Oil Sands 101

or

Issues in Alberta's oil sands: key concerns about environment, technology and access to market

September 16, 2013

Energy Club Presentation

Richard Dixon
Questions you asked in 2012

- Do oil sands have a major impact in the environment than other sources of oil?
- Why is Gateway and Keystone so important?
- What is the price of oil that is needed to make oil sands projects profitable? What are the chances that the price of oil could be so low that oil companies could start closing in Alberta?
- How much of the money obtained from Alberta's oil goes to other provinces through federal taxes?
- If I want to drill a well in Canada, who should I talk with? How much should I pay for use the land? How long can I have the land?
- Is there such thing as a Dutch disease in Alberta and Canada?
Questions you asked in 2013

1. Are we capable of bringing the land where oil was extracted back to 100%?
2. How many years does it take to bring the land back to 100% and how much does it cost in terms of $/barrel oil?
3. Does the extraction of oil lowers the elevation of the land (or does the land sinks where the oil was extracted?)
Framing the Picture of our Energy

### Crude oil production, 2012

- **Russia**: 12.1%
- **Saudi Arabia**: 10.7%
- **United States**: 10.3%
- **China**: 4.7%
- **Canada**: 4.2%
- **Iran**: 3.4%
- **Iraq**: 3.3%
- **Mexico**: 3.3%
- **United Arab Emirates**: 3.0%
- **Venezuela**: 2.8%
- **Rest of the world**: 42.0%

### Natural gas production, 2011

- **Russia**: 20.0%
- **United States**: 19.2%
- **Canada**: 4.7%
- **Qatar**: 4.5%
- **Iran**: 4.4%
- **Norway**: 3.1%
- **China**: 3.0%
- **Saudi Arabia**: 2.7%
- **Indonesia**: 2.7%
- **Netherlands**: 2.4%
- **Rest of the world**: 33.3%
Energy Production by Province

Energy production by, province and territory, 2011
(terajoules)

- Crude oil
- Natural gas
- Hydro
- Nuclear
- Coal

Atlantic, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, Territories

Natural Resources, Energy and Environment
Access to Markets

US becoming more self-sufficient

- **U.S. dry gas trillion cubic feet**
- **History**
- **2011**
- **Projections**

- **Consumption**: Green line
- **Domestic supply**: Black line
- **Net imports**: Red line

- **Range**: 1990 to 2040
Access to Markets by Pipes & Rail Terminals

Pipeline shipments

Figure 1: Rail Terminal Oil Capacity Additions 2012 to 2015

<table>
<thead>
<tr>
<th>Location</th>
<th>Capacity (B/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardisty, AB</td>
<td>120,000</td>
</tr>
<tr>
<td>Unity, SK</td>
<td>90,000</td>
</tr>
<tr>
<td>Edmonton, AB (Bruderheim)</td>
<td>70,000</td>
</tr>
<tr>
<td>Northgate, SK</td>
<td>70,000</td>
</tr>
<tr>
<td>Lashburn, SK</td>
<td>60,000</td>
</tr>
<tr>
<td>Cromer, MB</td>
<td>60,000</td>
</tr>
<tr>
<td>Southall, SK</td>
<td>52,000</td>
</tr>
<tr>
<td>Edmonton, AB</td>
<td>40,000</td>
</tr>
<tr>
<td>South Cheecham, AB</td>
<td>32,000</td>
</tr>
<tr>
<td>Lynton, Fort McMurray</td>
<td>25,000</td>
</tr>
<tr>
<td>Lloydminster, SK</td>
<td>23,000</td>
</tr>
<tr>
<td>Instow, SK</td>
<td>18,000</td>
</tr>
<tr>
<td>Unity, SK</td>
<td>15,000</td>
</tr>
<tr>
<td>Tilley, AB</td>
<td>9,000</td>
</tr>
<tr>
<td>Whitecourt, AB</td>
<td>9,000</td>
</tr>
<tr>
<td>Wainwright, AB</td>
<td>6,000</td>
</tr>
<tr>
<td>Sexsmith, AB</td>
<td>6,000</td>
</tr>
<tr>
<td>Lloydminster, SK</td>
<td>3,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>708,000</strong></td>
</tr>
</tbody>
</table>

Sources: Company Reports, ARC Financial Research
Increase in rail transport - Canada
(annual number of cars)

- Aviation fuels
- Fuel oils and crude petroleum
- Hydrocarbons, including LPG
- Coal coke & petroleum coke
- Other refined petroleum & coal products
But to compare

**Pipeline shipments**

- **Total net deliveries of crude oil and pentanes plus**
- **Total net deliveries of liquefied petroleum gases and refined petroleum products**

<table>
<thead>
<tr>
<th>Year</th>
<th>Thousand tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>220,000</td>
</tr>
<tr>
<td>2010</td>
<td>250,000</td>
</tr>
<tr>
<td>2011</td>
<td>300,000</td>
</tr>
</tbody>
</table>

- **Fuel oils and crude oil**

<table>
<thead>
<tr>
<th>Year</th>
<th>Thousand tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>10,000</td>
</tr>
<tr>
<td>2010</td>
<td>10,000</td>
</tr>
<tr>
<td>2011</td>
<td>10,000</td>
</tr>
<tr>
<td>2012</td>
<td>10,000</td>
</tr>
</tbody>
</table>
Are we capable of bringing the land where oil was extracted back to 100%?

• Short Answer: depending on where the oil and what is meant by 100% - the answer is yes

• Some things to think about:
  – Oil Sands (unconventional) and Conventional,
  – Definition of land reclamation
  – Science of reclamation – better on farm lands not as well on bogs and wetlands but getting there
  – But who pays? oil sands reclamation is a royalty deduction
Oil Sands 101 – Where & What

Alberta's Oil Sands Projects
- Oil Sands
- Producing Project
- Oil Sands Area
- Surface Mineable Area
- Existing Pipelines
- Pipelines Under Construction
- Upgraders

Map of Alberta's Oil Sands Projects showing locations of producing projects and pipelines.
Continuous or Progressive Reclamation?
Or Terra Forming?
Golden Cross Mine – Prior to ...
Golden Cross Mine – During ...
Golden Cross Mine – Today
Will End Pit Lakes work?

Ambitious plans for oil sands would create lakes from waste

NATHAN VANDERKLIPPE
CALGARY — The Globe and Mail
Published Wednesday, Oct. 03 2012, 6:00 AM EDT
Last updated Wednesday, Oct. 03 2012, 6:01 AM EDT

It could one day be Alberta’s very own Lake District, a recreational haven complete with campgrounds, boating, fishing – even swimming.

Or it could turn into a landscape of ponds sullied by toxins and oil, a malingered presence left by an industrial experiment gone wrong.

It may take a century to find out what is left around Fort McMurray. Because the lakes, 30 of them, will be built by Canada’s oil sands industry. When the companies mining heavy crude from northeastern Alberta finish their work, they intend to pump water into old mine pits, some with toxic effluent at their bottoms, before leaving the area to biological processes to restore it to health.
Let’s talk Conventional Oil – end 2012

• Almost 400,000 oil and gas wells drilled in AB
• 52,831 unreclaimed wells
  – 1/3 from ‘63 to 2002 and 2/3 in last 10 years
• Industry continues to drill new wells at a rate of 13,788 per year (10 year average)
How many years does it take to bring the land back to 100% and how much does it cost in terms of $/barrel oil?

Extraction – reduce the height?

• Cost – General Agreement $1B / mine works out to about $0.45 / barrel and again should we pay?

• Now let’s talk pipelines.
  – 420,000+ kms in Alberta alone
  – Remediation of existing lines can be $250/ meter
  – Farming community could make a big difference

• Extraction – compare to our open pit coal mines that provide us with electricity
Oil Sands 101 – The Resource

- Water layer
- Sand particle
- Bitumen film
Oil Sands 101 – Why Fort McMurray?

WESTERN CANADA SEDIMENTARY BASIN CROSS-SECTION

ROCKY MOUNTAINS

FOOTHILLS

Calgary

PLAINS

Fort McMurray

Metres

Sea level

-3,000

-2,400

-1,800

-1,200

-600

0

-600

-1,200

-1,800

-2,400

-3,000

-4,200

No oil or gas

Oil and gas

-2,800m below sea level

Oilsands and heavy oil deposits

Precambrian “basement”

British Columbia

Alberta

Saskatchewan

Younger clastic sediments (sandstones and shales)

Older carbonate sediments (limestones and dolomites)

Ancient crystalline rocks (i.e. granites)

Generation and migration of oil

Natural Resources, Energy and Environment
Oil Sands 101 – The Context

**Oil Reserves by Country**

These Fourteen Countries Represent 91% of the Planet's Oil Reserves

<table>
<thead>
<tr>
<th>Country</th>
<th>Billion Barrels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>263</td>
</tr>
<tr>
<td>Venezuela</td>
<td>211</td>
</tr>
<tr>
<td>Canada</td>
<td>174</td>
</tr>
<tr>
<td>Iran</td>
<td>138</td>
</tr>
<tr>
<td>Iraq</td>
<td>115</td>
</tr>
<tr>
<td>Kuwait</td>
<td>104</td>
</tr>
<tr>
<td>UAE</td>
<td>98</td>
</tr>
<tr>
<td>Russia</td>
<td>60</td>
</tr>
<tr>
<td>Libya</td>
<td>46</td>
</tr>
<tr>
<td>Nigeria</td>
<td>37</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>30</td>
</tr>
<tr>
<td>Qatar</td>
<td>25</td>
</tr>
<tr>
<td>China</td>
<td>20</td>
</tr>
<tr>
<td>United States</td>
<td>19</td>
</tr>
</tbody>
</table>

* OPEC Member  
Source: EIA, 2009 data.
Oil Sands 101 – The Mining

Recovery Rates – Oil Production

- Conventional light oil: Averages about 30% of the resource
- Conventional heavy oil: Up to 20%
- In-situ oil sands: 25 to 50%
- Oil sands mining: 80% plus
Oil Sands 101 – In-situ (SAGD)
Do oil sands have a major impact in the environment than other sources of oil?

- Oil sands emissions are 6% of Canadian emissions. Canada is 2% of world emissions.
Do oil sands have a major impact in the environment than other sources of oil?
Why are Gateway and Keystone XL so important?

<table>
<thead>
<tr>
<th>Trends</th>
<th>Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Increasing US domestic production &amp; NA market structure (e.g. unconventional)</td>
<td>1. Increased interest in marginal oil (improved economics, decline in conventionals, new technologies)</td>
</tr>
</tbody>
</table>
| 2. Rising complexity of geo-political with industry structure and investments (NOCs, IOCs) | 1. Energy supply security  
2. OPEC socio-political needs |
| 3. Increasing difficulties in access to markets                       | 1. Rising opposition to heavy oils, bitumen, etc.                                           |
| 4. Increasing third party verification systems                         | 1. Market access                                                                            |

http://www.eia.gov/todayinenergy/detail.cfm?id=3750
## EMERGING ISSUES - Oil

<table>
<thead>
<tr>
<th>Signals</th>
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<tbody>
<tr>
<td>1. The new margins – (e.g. conventional oil production increasing from marginal sources, sub-salts, Arctic to South China Sea)</td>
</tr>
<tr>
<td>2. OPEC surplus capacity declining</td>
</tr>
<tr>
<td>3. Rise of innovation, substitutes and disruptives</td>
</tr>
<tr>
<td>4. The disconnects (arbitrage, ratios, price volatility)</td>
</tr>
</tbody>
</table>
Why are Gateway and Keystone XL so important?

Markets
- Infrastructure
- Regulatory Approvals
- Contracts
- Trade Relations

Technology
- Deployment
- Research & Development
- Investment

Capitals
- Natural Resources
- Skilled Labour
- Finance
- Fiscal Regime

Social Licence
- Creating Shared Value
- Societal acceptance
- Corporate Social Responsibility
What is the price of oil that is needed to make oil sands projects profitable?
What are the chances that the price of oil could be so low that oil companies could start closing in Alberta?
What are the chances that the price of oil could be so low that oil companies could start closing in Alberta?
How much of the money obtained from Alberta's oil goes to other provinces through federal taxes?

- Major transfers to Alberta
- Equalization formula is not Alberta’s oil per se (in Millions)
  - P.E.I. 337  Que. 7,391
  - N.S. 1,268  Ont. 3,261
  - N.B. 1,495  Man 1,671

The Canadian Energy Research Institute (CERI) estimates oil sands will create $444 billion in tax revenue across Canada over the next 25 years. Over 70 per cent, or $322 billion, will go to the federal government.

But is that the real issue? (Excel exercise)
If I want to drill a well in Canada, who should I talk with? How much should I pay for use the land? How long can I have the land?

• On the Industry Association side  http://www.caodc.ca/
• The ERCB, on behalf of Alberta Energy, deals with all gas well activity, operation, maintenance, adjudication and regulation.
• Alberta Environment oversees reclamation and remediation activities on private land.
• Alberta Sustainable Resource Development oversees activities on public land.
• The Alberta Surface Rights Board deals with rights of access to wellsites on private and public lands.
Is there such thing as a Dutch disease in Alberta and Canada?

• Dutch Disease – what it really is.
  – Large revenues from one sector making others sectors less competitive

• What it is not?
  – If a company / industry needs lower exchange rates need also look at productivity, innovation and competitive advantage

• Now think about the incongruence – what price point does eastern Canada use for their oil?