Testimony prepared for the oversight hearing on "Spinning Straw into Black gold: Enhanced Oil Recovery Using Carbon Dioxide"
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My name is Mark Demchuk. I am Team Lead of the Weyburn Unit for EnCana Corporation. EnCana is a dynamic North American leader in the production of oil and gas. I am currently responsible for all aspects of the Weyburn Operation managing a staff of over 100 employees and contractors split between our Weyburn field site and in the Calgary head office.

I am here today at the invitation of the Chairman to discuss EnCana's experience with carbon dioxide(CO_2) enhanced oil recovery and the International Energy Agency's world-class research project at Weyburn centered on the geological storage of CO_2.

Introduction

The Weyburn oilfield, operated by EnCana, is demonstrating that oil production can be increased in an environmentally responsible manner through underground injection of CO_2. CO_2 has been injected into this oilfield since 2000, making valuable use of a by-product that would have otherwise been emitted from Dakota Gasification Company's (DGC) coal gasification facility located in the northern United States. The field is projected to store 30 million tonnes of CO_2 over the EOR life, equal to taking about 6.7 million cars off the road for one year. I will discuss in more depth how EOR is prolonging the life of the Weyburn oilfield, while at the same time contributing to reducing CO_2 emissions.

The Weyburn oilfield has also served as the highly coveted, commercial-scale laboratory for the International Energy Agency (IEA) Green House Gas Weyburn-Midale CO_2 Monitoring and Storage Project. This multi-party, international research project, run under the auspices of the IEA, is investigating the viability of long term storage of CO_2 in an oil reservoir and will provide a good foundation for the development of solid policy, regulations and operating practices for future CO_2 storage associated with EOR. The results of the first phase of the IEA project will be covered as well as the key elements of the final phase, which was launched in 2007.

EnCana Corporation – An Overview

Headquartered in Calgary, Alberta, Canada, EnCana is a leading oil and gas producer in North America, where the company's primary focus is on the development of resource plays. EnCana's portfolio of long-life resource plays includes four key resource plays in the U.S. that produce natural gas. In Canada, five key resource plays produce natural gas and five focus on oil, one of which is the Weyburn property.

In 2007, EnCana produced 3.6 billion cubic feet of natural gas per day from approximately 45,000 wells across North America, in addition to more than 134,000 barrels of oil and natural gas liquids per day. EnCana's U.S. natural gas production averaged 1.3 billion cubic feet per day in 2007.

On May 11, 2008, EnCana Corporation's Board of Directors unanimously approved a proposal to split EnCana into two highly focused energy companies – one a natural gas company with an outstanding portfolio of early life, North American, natural gas resource plays and the other a fully integrated oil company with industry-leading in-situ oilsands properties and top-performing refineries, as well as an underlying foundation of reliable oil and gas resource plays. This transaction, which is expected to be completed in early 2009, is designed to create two highly

sustainable, independent entities, each with an ability to pursue and achieve greater success by employing operational strategies best suited to its unique assets and business plans.

EnCana strives to increase the net asset value of the company for shareholders, make efficient use of resources and minimize its environmental footprint. The company's success is determined not only through its bottom line but also through its behaviour. Weyburn is an example of that commitment

Weyburn Oilfield – Enhanced Oil Recovery

Located in the southeast corner of the province of Saskatchewan in Western Canada, Weyburn is a 180-square-kilometer (70-square-mile) oil field discovered in 1954. It is part of the large Williston sedimentary basin, which straddles Canada and the U.S. Production is 25- to 34-degree API medium gravity sour crude. The reservoir is a Mississippian-aged Midale Marly zone, a low permeability chalky dolomite overlying the Midale Vuggy zone, a highly fractured and permeable limestone.

Water-flooding to increase oil recovery was initiated in 1964 and significant field development, including the extensive use of horizontal wells, was begun in 1991. In September 2000, the first phase of a CO_2 enhanced oil recovery scheme was initiated. The EOR project is to be expanded in phases to a total of 92 patterns over the next 15 years. The CO_2 is a purchased byproduct from DGC's synthetic fuel plant in Beulah, North Dakota. If this CO_2 had not been used for EOR and stored, it would continue to have been emitted into the atmosphere. It is transported through a 200 mile pipeline to Weyburn then injected into the reservoir, one mile underground. The CO_2 is 95% pure and Weyburn's current take is 6600 tonnes/day (equivalent to 125 mmscfd).

Discovered 50 years ago, we now expect the economic producing life of the Weyburn oil field to be extended up to an additional 30 years through the use of CO2 enhanced oil recovery It currently produces over 28,000 bbls/d of light crude oil, the highest production level in 30 years. Without EOR, it is estimated that current production would have declined to 12,000–13,000bbls/d leaving a huge resource untapped. The environmental benefits are also significant as CO_2 storage contributes to mitigating emissions. The Weyburn project has stored approximately 10 million tonnes of CO_2 to date and over the lifetime of the EOR project, it is projected that an additional 20 million tonnes of CO_2 will be sequestered.

IEA Green House Gas Weyburn CO_2 Monitoring & Storage Project - Phase I

Project description

The IEA Green House Gas Weyburn CO_2 Monitoring & Storage Project is a significant CO_2 monitoring and storage research and development effort that was run in parallel with the commercial Weyburn EOR project during 2000-2004. Phase 1 of this project was designed to contribute significantly to the understanding of greenhouse gas management, specifically the technical feasibility and long term fate/security of CO_2 storage in geological formations.

Initiated in 2000 by the Saskatchewan Ministry of Energy and Mines (now Saskatchewan Industry and Resources), the federal Department of Natural Resources, and PanCanadian Energy Corporation (now EnCana), the first $40 million phase of this multi-disciplinary project has been endorsed by the IEA GHG Research and Development Programme. It was managed by the Petroleum Technology Research Centre (PTRC) of Saskatchewan.

This project constitutes the largest, full-scale, in-the-field scientific study ever conducted in the world involving carbon dioxide storage. Weyburn has become the international flagship project

on GHG geological storage research, routinely receiving senior level business and government visitors, as well as media, from around the globe.

The collaborative Phase One research was funded by 15 public and private sector institutions. In addition to the two previously mentioned government departments, other government partners included the United States Department of Energy (US DOE), the European Union, and the province of Alberta through the Alberta Energy Research Institute. Industry sponsors included EnCana, BP plc, ChevronTexaco Corp., DGC, Engineering Advancement Association of Japan, Nexen Inc., SaskPower, TransAlta Corporation and Total SA of France. The project also involved 24 research and consulting organizations in Canada, Europe and the United States.

The overall objective of Phase 1 of the project was to predict and verify the ability of an oil reservoir to securely store and economically contain CO_2. The scope of work focused on understanding the mechanisms of CO_2 distribution and containment within the reservoir into which the CO_2 is injected and the degree to which the CO_2 can be permanently sequestered.

***Phase 1 results*[1]**

Completed in 2004, Phase 1 concluded that CO_2 can be securely stored underground in an oil reservoir such as Weyburn. Through extensive geological, geophysical and hydrogeological work, as well as initially simplistic deterministic and stochastic (probabilistic) performance assessment modeling, the work concluded that after 5000 years, 99.8% of the CO_2 injected into the Weyburn field would remain trapped underground.

A key feature of the project was the pre-injection baseline monitoring that was done prior to CO_2 injection at the field. While there are already commercial applications of CO_2 EOR in the United States, the Weyburn oilfield and the IEA GHG project are unique, due to the comprehensive knowledge of pre-injection reservoir conditions as a result of an extensive historical database of geological and engineering information. This has proven critical to following the movement of CO_2 in the Weyburn reservoir over the four years of the Phase 1 project and to the present day.

Excellent monitoring techniques were demonstrated through the project; the movement of the CO_2 was predicted, monitored and verified by a variety of different methods. The greatest success was encountered with four-dimensional time lapse seismic surveys, which can reliably detect relatively small volumes of CO_2 underground. Geochemical fluid sampling also gave good insights into the movement of CO_2 within the reservoir and could detect any CO_2 breakthrough at wells.

IEA Green House Gas Weyburn-Midale CO_2 Monitoring & Storage Project – Final Phase

Phase 1 of the IEA project has provided a good foundation for the development of solid policy, regulations and operating practices for future CO_2 storage/EOR projects; however, there is more work to be done. The Phase 1 final report identified a number of important gaps and recommended a follow-up “Final Phase” to build a technical Best Practices Manual that outlines geological storage site selection protocols, injection strategies, effective technologies for tracking CO2 through various geosciences technologies, completing and abandoning wellbores, and rigorous risk assessment strategies. Several gaps were identified at the end of the first phase of the project that will be addressed in the final phase project: understanding of the aging of wellbores over decades and centuries following abandonment, a credible peer-reviewed risk assessment approach, and a suite of cost-effective long-term measurement and verification protocols to track CO2 movement underground. It was clear during the initial planning of the final phase project that information and advice could be provided to regulators for the development of advanced regulations based on incremental improvements of existing oil and gas regulations. Further, measurement, monitoring and verification (MMV) protocols would be identified during the project that would be valuable for crediting protocols. Governments and industry alike would

derive benefits from completing the research at Weyburn through widespread knowledge and technology transfer. Demonstration of the integrity of geological storage at Weyburn would help to ensure public confidence in this greenhouse gas mitigation strategy through a proactive public communications and outreach program within the final phase project. The final phase of the project also includes the Apache Midale CO2-EOR operation that began CO2 injection in late 2006. We foresee a future where Weyburn has paved the way and future projects will not need to expend nearly as much research and monitoring resources to be assured of safe geological storage.

Next steps: Technical

Extensive investment and effort have been expended to get to the current level of understanding of geological storage at Weyburn but additional work is still necessary to develop cost-effective protocols to enable efficient site selection, design, operation, risk assessment and monitoring of future projects.

The key gaps identified in Phase I and the measures being taken in the Final Phase to address them and achieve win-win solutions include:

(i) Drafting of firm protocols for storage site selection.
(ii) Final selection of the most effective underground monitoring methods for CO_2 movements.
(iii) Identifying the most effective reservoir methods for maximizing storage capacity and oil recovery.
(iv) Finalizing the development of the most cost-effective and credible risk assessment methods and risk mitigation techniques to ensure the integrity of the storage medium.

Next steps: Non-technical

Advancement of the technical aspects of CO_2 storage is a necessary but insufficient requirement for the management of geological storage of CO_2 on a large scale. A successful CO_2 geologic storage "industry" must encompass a suite of technologies linked by a network of institutions, financial systems and regulations, along with public outreach activities, that are able to achieve broad public understanding and acceptance. Additional work is necessary in the following areas.

Regulatory Issues

For CO_2 storage to flourish, a predictable, science-based regulatory regime needs to be in place. Fortunately, regulations governing the injection of acid gases with a CO_2 component and other industrial applications are already in place. A complementary regulatory framework for long term storage applications with respect to safety and reliability may be required.

The experience from current provincial regulations on issues such as emergency planning and protection, health and safety, and drilling and well completion standards, as well as the fact the oil has been kept in the geological structure for many years should prove very helpful to future CO_2 storage regulatory efforts.

Finally, a transparent registry system should be created, with well-defined measurement protocols and verification requirements, to ensure proper accounting for greenhouse gas reductions created by geological storage and recognition of offset credits.

Public outreach

Geological Storage of CO_2 is increasingly recognized as a pragmatic way to address CO_2 emissions. An effective public outreach and consultation process could be helpful to

ensure public understanding and acceptance of geological storage as a viable means of CO_2 sequestration. The technology needs to be communicated to the public in the context of GHG mitigation options, with clear explanations regarding why it is safe and viable over the long-term.

Current Status – Final Phase

The initial technical research package was approved by the sponsors in November 2006 along with a first year budget of $2.9 million (Canadian). Several research agreements are in place with research activities underway[2]. A number of agreements are pending execution. The technical research program is being expanded in a carefully managed and stage-gated process to ensure that results are directly applicable to the needs of a comprehensive Best Practices Manual, regulatory and policy advice and public outreach activities. Final phase project activities are integrated by four theme leaders in: geological characterization, wellbore assessment, geophysical and geochemical CO2 tracking, and risk assessment. Semi-annual coordination meetings are held with all researchers and sponsors to ensure dissemination of information and research prioritization on a continuous basis. International interest in this research project remains strong with new industry sponsorship coming from Apache Canada, Saudi Aramco, OMV Austria and Schlumberger. Sponsorship from the public sector remains strong from US Department of Energy (NETL), and the Governments of Canada, Saskatchewan and Alberta. The project continues to be endorsed by the IEA Greenhouse Gas R&D Programme, with further endorsement coming from the Carbon Sequestration Leadership Forum since 2004.

Conclusion

It is EnCana's hope that the experience at Weyburn will enable the start-up of a significant number of commercial-scale EOR-based CO_2 geological storage projects, a win-win scenario for the economy and the environment. These projects would provide substantial environmental benefits by enabling the geological storage of significant quantities of CO_2 that would otherwise be emitted to the atmosphere. Ramping up development of CO_2-based EOR projects would also increase oil recovery and hence improve energy security. Conventional methods in North America may only recover approximately 30% of oil in place, leaving a tremendous resource in the ground for EOR.

Although EnCana's activities have focused on EOR-based operations and not on other storage alternatives such as deep saline aquifers or coal bed methane, many of the operating practices so developed would be applicable to these other storage alternatives. Furthermore, the operating practices developed for Weyburn's geological environment would also be transferable to other sites with different geological characteristics. EOR projects currently represent the storage alternative that is the closest to being economic and with the right policy and regulatory framework, market signals and economic conditions, a number of projects could realistically be initiated.

Finally, Weyburn, particularly the IEA GHG Project, demonstrates the power of collaboration and partnerships between governments, researchers and industry to unlock value through technology. The research was valuable to EnCana as it helped the company to better understand its oil field and to innovate (e.g. CO_2 monitoring by four-dimensional seismic survey). It provided the opportunity for a Canadian research centre to develop expertise and potentially become a world leader in CO_2 geological storage monitoring and assessment. Finally, it has enabled government to advance their innovation, technology and sustainability agendas.

References

1. Wilson M. and Monea M., IEA GHG Weyburn CO_2 monitoring & storage project - Summary report 2000-2004, 7th International Conference on Greenhouse Gas Control Technologies, Vancouver, Canada, Sept. 5-9, 2004.
2. Knudsen, R. and Preston, C.K., Update of the IEA GHG Weyburn-Midale CO2 Monitoring and Storage Project – Final Phase, 7th Annual Conference on Carbon Capture and Sequestration, Pittsburgh, PA, USA, May 5-8, 2008.

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