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Economic Impact of Utility Costs on Amine-Based and Cryogenic Carbon Capture Technologies

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Abstract

Carbon Capture and Storage (CCS) in expected to play a significant role in helping reduce greenhouse gas emissions, particularly from heavy industrial operations. Presently, amine-based capture systems, having a Technology Readiness Level (TRL) of 9, are the most mature technology for capturing CO_2 from flue gas streams from industrial processes and therefore, are often evaluated for near-term decarbonization efforts. Amine capture is suitable for flue gas streams with a range of CO_2 concentrations, typically from 3% to 30% [1]. The thermal energy requirement for amine technology is significant. In a typical 90% capture MEA plant, 78% of the operating costs can be attributed to the thermal energy required for amine regeneration [2]. This thermal energy is often produced by an auxiliary source such as a natural gas fired boiler, a combined heat and power plant, or from the host facility if steam is available. The addition of auxiliary sources to produce energy typically results in additional emissions to be captured, which impacts the size and cost of the capture plant but can improve project economicsimprove project economics and minimize the impact on the operations of the host facility.

As the CO_2 concentrations rise above 15%, other technologies become viable for post-combustion carbon capture. One such technology that is being evaluated by industrial emitters is cryogenic capture, with a TRL of 6-8 [1]. This process relies on electricity for cooling and compressing the flue gas, making it more dependent on the availability and cost of electrical energy compared to other technologies, while eliminating the need for thermal energy. Electricity for capture facilities is often sourced from the host facility, the electricity grid, or dedicated electricity generation at site.

A case study will be presented to examine the impact of utility costs on the economics of these two carbon capture technologies under different utility cost scenarios. Key parameters include the costs of electricity and natural gas which vary considerably across different jurisdictions. Regions with abundant, easily accessible natural gas tend to have lower natural gas prices, reducing the cost to generate thermal energy for the capture plant. Electricity prices vary by location, influenced by the availability of power plants and fuels, local fuel costs, and pricing regulations [3]. Generating power on-site may result in lower cost electricity for the capture plant which would factor into the

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overall economics. Understanding the economic impact of utility costs is important to evaluate the cost competitiveness of amine capture and cryogenic capture.

Keywords: Carbon capture and storage, Cryogenic capture, Amine-based capture, Utility costs, Economics

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