

Enhanced Coal Bed Methane Production and Sequestration of CO₂ in Unmineable Coal Seams

Award Number: DE-FC26-01NT41148

Project Summary:

This project was conducted to evaluate opportunities for carbon dioxide (CO₂) sequestration in an unmineable coal seam in the Northern Appalachian Basin with simultaneous enhanced coal bed methane recovery (CBM). The goal of the project was to construct and operate a coal bed CO₂ sequestration site composed of a series of horizontally drilled wells originating at the surface and extending through two overlying coal seams.

Figure 1: Shallow groundwater monitoring at W-1.



Prime Performer:
CONSOL Energy, Inc.

Principal Investigator:
James E. Locke

Project Duration:
10/1/2001 – 12/31/2015

Performer Location:
South Park, Pennsylvania

Field Sites:
Marshall County, West Virginia

Program:
Carbon Transport & Storage

Project Outcomes:

In 2003, work began on the development of the first of three CBM production sites, referred to as the North Site, where four wells were planned, two in the Upper Freeport (UF) seam and two in the Pittsburgh (PIT) seam. Drilling complications caused one UF well to end short of the planned 3,000-foot length and the loss of a drill string in the second well that was eventually abandoned and plugged when the drillers encountered thinning of the UF seam. A second CBM production site was established to the south and a pair of production wells were drilled, one in the UF and the second in the PIT. The northeasterly lateral of the UF well was terminated prematurely due to a thinning coal seam. A final site was drilled at a central location with two wells in the UF that would later be converted to injection wells for the project, following a period of CBM production. Injection was initiated in September 2009, injecting 4,968 tons of CO₂ with a maximum rate achieved of 22.09 tons per day. Injection was terminated in September 2013 following the detection of CO₂ breakthrough indicated by elevated concentrations of CO₂ in the UF produced CBM at the south well site. A detailed two-year post-injection monitoring program was undertaken to verify the absence of plume migration to water sources, the surface, or beyond the area of review (AOR) boundaries. No evidence of vertical migration or horizontal migration outside the AOR of the injected CO₂ was observed, although there was horizontal migration from the injection wells into a production well, production from that well ceased, CO₂ concentrations decreased to acceptable levels and that well was used as a monitoring well. At the time of the final report, the project had produced over one billion cubic feet of CBM, with production continuing after publication. Actual project costs compared to the realized benefits resulted in a selling price of gas that amounted to a \$3.29 per thousand cubic feet (mcf) loss. Alternative conceptual scenarios were evaluated by adjusting natural gas sales prices, costs of CO₂, and injection costs with varying results, some of which were profitable. The number of production wells and the commodity prices of methane and CO₂ have a significant impact on the economics.

Presentations, Papers, and Publications

Final Report: [Enhanced Coal Bed Methane Production and Sequestration of CO₂ in Unmineable Coal Seams](#) (March 2016) – James E. Locke, Richard A. Winschel