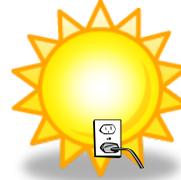


Electricity from the Sun



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.

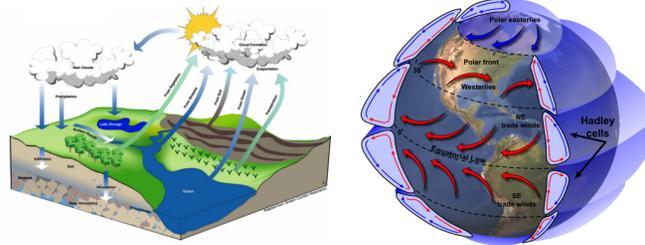
- a. Explain the role of the sun as the major source of energy and its relationship to wind and water energy.
- b. Identify renewable and nonrenewable resources.

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.



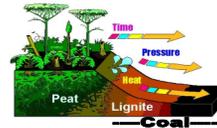
(From GA DOE Frameworks)

ENDURING UNDERSTANDINGS

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



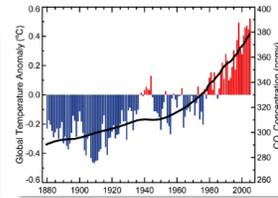
Nonrenewable resources form very slowly, over millions of years. When present supplies are used, there will be no more.



(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.



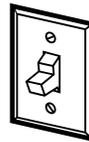
(From GA DOE Frameworks)

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)

Freeplay Foundation *Making access to information and education possible*

HOME ABOUT US GLOBAL PROJECTS LIFELINE RADIO SUPPORT OUR WORK MEDIA CENTRE CONTACT US

Yesterday I did not know anything, but tomorrow, I will know everything

Yesterday I didn't know anything, but tomorrow, I will know everything, said 60-year old grandmother Fatima Hussein, to Freeplay Foundation executive director, Kristine Pearson, as she took possession of her very first radio. With nine children and 12 grandchildren, Fatima says she wants to listen to health related and other information programmes that will help women like her who have little chance to learn more formally. Fatima, who is the head of a local women's association, also wants to listen to news. She has never left her village, Cheptopia, in the semi-arid North Pokot district in the Rift Valley near the Ugandan border and so she is fascinated by the idea of information from the world beyond. She said she thought that the radio would help her and the other women in her group to understand much better what was going on in the rest of Kenya and the region.

DONATE A LIFELINE

SIGN UP TO RECEIVE INFO

JOIN MAILING LIST

LATEST NEWS

The Freeplay Foundation is delighted to announce that our CEO, Kristine Pearson, has been named one of TIME magazine's Heroes of the Environment for 2007. [\[More\]](#)

Kristine Pearson, FF executive director, with Fatima during radio training

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 1A	Electricity Concentration 1B	Electricity Concentration 1C		1E Solar Panels (photovoltaic) 
---	---	---	---	--

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

Sun!



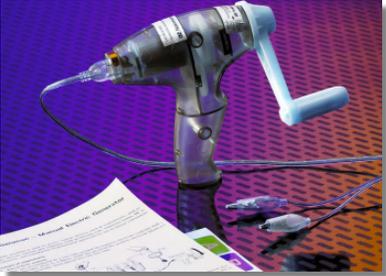
<http://www.newenglandbreeze.com/ithaca.shtml>

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.

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

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.

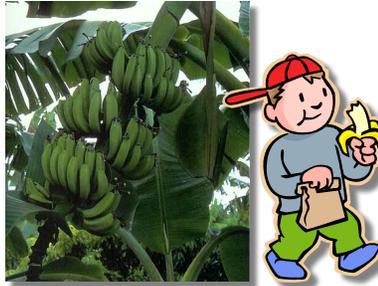
Electricity
Concentration
2A

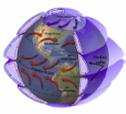
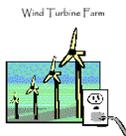
Electricity
Concentration
2B



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

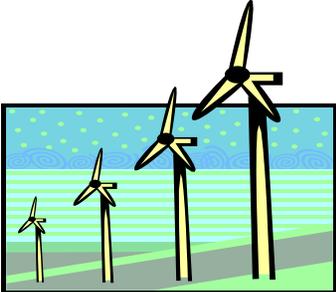
Sun!



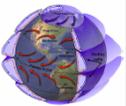
Electricity Concentration 3A	Electricity Concentration 3B	Electricity Concentration 3C		3E Wind Turbine Farm 
---	---	---	---	--

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

Wind!

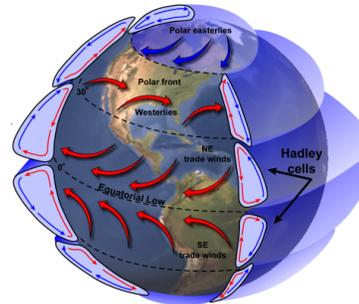


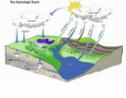
Hold up the generator again, illustrating its similarity to the much larger wind turbine.

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

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

Sun!



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

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...

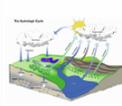
Rain!



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

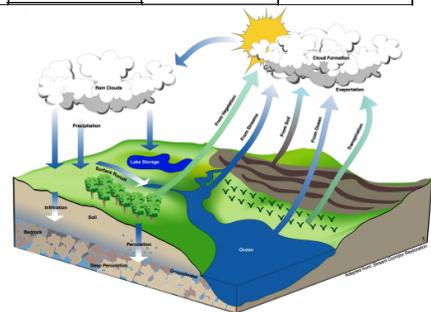
Electricity
Concentration
4A

Electricity
Concentration
4B



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

Sun!

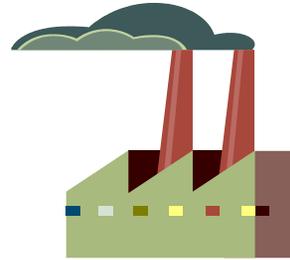


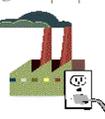
<http://www.water.ky.gov/dw/consumer/dwed/lessons.htm>

Electricity Concentration 5A	Electricity Concentration 5B	Electricity Concentration 5C		5E Coal-fired power plant 
------------------------------------	------------------------------------	------------------------------------	---	---

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

Steam!

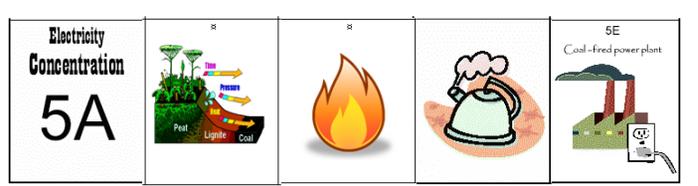


<p>Electricity Concentration</p> <p>5A</p>	<p>Electricity Concentration</p> <p>5B</p>	<p>8</p> 		<p>5E</p> <p>Coal-fired power plant</p> 
--	--	--	---	---

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

Fire!

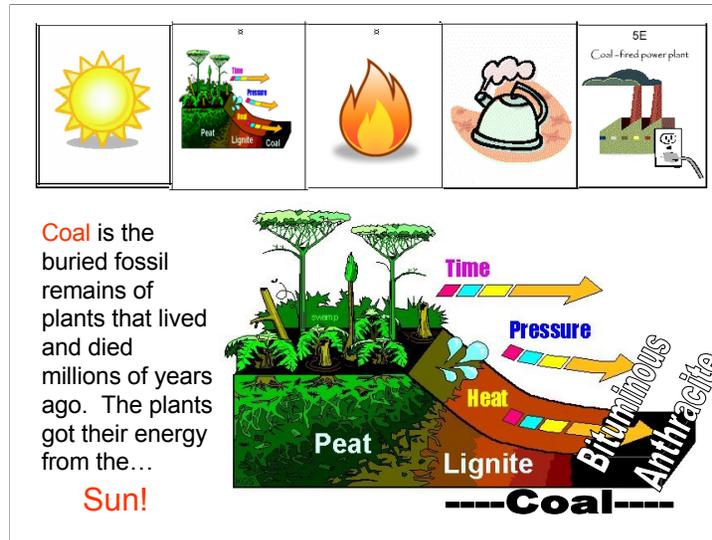




In a coal-fired power plant, the fuel for the fire is ...

Coal!





If you have examples of the stages of coal shown here (all are available at wardsci.com) 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

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.

most Polluting

Coal is a major source of...

Mercury pollution in fish...

Acid rain that weakens trees...

Smog that triggers asthma attacks...

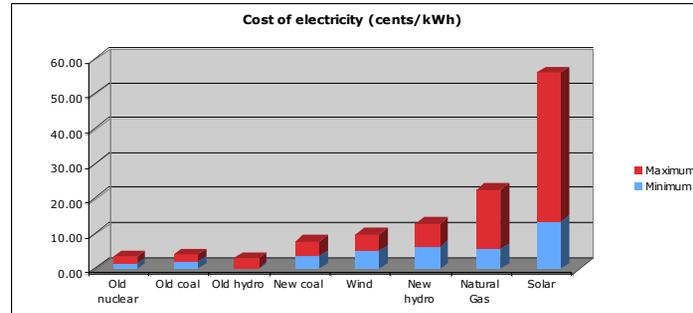
Carbon dioxide that causes climate change...

Mountaintop removal when coal is mined.



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

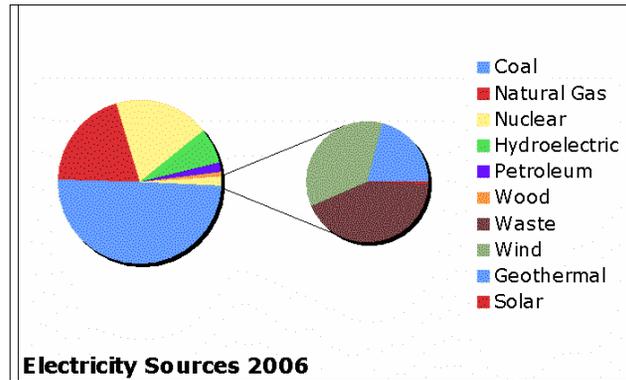
lowest Priced



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?)



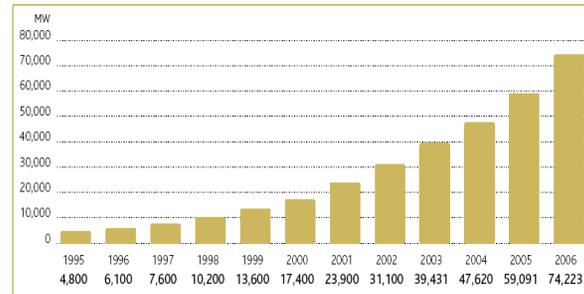
Electricity Sources 2006

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

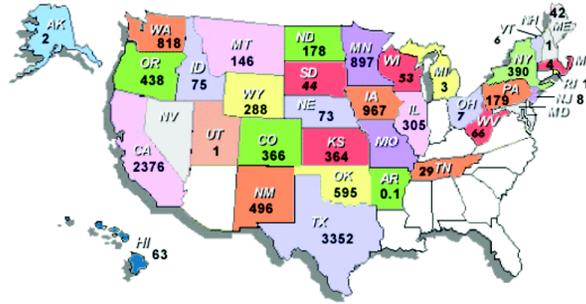
An update to this would show that coal is now less than half and gas is growing.

Wind power is the fastest growing renewable source of electricity

GLOBAL CUMULATIVE INSTALLED CAPACITY 1995-2006

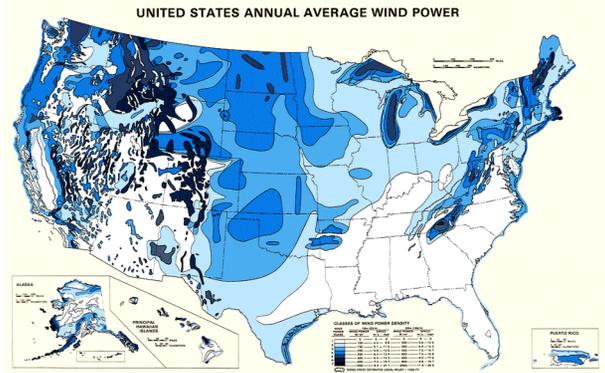


Most states have wind power projects

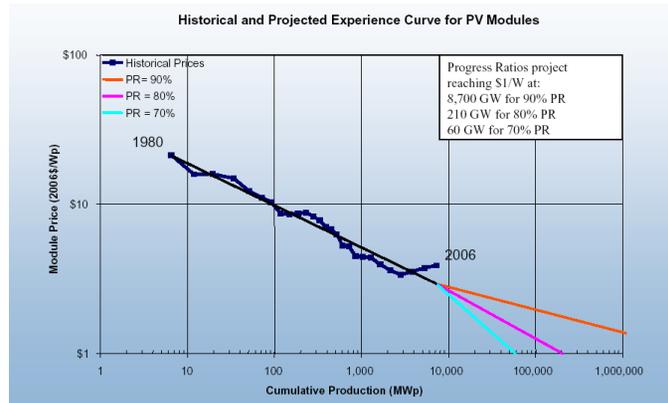


TOTAL INSTALLED U.S. WIND ENERGY CAPACITY: 12,634 MW as of June 30, 2007

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

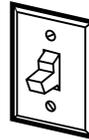


Change your light bulbs



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.

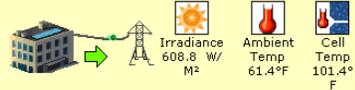
One World Sustainable Energy

Fernbank Science — Atlanta, GA

VIEW **Simple** Detail

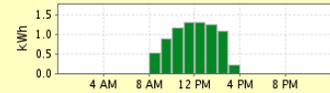
As of 3:13 PM Nov 10, 2008 System Size: 1.29 kW DC

Generating 892 W 



Historical  Today Week Month Year Lifetime

Generated 8 kWh 



Greenhouse Gases Avoided Since Installation May 27, 2008 

CO₂ 1,619 lbs.
Average household CO₂ output is 22,750 lbs./yr.



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<http://view2.fatspaniel.net/PV2Web/merge?&view=PV/detail/HostedAdmin&eid=46688>

One World Sustainable Energy

Fernbank Science — Atlanta, GA

VIEW **Simple** **Detail** 1.29 kW DC

AC OUTPUT		DC INPUT			
				Energy	Power
AC Power		Performance		Environmental	
Today Week Month				Irradiance 592.2 W/m ² Ambient Temp. 60.5 °F Cell Temp. 102.6 °F	
		Last update 3:18 PM Nov 10, 2008		enlarge	
Inv. 1 <input type="text" value="0.2 kW"/>		<p style="text-align: center;">■ Inv. 1</p>			

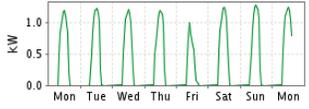
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<http://view2.fatspaniel.net/PV2Web/merge?&view=PV/detail/HostedAdmin&eid=46688>

One World Sustainable Energy

Fernbank Science — Atlanta, GA

VIEW **Simple** **Detail** 1.29 kW DC

	AC OUTPUT			DC INPUT	
	Energy	Power	Voltage	Current	Voltage
AC Power	Performance			Environmental	
Today Week Month				Irradiance 592.2 W/m ² Ambient Temp. 60.5 °F Cell Temp. 102.6 °F	
				<small>Last update 3:18 PM Nov 10, 2008</small> enlarge	
Inv. 1 0.2 kW <input type="text"/>	AC Power 				

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<http://view2.fatspaniel.net/PV2Web/merge?&view=PV/detail/HostedAdmin&eid=46688>

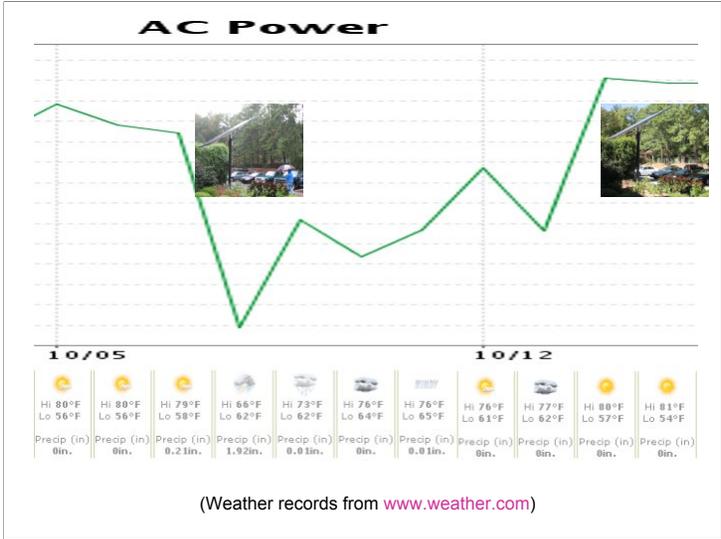
Fernbank Science — Atlanta, GA

VIEW **Simple** **Detail** 1.29 kW DC

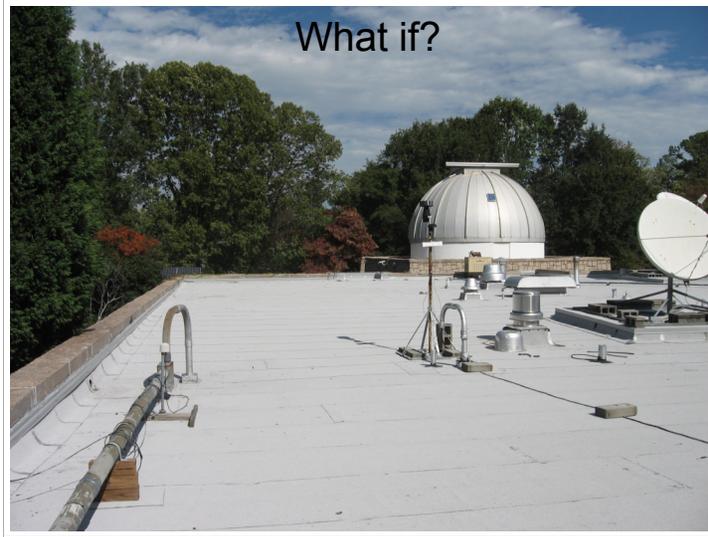
Energy	AC OUTPUT			DC INPUT		
	Power	Voltage	Current			
AC Power			Performance		Environmental	
Today Week Month					Irradiance 592.2 W/m ²	
					Ambient Temp. 60.5 °F	
					Cell Temp. 102.6 °F	
					Last update 3:18 PM Nov 10, 2008 enlarge	
			AC Power			
Inv. 1 0.2 kW <input type="text"/>						
			■ Inv. 1			

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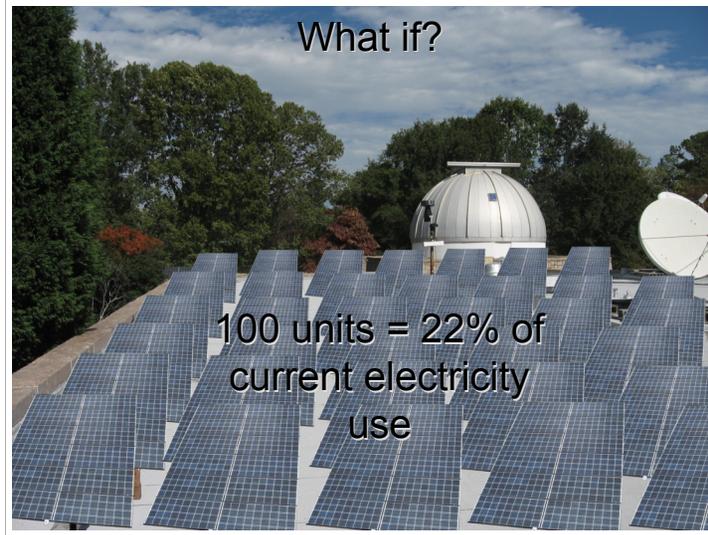
<http://view2.fatspaniel.net/PV2Web/merge?&view=PV/detail/HostedAdmin&eid=46688>



What if?



What if?



100 units = 22% of
current electricity
use

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