



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

Why New Mexico Should Develop Its Solar Energy Resource

prepared and presented by:

The Solar Energy Industries Assn. (SEIA), Solar Thermal Power Div.

The DOE Concentrating Solar Power (CSP) Program

**SunLab, a virtual laboratory comprising groups at Sandia National
Laboratories and the National Renewable Energy Laboratory (NREL)**

August 22, 2003

Santa Fe, New Mexico



- **New Mexico can add another engine for its economy by developing its solar energy resource.**
- **The economic benefits to New Mexico far exceed the cost to develop its clean and renewable solar energy resource.**

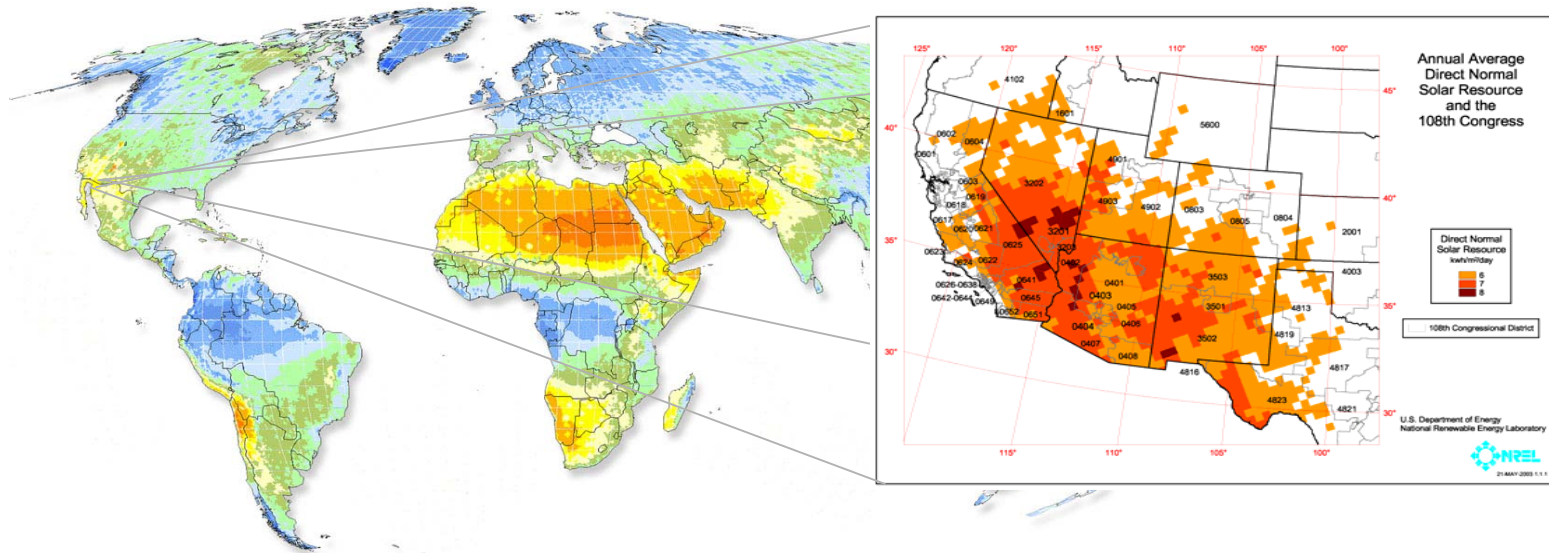


Background

- **In 2001 Congress asked DOE to determine what would be required to deploy 1000 MW of Concentrating Solar Power in the Southwest U. S.**
- **DOE and the CSP industry approached the Western Governors' Association through the Western Interstate Energy Board to explore implementation.**
- **Four states - AZ, CA, NM, and NV - have the highest solar potential, the best renewable energy portfolio standards, and the most to gain from development of their solar energy resources.**

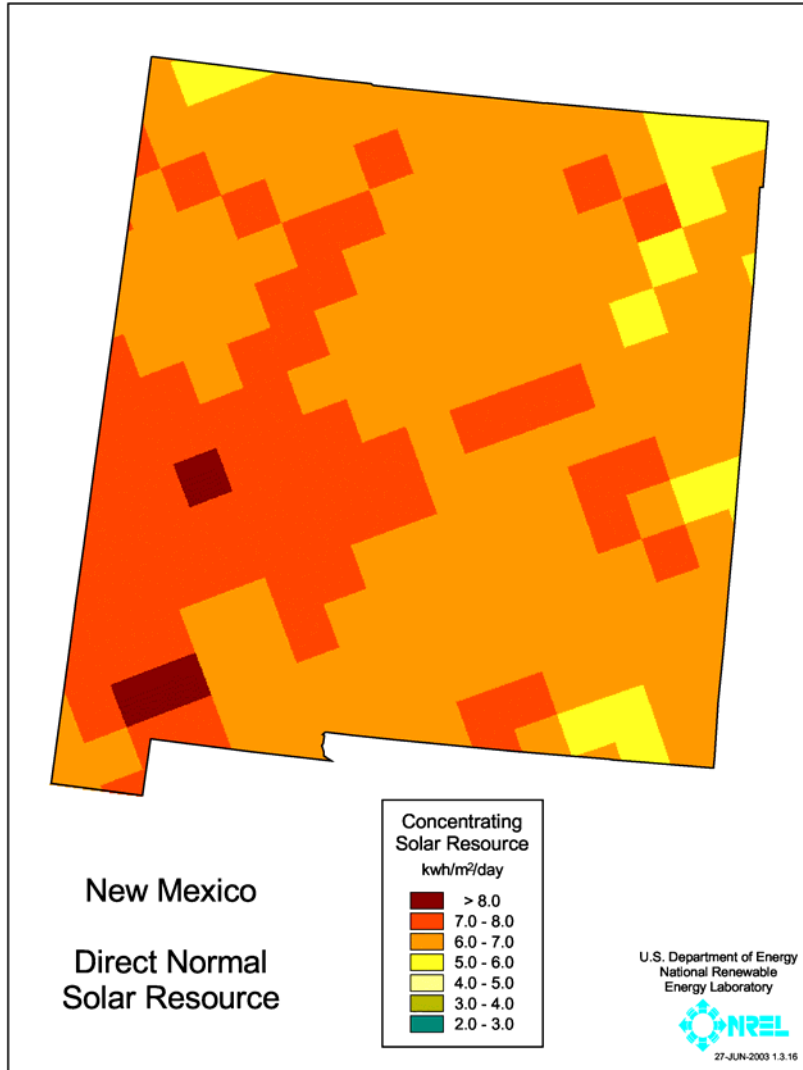


Solar energy resources in the Southwest U.S. are among the finest in the world





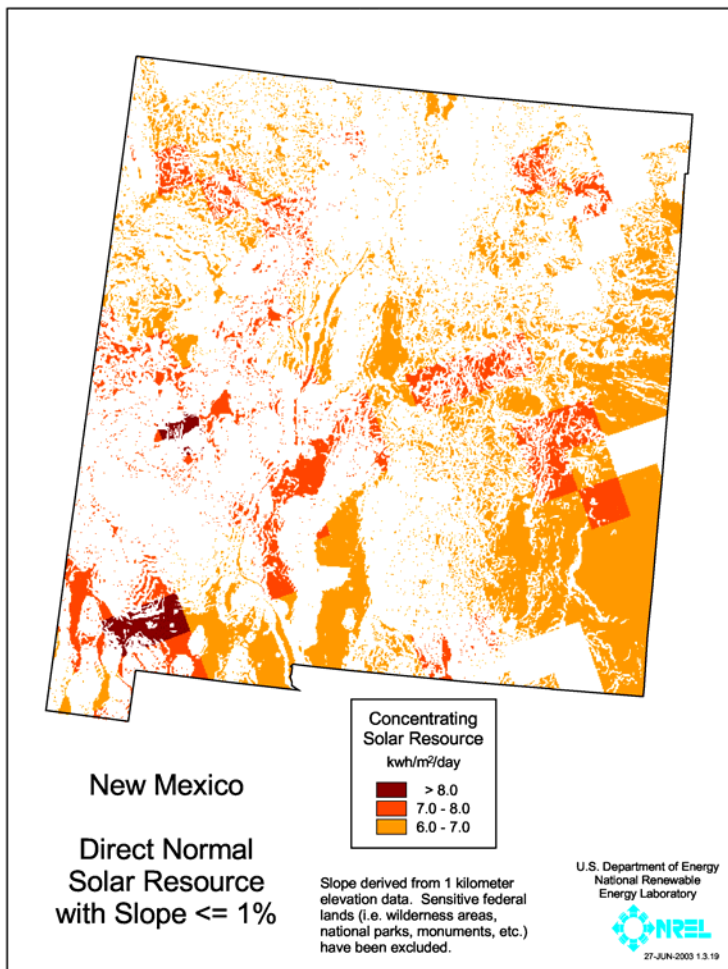
New Mexico's Solar Resource



- **Less than 0.09 percent of New Mexico's land could generate all of the state's current electricity needs**
- **This area is 106 mi² (about 5 miles by 20 miles), which is roughly twice the surface area of Elephant Butte Lake.**
- **One "solar dam" could do it all.**



NM's Solar Energy Potential



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

Solar Resource kWh/m²/day

| | > 8.0 | 7.0 – 8.0 | 6.0 – 7.0 | Total |
|-----------------------|-------------|---------------|---------------|---------------|
| Available Area* (mi) | 923 | 8,234 | 25,060 | 34,217 |
| Capacity (MW) | 119,000 | 1,000,000 | 2,550,000 | 3,669,000 |
| Generation (MWh/year) | 282,020,000 | 2,367,297,000 | 6,036,258,000 | 8,685,575,000 |



NM'S Generation Mix-2001

| <u>Technology</u> | <u>Capacity (MW)</u> | <u>Energy Delivered (MWhr)</u> |
|-------------------|--------------------------|------------------------------------|
| Coal | 3,935 | 28,371,000 |
| Natural Gas | 1,615 | 4,412,000 |
| Hydro | 82 | 96,000 |
| Other | <u>52</u> | <u>51,000</u> |
| State Total | 5,685 | 32,931,000 |

Coal and natural gas represent 99.6% of New Mexico's generation mix in 2001.

Source: RDI BaseCase, NewGen and PowerDat Databases



NM's Planned Generation

New Capacity 2002 through 2006

| <u>Technology</u> | <u>(MW)</u> |
|-------------------|-------------|
| Coal | 300 |
| Natural Gas | 1,431 |
| Wind | 204 |
| Other | <u>60</u> |
| Total | 1,994 |

Future planned capacity will result in an even greater dependence on natural gas and subject rate payers to price volatility and increases.

Source: RDI BaseCase, NewGen and PowerDat Databases



Solar Resource and Land

- **New Mexico's solar resource potential is very large and should be developed.**
- **New Mexico's planned new capacity (in fact total energy usage) is very small relative to that potential.**
- **This small “solar dam” would need 1.9 mi² (Area 1 by 2 mi)**

| CSP Capacity (MW) | Land Requirement (mi | % of Premium Resource |
|--------------------------|-----------------------------|------------------------------|
| | 1.9) | 0.2% |
| 1000 | 7.7 | 0.8% |
| 3000 | 23.2 | 2.5% |

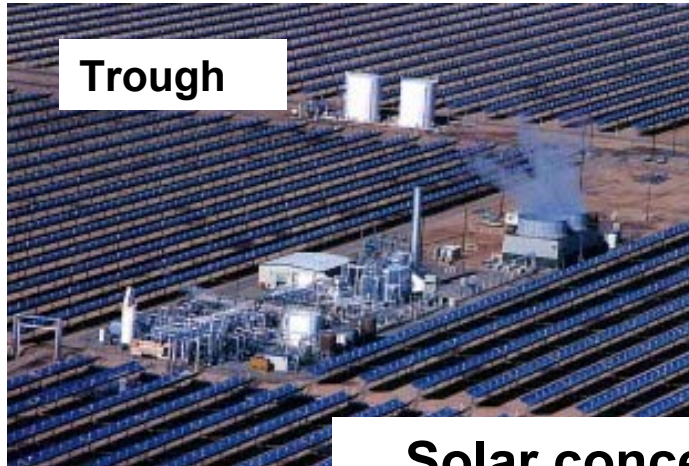


How do we develop this resource?

- **Concentrating Solar Technologies can be used to “mine” this resource.**
- **Some of these technologies use curved mirrors to focus the sun’s rays and to make steam, others directly produce electricity.**
- **This steam is used to produce electricity via conventional power equipment.**
- **In multi-Megawatt plants, CSP provides the lowest cost solar electricity.**



What is CSP?



Solar concentration allows tailored design approaches





Movie of three CSP technologies

This film clip shows

- **The Solar Two Power Tower experiment at Barstow, CA**
- **The Solar Energy Generating Systems (SEGS) at Kramer Junction, CA**
- **Two Stirling Energy Systems
10 kW Dish Stirling systems
operating in Albuquerque,
NM**





Concentrating Solar Power (CSP) is

- **ideally suited for multi-megawatt central power plants**
- **dispatchable power for peaking and intermediate loads through hybridization and/or thermal storage**
- **distributed power for grid support and remote applications**
- **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 a coal-fired plant**



Benefits to New Mexico from Development of its Solar Thermal Resource

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

Energy

- **Produce clean power in the state**
- **Hedge against NG price increases and volatility**
- **Reduce or mitigate transmission problems**



Economy

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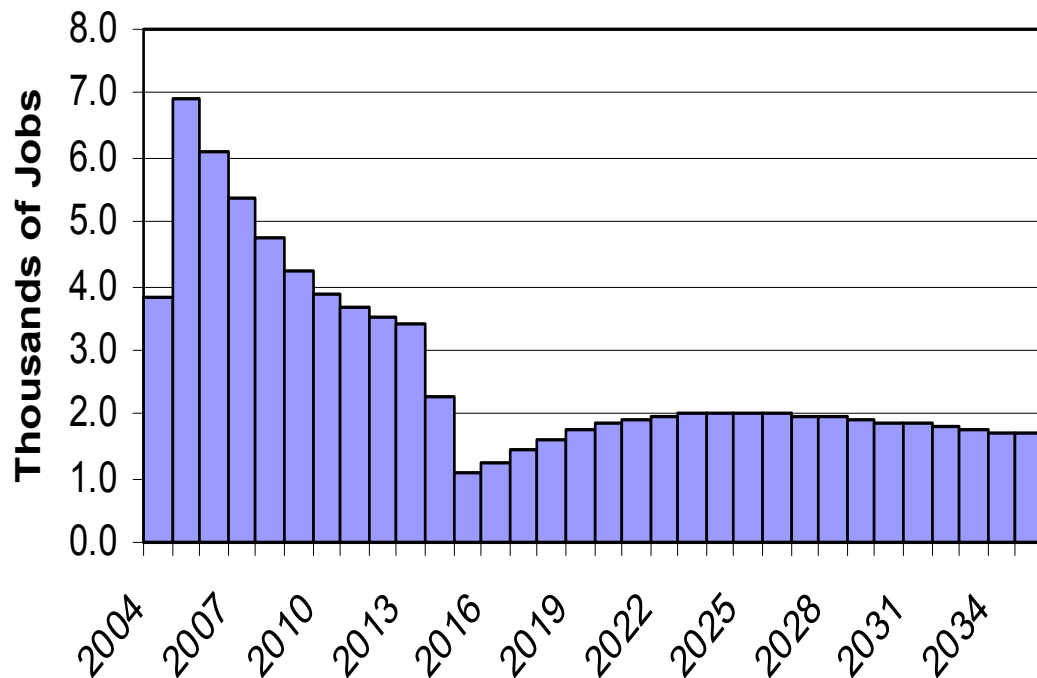
Create New Jobs in Rural Areas

- **At its peak, installation of 1000 MW of CSP power plants would create nearly 7,000 new jobs.**
- **New jobs will be created to build, assemble and operate the plants.**
- **These jobs can readily be created near Deming, Artesia, Tucumcari, Quemado, Farmington, and in other rural areas.**
- **With the location of CSP plants in NM, manufacturing and assembly plants can be expected to locate in the State.**



Economic Benefits to NM

Employment Impact of Constructing, Operating, and Maintaining 1000 MW CSP Generation Facilities in Nevada



**Detailed Study
for Nevada**

**Similar study
could be done to
evaluate
economic impact
in NM.**

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



Increased Cash Inflow For Energy

- **250 MW of CSP plants will displace approximately 5,000 mmcf (~ \$15 million) per year of natural gas usage for export.**
- **The retained funds will contribute to New Mexico's GSP, ultimately in multiples of the original savings.**
- **Development of CSP plants along the border could increase economic development and trade with Mexico.**
- **Development of CS Power Plants on native American Lands could provide development and jobs.**



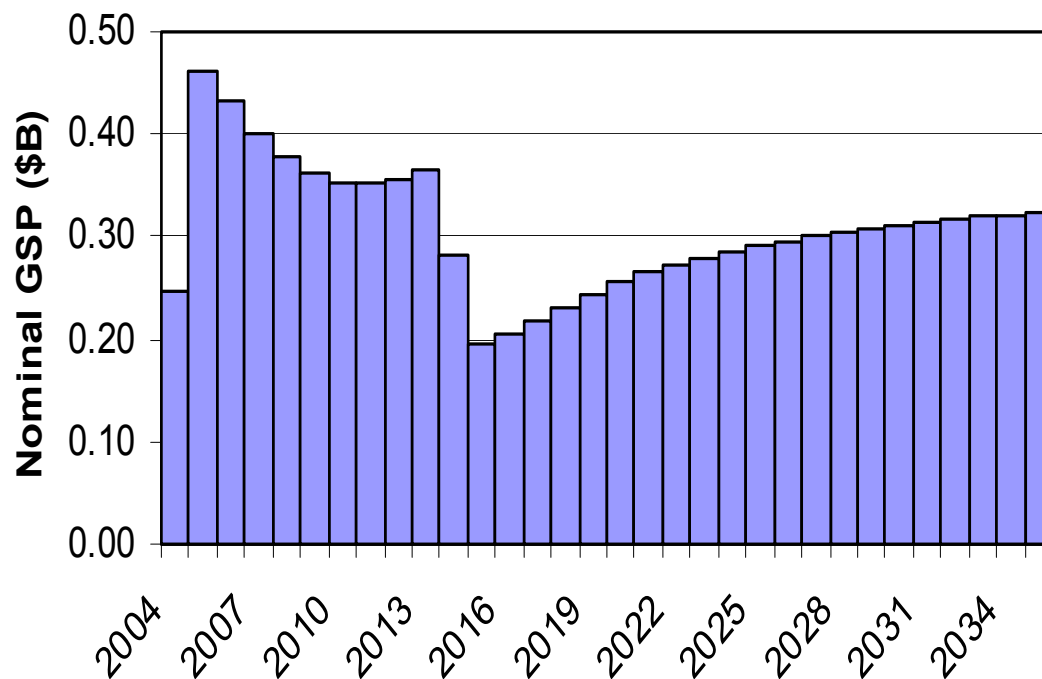
Increase Capital Investment in the State

- **CSP Plants built in New Mexico will bring substantial private investment.**
 - **250 MW – \$750 Million**
 - **1000 MW - \$2 Billion**
 - **6000 MW - \$11 Billion**
- **Should increase income to the state through increased tax base.**



Economic Benefits to NM

Impact on Nevada Gross State Product of Constructing, Operating, and Maintaining 1000 MW CSP Generation Facilities



**Detailed Study
done for Nevada**

**Similar study
could be done to
evaluate impact
on NM GSP.**



Environment

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



New Mexico Emissions in 2001

Million lbs.

| Technology | Generation (MWh) | CO ₂ | SO ₂ | NO _x |
|--------------|------------------|-----------------|-----------------|-----------------|
| Coal | 28,371,000 | 56,601 | 67.4 | 10.8 |
| Nat. Gas | 4,412,000 | 5,885 | 0.0 | 1.0 |
| State Totals | 32,931,000 | 62,486 | 67.4 | 11.8 |

Source: RDI PowerDat Database



Environmental Benefits

Displacement (millions of lbs)

| CSP Capacity (MW) | Displacement (millions of lbs) | | |
|----------------------|--------------------------------|-----------------|-----------------|
| | CO ₂ | SO ₂ | NO _x |
| 250 | 1,100 | 1.0 | 0.9 |
| 1000 | 4,600 | 3.8 | 3.6 |
| 6000 | 27,400 | 23.0 | 21.6 |

Based on displacement of best available coal technology

Emissions Based on Planned New NG and Coal Gen (millions of lbs)

| Planned (MW) | Emissions Based on Planned New NG and Coal Gen (millions of lbs) | | |
|-----------------|---|-----------------|-----------------|
| | CO ₂ | SO ₂ | NO _x |
| 1,994 | 10,563 | 6.4 | 1.9 |

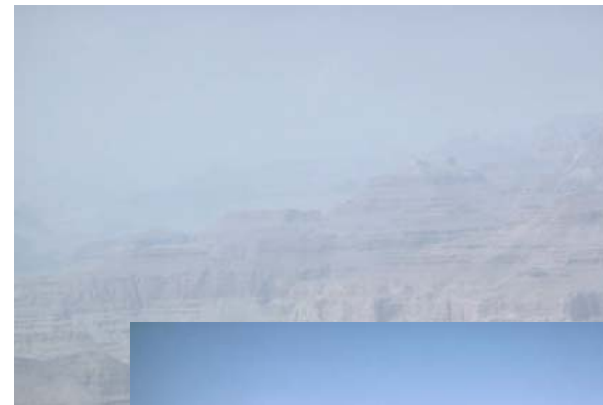


Photo Source: Western Regional Air Partnership

CSP will contribute to the WRAP goals of cleaner air, reduced air pollution, and haze reduction.



Energy Benefits to NM

Energy

- **Produce clean power in the state**
- **Hedge against NG price increases and volatility**
- **Reduce or mitigate transmission problems**



Energy Benefits to NM

Produce Clean Power in State

- **250 MW of CSP by 2006 will displace 12% of New Mexico's planned capacity additions.**
- **1000 MW of CSP by 2008 will displace 36% of New Mexico's planned capacity additions. (Constant capacity growth rate assumed.)**
- **3000 MW of CSP by 2012 will displace 68% of New Mexico's planned capacity additions. (Constant capacity growth rate assumed.)**

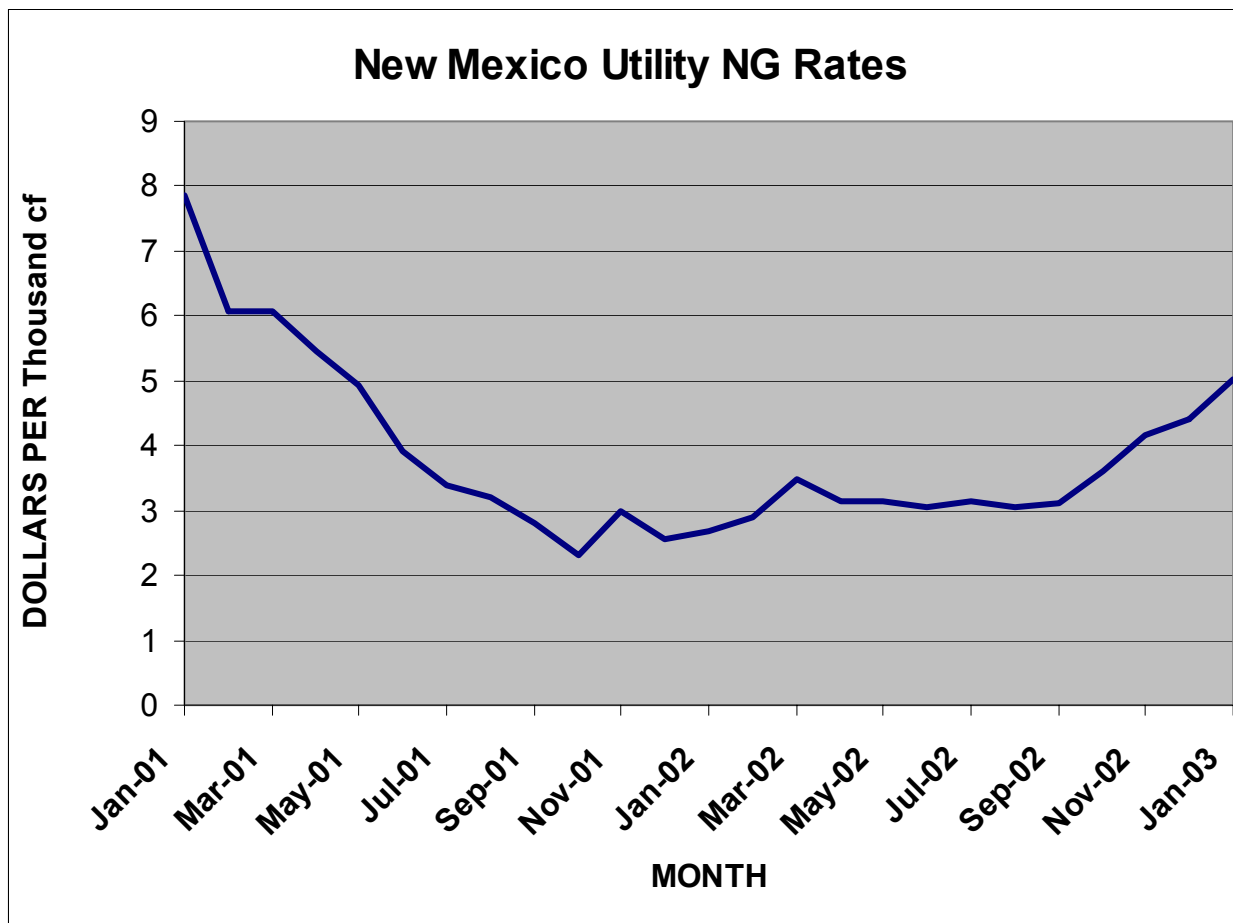


Hedge Against Natural Gas Price Volatility

- **The price of natural gas has a long history of volatility.**
- **New Mexico has seen its gas prices fluctuate between \$2.31 and \$7.87 per thousand cubic feet in the last two years.**
- **The price of natural gas has been rising for the past year and is not expected to return to its recent low levels.**
- **New natural gas-based generation will increase natural gas price instabilities.**



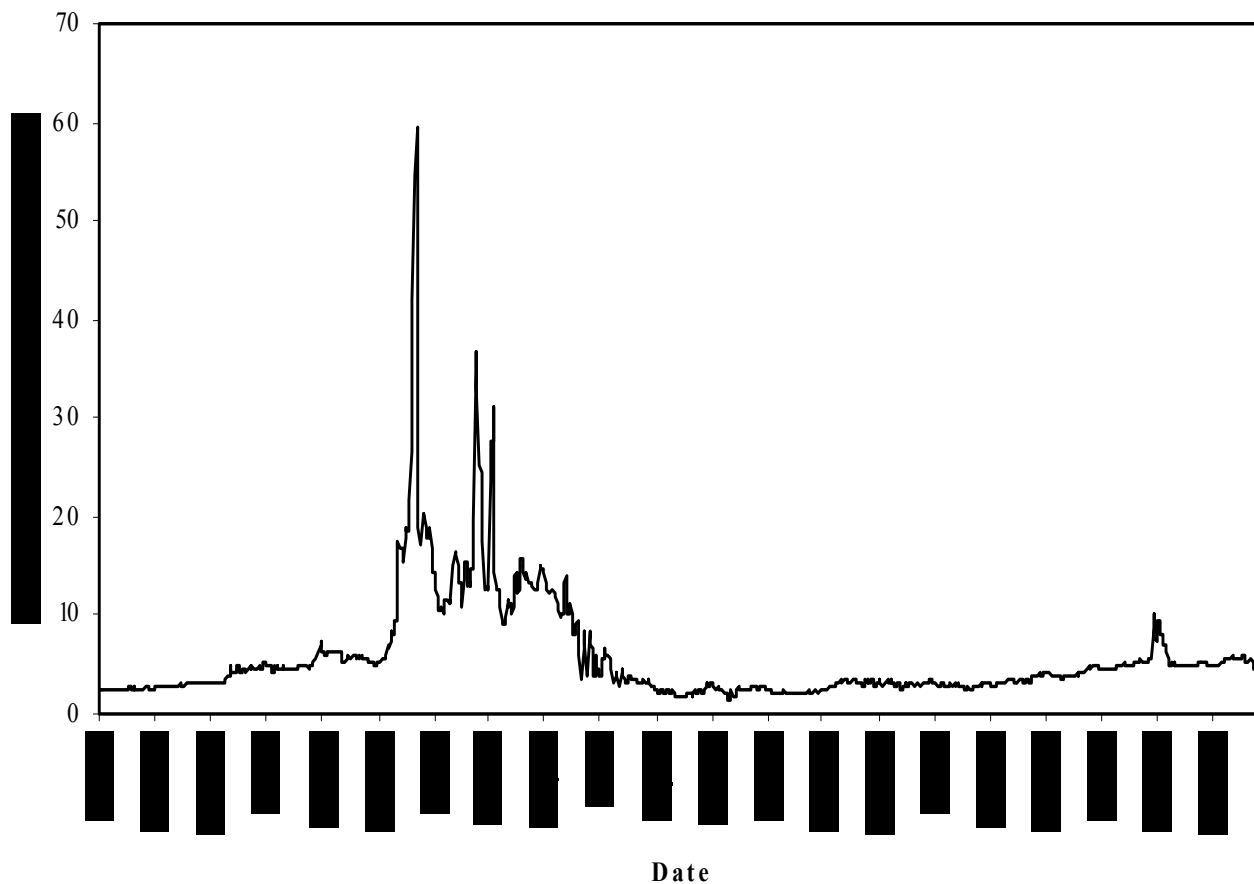
Natural Gas Prices in New Mexico





Natural Gas Price Volatility

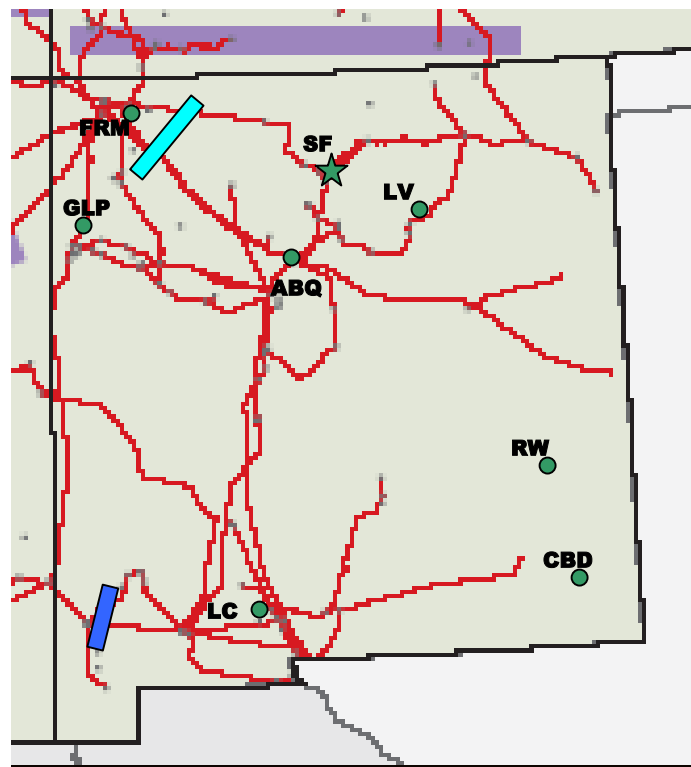
Southern California Hub Nat. Gas Price: Jan. 2000 – Jun. 2003





Reduce or Mitigate Transmission Problems in New Mexico

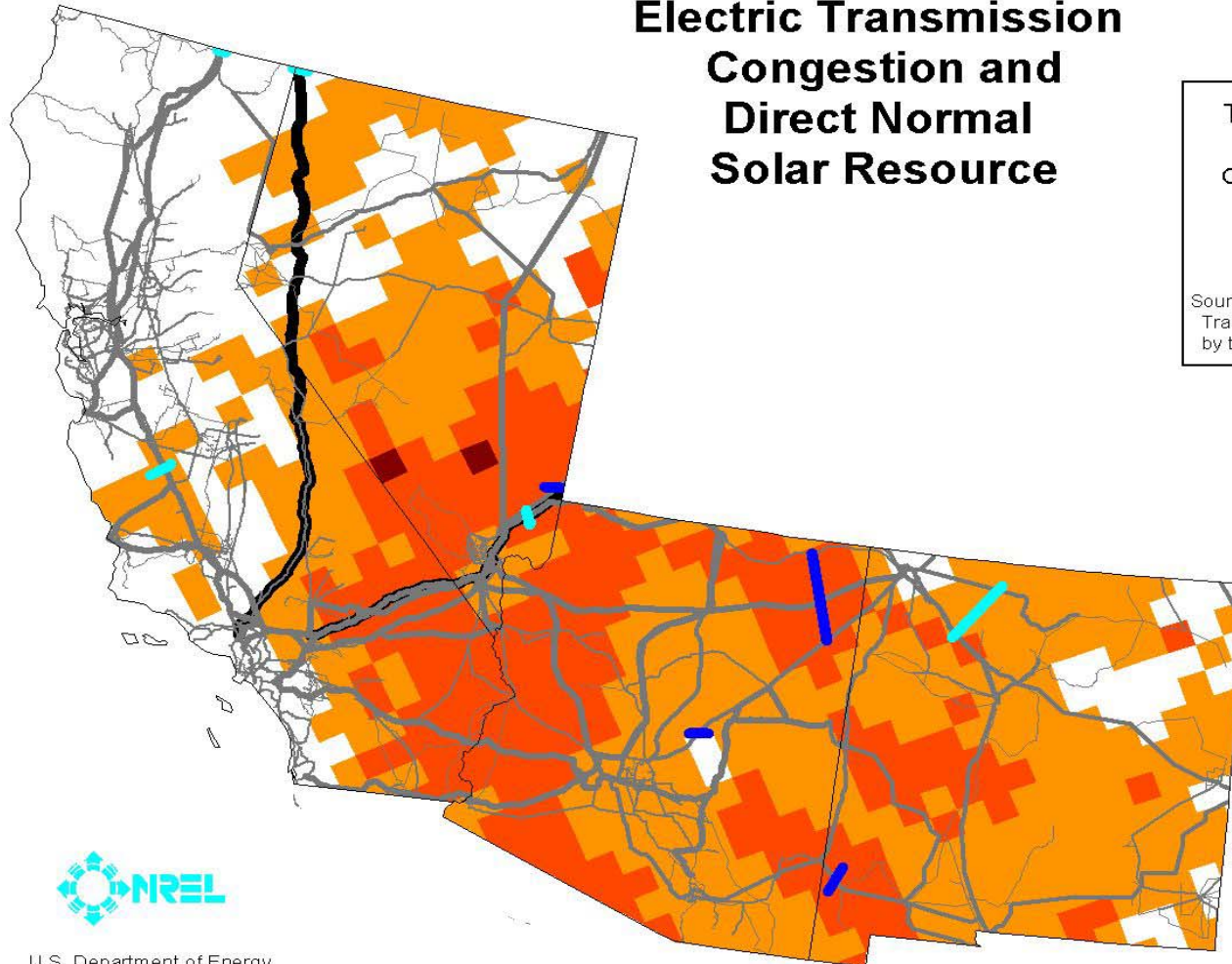
CSP plants can be located close to load centers, providing a means to relieve transmission bottlenecks.





SW Transmission Barriers

Southwest United States Electric Transmission Congestion and Direct Normal Solar Resource



Transmission Path Load
Time over 75% of
Operational Transfer Capacity
(in at least one season)

- > 50%
- 25 - 50%

Source: Draft Western Interconnection
Transmission Path Flow Study (Jan 2003)
by the Seams Steering Group

Transmission Line
Voltage

- Below 230kV
- 230kV - 344kV
- 345kV - 499kV
- 500kV - 734kV
- 735kV - 999kV
- DC

Source: PowerMap, ©2002
Platts, a Division of the
McGraw-Hill Cos.

Concentrating
Solar Resource

- kwh/m²/day
- > 8.0
 - 7.0 - 8.0
 - 6.0 - 7.0





An example of what it could cost to develop New Mexico's solar energy resource.

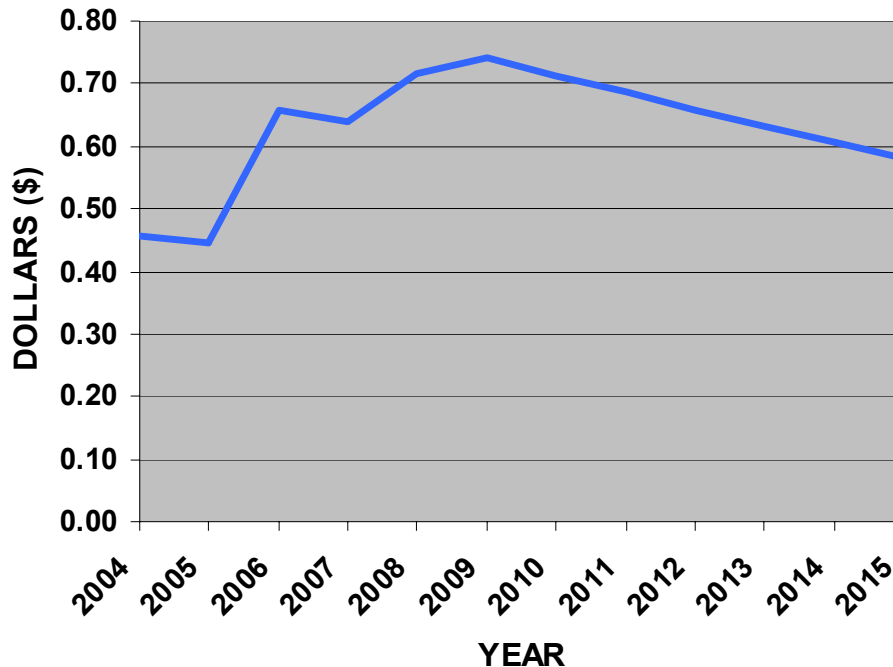
- **The investment to build the CSP plants could come from private money – not from the state's treasury.**
- **The kWh premium to cover this investment is shared among rate payers in the existing RPS.**
- **If rate based, the monthly ratepayers charge could be as low as 45 to 75 cents per month to support 250 MW.**
- **The monthly amounts need to be applied as a premium to the kWh purchases from the plant to support the plant developers debt and equity payments.**
- **This premium is smaller than many typical fuel adjustment charges.**



Cost to NM Ratepayers

If rate based, the cost to the NM ratepayer of deployment of 250 MW of CSP Power.

MONTHLY COST TO NM CONSUMER OF 250 MW DEPLOYMENT BY 2010



Assumes:

250 MW deployment in four states

Costs distributed to customers of 4 NM IOUs

1% per year cost increase of conventional power



Cost to NM Ratepayers

If NM installs 250 MW of CSP power

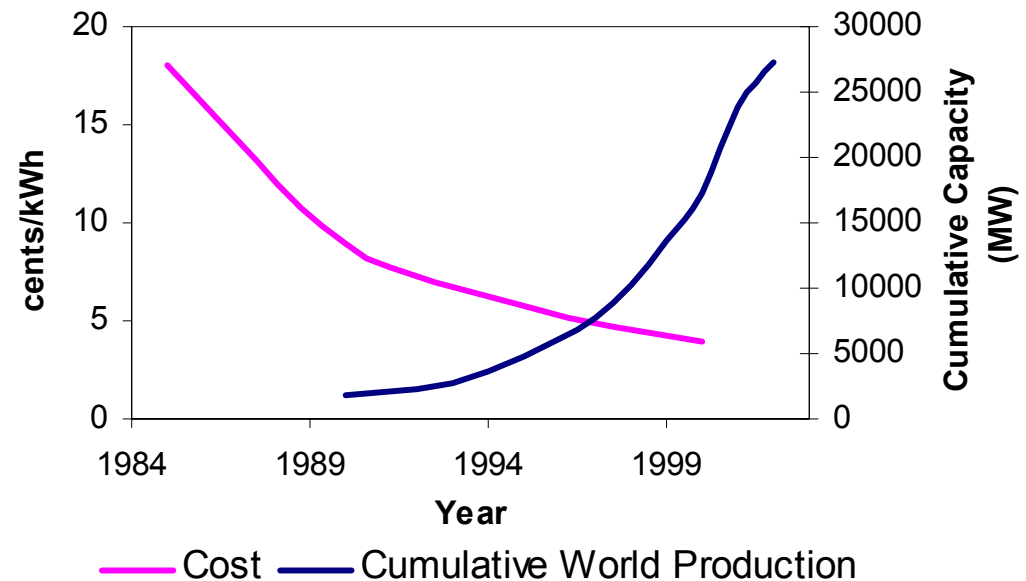
- **The average cost to ratepayers is about 60 cents per month for 15 years.**
- **If other states (and countries) also install CSP capacity, the price will decline faster and the cost to ratepayers will also decline.**
- **Austin Energy offers a voluntary premium of \$2.85 for green power and holds it fixed for 10 years. It's very popular and responsible for that firm being the leader in green power in the US.**



Cost reductions realized by wind power are good examples for CSP.

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

Wind Power Costs and Capacity



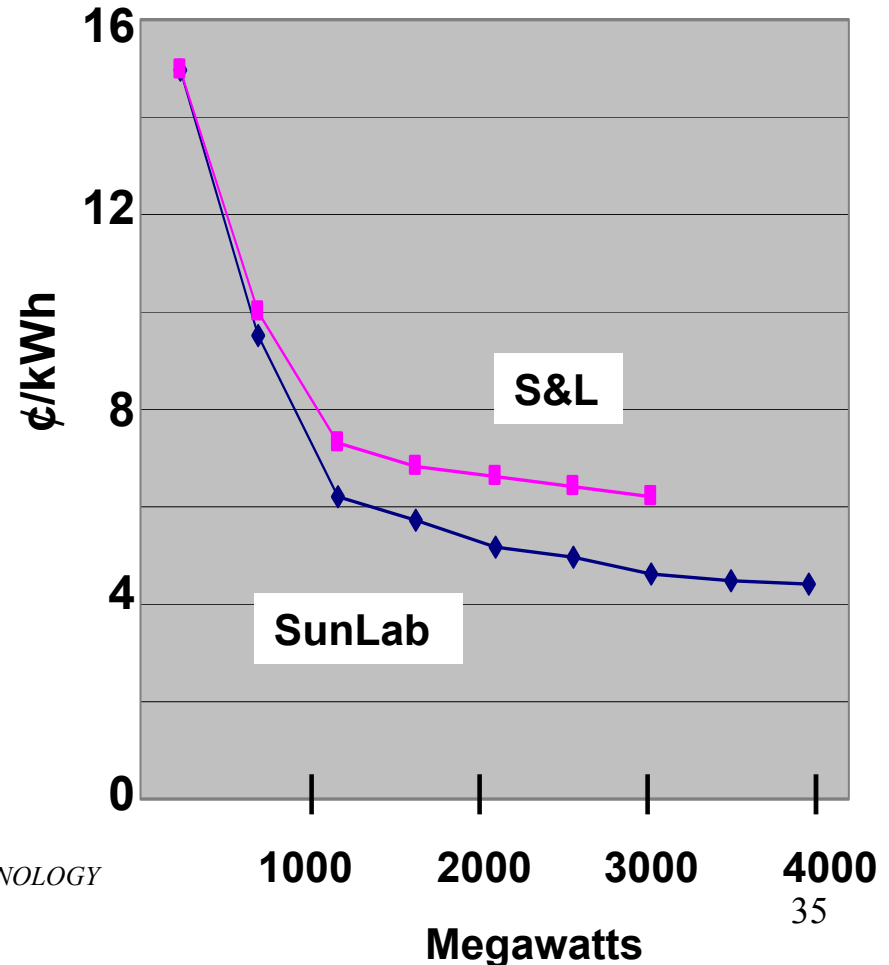


Projected Costs of CSP Generation

Sargent & Lundy* and SunLab each evaluated the potential cost reductions of CSP.

Cost reductions for trough technology will result from deployment, scale and R&D

Cost reductions are accelerated with faster deployment schedule



** ASSESSMENT OF PARABOLIC TROUGH AND POWER TOWER SOLAR TECHNOLOGY COST AND PERFORMANCE FORECASTS, SL-5641 MAY 2003.*



NM Renewable Incentives

Renewable Energy Tax Credit (1¢/kWhr)

ConservationSmart from Xcel EnergySM -
Windsorce® (Wind)

El Paso Electric Company - Renewable
Energy Tariff (Wind)

New Mexico Million Solar Roofs
Partnership (SWH, PV, SPH)

Interconnection Standards (< 10 kW)

Line Extension Analysis (PV)

Mandatory Utility Green Power Option
(everything but CSP)

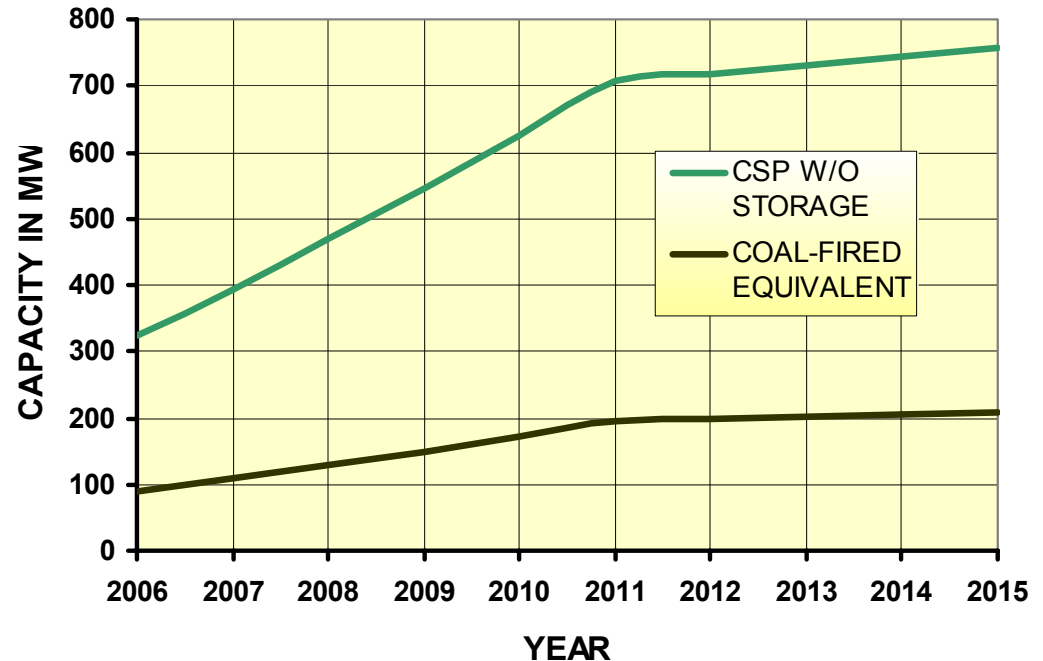
Net Metering (< 10kW)

Renewables Portfolio Standard

New Mexico has at least 9 mandatory and voluntary programs, regulations, and incentives for using renewable energy. Only TWO apply to CSP technology.

The maximum capacity of the NM RPS is just 200 MW base-load equivalent in 2015.

NM RPS Requirement



What Needs to be done?

CSP Industry recommendations:

- **Leadership by the Governor to develop the state's solar energy resource.**
- **Amend the NM RPS to increase the solar capacity proportionate to the State's resource.**
- **Participate in the 1000 MW Initiative by deploying a minimum of 250 MW of CSP power over the next 5 years.**
- **Work with PRC toward approval and support for the required rules and premiums.**



What needs to be done? (2)

CSP Industry recommendations:

- **Encourage continued congressional support for DOE's CSP R&D program.**
- **Support a Federal production tax credit (PTC) for CSP to reduce the burden on NM's rate payers.**
- **Work with WIEB and WAPA to aggregate CSP power plant purchases in the four SW states**
- **Encourage WAPA to aggregate CSP demand and bid to meet this demand.**
- **Explore ways to use federal and tribal lands to site CSP plants.**



Post-1000 MW Situation and Opportunities

- **CSP electricity costs declines to single digit c/kWh.**  **NM has access to a clean, in-state energy source at competitive prices.**
- **NM CSP leadership solidified, US companies positioned to capture international projects.**  **NM businesses gain major market share.**



New Mexico can add another engine for its economy by developing its solar energy resource.

The economic benefits to New Mexico far exceed the cost to develop this clean and renewable resource.