Carbon dioxide, capture, utilization and storage (CCUS) coupled with geothermal energy: An Overview

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As part of the international energy decarbonization goals, carbon capture, use and storage (CCUS) is considered to be one of the most efficient options that can help, along with the diverse renewable energies, to reduce carbon dioxide (CO_2) concentrations in the atmosphere.

In the other hand, geothermal energy offers clean and renewable energy, although conventional geothermal resources are well developed, unconventional resources confronts big technical and economic challenges. Heat extraction of unconventional sources, such as hot dry rock (HDR), deep saline aquifer (DSA) or low enthalpy resources (LER), can be carried out through a very particular scenario, in which it is possible to combine carbon capture and storage with geothermal energy.

The coupling of this two concepts dates back to 2000, when researcher Donald Brown proposed heat mining of a HDR reservoir using supercritical carbon dioxide ($_{SC}CO_2$) in stead of water. This new engineered geothermal energy concept consists in the injection of CO_2 in supercritical state into the subsurface, creating fractures and beeing heated by geothermal gradient, then hot CO_2 rises in to a production well so it can be use in a generation plant, all the process through a close loop. Some benefits of this switch may be the elimination of the parasitic load of pumps in production wells, since CO_2 densities in production and injection wells create a thermoshiphon effect that make it arise. Other advantage is cease using valuable water resources for energy generation.

In this overview several literature related to CCUS coupled with geothermal energy was collected and organized first chronologically and then in terms of the different challenges that this technology affronts, which are thermophysical properties and heat mining, geochemistry, infrastructure and economic issues. In addition projects were classified and analysed in terms of types of reservoir, in which CCUS is applied (HDR or DSA).