Oil Sand Imports to PADD III, WTI Discounts and Logistics, and Rising US Production

How does the lack of clarity in Washington create distortions and uncertainty in oil markets and logistics in the United States?

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Calgary, Alberta
• Nature of the US refining sector and increased heavy processing capacity

• Keystone XL and the potential for increased quantities of diluted bitumen into PADD III

• Rising production from the Bakken shale formation in North Dakota and Rocky Mountains and the lack of take-away infrastructure

• Logistical problems of WTI, its connection to rising Bakken production and increased Canadian imports - need for projects like Keystone XL
Overview of the U.S. Refining Sector

- End of price controls removed small inefficient refineries in favor of expansion of existing refineries
- As heavy imports have grown, refineries have invested in heavy processing capacity – U.S. has among the highest refining complexity in the world with PADD III higher than average in the US

Source: Map from NPRA United States Refining and Storage Capacity Report, August 2010.
Refinery Capacity vs. Number of Operating Plants

Source: EIA Data
Refining Basics

• The higher the API gravity, the lighter the crude → easier to refine, greater proportion of higher quality products such as transportation fuels

• Heavy Crude 18 degrees
• Light Crude 36 degrees
• Gasoline 60 degrees

• Processing heavy crudes requires significant capital investment

Source: 2006 Refinery Output Shares, EIA Presentation sourced with Purvin and Gertz and GPMO Service
U.S. Refinery Yield

Source: EIA Data
PADD III

- Most densely populated refinery district in the US
- 57 refineries
- Over 8.5 million b/d capacity
- 3 million b/d heavy capacity and growing
- Addition of cokers in recent years to expand heavy oil refining capacity
- Currently underutilized by 20% (some analysts currently suggesting)

- Examples include: WRB Borger 25,000 b/d expansion of heavy oil capacity; Navajo Refining Artesia, N.M. 40,000 b/d expansion; Motiva (Saudi Aramco Shell joint venture) 325,000 b/d capacity expansion-medium and heavy sour crude processing

Source: Map from NPRA United States Refining and Storage Capacity Report, August 2010.
Gulf Coast PADD III Imports by Country

Source: EIA Data
TransCanada’s Keystone Expansion Pipeline

- **Expansion to Gulf Coast:** expected completion late 2012
  - 509,000 b/d additional capacity (or 1.1 million b/d total capacity)

- **Phase I Hardisty to Patoka:** completed
  - 435,000 b/d capacity

- **Phase II Steele City to Cushing:** scheduled to be completed late 2010
  - 156,000 b/d additional capacity (or 591,000 b/d total capacity)

Source: EPRINC Design, using Google Maps, and TransCanada information
Canada’s Net Oil Imports and Exports to the United States

Canada produces ~3.3 million barrels of oil per day

--about 1.5 million barrels are bitumen from the oil sands (non-upgraded and synthetic)

The US imports ~2.5 million barrels of oil per day

--over 625,000 of these barrels are from the oil sands

Canada imports ~1.2 million barrels of oil and refined products per day (from the US and other countries)

*Includes refined products. Export/import/production data from EIA country profile. Oil sands figure from NEB 2009, figures converted to b/d. Wikipedia map.
Why it Matters…. U.S Production, Consumption, and Imports

Source: EIA Data. Excludes NGLs, associated liquids and refinery gain.
Back to Refining....Prices for Light-Medium, Heavy, and Bitumen Crude Oils

Source: Energy Resources Conservation Board (ECRB) Data and EPRINC Calculations (converting to barrels)
The Crude Spread and Refinery Profitability

Source: IEA, EIA, and ERCB Data with EPRINC Calculations
U.S. Imports of Crude Oil and Petroleum Products by Country

Source: EIA Data
Oil Sand Imports to PADD II and PADD III

Source: Map from NPRA United States Refining and Storage Capacity Report, August 2010. EPRINC additions of oil sand import info from NEB
Oil Sand Exports to U.S. by Type and Destination

Source: National Energy Board, Canadian Energy Overview 2009, EPRINC conversions from cubic meters
# EPRINC’s Estimation of Economic Benefits to Bakken Producers and Keystone Refiners - Annual

<table>
<thead>
<tr>
<th>Bakken Efficiencies ($ million)</th>
<th>Refining Margin Improvements ($ million)</th>
<th>Total ($ million):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakken Low Range - 50,000 b/d into Keystone XL at a savings of $2 a barrel</td>
<td>Low Range - Heavy Crude Discount Increases $1 a barrel, 200,000 b/d sent to Gulf</td>
<td>73 Low Estimate 109.5</td>
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<tr>
<td>Bakken High Range - 100,000 b/d into Keystone XL at a savings of $4 a barrel</td>
<td>High Range - Heavy Crude Discount Increases $3 a barrel, 400,000 b/d sent to Gulf</td>
<td>438 High Estimate 584</td>
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Williston Basin and Bakken and Underlying Three Forks Formation

Source: USGS
North Dakota Oil Production

Source: EIA Data
Williston Basin Production

Source: North Dakota Pipeline Authority
# Bakken Take-away Capacity

<table>
<thead>
<tr>
<th>Transportation System Capacity, Barrels Per Day</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
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<tbody>
<tr>
<td><strong>Pipeline Transportation</strong></td>
<td></td>
<td></td>
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<tr>
<td>Butte Pipeline</td>
<td>92,000</td>
<td>104,000</td>
<td>118,000</td>
<td>118,000</td>
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<tr>
<td>Enbridge North Dakota</td>
<td>80,000</td>
<td>110,000</td>
<td>110,000</td>
<td>161,500</td>
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<tr>
<td>Tesoro Mandan Refinery</td>
<td>58,000</td>
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<td>58,000</td>
<td>58,000</td>
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<tr>
<td><strong>Pipeline Only Total</strong></td>
<td>230,000</td>
<td>272,000</td>
<td>286,000</td>
<td>337,500</td>
</tr>
</tbody>
</table>

| **Rail Transportation**                       |        |        |        |        |
| Various Sites including: Minot, Dore, Donnybrook, Stampede | -      | 30,000 | 30,000 | 30,000 |
| EOG Rail, Stanley, ND (Up to 90,000 BOPD)      | -      | -      | 65,000 | 65,000 |
| Dakota Transport Solutions, New Town, ND      | -      | -      | -      | 20,000 |
| **Rail Only Total**                            | -      | 30,000 | 95,000 | 115,000|

| Pipeline and Rail Combined Total              | 230,000| 302,000| 381,000| 452,500|

Source: North Dakota Pipeline Authority
## Planned Capacity

<table>
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<tr>
<th>Transportation System</th>
<th>Capacity, Barrels Per Day</th>
<th>2007</th>
<th>2008</th>
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<td>-</td>
<td>100,000</td>
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<td>230,000</td>
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<td>286,000</td>
<td>337,500</td>
<td>418,000</td>
<td>518,000</td>
<td>738,000</td>
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</table>

*Project still in the proposed or internal review phase

Source: North Dakota Pipeline Authority
U.S Field Production of Crude Oil

Source: EIA Data
WTI Discount and Cushing Dilemma

- This year has been punctuated with widening price differentials between North Sea Brent and WTI
- Light Louisiana Sweet (LLS) is run in several Gulf refineries and has been trading closer to Brent, putting it at a premium to WTI
- Refiners in PADD II, the Midwest, are seeing good refining margins, benefiting from their geographic position and the WTI discount
- For producers, well-head values are suffering and this is impacting the legitimacy of WTI as a global benchmark
WTI Brent Discount

Source: USGS
Cushing Stocks and WTI Discounts ➔
“Cushing Dilemma”

Source: EIA Data
US Cracking Margins

Source: Platts Oilgram News
Pipeline Evolution

Source: Info. From CME Group and Purvin and Gertz Study
2008 Pipeline Flows

Source: Info. From CME Group and Purvin and Gertz Study
U.S. Imports from Canada of Crude Oil

Source: EIA Data
Pipelines In and Out of Cushing 1988

Source: Info. From CME Group and Purvin and Gertz Study
Pipelines In and Out of Cushing 2009

Source: Info. From CME Group and Purvin and Gertz Study
Bringing it all together....Concluding Remarks

- Bringing Canadian Oil Sands into PADD III as proposed by projects such as Keystone XL represents a significant policy issue that has systemic impacts.
- The complex nature and capacity to refine heavy crudes in PADD III make it a strong match for oil sands bitumen (as it is in PADD II).
- The expansion pipeline has the ability to carry Bakken crude, offering producers needed take-away capacity and increased efficiency via higher well-head values.
- With increased supplies coming from the North (Canada and Bakken) the U.S. needs to adjust its crude oil transportation to avoid bottlenecks and maximize efficiency.
- The Cushing bottleneck is not simply a local dislocation issue, but one that is impacting the legitimacy of WTI as a global crude benchmark. The discount has made Brent priced markets the favorite for exporters and the bottleneck prevents the U.S. from maximizing the efficiency of its refining capacity.