**2018-IP19: Water-energy-CCS nexus: water consumption is not a constraint to implement CCS in power plants**

Water and energy consumption are highly connected: Energy production consumes significant amounts of water; equally, providing water demands energy. The 2°C, "well below" 2°C, or the 1.5°C scenarios, place CCS (Carbon Capture and Storage) as one important mitigation strategy within the mixture of measures. CCS is considered as a technology which significantly increases the water consumption in power plants. However, it must be differentiated the Carbon Capture from the Storage sections. While Carbon capture systems could increase the water consumption[1] under the premises of traditional technologies, water is frequently extracted from the storage sites. This technique can be beneficial to adjust the reservoir pressure, manage the plume and increase the storage capacity.

In the past, IEAGHG reviewed both areas: "Water usage and loss analysis of bituminous coal fired power plants with $CO_2$ capture" (2010/05) and "Extraction of formation water from $CO_2$ storage" (2012/12). Within the conclusions, IEAGHG communicated that: 1) With and without carbon capture systems, there are strategies to reduce water consumption in power plants. The increase of water usage by adding a carbon capture system can be managed. The cost would be linked to electricity price, water availability, and cooling equipment. Consequently, location is a key factor for power plants with and without carbon capture systems; 2) $CO_2$ storage often requires the extraction of water in the geological structure to inject the $CO_2$. Outputs indicated that the storage capacity of a reservoir is generally increased. The cost of water treatment would depend on the final use, energy costs and the water quality requirements. It is needed to do a more specific evaluation under the individual regions scenarios, for example, in water-stressed zones.

Based on those conclusions, recently, IEAGHG went one step further and delivered a report titled "Effects of plant location on costs of $CO_2$ capture" (2018/04). The aim was to analyse the cost of $CO_2$ capture in different locations. Technical differences (such as ambient conditions, fuel analysis and water availability) and local economic parameters (such as fuel price, construction and operating labour costs, productivity, project contingency, maintenance costs, material and equipment costs, local taxes and costs of $CO_2$ transport and storage) were considered. Connected to this water-energy-CCS, it was concluded that: 1) Changes on the cooling system, compared to traditional techniques, impact negatively on the power plant efficiency. However, that is a site-specific consequence. For example, in locations as China, air cooling has a high efficiency due to the ambient conditions; 2) In some cases, the amount of water recovered from the fluegas can even exceed the raw water demand of the power plant, representing a significant advantage in locations where water supply is limited.

Supported on those previous results, IEAGHG recently started a technical study, titled "Understanding the Cost of Reducing Water Usage in Coal and Gas Fired Power Plants with CCS" and carried out by CSIRO. The objective is to analyse, from technical and economic perspectives, the previous three areas within a common framework: 1) Water consumption in power plants with carbon capture; 2) treatment of water extracted from the storage site for its reuse in the power plant with carbon capture; and 3) which locations can benefit from this strategy. The output will be a techno-economic overview of the water usage in the entire CCS chain at global scale. That will contribute to the decisions-making process for the design of power plants with carbon capture, with or without a storage site nearby.

[1] Solvent-based chemical absorption configuration

In summary, water consumption is not a constraint to implement carbon capture systems in power plants. Available strategies can reduce the water consumption in power plants with and without carbon capture. As in every analysis, details are tremendously important. We are covering CCS in all the potential costs-water-energy scenarios and we expect to release some updates soon. This work was presented recently in the event "*Addressing the energy-water nexus through R&D planning and policies*", organised under the auspices of the Expert's group on R&D priority setting and evaluation (EGRD) and hosted by the European Commission DG Joint Research Centre, in Brussels. The presentation can be found in our website (www.ieaghg.org).

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**31/05/2018**