BRAE 348 – Energy for a Sustainable Society
BioResource And Agricultural Engineering Department
Winter 2004

Name:_____

Activity 7: Solar photovoltaic, hydrogen and wind energy
March 1 and 2, 2004
Text: Chapter 12, and Fuel Cell Car Lab Manual.

1. The text gives information about the operation of solar cells and wind turbines in production of electricity. The objective of this activity is to give the students practical experience in the production of electric energy from wind and solar.
2. The Fuel cell car lab manual gives information about hydrogen fuel cells. The further objective of this exercise is to give the students practical experience in the use of solar energy to produce hydrogen for use in a fuel cell to produce electricity.

FIND:

1. Solar Photovoltaic Cells: From the literature describing the specifications of the Shell solar cell, the average solar input for this region and the electric inverter specifications, determine the average daily output of the system in kwhrs. What is the maximum power output in KW from the system, and how long can the daily production of solar energy provide this power level?

2. Wind energy system: from the specifications of the wind turbine and the average wind speed and availability of this region, determine the average daily output of the wind turbine in kwhrs? If this energy production is added to that produced by the solar PV system and is converted to AC through the inverter, what is the maximum power output in KW, and how many additional hours per day can the system provide this power output?

3. Solar Cell Fuel Cell Car:

a. In full sunlight operate the solar car with the motor detached (see Experiment 15) to produce hydrogen and oxygen. Record the volumes of hydrogen and oxygen and time for producing these volumes. Calculate the rate of hydrogen production, _____ml/s.

b. While producing hydrogen, measure the voltage, in volts and the current, amps (See experiment 16). Calculate the average watts and watt-hours produced by the solar cell. Based on the measurement of the solar meter, what is the efficiency of this solar cell?

c. Based on the electrical power P_{in} produced by the solar panel, watts from 3b., calculate the efficiency of water electrolysis (Experiment 17). Use equation 9,
P_{out} =(____ ml/s (from 3a.)/24,000ml/mole) X 237,000 J/mole = _____ watts.
Efficiency = P_{out} /P_{in}

d. When the gas tanks are full, perform experiment 23 by connecting the circuit according to Fig. 117. The car should run now, and operate the car until the fuel runs out. Set up a circular track as shown in experiment 27 and fill in the blanks listed on pages 83. Keep track of the time to run out of fuel.

e. At some point during this run, perform Experiment 33, in finding the voltage output of the fuel cell and the resulting efficiency of this fuel cell, see equations and fill in blanks on Experiment 33 handout.

4. Write one conclusion for each of the above activities 1, 2 and 3.