Cost Comparisons for Mitigating Fluctuations in Power Plant CO_2 Capture in Integrated Carbon Capture and Sequestration Network by Using a Stacked Storage Geologic System

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ABSTRACT

The coal power plants in Texas operate as base load capacity systems, but their power output is not uniform throughout the year. While they operate at near full capacity during the peak summer demand months, during months of lower demand, the power output follows regular daily and seasonal patterns. In designing a pipeline to connect multiple CO_2 sources and sinks, some of these short duration fluctuations can be tolerated by the storage capacity in the pipeline network itself. For those fluctuations that cannot be absorbed in the pipeline, the CO_2 injection design may need to be altered accordingly.

Power generation data from the Electric Reliability Council of Texas (ERCOT) is used to estimate CO_2 capture from an existing coal power plant. This paper estimates the cost trends associated with handling CO_2 input fluctuations relative to a nominal constant CO_2 output via (1) pipeline size for storage capacity and (2) number of injection wells to store efficiently CO_2 with a fluctuating flow rate.

The design of such a CO_2 injection facility depends on certain geologic characteristics including porosity, permeability, relative permeability, and fluid saturations. It is assumed that a deep saline aquifer will accompany an enhanced oil recovery (EOR) operation, known as a stacked storage system. The Conroe Field in Montgomery County, Texas, is used as a model for such an operation. Conroe Field is an old oil reservoir that initially had 1.45 billion barrels of oil and permeability ranging from 0.5-2.0 darcies. These characteristics would be very desirable for developing a stacked storage project.

To optimize production from EOR, the injection rate flexibility is minimal. Thus, in a "stacked storage" system, a potential EOR operation will be considered from an economic basis, where revenue is recovered from additional oil production. In such an operation, a deep saline formation can handle the fluctuations associated with carbon capture systems at a power plant. During the years of maximum EOR production from the Conroe Field, injection into a deep saline aquifer would be only to handle periods of peak load from the coal plant and daily or seasonal fluctuations from the average CO_2 captured. Before and after peak production a deep saline aquifer allows safe storage of excess CO_2 from the EOR operation. A stacked storage injection system at the Conroe Field designed to handle the rate of emissions during peak load periods (14,000 tonnes of

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CO_2/day) is approximately $28 million spent over the 20-yr project life more than if designing the EOR and saline infrastructure for the average coal plant output (11,600 tonnes of CO_2/day). When using the pipeline itself to act as a storage buffer to mitigate the power plant output fluctuations, an additional $117 million would need to be spent on a constructing a larger pipeline. Thus, for this first-order analysis, saline injection wells are a more economical strategy for handling the variability in CO_2 captured at a coal plant.