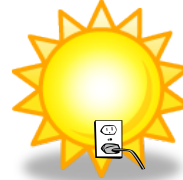


## Electricity from the Sun



**S6E5. Students will investigate the scientific view of how the earth's surface is formed.**

- j. Describe methods for conserving natural resources such as water, soil, and air.

**S6E6. Students will describe various sources of energy and with their uses and conservation.**

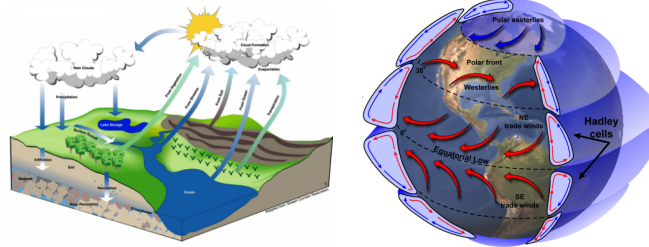
- a. Explain the role of the sun as the major source of energy and its relationship to wind and water energy.
- b. Identify renewable and nonrenewable resources.

Dr. Witherspoon and Ms. Breen  
Fernbank Science Center  
DeKalb County Schools

Annotations for using this slide show begin on slide 7.

## ENDURING UNDERSTANDINGS

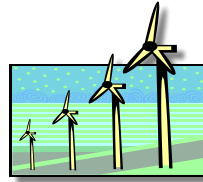
The sun is the major source of energy for phenomena on the Earth's surface, including winds, ocean currents, and waves.



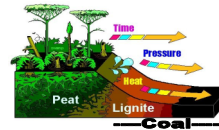
(From GA DOE Frameworks)

## ENDURING UNDERSTANDINGS

Renewable resources can be replenished within a relatively short time period.



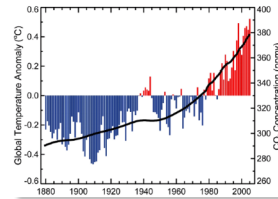
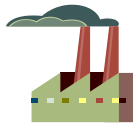
Nonrenewable resources form very slowly, over millions of years. When present supplies are used, there will be no more.



(From GA DOE Frameworks)

## ENDURING UNDERSTANDINGS

The atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally. Cleaning up polluted air, water, or soil or restoring depleted soil, forests, or fishing grounds can be very difficult and costly.



(From GA DOE Frameworks)

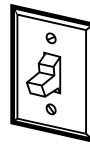


## ENDURING UNDERSTANDINGS

The Earth's resources can be reduced or used up if humans don't use conservation strategies.

Through conservation strategies, people can slow down the degradation of the environment and the depletion of non-renewable resources.






Turn off lights





(From GA DOE Frameworks)



I open the program by demonstrating a radio (from Sharper Image) that uses Freeplay technology, which is powered up by either a hand crank or a solar cell. I use a little radio transmitter to broadcast the clip about Freeplay's work in Africa, Freeplay Foundation lighting.mp3, by the PRI program *The World*, while showing this slide.


Electricity Concentration 1A	Electricity Concentration 1B	Electricity Concentration 1C	Electricity Concentration 1D	1E Solar Panels (photovoltaic) 
Electricity Concentration 2A	Electricity Concentration 2B	Electricity Concentration 2C	Electricity Concentration 2D	2E Hand-cranked generator 
Electricity Concentration 3A	Electricity Concentration 3B	Electricity Concentration 3C	Electricity Concentration 3D	3E Wind Turbine Farm 
Electricity Concentration 4A	Electricity Concentration 4B	Electricity Concentration 4C	Electricity Concentration 4D	4E Hydroelectric Dam 
Electricity Concentration 5A	Electricity Concentration 5B	Electricity Concentration 5C	Electricity Concentration 5D	5E Coal-fired power plant 

This shows the layout of Electricity Concentration cards, which students are asked to lay out as shown - note that A's are down the left and 1's are across the top.

Electricity Concentration <b>1A</b>	Electricity Concentration <b>1B</b>	Electricity Concentration <b>1C</b>		1E Solar Panels (photovoltaic) 
---	---	---	---	--


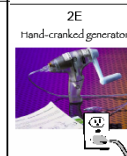
This solar panel makes electricity directly from the energy of the...

**Sun!**



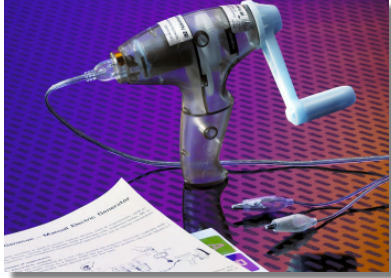
<http://www.newenglandbreeze.com/ithaca.shtml>

For each row, this series of slides is designed to lead students to trace electricity back to the Sun. They turn over their cards as the slide animations turn them over. Students are to “memorize” the pictures they revealed (for later play of the Concentration game) and turn them back to number side up (except for the “E” column) before proceeding to the next row.

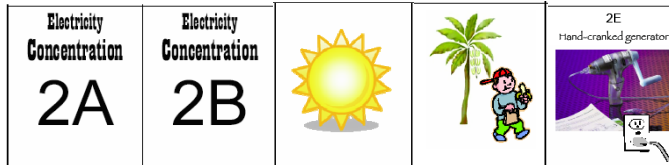
Electricity Concentration <b>2A</b>	Electricity Concentration <b>2B</b>	Electricity Concentration <b>2C</b>		2E Hand-cranked generator 
---	---	---	---	---

This hand generator makes electricity when you crank it. Its energy source is ...

**You!**

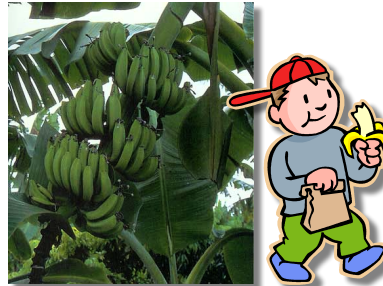


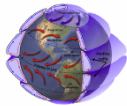
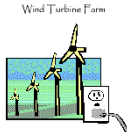
Hold up one of the generators used in the program as this slide is shown.



You get your energy by eating food such as a banana. A banana tree uses its leaves to capture energy from the ...

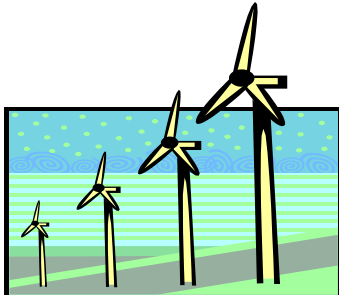
**Sun!**



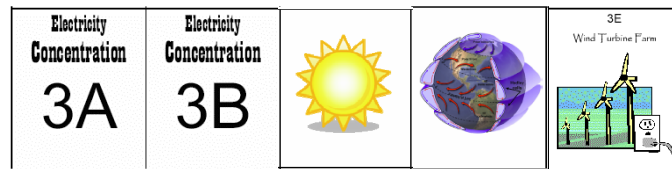
Electricity Concentration <b>3A</b>	Electricity Concentration <b>3B</b>	Electricity Concentration <b>3C</b>		<b>3E</b> Wind Turbine Farm 
---	---	---	---	---

A wind turbine makes electricity whenever its blades are turning. The energy that turns the blades comes from ...

**Wind!**

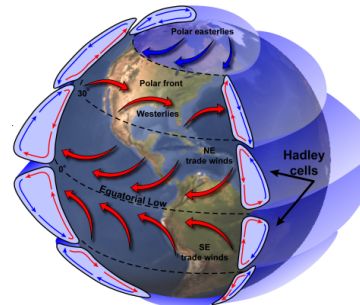


Hold up the generator again, illustrating its similarity to the much larger wind turbine.

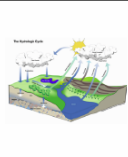



Wind blows on our planet because hot air rises in places where the air is heated by the...

**Sun!**





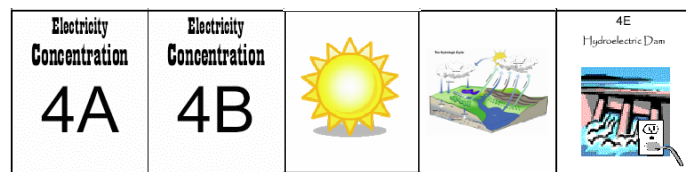
Electricity Concentration <b>4A</b>	Electricity Concentration <b>4B</b>	Electricity Concentration <b>4C</b>		4E Hydroelectric Dam 
---	---	---	---	--

Electricity is made in a powerhouse. There turbines are turned by the weight of the water behind the dam. The water is put there by...

**Rain!**

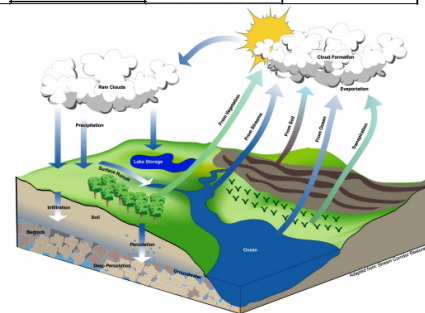


<http://a0700202.uscgaux.info/lakes.html>


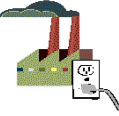


Rain falls from clouds. Water evaporated to make the clouds because it was warmed by the...

Sun!

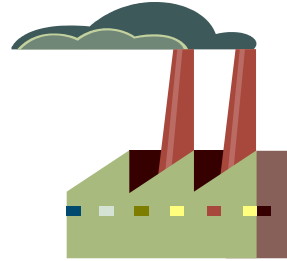




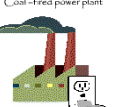
<http://www.water.ky.gov/dw/consumer/dwed/lessons.htm>

Electricity Concentration <b>5A</b>	Electricity Concentration <b>5B</b>	Electricity Concentration <b>5C</b>		<b>5E</b> <i>Coal-fired power plant</i> 
---	---	---	---	---

Electricity is made in a coal-fired power plant, using turbines that are turned by the energy of ...

**Steam!**

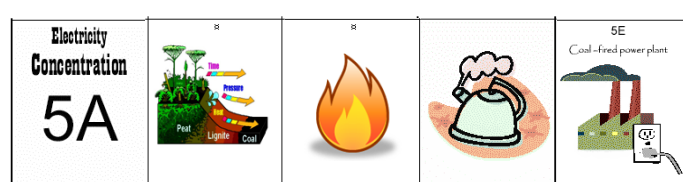


Electricity Concentration <b>5A</b>	Electricity Concentration <b>5B</b>	8 		5E Coal-fired power plant 
---	---	--	---	---

The **steam** in a coal-fired power plant is made when water is heated by...

**Fire!**

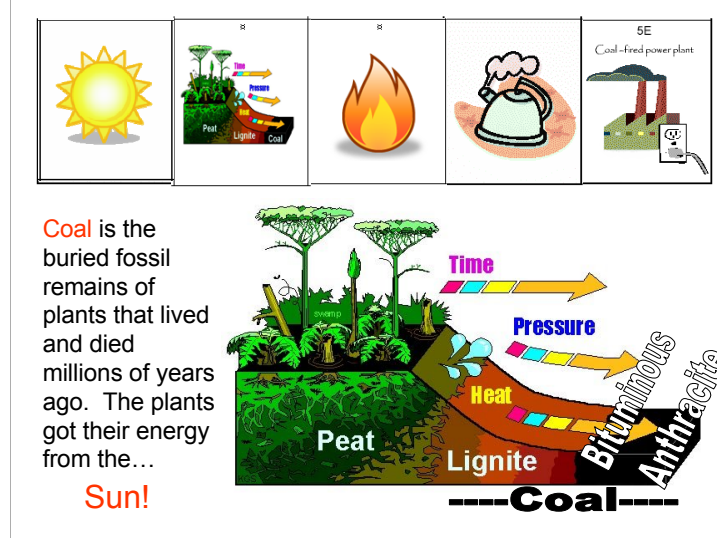




In a coal-fired power plant, the fuel for the fire is ...

Coal!





If you have examples of the stages of coal shown here (all are available at [wardsci.com](http://wardsci.com)) they can be passed around at this point; I also pass around a rock sample with good fossilized (black, carbonized) leaves.

## Play Electricity Concentration

Can you remember  
the steps  
for each kind of  
electricity from the sun?

Once all cards (except E column) are number side up, challenge them to turn over, with as few tries as possible, the correct card as you call the name of each out. After this is done they should reassemble the card deck in order, but leave the E cards out.

Predict...  
which electricity source is the...

- most Powerful?
- most Polluting?
- lowest Priced?
- most Popular?

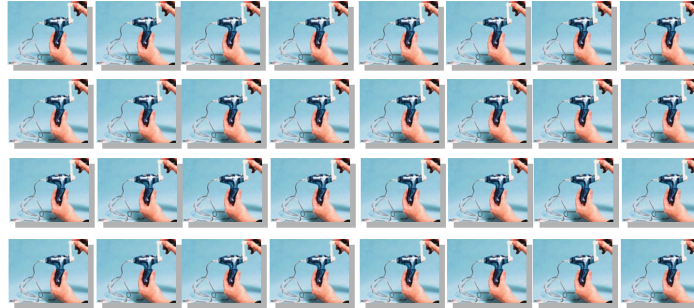
This poll (pretest) is taken by having students hold up the “E” card they think answers each question. “Most powerful” means most electricity for least input of resources or effort. “Most popular” means which one is most used to make electricity at present. The answer for all four is intended to be coal, but they don’t need to know that yet. This slide introduces the investigation of which is most powerful. First make the electricity - I use a PV cell connected to a motor and tiny fan, and bring it to a 75-W lightbulb to show that the fan blade will turn. Next I use a Genecon generator to power a light. A slight detour that evokes a delighted response is to hook a second Genecon up to the same light, and invite a volunteer to crank it first, while holding the other generator. The generator I am holding turns on its own as the volunteer cranks the other generator. I pretend surprise at first, then explain that a generator and motor are the same device for converting between mechanical and electrical energy - in either direction.

Then do the actual measurements - hook the PV to a Vernier voltage probe, connected by USB port to the projection computer, which runs LoggerLite software. Let the software graph voltage over time as you show that the voltage reading varies depending on whether it is covered and how close it is to the light source. Then switch to hooking up one of the generators, demonstrating effects of cranking harder (but not too hard, which can break a Genecon) and also reversing direction. (At least according to voltage) this demonstrates that the generator is more powerful than a similar-sized PV panel.



most  
Powerful

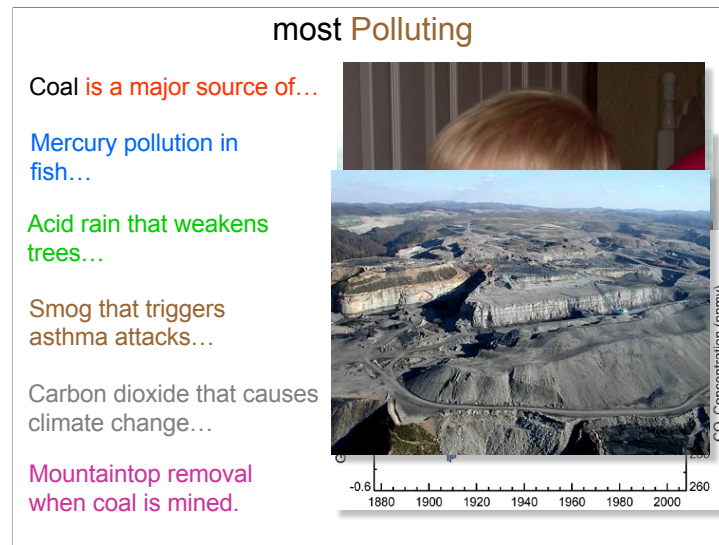
How many people  
would have to crank a generator  
for an hour  
to make as much electricity  
as one ounce of coal makes?



32!

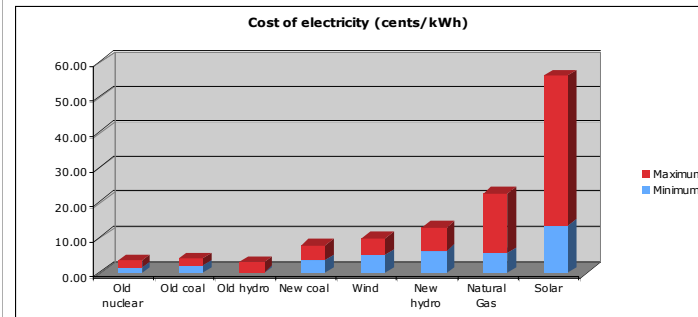
[www.wolverinesports.com/SCI/ELECTRIC/12634.JPG](http://www.wolverinesports.com/SCI/ELECTRIC/12634.JPG)

Since it is not possible to make electricity from coal in the classroom for comparison, I found out how much coal the power company is using to make our electricity, and with some calculations came up of this comparison of one ounce of coal to the output of the hand-ranked generator. Before going to the next slide, ask the students again which source of electricity is clearly most powerful.



This shows that most of them correctly guessed that coal is the most polluting source.

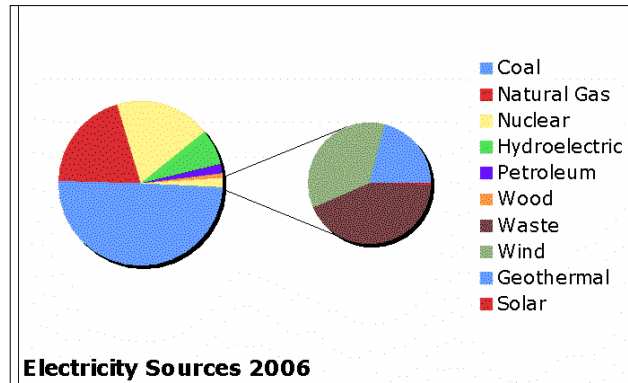
lowest Priced



Data from <http://www.tva.gov/environment/air/ontheair/renewable.htm>

These figures could be updated - gas is now relatively cheaper and solar has come down a bit. Still no experience of newly built nuclear plants in the US, so that estimate will not show.

most Popular  
(for now... but in the future?)



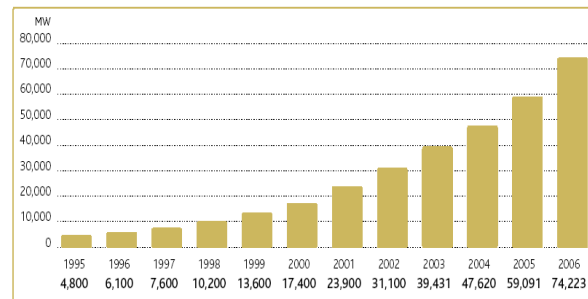
**Electricity Sources 2006**

Data from <http://www.eia.doe.gov>

An update to this would show that coal is now less than half and gas is growing.

## Wind power is the fastest growing renewable source of electricity

GLOBAL CUMULATIVE INSTALLED CAPACITY 1995-2006

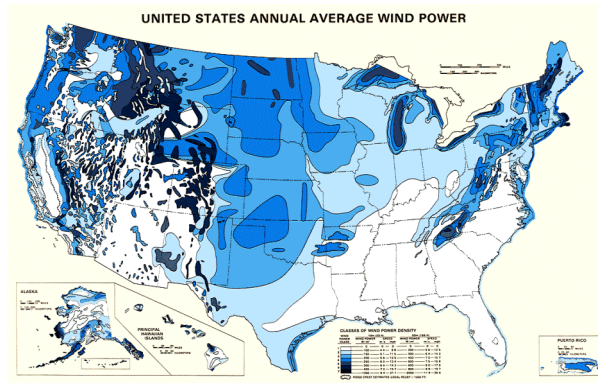


A map of the United States showing the number of people in each state who have a first name that is also a state name. The states are color-coded and labeled with their abbreviation and the count. For example, California (CA) has 2376, Texas (TX) has 3352, and New York (NY) has 390. Some states like Alaska (AK) and Hawaii (HI) are also shown with their respective counts.

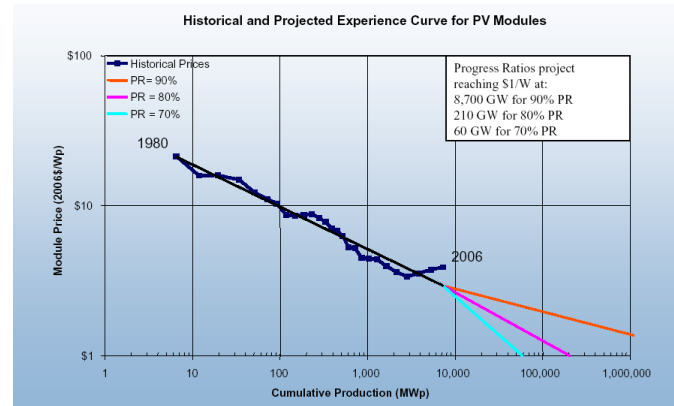
State	Count
AK	2
AL	1
AR	0.1
AS	1
CA	2376
CO	366
CT	1
DE	1
FL	1
GA	1
HI	63
ID	75
IL	305
IN	7
IA	967
KS	364
KY	179
LA	1
MA	1
MD	8
ME	1
MI	897
MO	1
MN	3
MT	146
NC	1
ND	178
NE	73
NH	1
NJ	8
NM	496
NY	390
OH	7
OK	595
OR	438
PA	1
RI	1
SC	1
SD	44
SH	1
SI	1
TN	29
TX	3352
UT	1
VA	1
VT	1
WA	818
WI	53
WY	288

**TOTAL INSTALLED U.S. WIND ENERGY CAPACITY: 12,634 MW as of June 30, 2007**

Georgia has limited wind power potential



## Cost of solar is going down





Will every roof look like this someday?



In the meantime, please save electricity

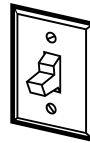


Change your light bulbs



Look for the Energy Star label

Turn off lights



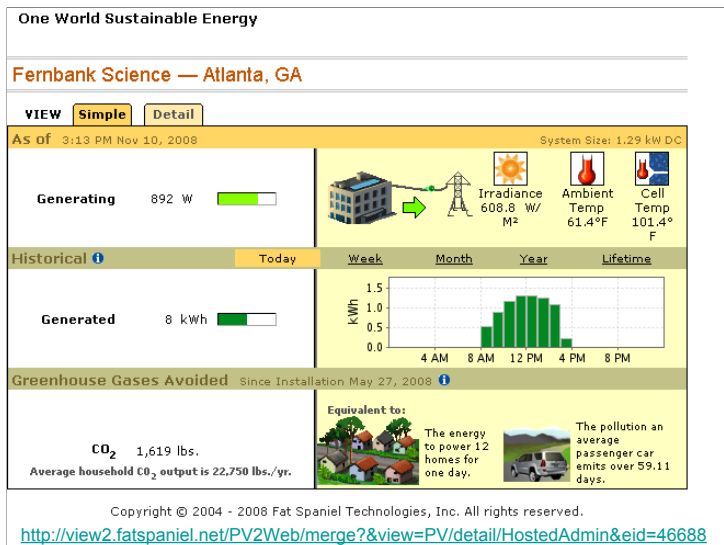
Set the thermostat

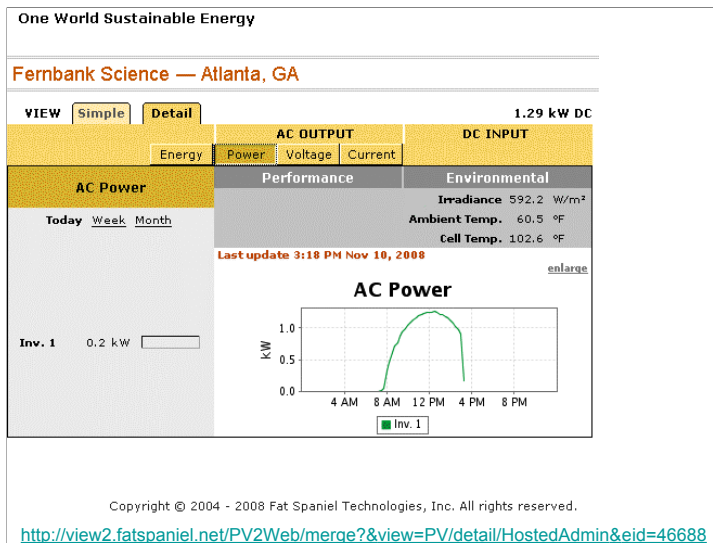


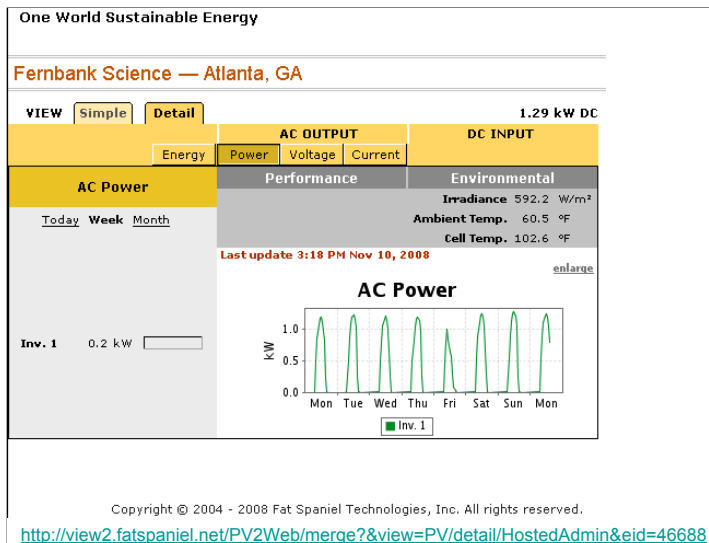
## Fernbank Solar Experiment

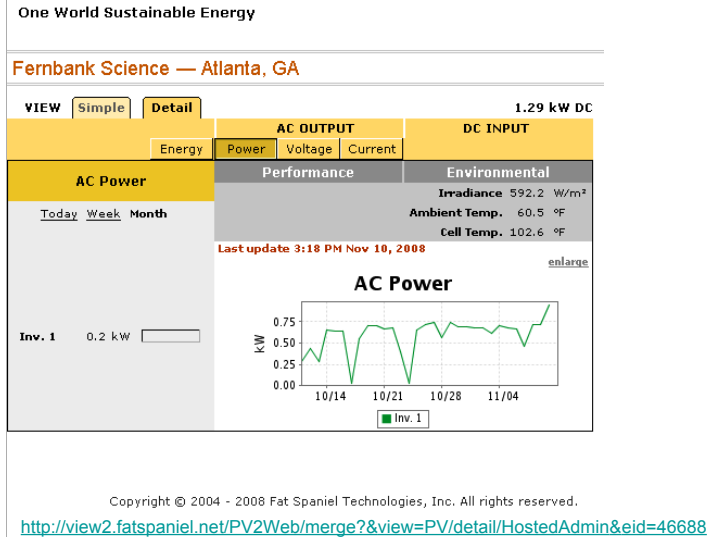


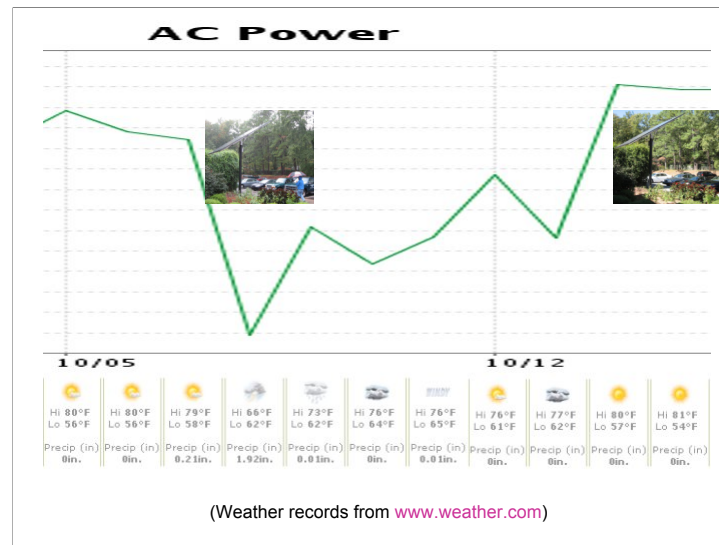
This series of slides reinforce the point that solar is not a very concentrated source of electricity. Energy efficiency will be needed to make best use of this resource - waste is not helpful.





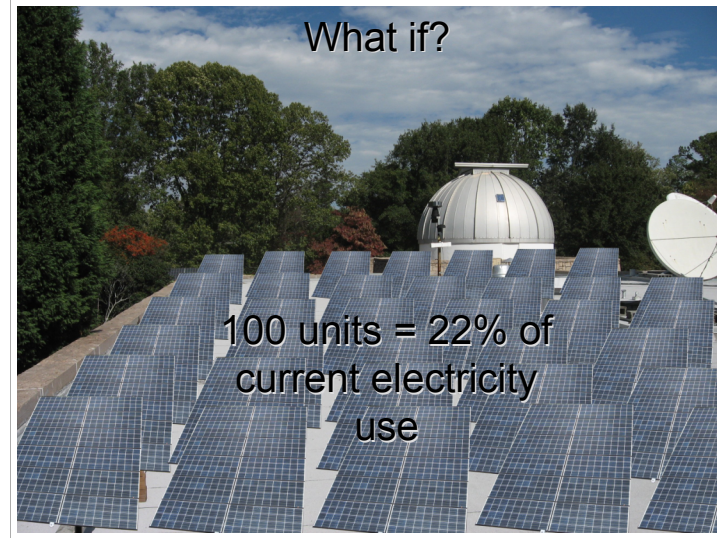












## To get to a solar economy:

- Improve building energy efficiency
- Keep bringing solar panel costs down



Alternatives to Fossil Fuels – United Streaming



Everyday Energy Conservation – United Streaming