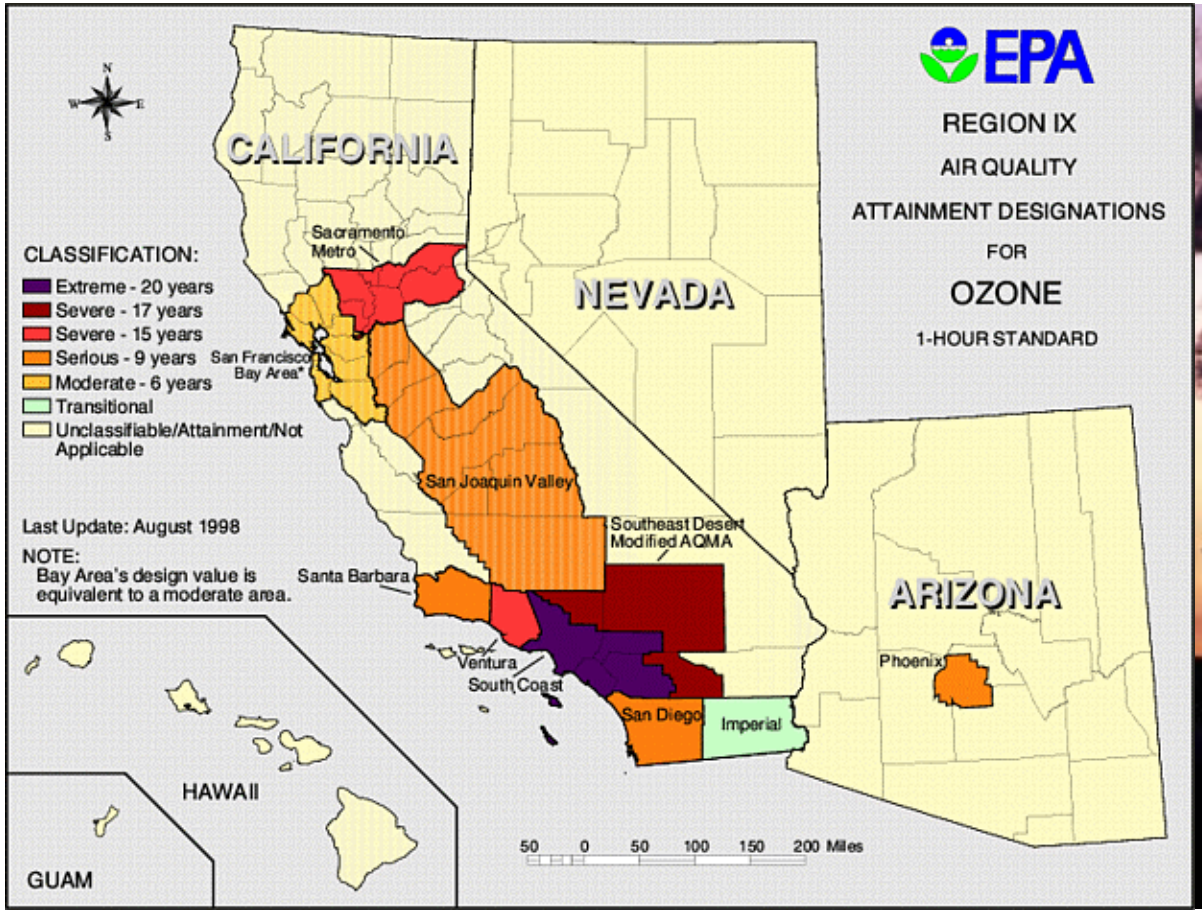
Clean solar power is good for areas with poor air quality, …



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… areas with the most pristine air quality, …

– where power can be hard to access!

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… or entities concerned with global warming.

- Electricity generated from solar energy releases no CO_2 to the atmosphere. This saves 1,600 lb. of CO_2 per Megawatt-hr. relative to coal or 800 lb. relative to natural gas.

- A 1,000 MW solar plant would offset 3.0 Billion pounds of CO_2 each year relative to coal or 1.5 Billion pounds relative to natural gas.

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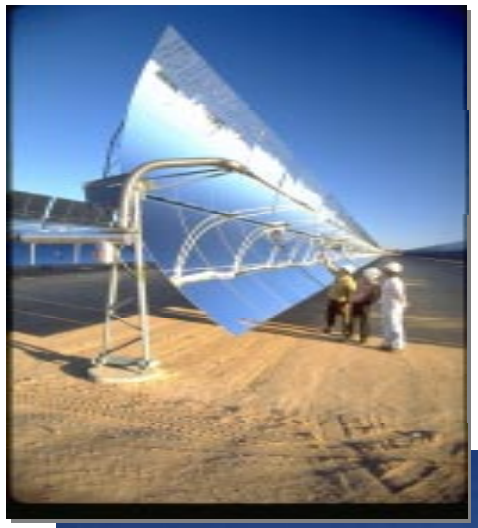
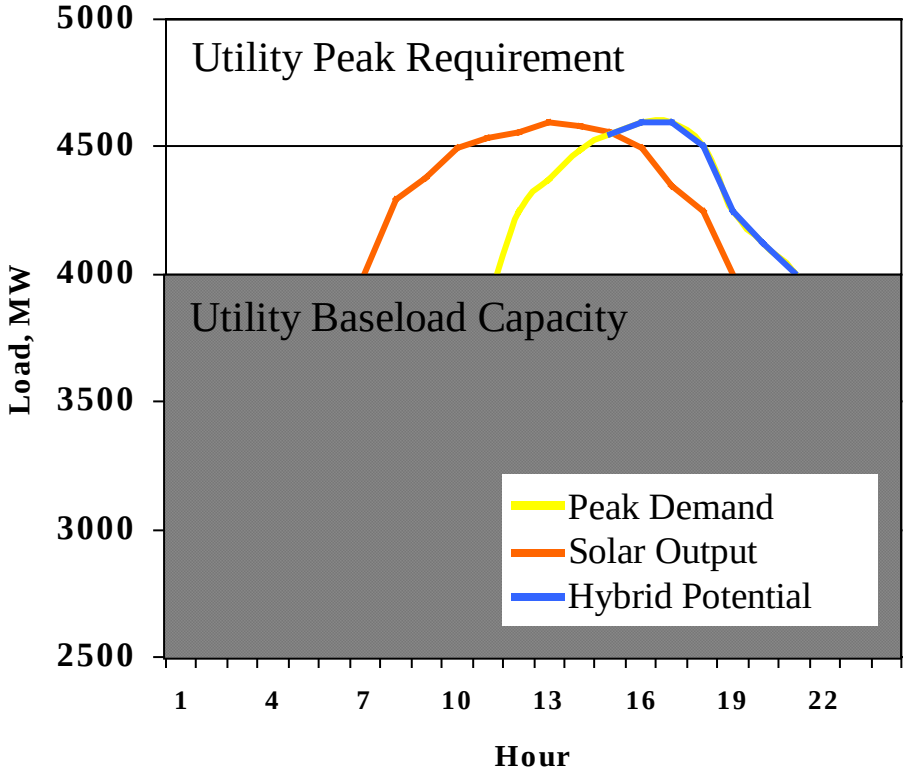
Solar is a good match for utility peak demand …

Solar systems provide the most power when daily demand for cooling is highest





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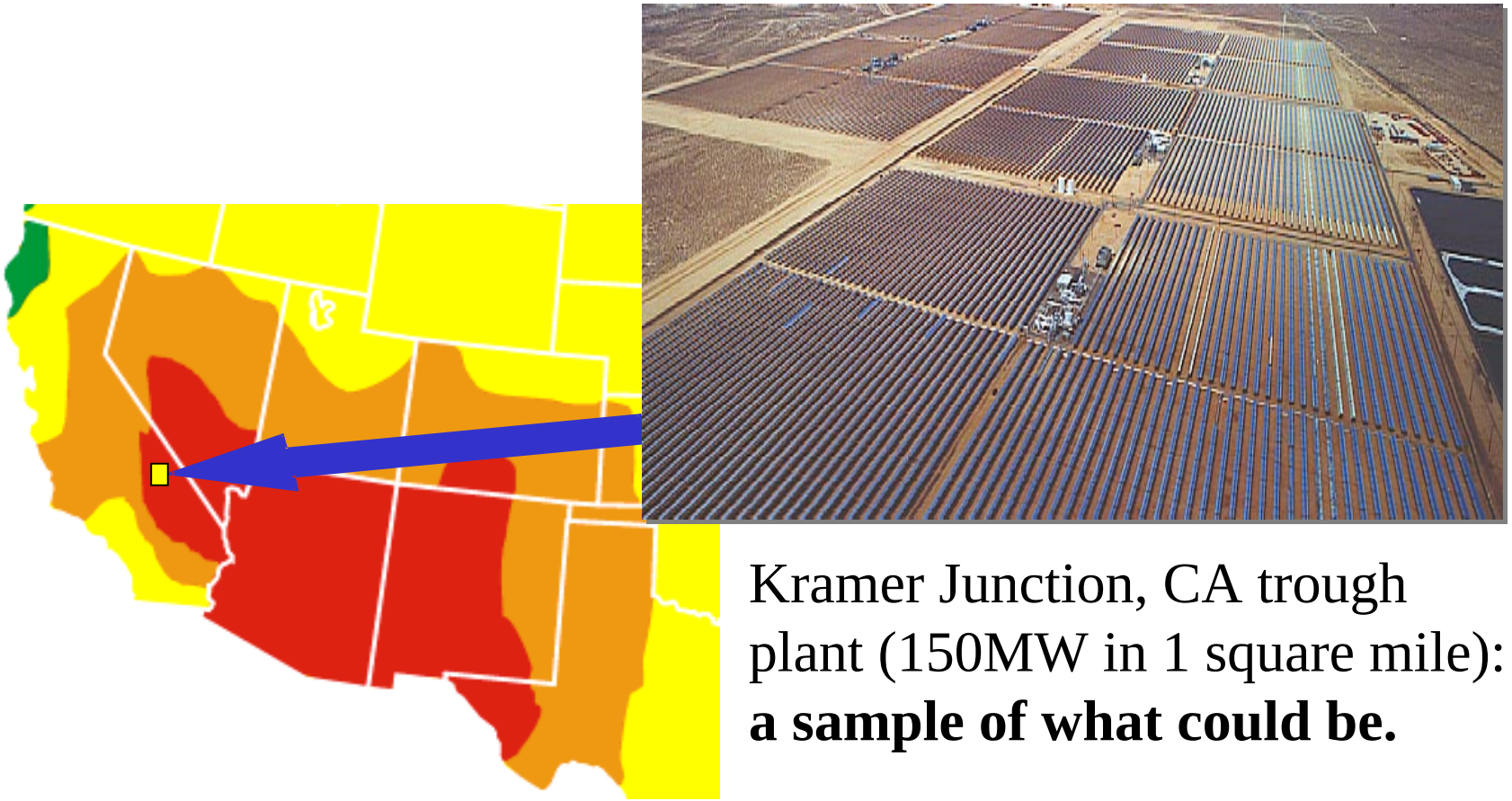
Concentrating Solar Power Program: *Turning SW solar into megawatts*



Kramer Junction, CA trough plant (150MW in 1 square mile): **a sample of what could be.**

FY 2001Activities: Dispatchable Power Systems

OBJECTIVE: Develop technology that reduces energy cost to below $0.10/kWh and support ongoing project

- Trough R&D (Duke Solar, Kearney Assoc)
  - Develop storage system
  - Develop new concentrator structure
  - Complete evaluation of new receiver
  - Support CEC 1,000 MW study
- Power Tower Project (Nexant, Boeing)
  - Provide component testing and design assistance to 42 MW_t Solar Tres project

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FY 2001 Activities: Distributed Power Systems

OBJECTIVE: Develop technology that reduces energy cost to below $0.15-0.20/kWh and support ongoing projects

- 25kW Dish Systems (SES & SAIC)
  - Installation of first systems in the Nevada 1.0 MW project
  - Improve design of Stirling systems to increase reliability
  - Initiate dish support capability at UNLV
- 10kW Dish System (WGA)
  - Prepare unit for operation on Native American tribal land

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FY 2001 Activities: Advanced Component R&D

OBJECTIVE: Identify technology that can generate energy at $0.06-0.08/kWh or compete in niche markets.

- Component R&D
  - Develop concentrating PV receiver and concentrator
  - Optical Materials: develop "super thin" glass concept
- System R&D
  - Develop 2.0kW high efficiency concentrating PV system

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Nevada Dish Project

- FY01 – first dishes installed and operated at UNLV
- FY02 –issue RFP, select contractor(s), begin dish field installation
- FY03 – 1.0 MW dish field completed (if funds are available)

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Budget Process

- DOE requests funds from Congress
- Congress appropriates funds (sometimes adding earmarks)
- Process impacts planning
  - CSP Budgeting History ($M):

	FY00	FY01	FY02
DOE Request	**18.85**	**15.0**	**1.93**
Appropriation	**14.9**	**13.6**	**TBD** ⟵ { **House 7.93**, **Senate 15.3**

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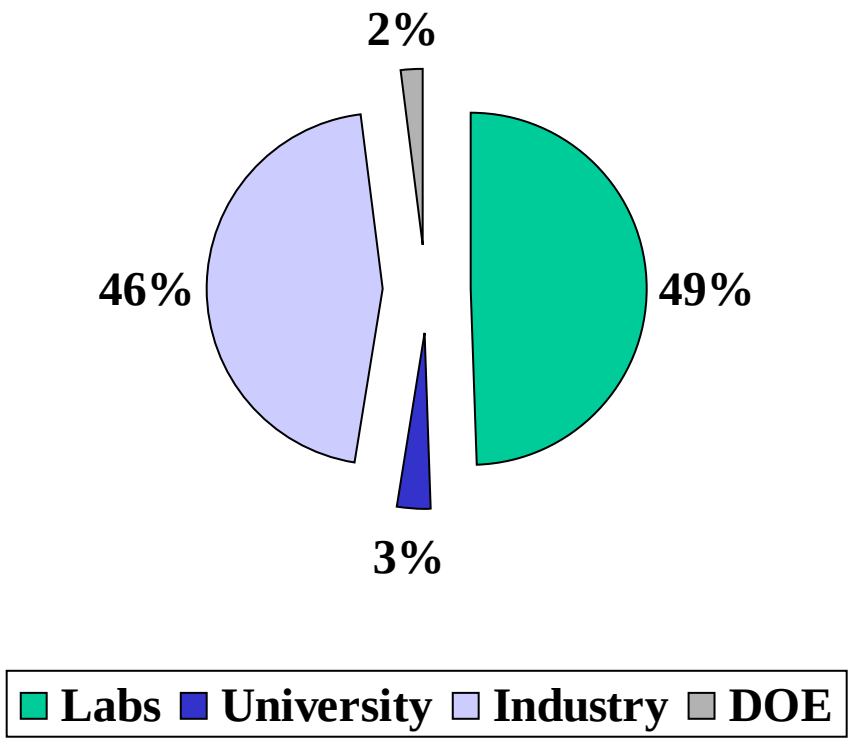
FY01 Spending

Distribution:

- Sandia – $7.10M
  - $4.50M FTE
  - $2.60M contracts
- NREL – $5.52M
  - $2.20M FTE
  - $3.32M contracts
- Albuquerque Ops – $0.48M
  - UNLV, Solar Tres contracts
- Golden Field Ofc – $0.19M
  - University contracts
- DOE - $0.26M

Total - $13.6M

Participation:



The CSP Challenge

- Even though:
  - U.S. has better solar resource than any industrial nation,
  - trough plants (354 MW) operating reliably for decade,
  - cost has been reduced by over 70% in the last 20 yrs, and
  - "Market for CSP technology is large and could reach an annual installation rate of 2,000 MW"*
- Market penetration has been minimal because:
  - large up front capital costs (e.g., $100M for 50MW plant), and
  - long term power purchase agreements required at about 12 cents per kWh vs natural gas at 4 cents

*Enermodal Engineering study done for the World Bank, May 1999

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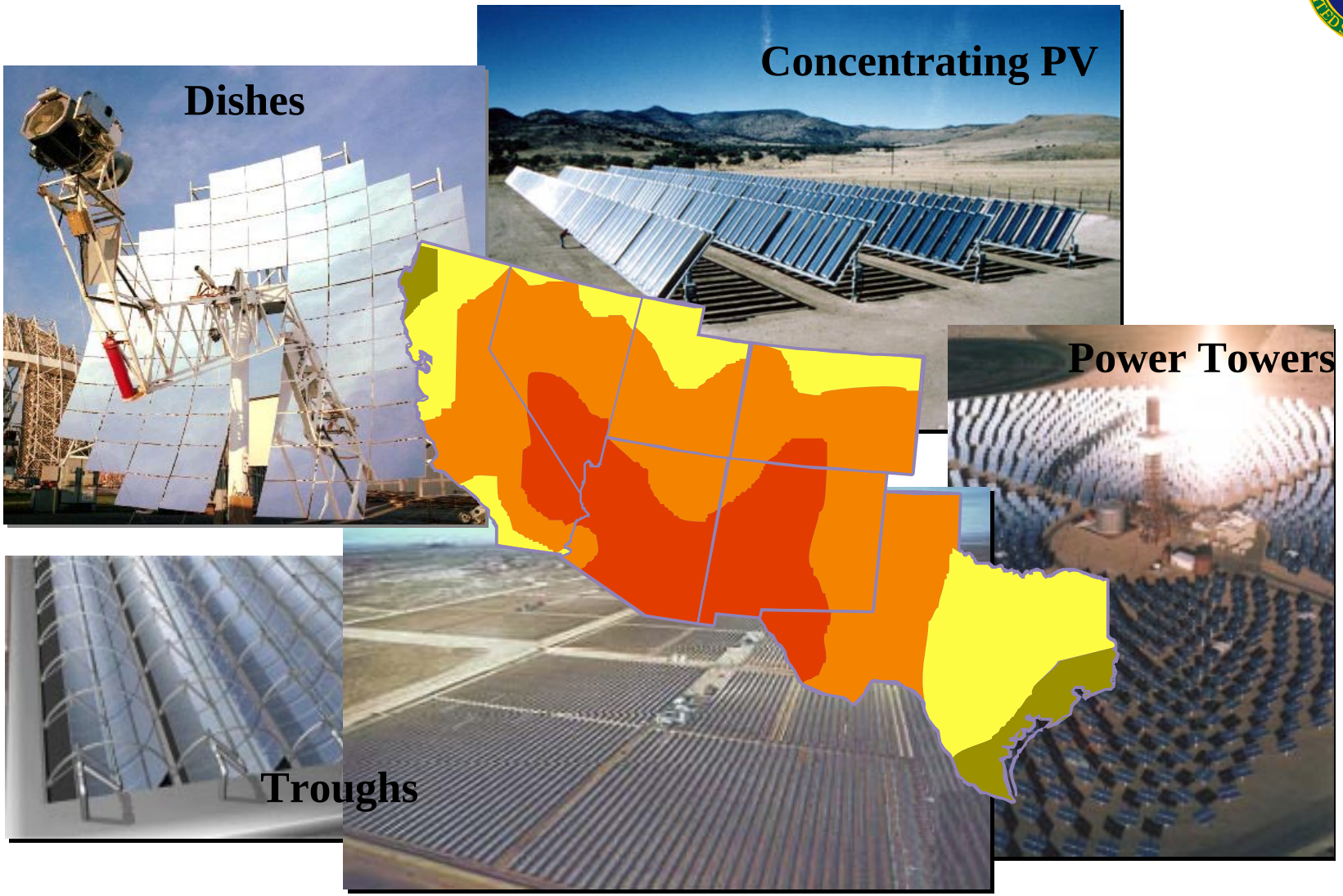
The CSP technology portfolio