GHGT-11

Economic and market analysis of CO₂ utilization technologies – focus on CO₂ derived from North Dakota lignite


Abstract

Based on information obtained about the technical aspects of the technologies, several challenges are expected to be faced by any potential CO₂ utilization technologies intended for North Dakota lignite plants. The weather, alkaline content of lignite fly ash, and space limitations in the immediate vicinity of existing power plants are challenging hurdles to overcome. Currently, no CO₂ utilization option is ready for implementation or integration with North Dakota power plants. Mineralization technologies suffer from the lack of a well-defined product and insufficient alkalinity in lignite fly ash. Algae and microalgae technologies are not economically feasible and will have weather-related challenges.

Keywords: CO₂ utilization; CO₂ reuse

1. Introduction

Because of the abundant supply of coal resources such as lignite in North Dakota and some of the Midwestern states, the United States will rely on the use of fossil fuels for its energy needs for many years to come, thus sustaining or increasing the level of CO₂ emissions. Since lignite produces more CO₂ per unit of energy compared to the other ranks of coal, it will be the fuel most impacted by any move to force CO₂ emission reductions from power plants. Given that the primary use for North Dakota lignite is minemouth electrical power plants, any CO₂ regulations will potentially have more impact on the North...
Dakota power industry and economy. To lessen the impact on the state, it is important to begin exploring ways of addressing the CO₂ emission issue in a sustainable manner. To this end, approaches that focus on CO₂ capture and reuse are attractive, particularly in areas where geologic storage may not be an optimal solution. Also, finding a potential use for the captured CO₂ might generate additional revenue to help offset some of the costs associated with CO₂ capture and, hence, act as an incentive for capturing CO₂ from lignite-fired power plants.

The primary purpose of this Energy & Environmental Research Center (EERC) study was to assess existing and emerging technologies for the beneficial use of CO₂ captured from North Dakota lignite-fired power plants. In the context of this study, the best technology is defined as one that not only utilizes CO₂ efficiently and cost-effectively but also results in or produces the most marketable product. By specific recommendation of the North Dakota Industrial Commission’s (NDIC’s) Lignite Research Council, technologies related to enhanced oil recovery (EOR), enhanced coalbed methane (ECBM), and enhanced gas recovery (EGR) were not considered in the investigation. All other areas that show both near- and long-term promise were considered in the study.

2. Methods

While carbon capture, utilization, and storage (CCUS) technologies are developing rapidly worldwide and possess the potential to offer a significant contribution to CO₂ mitigation, there is interest in also exploring the possibility of CO₂ utilization in other end uses, such as in building material production, fuels, and chemicals. Several broad technology areas are being developed to facilitate the beneficial use of captured CO₂ from large point sources, such as coal power plants. These technologies encompass various applications, including EOR, ECBM recovery, CO₂ conversion to chemical feedstocks and fuels, biological conversion (photosynthesis) processes, and CO₂ mineralization for the production of materials. EOR is one of the largest uses of CO₂ captured from anthropogenic point sources, especially in the last few decades when there has been a greater desire to rely more on locally produced oil. During times of high natural gas prices in the United States, some of the CO₂ has been directed to ECBM recovery to boost production. In the last several years, more attention is being directed to other technologies such as algae growth, electrofuels, and chemicals as a means of providing a beneficial use for the captured CO₂, which could offset some of the high costs associated with CCUS technologies. An overview of these technologies is presented in Figure 1.
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