Abstract

A Techno-Economic Study of a CO_2-Plume Geothermal System in Mature Gas Reservoirs of the Brazos Area Protraction, Gulf of Mexico

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The Brazos Area protraction of the Gulf of Mexico was the focus of exploration and development of Middle Miocene aged natural gas reservoirs along the Corsair fault trend for many decades of the late 20th century. With this development came the installation of supporting infrastructure. This included fixed offshore platforms and pipelines to bring the produced natural gas back to shore, roughly 65 kilometers in waters between 40 to 60 meters deep. As operations have shifted to deeper waters with larger reservoirs, much of this infrastructure has been left abandoned with removals being delayed due to the high decommissioning costs. Carbon capture and sequestration (CCS) and geothermal energy are two such technologies that received increased attention in the Gulf Coast region as efforts to reduce atmospheric CO_2 concentrations accelerate. Specifically, CO_2-plume geothermal (CPG) systems inject supercritical CO_2 (sCO_2) into a sandstone reservoir where the heat is extracted from the surrounding rock as the fluid migrates, then the fluid is

produced into a direct-sCO_2 turbine power plant. Upon exiting the power cycle, the sCO_2 is then reinjected into the reservoir to start the sequence again.

This study uses open-source well data from the National Geothermal Data System (NGDS), reservoir and infrastructure data from the Bureau of Ocean Energy Management (BOEM), and the Sequestration of CO_2 Tool (SCO_2T^{PRO}) software to conduct a resource assessment in terms of geothermal energy and CO_2-capacity of the gas reservoirs in the Brazos Area protraction and the potential power output and specific capital costs of greenfield and brownfield CPG systems. These characteristics are then used to adapt the CPG system to an offshore application exploiting the mature/depleted reservoir with the most potential, the BA133A_CM7D sand. This application is modeled by creating a workflow to conduct a techno-economic analysis involving three main schemes and the implications of current policy incentives under the Inflation Reduction Act of 2022, namely the 45Q carbon tax credit and the investment tax credit. The schemes analyzed are a Post-CCS CPG-only application (PCC), a combined CCS and CPG operation with newly built infrastructure (CCNB), and a combined CCS and CPG operation utilizing repurposed infrastructure (CCRI).

The economic analysis yields a levelized cost of electricity (LCOE) range for the PCC scheme of 72-332 \$/MWh. The reduction potential (25-78%) is driven by the amount of infrastructure reuse and ITC incentive at a 20 \$/tCO_2 storage cost and 35 \$/tCO_2 purchase price. The LCOE range under the CCNB and CCRI schemes are about 84-573 \$/MWh (52-85% reduction potential) and 5-464 \$/MWh (58-99% reduction potential), respectively. A sensitivity analysis was performed for 35, 60, and 85 \$/tCO_2 purchase price and number of sCO_2 power plants (1-10) that can be installed on the platform. LCOE ranges for either CCNB or CCRI scenarios are shown to decrease from roughly 1,385 \$/MWh to 441 \$/MWh.

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