

# Canada's Oil Sands Industry - Production & Supply Outlook

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**StrategyWest**  
Inc.  
[www.strategywest.com](http://www.strategywest.com)

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

# Table of Contents

Table of Contents.....	i
List of Figures .....	ii
List of Tables .....	ii
<b>1. Introduction .....</b>	<b>1</b>
<b>2. Oil Sands Resources and Reserves .....</b>	<b>3</b>
2.1. <i>Initial Volume In-Place</i> .....	3
2.2. <i>Reserves</i> .....	4
2.3. <i>Ultimate Potential</i> .....	5
<b>3. Historical Bitumen and Synthetic Crude Oil Production .....</b>	<b>6</b>
<b>4. Oil Sands Industry Outlooks .....</b>	<b>8</b>
4.1. <i>Approach used by Strategy West</i> .....	8
4.2. <i>Existing and Proposed Canadian Oil Sands Projects</i> .....	9
4.3. <i>Strategy West Oil Sands Industry Outlook</i> .....	10
4.3.1. Bitumen Production .....	10
4.3.2. Synthetic Crude Oil and Non-upgraded Bitumen Supply .....	11
4.4. <i>Comparative Oil Sands Supply Outlooks</i> .....	12
<b>5. Summary .....</b>	<b>14</b>

## List of Figures

Figure 1-1: Alberta's Oil Sands Areas .....	1
Figure 3-1: Alberta Bitumen Production (1994-2008).....	6
Figure 3-2: Alberta SCO and Non-Upgraded Bitumen Production (1994-2008) .....	7
Figure 4-1: Existing and Proposed Commercial Project Capacities .....	9
Figure 4-2: Strategy West Bitumen Production Outlook .....	11
Figure 4-3: Strategy West Oil Sands Supply Outlook.....	12
Figure 4-4: Comparative Oil Sands Supply Outlooks .....	13

## List of Tables

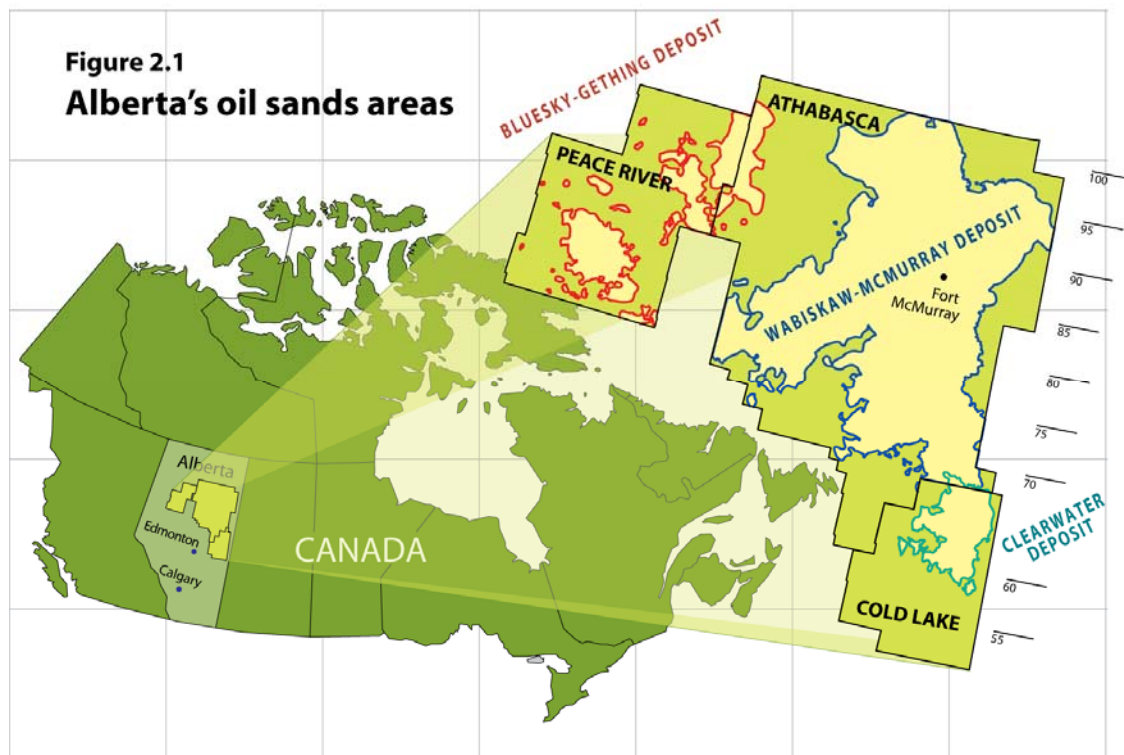
Table 2-1: Initial Crude Bitumen Volume In-Place .....	3
Table 2-2: Initial Established Crude Bitumen Reserves.....	4
Table 2-3: Alberta Crude Bitumen Production to Year-end 2008 .....	4
Table 2-4: Remaining Established Crude Bitumen Reserves.....	4
Table 2-5: Remaining Established Crude Bitumen Reserves under Active Development .....	5

## 1. Introduction

With an estimated initial volume in-place of approximately 1.7 trillion barrels (270 billion m<sup>3</sup>)<sup>1</sup> 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 m<sup>3</sup>), compared to 4.9 billion barrels (780 million m<sup>3</sup>) 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.<sup>2</sup>

The three designated Oil Sands Areas (OSAs) in Alberta are shown in Figure 1-1.

**Figure 1-1:  
Alberta's Oil Sands Areas**



Source: Alberta Energy Resources Conservation Board

<sup>1</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018; ERCB ST98-2009, June 2009

<sup>2</sup> 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 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 km<sup>2</sup> (54,000 square miles).

While most industry activity to date has focussed on Alberta, several companies have leased land in northwest Saskatchewan, 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".<sup>3</sup>

### 2.1. Initial Volume In-Place

At year-end 2008, the Alberta Energy Resources Conservation Board (ERCB) estimated the Initial Volume In-Place of crude bitumen in Alberta's oil sands to be 1,731 billion barrels (275.1 10<sup>9</sup>m<sup>3</sup>).<sup>4</sup>

The ERCB reported that 8% of the volume in-place, 130 billion barrels (20.7 10<sup>9</sup>m<sup>3</sup>), is contained in shallow deposits that are amenable to surface mining and bitumen extraction recovery technologies, generally less than about 215 feet (65 m) to the top of the oil sands zone. All of the shallow oil sands are located in the Athabasca Oil Sands Area.

The remaining 92% of the volume in-place, 1,601 billion barrels (254.4 10<sup>9</sup>m<sup>3</sup>), is contained in deeper deposits. Deep oil sands 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 <sup>3</sup>
Mineable:	130	20.7
In Situ:	1,601	254.4
Total	1,731	275.1

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

<sup>4</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018; ERCB ST98-2009, June 2009

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 <sup>3</sup>
Mineable:	38.8	6.16
In Situ:	138.1	21.94
Total	176.8	28.09

To year-end 2008, approximately 4% of the initial established reserves had been produced. Cumulative production to year-end 2008, as reported by the ERCB, is summarized in Table 2-3.

**Table 2-3:  
Alberta Crude Bitumen Production to Year-end 2008**

	Billion Barrels	Billion m <sup>3</sup>
Mineable:	4.2	0.67
In Situ:	2.2	0.35
Total	6.4	1.02

The ERCB's estimates of Remaining Established Reserves at year-end 2008, after accounting for cumulative production, are reported in Table 2-4.

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

	Billion Barrels	Billion m <sup>3</sup>
Mineable:	34.5	5.49
In Situ:	135.8	21.58
Total	170.3	27.07

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 2008 is reported in Table 2-5.

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

	Billion Barrels	Billion m <sup>3</sup>
Mineable:	23.5	3.74
In Situ:	3.5	0.56
Total	27.1	4.30

The Canadian Association of Petroleum Producers (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 10<sup>6</sup>m<sup>3</sup>) at year-end 2006.<sup>5</sup> CAPP's reserve estimates for year-end 2008 were not available at the time of publication of this report.

### **2.3. Ultimate Potential**

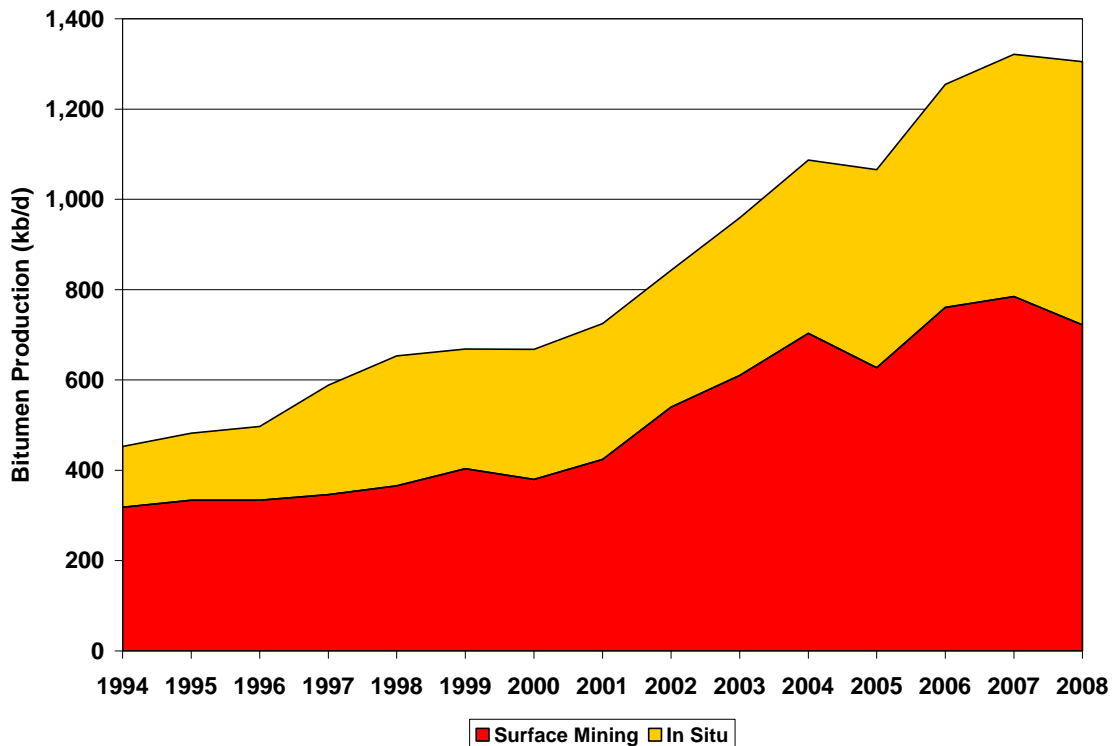
The ERCB estimates the ultimate potential of crude bitumen recoverable by in situ recovery methods from Cretaceous sediments to be 33 10<sup>9</sup>m<sup>3</sup> (~210 billion barrels) and from Paleozoic carbonate sediments to be some 6 10<sup>9</sup>m<sup>3</sup> (~40 billion barrels). Nearly 11 10<sup>9</sup>m<sup>3</sup> (~70 billion barrels) is expected from within the surface-mineable boundary, with a little more than 6 10<sup>9</sup>m<sup>3</sup> (~60 billion barrels) coming from surface mining and about 0.4 10<sup>9</sup>m<sup>3</sup> (~3 billion barrels) from in situ methods. The total ultimate potential crude bitumen is therefore about 50 10<sup>9</sup>m<sup>3</sup> (~315 billion barrels).

<sup>5</sup> 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 1,305 thousand barrels per day (kb/d) of crude bitumen in 2008, 722 kb/d from surface mining and 583 kb/d from in situ projects.

**Figure 3-1:  
Alberta Bitumen Production (1994-2008)<sup>6</sup>**



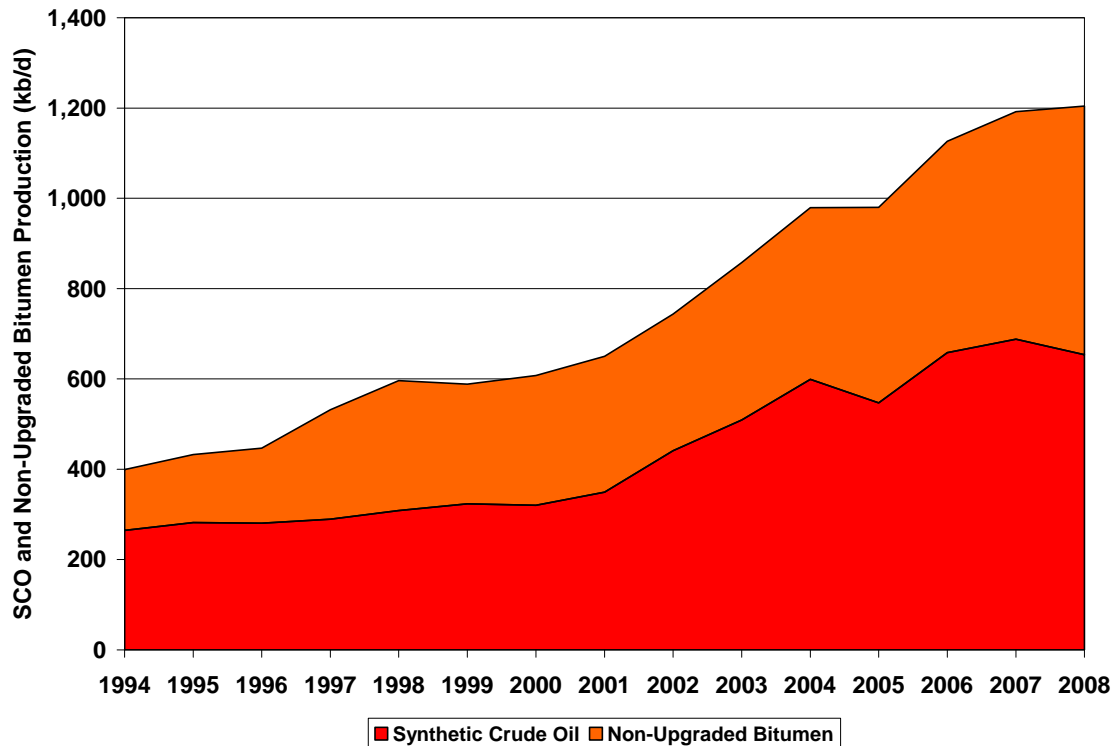
While not shown on this chart, first commercial production from the Canadian oil sands industry began in 1967, more than 40 years ago, with the startup of the Great Canadian Oil Sands (GCOS) mining, extraction and upgrading project north of Fort McMurray, Alberta. GCOS was subsequently acquired by Suncor 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

<sup>6</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018; ERCB ST98-2009, June 2009

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 2008, the fraction of bitumen that was upgraded dropped to 58% due to extended outages at mining projects and their associated upgraders and increased production of bitumen at in situ projects without upgraders. 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 (1994-2008)<sup>7</sup>**



After upgrading, production of synthetic crude oil and non-upgraded crude bitumen totalled 1,204 kb/d in 2008 (654 kb/d of synthetic crude oil and 551 kb/d of non-upgraded crude bitumen).

<sup>7</sup> 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),<sup>8</sup> the Canadian Association of Petroleum Producers (CAPP)<sup>9</sup> and Canada's National Energy Board (NEB).<sup>10</sup> Reference is also made to the long-term vision for the industry released by the Alberta Chamber of Resources in 2004.<sup>11</sup> Copies of these reports may be downloaded at [www.strategywest.com](http://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.)<sup>12</sup>
- Degree of project integration

<sup>8</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018; ERCB ST98-2009, June 2009

<sup>9</sup> Source: Canadian Association of Petroleum Producers; Crude Oil Forecast, Markets & Pipeline Expansions; June 2009

<sup>10</sup> Source: National Energy Board; 2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020; An Energy Market Assessment; July 2009

<sup>11</sup> Source: Alberta Chamber of Resources; Oil Sands Technology Roadmap; January 30, 2004

<sup>12</sup> See Section 4.2 for further information on this topic

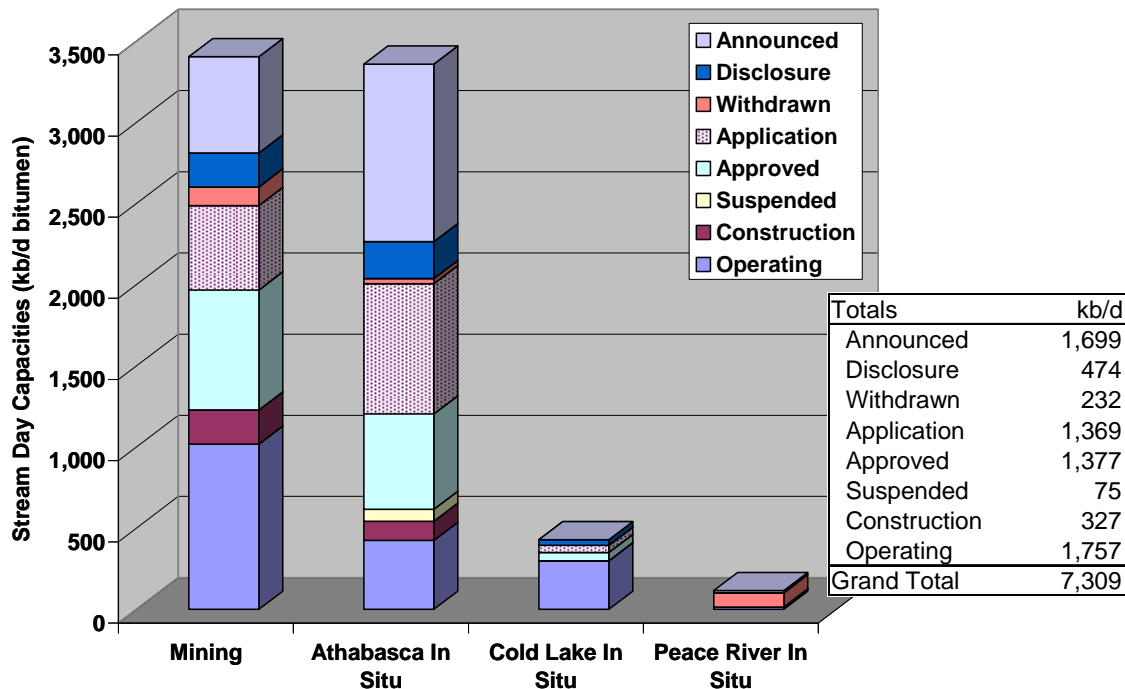
- Project owners (operating experience, financial capacity, technical capabilities, etc.)
- Technology employed (i.e., commercially proven, pilot, bench scale)
- Whether there are existing operations
- Project timing

Strategy West forecasts 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. Additionally, Strategy West applies assumptions concerning capacity factors for in situ, mining and upgrading projects and ramp-up rates for new facilities.<sup>13</sup>

**4.2. 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 4-1.

**Figure 4-1:  
Existing and Proposed Commercial Project Capacities<sup>14</sup>**



<sup>13</sup> Some projects are not achieving design capacities for three years or more.

<sup>14</sup> Source: Strategy West Inc.; Existing and Proposed Canadian Commercial Oil Sands Projects; August, 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 and reached 187 kb/d in 2008.

The project classifications used in Figure 4-1 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 1.8 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 about 0.3 mb/d of crude bitumen production capacity were under construction at the time of writing (“Construction” projects). These projects will bring oil sands industry stream-day<sup>15</sup> bitumen production capacity to over 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.

### **4.3. Strategy West Oil Sands Industry Outlook**

#### **4.3.1. Bitumen Production**

Strategy West developed its outlook for bitumen production using the methods described in Section 4.1. Strategy West’s outlook assumes that:

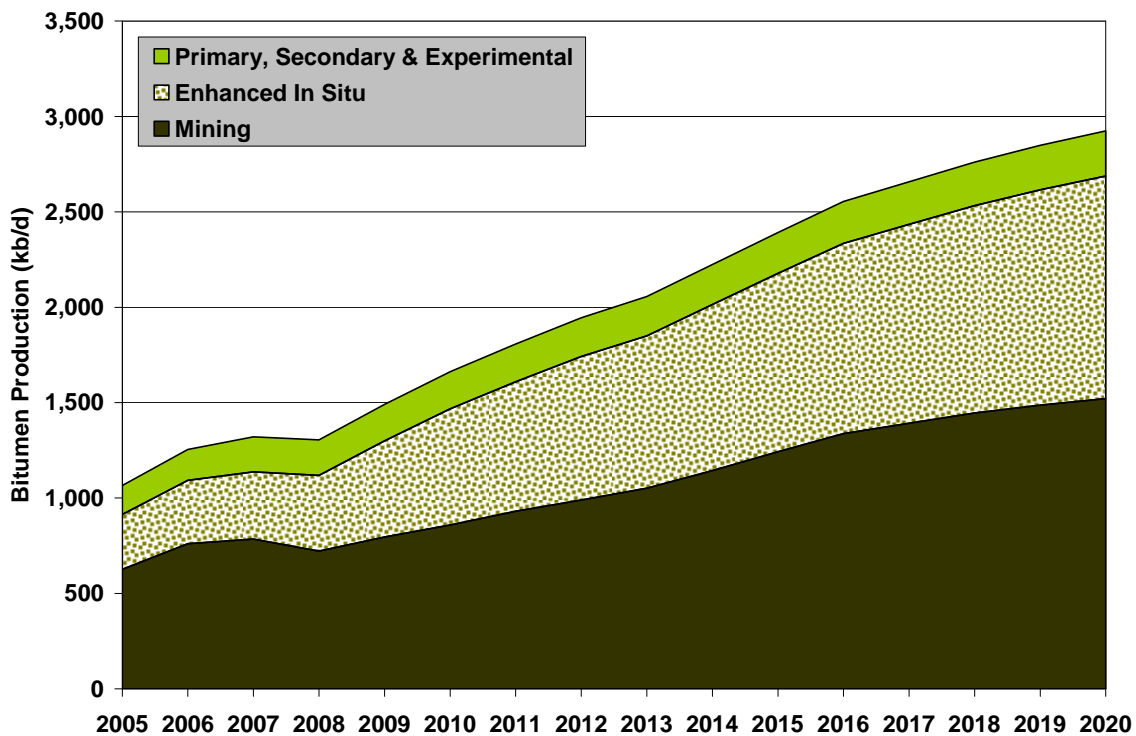
- Global economic recovery is underway and will be confirmed by year-end 2009
- Oil prices will be sufficient to justify new oil sands industry investments
- Oil sands growth will be led by established operators and majors

<sup>15</sup> “Stream day” capacities are design capacities at full production. “Calendar day” capacities (the production quantities actually achieved) are less due to planned shut downs, operational upsets, etc.

- There will be little incentive to develop new upgrading capacity in Canada

Under the Strategy West August outlook, bitumen production would increase from 1,305 kb/d in 2008 to 2,934 kb/d in 2020 with an approximately equal split between production from mining projects and in situ projects (including primary and secondary production). This is illustrated in Figure 4-2.

**Figure 4-2:  
Strategy West Bitumen Production Outlook**



Bitumen production from mining projects fell substantially in 2008 due to reliability issues at existing facilities. Production is expected to recover in 2009 partly due to the startup of new projects brought on stream in late 2008 and during 2009.

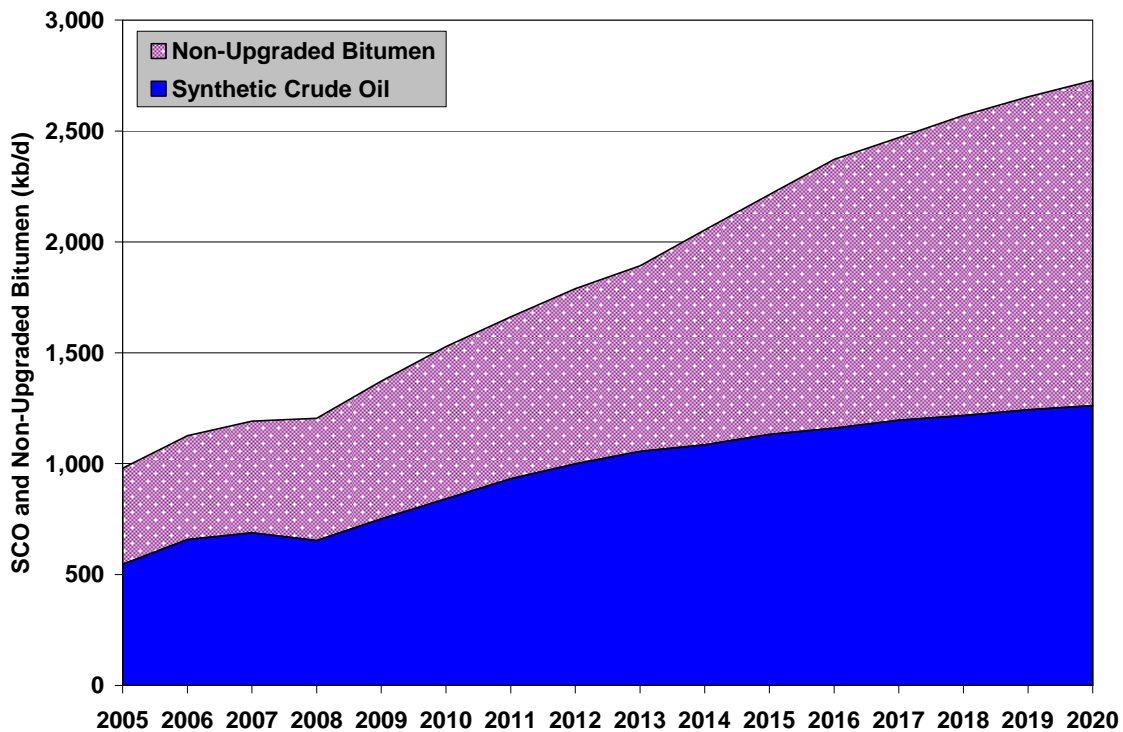
#### 4.3.2. Synthetic Crude Oil and Non-upgraded Bitumen Supply

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 year-end 2008, almost all Alberta

SCO was produced at upgraders that are integrated with oil sands mining projects (Suncor, Syncrude and the Athabasca Oil Sands Project).

Under the Strategy West outlook, synthetic crude oil and non-upgraded bitumen supply would increase from 1,204 kb/d in 2008 to 2,728 kb/d in 2020. In 2020, about 50% of bitumen production would be upgraded to synthetic crude oil, a drop from 58% in 2008. This is illustrated in Figure 4-3.

**Figure 4-3:  
Strategy West Oil Sands Supply Outlook**



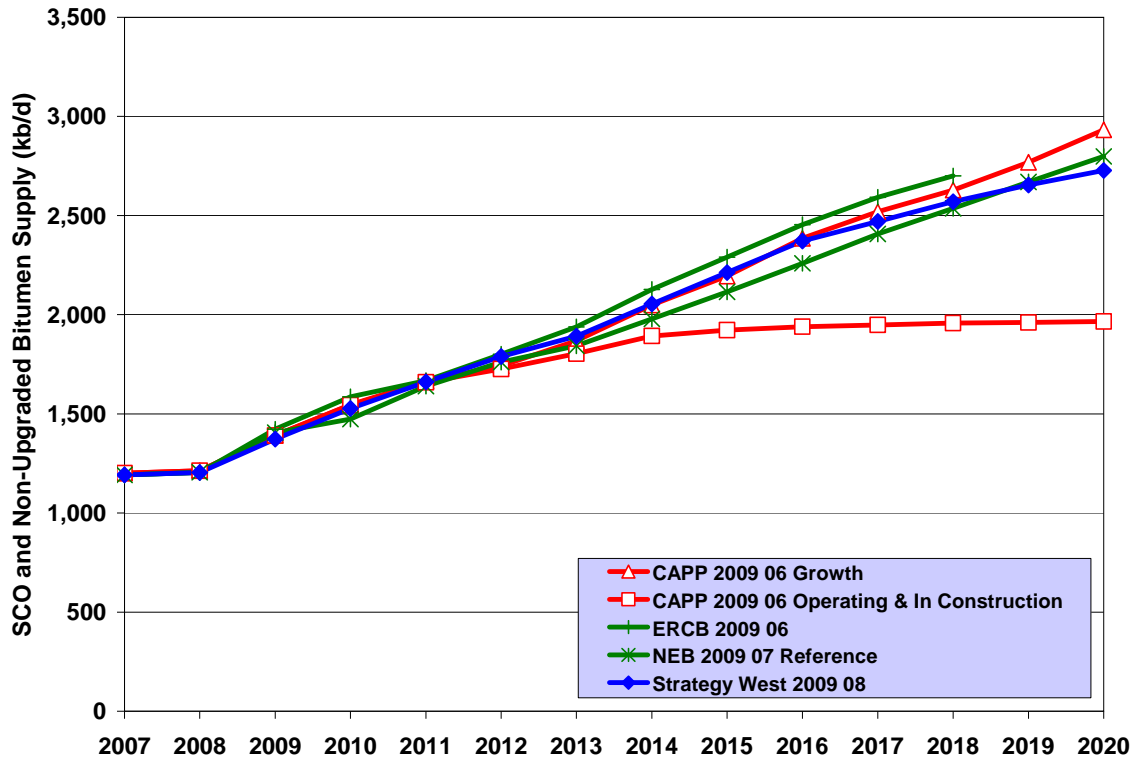
Note that, in aggregate, some volumetric loss occurs during upgrading. The amount depends on the upgrading processes employed at a particular project; some upgrading processes result in volumetric gain due to extensive hydroconversion.

#### **4.4. Comparative Oil Sands Supply Outlooks**

The Strategy West oil sands supply (synthetic crude oil and non-upgraded bitumen) outlook is compared to the most recent oil sands supply outlooks by the Canadian Association of Petroleum

Producers (CAPP),<sup>16</sup> the Alberta Energy Resources Conservation Board (ERCB),<sup>17</sup> and Canada's National Energy Board (NEB)<sup>18</sup> in Figure 4-4.

**Figure 4-4:  
Comparative Oil Sands Supply Outlooks**



CAPP's 2009 06 "Operating and In Construction Case" assumes that:

- Existing projects will remain operating
- Projects under construction will be completed
- No additional projects will be built

The CAPP, ERCB and NEB outlooks are available for download at [www.strategywest.com](http://www.strategywest.com)

<sup>16</sup> Source: Canadian Association of Petroleum Producers; Crude Oil Forecast, Markets & Pipeline Expansions; June 2009

<sup>17</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2008 and Supply/Demand Outlook 2009-2018; ERCB ST98-2009, June 2009

<sup>18</sup> Source: National Energy Board; 2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020; An Energy Market Assessment; July 2009

## 5. Summary

In summary:

- 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](http://www.strategywest.com) for further information.