The system-wide economics of a carbon dioxide capture, utilization, and storage network: Texas Gulf Coast with pure CO_2-EOR flood

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Abstract

This letter compares several bounding cases for understanding the economic viability of capturing large quantities of anthropogenic CO_2 from coal-fired power generators within the Electric Reliability Council of Texas electric grid and using it for pure CO_2 enhanced oil recovery (EOR) in the onshore coastal region of Texas along the Gulf of Mexico. All captured CO_2 in excess of that needed for EOR is sequestered in saline formations at the same geographic locations as the oil reservoirs but at a different depth. We analyze the extraction of oil from the same set of ten reservoirs within 20- and five-year time frames to describe how the scale of the carbon dioxide capture, utilization, and storage (CCUS) network changes to meet the rate of CO_2 demand for oil recovery. Our analysis shows that there is a negative system-wide net present value (NPV) for all modeled scenarios. The system comes close to breakeven economics when capturing CO_2 from three coal-fired power plants to produce oil via CO_2-EOR over 20 years and assuming no CO_2 emissions penalty. The NPV drops when we consider a larger network to produce oil more quickly (21 coal-fired generators with CO_2 capture to produce 80% of the oil within five years). Upon applying a CO_2 emissions penalty of 60\$2009/tCO_2 to fossil fuel emissions to ensure that coal-fired power plants with CO_2 capture remain in baseload operation, the system economics drop significantly. We show near profitability for the cash flow of the EOR operations only; however, this situation requires relatively cheap electricity prices during operation.