An Introduction to Development in Alberta’s Oil Sands

Presented By
Rob Engelhardt
Marius Todirescu
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Agenda

- Introduction
- What are Oil Sands?
- Alberta’s Deposits
- Exploitation Methods and Upgrading
- Emerging Technologies
- Economic Perspective
- Future Challenges
- Conclusions
Introduction

- Alberta’s Oil Sands are one of the world’s largest hydrocarbon reserves
  - 1.6 Trillion barrels in total
  - 178 Billion barrels economically recoverable at this time
- To this date, over C$20 Billion has been invested in various projects – with over C$60 Billion in new investments coming over the next 5 – 10 years
Introduction

![Graph showing World Oil Reserves - Top 20 countries with their respective oil reserves. The graph highlights the bitumen reserves of Canada, a significant reserve in comparison to other countries. The graph data is sourced from the Oil and Gas Journal.](image-url)
What are Oil Sands?

- Oil Sand is a mixture of bitumen, quartz, clay, water and traces of other minerals.

Composition of Alberta Oil Sand:
- Bitumen
- Water
- Inorganic Material
Alberta’s Oil Sands Deposits

• Oil sands located in 54,400 sq. mi. area in NE part of province
• There are three major deposits

Source: Syncrude Canada
Alberta’s Oil Sands Deposits

- Low overburden regions = CHOPS or Mining
- Increased overburden = SAGD, CSS, etc.
Oil Sands Exploitation Methods

• Mining Based Bitumen Extraction
  (for close to surface deposits, >90% recovery rate.)

• In Situ Methods
  - Steam Assisted Gravity Drainage (SAGD)
    (for deep deposits, 40-70 % recovery rate.)
  - Cyclic Steam Stimulation (CSS)
    (for deep deposits, 20-25 % recovery rate.)
Mining and Extraction Technologies

Old: DL/BWR

New: Shovel/Truck

Shovel/Truck

Source: Syncrude Canada Ltd.
Process Scheme

1. Truck & Shovel Mining
2. Crushing & Conveying
3. Slurrying
4. Rejects Processing
5. Slurry Pumping
6. Bitumen Separation

Source: Syncrude Canada Ltd.
CSS – Cyclic Steam Stimulation

Stage 1
Steam Injection

Stage 2
Soak Phase

Stage 3
Production

- Glacial TILL
- Colorado Stairs
- Grand Rapids
- Clearwater
- McMurray
- Devonian

Steam injected into the reservoir
steam and condensed water heat the viscous oil
heated oil and water are pumped to the surface

Source: EnCana
SAGD Process

Injector

Producer

Source: Japan Canada Oil Sands Ltd.
Upgrading Process

Source: Alberta Chamber of Resources
Oil Sands: Products and By-products

Source: Syncrude Canada Ltd.

- 1900 kg Tailings Sand
- 2100 kg Oil Sand
- 200 kg Bitumen
- 19 kg Coke
- 6.9 kg Sulfur
- 175 kg SSB
- 22.8 m³ Fuel Gas
Specific Issues

- Land disturbance
  - Mining
- Water Conservation
  - Tailings Processing
- Gas Dependency
  - $H_2$ for upgrading, in situ methods – steam generation
- Air Emissions
  - $CO_2$, $SO_2$, $NO_x$, $H_2S$, (CO), methane and other volatile organic compounds (VOCs), ozone and particulates
Emerging Technologies

• Nexen-OPTI Project
  • Improvement on existing SAGD technology
  • Involves SAGD with an integrated onsite upgrader
  • Fuels produced on-site - eliminates the dependency
  • Use synthetic gas produced from heavy bottoms, or asphaltenes contained in the bitumen
Emerging Technologies

• VAPEX (Vapour Extraction Process)
  – Technically similar to SAGD but instead of steam solvent is being injected into the oil sands resulting in significant viscosity reduction, lower injection pressure and temperature
  – Improved energy efficiency
  – No emulsion
  – Partial upgrading within the reservoir resulting from the precipitation of asphaltenes from the bitumen.
Toe-to-Heel Air Injection - THAI

Source: University of Bath
Emerging Technologies

• Most technology designed with the objective of reducing the amount of Natural Gas used in exploitation
Economic Considerations

- Markets
- Capital and Production Costs
- Government Policy
Markets

• Two Challenges:
  • Most refineries cannot accept bitumen/blends as inputs
  • Projected growth may outpace market growth
Markets

- Oil sands producers strategies to access markets:
  - Buying refineries
  - Entering into long term contracts so that refineries can justify spending money on additional facilities
  - Producing tailored products that can be used by specific refineries
  - Upgrading to SCO
Markets

• Typically, increases in Canadian crude production have easily been absorbed by the U.S. market
• Oil sands growth will be much larger than previous experience
• U.S. energy demand is growing and conventional reserves are in decline
• Other potential markets - Asia
Markets

Petroleum Administration for Defense Districts

PADD 5: West Coast, AK, HI
PADD 4: Rockies
PADD 3: Gulf Coast
PADD 2: Midwest
PADD 1: East Coast

http://www.eia.doe.gov/
## Capital & Production Costs

<table>
<thead>
<tr>
<th>Recovery Type</th>
<th>Crude</th>
<th>C$</th>
<th>C$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Production</td>
<td>Bitumen</td>
<td>4 to 7</td>
<td>10 to 14</td>
</tr>
<tr>
<td>CHOPS</td>
<td>Bitumen</td>
<td>6 to 9</td>
<td>12 to 16</td>
</tr>
<tr>
<td>CSS</td>
<td>Bitumen</td>
<td>8 to 14</td>
<td>13 to 19</td>
</tr>
<tr>
<td>SAGD</td>
<td>Bitumen</td>
<td>8 to 14</td>
<td>11 to 17</td>
</tr>
<tr>
<td>Mining/Extraction</td>
<td>Bitumen</td>
<td>6 to 10</td>
<td>12 to 16</td>
</tr>
<tr>
<td>Integrated Mining/Upgrading</td>
<td>SCO</td>
<td>12 to 18</td>
<td>22 to 28</td>
</tr>
</tbody>
</table>

Source: National Energy Board
Government Policy

- Alberta government owns 97% of the bitumen in the province
- Royalty System
- Until 1996, Royalties negotiated on a project by project basis
- Oil Sands Royalty Regulation
  - 1% of Gross Revenue before project payout
  - 1% of Gross Revenue + 25% Net Revenue after project payout
Future Challenges

• Capital Cost Overruns and Labour Constraints
• Natural Gas Supply
Capital Cost Overruns & Labour Constraints

• Largest problem facing oil sands projects is capital cost overruns
• Usually related to availability of qualified trades people
• In terms of total supply cost, a 25% capital cost overrun means a loss of $3.70 per barrel of SCO
Capital Cost Overruns & Labour Constraints

Supply Cost Sensitivities: 200 mb/d Athabasca Mining/Extraction and Upgrading Project

- Capital Costs (+/- 25%)
- Production (+/- 10%)
- Non-Fuel Operating Costs (+/- 15%)
- Natural Gas Price (+/- 15%)

Source: National Energy Board
Natural Gas Supply

- Both mining and in situ recovery methods use a great deal of natural gas

Source: National Energy Board
Natural Gas Supply

- It is anticipated that by 2010 oil sands production will use 1.2 Bcf per day
- Alberta’s total NG reserves are expected to be 14.5 – 16 Bcf/d
- Solutions:
  - McKenzie Delta/Beaufort Sea NG
  - Emerging Technologies
Conclusions

• Keys to continued growth of oil sands
  – WTI price of $24USD
  – Continuous cost improvements
  – Increase number of qualified trades
  – Further development of emerging in situ technologies