

## PROBLEM SET 2: ENERGY TRENDS, DEVELOPMENT, AND THERMO

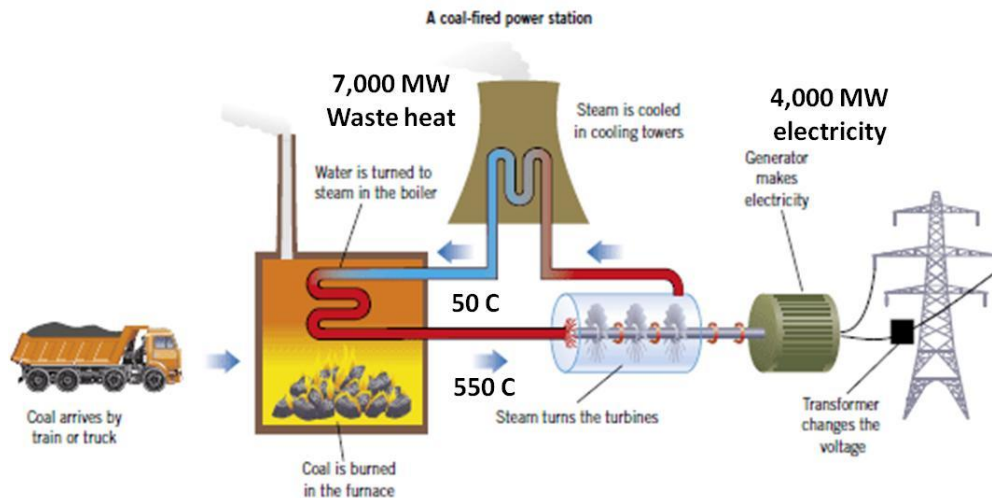
### *Energy and the built environment CRP 570.004/470.004*

Total Points: 25 pts

Due Date: 2/11, 12 pm, in class.

Grading: Most of the problems are worth 2 points: 1 point for completion, 1 points for clearly showing all steps of your work. Every number should have a unit next to it (unless they it is unitless, like efficiency).

1. Energy and development (8)
  - a. Define energy poverty (2)
  - b. Explain how energy poverty impacts women and children more than men (2)
  - c. A typical car battery has 500 Wh of energy. Only 250 Wh can be used without damaging the battery. If a rural household charges their battery every day with a solar panel and they have three 6W light bulbs, how many hours can they use the three lights for each night? (2)
2. Power plant. The diagram below shows a coal burning power plant. (9)
  - a. Draw a boundary for a closed system for analysis. (1)
  - b. Draw arrows showing all transfer of work or heat across your system boundary. (1)
  - c. Using the 1<sup>st</sup> law of thermodynamics, calculate the rate of heat input (MW) to your system.(2)
  - d. Calculate the thermal efficiency (first law efficiency) of the system. (2)
  - e. Calculate the carnot efficiency of the system (remember to convert temperatures to Kelvin). (2)
  - f. Calculate the 2<sup>nd</sup> law efficiency (thermal efficiency/carnot efficiency). (2)



3. Combustion (8)
  - a. Write the equation for the combustion of ethane in pure oxygen and balance the equation. (2)
  - b. What is the molar mass of ethane? (2)
  - c. Use this to calculate the total mols in a metric ton of ethane. (2)
  - d. What is the mol ratio of ethane to carbon dioxide? The mol ratio is the number of ethane molecules to the number of carbon dioxide molecules in the balanced equation. (2)