



Canadian Petroleum Growth and Development

Abstract

The demand for energy continues to grow in North America. Canada plays a key role in balancing the demand and supply requirements. As the conventional oil reserves are declining in the world, there will be an ever-growing need for exploring the oil resources at remote locations including the vast oil sands deposits in the Athabasca region of northern Alberta and deep water. This paper will present an overview of Canada's conventional oil, oil sands and offshore industry, with primary focus on current production levels, future production forecasts, pipeline issues, and current and potential markets.

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1. Introduction

Canada is the 8th largest producer of crude oil in the world and a major exporter of crude oil to the US. Since the conventional oil reserves are declining in North America and security situation in major oil exporting countries is deteriorating, guaranteed supplies from within in the North American continent is becoming more important and desirable. In this scenario, Canada sitting on vast oil reserves, second to Saudi Arabia, has the potential of meeting the growing oil demand from United States. In addition, Canada also can supply oil to energy hungry economies of Southeast Asia through trans-pacific oil trade. It is important to look at Canada's conventional oil and oil sands industry, its current production levels, future production forecasts and infrastructure availability issues to analyze its potential in meeting these demands.

2. Conventional Oil Production and Forecast

The conventional oil reserves in Canada are estimated to be about 5.2 billion barrels as per 2005 estimate¹. The crude oil production from conventional oil reserves reached its highest production level in 1997, and since then it is showing a declining trend. This trend is expected to continue at a rate of 4-5% per year in the upcoming years. However, there are opportunities to offset this trend by improvement in production and drilling technologies and increasing the number of production wells.

Canada's oil reserves are spread across the country. The oil reserves in the provinces of British Columbia, Alberta, Saskatchewan and Manitoba are called Western Canada Sedimentary Basin (WCSB). In the WCSB region the conventional oil is getting mature.



The conventional oil sector has been the main driver of the Alberta economy for more than 50 years. Most of the crude oil produced in Alberta is exported to other markets. Alberta's oil industry remains a key component of the provincial economy, accounting for thousands of jobs in exploration, production, transportation, refining, distribution and marketing. In the 2005/2006 fiscal years, conventional crude oil production was the third-largest source of non-renewable resource revenue for Albertans. Overall, it accounted for more than C\$3.7 billion in royalty payments to the provincial government in the past three fiscal years alone (2003/2004 to 2005/2006). In the fiscal year 2005/2006, revenues to the province from crude oil and natural gas accounted for more than 40% or C\$14.3 billion of Alberta's total revenues¹.

In the Eastern Canada region the major activities are both onshore/offshore of Newfoundland and offshore of Nova Scotia. There are three offshore fields in Newfoundland - Hibernia, Terra Nova and White Rose, which was commissioned in 2005. White Rose produced about 32 million barrels of oil in 2006². The oil producing offshore field Cohasset, Nova Scotia, stopped operation in 1999. However there are plans for further developments in drilling activities. There are other exploration activities in the Orphan Basin, South Whale basin including land based exploration in the Port au Port and Dear Lake basin areas.

Oil exploration and production first started in mid 1850s in the Oil Springs of Southern Ontario. Over the past five years very low levels (with around 25 well per year) of oil production is taking place in this region. Even though the rate of production per



well is only around 100 Bbl/d, still it appears to be economical³. In the Gaspé Peninsula of Québec, exploration by Junex Inc. and its partner Gestion Berard Lemaire indicates that it produced 48⁰API very light crude on test basis and is expected to be a potential for commercial production. Another potential area in Québec is the Anticosti Island (Chaloupe well) where exploration activities are progressing by Corridor Resources Inc. in partnership with Hydro- Québec. About 105 million barrels of recoverable light crude oil is the expected production from this formation³.

Oil exploration activities are also underway in the Yukon and Northwest Territories in the Eagle Plains, Colville Hills and Norman Wells. Northrock Resources Ltd. In partnership with Husky, EOG Resources Inc. did successful test near Norman Wells at their Summit Creak well. Mackenzie Delta and Beaufort Sea area has an estimated 6.7 billion barrels of oil; however most of the activities are geared towards gas exploration in anticipation of completion of gas pipeline systems to build access to the North American pipeline systems.

Conventional crude oil includes both light and heavy crude oils. The costs of exploration of light and heavy crude oils are different and the prices of each are different as well. Conventional light oil is steadily seeing a decline in production and conventional heavy oil is approaching its peak production level expected to be declining in the coming years. Enhanced oil recovery (EOR) initiatives such as water floods, application of thermal energy, gas injection to maintain well pressures etc. are being employed to recover maximum oil from the wells. Several research initiatives are also underway for

further improvement including investment in research. The operating costs of the conventional oil industry have been showing an increasing trend and continue to be the case with declining production. . Offshore exploration activities described above are very capital intensive and long lead times for production.

The current oil reserves and production rates per provinces are presented in the table below.

**CONVENTIONAL CRUDE OIL & EQUIVALENT
REMAINING ESTABLISHED RESERVES IN CANADA**

2005

Thousand Cubic Metres

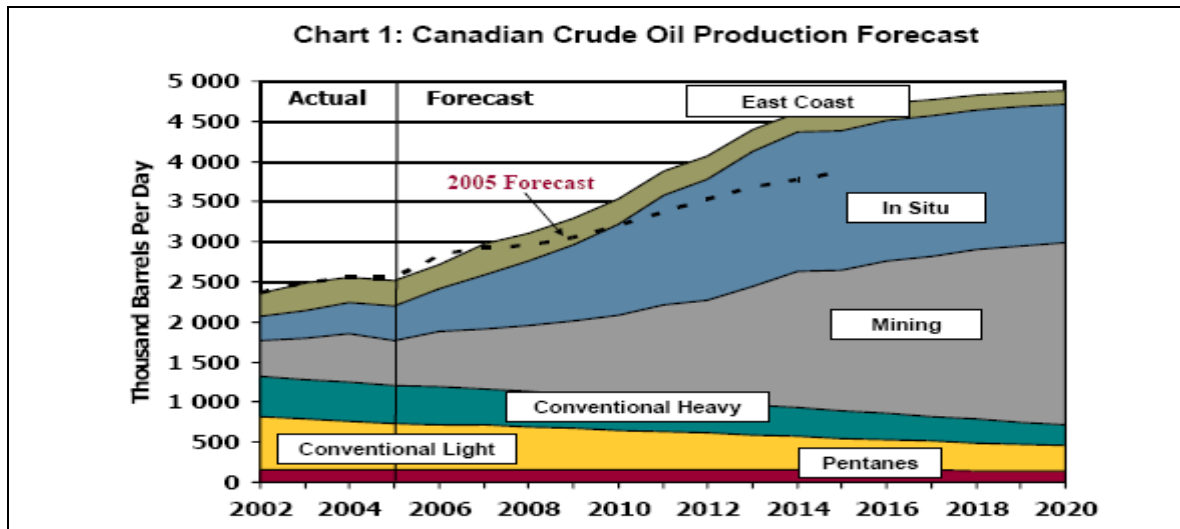
	Remaining Reserves at 2004-12-31	2005 Gross Additions *	2005 Net Production *	Remaining Reserves at 2006-12-31	Net Change In Reserves during 2005
CRUDE OIL					
Conventional Areas					
British Columbia.....	22 162	1 237	1 928	21 471	-691
Alberta.....	275 632	27 153	33 050	270 735	-5 867
Saskatchewan.....	187 902	34 264	24 515	197 651	9 749
Manitoba.....	3 861	893	812	3 942	81
Ontario.....	1 947	-214	138	1 856	-352
Quebec.....	0	-	-	0	0
New Brunswick.....	0	-	-	0	0
Mainland Territories.....	6 788	-	1 089	5 699	-1 089
Eastcoast Offshore.....	138 639	151 851	17 885	272 605	134 166
TOTAL	637 981	215 224	78 227	773 988	136 987
Frontier Areas					
Mackenzie/Beaufort.....	53 950	-	-	53 950	0
Arctic Islands.....	0	-	-	0	0
TOTAL	53 950	0	0	53 950	0
TOTAL CRUDE OIL	691 931	215 224	78 227	827 938	136 987
PENTANES PLUS					
Conventional Areas					
British Columbia.....	6 477	629	466	6 640	163
Alberta.....	53 536	9 076	8 830	53 782	246
Saskatchewan.....	262	61	76	247	-15
Manitoba.....	0	-	-	0	0
Mainland Territories.....	2 731	-	66	2 676	-55
Eastcoast Offshore.....	7 549	-	185	7 363	-186
TOTAL PENTANES PLUS	70 555	9 766	9 612	70 708	154
TOTAL CRUDE OIL & EQUIV.	762 486	224 990	88 839	898 646	138 151

* Preliminary estimate. Corrections to previous year cumulative production included with gross additions

Source: CAPP Statistical Hand Book- November-2006

The production of crude oil in Canada is expected to grow in the upcoming years. The production in 2005 was 2.5 million barrels per day. This will grow up to 4.6 million barrels per day in 2015 and further expected to reach 4.9 million barrels per day by 2020¹.



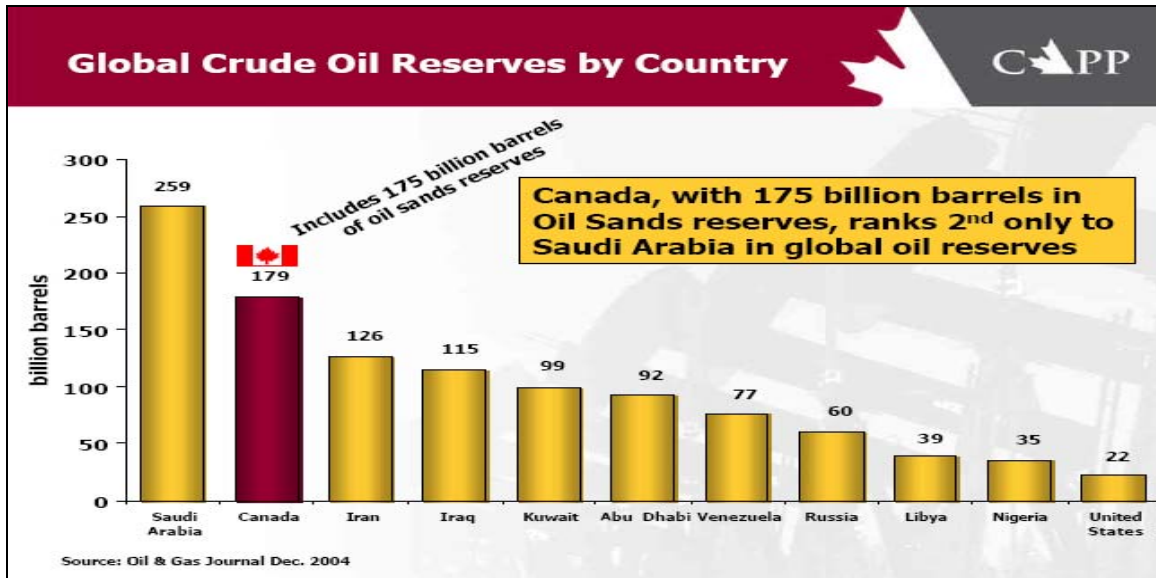


Source: Canadian Association of Petroleum Producers (CAPP) 2006- 2020 forecast

The conventional oil production in Western Canada is expected to show a declining trend both in light and heavy oil, as the wells are at their maturity stage. It is projected that the production will decline to 550,000 barrels per day by 2020. The rate of decline can be reduced by enhanced oil recovery.

3. Canadian Oil Sands production and Growth

Since the conventional oil reserves are declining in Canada and rest of the world, the oil sands of Alberta are becoming very important in terms of replacing the conventional crude oil production. Canada ranks second in proven oil reserves based on the current economics and current technology to extract bitumen.



Source: <http://www.capp.ca/raw.asp?x=1&dt=PDF&dn=98992>

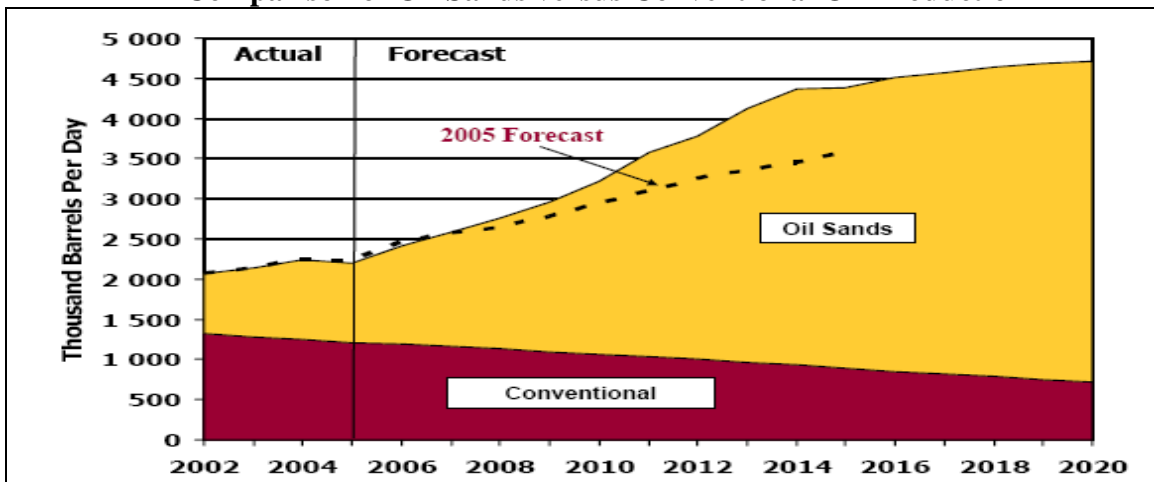
The political instability in the world, Iraq war, Iran's nuclear ambitions, Nigeria's unrest, nationalization of oil companies in Russia and Venezuela, and rapidly growing demand for oil in the emerging economies make the Canadian oil sands secure supply of oil for North America. CIBC World Markets reported that Canada holds almost 60 percent of the recoverable oil reserves in the world today. Canadian oil sands production will be the planet's single largest source of new supply by the end of the decade⁸.

The production life of conventional oil project declines with time. However the oil sands project has steady expected production life usually for 30 years. Moreover, the oil sands projects have no exploration risks and costs, unlike conventional oil projects. This makes the oil sands projects very attractive in terms of resource availability and predictable production over the life of the oil sands projects.

3.1 Current and Future Oil Sands Production

The oil sands production has increased from 0.4 million barrels per day in 1996 to 1.1 million barrels per day in 2006⁹. This represents 175% increase in crude oil production from the oil sands in 10 years. If all the planned oil sands projects start on schedule, total oil sands production could reach 4.7 million barrels per day in 2015⁹. The surface mining oil sands projects are built where the overburden is less than 75 meters. The bitumen recovery rates in typical surface mining oil sands projects are around 90 %. One barrel of synthetic crude oil is produced by processing two tones of oil sands ore and consumes 2-4.5 barrels of water³.

Comparison of Oil Sands versus Conventional Oil Production



Source: <http://www.capp.ca/raw.asp?x=1&dt=NTV&e=PDF&dn=103586>

Only about 20% of Canada's oil sands resources are recoverable using surface mining operation while the other 80% are too deep to be recovered by this method and need in-situ processes. The recovery rates are usually in the range of 25–50 % in steam assisted gravity drainage (SAGD) in-situ processes.

The most of oil sands projects are integrated operations, where bitumen is converted into synthetic crude oil to eliminate the price differential risk. Syncrude and Suncor are the major oil sands players in Alberta with initial synthetic crude oil production of 300,000 Bbls/day and 280,000 Bbls/day respectively. Shell Canada is the emerging bigger oil sands player with initial production of 167,000 Bbls/day with potential of reaching 670,000 Bbls/day.

Key Oil Sands Projects in Alberta

Project	Operator	Barrels per day	
		Initial	Potential
Athabasca – Mining			
Base Plant	Syncrude	300,000	593,000
Muskeg/Jackpine	Albian/Shell	155,000	570,000
Horizon	CNRL	135,000	415,000
Base Plant	Suncor	280,000	328,000
Kearl	Imperial	100,000	200,000
Fort Hills	Petro-Canada	100,000	190,000
Northern Lights	Synenco	100,000	100,000
Athabasca – In Situ Thermal			
Borealis/Christina/Foster	Encana	70,000	650,000
Firebag	Suncor	35,000	401,000
Long Lake	OPTI/Nexen	72,000	216,000
Sunrise	Husky	50,000	200,000
Surmont	ConocoPhillips	25,000	100,000
MacKay River /Lewis/ Meadow Creek	Petro-Canada	33,000	73,000
Jackfish	Devon	35,000	70,000
Joslyn Creek	Total E&P	10,000	40,000
Cold Lake – In Situ Thermal			
Cold Lake	Imperial	110,000	170,000
Wolf Lake/Primrose	CNRL	50,000	110,000
Tucker	Husky	18,000	35,000
Peace River – In Situ Thermal			
Peace River	Shell	12,000	100,000

Source: NEB, Canadian Association Of Petroleum Producers and CIBC World Markets Inc.

The Canadian Association of Petroleum Producers (CAPP) predicts that the oil production from the oil sands will reach almost 4 million barrels per day in 2020. The rapid oil sands production will occur between the periods from 2005 – 2010 due to massive investment happening in the oil sands industry of Alberta during this time frame. Refer to the CAPP oil sands production forecast table below.

CAPP Oil Sands Production Forecast (2006 – 2020) in 000's Bbls/day

Year	1990	1995	2000	2005	2010	2015	2020
Oil Sands Mining Production	209	279	321	552	1019	1750	2273
Oil Sands In-Situ Production	135	149	289	438	1132	1745	1724
Total Oil Sands Production	344	428	610	990	2,151	3,495	3,997
Year/ Year % Change		24.42%	42.52%	62.30%	117.27%	62.48%	14.36%

Source: <http://www.capp.ca/raw.asp?x=1&dt=NTV&e=PDF&dn=103586>

3.2 Oil Sands Costs and Profits

The profit in the oil sands business primarily depends on crude oil prices, costs, production and royalty regime. The oil sands industry is plagued with the rising costs to build the oil sands projects in Alberta. The higher costs are squeezing the profits of the industry and making it more economically risky. The capital costs to produce 100,000 barrel of crude oil from the oil sands are in the range of US\$7.60 -10.20 billion¹⁰. The operating costs are in the range of US\$16.20 – 18.70 per flowing barrel of synthetic crude oil⁶. The oil sands profit range from 10-17.5% at NYMEX crude oil prices of US\$30 – 50 per barrel and at a capital cost of 10%⁹. The Canadian–US exchange rate of 0.85 has been considered in converting the costs. The capital costs can be reduced through front-end planning, engineering design and phased construction on the oil sands projects. The operating costs can be controlled through less dependence on the Natural gas and developing new technologies.

3.3 Oil Sands Production Challenges and Risks

One of the major risks to crude oil production from the oil sands is lower oil prices. The oil sands projects become economically unattractive at NYMEX crude oil prices



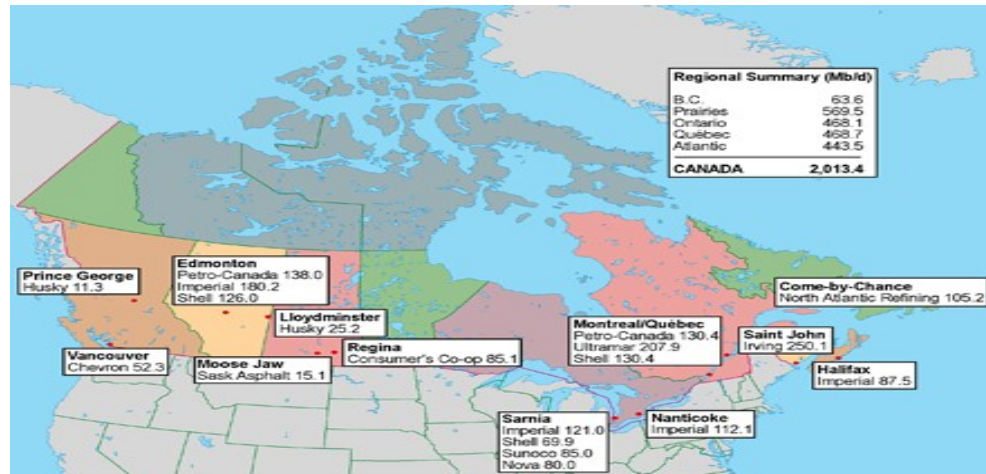
below US\$30 per barrel under the current costs⁹. The oil sands projects are very capital intensive and usually require 4 to 6 years to build – preliminary design to construction. The oil sands projects in Alberta face many challenges today including falling oil prices from its peak high in summer 2006, costs escalations, delays in construction schedule, environmental issues, shortage of skilled labor, higher equipment & material costs, and lack of adequate infrastructure to support the rapid growth in the oil sands investment.

4. Markets and Refining

Canadian crude Oil production and supply has seen tremendous growth due to development of vast oil sand resources in Alberta during the last five years. This makes Western Canada highly significant region in terms of crude oil supply to the North American markets. Also it is important to note that production growth alone cannot realize attractive profits unless adequate refining, pipeline and other transportation infrastructure keep pace with the crude oil production.

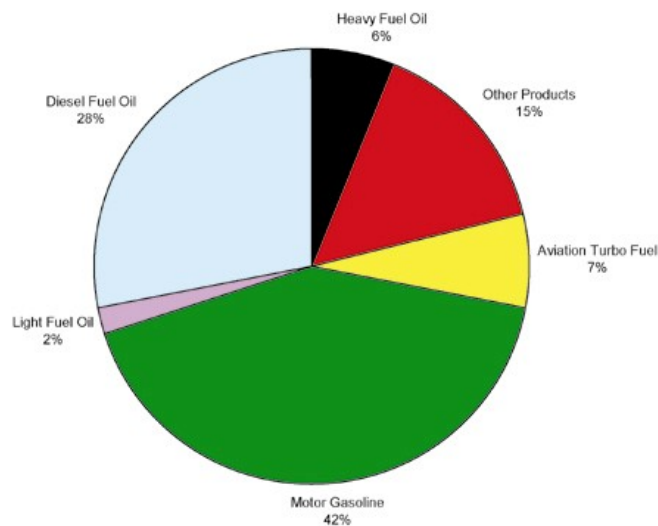
In terms of current refining capacity, Canada has 19 oil refineries operating with a total capacity of about 2 million barrels per day. The location and capacity of Canada's refineries are shown in Figure below. Refineries in the Eastern Canada import most of their crude oil (931 Mb/d) and utilize some of the crude oil from local production. Western Canadian refineries only process Western Canadian crude oil (580 Mb/d). The remainder crude oil from Western Canada (1590 Mb/d) is exported to the United States³. Due to high availability of local crude, Canadian refining capacity has grown moderately in recent years and utilization has been slightly over 90 percent. However, like the rest of North America, major capacity addition in the refining sector did not take place.





Location and Capacity of Canada's Refineries (*Source CAPP*)

In Canada, almost 70 percent of domestic sales are transportation fuels, including aviation turbo fuel, gasoline and diesel. These percentages may vary by region and season. Figure 2 shows the sales of petroleum products within Canada. In the summer, refineries increase their output of gasoline and asphalt, while in the winter refineries, particularly in central and eastern Canada, produce more heating fuel or light fuel oil¹.



Estimated Domestic Sales of Refined Petroleum Products (*Source CAPP*)

On the pipeline side, western Canada has sufficient pipeline capacity to move crude oil to its traditional eastern markets, primarily the US Midwest. These markets are accessed through the Enbridge Pipe Line System. Crude Oil is shipped to the secondary markets, such as West Coast United States, when the Enbridge pipeline system is fully apportioned. Currently, Crude Oil produced from western Canada moves through three major pipelines; Enbridge, Terasen Express and Terasen Trans Mountain. Enbridge is the world longest crude oil and Petroleum products pipeline. It is capable of taking multiple types of products with a total capacity of around 2 MMb/day. The smaller ones, Terasen Trans Mountain and Terasen Express has capacities of 282 Mb/d and 225 Mb/d. Although a small pipeline, Trans Mountain has strategic importance due to its access to West Coast Ship terminals.

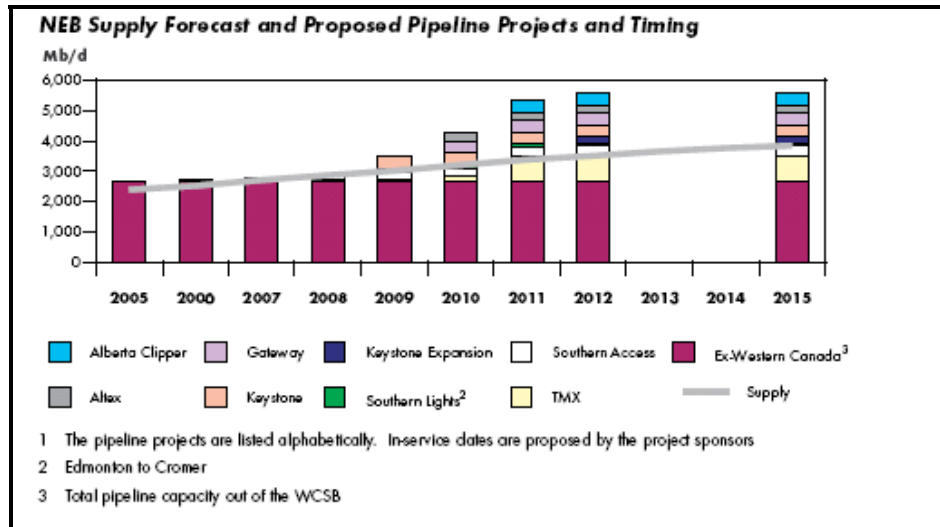


Major Oil Pipeline Network to US (*Source CAPP*)

While current pipeline capacity is adequate, this will no longer be the case if new pipeline capacity is not added to cope with the growing supplies from Western Canadian Oil Sands. According to National Energy Board Canada (NEB), there will be a short fall

of pipeline transportation capacity of around 1.0 million barrels per day by 2015, if new expansion or addition does not take place. Some of the announced or proposed pipeline projects are: Northern Option TMX, Enbridge Southern Lights and Southern Access, Alberta Clipper, TCPL Keystone, and Southern Option.

Western Canadian crude marketing is currently focused on four core markets: Western Canada, Ontario, The US Midwest (Upper PADD II), and the US Rockies (PADD IV). These core areas represented an aggregate demand of over 3.0 MMb/d. These markets need traditional cuts of light and heavy crude oil. But western Canadian Producers are switching to SYNBIT – A mixture of Synthetic Crude and Bitumen. SYNBIT is close in its properties to conventional medium sour crude and therefore is not capable of replacing supplies of conventional light and heavy crude oil market. Therefore the target markets for Canadian Crude should be the one looking for medium sour crude.



Major Oil Pipeline Network to US (*Source NEB*)

In addition to these Core markets, Crude oil is occasionally delivered into extended markets, the lower Midwest (PADD II) and Washington State (PADD V) region. Market



in these regions demand light or medium sour crude. The pricing parity shifts mechanism makes this region highly competitive and therefore less attractive. There is also a potential market in the Wood River Region to replace some of the declining domestic crude supplies but the competition there seems to be tough, as local crude supplies has obvious advantage over the imported one.

Therefore, Canadian producers have to look for new markets like California and US Gulf Coast (USGC). Both markets provide demands of 1.5 MMb/d and 6.5 MMb/d respectively¹. These markets are primarily looking for medium and heavy crude, making them ideal markets for Canadian Crude. California is currently using significant amount of supplies from Alaska (Alaska North Slope-ANS) but the sources of these supplies are in constant decline, providing new opportunities for Canadian Crude oil.

Another potential market for Canadian Crude could be Southeast Asia, predominantly China. China is thirsty for Oil resources and is desperate to establish long-term trade deals with oil rich countries. Despite greener markets and long term deals, the long distances involved and geopolitical issues make this option less attractive. Hence producers would like to develop new markets on the American Continent and increase their Net Back value.

Announced and Proposed Canadian Oil Pipelines and Expansions

Pipeline	Potential Filing Date	Capacity Increase (Mb/d)	Proponents' Estimated Completion Date	Market
Terasen (TPTM) Phase One TMX1 Phase Two TMX1	Filed July 2005 Filed February 2006	75 35 40	April 2007 Nov. 2008	PADD V Offshore/Far East
Southern Option TMPL TMX2 TMPL TMX3	01Q2007 N/A	700¹ 100 300	Jan. 2010 Jan. 2011	PADD V Offshore/Far East
Northern Option (TMX)	N/A	450	2011	PADD V Offshore/Far East
Enbridge Gateway (oil/diluent)	Fall 2006	400/150	Mid-2010	PADD V Offshore/Far East Alberta (diluent line)
Pembina Spirit (diluent)	N/A	100	April 2009	Alberta
Enbridge Southern Lights Southern Lights (diluent) Line 2 Expansion (oil) Edmonton to Cromer Cromer to Clearbrook Clearbrook to Superior	N/A	180 169 103 33 33	2009	Alberta PADD II PADD II PADD II
TCPL Keystone	June 2006	435	2009	Southern PADD II/ PADD III
Alberta Clipper	N/A	400	2010/11	Southern PADD II
Altex Energy	N/A	250	4Q2010	PADD III
Enbridge (Southern Access) Phase I Phase II Phase III	May 2006 N/A N/A	315 120 148 47	Oct. 2006 and Feb. 2007 2008/09 N/A	Midwest/Southern PADD II

N/A Not Available

¹ The 700 mb/d includes the existing capacity of 300 mb/d and the capacity additions from TMX2 and TMX3.

Proposed or Announced Pipelines (Source NEB)

5. Conclusions

Even with declining conventional oil reserves, with its vast oil sands deposits, Canada can provide significant amount of crude oil to meet the North American demand. However there exists many challenges that include inadequate heavy sour crude refining capacity, lack of pipe lines to potential markets, labor shortages and serious environmental issues. As far as crude oil price remains high, Canadian crude will find its markets and play a leading role in the North American energy market.

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