The Weyburn Project: A Model for International Collaboration

By Eileen Fitzpatrick

The Weyburn oil field, located on the northwestern rim of the Williston Basin in the southern part of the Saskatchewan province of Canada, was first drilled in 1954. Today, about 650 production and water injection wells are operated by EnCana Resources (formerly PanCanadian Resources). During its lifetime, this 70-square mile oil field has produced some 55 million cubic meters of oil from primary and waterflood production. But, having produced in excess of 25% of its estimated recoverable oil reserves, in the last few years the field began to decline.

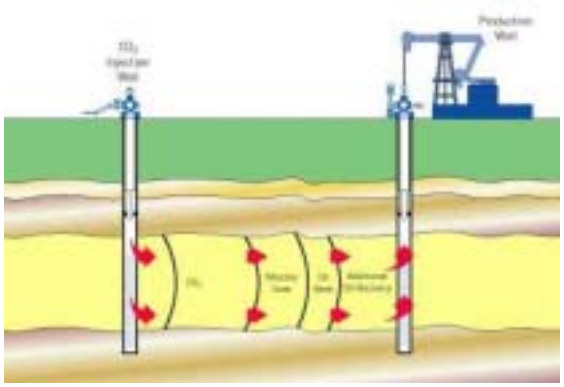
Route of CO_2 pipeline from North Dakota Gasification plant to Weyburn oilfield. Courtesy of IEA GHG.

In 2000, with a $20.5 million cooperative agreement with the Canadian Federal Government and the Saskatchewan Provincial Government, EnCana began enhanced oil recovery (EOR) efforts using CO_2 to extend the life of the Weyburn field by more than 25 years, anticipating the extraction of 130 million or more barrels of oil from the depleted field.

You may ask why this is so important, considering enhanced oil recovery has been in existence and operation for some time now. Since its inception, the original project sponsors have been joined by the European Union, the Alberta Government, the U.S. Department of Energy, the Japanese ENAA, and industrial sponsors, including BP, ChevronTexaco, TotalFinaElf, Dakota Gasification Co., TransAlta Utilities, SaskPower and Nexen, providing another $20 million in in-kind contributions. Now in its third year, the Weyburn Project represents a unique opportunity for the governments and industries around the world to collaborate on the largest scale emissions-reduction project to date. The key aspects of the Weyburn Project are to use waste CO_2 as the miscible flood in enhanced oil recovery, and to study the behavior of the CO_2 in what is considered the most logical place to store carbon--depleted oil and gas wells. Over the project's 20-year lifetime, approximately 20 million tonnes (22 million tons) of CO_2 will be stored in the Weyburn oil field, recycling and eventually storing .3% of the world's total annual emissions, an amount equivalent to emissions generated by the state of Maryland.

CO_2 Enhanced Oil Recovery (EOR)

For over 40 years now, enhanced oil recovery techniques have used water and various fluids in the remediation of gas and oil wells, and now waste CO_2 is also considered a viable option. When CO_2 floods were first used, they were typically supplied from abundant, naturally occurring sources in a relatively pure state, within a short distance of the site, because the farther away the site was from the source, the less economically viable a CO_2 flood became. But the energy industry is now realizing that their waste CO_2 is a valuable resource for EOR projects. The Dakota Gasification Company, which



Schematic diagram of a miscible CO_2-EOR flood. Courtesy of IEA GHG.

delivers the CO_2 to the Weyburn oil field via a 320-km pipeline, demonstrates perfectly the economic feasibility of long distance CO_2 transportation. Of the 199 active U.S. EOR projects operating in 1998, 66 of these projects used miscible CO_2 floods, which accounted for the production of more than 179,000 million of a total 759,965 million barrels per day, or 4.25% of daily production. The number of projects will likely increase as CO_2 -EOR activities translate into the bottom line for industry: the opportunity to offset production costs with an increase in yield.

The CO_2 enhanced oil recovery process is relatively simple: Pump compressed CO_2 into an injection well near the production well site. The injected fluid forces oil toward the production well, thus increasing yield. An additional benefit of this method is that the CO_2 mobilizes lighter fractions of oil, which improves the quality of the oil produced.

Since Weyburn CO_2-EOR operations began in October 2000, a daily supply of 2.7 million cubic meters of waste CO_2 (95% pure) has been supplied to the Weyburn oil field from the Great Plains Synfuels Company in Beulah, North Dakota. As part of an international carbon sequestration partnership initiative, the U.S DOE has provided $4 million in funding to the Weyburn Project to study CO_2 storage in the Weyburn oil field

CO_2 Storage

Approximately 1/3 of the CO_2 used in EOR activities remains in the oil field. According to the IEA GHG, most CO_2-EOR projects have been designed to minimize CO_2 losses in the reservoir, since the CO_2 traditionally represents an additional production cost. So, most EOR operations have not considered what happens to the stored CO_2, how much can be stored, or the relative merits of storage with enhanced oil production. The Weyburn Project is the perfect opportunity to answer these questions. The potential exists for industry to offset some of their operation costs by combining CO_2 storage with enhanced recovery of fossil fuels. And this project is uniquely structured to analyze the feasibility of this combined approach.

Researchers will gather information before and after CO_2 flooding to assess CO_2 as an oil enhancement, and to analyze the conditions and behavior of the CO_2 in ground. Another element of the study is determining yield and storage capacity to fully realize cost effectiveness. That is, determining the potential CO_2 storage capacity of the reservoir for every enhanced barrel of oil produced.

CO_2 Monitoring

The IEA Weyburn CO2 Monitoring and Storage Project is coordinated by 20 research organizations in the U.S., UK, France, Italy and Denmark, and co-administered by the Petroleum Technology Research Centre, Natural Resources Canada, Saskatchewan Industry and Resources, the Saskatchewan Research Council, the University of Regina and IEA GHG. This international collaboration will improve the knowledge and understanding of geologic sequestration by monitoring the CO_2 that remains in the oil field over a 4-year period. Key objectives of this research are to study the geological, geophysical and geochemical aspects of the Weyburn field, and map the migration and distribution of existing formation fluids (including resident CO_2) as well as injected fluids.

CO_2 recycle compressors used in EOR activities at the Weyburn oil field. Courtesy of IEA GHG.

What makes the Weyburn oil field a most promising site for research is the Saskatchewan Province's near-complete collection of records and reports on the geophysical, production, and injection activities in

the Weyburn oil field since its discovery. These records are expected to provide a sound basis for developing analytical and monitoring methodologies for future carbon sequestration efforts.

The Bottom Line

Until now, vague knowledge of the geologic formation and activities, combined with the constant fluctuation of oil prices have made predicting the economic success of EOR projects difficult. But the historical data on the Weyburn oil field is anticipated to provide unique insights for a sound economic model of current and future CO_2-EOR/sequestration efforts. The efforts of this and other EOR/sequestration projects are aimed to give worldwide support to the notion that geologic storage is a safe, environmentally acceptable means of CO_2 mitigation.

An ongoing international exchange of information among policymakers, scientists, technology developers, regulators, and the public, based on ideas, data, and perspectives developed by a broad range of research efforts will keep the lines of communication open on a global scale, and will lead to economically and environmentally acceptable approaches to reducing CO_2 and regulating climate change.