

Gigaton-scale CO₂ Storage in the Wabamun Lake Area

Robert Lavoie*

CalPetra Research and Consulting Inc, Calgary, AB
rob@calpetra.com

and

David Keith

University of Calgary, Calgary, AB, Canada

Summary

Geologic storage of CO₂ is a crucial tool to enable Canada to exploit its hydrocarbon resources while managing CO₂ emissions. The long term safety of CO₂ storage is critical to assure policy makers, regulatory agencies and the public that these operations are safe and that CO₂ is removed permanently from the atmosphere. Large stationary CO₂ emitters are located in central Alberta with cumulative annual emissions in the order of 30 Mt CO₂. This includes four coal-fired power plants in the Wabamun Lake area, southwest of Edmonton with emissions between 3 to 6 Mt/year each. Although significant CO₂ storage capacity exists in depleted oil and gas reservoirs, these may not be available in the near future because most of these reservoirs in the Wabamun lake area are still producing. Moreover, the large Pembina Cardium oil fields, located just south of the Wabamun Lake area, now producing as mature waterfloods, are in the initial stages of investigating possible use of CO₂ as a miscible flooding agent to further enhance oil recovery. Commercial scale use of CO₂ for this purpose is still a few years away and until then these pools will require only pilot scale volumes of CO₂ for EOR reservoir characterization and test purposes. As a result, CO₂ storage in deep saline aquifers is the most likely near future scenario for large scale CO₂ sequestration. While it is certainly possible to move CO₂ from the Wabamun area to distant storage locations, it is of considerable interest to public policy makers to determine if very large scale storage is feasible in the immediate vicinity of the power plants. The study will perform a comprehensive characterization of large-scale CO₂ storage opportunities in the Wabamun Lake area and analyze any potential risks. As a benchmark, the project will examine the feasibility of storing 20 Mt-CO₂/year for 50 years within 30 km of Wabamun. This gigaton-scale storage project is one to two orders of magnitude larger than the commercial projects now under study. It will fill a gap between the province-wide capacity estimates (which do not involve site specific studies of flow and geomechanics etc.) and the detailed commercial studies of small CO₂ storage projects currently underway. Unlike the commercial projects, this project is planned as a public non-confidential project lead by the University of Calgary (U of C) and in cooperation with the Alberta Geological Survey (AGS).

The study will first assess the possible injection formations within the area based on storage capacity, ease of injectivity, leakage likelihood and interference with current petroleum production. Then a few (1-3) specific targets will be selected for more detailed studies. The detailed studies will

evaluate how the injected CO₂ moves and reacts within the reservoir, the storage integrity of the over and underlying shaly aquitard (impermeable) formations, leakage risks of CO₂ along existing wells and a preliminary well injection design. Finally, the study will do a preliminary assessment of currently available options for monitoring such large scale injection of CO₂. Since the project is planned to develop a realistic scenario we will add an economic evaluation of the total project costs downstream of the capture and pipeline transportation components. Furthermore, the study will outline the necessary next steps to close any remaining knowledge gaps before planning and conducting the actual injection phase of the project.

The study will extend research conducted during the 90's and early 2000's on the Wabamun Lake region and will cover the following topics:

- Geology and geochemistry
- Geological Model
- Reservoir simulations and injection well design
- Geomechanical analysis
- Well integrity and remediation assessment
- Monitoring
- Integrated risk assessment
- Regulatory and legal issues
- Economics