CO_2 Storage Capacity Estimates for Stacked Brine-Saturated Formations in the North Dakota Portion of the Williston Basin

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Abstract

The capture of CO_2 from large industrial sources and its subsequent injection into deep brine-saturated formations is one option being considered to reduce greenhouse gas emissions. As part of its ongoing regional characterization efforts, the Plains CO_2 Reduction (PCOR) Partnership has conducted a detailed evaluation of the potential CO_2 storage capacity of several stacked brine-saturated formations. The study area, referred to as the Washburn area, encompasses 7500 square miles and is home to six coal-fired power plants and one coal gasification plant which combine for annual emissions of over 36 million tons of CO_2. The Washburn area is underlain by over 10,000 feet of sedimentary rock representing every period of the Phanerozoic. The stratigraphy of the Washburn area includes several thick and laterally continuous formations of brine-saturated clastics and carbonates of moderate to high porosity and permeability, many of which are hydrogeologically separated by extensive low-permeability shales and evaporites. The characterization of the Washburn area included the development of CO_2 storage capacity estimates for four formations that were identified as being potential targets for sequestration. The potential injection target formations include carbonates of the Ordovician Red River Formation and the Mississippian Mission Canyon Formation and sandstones of the Pennsylvanian–Permian Broom Creek Formation and the Cretaceous Dakota Group. Formations that could act as seals, including the shales and evaporites of the Ordovician systems, evaporites of the Mississippian Charles Formation, shales and evaporites of the Permian Opeche Formation, and shales of the Cretaceous Mowry and Pierre Formations were also evaluated. Characterization of the sink and seal formations in the Washburn area was accomplished using an approach that integrated well log data from over 50 wells, core analyses, drill stem test data, water analyses, and other published data to construct detailed petrophysical models. Based on the petrophysical model and the reservoir fluid properties and pressure/temperature conditions, dynamic injection simulations were developed in order to estimate potential injection rates and storage capacities and predict injection plume size and migration extent. Results indicate that brine-saturated formations in the Washburn area of North Dakota have a CO_2 storage capacity greater than 13 billion tons.

Keywords: CO_2 sequestration, Williston Basin, CO_2 storage capacity estimates