BACK

Sparking a Less Carbon-Intensive Future – Greenhouse Gas Technologies:

Enhanced Coalbed Methane and Biomass Power

Technology Contributions to Climate Change Challenges - The story continues

Allan Amey

Welcome to the fifth issue of *C3 Views* and the second in a three part series on the contributions technology might make to the climate change challenge. In the last issue, we focused on two important energy technology contributions - wind power and enhanced oil recovery through the use of CO_2 injection. This issue looks at two additional, potentially beneficial, climate change energy technologies – biomass and coal bed methane.

Both of these technologies provide exciting opportunities to not only reduce greenhouse gas emissions but also produce additional energy and reduce overall lifecycle energy costs. A balancing of environmental and economic priorities is required in a truly "sustainable development" future.

These, and indeed all climate change energy technology advancements, are not without challenges. As noted in our last newsletter, to make significant reductions in greenhouse gas emissions globally will require broad commercialization of sustainable energy technologies. Technologies are needed to decrease carbon intensities in potential energy sources, and increase the absorption of carbon dioxide from large emission sources.

The challenge will be to develop technologies that are economically viable and perceived by potential users and consumers as adding increased value. We have attempted to provide a perspective of the successes and challenges relating to both hydrocarbon-based and renewable energy technologies.

Cooperation and innovation amongst diverse stakeholders and experts will drive climate change solutions for the future. Canadians, and Albertans, seem up to the challenge.

Allan Amey is the President and CEO of Climate Change Central.

This is the second in a series of three issues devoted to greenhouse gas technologies.

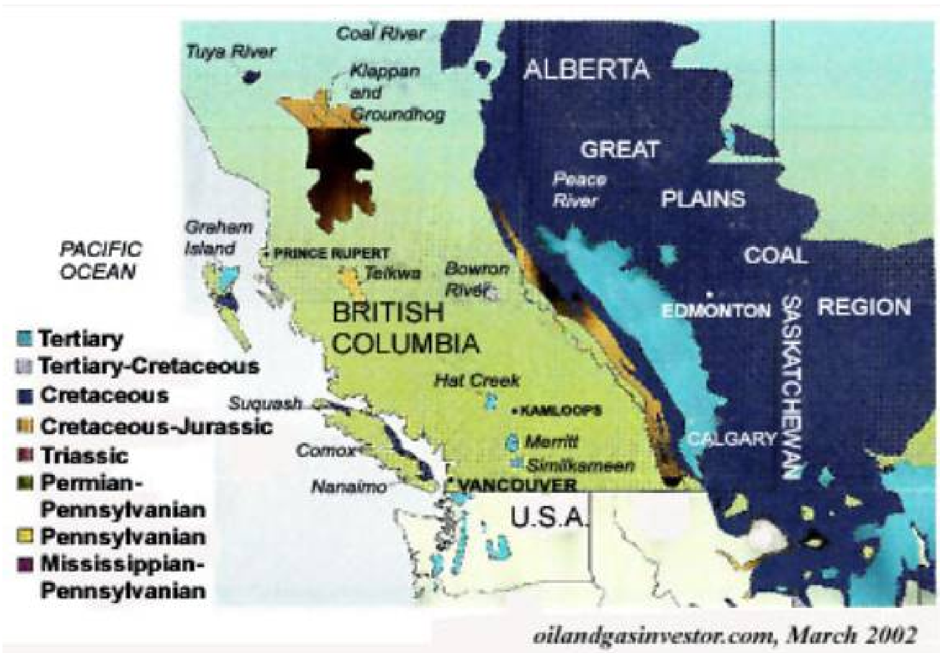
Enhanced Coalbed Methane Recovery – Technology Overview

Enhanced coalbed methane (ECBM) recovery is aimed at sequestering carbon dioxide (CO_2) while boosting production of methane trapped in coal beds. This is accomplished by injecting carbon dioxide into unmineable coal beds where it is adsorbed, and stored, or sequestered, in the pore matrix of the coal seams. The CO_2 displaces methane gas, which is brought to the surface through wells and pipelined to market much like natural gas. ECBM is similar to the popular practice of injecting CO_2 to enhance production from oil reservoirs.

There could be up to 135 trillion cubic feet of recoverable methane in the Foothills and Plains regions.

ECBM is in the early stages of development in Canada. Research is being conducted by the Alberta Research Council (ARC) in conjunction with a consortium of provincial, national and international organizations and companies. While pilot projects are being undertaken by some companies, full commercial development hinges on the success of these efforts.

Alberta and British Columbia coalbed methane deposits



oilandgasinvestor.com, March 2002

Climate Change Solutions May Be Found in Coalbed Methane Recovery

Enhanced coalbed methane (ECBM) recovery could provide a two-fold environmental benefit, according to Bill Gunter, of the Alberta Research Council (ARC). First, the ECBM process involves sequestering or storing carbon dioxide (CO_2) in the ground instead of releasing it into the atmosphere, thus reducing emissions of greenhouse gases (GHG) that have been linked to global climate change. Second, this process increases methane recovery, providing a clean-burning fossil fuel that produces fewer GHG emissions per unit of energy than oil or coal.

"Geological sequestration of CO_2 is a bridging technology for fossil fuels until we develop greater use of renewables. You can't just stop fossil fuels and start renewables; you have to have these bridging technologies," says Gunter, whose group is leading Canadian research in ECBM.

Alberta Energy and Utilities Board estimates about 43 trillion cubic feet remaining of established natural gas reserves.

About 18,000 oil and gas wells were drilled in Western Canada in 2001.

There is also a strong economic case for ECBM since methane, the chief component of natural gas, is a highly valued energy commodity. However, Gunter points out commercialization of ECBM largely depends on what happens following ratification of the Kyoto Protocol. "To be successful, a dollar value has to be attached to CO_2 emission reductions in the future, something that will likely happen with Kyoto." In December, the Canadian government ratified the Kyoto Protocol, an international climate change agreement that requires Canada to reduce its GHG emissions to six per cent below 1990 levels by 2008-2012.

In anticipation of limits on GHG emissions such as CO_2, ARC began working on enhanced coalbed methane in 1996 with the launch of a feasibility study. The second phase moved the project from the drawing board to the field, where a single well test was carried out. In a micro-pilot process similar to huff-and-puff, pure CO_2 was injected and then methane and CO_2 were produced from an existing well in the deeply-buried Mannville coal seams of the Fenn-Big Valley area, southeast of Red Deer, Alberta. The micro-pilot project was then expanded to include three more huff-and-puff-like tests, in which CO_2-N_2 mixtures (simulating industrial waste gas sources) were injected into an existing well and a new well at the same site.

Now, the project is moving into phase four, where Alberta CO_2 sources are being matched with Alberta coalbed methane reservoirs, leading to more micro-pilot projects in different areas of Alberta. Successful micro-pilot tests will be followed by multi-well tests, with the first project led by Suncor Energy Inc.

Although ARC is the only group in Canada working on enhanced coalbed methane recovery, the world's longest field-scale test using CO_2 injection was undertaken by Burlington Resources Inc. in New Mexico.

Environmental Concerns

Mary Griffiths, Environmental Policy Analyst with the Pembina Institute for Appropriate Development, says since enhanced coalbed methane is a new process, care must be taken to establish appropriate legislation to manage development and monitor the environmental impact of these projects.

"We're very much in the learning stages and we have to know a lot more about this process. We need to move forward with caution and not rush in until we know all the benefits and risks."

Griffiths says issues need to be resolved surrounding the permanence of CO_2 sequestration to ensure today's ECBM projects don't create problems for future generations. "We need to verify that the CO_2 stays underground. Monitoring must be in place to ensure that once it's injected, the CO_2 doesn't leak back to the surface.The cost of monitoring should be picked up by industry – not the public."

Issues surrounding "dewatering" of ground water as well as the potential for ground water contamination must be addressed to ensure ECBM isn't affecting valuable water resources. Water is produced prior to methane production. The quality of the produced water depends on the depth of the coals. At shallow

About 18,000 oil and gas wells were drilled in Western Canada in 2001.

depths, the water produced is fresher and may be useful for agriculture or human consumption. Deeper coals contain saltier water, which when produced is of no value and must be disposed of in deep injection wells.

Griffiths also suggests an evaluation of the net reductions of CO_2 from ECBM is needed because energy is expended to inject the CO_2 used to help produce methane that will be burned and, in the process, produce more CO_2. While ECBM may turn out to be a good bridging technology between fossil fuels and renewables and there is value in supporting this kind of research, Griffiths thinks that there is also a serious need to increase the amount of funding available to support other options, like renewable energy.

ARC's Gunter agrees that rules will be needed to manage ECBM development. "ECBM needs to be dealt with intelligently so that we can get the best of both worlds from this process," he says.

Gunter says ECBM must be carried out in a way that protects water sources and ensures land erosion doesn't occur due to water disposal methods. He notes the drinkable water from some U.S. coalbed methane operations is being used for irrigation and in one case helped replenish a city's aquifer.

He points out that the geological barriers that have kept methane trapped beneath the earth's surface will keep CO_2 from escaping, particularly since CO_2 more strongly adsorbs into coal than methane. Since Alberta reservoirs are considered "tight" there have been very few cases where natural methane leakage has occurred, which bodes well for CO_2 sequestration.

Breakthrough of CO_2 was not a major issue for Burlington Resources at its Allison Unit Project in the San Juan basin. According to Burlington reservoir engineer Jim Schlabaugh, CO_2 breakthrough was controllable and losses through producing wells were contained. However, "long-term migration from the formation through natural avenues has not been studied to this point in time."

Injection of CO_2 at the Allison Unit project was started in 1995 and suspended in 2001. The primary objective of the project was to improve coalbed methane recovery, with the coal seam target at an average depth of 1,000 metres. Schlabaugh explains 6.4 billion cubic feet of CO_2 were injected, with an estimated hydrocarbon recovery of 1.6 billion cubic feet. The relationship between these two numbers has "significant uncertainty" because of changes to production operations during the pilot injection period.

In retrospect, Schlabaugh says the Allison Unit project was started too early in the methane depletion process. As a result, high bottom-hole pressures, water production and low permeability in the pilot area hindered injection of CO_2.

"In addition, the CO_2 has a tendency to swell the coal matrix as it is adsorbed, resulting in even further reductions in permeability and injectivity. Injectivity appears to be the key factor in the success of a commercial project."

Injection will not be re-established at the Allison unit project because injection is expensive and there wasn't a significant production decline after injection was suspended.

Methane Potential

The potential for coalbed methane is substantial. In Canada, coal is the largest fossil fuel reserve, containing an estimated 135 to 261 trillion cubic feet of coalbed methane, according to the Canadian Potential Gas Committee. According to ARC, Alberta's largest methane resource lies in coal beds thought to hold as much methane as conventional sources.

Gunter says the challenge for the consortium of provincial, national and international organizations and companies working with ARC on the enhanced coalbed methane recovery project is to develop a viable technology that can be put into commercial operation. Due to the cost and logistics of obtaining a pure CO_2 stream, ARC is also investigating the potential of injecting gases from flue stacks that contain a mixture of CO_2 and other gases.

This work, Gunter says, could lead to the design of zero-GHG emissions power plants that are fuelled either by mined surface coal or by the methane released from coal reservoirs. In this closed process, the CO_2 produced from coal- or methane-burning power plants is injected into deep coal beds to produce more methane. The geological sequestration established in the deep coalbed methane reservoir virtually eliminates the release of CO_2 to the atmosphere.

Primary recovery – where wells are drilled into the coal and methane is produced like natural gas – was first commercialized in the United States because of natural gas shortages and now contributes more than six per cent to their annual gas consumption. Interest in primary methane recovery is also growing in Canada, where the first commercial operation began production last spring.

But Gunter says ARC's work will continue to focus on the dual tasks of sequestering CO_2 while recovering methane.

"Our work is basically driven by the need to reduce CO_2 emissions."

Further Reading:

The Potential for Coalbed Methane (CBM) Development in Alberta
http://www.energy.gov.ab.ca/gmd/docs/Coalbed_Methane_Final_Report_Sept_2002.pdf

Geological Survey of Canada - An Assessment of Coalbed Methane Exploration Projects in Canada
http://rncan.gc.ca/gsc/calgary/whatsnew/newpubs/pdf/B549_e.pdf

Alberta Research Council
http://www.arc.ab.ca/