Upgrading Bitumen Derived Feedstocks - Choices and Opportunities

Presented to:

Canadian Crude Quality Technical Association (CCQTA)

Crude Oil Quality Group (COQG) Joint Meeting

Calgary, June 24, 2008

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Outline

• Heavy oil development in Alberta, Canada
  – Growth and development plans

• Bitumen Upgrading
  – More than just delayed coking

• The Future revealed
Where Heavy Oil Lives

- Conventional heavy oil in the Lloydminster area
  - Cold production (CHOP)
    - With/without sand
- Mining near Fort McMurray
  - Athabasca river area
- Thermal production
  - Steam assisted gravity drainage (SAGD)
  - Cyclical Steam Stimulation (CSS)
Mining vs Thermal Production

- In-situ thermal methods are used to access “deep” bitumen

Canadian Heavy Oil Association
Bitumen Driven

- 12% oil in the “oil sands”
  - Mining or in-situ thermal production
- Oil is referred to as bitumen
  - Heavy, sour, poor quality, difficult to deal with
## Bitumen is a Difficult Feedstock

<table>
<thead>
<tr>
<th></th>
<th>Athabasca Bitumen</th>
<th>Cold Lake Bitumen</th>
<th>Cold Lake Blend</th>
<th>Syncrude Sweet Blend</th>
<th>West Texas Intermediate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravity, API</td>
<td>7.9</td>
<td>11.0</td>
<td>23.1</td>
<td>31.8</td>
<td>40.8</td>
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<tr>
<td>Specific gravity</td>
<td>1.0151</td>
<td>0.9928</td>
<td>0.915</td>
<td>0.8663</td>
<td>0.8212</td>
</tr>
<tr>
<td>Sulphur, wt%</td>
<td>4.9</td>
<td>4.6</td>
<td>3.5</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Nitrogen, ppm</td>
<td>4000</td>
<td>3740</td>
<td>3230</td>
<td>630</td>
<td>800</td>
</tr>
<tr>
<td>CCR, wt%</td>
<td>13.4</td>
<td>12.9</td>
<td>11.0</td>
<td>0.0</td>
<td>1.08</td>
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<tr>
<td>Vanadium, ppmw</td>
<td>222</td>
<td>182</td>
<td>152</td>
<td>&lt;0.4</td>
<td>1.6</td>
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<tr>
<td>Nickel, ppmw</td>
<td>87</td>
<td>65</td>
<td>57</td>
<td>&lt;0.4</td>
<td>1.6</td>
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<tr>
<td>Asphaltenes, wt%</td>
<td>17.5</td>
<td>16.0</td>
<td>13.4</td>
<td></td>
<td>0.1</td>
</tr>
<tr>
<td>TAN</td>
<td>3</td>
<td>1</td>
<td>0.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salt, lb/1000 bbl</td>
<td>40</td>
<td>20</td>
<td>15-20</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Message:** Bitumen derived feedstocks are very different than Medium Sweet Crude
Alberta Production Growth

4.5 million barrels/day

3.5 million Oil Sands Derived

Source: CAPP – June 2008 (moderate case)
Investment

• Bitumen production
  – Mining and extraction
  – Thermal bitumen production
    • *Steam assisted gravity drainage (SAGD)*
    • *Cyclical steam stimulation (CSS)*

• Upgrading/refining
  – Either linked with production or “stand alone”
    • *Field location vs central*
  – Fort McMurray vs Edmonton

• Pipelines
  – Including condensate import/return
Planned Alberta Investment

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Number of Projects</th>
<th>Value of Projects ($millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture &amp; Related</td>
<td>7</td>
<td>$83.0</td>
</tr>
<tr>
<td>Biofuels</td>
<td>17</td>
<td>$2,324.0</td>
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<tr>
<td>Chemicals &amp; Petrochemicals</td>
<td>5</td>
<td>$442.0</td>
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<tr>
<td>Commercial/Retail</td>
<td>124</td>
<td>$8,625.4</td>
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<tr>
<td>Commercial/Retail and Residential</td>
<td>14</td>
<td>$4,405.8</td>
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<tr>
<td>Forestry &amp; Related</td>
<td>2</td>
<td>$72.0</td>
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<tr>
<td>Infrastructure</td>
<td>284</td>
<td>$17,111.5</td>
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<tr>
<td>Institutional</td>
<td>211</td>
<td>$13,232.9</td>
</tr>
<tr>
<td>Manufacturing</td>
<td>1</td>
<td>$12.0</td>
</tr>
<tr>
<td>Mining</td>
<td>7</td>
<td>$2,945.4</td>
</tr>
<tr>
<td>Oil &amp; Gas</td>
<td>15</td>
<td>$4,140.0</td>
</tr>
<tr>
<td><strong>Oilsands</strong></td>
<td><strong>52</strong></td>
<td><strong>$162,609.0</strong></td>
</tr>
<tr>
<td>Other Industrial</td>
<td>11</td>
<td>$160.4</td>
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<tr>
<td>Pipelines</td>
<td>37</td>
<td>$11,943.8</td>
</tr>
<tr>
<td>Power</td>
<td>42</td>
<td>$10,971.0</td>
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<tr>
<td>Residential</td>
<td>138</td>
<td>$6,439.3</td>
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<tr>
<td>Tourism/Recreation</td>
<td>109</td>
<td>$9,319.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1076</strong></td>
<td><strong>$254,917.0</strong></td>
</tr>
</tbody>
</table>

**Oil Sands**  > $C162 billion
**TOTAL**  >$C254 billion

Source: Alberta Finance and Enterprise – March 2008 Update

Canadian Heavy Oil Association
Projects Backing Up

• May 2008 update

• Construction craft personnel forecast

Source: COAA
Canadian Heavy Oil Association
• Many projects are “on the books”

• There are many projects “clustered” in the same schedule

• Realities:
  – workforce, construction, equipment, and infrastructure

• Schedules will extend
Upgrading Bitumen
Where to Start Upgrading?

**Mining Methods**
- Mining
- Oil Sands
- Water/Oil Separation
- Thermal In Situ

**Thermal Production Methods**
- Gasification

**Steps**
1. Mining
2. Extraction
3. Thermal In Situ
4. Upgrading
   - Synthetic Crude
   - By product
5. Refineries
   - Imperial Oil, CNRL, Encana
   - Blend with Diluent
6. Bitumen
   - Bitumen Blend
7. Refineries
   - Fuels, Lubricants, Asphalt, Petrochemicals
   - Hydrogen
Upgrading Perspective

• Starts at the mine with extraction
  – Froth treatment

• Can be done in the field with thermal production
  – Make your own fuel, get rid of diluent

• Can be a purpose built upgrader making SCO
  – Syncrude, Suncor for example

• Can be “linked” to refining
New Words – DILBIT and SYNBIT

Bitumen Production
(Mining or In-Situ)

Bitumen Upgrading
(Carbon OUT or H₂ IN)

Light SCO Product

Light Crude Refinery

Heavy SCO Product

SYNBIT Product

Medium Crude Refinery

DILBIT Product

SYNBIT Product

Heavy Crude Refinery

Naphtha Diluent

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Alberta Upgrading Plans

• Existing capacity and planned capacity additions

• 16 companies with multi-phase upgrading plans
  – 48 distinct project “phases”

• Range of facility configurations

• Values change “monthly”, but only seem to go in one direction (up).
Upgrading in Alberta

April 2008 data – Strategy West

TOTAL Upgrading = 4.7 million BPD
Operating

Note: Excludes Canadian refineries with Upgrading (Petro-Canada, Imperial, Husky)
Construction

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Approved

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Application

- Value Creation (pilot)
- Total (1,2)
- Shell Scotford 2 (1-4)
- Synenco (1,2)
- StatOil Hydro (1,2)
- Petro-Canada Fort Hills (1,2,3)
Announced

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Alberta Industrial Heartland

- Petro-Canada Sturgeon
- NorthWest Upgrading
- Total land position
- Suncor land position
- others

40 kms NE of Edmonton

Source: Alberta Industrial Heartland Association

Canadian Heavy Oil Association
Alberta Industrial Heartland

Source: AIHA
Canadian Heavy Oil Association
Upgrading Development

- At/near production site
  - Syncrude, Suncor, CNRL, Opti/Nexen, Value Creation

- Edmonton Region
  - Merchant Upgrading
    - *North West Upgrading*
    - *BA Energy*
  - Shell, Petro-Canada, StatOil Hydro, Total, Synenco, others
The Future (revealed)

• There will be significant volumes of bitumen derived feedstocks in the market place
  – Bitumen blends
  – Synthetic Crude Oil (variety of qualities)
  – Finished products

• Encouragement to add value to bitumen in Alberta
  – Global marketplace

• Environmental responsibility
  – Emissions managed and by-products eliminated
Opportunities

• Application of innovative technology
  – Production, upgrading and refining
    • Anticipating environmental compliance