APES Energy lab-PV panels

You will study several photovoltaic (PV) panel systems:

- PPA (purchase power agreement) array above the elab
- Solo PV panel of your choice
- Various PV arrays around campus

Part 1: PPA array process:

- Walk up to the PV array and count the number of panels
- With a meter stick, measure the active (blue) part of one panel, length and width
- Go to the data sources below and record the solar radiation now (you may also want to go to 10.14.4.57:8080 and look at the solar radiation there)
- Go to 10.14.8.2 and record the power from the PPA array
- Calculate the panel efficiency (see below)
- Solar data:
  - http://10.14.62.10/
  - http://10.14.58.3/
  - http://10.14.4.33/WCweb/
  - http://10.14.4.57:8080/

Calculations:

Solar radiation: _____W/m2
Panel area: _____m2
number of panels: _____
Total array area (area of one panel x number of panels):
_____m2
Total ideal power from array: (total area x solar radiation):
_____Watts
Recorded actual power: _____Watts
Efficiency: (actual power/ideal power. x 100) _____%

Part 2: Solar panel:

- Each panel produces DC energy, so look for a + and a minus - sign.
- connect a DC voltmeter to the panel while the sun shines on it and record the open circuit (no load) voltage
- rotate the panel in the sunlight to get the maximum voltage
- measure the area of the panel in m^2, as you did with the PPA panel above
- record the solar radiation as you did above as well
- measure the resistance of the tea maker (make sure the switch is on)
- to calculate power, attach the panel to a resistive load (e.g. tea maker) and measure the current and voltage
- to get power, multiply voltage x current to get Watts

- to calculate efficiency, follow the steps you did with the PPA array above

Tea maker (ohmic load):

Calculations:

Open circuit voltage _____V
Closed circuit voltage _____V
Panel area _____m2
solar radiation _____W/m2
ideal power: (area x radiation) _____W
load resistance _____Ω
current _____A

measured power (Volts x Amps)_____W
efficiency _____%

Cloudy day option:
Open circuit voltage _____24_____V
Closed circuit voltage _____22_____V
Panel area ____1.2_____m2
solar radiation _____600_____W/m2
ideal power: (area x radiation) _____W
load resistance _____11_____Ω
current _____1.6_____A
measured power (Volts x Amps)_____W
efficiency _____%

Part 3: Solar arrays around campus
Using the master eGauge unit at the elab: http://10.14.8.2/

- Pick a location you are interested in (e.g. CLH, GPAC, etc.)
- Find the power delivered by the system now (Volts x Amps)
- Locate the solar radiation data at one of the locations below:
- Solar data:
  - http://10.14.62.10/
  - http://10.14.58.3/
  - http://10.14.4.33/WCweb/
  - http://10.14.4.57:8080/
- Calculate the percent efficiency for that array, as you did above
- Each of the solar arrays (CLH, english, art) have active area of 1.75m2 per panel and 90 panels for a total max capacity of 29.7 kW

Questions:

1. What is the maximum efficiency for this array?
2. How does it compare with the PPA array (7 years old) and the panel you studied (15 years old)
3. What do you notice about the efficiency in the morning, noon and afternoon?
4. How does location and direction of the roof impact this?
5. If you were to install PV on your roof, how would you use this

information?

6. If this panel cost you $100 and lasted for 15 years producing this amount of energy each day, how much money would it make you total? (use $0.42/kWh)
7. How long would it take to pay it off?