Canadian Oil Sands: Current Projects and Plans, and Long-term Prospects

By Yuliya Pidlisna*

Introduction

Oil sands reserves are found in several locations around the world, including Venezuela, USA, and the Russian Federation. The largest oil sands operations are in the province of Alberta, Canada (Ordorica-Garcia, 2009). However, British Columbia, Saskatchewan and Manitoba also have producing or potential oil sands operations. In Eastern Canada, the potential for tight oil resources exits in Anticosti Island in Quebec and Western Newfoundland. The largest four projects are those of Syncrude, Suncor, Shell/Albian's Athabasca oil sands project and Imperial's Cold Lake. Canadian oil sands are a strategic future resources for Canada, North American and the global market

Referring to the IEA and the BP Statistical Review, in 2011 Canada ranked as the 6th largest oil producer after such countries as Russia, United States, Saudi Arabia, Iran and China. When taking into consideration proved oil reserves Canada is ranked third in the world after Venezuela and Saudi Arabia with 28.2 thousand million tones or 175.2 thousand million barrels or about 10.6% of total world reserves (see Figure 1). The oil sands account for more that 97% of proven oil reserves in Canada. Recently, the number of Canadian oil sands projects under active development has increased from 11.5 thousand million barrels in 2001 to 25.9 thousand million barrels in 2010 (see Figure 2). The Kearl oil sand project accounts for 4.6 billion barrels of the recoverable reserves of bitumen resources. It is Canadian largest and one of the highest quality oil sands deposits. The project life is over 40 years with a production capacity up to 345,000 bpd.

So what do unconventional oil reserves in Canada consists of, and what role will they play in the future as more easily accessible and lighter crude oil resources are depleted?

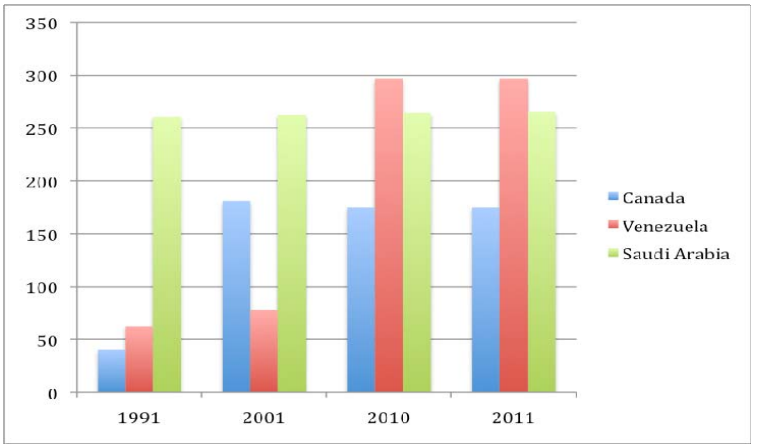

Figure 1. Proved Reserves in billion barrels
Source: BP Statistical Review, 2012

Unconventional Oil in Canada

Unconventional oil reserves in Canada consist of high deposits of oil sands. Shale's tight sands and tight carbonates are unconventional sources of oil, as the reservoir rock must be stimulated or fractured to enable the oil to flow. Extracting requires large amounts of energy in the form of steam, hot water, hydrogen, power, process heat, and diesel fuel. Most of the resources consist of an extra-heavy crude oil known as bitumen.

Technological advancements in drilling (long-reach horizontal well bores) and completion techniques (multi-stage hydraulic fracturing) are increasing the outlook for the supply of crude oil in North America.

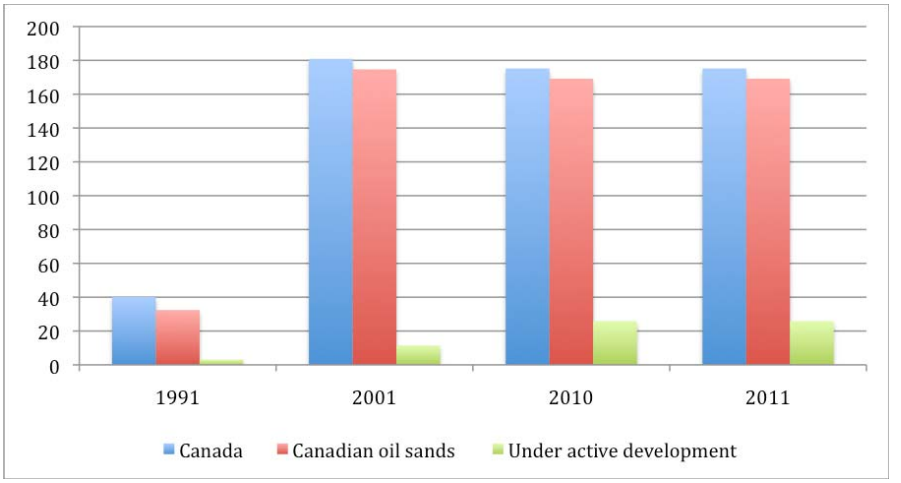

Figure 2. Proved Canadian Oil Reserves in billion barrels
Source: BP Statistical Review, 2012

In Canada there are two primary methods of extracting bitumen: open cast mining and situ thermal extraction. In situ extraction, steam injection is the most commonly used method with intense use of natural gas to run steam generators. CSS (cyclic steam stimulation) comprises a three-stage process used where the overburden is more than

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300m. The SAGD (steam assisted gravity drainage) is a newer method comprising drilling two wells parallel with the formation (Soderbergh et al. 2007).

Unconventional Resources and Opportunities in Canada

Most of Canada's recoverable reserves (175.2 billion barrels) are unconventional sources, the remaining 6 billion barrels are conventional oil (BP Statistical Review, 2012).
According to Statistics Canada, in 2009 mined oil sands equaled 465,926 thousands tones of oil. Canadian Energy Research Institute reports that daily production from Alberta's oil sands is exceeding the country's conventional oil production (see Figure 3).

In the IEA's World Energy Outlook (2004) conventional oil is expected to peak around 2015, and non-conventional oil will account for a third of the world's needs in 2030. Results of a study undertaken by Green et al. (2006) suggest that the transition from conventional to unconventional oil will begin before 2023. According to research done by Mohr & Evans (2010), Canadian natural bitumen will reach peak production in 2040. Other authors suggest that the unconventional oil peak will be reached in 2078.

According to Natural Resources Canada, North America is now the fastest growing oil-producing region outside of OPEC. Additionally, output is expected to jump by 11% over the 2010 to 2016 period due to increased output from Canada's oil sands. Canadian oil production is expected to breach the 4 mb/d marker in late 2012, and new in situ and mining bitumen projects are forecast to raise Canada's oil output by 280 kb/d to 4.1 mb/d in 2013.

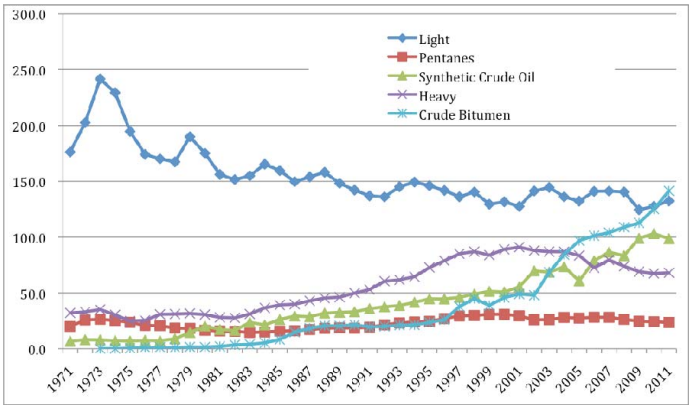

Figure 3. Canadian Crude Oil & Equivalent Production by type (1971-2011) in thousands cubic meters per day

Challenges of Oil Sands Production-- Environmental Issues

The strong growth and expansion of oil sands projects in Canada raises a number of environmental issues and challenges. Most attention is giver to issues addressing GHG emissions, but other matters such as surface disturbance and water conservation are also presenting serious problems to the environment. According to Soderbergh et al. (2007), GHG emissions of large amounts of carbon dioxide (CO_2) and some methane (CH_4) gas and nitrous oxide (N_2O) are the most complicated future environmental issues.

Extracting and upgrading bitumen to SCO yields substantial level of CO_2 emissions. The CO_2 emissions from hydrogen and power production total 40% of overall CO_2 production in Canada (Ordorica-Garcia, 2009). Therefore, Carbon Capture and Storage (CCS) technology is recognized as an essential element in Canada's overall CO_2 mitigation plans.

Extracting bitumen and other heavy crude oil requires more energy than the production of more accessible lighter crude oil. According to Canadian Natural Resources Agency, in 2009 GHG emission from oil sands contributed to 6.5% of Canada's total GHG emission and 0.1% of global emissions.

Regulations

Under Canada's Constitution, each province owns the onshore hydrocarbon resources within its provincial boundaries and is responsible for regulating resource development. Therefore, provincial regulatory environment defines each aspect of tight oil development (e.g., pre-drilling and drilling activities, hydraulic fracturing and production, resource management, abandonment and reclamation). Canadian regulation of the oil and gas sector is designed to protect water resources during oil and gas development. Specific regulations vary between provinces, but in most cases steel casing and cement are used to isolate and protect groundwater zones from deeper oil, natural gas and water zones.

According to the British Columbia Oil and Gas Commission (BCOGC), the Saskatchewan Ministry of Energy Resources, and the Alberta Energy Resources Conservation Board (ERCB), there has never been a confirmed case of groundwater contamination resulting from hydraulic fracturing in British Columbia, Saskatchewan or Alberta, the three provinces where most oil and gas drilling activity in Canada occurs. Hydraulic fracturing is a proven technology already used safely in a large proportion of the roughly 11,000 oil and gas wells drilled each year in Canada; this technique is essential to the effective operation of the oil and gas sector; and it is routinely done without negative safety consequences or significant adverse environmental impacts.

Market for Canadian Crude Oil

Canadian crude oil traditionally supplies markets in the U.S. midwest and Canada. With increasing heavy oil refining capacity in the region, the demand for Canadian crude oil in the U.S. midwest will grow. Due to expected growing supplies of Canadian bitumen there will be a quest for new markets for larger volumes. One of these projects is TransCanada Keystone XL pipeline project.

If the project receives presidential approval in 2013, it can start construction of 1,897 km pipeline. Construction has already started on TransCanada's Gulf Coast pipeline project. Both the Keystone and Gulf Coast pipelines will eventually be connected to move crude oil from the Athabasca oil sands region to refineries on the gulf coast of Texas.

Additionally new ways of supplying the ever-growing demand for crude oil in Asian markets must be found. One example of future projects is the Northern Gateway Pipeline Project from Edmonton, Alberta to port in Kitimat. Crude oil will be shipped via pipeline to the Pacific coast and then loaded on tankers for delivery to the U.S. west coast and Asian markets.

Oil Sands Projects

The development of oil sands projects requires twenty to thirty years of advance planning for production, upgrading, transportation, and marketing. Additionally, upgrading bitumen to be acceptable to conventional refineries requires natural gas and hydrogen. The capital investment required is huge and thus only the largest of companies can participate. Still, so far only the more favorable sites are being developed, given that the bitumen in oil sands is variable, thus the future would appear bright.

Conclusion

Canadian oil sands will remain a central topic for both the Canadian and world's economy. Canada is affected by future unconventional resources development both as producer and consumer of oil products.

Development of Canadian oil sands depends on multiple factors such as national government and public policy making regimens, U.S. legislation, capacity levels, technological advances, the marginal cost of production, greenhouse gas emissions regulations, etc. Future production of Canadian oil sands is focusing on in situ production and new technologies advancing in that area. One of the challenging matters is the question of the availability the large supply of energy, such as natural gas, needed for the continuous development of in situ projects. The option of constructing nuclear power in order for Canada to meet its commitments to the Kyoto Agreement is will be considered in the future as a constant energy provider is needed for situ production. Another important issue that is supposed to be addressed is whether SAGD techniques can be used to yield high production from lower quality reservoirs. And finally there it the question of how many oil sands deposits enable situ production.

The future will see higher rates of development of unconventional oil, and a transition from conventional to unconventional resources. Canadian unconventional oil resources are going to play a major role in the future of world energy resources.

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