**TIM 155: Problem Set 6**

Due **Thursday, May 18**, in class.

This homework focuses on the NREL System Advisory Model (SAM). The printout of the SAM online help documentation could provide assistance and is on the course website.

1. In a couple of paragraphs describe what the NREL System Advisor Model (SAM) is. (1 point)
2. In class we downloaded the SAM system onto our laptops. One of the SAM models is called the *photovoltaic* (*detailed)* model. Begin a new project involving detailed PV for a residential home. Select a weather file that you think most closely approximates Santa Cruz weather. Explain why you chose it. (1 point)
3. In your weather data, take a look at the direct normal (beam) irradiance. It should be measured in kWh/m2/day. Now compare this irradiance level to levels in 5 other U.S. states, in the northeast, southeast, midwest, northwest, and southwest. What does this tell you about the likely expansion of PV power in these other parts of the country? (1 point)
4. Now take a look at the article written by Stephanie Pappas (alumna of UCSC’s Science Writing program) - http://www.livescience.com/41747-best-solar-panels.html. Her first recommended solar panel is a Kyocera model. Select the exact model from the SAM module menu. There seems to be a minor discrepancy between the article’s claim about the panel’s efficiency and SAM’s listed nominal efficiency – what is it? (*Side note – Stephanie’s article is two years old so there is likely a better panel on the market now.*) (1 point)
5. Now look at the System Design page. We are going to specify the desired array size, so click that radio button. Let’s select 4.5 kWdc on the assumption that the residence will not utilize more than 4.5 kWdc even if all the major appliances were turned on simultaneously. What does kWdc mean? We also need to specify a DC-AC ratio, which is also known as the array-to-inverter ratio. This is our expectation of what will cause the solar array to not generate its maximum theoretical power. The larger this ratio, the more panels one needs to install. Typical ratios range from 1.1 to 1.25. Select a ratio in this range and explain why you chose it for Santa Cruz. Also explain the sources of the efficiency loss that requires us to use a DC-AC ratio. (1 point)
6. Select an inverter that brings you close to your DC-AC ratio. You can do this by selecting an inverter from the inverter menu, and then checking the DC-AC ratio on the System Design page. Which inverter did you choose? (1 point)
7. We will ignore shading and snow and other losses. Under Financial Parameters, let’s assume we have the cash to purchase and install this equipment without debt. Enter the correct information for an all-cash purchase of a solar system. Under Incentives, check the DSIRE Incentives Database for any additional incentives provided by the city of Santa Cruz. What incentives are there and do they *directly* effect the cost or value of the system?

Under Electricity Rates, we will study the neighborhoods in Santa Cruz that are part of PG&E Region T. We need to choose a type of tariff (cost of power) plan. Our options are E-1 and E-6. Review the basics of these tariffs at this website: <http://www.pge.com/tariffs/ERS.SHTML#ERS>. Chose one or the other and enter it into SAM. Explain why you chose the one you did. (1 point)

1. When we looked at the Electricity Load default data in class we noticed that there was greater electricity use in summer than in winter. We didn’t think that load profile matched Santa Cruz well. Why not? Instead, let’s edit the load profile using actual data from Professor Haddad’s house. It is on the course website. Enter the most recent 12-month data (note: December data will be a year older than the rest.)

Now run a simulation of this home’s energy production, consumption, and costs. Click on “untitled” and rename your work “<YOUR NAME> TIM 155 Homework.” On the same menu, create a report and submit it along with your homework. Based on your report, provide information on payback period and total cost. Returning to the SAM model, look at the Profiles section and click on *Electricity to/from grid (kWh)*. If the goal is to have a house that is electricity-neutral, do you think this system is sized properly, too small or too large? Explain. (1 point)