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TECHNOLOGIES FOR CCS (CARBON CAPTURE AND STORAGE): COST COMPARISON OF DIFFERENT PROCESSES

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OVERVIEW

Carbon capture and storage (CCS) is a way of mitigating the contribution of fossil fuel emissions to global warming, based on capturing carbon dioxide (CO_2) from large point sources such as fossil fuel power plants, and store it away. Various pilot plants are near to start operations. [1]

Application of CCS could reduce CO_2 emissions by approximately 80-90%. But capturing and compressing CO_2 requires much energy and would increase the fuel needs of a by 25%-40%[2], so increasing the cost of produced electricity. These estimates apply to purpose-built plants near a storage location; costs are even higher if CCS is applied to pre-existing plants and far from a storage location. However, recent industry reports suggest that sequestered coal-based electricity generation in 2025 will cost less than unsequestered coal-based electricity generation today.[3]

The aim of this paper is to analyse the efficiency reduction and economic impact of the CO_2 capture technologies on the power plant.

METHODS

Some different theoretical cases are studied for both types of power plant, pulverized coal (PC) and combined cycle gas turbine (CCGT). CCS processes are the following:

1. Mono-ethanol amine (MEA) based chemical absorption
2. Chilled Ammonia (Alstom Power) chemical absorption
3. Aqueous Ammonia (Powerspan ECO2) chemical absorption
4. Cryogenic CO_2 capture, solid separation
5. Oxy-fuel combustion

An original numerical process analysis has been used considering all the steps of CCS process, from gas pre-treatment to capture and compression of CO_2, obtaining a comparison of processes on a common basis. Another analysis has been developed for an estimate of investment costs.

RESULTS

For all the analyzed processes a full report is available, comprising detailed power consumption for each step (Fig. 1). It will be performed a calculation of overall energy efficiency, a detailed investment analysis for each plant (Table 1) and finally an analysis of the overall cost of produced electricity (Table 2).

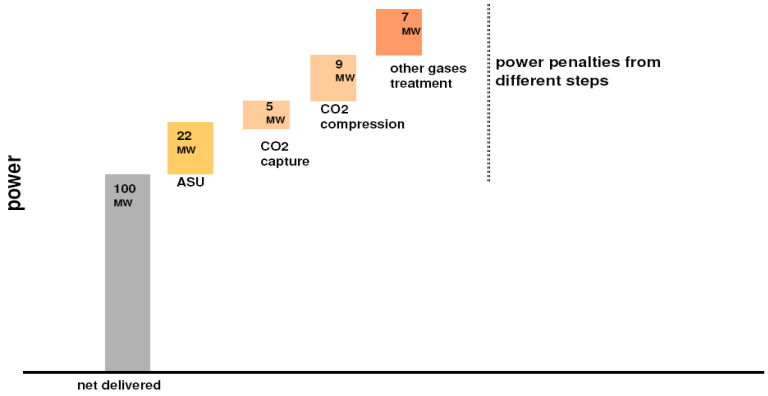

Fig. 1 Power penalties for different steps of gas treatment (PC Oxy Combustion)

Table 1. CAPEX for different technologies

CCS Plant	CAPEX (M€)
CA (Chilled Ammonia)	105,1
AA (Aqueous Ammonia)	202,1
Oxy fuel IGCC	….
MEA (Ammines)	220,9

Table 2. overall cost of produced electricity

CCS Plant	Electricity cost (c€/kWh)
CA (Chilled Ammonia)	5,3
AA (Aqueous Ammonia)	5,7
Oxy fuel IGCC	….
MEA (Ammines)	6,3

CONCLUSIONS

This analysis gives an outlook of the performance and economical impact of different CO_2 capture technologies for different power plants.

Among these technologies, while some of them seem to be detrimental from efficiency and economical point of view, others seem promising and worth to be analyzed further. An important contribution to overall costs is given by CO_2 compression for transportation, so decisions about storage plants are fundamental for the technical and business analysis of CCS projects.

Huge investments are needed for CCS: so it is important to define clear paths in order to obtain the best environmental advantages while limiting costs and project risks.

REFERENCES

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