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The Alberta Carbon Trunk Line and the Benefits of CO2

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Abstract

The Alberta Carbon Trunk Line – Update on the World’s Largest Carbon Capture and Storage Project

Enhance Energy Inc. (Enhance), located in Alberta, Canada, specializes in Enhanced Oil Recovery (EOR) and Carbon Capture and Storage (CCS). Along with its partner North West Redwater Partnership (NWRP), Enhance has developed a fully integrated CCS project incorporating gasification, CO2 capture, transportation, storage and EOR. The project utilizes proven technology to provide a critical CO2 gathering and distribution infrastructure, which will enable the cost-effective management of CO2 emissions in Alberta, Canada. The project also demonstrates how Alberta’s vast bitumen resources can be produced amid tightening environmental standards.

At the heart of the proposed project is the Alberta Carbon Trunk Line (ACTL), a 16”, 240 km pipeline, which will be fully operational in 2015. Laterals have been designed to allow for multiple entry points. CO2 will be collected from various emitters such as coal fired power plants, upgrading/refining operations, petrochemicals and natural gas processing plants in and around Alberta’s Industrial Heartland. The CO2 will then be transported to aging reservoirs in southern Alberta for storage in EOR projects. The ACTL will be able to access reservoirs which are capable of storing over two billion tonnes of CO2, and producing an additional one billion barrels of high quality light crude oil using CO2 EOR. The ACTL will initially capture and store up to 1.6 million tonnes/year of CO2 from the Agrium fertilizer manufacturing facilities and North West Redwater Partnership Sturgeon Refinery (NWRPSR). At full capacity the ACTL project will store 14.6 million tonnes/year of CO2, the equivalent of removing 2.6 million cars from Alberta’s roads. Once fully operational, the ACTL project will be the world’s largest CCS development.

This paper will provide an update on the progress being made on the project as the ACTL has moved passed the regulatory phase and is now completing detailed engineering, with procurement underway. The ACTL has received regulatory approval for its pipeline construction and landowners along the entire

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pipeline route are supportive of the project. The presentation will address the project’s development and stress the importance of the support from stakeholders. The paper will also outline the benefits of the project, and will explain how it balances environmental sustainability and economic viability while garnering public support.

The project is significantly advanced and is being financially supported by the Governments of Alberta and the Government Canada; the former through the Carbon Capture and Storage Program in the amount of $495MM CDN, and the latter through the ecoEnergy Technology Initiative and Clean Energy Fund in the amount of $63MM CDN. The estimated total cost of the full project is $1.15B CDN.

Susan Cole will present the paper at the GHG-T 11 Conference. Susan is the founder and President of Enhance. Ms. Cole is a professional engineer with over 20 years of experience in the energy industry. Prior to founding Enhance, Ms. Cole was manager of the Weyburn CO2 Project in Saskatchewan, Canada, which is the largest industrial CO2 capture, transportation, and EOR/secure storage project in the world. She managed initial approval, facility construction and start-up phases of this project. As project manager she was responsible for the project implementation, including overall project coordination, economic modeling and start up. The Weyburn project is currently injecting over 6,000 tonnes of CO2 a day (or two million tonnes of CO2 a year) and is very similar in design and concept to the ACTL CCS-EOR project.

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1.1 Introduction

The team at Enhance Energy Inc. (Enhance) was instrumental in designing and implementing the Weyburn CO2 Miscible Flood Project located in Saskatchewan, Canada — currently the largest Carbon Capture Utilization and Storage (CCUS) project in the world. Weyburn utilized CO2 in an Enhanced Oil Recovery (EOR) scheme to capture incremental barrels of oil from this particular field. While implementing a CCS-EOR project was the next logical step in maximizing oil recovery rates for the company, this opportunity allowed the project team to become pioneers in the field of CCUS. There has been a transition from the term CCS to the term CCUS as prohibitive costs have caused many carbon capture projects to fail, and has led to a conclusion that the CO2 must be utilized for EOR or fertilizer production to make such projects economical.

The Weyburn project will unlock 155 million barrels of light oil reserves while storing 45 million barrels of CO2; both significant and positive outcomes.

Weyburn was operational in December 1999, and it initially took 5,000 tonnes of CO2 a day from Dakota Gasification Company’s facility in Beulah, North Dakota. The CO2 was considered an industrial waste product from the gasification project at the time. In order to get the CO2 to Weyburn a 300 km pipeline was constructed. The similarities to Enhance Energy’s project, The Alberta Carbon Trunk Line (ACTL), are quite numerous. Initially the ACTL will take approximately 5,000 tonnes of CO2 a day from industrial sources, the majority coming from gasification process. The CO2 will then be transported through a 240 km pipeline to an initial EOR field where it can be used to unlock light oil reserves from depleted reservoirs. CO2 utilization is again the next logical step.
An analogous scenario has occurred before in Canada. In the 1930’s, natural gas was considered a waste product that interfered with oil production, and as a result was stranded and vented. That is until the government stepped in and facilitated the construction of the first gas trunk line to take natural gas to markets. Conservation regulations followed, and the natural gas pipeline system grew to what it is today – a province wide and country wide distribution system.

Due to the bold policies set out by the government, the natural gas industry was able to develop and then help establish a petrochemical industry, which today have combined revenues in the billions of dollars a year and employ hundreds of thousands of people.

Today CO₂ is seen as a waste product. Alberta produces over 100 MT of CO₂ a year, mainly from coal fired power generation and the production and refining of the province’s oil sands. Alberta’s commitment is to reduce these emissions by 50 MT by 2020 and 200 MT by 2050. This is a lofty target given that the CO₂ emissions in Alberta are scattered throughout the province, and that the CO₂ is typically produced in a very dilute form as exhaust gases which is expensive to clean up. The most obvious solution is to produce purer streams of CO₂ right from the start, and to build the infrastructure required to move it to places where it can be used and stored.
CO₂ is a valuable commodity for Alberta, and must begin to be seen as such. Every tonne of CO₂ produced can be used to yield on average two barrels of light oil. So, just like the situation where natural gas had value but faced challenges before it could be fully utilized and benefited from, the large CO₂ supply in the province needs to overcome the challenges of lack of infrastructure and purity to fully unlock its potential. The valuable outcomes from the development of the natural gas industry in Alberta are the production of fuels and petro chemicals. For CO₂ the benefits include the production of light oil and the reduction of greenhouse gas emissions.

1.2 Components of The ACTL

The ACTL has three parts – capture-ready CO₂ supply sources (capture), a pipeline (transportation) and an EOR project field (use and storage). The initial suppliers for the ACTL are Agrium, a fertilizer facility, and North West Redwater Partnership Sturgeon Refinery (NWRPSR), a refinery producing low carbon fuels from bitumen (oilsands) using gasification. These are the first two capture sites for the project.

All the major mechanical equipment has been purchased and deliveries are anticipated by the first quarter of 2013 for the Agrium capture site. At the North West site engineering is underway. The difference between these two sources is that the Agrium CO₂ is in a wet stream (and therefore the CO₂ needs to be dehydrated before use), and that the volumes captured from the NWRPSR are larger than the Agrium volumes. The NWRPSR facility is being built in three phases. The first phase will produce 3,500 tonnes of CO₂ a day. If all three phases of the NWRPSR proceed, then the CO₂ from this site will reach over 10,000 tonnes of CO₂ a day. Both the Agrium and the NWRPSR streams are high purity CO₂ sources, and combined will total well over 5,000 tonnes of CO₂ a day.

The pipeline engineering and surveying for the project are complete. Landowners have been very supportive and have given 100% consent for the construction of the line. The pipeline specifications have been determined and the next step is to purchase the materials.

Alberta is blessed with a geological environment that is ripe with opportunity for CO₂ EOR, and this helps address the question of where to use the CO₂. The ACTL has been routed to maximize access to these reservoirs, which are amenable to EOR. Industry estimates predict that over one billion incremental barrels of oil can be extracted in the province through tertiary recovery techniques such as EOR. An added bonus is that there is also storage capacity for two to three billion tonnes of CO₂ in these EOR fields, and other depleted hydrocarbon reservoirs in proximity to the line. The ACTL will help connect the sources of CO₂ to the reservoirs in which it can be used. The CO₂ emission hubs and the EOR fields able to take the CO₂ are shown in Figure 2.
1.3 Benefits of Using CO₂ – Revenues, Jobs and a Lower Carbon Footprint

The transition from CCS to CCUS emphasises the benefits achieved from using CO₂ in EOR projects, rather than simply storing it in a saline aquifer. The benefits realized are fairly obvious; light oil production resulting in a revenue stream to the project developer, revenue streams to the public through royalties and taxes paid to the government, revenues to the emitter, and a reduction in global greenhouse gas emissions.

CO₂ has successfully been used in the EOR industry in the United States for the past 40 years. Light oil production from EOR projects has topped 350,000 barrels of oil per day (bopd), as shown in Figure 3. There are currently over 110 projects and over 4,000 miles of CO₂ pipelines in the USA. These projects and resulting increased oil production have generated significant revenues and jobs in that country.
The Alberta and Canadian governments are helping to kick start a CO₂ EOR industry in Alberta. Their investment is both helping promote economic growth as well as working towards environmental sustainability, by reducing provincial CO₂ emissions and showcasing that the oilsands can be developed in a sustainable fashion. With the NWRPSR gasification process and the ACTL, emissions from the oilsands can be reduced by 20% from what normal operations emit today, and the ACTL then has the ability to move up to 15 MT of CO₂ per year to where it can be used and stored – both realities that will achieve important environmental and economic benefits of the project.
Figure 4 illustrates how bitumen is currently partially upgraded in Alberta and where the current sources of emissions are, while Figure 5 illustrates the reduction of these emissions from using gasification at NWRPSR and then using/storing the pure CO$_2$ that is captured.

1.4 Conclusion

The ACTL has been designed so it can accept CO$_2$ from a variety of sources such as coal, petrochemicals, natural gas processing and refining. With the ACTL operating in the province, Alberta will become the place to build new industrial facilities that produce CO$_2$, because there will be a ready a solution for these emissions. So not only will the ACTL project itself generate revenues and emission reduction for the province and country, it will also attract new industry.

CO$_2$ is no longer a waste product in Alberta but a valuable commodity, and the ACTL will serve as a model for other oil producing regions of the world.