Carbon Capture and Storage – Proven, Safe Technology

Technology to capture and store carbon dioxide (CO_2) emissions is being broadly pursued in Canada, the United States and Europe. While still in its development stage, the technology is a safe and effective alternative to allowing greenhouse gases to enter the atmosphere.

Ongoing research is aimed at two objectives:

1. Profiling and selecting geological formations, including depleted oil and gas reservoirs, that can be used for safe, long-term CO_2 storage, and
2. Developing improved, long-term monitoring technology for active storage reservoirs.

In Canada, the geological formations being considered as likely candidates for long-term CO_2 storage – namely depleted oil and gas reservoirs, coal formations and saline aquifers – have already proven safe for storing other gases and liquids. These same formations have trapped crude oil and natural gas underground for millions of years.

The formations consist of a layer of permeable rock capped by a thick layer of impermeable rock. While the gases and fluids can pass through the pores of the permeable rock, they cannot get past the impermeable rock. As a result, any CO_2 injected into the permeable formation remains trapped there.

Groundwater

Ensuring the safety of groundwater is another key issue. For the same reasons that stored CO_2 cannot be released back into the atmosphere, it also has difficulty migrating into aquifers that provide drinking water. If there was a potential for leakage, any potable water would have already been contaminated by brine or hydrocarbons trapped in the formations.

In Canada, a landmark CO_2 capture and storage project is now under way. The three-year initiative is being conducted by the University of Calgary's Institute for Sustainable Energy, Environment and Economy, in conjunction with industry and the federal and Alberta governments, as well as the University of Alberta, Princeton University and Lawrence Livermore National Laboratory at the University of California.

The project will initially focus on storing CO_2 in deep saline aquifers more than a kilometre underground. It will also examine reservoirs in Western Canada and the potential for combining CO_2 storage with enhanced oil recovery (EOR) projects.

The research effort is linked to the University of Calgary's participation in the ongoing $1 billion EnCana – International Energy Agency CO_2 enhanced oil recovery and storage project in Weyburn, Saskatchewan. This initiative involves piping CO_2 from a coal gasification facility in Beulah, North Dakota, to a mature oil field reservoir at Weyburn. It's expected the project will result in storing approximately 14 million tonnes net of CO_2 underground while producing an incremental 130 million barrels of oil over the next 25 years.

Proven technology

Carbon capture and storage, along with EOR, are also being explored extensively in the United States and Europe.

CO_2-based EOR techniques were pioneered in Texas as early as 1972. Since then, CO_2 injection has been used successfully throughout west Texas and eastern New Mexico. An extensive pipeline system for delivering this CO_2 has operated safely for over 25 years. CO_2-based EOR is also being pursued to a more limited extent in Pennsylvania, Kansas, Mississippi, Oklahoma, Colorado, Utah, Wyoming, Montana and Alaska.

The most significant project in the U.S. is FutureGen – a US$1 billion public/private partnership to design, build and operate a prototype coal-fuelled, "zero emissions" power plant. The CO_2 generated in the process would be captured and stored.

The commercial-scale FutureGen plant is intended to prove the technical and economic feasibility of using coal to produce hydrogen and electricity with virtually no emissions. It will also support testing and commercialization of technologies focused on generating clean power, producing hydrogen and capturing and permanently storing CO_2. Construction of FutureGen is expected to start within three years, with the plant becoming fully operational by 2012.

A similar initiative is being proposed for British Petroleum's Carson refinery in California. In this case, petroleum coke would be gasified, with the resulting hydrogen used in electricity generation. The byproduct CO_2 would be sent to nearby oil fields for use in EOR.

Work on 'clean coal' is also under way in Canada. SaskPower has formed a $30-million partnership with the federal and Saskatchewan governments to undertake first stage engineering for a new clean coal facility. Similarly, in Alberta the Clean Coal Power Coalition is undertaking a $20-million study with the Alberta government on technology applications at one of Epcor's sites.

The first of 25 CO_2 storage projects to occur under the U.S. Department of Energy's new *Regional Carbon Sequestration Partnerships* program has a Canadian connection. Gas from Apache Canada Ltd.'s processing plant in Zama, Alberta, is to be injected into the nearby Zama oil field. The Zama test will help determine the impact that high concentrations of hydrogen sulfide may have on CO_2 integrity, as well as on EOR.

European initiatives

CASTOR (CO_2 from Capture to Storage) is a European project involving 30 industry partners as well as research institutes and universities from 11 European countries. The group's objective is to capture and store roughly 30 per cent of the CO_2 emitted by European power and industrial plants.

In 2006, CASTOR launched its first pilot project at the 420-megawatt Elsam power station near Esbjerg, Denmark. The goal of the Elsam project is to remove one tonne of CO_2 per hour from the coal-fired plant's flue gases. The European Commission is paying for about half of the €16 million pilot project, with the remaining funds coming from private partners.

Elsewhere in Europe, the Shell Group and Norway's Statoil have signed an agreement to develop the world's largest project using CO_2-based offshore EOR. The plan is to store about 2 million to 2.5 million tonnes of CO_2 per year in two different fields.

The project will see a Norwegian gas-fired power plant and methanol production facility provide CO_2 to two offshore oil and gas fields. Power from the plant will also be provided to the offshore fields, resulting in near zero CO_2 and nitrogen oxide emissions from these installations. The project is expected to be phased in between 2010 and 2012.

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