**Photovoltaic / Solar Electric Lab**

**Background**: Photovoltaic (PV) panels convert sunlight directly into electricity. Our classroom has 2 PV panels. In this lab you will use online data and field measurements of your own to analyze our PV system and suggest possible improvements in electrical production.

**Classroom measurements:**

1. How many watts is the LAHS PV system currently generating? (do as entire class)?

2. Plug a macbook into the “Kill A Watt” device. Make sure it is set to “Watts”. How many Watts is your macbook using?

3. How many macbooks can our PV system power?

**Outside Measurements:**

1. Using the “altitude Finder” Measure the angle of insolation and the angle of our solar panels and fill in the picture below with the data:

2. The Sun rises in the \_\_\_\_\_\_\_\_\_\_\_\_ and sets in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. What problem/s do you see with the LAHS PV system set-up?

1. At what tilt angle would our PV panels be **perpendicular** to the Sun?

**Online data:**

Go to http://rredc.nrel.gov/solar/calculators/PVWATTS/version1/US/Pennsylvania/

1. Click the closest town to Lewisburg. Leave all default information unchanged and click “calculate”. What is the “DC rating”?

2. What is the value of electricity over 1 year for a system of this size (bottom right)?

3. Click back 1 page and change DC rating to 20kW, then click “calculate”. What is the “AC energy” (in KWh) for 1 year (bottom right)?

4. What is the value of electricity over 1 year for a system of this size (bottom right)?

**LAHS PV online system data (do as a class)**

1. What was the total electricity (kWh) generated by our LAHS panels in the past 24 hours?

2. Assume a kWh is worth about $0.10. What is the value of the electricity we generated in the past 24 hours?

3. Assume this to be our daily average. What will be our value after 1 year (365 days)?

4. We have 2 PV panels. Look at your answer to #4 in the previous section (value of a 20kWh system). How many panels would it take to generate this much power?

**Analysis**:

The greatest solar resources are located in the Southwestern states, where sufficient solar energy falls on an area of 100 miles by 100 miles to provide all of the nation's electricity requirements. Covering 4% of the world's desert area with photovoltaics could supply the equivalent of all of the world's electricity. The Gobi Desert alone could supply almost all of the world's total electricity demand.

1. It takes about 100 ft2 of array for 1 kW of power. How many square feet of panels would it take to generate the 20kW system you researched in the “online data question #3”?

2. In a parking lot, a typical parking space for a car is about 160 ft2. To get a sense of scale, how many parking spaces of space would this solar array require?

3. 87 Octane gasoline is currently $3.79 / gallon. (1 gallon of gasoline = 124,000 Btu). What is the cost per BTU for gasoline?

4. Electricity averages about $0.11/KWh locally. (1 kilowatthour of electricity = 3,412 Btu). What is the cost per BTU for electricity?

5. Based on your answers to questions 3 and 4, what is currently the cheapest option to power a car, electric or gasoline?

6. PV panels are not perfect. In fact an area the size of a 20kWh system (like we are discussing in question #2) would receive about 90,000kWh from the Sun per year. Compare this to what you got for “Online Data #3” previously. What percentage of the Sun’s energy would these panels be able to convert to electricity?