

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

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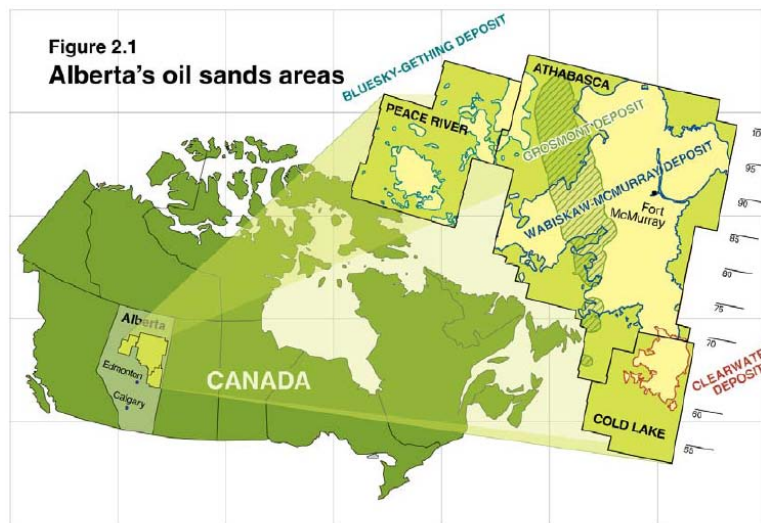
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## 1. Introduction

With an estimated initial volume in-place of approximately 1.8 trillion barrels<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 compared to 4.9 billion barrels 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 as of the end of 2009 are shown in Figure 1-1.

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



Source: Alberta Energy Resources Conservation Board

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.

<sup>1</sup> Source: Alberta Energy Resources Conservation Board; Alberta's Energy Reserves 2009 and Supply/Demand Outlook 2010-2019; ERCB ST98-2008, June 2010

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

The known extent of the largest OSD, the Athabasca Wabiskaw-McMurray, as well as the 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. The areal extent of the Grosmont carbonate deposit is shown on Figure 1-1. 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 142,000 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. The remainder of 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 2009, the Alberta Energy Resources Conservation Board (ERCB) estimated the Initial Volume In-Place of crude bitumen in Alberta's oil sands to be 1,804 billion barrels.<sup>4</sup>

The ERCB reported that 7% of the volume in-place, 131 billion barrels, is contained in shallow deposits – that are generally less than 65 m (215 feet) 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 bitumen extraction technologies are used to recover crude bitumen from these shallow deposits.

The remaining 93% of the volume in-place, 1,673 billion barrels, is contained in deeper deposits that 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**

	10 <sup>9</sup> barrels	Percent
Mineable	131	7.3%
In Situ	1,673	92.7%
Total	1,804	100.0%

<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 2009 and Supply/Demand Outlook 2010-2019; ERCB ST98-2008, June 2010

These figures represent the ERCB's best estimates of initial 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 at year-end 2009 are given in Table 2-2.

**Table 2-2:  
Initial Established Crude Bitumen Reserves at Year-end 2009**

	10 <sup>9</sup> barrels	Percent
Mineable	38.8	21.9%
In Situ	138.1	78.1%
Total	176.8	100.0%

To year-end 2009, approximately 4% of the initial established reserves had been produced. Cumulative production to year-end 2009, as reported by the ERCB, is summarized in Table 2-3.

**Table 2-3:  
Alberta Crude Bitumen Production to Year-end 2009**

	10 <sup>9</sup> barrels	Percent
Mineable	4.5	65.5%
In Situ	2.4	34.5%
Total	6.9	100.0%

The ERCB's estimates of Remaining Established Reserves at year-end 2009, after accounting for cumulative production, are reported in Table 2-4.

**Table 2-4:  
Remaining Established Crude Bitumen Reserves at Year-end 2009**

	10 <sup>9</sup> barrels	Percent
Mineable	34.2	20.2%
In Situ	135.6	79.8%
Total	169.8	100.0%

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 2009 is reported in Table 2-5.

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

	10 <sup>9</sup> barrels	Percent
Mineable	23.2	87.4%
In Situ	3.3	12.6%
Total	26.6	100.0%

### **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).

### 3. Historical Bitumen and Synthetic Crude Oil Production

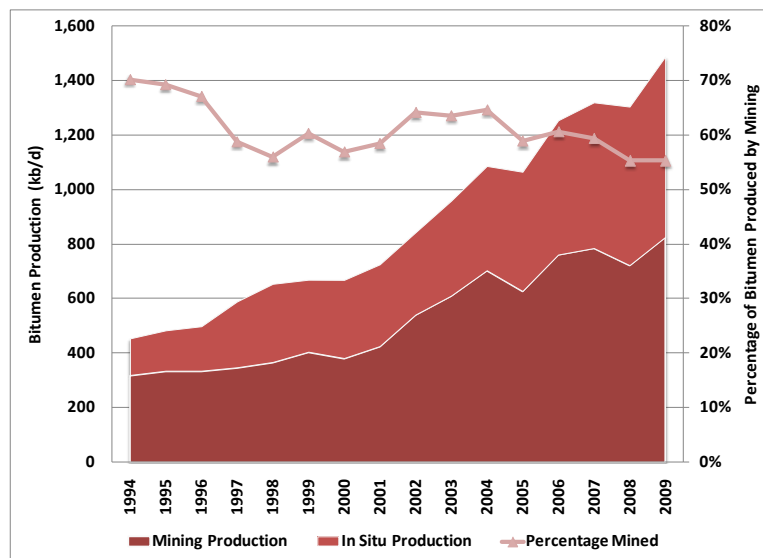
Commercial operations in Canada's oil sands industry commenced with the startup of the Great Canadian Oil Sands<sup>5</sup> (GCOS) mining, extraction and upgrading project in 1967. This was followed by startup of the Syncrude mining, extraction and upgrading project in 1978. The first commercial in situ project was Imperial Oil's Cold Lake project, which commenced commercial operations in 1985.

Substantial growth has occurred since these early projects commenced operations resulting in production of 1,490 thousand barrels per day (kb/d) of crude bitumen in 2009, 826 kb/d from surface mining and 664 kb/d from in situ projects. The oil sands industry represented approximately 50% of Canada's total oil production in 2009.

By year-end 2009, the oil sands industry had produced 6.9 billion barrels of crude bitumen: approximately 65% (4.5 billion barrels) using surface mining/extraction technologies and the remaining 35% (2.4 billion barrels) using in situ recovery technologies.

Historical bitumen production over the last 15 years is illustrated in Figure 3-1.

**Figure 3-1:  
Historical Bitumen Production**

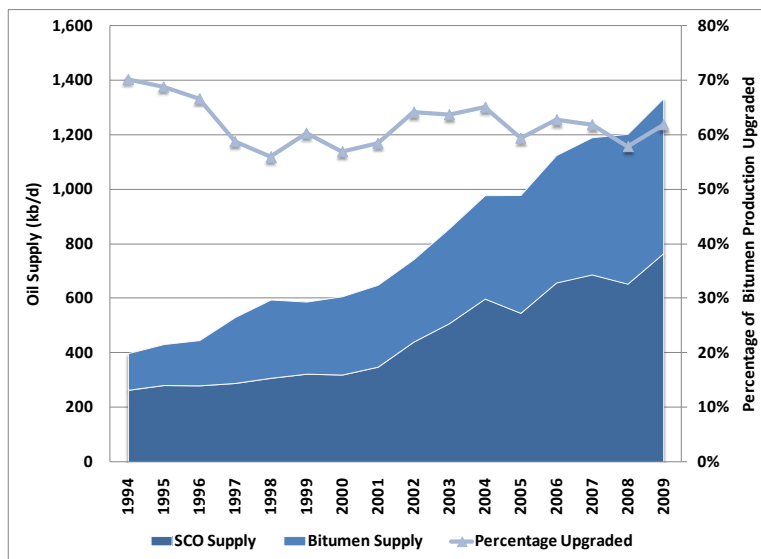


<sup>5</sup> Predecessor to Suncor Energy's mining, extraction and upgrading operations.

As new commercial in situ capacity has come on stream, the percentage of bitumen produced by mining projects has declined from 70% to 55% of total annual bitumen production over this period.

A large portion of Alberta's bitumen production is upgraded to synthetic crude oil and other products. After upgrading, supply of synthetic crude oil (including other products) and non-upgraded crude bitumen totalled 1,335 kb/d in 2009 (766 kb/d of synthetic crude oil and 570 kb/d of non-upgraded crude bitumen) as illustrated in Figure 3-2.

**Figure 3-2:  
Historical Oil Sands Supply**



Note that some volumetric loss occurs due to upgrading – i.e., total bitumen production of 1,490 kb/d resulted in the oil sands industry supplying 1,335 kb/d of synthetic crude oil and non-upgraded crude bitumen to downstream markets. Bitumen produced at all existing mining operations is upgraded, while most in situ bitumen production is not.

## 4. Oil Sands Industry Outlooks

Strategy West 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 organizations regularly prepare and publicly release their outlooks for production/supply from the Canadian oil sands. Some recent outlooks include those released by:

- The Canadian Association of Petroleum Producers (CAPP)<sup>6</sup>
- The ERCB<sup>7</sup>
- Canada's National Energy Board (NEB)<sup>8</sup>

The most recent CAPP and ERCB outlooks were released in June 2010. The NEB outlook has not been updated since it was last issued in July 2009. Reference is also made to the long-term vision for the industry released by the Alberta Chamber of Resources in 2004.<sup>9</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:

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<sup>6</sup> Source: Canadian Association of Petroleum Producers; Crude Oil Forecast, Markets & Pipelines; June 2010

<sup>7</sup> Source: Alberta ERCB; Alberta's Energy Reserves 2009 and Supply/Demand Outlook 2010-2019; ERCB ST98-2010, June 2010

<sup>8</sup> Source: National Energy Board; 2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020; An Energy Market Assessment; July 2009

<sup>9</sup> Source: Alberta Chamber of Resources; Oil Sands Technology Roadmap; January 30, 2004

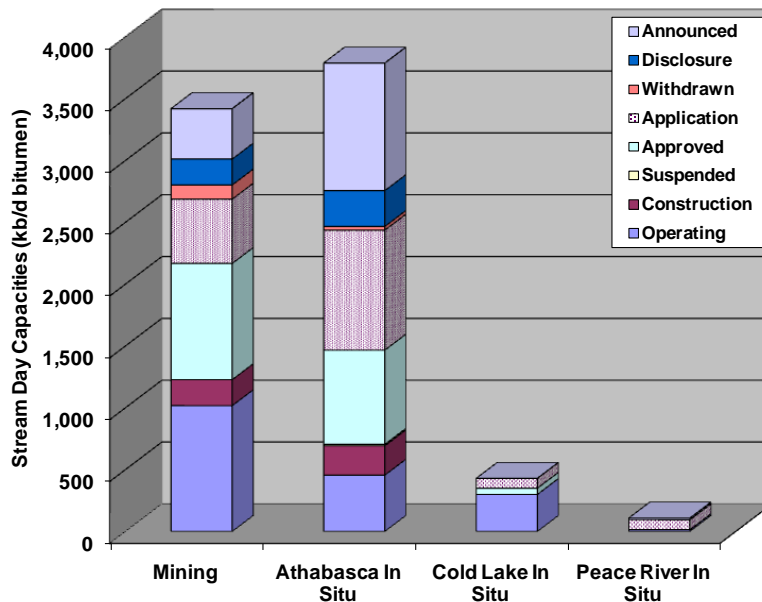
- Project status (operating, under construction, approved, etc.)<sup>10</sup>
- Degree of project integration
- Project owners (operating experience, financial capacity, technical capabilities, etc.)
- Technology employed (i.e., commercially proven, pilot, bench scale)
- Whether there are existing operations
- 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>11</sup>

#### 4.2. Existing and Proposed Canadian Oil Sands Projects

At the time of writing, the industry had proposed projects representing almost 8 mb/d of bitumen production capacity as illustrated in Figure 4-1.

**Figure 4-1:  
Existing and Proposed Commercial Project Capacities<sup>12</sup>**



<sup>10</sup> See Section 4.2 for further information on this topic

<sup>11</sup> Some projects are not achieving design capacities for three years or more.

<sup>12</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

Table 4-1 summarizes the aggregated project data used to prepare Figure 4-1.

**Table 4-1:  
Existing and Proposed Canadian Oil Sands Project Capacities**

	Capacities (b/d bitumen)					Total
	Mining	In Situ				
		N Athabasca	S Athabasca	Cold Lake	Peace River	
Operating	1,018,000	128,000	327,800	300,000	13,500	1,787,300
Construction	210,000	68,000	169,200	-	-	447,200
Suspended	-	12,000	-	-	-	12,000
Approved	940,000	456,200	305,600	50,000	1,550	1,753,350
Application	520,000	219,000	751,155	79,200	80,015	1,649,370
Withdrawn	114,500	30,000	-	-	-	144,500
Disclosure	210,000	80,000	210,000	-	-	500,000
Announced	407,000	515,000	516,000	-	13,000	1,451,000
Total	3,419,500	1,508,200	2,279,755	429,200	108,065	7,744,720

Note that total oil sands crude bitumen production capacity ("Operating" projects) has reached almost 1.8 mb/d. This includes the capacity of several new projects that were recently brought on stream and have not yet reached full capacity. Additionally, projects representing more than 0.4 mb/d of crude bitumen production capacity are under construction ("Construction" projects).

These projects will bring oil sands industry stream-day<sup>13</sup> bitumen production capacity to over 2.2 mb/d by early this decade.

Note also that the capacities shown are for bitumen production and do not reflect the upgrading segment of the industry. Some volumetric loss may occur during upgrading, depending on the processes employed. The bitumen feedstock and product capacities of existing and proposed upgraders is provided in Table 4-2.

**Table 4-2:  
Existing and Proposed Upgrader Capacities**

	Capacities (b/d)	
	Bitumen	Products
Operating	1,209,000	1,037,500
Construction	90,000	91,000
Suspended	296,530	243,260
Approved	822,060	712,220
Application	705,000	670,400
Withdrawn	363,200	318,200
Disclosure	-	-
Announced	753,000	641,200
<b>Total</b>	<b>4,238,790</b>	<b>3,713,780</b>

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

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

Strategy West developed its outlook for the oil sands industry using the approach described in Section 4.1.1. This outlook assumes that:

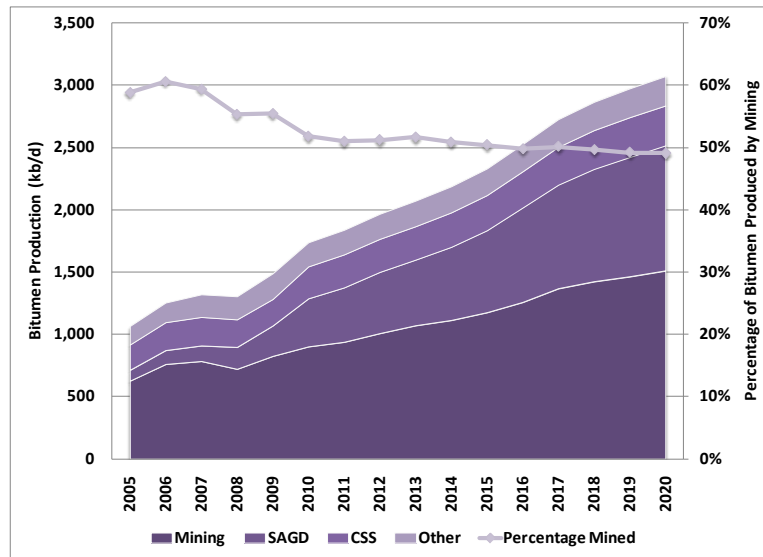
- Global economic recovery is underway
- Oil prices will be sufficient to justify new oil sands industry investments in both the mining and the in situ segments of the industry
- Heavy/light oil price differentials will not be sufficient to justify investments in new upgrading capacity
- Oil sands growth will be led by established operators and majors

Under the Strategy West outlook, bitumen production would increase from 1,490 kb/d in 2009 to 3,077 kb/d in 2020. Over the projection period, there would be a slow decline in the fraction of bitumen produced by mining to about 50% by 2020.

<sup>13</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.

Strategy West's overall oil sands industry bitumen production outlook is illustrated in Figure 4-2.

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



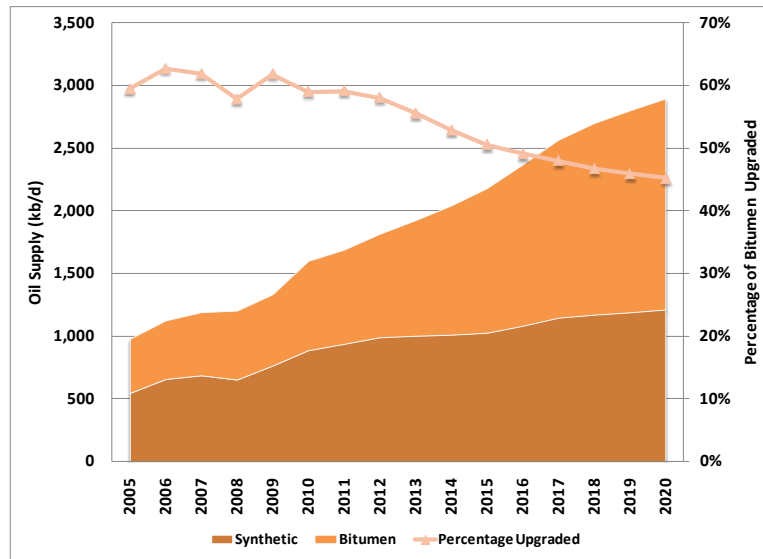
Bitumen production from mining projects fell substantially in 2008 due to reliability issues at existing facilities. Bitumen production from mining projects recovered in 2009.

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

Over the last several years about 60% 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 2009, almost all Alberta SCO was produced at upgraders that are integrated with oil sands mining projects (Suncor, Syncrude, the Athabasca Oil Sands Project and CNRL Horizon). Recently, some in situ bitumen has been upgraded as well, i.e., bitumen produced by Suncor at Firebag and MacKay River and bitumen produced by Nexen at Long Lake. However, upgrading economics today are not attractive due to narrow heavy/light crude oil price differentials. Beyond the completion of the Scotford Upgrader 1 expansion, currently under construction, no new upgrading capacity is expected to be built over the 2010-2020 period.

Under the Strategy West outlook, synthetic crude oil and non-upgraded bitumen supply would increase from 1,335 kb/d in 2009 to 2,897 kb/d in 2020. In 2020, 45% of bitumen production would be upgraded to synthetic crude oil, a drop from 62% in 2009. This is illustrated in Figure 4-3.

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



As stated earlier, some volumetric loss may occur 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. However, in aggregate, there is a volumetric loss.

#### 4.4. Comparative Oil Sands Supply Outlooks

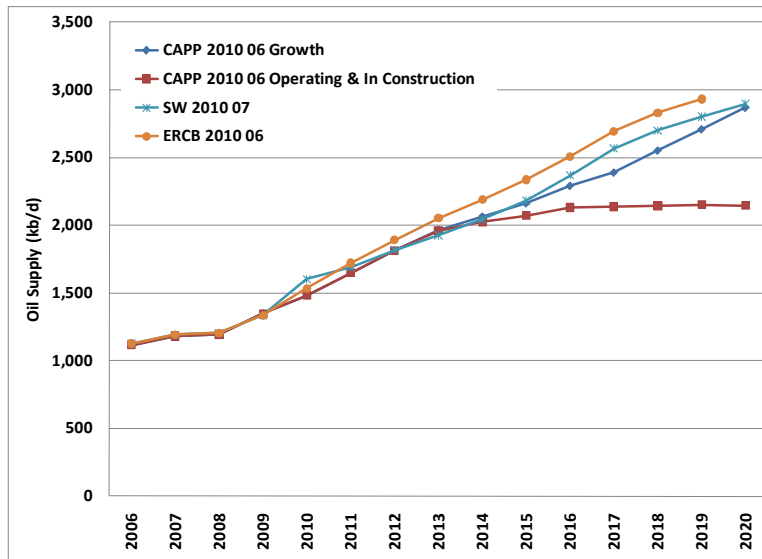
The Strategy West oil sands supply (synthetic crude oil and non-upgraded bitumen) outlook is compared to the most recent oil sands supply outlooks by CAPP<sup>14</sup>, the ERCB<sup>15</sup> and the NEB<sup>16</sup> in Figure 4-4.

<sup>14</sup> Source: Canadian Association of Petroleum Producers; Crude Oil Forecast, Markets & Pipelines; June 2010

<sup>15</sup> Source: Alberta ERCB; Alberta's Energy Reserves 2009 and Supply/Demand Outlook 2010-2019; ERCB ST98-2010, June 2010

<sup>16</sup> Source: National Energy Board; 2009 Reference Case Scenario: Canadian Energy Demand and Supply to 2020; An Energy Market Assessment; July 2009

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



CAPP's 2010 06 "Operating and In Construction Case" assumes that existing projects will remain operating, projects under construction will be completed, and no additional projects will be built.

## 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 2008/2009 financial and economic crisis caused project deferrals and cancellations.
- Industry growth is resuming slowly; however, the rate will depend upon oil prices and how the many challenges facing the industry are addressed.

Please contact Strategy West or visit [www.strategywest.com](http://www.strategywest.com) for further information.