

# SOLAR FROM SPACE TO EARTH

SOLAR ENERGY NOW

Presented by:

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DECEMBER 2, 2003





# Electric Lights from Space

Electric Lights on Earth from Space  
The Earth Is Becoming Crowded

Photo Courtesy of NASA

HH01/032/112101

# WHY IS SOLAR IMPORTANT NOW

	“Soccer Mom or Dad” ( 270 Million)	Conservative Use (Not enough)	World Average (7,000 Million)
ELECTRICITY	14,000 kWh/year	7,000 kWh/year	1,000 kWh/Year
	3.8 Tons of CO2	1.9 Tons of CO2	0.3 Tons of CO2
	@.05/kWh =\$700	@.05/kWh =\$350	@.05/kWh =\$50
HOT WATER (gas)	5000 kWh/year	3400 kWh/year	200 kWh/year
	2.0 Tons of CO2	1.4 Tons of CO2	0.1 Tons of CO2
	@2.50/MBTU =\$250	@2.50/MBTU =\$170	@2.50/MBTU =\$10

# WHY IS SOLAR IMPORTANT NOW (Cont.)

	“Soccer Mom or Dad” ( 270 Million)	Conservative Use (Not enough)	World Average (7,000 Million)
TRANSPORTATION	700 Gallons/year INTIMIDATION CLASS SUV	230 Gallons/year HYBRID CAR	10 Gallons/year
	3.0 Tons of CO2	1.2 Tons of CO2	0.05 Tons of CO2
	@ 1.50/Gallon =\$1050	@ 1.50/Gallon =\$345	@ 1.50/Gallon =\$15
<b>TOTALS</b>	<b>19,000 kWh/year</b> <b>700 Gallons</b>	<b>10,400 kWh/year</b> <b>230 Gallons</b>	<b>1,200 kWh/year</b> <b>10 Gallons</b>
	<b>8.8 Tons of CO2</b>	<b>4.5 Tons of CO2</b>	<b>0.45 Tons of CO2</b>
	<b>\$2000</b>	<b>\$865</b>	<b>\$75</b>



# United States Can Have 5,000MW of Clean Solar Electricity by 2006

A first step toward energy independence and stable prices.

Power Electric Plant Totals	USA Capacity (MW)	USA Percent of Supply	California Capacity (MW)	California Percent of Supply
Hydroelectric	79,300	10.4%	14,117	26.9%
Geothermal	2,800	0.4%	2,562	4.9%
Oil/Gas	256,000	33.6%	27,733	53.0%
Coal	313,000	41.1%	550	1.0%
Wind (Wind Park Areas)	2,400	0.3%	1,815	3.5%
Biomass	6,600	0.9%	690	1.3%
MSW (Municipal Solid Waste)	3,300	0.4%	202	0.4%
Nuclear	97,500	12.8%	4,310	8.2%
Solar	500	0.1%	413	0.8%
<b>GRAND TOTAL:</b>	<b>761,400</b>	<b>100%</b>	<b>52,392</b>	<b>100%</b>

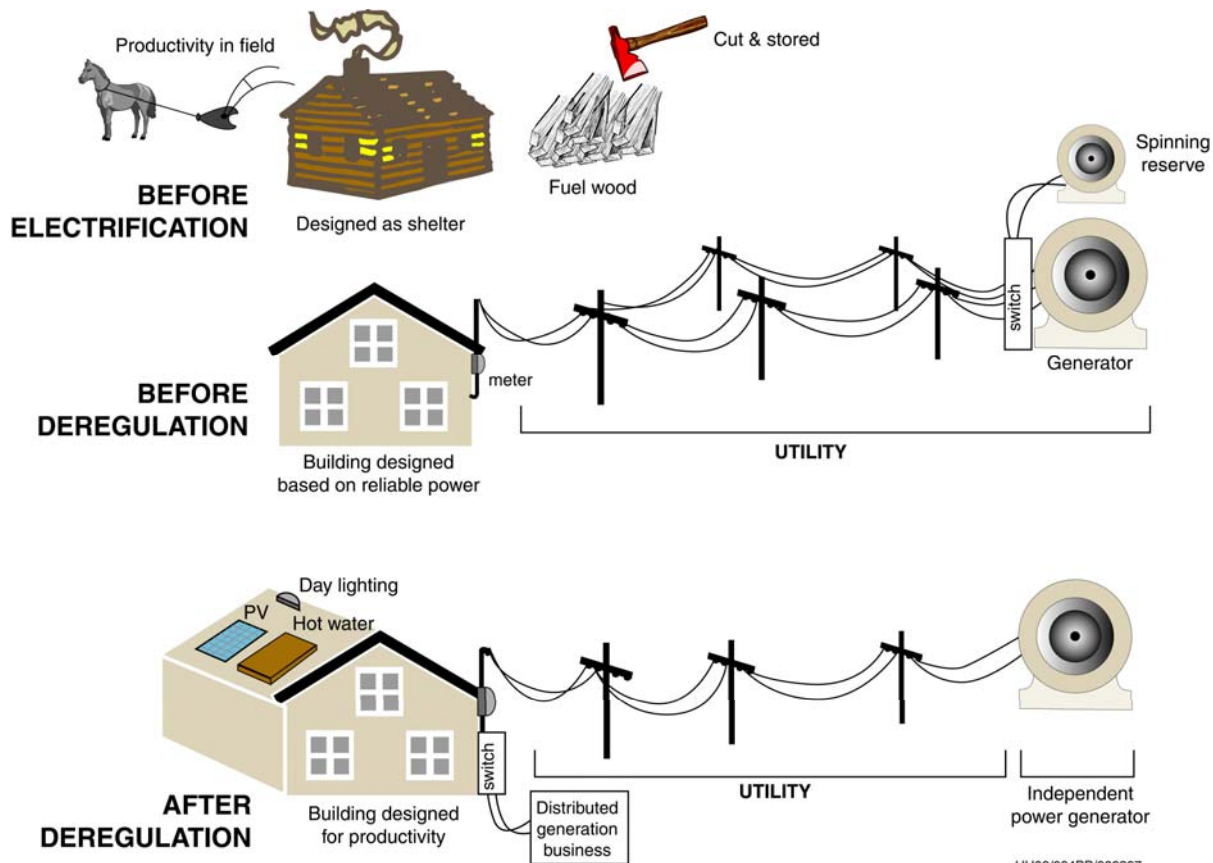
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World Generating Capacity is 3,000,000 MWe  
 @2% Growth, 60,000 MWe Every Year.



# SOLAR- EMPOWERMENT

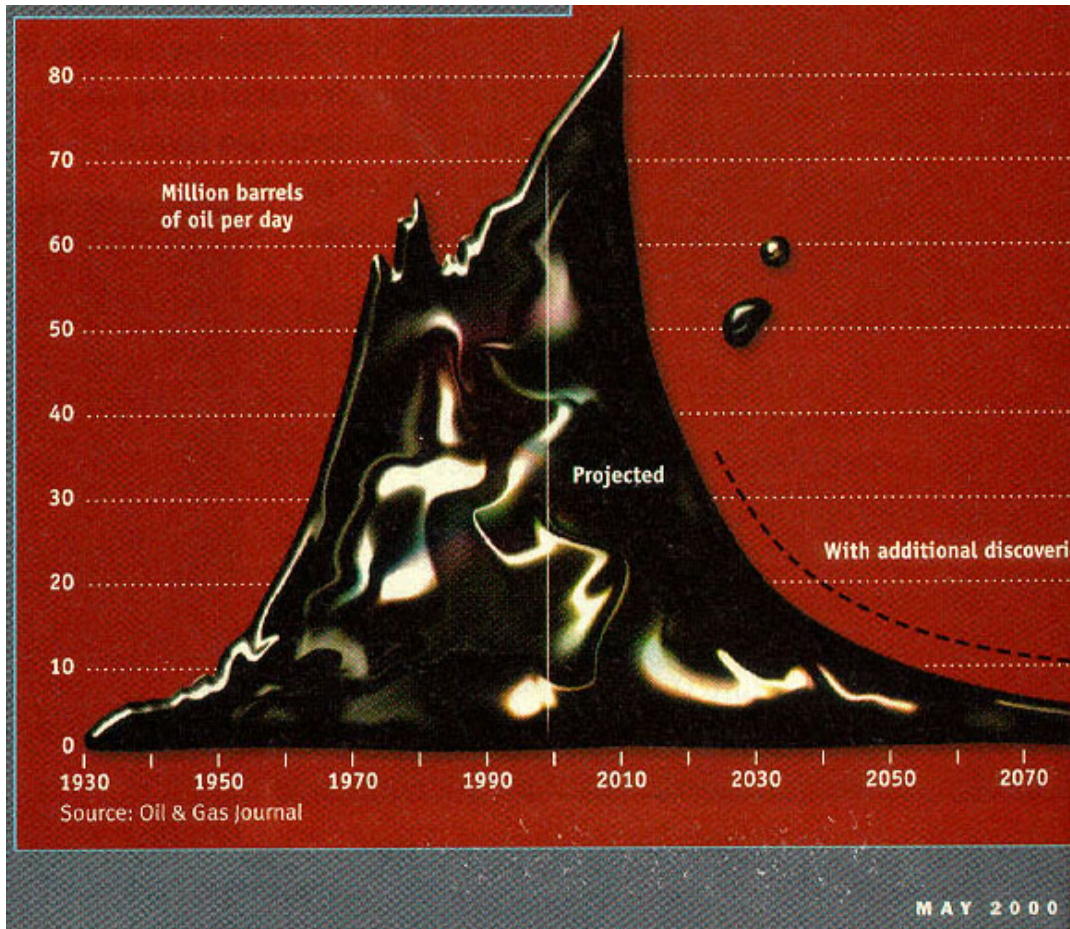
Building owner must meet energy needs cost-effectively.



HH00/004BB/000307



# Are We Really Running Out of Oil?

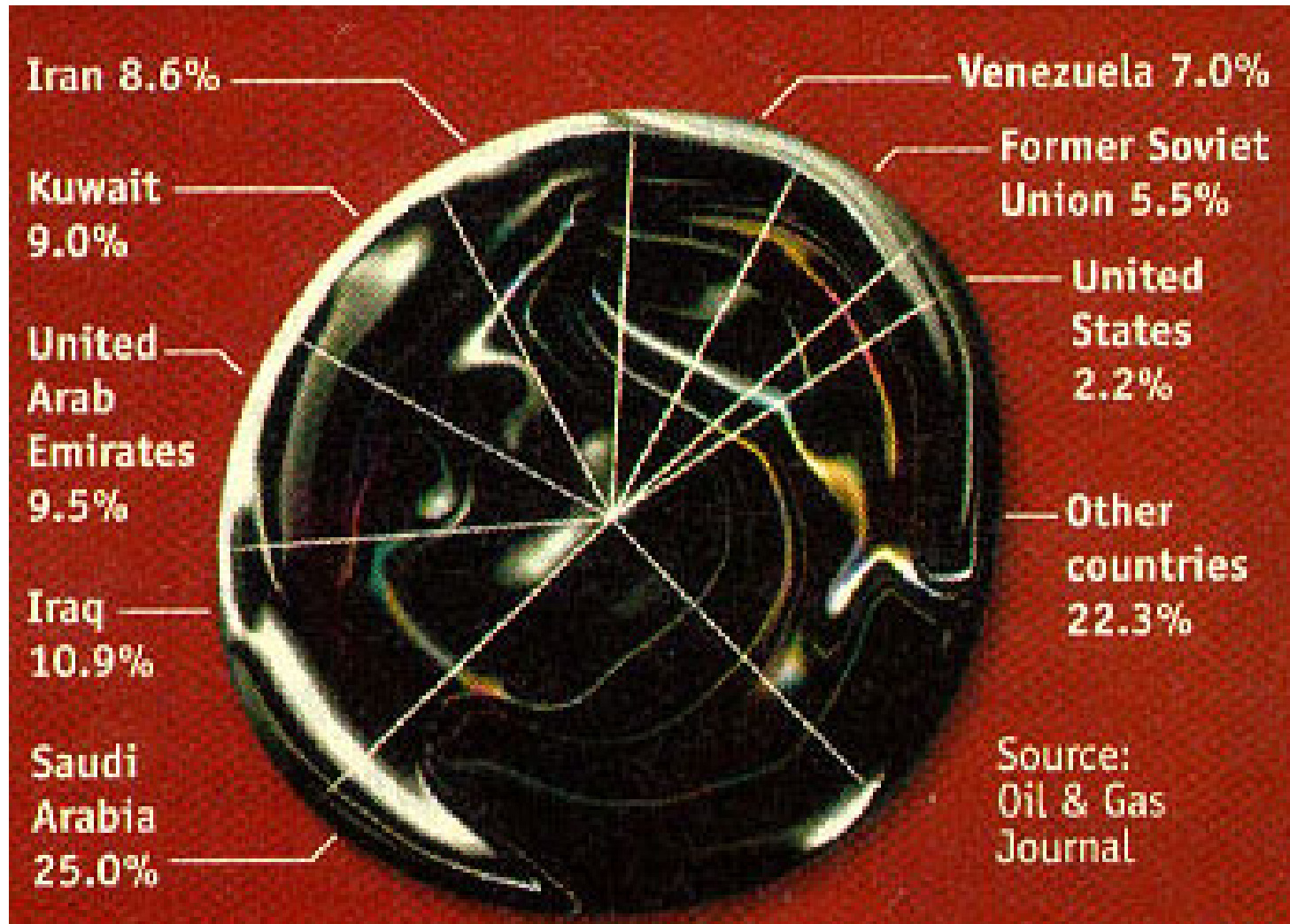


THE WORLD consumes more than 72 million barrels of crude oil each day, but consumption is on the rise and should peak at 85 million barrels in 2010. In subsequent years, however, supply problems will begin to limit production, as evidenced by the precipitous drop on the chart shown. The dotted line represents daily production if anticipated discoveries are included.

Source: POPULAR SCIENCE, May 2000

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# World's Oil Slippery Slope



**Geographic breakdown of today's oil reserves.**

Source: POPULATION SCIENCE, May 2000

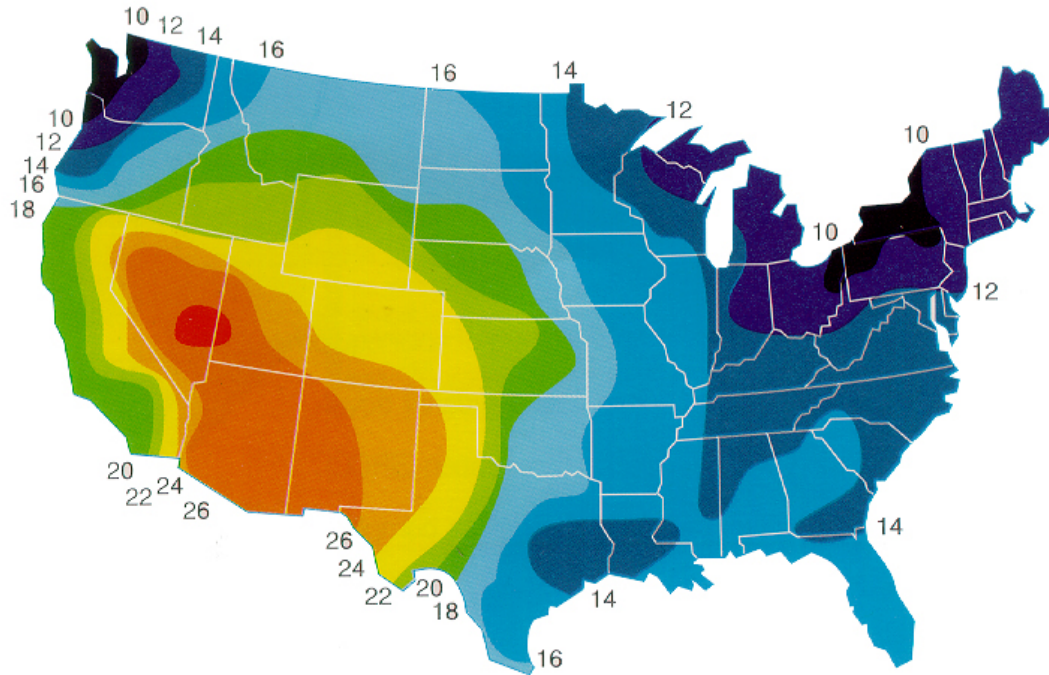


# 5-E's of SOLAR

- **Solar ENERGY-**
  - Reliable, Affordable, Available Day and Night (Storage)
- **Solar EMPOWERMENT-**
  - Secure, Distributed, USA Produced
- **Solar EMPLOYMENT-**
  - Auto Industry Type Jobs
- **Solar ENVIRONMENT-**
  - No Emissions From Energy Production
- **Solar EXPORT-**
  - USA World Leader, Solar Energy is Global, Solar Use Increases A Country's Domestic Resource Base

# SOLAR- EMPOWERMENT

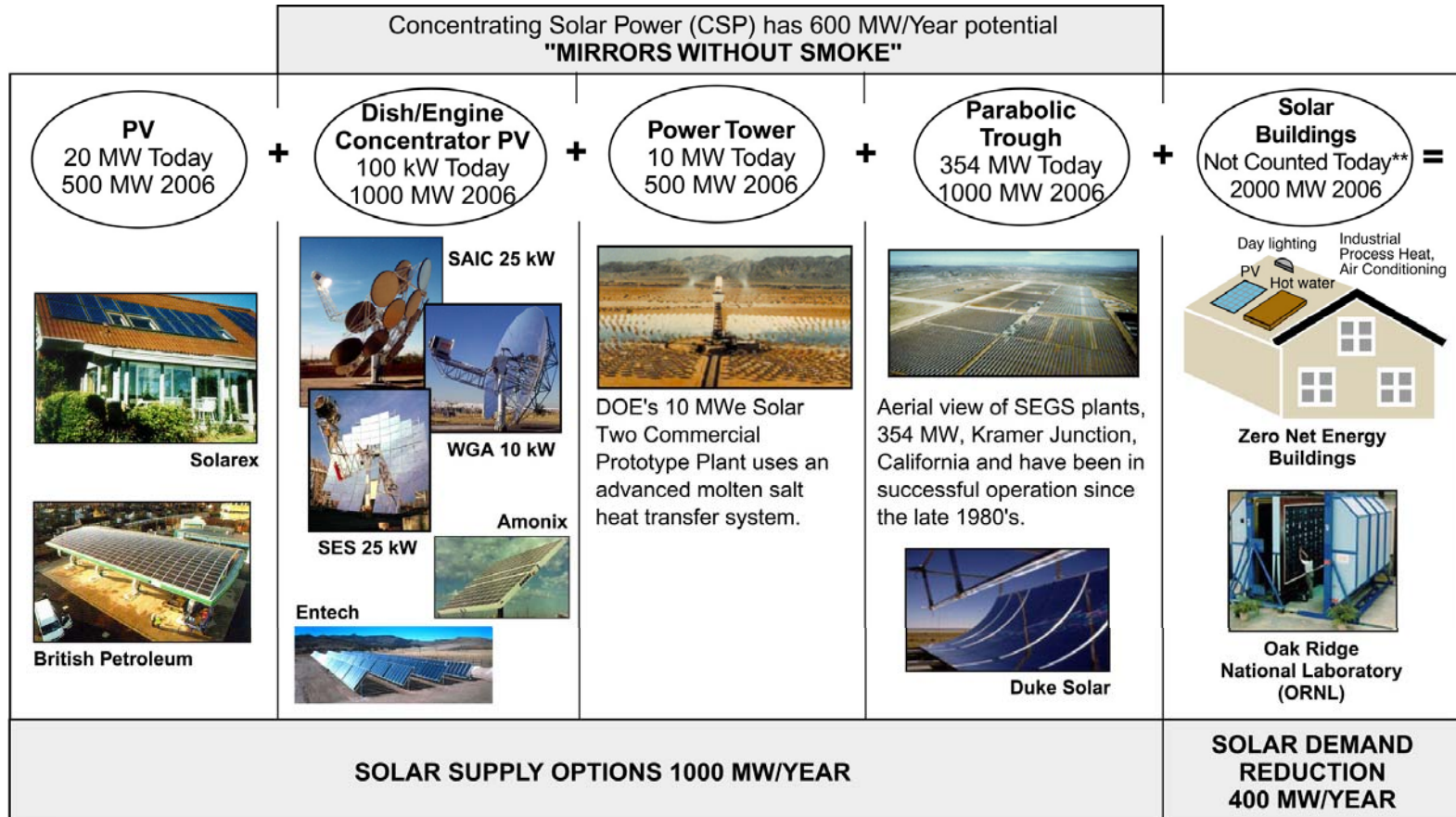
## Natural Insolation Across the U.S.



Much of the United States receives abundant sunshine, making solar hot water systems a very economical investment. This map shows the average daily solar radiation available on a south-facing surface measured in megajoules per square meter each day.

Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*

# “Don’t put all National energy eggs in coal/oil/gas basket” Solar Has Fuel Price Escalation Resistant Eggs.



HH01/006D-2

\*\* near 2000 MW today

**Solar could provide .7% of National capacity by 2006.**

Restore DOE solar energy line item funding to 2001 level while keeping solar building at 2003 DOE request.

## B. Butler Solar Electricity Backup





# B. Butler's 1.5kW PhotoWatt Polycrystalline Net Metered Array



*Reliability of Distributed Power*

of solar power





# SAIC and SES Solar Dish Systems in Operation UNLV Installation, 8/17/01



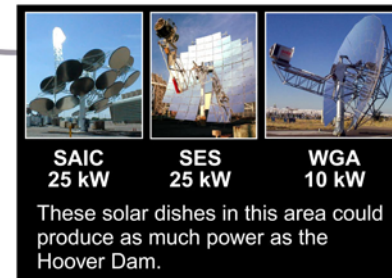
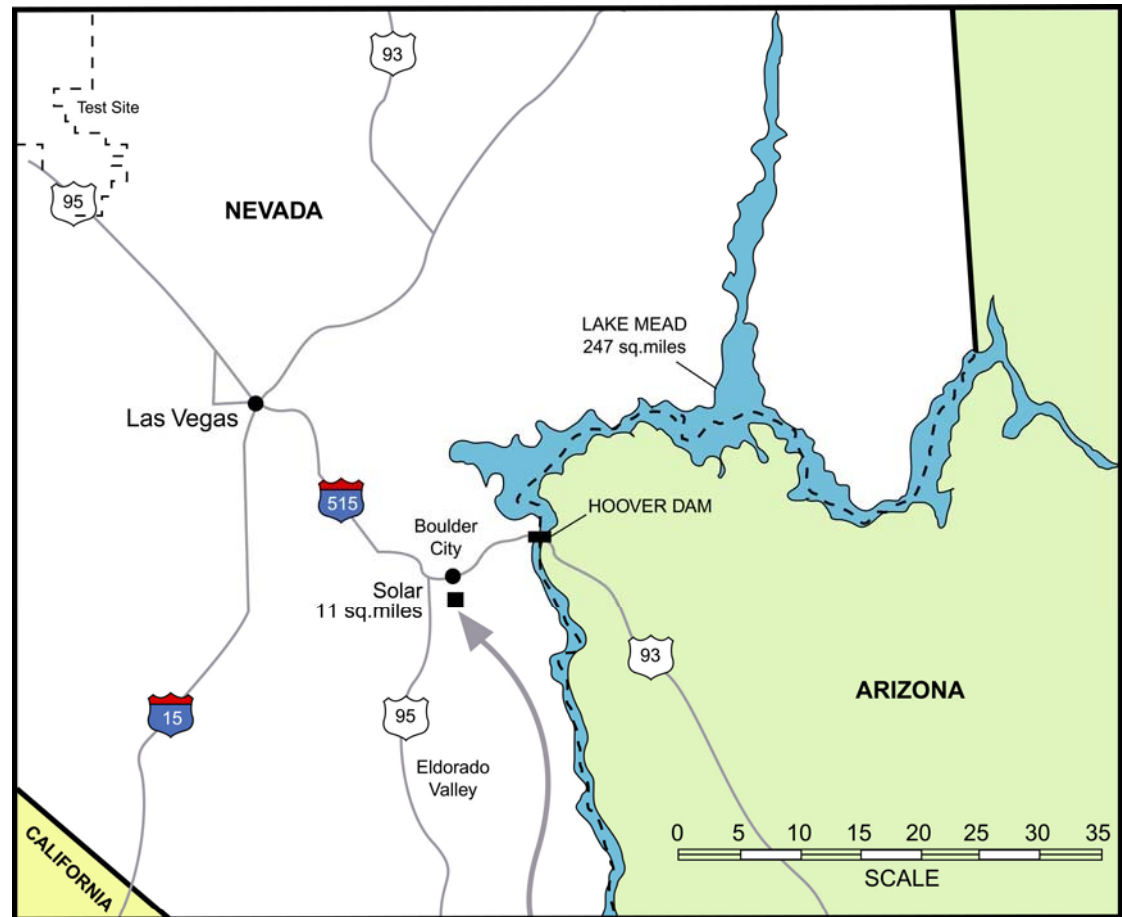
# Concentrating Solar Power Industry

The enlarged square shows the area that a solar system of 2,200 peak megawatts, generating the same amount of electricity as the Hoover Dam, would occupy (2,500 gigawatt-hours per square kilometer are assumed). The installed capacity of the Hoover Dam system is 2,074 peak mega-watts, and it generated 4,000 gigawatt-hours last year.

25 kW dish engine systems produce about 58,000 kWh/yr.

59,000 dish systems = 4,000 GWh/yr.

At 10 dish systems per acre, 10.8 sq. miles are needed (3.3 miles x 3.3 miles) or 27 sq. kilometers are needed (5.2 km x 5.2 km)





# Dish/Engine Dish/PV

## 100 kW Today, 1000 MW 2006

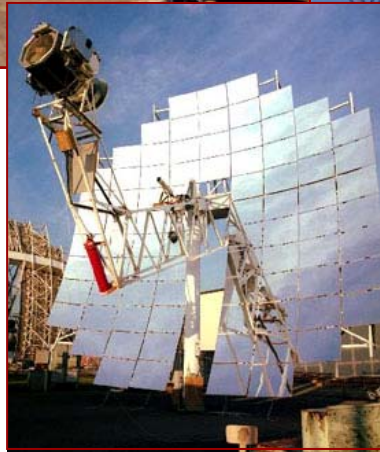
SAIC 25 kW



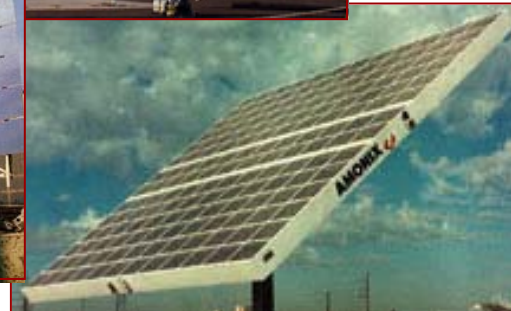
WGA 10 kW



Amonix



SES 25 kW



# Power Tower

## 10 MW Today, 500 MW 2006



**DOE's 10 MWe Solar Two Commercial Prototype Plant uses an advanced molten salt heat transfer system. Nexant/Bechtel is building a 15 MW plant in Spain.**

# Parabolic Trough

354 MW Today, 1000 MW 2006



**Aerial view of SEGS plants, 354 MW,  
Kramer Junction, California and have been  
in successful operation since the late 1980's.**

**Duke Solar**



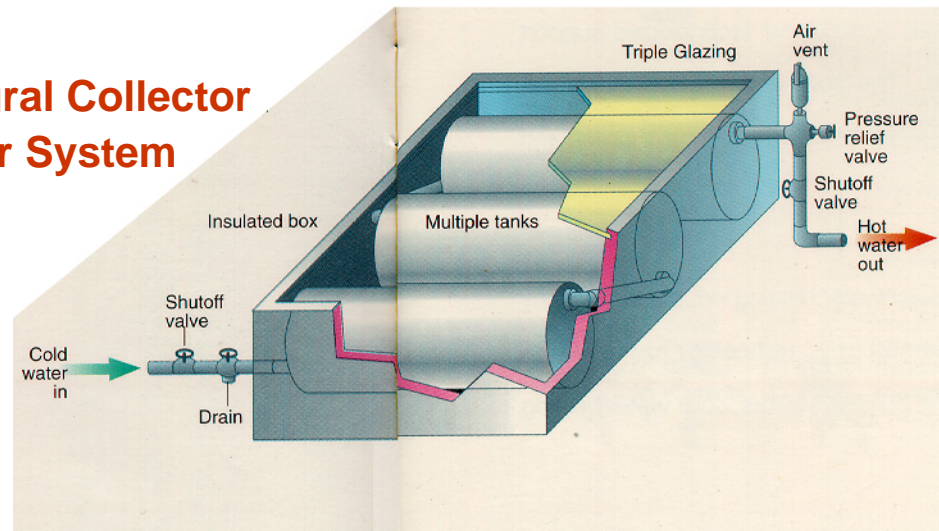
# SOLAR HOT WATER – ENERGY

- Buildings last a long time
- Energy prices are low today, \$3.50/MBTU
- Energy prices in real terms will double in five years
- 1000 DHW systems (40 ft<sup>2</sup>) at 2 kW each displaces a 2 MW electric generate equivalent



# SOLAR HOT WATER – ENERGY

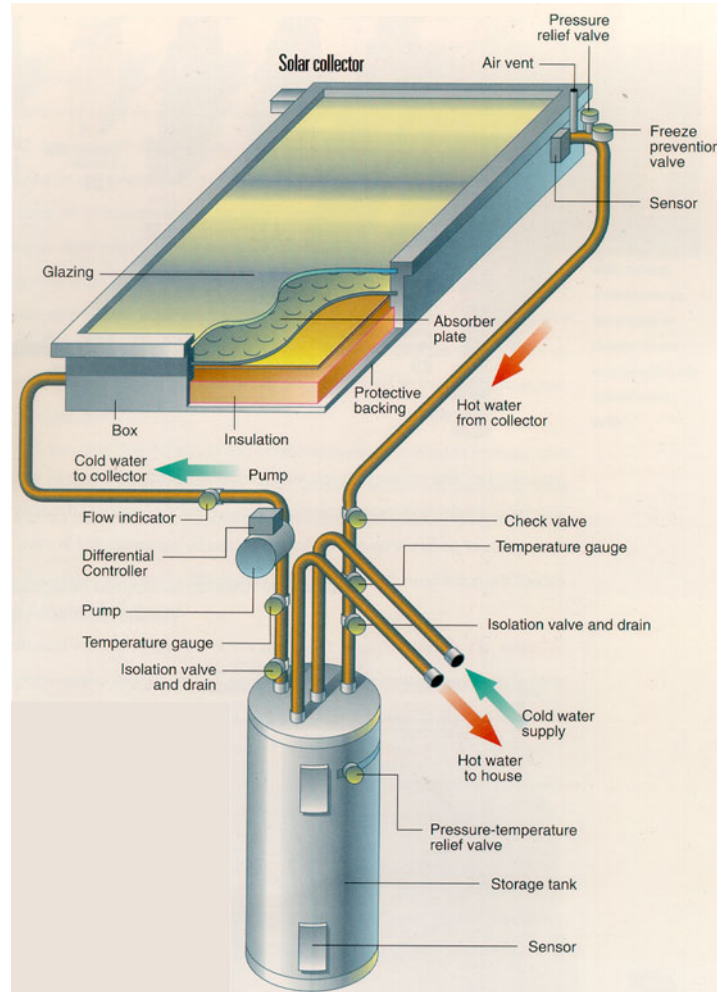
## An Integral Collector Storage Solar System



Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*

# SOLAR HOT WATER – ENERGY

## A Typical Active Open-Loop System



Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*

# SOLAR HOT WATER – ECONOMICS

[www.bio-radiant.com/WaterCal.html](http://www.bio-radiant.com/WaterCal.html)

## Domestic Hot Water Heating Calculator

Water Heater Characteristics			
Physical		Thermal	
? Diameter (feet)	1.5	? Water Inlet Temperature (Degrees F)	58
? Capacity (gallons)	50	? Ambient Temperature (Degrees F)	70
? Surface Area (calculated - sq ft)	21.36	? Hot Water Temperature (Degrees F)	135
? Effective R-value	15.24	? Hot Water Usage (Gallons per Day)	64.3
Energy Use			
	1694	? Heat Delivered in Hot Water (BTU/hr)	
	91.1	? Heat loss through insulation (BTU/hr)	

Gas vs. Electric Water Heating		
Gas		Electric
0.5699	? Overall Efficiency	0.93
0.6005	? Conversion Efficiency	0.98
2972 BTU/hr	? Power Into Water Heater	1822 BTU/hr
Cost		
\$0.80 /Therm	? Utility Rates	\$0.08 /kWh
\$208.27	? Yearly Water Heating Cost	\$373.95
How Do Alternative Measures Compare?		
? Alternative Measure Cost: \$1500		? Percentage Solar: 70
10.288 years for gas	? Payback Time for Alternative Measure	5.7301 years for electric

Use this Domestic Water Calculator to explore the energy usage of your water heater, and to estimate whether Solar or other Alternative Energy measure could save you money.

Source: [www.bio-radiant.com/WaterCal](http://www.bio-radiant.com/WaterCal)



## B. Butler Solar Hot Water & Hot Tub





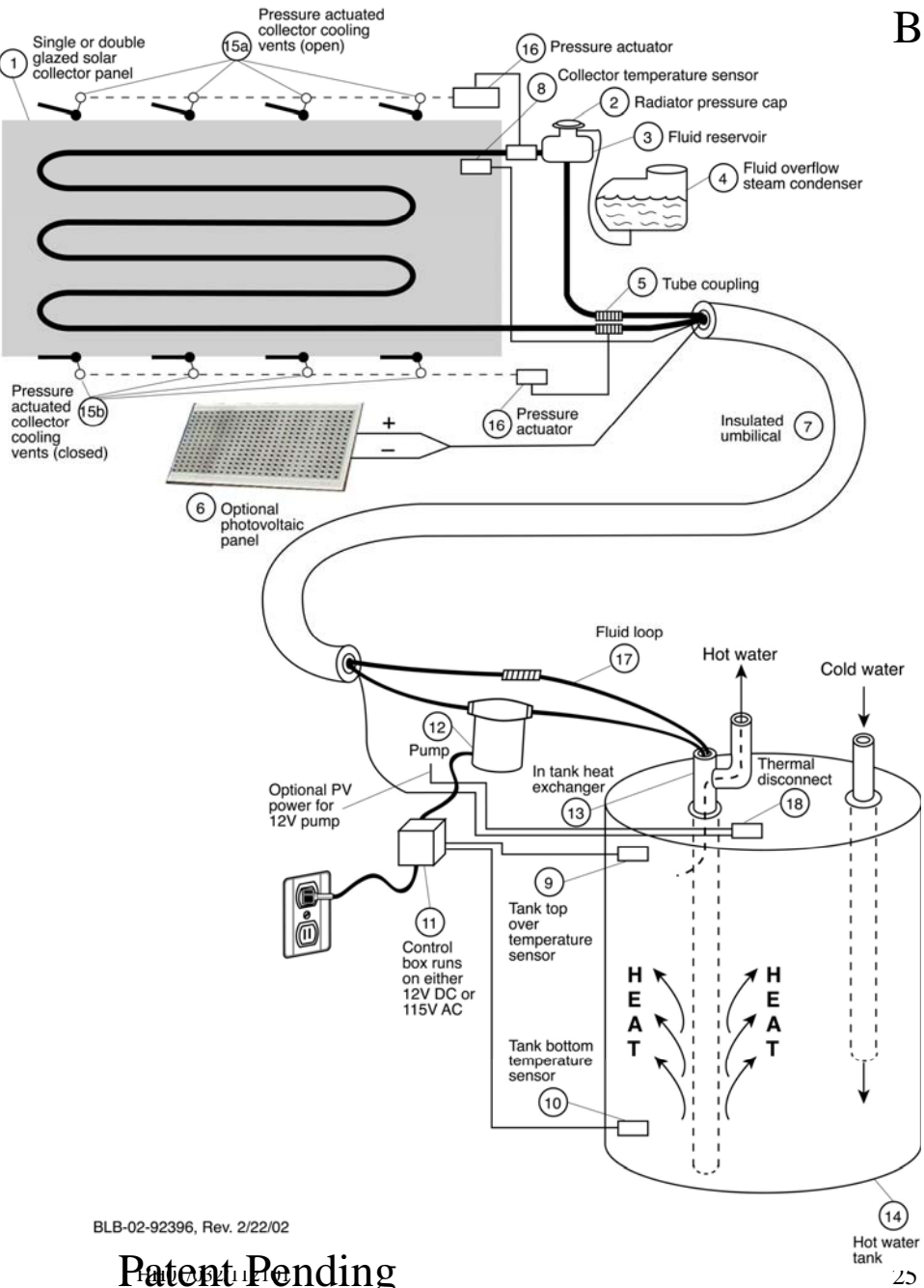
# BUTLER'S SOLAR HOT WATER SYSTEM



Solar  
Wand  
is Here



Double Wall In Tank Heat Exchanger



BLB-02-92396, Rev. 2/22/02

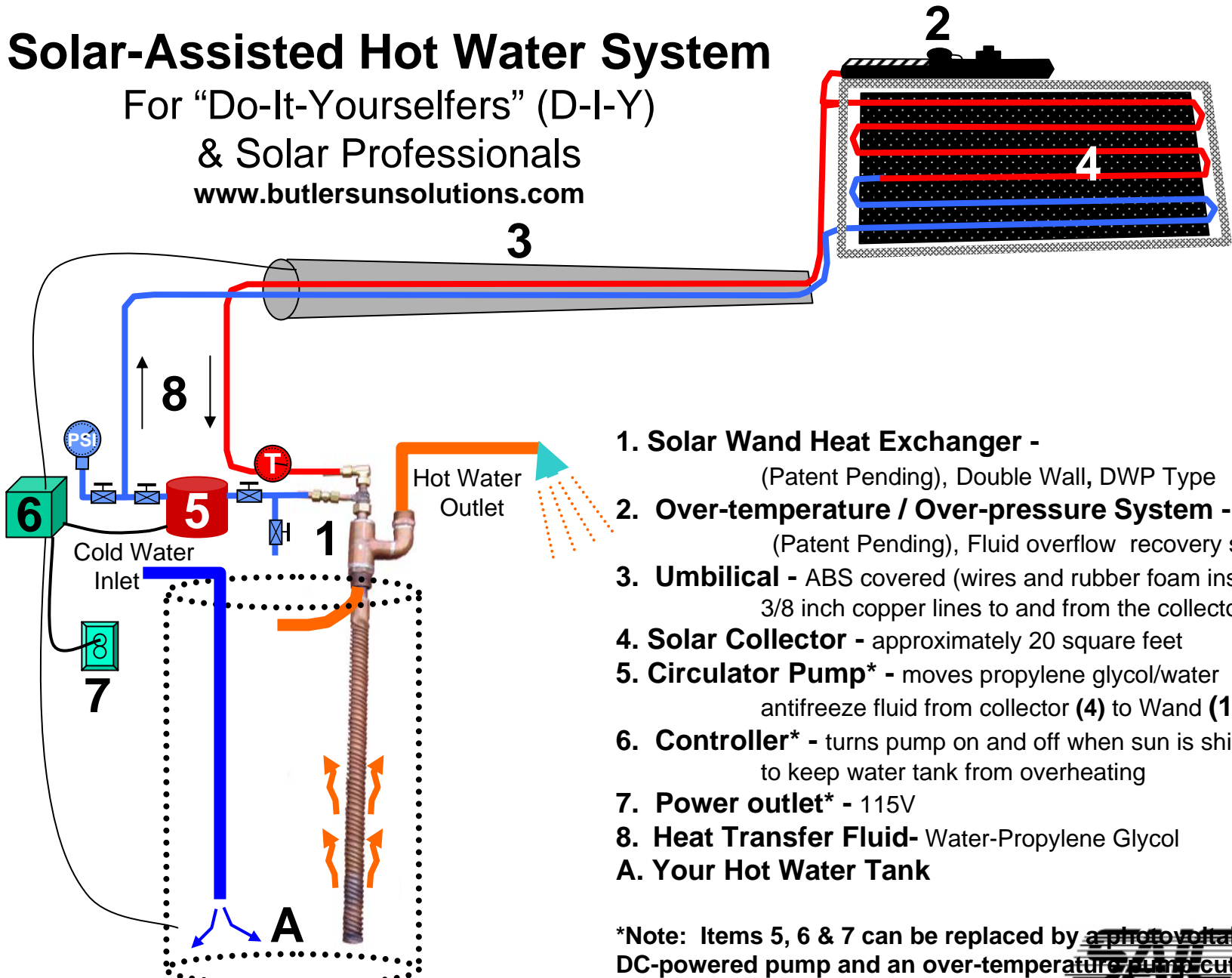
Patent Pending

# Solar-Assisted Hot Water System

For "Do-It-Yourselfers" (D-I-Y)

& Solar Professionals

www.butlersunsolutions.com



1. **Solar Wand Heat Exchanger -**  
(Patent Pending), Double Wall, DWP Type
  2. **Over-temperature / Over-pressure System -**  
(Patent Pending), Fluid overflow recovery system
  3. **Umbilical -** ABS covered (wires and rubber foam insulated 3/8 inch copper lines to and from the collector(4))
  4. **Solar Collector -** approximately 20 square feet
  5. **Circulator Pump\*** - moves propylene glycol/water antifreeze fluid from collector (4) to Wand (1)
  6. **Controller\*** - turns pump on and off when sun is shining to keep water tank from overheating
  7. **Power outlet\*** - 115V
  8. **Heat Transfer Fluid-** Water-Propylene Glycol
- A. Your Hot Water Tank**

\*Note: Items 5, 6 & 7 can be replaced by a photovoltaic panel, a DC-powered pump and an over-temperature pump cutoff switch

**SAC**  
An Employee-Owned Company



# Butler Solar Hotplate

- Heats like a 500 Watt stove top
- Hot enough to fry (bacon, eggs, grilled cheese, quesadillas)
- Boils (rice, spaghetti, beans & sauces)
- No Electricity Needed
- Can be moved

New Product  
Patent Pending



An Employee-Owned Company

## B. Butler Solar Day lighting



# SOLAR HOT WATER – ENVIRONMENT

**Clean and Safe** Solar hot water systems in use today produce approximately 1000 megawatts of energy annually. That is the equivalent of two medium-sized coal plants. The life-cycle costs of SHW systems are about the same as gas and far better than electric water heating systems.

Solar energy is pollution-free, an important benefit when the cost of removing pollutants from the environment is considered. For example, a typical SHW system will, over its lifetime, displace 105 tons of CO<sub>2</sub> if replacing a natural gas system, or 71.5 tons if replacing an electric system.

Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*

## Pollutant Emission Factors for Electrical Generation (g/kWh): The Total Fuel Cycle\*

Energy Source	CO <sub>2</sub>	NO <sub>x</sub>	SO <sub>x</sub>
Coal	322.8	1.8	3.400
Oil	258.5	0.88	1.700
Natural Gas	178.0	0.9	0.001
Nuclear	7.8	0.03	0.030
Photovoltaics	5.3	0.007	0.020
Biomass	0.0 <sup>1</sup>	0.6	0.140
Geothermal	51.5	TR	TR
Wind	6.7	TR	TR
Solar Thermal	3.3	TR	TR
Hydropower	5.9	TR	TR

TR = trace

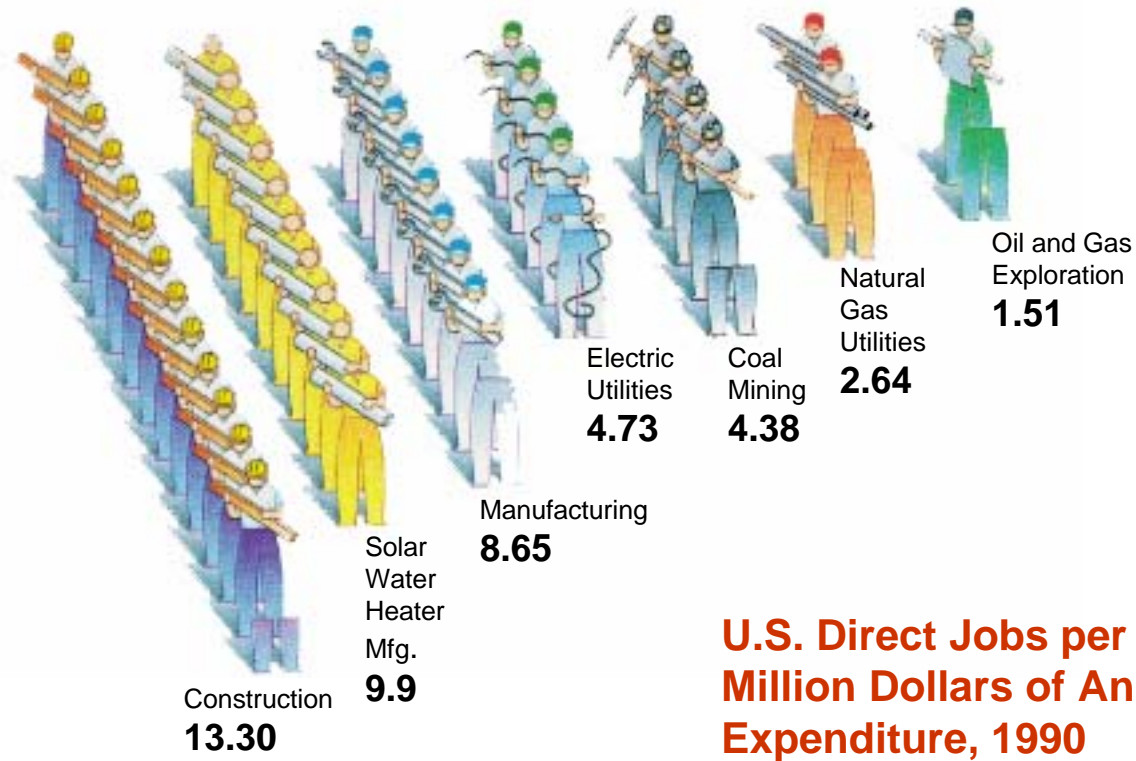
<sup>1</sup> with biomass fuel regrowth program



\* Fossil fuel emission factors provided by the American Gas Association; nuclear and renewable energy sources from the Council for Renewable Energy Education.

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# SOLAR- EMPLOYMENT

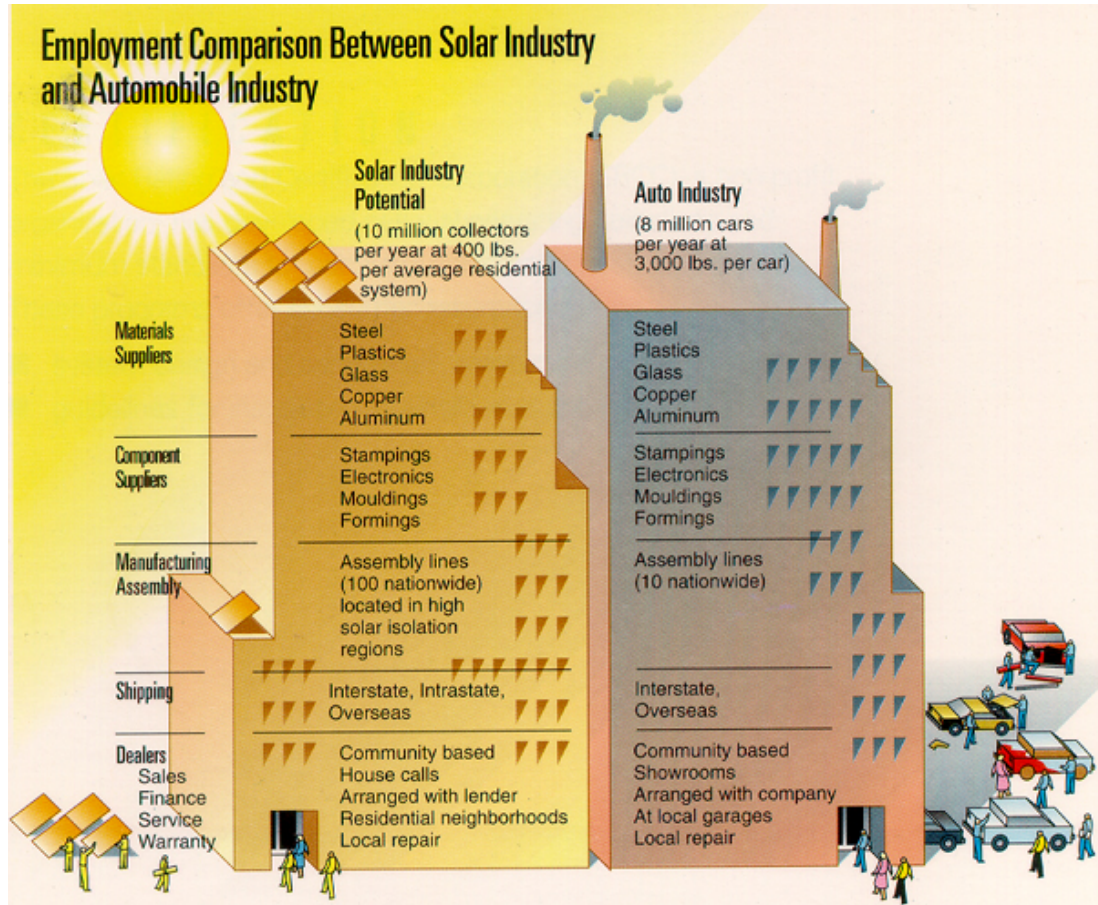


**U.S. Direct Jobs per Million Dollars of Annual Expenditure, 1990**

Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*



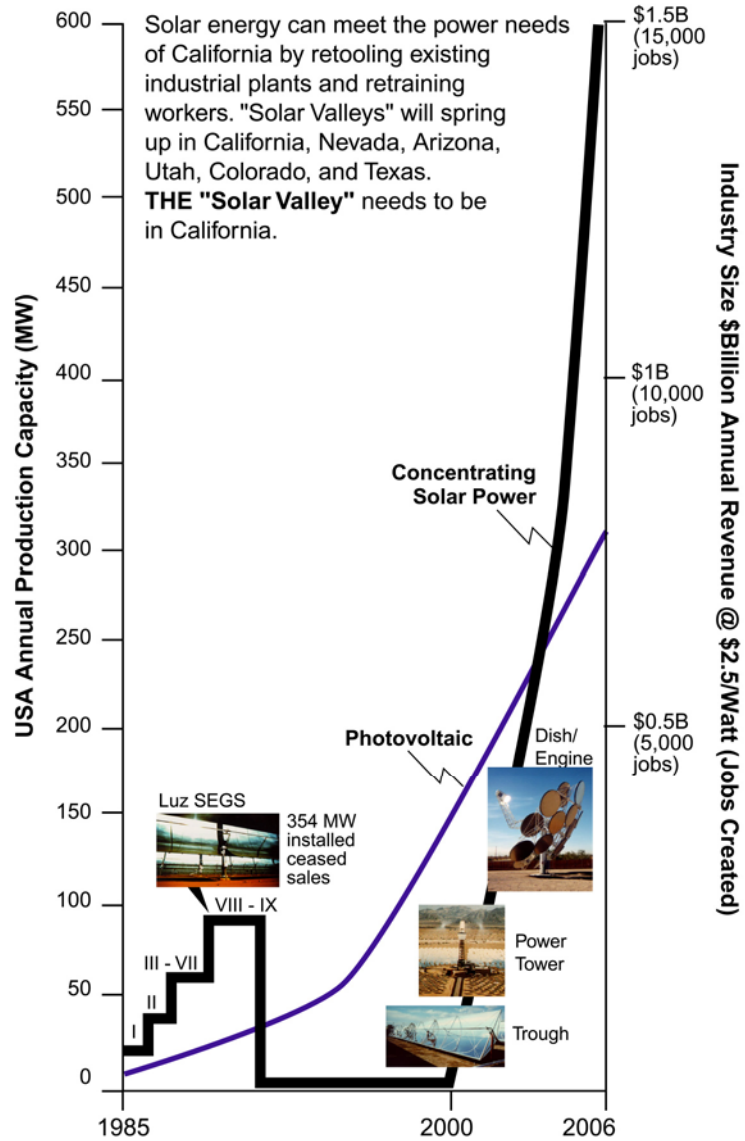
# SOLAR- EMPLOYMENT



Source: Solar Energy Industries Association:  
*Solar Thermal Water Heating: The U.S. Industry*

# Economics

## Economics





# SOLAR COMING TO A COUNTRY NEAR YOU

- Marginal at today's energy cost
- Cost-effective at twice today's price
- Cost of solar will not rise
- Systems are reliable and long life
- Future generations will see solar as a way to achieve local energy independence.

# Prius for Two “Prius Envy ??”



45 MPG  
HIS

43 MPG  
HERS

# We Need Energy Independence !!!



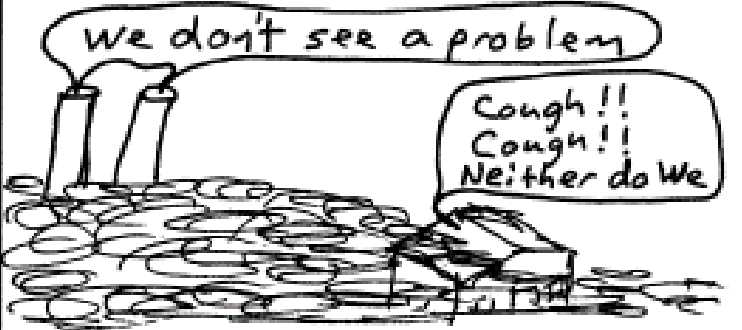
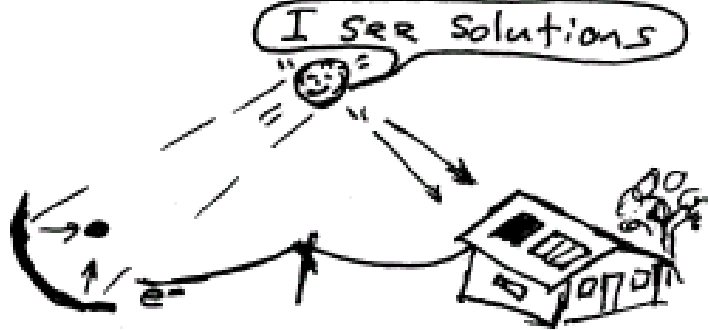
"We  not

erate Saddam



Hussein for his actions. We will  
**Mobilize** to meet this threat to  
vital interests in the Persian   
until an ble solution is reached.  
Our best strategy is to repared.  
Failing that, we ming  
to kick your ass."

# WHY 5,000 MW OF CONCENTRATING SOLAR POWER NOW ???

MANKINDS ROLE	AS DISCONNECTED FROM THE EARTH, WITH NO CONSEQUENCES FOR HUMANITIES OWN ACTIONS	AS STEWARDS OF THE EARTH
Options:	 <p>A cartoon showing a factory with two smokestacks emitting smoke into a hazy sky. A person is coughing, with a speech bubble that says "Cough!! Cough!! Neither do We". Another speech bubble above the factory says "we don't see a problem".</p> <p>Status Quo, Coal, Oil and Gas</p>	 <p>A cartoon showing a person pointing towards a house with a solar panel on the roof. A speech bubble above the person says "I see solutions".</p> <p>Major Use of all Solar Power</p>
<b>E</b> NERGY	Import more oil and gas. More large remote power plants, Not In My Back Yard (NIMBY)	Produce up to 50% of USA electricity from solar and achieve higher grid security and reliability.
<b>E</b> MPLOYMENT	Create jobs overseas exploring, winning, refining, and shipping fossil fuels to the USA.	Create non-exportable jobs in the USA; engineering, manufacturing, fabricating, installing and operating solar power systems.
<b>E</b> XPORT	Pay money to foreign countries for fossil fuels and worsen the balance of trade.	Other countries pay the USA for solar technology and products improving the balance of trade.
<b>E</b> NVIRONMENT	Accelerating the degradation of the atmosphere we share with all life on earth.	Reduce climate change and air pollution, while decreasing lung disease such as children's Asthma.
<b>E</b> MPOWERMENT	USA becomes more dependant on OPEC and other nations for electric power at : True Cost of Electricity = <b>6 Cents/kWh</b> + ? <b>Scents/kWh</b>	Energy Sovereignty; USA citizens control our energy future and pay the price of solar power. True Cost of Electricity = <b>12 Sense/kWh</b>
Choice:	<b>WE ARE CHOOSING THIS</b>	<b>SHOULDN'T WE CHOOSE THIS ????</b>
Branding:	<b>"Clean Affordable Coal"</b>	<b>"Solar The Power For Life"</b>
Action:	Ignore the unhealthy air, breathe it and pass it along to your children and their children - they can't vote yet.	Support the Concentrating Solar Power - Global Marketing Initiative to deploy 5,000 MW by 2010, and Vote for Elected Officials Who Support Solar Power.

**Space Ship Earth Must Be Sustainable  
Native Americans Energy Decisions Considered the  
Consequences Seven Generations into the Future,  
Not one Election.**

