Homework 3 - (100 points)

A. INSTRUCTION

(a) Due: by 8:00pm Wed Mar 1
(b) Scoring rubric for each problem:
    100% Correct answer with detailed calculation displayed
    50   Incorrect answer with detailed calculation displayed
    5%   Correct answer <u>without</u> calculation displayed
    0   Incorrect answer <u>without</u> calculation displayed
(c) Late submission: Max score is reduced by 10% for each day after the deadline.
(d) If any two or more submitted works are (almost) identical, all such works will be considered as cheated ones, and are subject to 0 point first and then to possible additional disciplinary action from the university.

B. Problems

1. An 1-MW natural-gas powered power plant has an efficiency of 52 %. Natural gas has the heating value of 55,340 kJ/kg, and about 77% is carbon.

 Q1. What is the heat rate of this power plant [kJ/kWh]?
 Q2. What is the carbon (C) and Carbon dioxide (CO2) emission rates, [kg C/kWh] and [kg CO_2 /kWh], respectively?
 Q3. If the power plan runs in full capacity for 8700 hours per year, how much total electric energy the power plant generate per year [kWh/year]
 Q4. If the carbon penalty cost set by the Clean Air Act is $10 per every 1,000 kg of CO2, how much would the power plant pay per year[$/year]?

2. If you access the California ISO web page (www.caiso.com/Pages/default.aspx), you see real time electric power demand such as 21,749 MW, along with current renewables such as 14,077 MW and renewables serving demand such as 65%. In this case, renewable energy supplies 65% of the demand of 21,749 MW while the rest is supplied by other means such as natural gas-fired power generators.
 Q1: What time do you access the web site, in California local time?
 Q2: What are the <u>current demand</u>, <u>current renewables</u>, and <u>renewables serving demand</u> at the time of your access?
 Q3: If the remaining demand (not served by the renewables) is supplied by natural gas-fired power plants (with the same efficiency and the same CO2 emission rate as described in 1 above), how much carbon dioxide (CO2) will be emitted per hour?