CO_2 Capture and Storage, technologies and challenges to take up

C. Barrere-Tricca, L. Nougier
IFP, France

We are facing three major energetic challenges: the demand increase, even if the present economical crisis impacts the short term demand, the CO_2 emission and the pic oil.
It is expected that the developing countries will be responsible of about 50% of the energy demand in 2030 compared to 37% today The CO_2 emissions will reach 38 Gt in 2030, compared to about 23 Gt at the present time.
In this context of climate emergency, the CO_2 capture and storage installed on centralised CO_2 production units such as electricity production and heavy industry is seen as a promising solution.

But we are facing some critical technical challenges.
It is well-known that three main solutions could be developed for CO_2 capture, but all off them present some technical and economical advantages and drawbacks and need demonstration before industrialisation.

- the oxyfuel solution is based on a combustion with pure oxygen thanks to an air separation unit or chemical looping unit. This technology lead after water condensation to a relatively pure CO_2 stream that could be send to the compression unit. This solution is on the demonstration stage but additional work has to be done to optimise the oxyfiring area and to limit CAPEX and OPEX.
- the precombustion solution consist in a gasifier using air or pure oxygen followed by a shift reactor to increase hydrogen production and a high pressure CO_2 separation unit. The CO_2 stream can be send to the compression unit and the H_2 stream can be used in the power unit. This technology presents the advantages and the drawback of the IGCC unit.
- the post combustion treatment with a CO_2 capture realised on the flue gases. This technology could be installed for rewamp of existing power unit, but it presents some drawbacks such as the low CO_2 partial pressure in the flue gases and the very high flue gases flow. Most of the time, the CO_2 capture is realised with solvent and the heat of regeneration has a large impact on the economic value of the projects.

After capture, the storage management has also to be validated. The control and the numerical modeling of the storage are mandatory to ensure the efficiency and the security for a long period of time.
This system is very complex, it consists in a multiphasic flow: water, oil and CO_2 with interaction between the three phases and a complex thermodynamic. Depending on the storage zone, the reactions have to be take into account to evaluate the carbonate formation or the dissolution which can affect the porosity.
Moreover different space scales and time scales have to be considered to cover the well, the storage zone, the basin, the injection time and the post injection phase.
Another major challenge for the CO_2 geological storage is the capacity of the storage and the injectivity which give the rate of injection or the number of well necessary for a given capacity.

The talk will highlight on the undergoing research work at IFP related to this topic.