





# *Central Solar Power: The Climate Connection*

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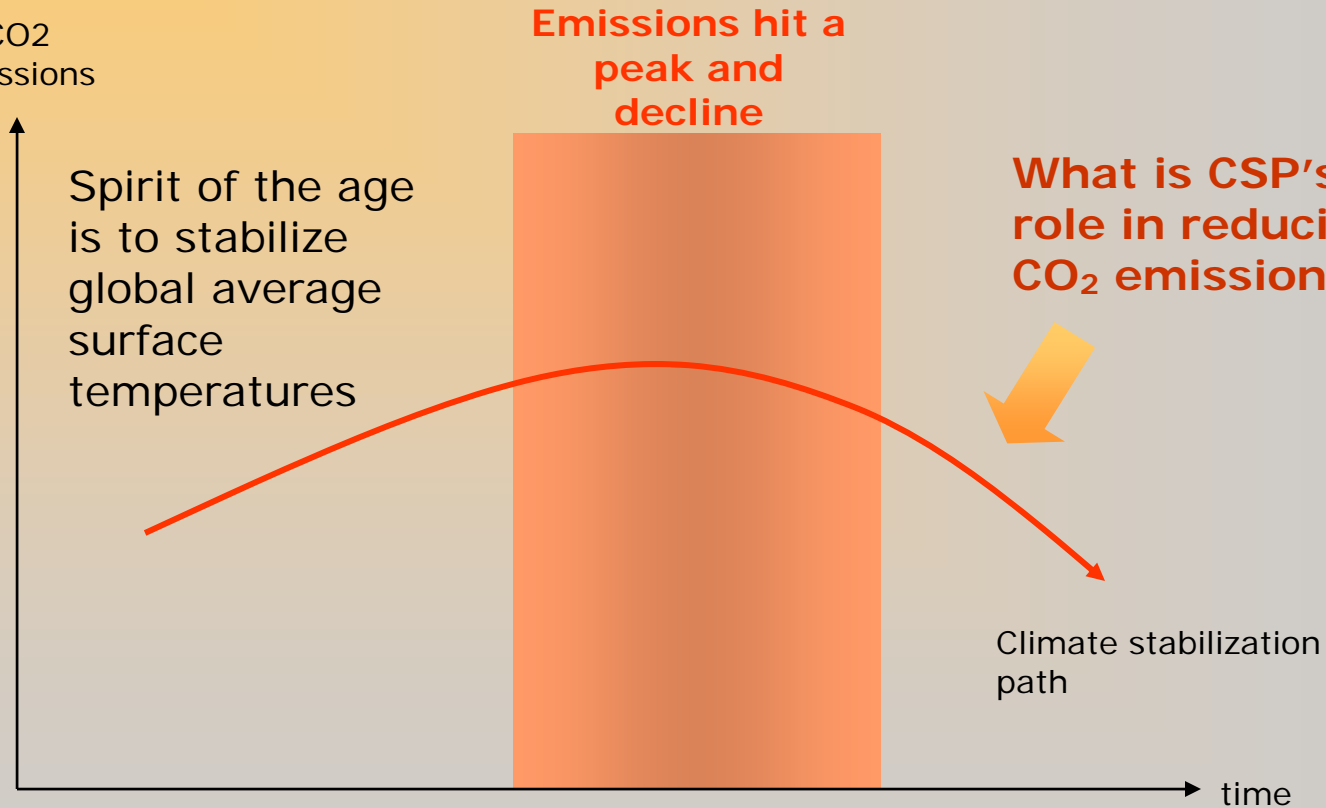
***WITH COMMENTARY BY VOLTAIRE***



*"He who has not the spirit of this age has all the misery of it"*



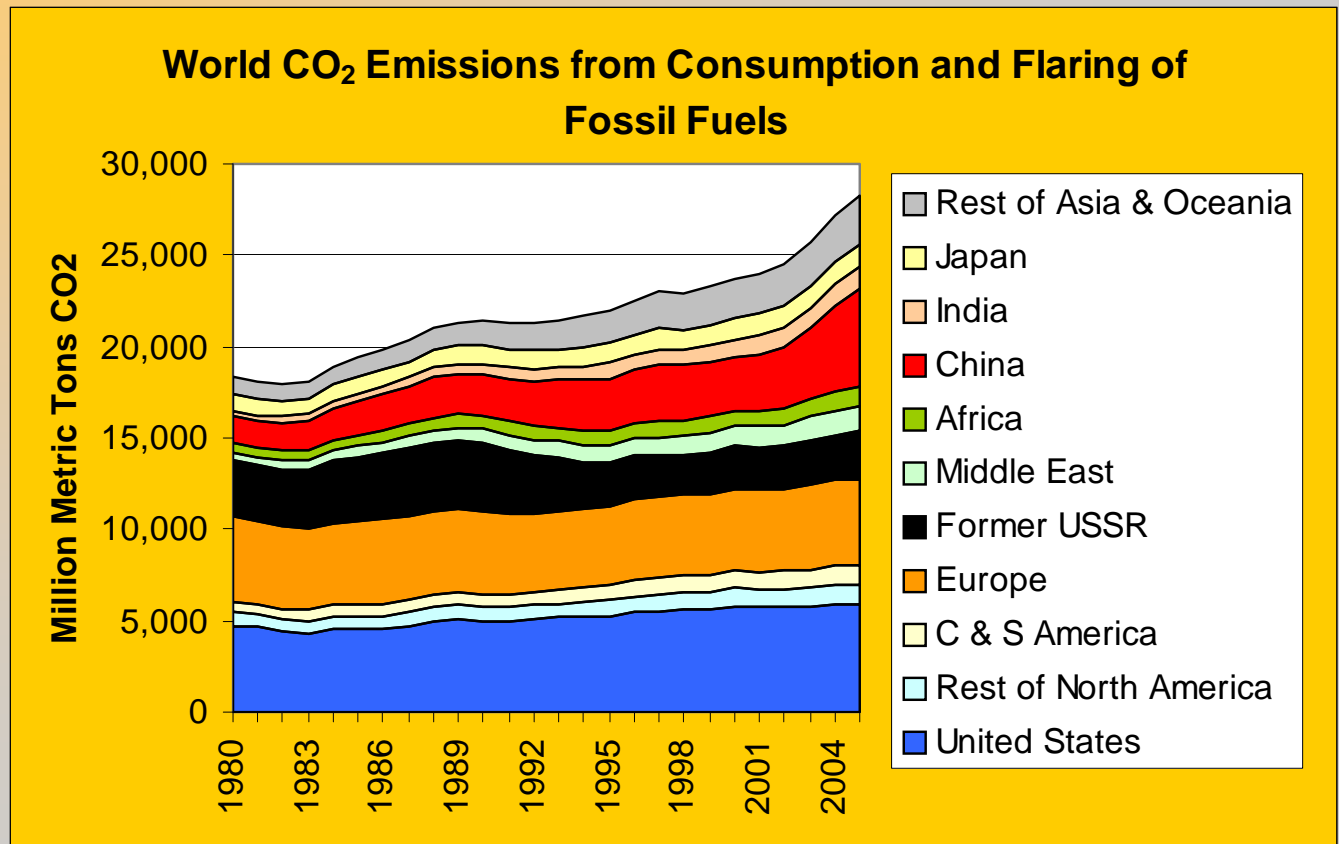
CO2 emissions





*"O what fine times, this age of iron!"*

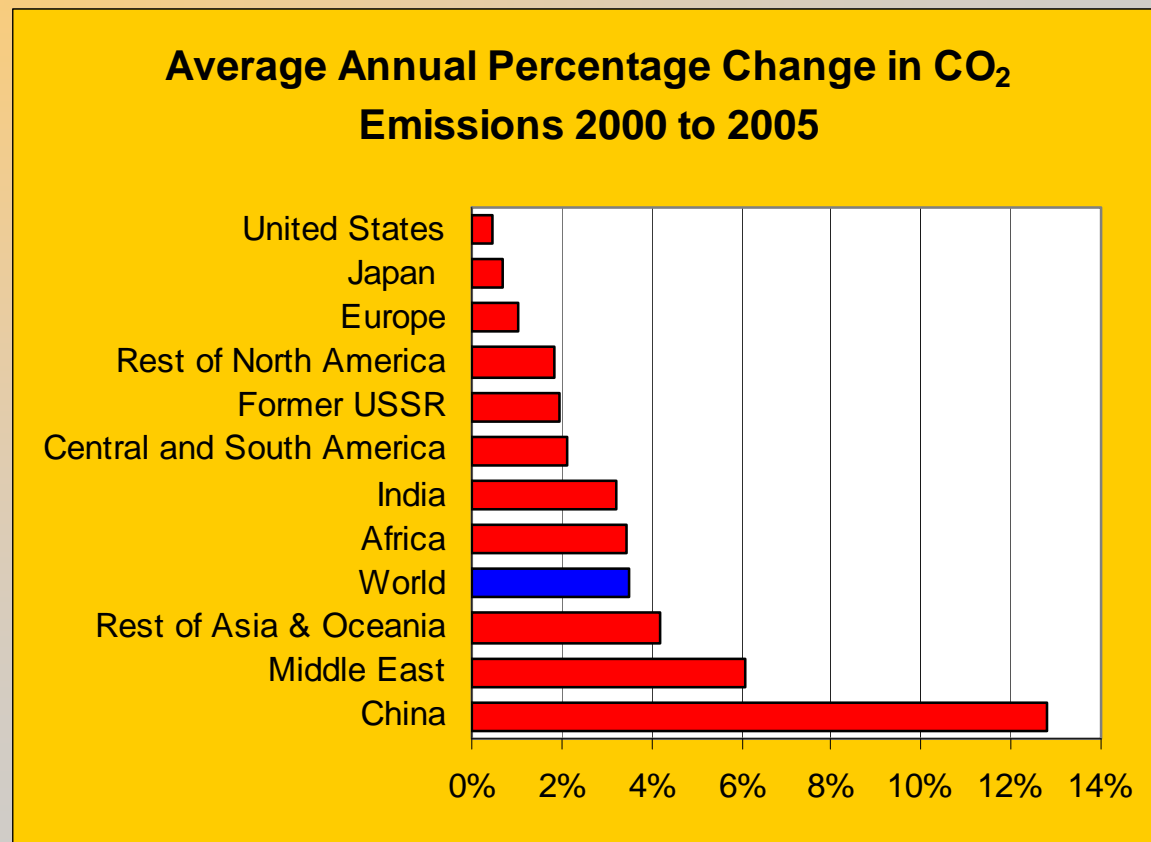
**Global CO<sub>2</sub> emissions have increased 54% since 1980**



Source: EIA, *International Energy Annual 2005*, Table H.1co2



*The most rapid growth rate in CO<sub>2</sub> emissions since 2000 has occurred in China*

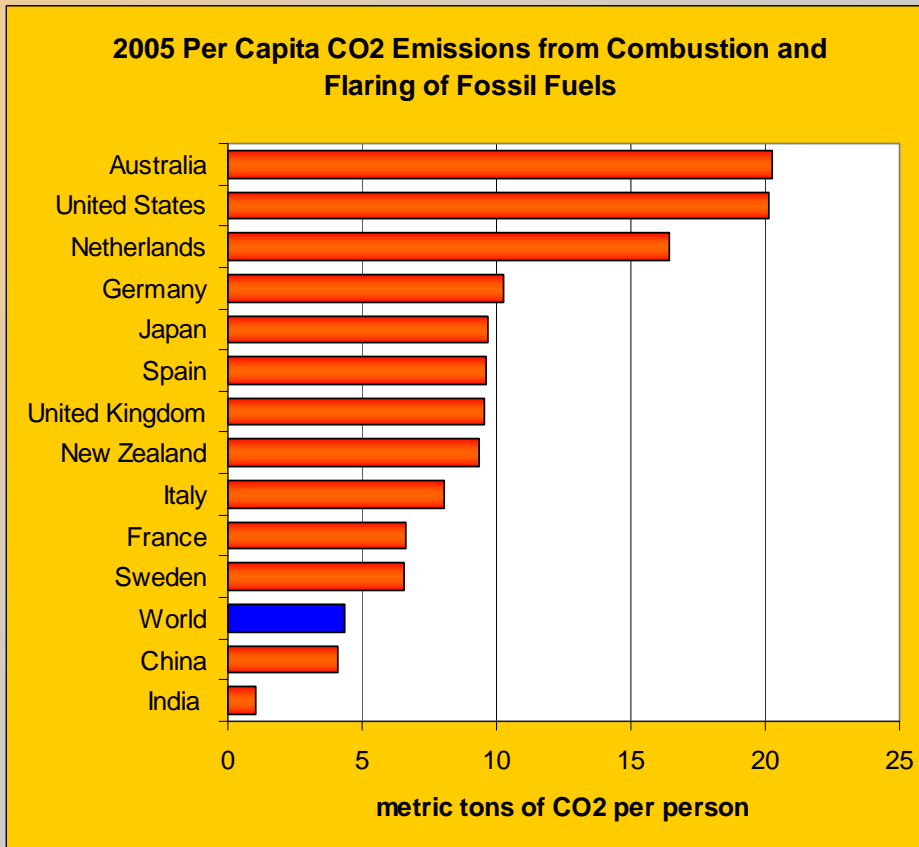


Source: EIA, *International Energy Annual 2005*, Table H.1co2



*"If this is the best of all possible worlds, what are the others like?"*

**The US & Australia have much higher per capita CO<sub>2</sub> emissions than other developed countries.**



Source: EIA *International Energy Annual 2005*, Table H.1cc02



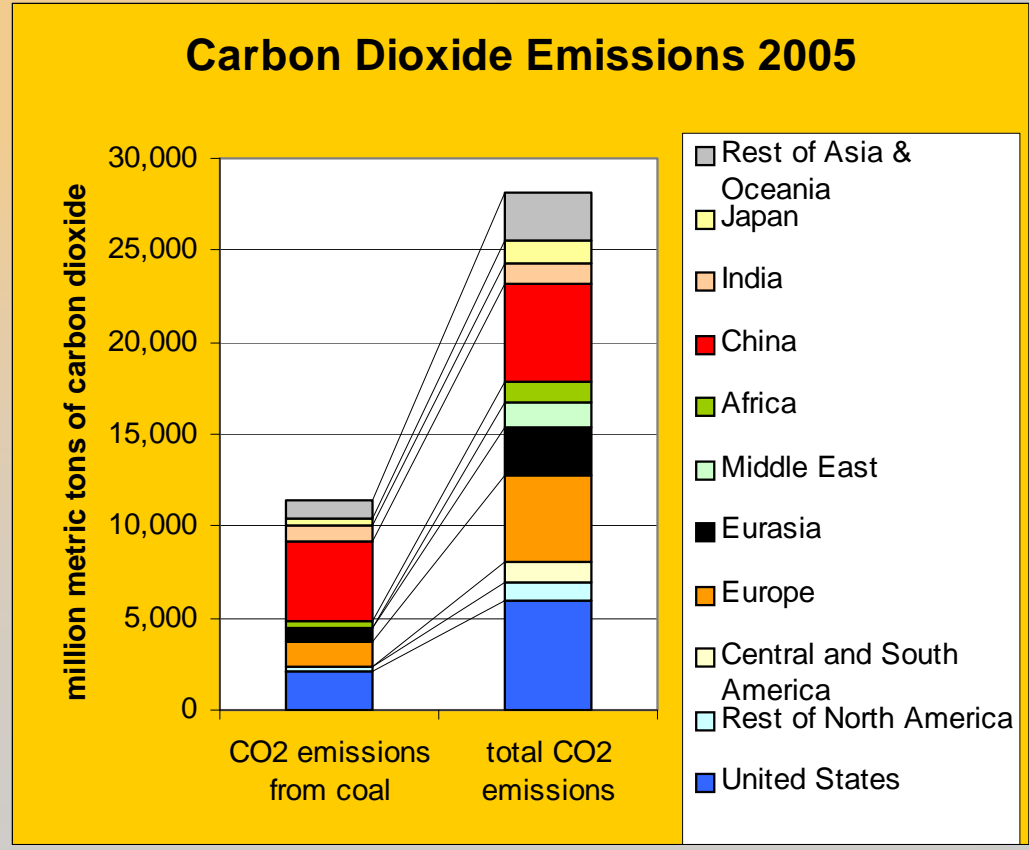
# Combustion of coal accounts for 40% of worldwide carbon dioxide emissions



Source: EIA  
*International Energy Annual 2005*, Tables H.4co2 & H.1co2



**82% of China's CO<sub>2</sub> emissions are from consumption of coal and 68% of India's are from consumption of coal**





*"Everything's fine today, that is our illusion."*

## The Southwest's climate future:

- ★ Drier climate, continued drought, reduced snowpack, declining water supplies
  - Conflict among water uses, wildfires
- ★ Warmer climate: 5° to 8° F warmer by 2100 if CO<sub>2</sub> concentration is 2.5 times higher than in pre-industrial era.
  - More heat waves, exacerbated urban heat island effect
- ★ Ecological changes
  - Invasive species, earlier spring, insect invasions, loss of habitat
- ★ References: Jim Steenburgh, University of Utah, "BRAC Climate Science Report Overview," 2007. C.B. Field et al., "North America," Chapter 14 in *Climate Change 2007: Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press 617-652, 2007. Institute for the Study of Planet Earth, "Global Warming in the Southwest: How Does It Affect Us?" University of Arizona.



*GHG emissions must decline dramatically, starting now, if temperature increases are to be moderate*

CO <sub>2</sub> concentration ppm	CO <sub>2</sub> equivalent concentration ppm	Global mean temperature increase above pre-industrial equilibrium °C	Peaking year of CO <sub>2</sub> emissions	Change in global CO <sub>2</sub> emissions in 2050 (% of 2000 emissions)
350 to 400	445 to 490	2.0 to 2.4	2000 to 2015	-85 to -50
400 to 440	490 to 535	2.4 to 2.8	2000 to 2020	-60 to -30
440 to 485	535 to 590	2.8 to 3.2	2010 to 2030	-30 to +5
485 to 570	590 to 710	3.2 to 4.0	2020 to 2060	+10 to +60
570 to 660	710 to 855	4.0 to 4.9	2050 to 2080	+25 to +85
660 to 790	855 to 1130	4.9 to 6.1	2060 to 2090	+90 to +140

Source: IPCC Fourth Assessment Report, Working Group III, Summary for Policymakers, 2007, p. 15



***“No problem can withstand the assault of sustained thinking”***

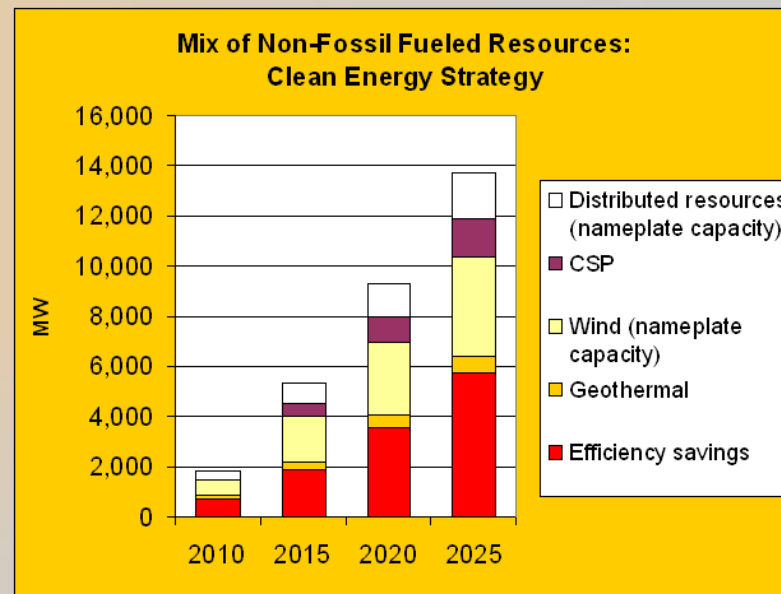
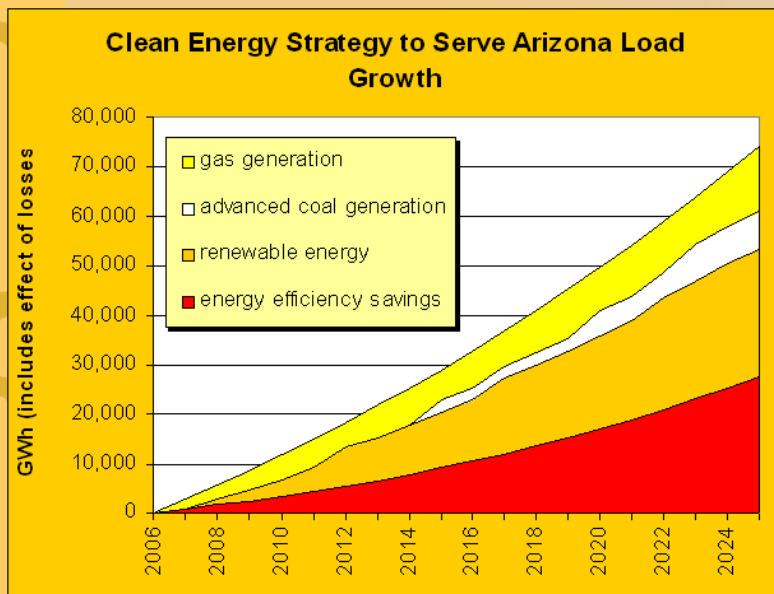
### **Role of CSP in climate policy:**

- ★ CSP could play a major role in implementing climate policy by:
  - Displacing future conventional coal-fired power plants
  - Replacing existing conventional coal-fired power plants
  - Thereby reducing carbon dioxide emissions
  
- ★ However, CSP will probably have to be coupled with other generation, such as gas-fired generation, to fully substitute for conventional base-load coal-fired power plants



*“Life is bristling with thorns, and I know no other remedy than to cultivate one's garden.”*

## A clean energy strategy for serving AZ load growth



Renewable energy would serve about one-third of load growth

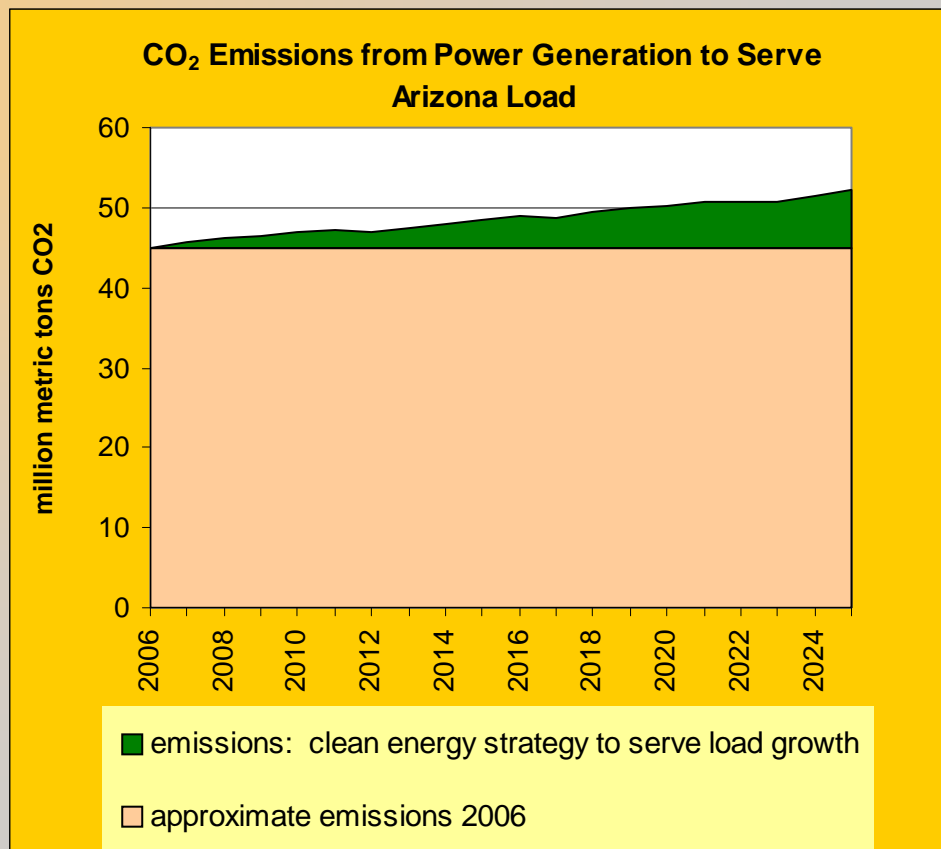
Of that, CSP's role will depend on cost and performance

Source: Western Resource Advocates, *A Clean Electric Energy Strategy for Arizona*, 2007.



# *The Clean Energy Strategy reduces CO<sub>2</sub> emissions from serving load growth*

Load in 2025 is about double that in 2006, but CO<sub>2</sub> emissions from serving load growth with clean energy resources are only about one sixth of the emissions from the power supply portfolio existing in 2006





*Emissions from existing power plants must also be reduced via retirement and replacement with clean resources or capture & storage of CO<sub>2</sub> emissions*



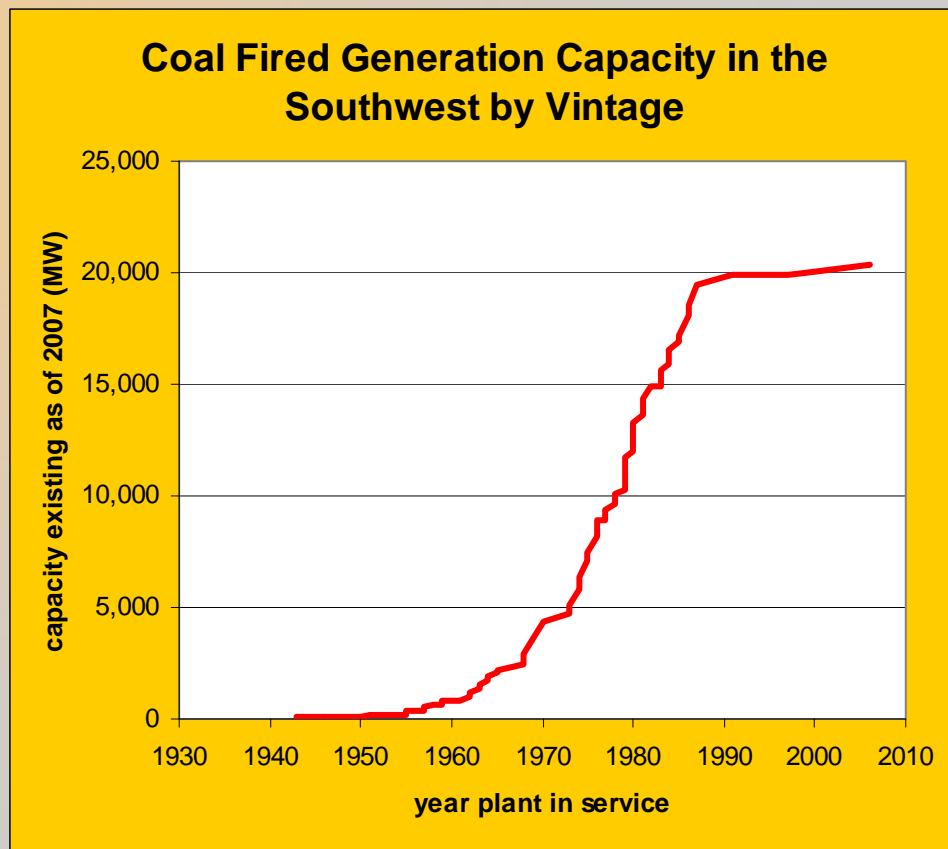
Old coal plants are obvious candidates for retirement

Five states: AZ, NM, NV, UT, CO

Of the 20,000 MW of coal fired generation capacity:

about 5,000 MW was installed before 1974

nearly 12,000 MW was installed before 1980





## *Competitors of CSP – high capacity factor energy services with low CO<sub>2</sub> emissions*



	<b>CSP with storage</b>	<b>Energy Efficiency</b>	<b>Geo-thermal</b>	<b>Nuclear</b>	<b>IGCC with CCS</b>
<b>CO2 emissions (metric tons per MWh)</b>	0	0	0 – 0.03	0	0.4 for early plants to 0.1 for later plants
<b>cost</b>	High, but costs expected to fall over time	low	moderate	???	high
<b>status</b>	To be discussed at this conference	Lowest cost resource	Geographically limited supply	No recent projects. Waste storage not set	Still in planning phase



*"The secret  
of being a  
bore is to  
tell  
everything"*

