

Commercial Deployment of Carbon Capture, Utilization, and Storage (CCUS) in the Williston Basin – An Overview of Current Projects and Opportunities

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Summary

A review of publicly available information has been used to identify several projects in the Williston Basin that are focused on carbon capture, utilization, and storage (CCUS) as a major component of the business model. Stages of development for these commercial-scale projects range from initial feasibility studies to active CO₂ capture and injection operations. Economic drivers for CCUS projects were identified, including federal and state tax incentives, monetization of credits associated with low-carbon-fuel standards in California, and enhanced oil recovery (EOR) projects. Sources of captured CO₂ for Williston Basin projects include a coal gasification plant, coal-fired power plants, ethanol plants, and natural gas-processing plants. Sinks for the captured CO₂ include oil fields and deep saline formations (DSFs).

Results, Observations, and Conclusions

Since 2000, the Great Plains Synfuels Plant operated by Dakota Gasification Company near Beulah, North Dakota, has captured approximately 1 million tonnes/yr of CO₂ and delivered it via a 205-mile pipeline to the Weyburn and Midale oil fields in southeastern Saskatchewan for EOR. In 2014, additional CO₂ captured from the Boundary Dam power plant near Estevan, Saskatchewan, was added to the project. Operated by Whitecap Resources, as of 2019, CO₂ EOR at Weyburn has produced over 20,000 bbl/day of incremental oil. The Weyburn and Midale oil fields have also hosted world-class research activities to advance the science and engineering of CCUS. The IEAGHG (IEA Greenhouse Gas R&D Programme) Weyburn CO₂ Monitoring and Storage Project has generated a wealth of knowledge and data focused on four research themes: 1) geological characterization of the geosphere and biosphere; 2) prediction, monitoring, and verification of CO₂ movements; 3) CO₂ storage capacity/distribution, prediction, and application of economic limits; and 4) long-term risk assessments of the storage site (IEAGHG, 2021).

In 2014, the SaskPower-owned and operated Boundary Dam lignite coal-fired power plant became the first power station in the world to successfully deploy commercial carbon capture and storage (CCS) technology. As of March 2021, over 4 million tonnes of CO₂ has been captured. Of the captured CO₂, over 350,000 tonnes has been injected into two brine-saturated sandstone units as part of the Aquistore Project, Canada's first dedicated CO₂ storage project. Aquistore also hosts an internationally recognized research program focused on monitoring methods. The remainder of the captured CO₂ from Boundary Dam has been sold and delivered to the Weyburn oil field in southeastern Saskatchewan for EOR (SaskPower, 2021).

Red Trail Energy is in the late stages of planning a CCS project that will capture approximately 200,000 tonnes/year of CO₂ from the biofermentation process at its ethanol plant near Richardton, North Dakota. There are two commercial drivers for the project: 1) the U.S. federal 45Q tax credit program, which provides a tax credit worth up to US\$50/tonne for dedicated storage in saline

formations and 2) California Air Resources Board (CARB) Low Carbon Fuel Standard (LCFS) credits, which in 2019 were trading for up to US\$218/tonne. Geological characterization, permit application development activities, and full carbon life cycle analysis have been conducted to satisfy the requirements of the CARB LCFS Program. Two U.S. Environmental Protection Agency (EPA) underground injection control (UIC) Class VI-compliant wells have been drilled, the target storage reservoir and seal have been characterized, and baseline monitoring activities, including seismic surveys and near-surface soil gas and groundwater sampling, have been conducted. The area of review for the CO₂ storage facility has been established, and pore space leasing has been initiated. A permit application for a CO₂ storage facility was submitted to the North Dakota Department of Mineral Resources (NDDMR) in February 2021. Pending authorization of the storage facility permit (SFP), CO₂ injection is anticipated to begin in late 2021.

Project Tundra has a goal of capturing up to 4 million tonnes/year of CO₂ from the Milton R. Young lignite coal-fired power station, operated by Minnkota Power Cooperative, near Stanton, North Dakota. The CO₂ would be injected for dedicated geologic storage in DSFs. The commercial driver for the project is the U.S. federal 45Q tax credit program. If the project moves ahead, construction is anticipated to commence in 2022–2023. Activities to date include pre-FEED and FEED studies for the capture system, the drilling of two stratigraphic test wells, identification and characterization of multiple deep sandstone formations for stacked storage, development of materials to support the permit application, and initiation of pore space-leasing activities. Submission of a CO₂ SFP application to NDDMR is expected in 2021.

Midwest AgEnergy, the owner and operator of the Blue Flint Ethanol Plant near Underwood, North Dakota, is in the early stages of a project that would capture and store up to 200,000 tonnes/year of CO₂ from the ethanol biofermentation process. Activities to date include a seismic survey, one stratigraphic test well drilled in 2020, and geologic modeling and simulations. It is anticipated that an application package for a CO₂ SFP will be submitted to NDDMR in 2021.

Denbury Resources operates the Greencore pipeline that transports CO₂ from sources in Wyoming to its Bell Creek oil field in southeastern Montana. Denbury has plans to extend that pipeline in 2021 to the Cedar Creek Anticline (CCA) in North Dakota, where Denbury intends to conduct EOR operations in Red River Formation reservoirs. Later phases of EOR development are expected to target reservoirs in the Interlake and Stony Mountain Formations. Denbury (2021) reports that it has at least 42.2 MMBOE of incremental proved reserves in its CCA assets.

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