Clean Energy Technology: Carbon Capture & Storage

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Prime Minister Stephen Harper recently announced funding for the carbon capture project west of Edmonton. The federal and Alberta governments pledged $769 million on October 14, 2009 to retrofit a coal-fired electricity generation plant to capture and store some of the carbon dioxide generated from the project.

Alberta will spend $436 million over the next 15 years on the project, with most of the money coming from its $2-billion Carbon Capture and Storage Fund. Ottawa is kicking in $343 million from its Clean Energy Fund. The government is promoting it as a “leading-edge coal-fired electricity generation plant” that will capture and store up to one million tonnes of carbon dioxide (CO2) per year.” The captured CO2 will be used for Enhanced Oil Recovery (EOR) in nearby fields or stored almost three kilometres underground.

The CCS technology is getting a lot of attention lately. Last month Canadian Environment Minister, Jim Prentice and US Energy Secretary, Steven Chu, presented the Clean Energy Dialogue Report to President Obama and Prime Minister Harper in Washington D.C. which identifies ways Canada and the US can jointly develop energy solutions to reduce greenhouse gases and to combat climate change. This was the first report of the Joint Canada-U.S. Working Groups who have developed an Action Plan for cooperation and one of the three areas covered by this plan identifies the CCS among the available clean energy technologies with the enormous potential to control greenhouse gas (GHG) emissions.

Last week at the Carbon Capture and Storage Conference in London, chief Nobuo Tanaka, International Energy Agency (IEA), cited that the world needs to build 100 major projects for capturing and burying GHG by 2020 and thousands more by 2050 to help combat climate change. He further stated that the drive, mostly to capture emissions from coal-fired power stations, would cost $56 billion by 2020 alone. The IEA estimates that after the $56 billion investment in CCS globally from 2010-2020, a further $646 billion will be needed from 2021 to 2030. UN studies have indicated that CCS could do more to limit greenhouse gas emissions this century than a shift to renewable energies such as wind or solar power. CCS has been limited by high costs.

Perhaps the most common definition of CCS is that it is a method for reducing GHG emissions to the atmosphere by capturing carbon dioxide (CO_2) from large stationary emitters and disposing of it in deep geological formations. Studies show that CCS has broad application wherever fossil energy is used. It is one of the only ways to manage GHG emissions growth in coal-fired power generation and in the rapidly expanding oil sands sector. It is suggested in various reports that CCS is a potential solution for these and other sectors across the nation, as the whole country uses oil, gas, or coal in refining, petrochemicals, manufacturing, cement, and steel. However, it was identified in various studies that there are economic costs associated with the use of CCS, and it presents various risks to the environment and to human health.

CCS projects are being pursued around the world in a variety of countries including Norway, the United Kingdom Denmark and Australia. According to the ecoENERGT Carbon Capture and Storage Task Force report, Canada-wide potential for CO_2 capture and storage may be as high as 600 megatonnes (Mt)/year, or roughly 40 percent of Canada's projected GHG emissions in 2050.

On July 8, 2008, the Alberta Government announced it will contribute $2 billion to reduce GHG emissions through new CCS projects. The expected result is five million tonnes in annual reductions by 2015—comparable to taking one million vehicles off the road.

Alberta committed to reducing projected emissions by 200 megatonnes by 2050—70% of which will be achieved through CCS. CCS will be a process that captures CO_2 emissions and stores them in geological formations deep inside the earth. The CO_2 will be separated from other emissions, then dehydrated, compressed and transported by pipeline to a storage site where it will be injected one to two kilometres deep into the porous rock formation. It will then be sealed and monitored by experts to ensure there is no leakage or impact on either public safety or the environment.

The cost associated with the process of capturing CO_2 from the source, which is typically a smokestack, is the most expensive part of the CCS process. Retrofitting existing facilities to capture CO_2 would have significant costs, as it would be to integrate CO_2 capture into the design of new plants.

Transporting the CO_2 through a pipeline is the least expensive part of CCS and injecting it deep into the earth is more expensive than transporting it.

In addition to help reducing GHG emissions, the use of captured CO_2 for EOR is turning out to be a real success. When the captured CO_2 is injected into the oil reservoir, it mixes with the oil and mobilizes more of it – like turpentine cleaning paint – and then allows it to be jumped to the surface. A good example of EOR is the Dakota Gasification Project which creates synthetic gas and takes the CO_2 from that process and pipelines it to the Weyburn oil field in southeast Saskatchewan, Canada, where the CO_2 is injected into a depleted oil field.

Weyburn oilfield covers more than 210 square kilometres (53,000 acres) and contains approximately 1.4 billion barrels of enhanced oil. It is also the world's largest carbon sequestration site. They currently produce approximately 28,000 barrels of oil per day at Weyburn - an 18,000 barrel per day increase over the 10,000 barrels of oil per day that would be produced without the carbon dioxide flood from the Dakota Gasification Project, which began in 2000.

David Biello in his article which was published in Scientific American included the following examples where EOR was used to boost the production:

- The Scurry Area Canyon Reef Operators Committee oil field, better known as SACROC, near Snyder, Tex., has slurped 140 million metric tons of liquid CO_2 since 1972—80 million metric tons of which has stayed trapped in the reservoir. Pumping all that CO_2 down has meant pumping more oil out;
- For 36 years, oil services companies like Denbury Resources and Kinder Morgan have piped carbon dioxide from naturally occurring reservoirs in Colorado to the declining oil fields of the Permian Basin in West Texas; and
- The U.S. has at least 100 such projects like SACROC and 3,100 miles (5,000 kilometers) of CO_2 pipelines. All told, companies have injected some 10.8 trillion cubic feet of the greenhouse gas since the 1970s, according to petroleum engineer R. Tim Bradley, Kinder Morgan's president of CO_2, to raise the yield from oil fields by some 650,000 extra barrels a day—more than 10 percent of daily U.S. total production.

The U.S. Department of Energy (DoE) has invested more than $3 billion since 2001 to fund multiple CCS projects being conducted by seven regional partnerships, including demonstrations of ammonia capture technology at the massive coal-fired Pleasant Prairie power plant in Kenosha County, Wisc., and the R. E. Burger plant in Shadyside, Ohio. The Obama administration may even resurrect the FutureGen project—a 275-MW IGCC power plant that would capture 90 percent of its emissions.

Australia and China have demonstrated that post-combustion capture is possible in pilot plants. At Loy Yang Power Station in Victoria, a pilot plant run by Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO) will capture 1,000 metric tons of CO2 a year; the Australian research organization has also collaborated with China's Huaneng Group to use an amine scrubber to capture CO2 from a co-generation power plant in Beijing and then sell it.

In spite of numerous success stories around the globe about the use of CCS and EOR, there is a fear that is commonly associated with this technology that trapped CO2 might suddenly escape to the surface with deadly consequences. However, this technology is being used commercially for three decades and there have been no dangerous leaks. Typically, each CCS project is being monitored extensively by international team of scientists to make sure that there is no CO2 leakage. Furthermore, the United Nations Intergovernmental Panel on Climate Change fully supports CCS technology as does the International Energy Agency and the International Panel on Climate Change which also should mean that the CCS technology is safe.