

Canada's Oil Sands Industry - Production & Supply Outlook

December 2008

StrategyWest
Inc.
www.strategywest.com

Prepared by:
R.B. (Bob) Dunbar
bob.dunbar@strategywest.com

Table of Contents

Table of Contents.....	i
List of Figures	ii
List of Tables	ii
1. Introduction	1
2. Oil Sands Resources and Reserves	3
2.1. <i>Initial Volume In-Place</i>	3
2.2. <i>Reserves</i>	4
2.3. <i>Ultimate Potential</i>	5
3. Historical Bitumen and Synthetic Crude Oil Production	6
4. Oil Sands Industry Outlooks	8
4.1. <i>Approach used by Strategy West</i>	8
4.2. <i>Mid-2008 Oil Sands Industry Outlooks</i>	9
4.3. <i>Existing and Proposed Canadian Oil Sands Projects</i>	10
4.4. <i>Late-2008 Oil Sands Industry Outlooks</i>	11
4.4.1. Strategy West Scenarios.....	11
4.4.2. Strategy West Bitumen Production Outlooks.....	12
4.4.3. Strategy West Oil Sands Supply Outlooks.....	13
4.4.4. Comparative Oil Sands Supply Outlooks	14
5. Conclusions.....	16

List of Figures

Figure 1-1: Oil Sands Areas.....	1
Figure 3-1: Alberta Bitumen Production (1994-2007).....	6
Figure 3-2: Alberta SCO and Non-Upgraded Bitumen Production (1994-2007)	7
Figure 4-1: Comparative Oil Sands Supply Outlooks before the Crash	9
Figure 4-2: Existing and Proposed Commercial Project Capacities	10
Figure 4-3: Strategy West Bitumen Production Outlooks	13
Figure 4-4: Strategy West Oil Sands Supply Outlooks	14
Figure 4-5: Comparative Supply Outlooks.....	15

List of Tables

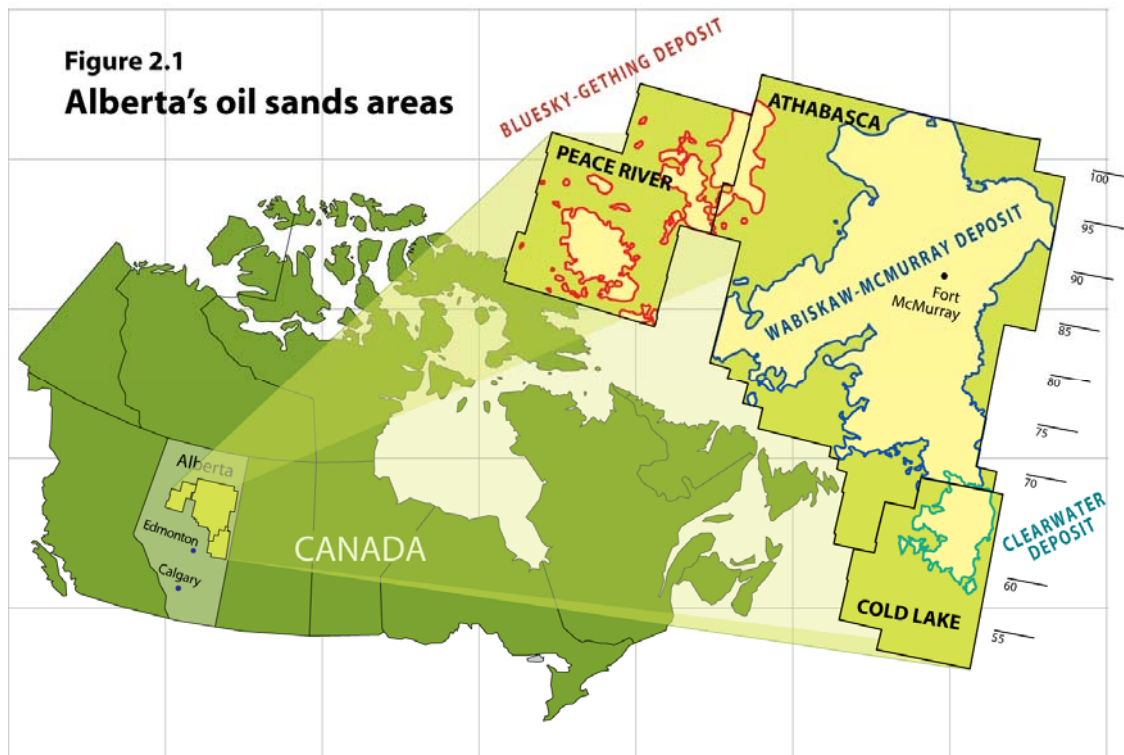
Table 2-1: Initial Crude Bitumen Volume In-Place	3
Table 2-2: Initial Established Crude Bitumen Reserves.....	4
Table 2-3: Alberta Crude Bitumen Production to Year-end 2007	4
Table 2-4: Remaining Established Crude Bitumen Reserves.....	4
Table 2-5: Remaining Established Crude Bitumen Reserves under Active Development	5
Table 4-1: Strategy West Scenarios	12

1. Introduction

With an estimated initial volume in-place of approximately 1.7 trillion barrels (270 billion m³)¹ of crude bitumen, Canada's oil sands, located in the Province of Alberta, are one of the world's largest hydrocarbon accumulations. When the Oil and Gas Journal released its estimates of global proved petroleum reserves at year-end 2002, it increased Canada's proved oil reserves to 180 billion barrels (29 billion m³), compared to 4.9 billion barrels (780 million m³) the previous year. This almost forty-fold increase catapulted Canada into second position for total oil reserves behind only Saudi Arabia, and cut the Organization of Petroleum Exporting Countries' (OPEC's) share of world oil reserves by more than 10 percent.²

The three designated Oil Sands Areas (OSAs) in Alberta as of the end of 2007 are shown in Figure 1-1.

**Figure 1-1:
Oil Sands Areas**



Source: Alberta Energy Resources Conservation Board

¹ Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2007 and Supply/Demand Outlook 2008-2017; ERCB ST98-2008, June 2008

² Source: Oil & Gas Journal; Worldwide Report: Worldwide Reserves Increase as Production Holds Steady; Marilyn Radler; December 23, 2002

Alberta's massive crude bitumen resources are contained in sand (clastic) and carbonate formations in the three OSAs shown in Figure 1-1. Contained within the OSAs are 15 Oil Sands Deposits (OSDs), which designate the specific geological zones containing the oil sands. Each OSA contains a number of bitumen-bearing deposits.

The known extent of the largest OSD, the Athabasca Wabiskaw-McMurray, as well as the significant Cold Lake Clearwater and Peace River Bluesky-Gething deposits, are shown in Figure 1-1. The bitumen in these three OSDs is contained in sand (clastic) formations. Most of the development activity to date has occurred in these three OSDs.

The bitumen in four of the 15 OSDs is contained in carbonate formations. While there is no commercial production of bitumen from the carbonate deposits, several companies have acquired oil sands carbonate leases and are developing recovery technologies.

As an indication of scale, the right-hand edge of Figure 1-1 shows township markers that are about 50 kilometres (km) (30 miles) apart. Together the three OSAs occupy an area of about 140,000 km² (54,000 square miles).

While most industry activity to date has focussed on Alberta, several companies have leased land in northwest Saskatchewan and are evaluating the extent of the Saskatchewan oil sands resources and are investigating bitumen recovery technologies. However, this work is still at an early stage, and while Saskatchewan's oil sands have the potential to make an important contribution in the long term, this document focuses on oil sands industry activity in Alberta.

2. Oil Sands Resources and Reserves

Oil sands are a mixture of sand and other rock materials that contain crude bitumen (extra-heavy non-conventional crude oil). Oil sands are composed of approximately 80-85 percent sand, clay and other mineral matter, 5-10 weight percent water, and anywhere from 1-18 weight percent crude bitumen.

Crude bitumen is a thick, viscous crude oil that, at room temperature, is in a near solid state. The definition used in the industry is that crude bitumen is “a naturally occurring viscous mixture, mainly of hydrocarbons heavier than pentane, that may contain sulphur compounds and that, in its naturally occurring viscous state, will not flow to a well”.³

2.1. Initial Volume In-Place

At year-end 2007, the Alberta Energy Resources Conservation Board (ERCB) estimated the Initial Volume In-Place of crude bitumen in Alberta's oil sands to be 1,712 billion barrels (272.0 10⁹m³).⁴

The ERCB reported that 6% of the volume in-place, 101 billion barrels (16.1 10⁹m³), is contained in shallow deposits – that are less than 250 feet (75 m) to the top of the oil sands zone. All of the shallow oil sands deposits are located in the Athabasca Oil Sands Area. Surface mining and extraction is used to recover crude bitumen from these shallow deposits.

The remaining 94% of the volume in-place, 1,610 billion barrels (255.9 10⁹m³), is contained in deeper deposits. Deep oil sands deposits are present in all three Oil Sands Areas. In situ recovery techniques are used to recover crude bitumen from the deeper deposits.

The ERCB's estimates of initial volume in-place are given in Table 2-1.

**Table 2-1:
Initial Crude Bitumen Volume In-Place**

	Billion Barrels	Billion m ³
Mineable:	101	16.1
In Situ:	1,610	255.9
Total	1,712	272.0

³ Source: Alberta Statutes and Regulations; Oil Sands Conservation Act, Section 1(1) (c)

⁴ Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2007 and Supply/Demand Outlook 2008-2017; ERCB ST98-2008, June 2008

These figures represent the ERCB's best estimates of volume in-place. However, only a fraction of the volume in-place is expected to be technically and economically recoverable. The amounts estimated to be recoverable are classified as reserves and are discussed in the next section.

2.2. Reserves

The ERCB estimates that approximately 10% of the bitumen in-place is recoverable. Its estimates of Initial Established Reserves are given in Table 2-2.

**Table 2-2:
Initial Established Crude Bitumen Reserves**

	Billion Barrels	Billion m ³
Mineable:	35.2	5.59
<u>In Situ:</u>	<u>143.4</u>	<u>22.80</u>
Total	178.7	28.39

To year-end 2007, approximately 3% of the initial established reserves had been produced. Cumulative production to year-end 2007, as reported by the ERCB, is summarized in Table 2-3.

**Table 2-3:
Alberta Crude Bitumen Production to Year-end 2007**

	Billion Barrels	Billion m ³
Mineable:	3.9	0.63
<u>In Situ:</u>	<u>2.0</u>	<u>0.32</u>
Total	5.9	0.94

The ERCB's estimates of Remaining Established Reserves at year-end 2007, after accounting for cumulative production, are reported in Table 2-4.

**Table 2-4:
Remaining Established Crude Bitumen Reserves**

	Billion Barrels	Billion m ³
Mineable:	31.2	4.96
<u>In Situ:</u>	<u>141.5</u>	<u>22.49</u>
Total	172.7	27.45

Only a fraction of these reserves are associated with active development projects. The ERCB's estimate of Remaining Established Reserves "Under Active Development" at year-end 2007 is reported in Table 2-5.

**Table 2-5:
Remaining Established Crude Bitumen Reserves under Active Development**

	Billion Barrels	Billion m ³
Mineable:	18.3	2.91
In Situ:	3.7	0.59
Total	22.0	3.50

The reserve figures in Table 2-5 are roughly comparable with reserve estimates reported by the Canadian Association of Petroleum Producers (CAPP). CAPP reported remaining reserves for developed (producing) oil sands projects of 8,871 and 4,706 million barrels for mining and in situ bitumen respectively (1,410 and 748 10⁶m³) at year-end 2006.⁵ CAPP's reserve estimates for year-end 2007 were not available at the time of publication of this report.

2.3. Ultimate Potential

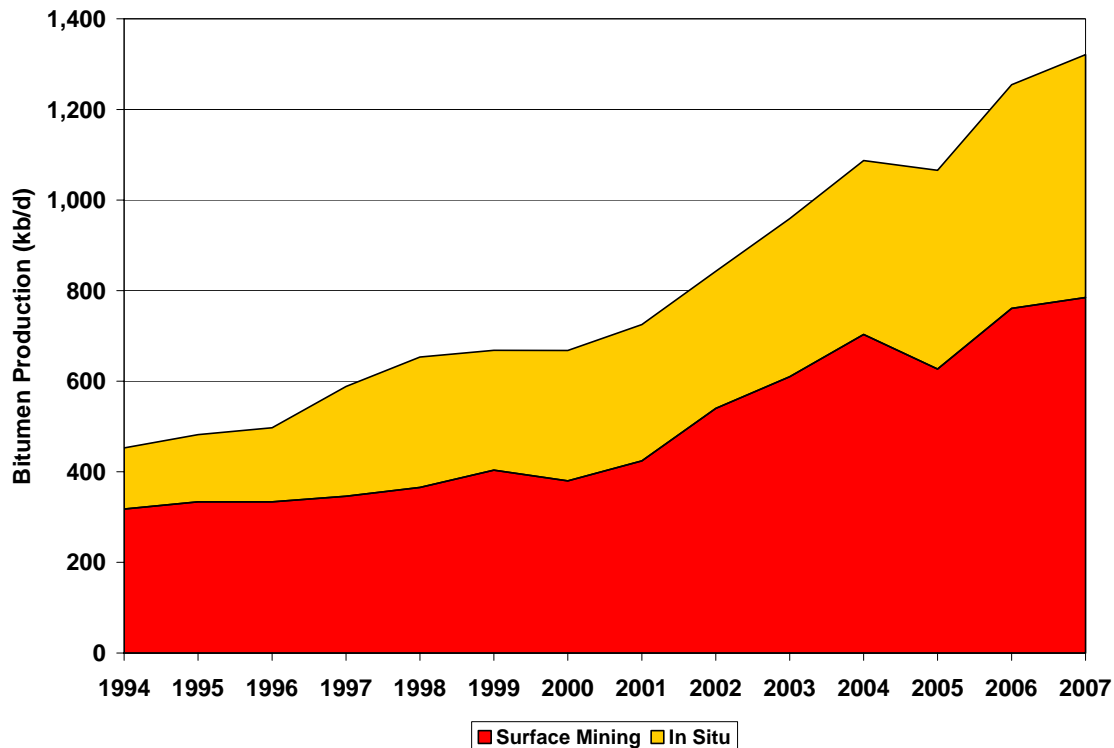
The ERCB estimates the ultimate potential of crude bitumen recoverable by in situ recovery methods from Cretaceous sediments to be 33 10⁹m³ (~210 billion barrels) and from Paleozoic carbonate sediments to be some 6 10⁹m³ (~40 billion barrels). Nearly 11 10⁹m³ (~70 billion barrels) is expected from within the surface-mineable boundary, with a little more than 6 10⁹m³ (~60 billion barrels) coming from surface mining and about 0.4 10⁹m³ (~3 billion barrels) from in situ methods. The total ultimate potential crude bitumen is therefore about 50 10⁹m³ (~315 billion barrels).

⁵ Source: Canadian Association of Petroleum Producers ; <http://www.capp.ca/>

3. Historical Bitumen and Synthetic Crude Oil Production

While Western Canadian conventional heavy oil production is in decline, bitumen production from Alberta's oil sands has been increasing as illustrated in Figure 3-1. The oil sands industry produced 1,321 thousand barrels per day (kb/d) of crude bitumen in 2007, 785 kb/d from surface mining and 536 kb/d from in situ projects.

**Figure 3-1:
Alberta Bitumen Production (1994-2007)⁶**



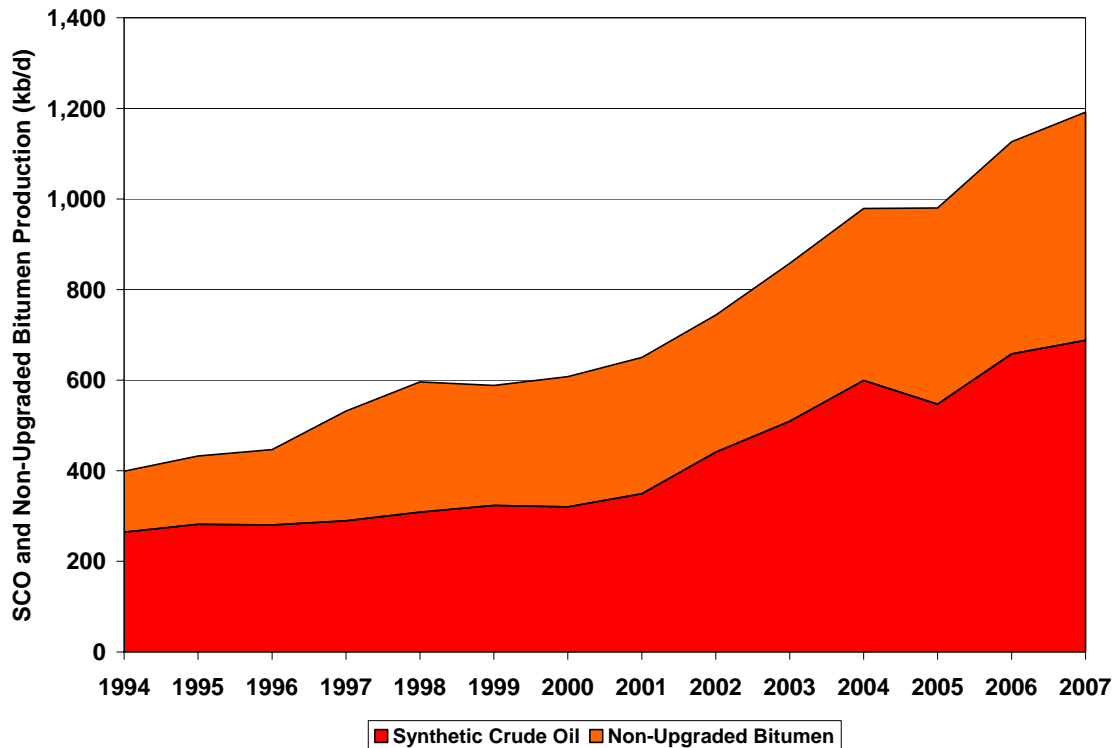
While not shown on this chart, first commercial production from the Canadian oil sands industry began in 1967, more than 40 years ago, with the startup of the Great Canadian Oil Sands (GCOS) mining, extraction and upgrading project north of Fort McMurray, Alberta. GCOS was subsequently acquired by Suncor Energy Inc. and under Suncor's leadership has undergone several expansions since operations commenced.

Over the last several years, about 60-65% of all bitumen produced in Alberta has been upgraded to synthetic crude oil (SCO) and other products before being delivered to downstream refineries

⁶ Source: Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2007 and Supply/Demand Outlook 2008-2017; ERCB ST98-2008; June 2008

for further processing. To date, almost all Alberta SCO has been produced at upgraders that are integrated with oil sands mining projects (Suncor, Syncrude and AOSP). In 2005, the fraction of bitumen that was upgraded dropped to 59% of all bitumen produced due to the extended shutdown following a fire at Suncor's Millennium upgrader and outages at AOSP's Scotford upgrader. The production of synthetic crude oil and non-upgraded bitumen in Alberta since 1994 is illustrated in Figure 3-2.

**Figure 3-2:
Alberta SCO and Non-Upgraded Bitumen Production (1994-2007)⁷**



After upgrading, production of synthetic crude oil and non-upgraded crude bitumen totalled 1,192 kb/d in 2007 (688 kb/d of synthetic crude oil and 504 kb/d of non-upgraded crude bitumen).

⁷ Source: Ibid

4. Oil Sands Industry Outlooks

Strategy West Inc., a Calgary-based consulting company, maintains a comprehensive database of existing and proposed Canadian oil sands projects and has prepared long-term industry outlooks for several clients. These outlooks have included project-by-project and aggregated projections of oil sands industry:

- Bitumen production
- Synthetic crude oil and non-upgraded bitumen supply
- Purchased natural gas requirements
- Thermal energy (steam and hot water) requirements
- Electricity requirements
- Hydrogen requirements

Several other organizations also prepare outlooks for the Canadian oil sands industry. This document summarizes Strategy West's current outlook, and recent industry outlooks released by the Alberta Energy Resources Conservation Board (ERCB)⁸ and the Canadian Association of Petroleum Producers (CAPP).⁹ Reference is also made to the long-term vision for the industry released by the Alberta Chamber of Resources in 2004.¹⁰ Copies of these reports may be downloaded at www.strategywest.com.

4.1. Approach used by Strategy West

Strategy West uses its database of existing and proposed oil sands projects as the basis for its industry outlooks. Since it is likely that some projects will experience delays and unlikely that all projects will proceed, Strategy West assigns a probability to and adjusts the startup date of each phase of each project in its database and then aggregates the results to prepare its overall industry outlook. The methods used to assign project probabilities and adjust project startup dates are described below.

Project probabilities are determined based on the following factors:

- Project status (operating, under construction, approved, etc.)¹¹
- Degree of project integration

⁸ Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2007 and Supply/Demand Outlook 2008-2017; ERCB ST98-2008; June 2008

⁹ Source: Canadian Association of Petroleum Producers; Crude Oil Forecast, Markets & Pipeline Expansions; June 2008; and CAPP's Crude Oil Forecast - Interim Update; December 11, 2008

¹⁰ Source: Alberta Chamber of Resources; Oil Sands Technology Roadmap; January 30, 2004

¹¹ See Section 4.3

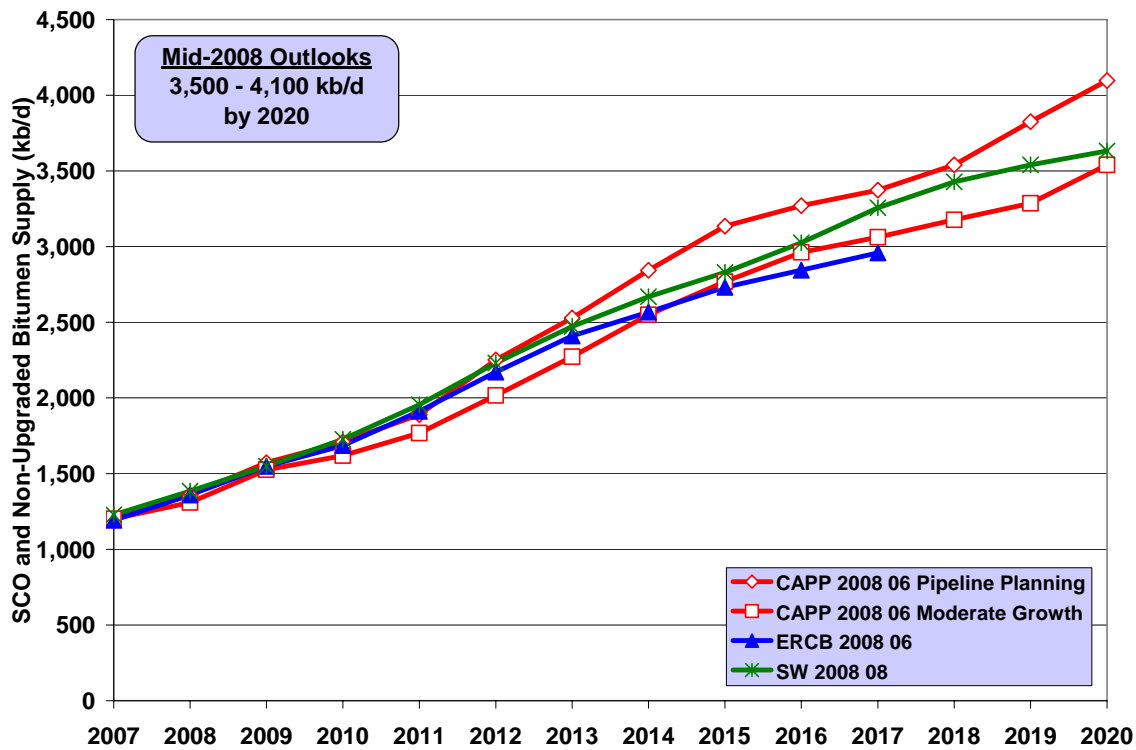
- Project owners (operating experience, financial capacity, technical capabilities, etc.)
- Technology employed (i.e., commercially proven, pilot, bench scale)
- Whether there are existing operations
- Project timing

Strategy West also adjusts the startup date for each phase of each proposed project based on typical times for each development step and its assumptions regarding the intervals between the startup dates of separate phases.

4.2. Mid-2008 Oil Sands Industry Outlooks

Prior to the 2008 collapse of global capital markets and the concomitant economic crisis, the oil sands industry was expanding rapidly in response to increasing global demand for petroleum products and high crude oil prices. Various organizations, including Strategy West, had released industry outlooks that anticipated that industry supply (synthetic crude oil and non-upgraded crude bitumen) would reach 3.5 to 4.1 million barrels per day (mb/d) by 2020 as illustrated in Figure 4-1.

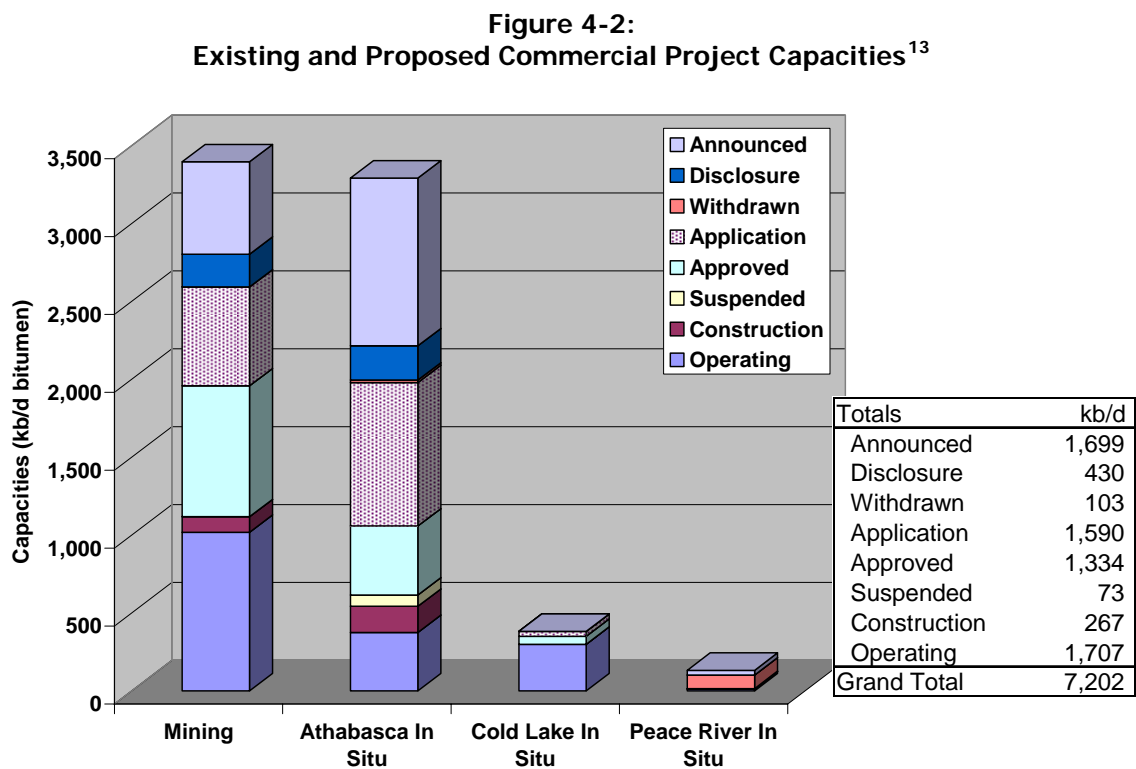
**Figure 4-1:
Comparative Oil Sands Supply Outlooks before the Crash**



In addition to the outlooks illustrated above, a long-term vision for Canada's oil sands industry was articulated in the Oil Sands Technology Roadmap.¹² That document anticipated that oil sands production will increase to 5 mb/d by 2030, with 4 mb/d of synthetic crude oil and other upgraded products provided from a 50/50 mix of mined and thermally produced bitumen and 1 mb/d of thermally produced bitumen in diluted products.

4.3. Existing and Proposed Canadian Oil Sands Projects

At the time of writing, the industry had proposed projects representing more than 7 mb/d of bitumen production capacity as illustrated in Figure 4-2.



¹² Source: Alberta Chamber of Resources; Oil Sands Technology Roadmap; January 30, 2004

¹³ Source: Strategy West Inc.; Existing and Proposed Canadian Commercial Oil Sands Projects; February, 2009. Note that this listing does not include projects that produce crude bitumen using primary and secondary recovery techniques or oil sands experimental schemes. Bitumen production volumes from these sources have exceeded 100 kb/d for the last several years.

The project classifications used in Figure 4-2 are described below:

Operating	Projects that are in operation
Construction	Projects that are under construction (beyond initial site preparation)
Suspended	Projects that began construction (beyond initial site preparation) that is no longer underway
Approved	Projects that have received regulatory approvals but have not commenced construction
Application	Projects that have filed applications that are being reviewed by regulatory agencies
Withdrawn	Projects that have filed applications that were subsequently withdrawn
Disclosure	Projects that have issued formal public disclosures but have not filed applications
Announced	Projects that have been announced but have not issued formal public disclosures

Note that total oil sands crude bitumen production capacity ("Operating" projects) has reached approximately 1.7 mb/d. This includes the capacity of several new projects that were brought on stream in late 2008 and are not expected to reach full capacity until late 2009 or 2010. Additionally, projects representing almost 0.3 mb/d of crude bitumen production capacity were under construction at year-end 2008 ("Construction" projects). These projects will bring oil sands industry bitumen production capacity to almost 2.0 mb/d by early next decade.

Most of the remaining projects, those that are not "Operating" or under "Construction" have been deferred in the present economic environment; some have been cancelled.

4.4. Late-2008 Oil Sands Industry Outlooks

4.4.1. Strategy West Scenarios

Due to the uncertainty associated with the economic environment at year-end 2008, and the uncertain outlook for global crude oil prices, Strategy West decided to develop its outlook for the oil sands industry under the two broad scenarios summarized in Table 4-1.

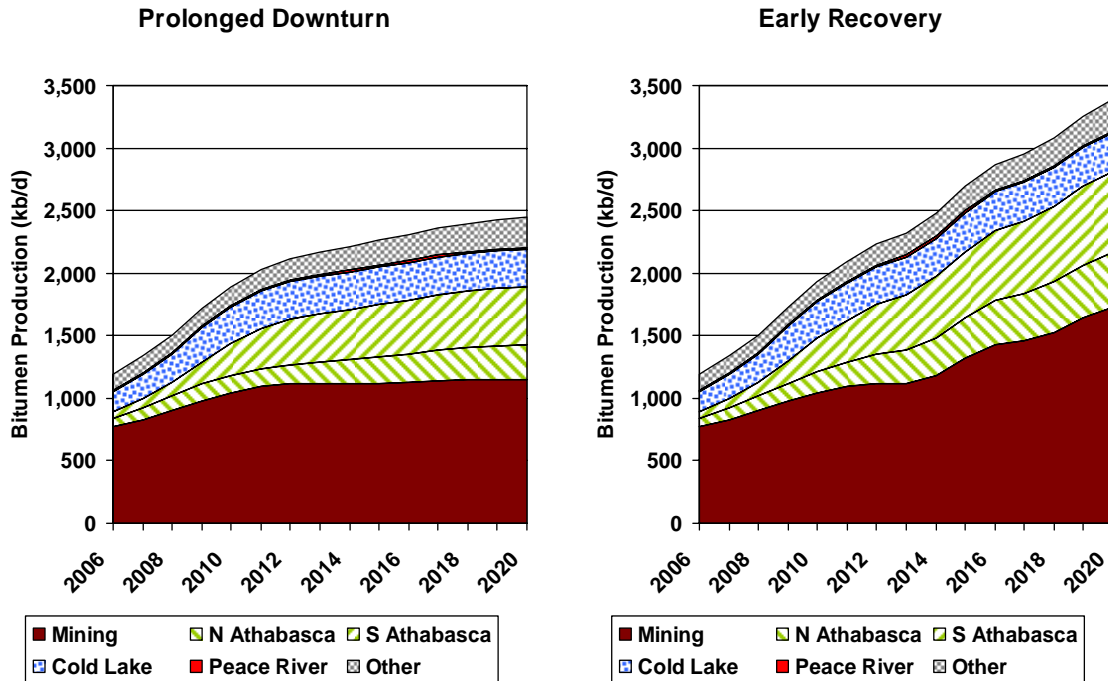
**Table 4-1:
Strategy West Scenarios**

Prolonged Downturn	Early Recovery
Projects under construction are completed	Projects under construction are completed
No economic recovery for several years	Economic recovery commences by year-end 2009
Slow growth thereafter led exclusively by established industry players	Moderate growth thereafter led mainly by established industry players
No investment in new upgrading capacity	Some investment in new upgrading capacity

4.4.2. Strategy West Bitumen Production Outlooks

Under both scenarios, bitumen production from Canadian oil sands projects would reach 2.0 mb/d by early next decade. However, under the Prolonged Downturn Scenario, growth thereafter would be slow with bitumen production reaching 2.4-2.5 mb/d by 2020. Under the early Recovery Scenario, bitumen production would reach 3.4 million barrels per day by 2020. The two cases are illustrated in Figure 4-3.

**Figure 4-3:
Strategy West Bitumen Production Outlooks**



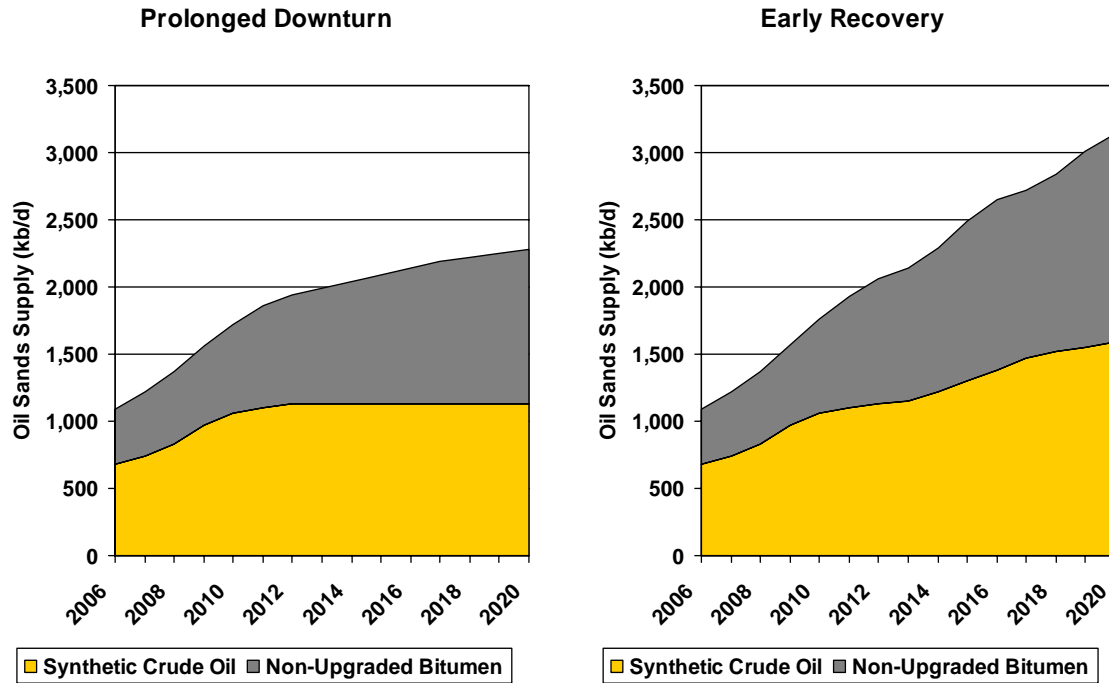
4.4.3. Strategy West Oil Sands Supply Outlooks

As stated earlier in this report, over the last several years, about 60-65% of all bitumen produced in Alberta has been upgraded to synthetic crude oil (SCO) and other products before being delivered to downstream refineries for further processing. To date, almost all Alberta SCO has been produced at upgraders that are integrated with oil sands mining projects (Suncor, Syncrude and the Athabasca Oil Sands Project - AOSP).

Under the Prolonged Downturn Scenario, synthetic crude oil and non-upgraded crude bitumen supply from Canadian oil sands projects would reach 2.3 mb/d by 2020. Under the Early Recovery Scenario, supply from Canadian oil sands projects would reach 3.1 mb/d by 2020. In both scenarios, the percentage of bitumen upgraded before shipment to market would drop from current levels – to 53% in 2020 in the Prolonged Downturn Scenario and to 54% in 2020 in the Early Recovery Scenario. The two cases are illustrated in Figure 4-4.

Note that, in aggregate, some volumetric loss occurs during upgrading; the amount depends on the upgrading processes employed at a particular project (some upgrading processes result in a volumetric gain due to extensive hydroconversion).

**Figure 4-4:
Strategy West Oil Sands Supply Outlooks**



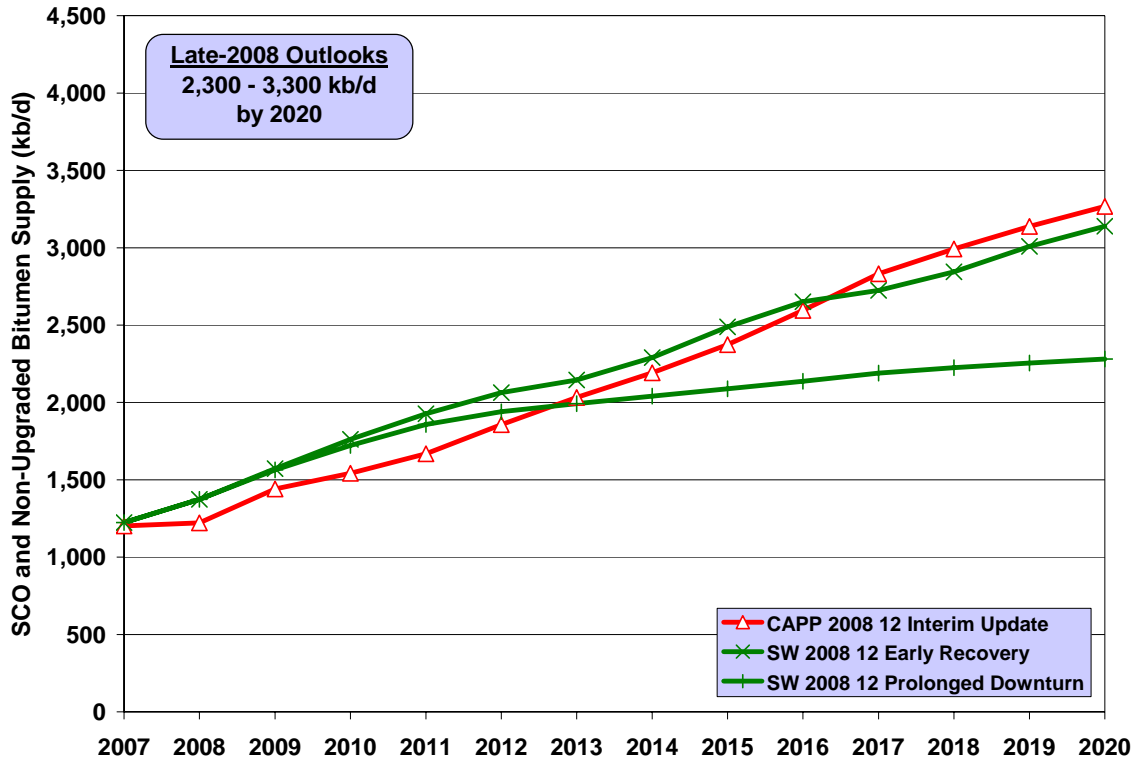
4.4.4. Comparative Oil Sands Supply Outlooks

The Canadian Association of Petroleum Producers (CAPP) updated its supply outlook for the oil sands industry in December 2008.¹⁴ Under its revised outlook, CAPP forecasted minimal change from its June 2008 Moderate Growth Case in the 2008-2012 period but that slower growth would occur thereafter, resulting in up to 300 kb/d less supply in the 2013-2017 period. CAPP also expected that deferrals in upgrader projects would reduce the percentage of bitumen upgraded in Alberta. This would increase the fraction of heavy blend and decrease the fraction of synthetic crude oil in the supply mix. This is consistent with Strategy West's view.

The most recent Strategy West and CAPP outlooks are illustrated in Figure 4-5.

¹⁴ Source: Canadian Association of Petroleum Producers; CAPP's Crude Oil Forecast - Interim Update; December 11, 2008

Figure 4-5:
Comparative Supply Outlooks



5. Conclusions

It is concluded that:

- Canada's oil sands deposits are among the world's largest hydrocarbon accumulations.
- The Canadian oil sands industry is well established and making a significant contribution to global oil supply.
- The current economic/financial crisis has caused project deferrals and cancellations.
- Industry growth will resume after global economic recovery; however, the rate will depend upon oil prices and resolution of the economic, environmental and societal challenges facing the industry.

Please contact Strategy West or visit www.strategywest.com for further information.