Cost comparison of technologies for pre-combustion CO_2 capture from an lignite-fired IGCC

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Abstract:

Although solvent-based CO_2 capture is the most mature and demonstrated technologies for CO_2 capture, other emerging technologies such as membrane, cryogenic separation, precipitating solvents, and adsorption have the potential to significantly reduce costs in the long run [1]. CO_2 capture from an IGCC with solvent-based technology or the comparison of a specific emerging capture technology with solvents have been extensively studied, however no systemic cost-comparison of CO_2 capture technologies from an IGCC have been investigated.

This work will therefore present the cost-comparison for a lignite-based IGCC plant of three pre-combustion CO_2 capture technologies:

1) Rectisol-based CO_2 capture, a physical solvent that can be used to remove CO_2 and the H_2S present in the syngas in a staged removal process;

2) Membrane-based CO_2 capture which will consider the potential of both CO_2 selective membrane [2] and hydrogen selective membrane [3] processes;

3) Low-temperature CO_2 capture which is based on partial condensation and phase separation of liquid CO_2 from non-condensables [4].

The IGCC plant considered is based on a lignite input of 39 kg_{wet}/s, leading to a net power output of 279 MW for the plant without CO_2 capture. The syngas after the water gas shift is available at 28 bar and contain 29.2 $\%_{CO2,wet}$. A generic process flow diagram of the IGGC plant with CO_2 capture is provided in Figure 1 for the membrane-based and low-temperature based cases[1].

The results will present the energy performances of the IGCC with CO_2 capture using each of the three technologies, as well as the economic performances (Electricity production cost and CO_2 capture cost) taking into account the maturity differences between technologies maturity.

[1] It is worth noting that in the case of Rectisol-based CO_2 capture, the AGR unit is combined with the capture unit after the water gas shift units.

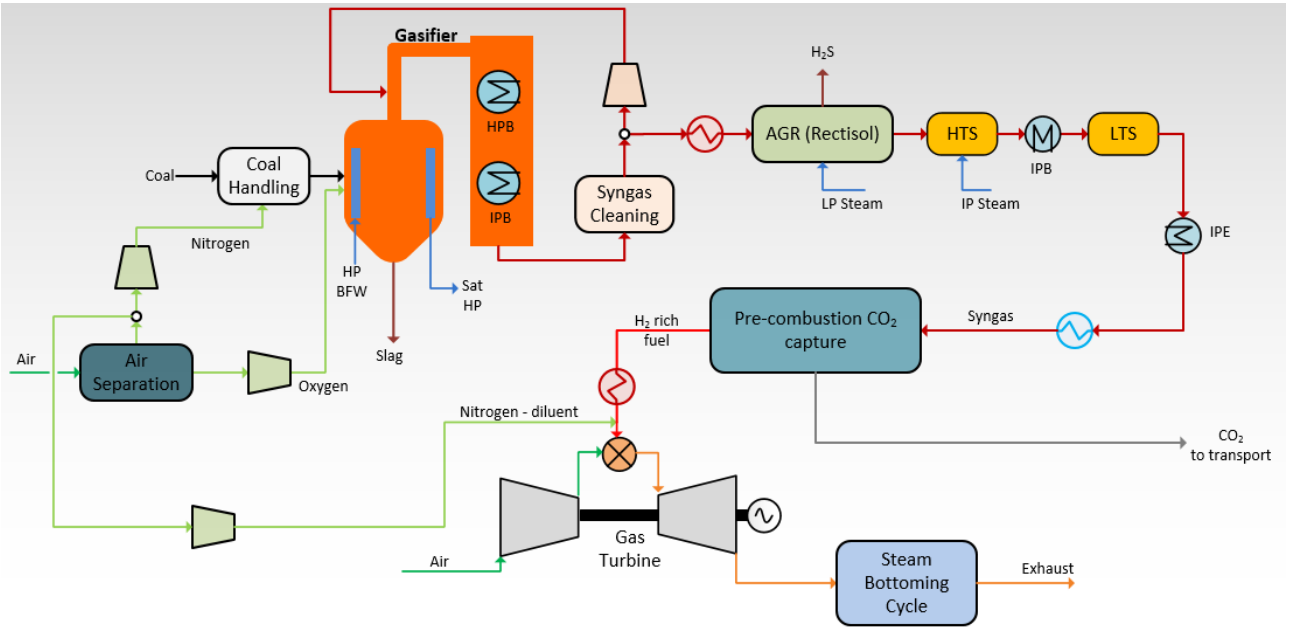

Figure 1: Generic Process Flow Diagram of the IGCC plant with CO_2 capture

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