**INSTRUCTION SHEET**

In a 1200 MW gas power plant, 24,500 m3 (at 25oC and 1 atm) of natural gas are consumed per hour (consider only methane, CH4, density of 0.657 kg/m3 at 25oC and 1 atm.

In the coal power plant, it is intended to maintain the same electrical capacity as for the gas power plant, with the coal power plant having an efficiency of 43%. The coal to be used has the following composition: C: 70.5; H: 5.5; O: 3.8; N: 0.3; S: 0.4; Ash: 19.5 (dry weight % (wt%), molecular weight (MW) = 100 g/mol, higher heating value (HHV) = 29.6 MJ/kg). For both fuels, the power plants operate the entire year, except for a period of 45 days, where maintenance is carried out.

In order to curb additional carbon dioxide (CO2) emissions, engineers are considering the implementation of a post-combustion capture aiming at achieving a capture at 95% and 90 mol% purity of the CO2 stream. However, they estimate that 20 wt% more coal will be consumed in this case, to avoid a reduction of the electrical capacity of the power plant.

1. Based on the information above, evaluate:

1) The CO2 emissions produced per year in both natural gas and coal-fired power plants before implementation of the carbon capture unit.

2) The minimum work required (in kJ/kgCO2) to separate the CO2 from the flue gas mixture (at a temperature of 358 K) after the implementation of the carbon capture unit in the coal power plant. How would this compare with the minimum work that would be required if the fuel was natural gas, assuming the same capture conditions? Consider the combustion of 1 mol of fuel for the calculations.

3) The impact on the coal power plant efficiency of the implementation of the carbon capture unit.

4) The total CO2 produced per year due to the combustion of the coal after the implementation of the carbon capture unit in the coal power plant, as well as the CO2 amounts captured, emitted, and avoided. According to these results, investigate and comment on the economic viability of the CO2 capture system.