How the Game Has Changed

Infrastructure and the North American Petroleum Renaissance

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Energy Policy Research Foundation, Inc. (EPRINC)
NDPA Webinar
March 8th, 2013
Who is EPRINC?

EPRINC stands for *Energy Policy Research Foundation, Inc.* We are a non-profit research group that does economic and policy analysis on the petroleum industry.

Founded in 1944 in New York. Established as a group to explain markets and fundamentals.

Previously the Petroleum Industry Research Foundation, Inc (PIRINC) until we moved to Washington in 2007.

Grew largely into a downstream organization, but have since moved extensively into upstream and midstream.

Extensive work on ethanol, refining, U.S. shale plays, Keystone XL, natural gas flaring.

[www.eprinc.org](http://www.eprinc.org) -- check out our research, it's free.
Recent and Forthcoming

EPRINC Embassy Series: LNG Exports from North America

The second event in the EPRINC Embassy Series was held on January 29, 2013 at the Russian Embassy in Washington, D.C. The event, LNG Exports From North America: Understanding the Policy Debate, featured presentations by Jim Jensen, Piotr, and Michelle Michot Foss. EPRINC is grateful to the Russian embassy for its hospitality and support of this event and in particular would like to thank H. E. Sergey I. Kislyak, ambassador of the Russian Federation to the U.S. and the Honorable Yury P. Sentiyurin, state-secretary – deputy minister of energy of the Russian Federation.

EPRINC’s North American Pipeline, Rail, and Refinery Infrastructure Study

EPRINC is proposing a public study with industry sponsorship from upstream and downstream participants. The purpose of this study is to examine and assess the economic implications and policy consequences of near North American crude oil supplies on demand transportation infrastructure. The study will focus on the evaluation of takeaway capacity in and around North Dakota, but will also address the impact of the Bakken on near-east and east-west crude movements. It will also address the transportation of crude from the Canadian oil sands as well as prorated crude exports to the U.S. such as the Eagle Ford and the Permian Basin.

Over the past three years U.S. and Canadian crude production has risen by 2 million barrels per day. These new volumes have created multiple pipelines throughout the U.S., leading to several pricing pressures for both U.S. and Canadian crude and the need for the re-allocation of crude to be moved by rail each day. The private sector has launched a wave of joint ventures to improve the flow of oil throughout the United States. However, there remains uncertainty regarding the economic and political viability of these projects.

Below is a preliminary outline of elements to be addressed within the study:

1. U.S. Crude Production: An Overview of Recent Crude Production Trends in the U.S. and Canada
2. U.S. Crude Production: Which Countries and What Types of Crude Are Likely to Be Exported Next?
3. Canadian Imports, Existing and Planned Pipeline Capacity and Crude-by-Rail
4. U.S. Crude Exports: Crude Movements by Pipeline, Rail, and Shale
5. The Bottlenecks: Current and Developing
6. Pipeline Development/Examining Crude Price Differentials Among Various Basins as well as the NTD Brent Spread
7. Getting Crude to the Refineries: Better Understanding the Costs of Crude by Rail, How it Works, and the Potential
8. Refineries Crude Appetite: How Much Light Sweet can Refineries “Eat”
   a. refinery capacity
   b. Demand for SGR
9. Regulatory Uncertainty and Constraints Preventing New Infrastructure Build Out
Main Discussion Points

1) Trends in production throughout the Northern Tier in the next 5-10 years
2) Pricing and Logistical Constraints
3) Likely markets for U.S. light and Canadian heavy crude oil
4) Keystone XL and its relationship to other Canadian and U.S. Midcontinent projects
5) Prospect for movement of new crude supplies to U.S. East and West coasts
6) Regulatory and market constraints on the movement of North American crude
U.S. Oil Production - 7 mbd

Source: EIA (mbd million barrels per day)
Canadian Oil Production - 3.2 mbd

Source: EIA International Energy Statistics

3,243,000 b/d
November 2012 Canadian Oil Production

Canada Oil Production Including Lease Condensate (Thousand Barrels Per Day)
U.S. Growth Stories

[Graph showing production data from various fields and years, with labels for North Dakota Field Production of Crude Oil, Oklahoma Field Production of Crude Oil, Alaska Field Production of Crude Oil, Colorado Field Production of Crude Oil, California Field Production of Crude Oil, New Mexico Field Production of Crude Oil, and Texas Field Production of Crude Oil.]

Source: U.S. Energy Information Administration
Renaissance in the Making
EPRINC’s Forecast for Major U.S. Shale Plays

Adding 4 mbd by 2020 with selected plays alone — upside exists in periphery plays and enhanced recovery

Source: HPDI data with EPRINC forecast estimates
The Forecast Numbers

Bentek
• Between 2011-2016 3.1 mbd increase (or 36%) in both Canadian and US oil production
• 900,000 b/d increase in exports from Canada to US
• US oil imports (exclude Canada) drop 2.8 mbd or 41% to 3.9 mbd average by 2016

Raymond James
• “U.S. oil production (excluding NGLs) will grow from 5.6 MMBpd in 2010 to a whopping 9.1 MMBpd in 2015. Including natural gas liquids, total U.S. petroleum liquid production grows 60% from 7.7 MMBpd in 2010 to 12.2 MMBpd in 2015.”

Citi (from 2011 to 2020)
• US liquids grow from 9 mbd to 15.5 mbd
• Canada liquids grow from 3 mbd to 7 mbd
Canadian Production

Additional 1 mbd in three years = tightness

Possible upside in tight oil

Source: CAPP
Canadian Consumption to Remain Flat...

....Every incremental barrel must be exported
U.S. Total Imports, U.S. Canadian Imports, U.S. Production

Source: EIA
Fuel efficiency, plateauing demand, and rising production offer the potential to drastically reduce oil imports over the coming years.

“Net Oil Imports in Selected Countries and Regions in the New Policies Scenario”

Remember to be humble...Projected Imports of LNG vs. Actual

Reference Case - Net U.S. imports of LNG (tcf) - 2008 EIA Annual Energy Outlook

Actual US Net LNG Imports

Henry Hub Gulf Coast Natural Gas Spot Price ($/MMBTU) (right axis)

Source: EIA data and forecasts

March 7th $3.59 nat gas
U.S. Rig Count and Play Breakdown with Rig Totals

- Williston Basin (Bakken reservoir play) 193
- Denver Julesburg (Niobrara/Codell reservoir play) 38
- Anadarko Basin 224
- Appalachian Basin 137/Ohio (Utica/Point Pleasant reservoir play) 32
- Powder River Basin 31
- Uinta Basin 23
- Permian Basin 467
- Eagle Ford Reservoir 222

Source: HPDI Feb 12 2012

Legend:
- O/G: 865
- Oil: 562
- Gas: 306
- (N/A): 125
- All Others
U.S. and North Dakota and Texas Rig Count

Source: Baker Hughes Jan 2013. All but 51 rigs nationwide are onshore.
Bakken and Three Forks Wells in the Williston Basin (Montana and North Dakota)

All Wells

2012 Wells

Source: HPDI
North Dakota Oil Production

North Dakota December Oil Production 769,000 b/d

Source: NDPA
A lot of potential...

Bakken Development Plan

- Original dual-zone development plan
  - 8 wells per 1,280 acres – 4 MB, 4TF
  - 603,000 Boe EUR per well (avg. 24.5 stages/completion)
  - ECO-Pad® design: 2 wells south, 2 wells north

- Additional Three Forks potential
South Texas’ Eagle Ford Reservoir Wells (Black-Oil, Yellow-Gas)

Source: HPDI Dec 10 2012
South Texas’ Eagle Ford Reservoir Liquid and Gas Production

December Liquids Production 693,447 b/d

Source: HPDI Dec Feb 8th 2012, liquid volumes includes condensate, estimated condensate volumes are up to 40% of liquids production.
Permian Basin Wells

All Wells

2012 Wells

Source: HPDI
Permian Basin Liquids and Gas Production

1,214,026 bpd total Permian Production as of Sept 2012

Source: HPDI Jan 2013
And with all this production what’s happening to prices?
Brent, WTI, and Bakken Markets

Brent $111  
WTI $91  
LLS $112  
WCS $66  
Bakken Clearbrook $91  
North Dakota $85.50  
Wyoming Sweet $85  
DJ Basin $87  
Midland $91  
Eagle Ford $99.25

Source: AFPM Map; Bloomberg Brent, Midland, LLS, and WTI Prices; Flint Hills and estimates, Canadian assumptions and estimates (Bloomberg)
Bakken Prices at Clearbrook

Source: Bloomberg, June 14, 2012 and March 7 2013
Midland (Permian) Differential

Bloomberg Midland Crude Oil Differential

USCSWTIM:IND  -0.50  ↓ 0.05  11.11%

As of 16:22:43 ET on 03/07/2013.

Source: Bloomberg March 7th 2013
Price Discounts

Canadian discounts even steeper
WCS -$25 to WTI

Source: Flint Hills, EIA, and estimates
Price of Canadian Crude Imports

Canadian prices being hammered by U.S. surge in production and lack of adequate outbound capacity to refining centers

Landed Cost: The dollar per barrel price of crude oil at the port of discharge. Includes charges associated with the purchase, transportation, and insuring of a cargo from the purchase point to the port of discharge. Does not include charges incurred at the discharge port (e.g., import tariffs or fees, wharfage charges, and demurrage).
Refinery Acquisition Cost of Crude Oil

PADD 1 has the highest RAC in the U.S. – and the least heavy crude processing capability.

Source: EIA
PADD 1 East Coast RAC of Crude: Domestic vs. Imported

Source: EIA Data
Understanding the Infrastructure
Markets for Bakken and Canadian Crude

• The current markets for Canadian crude are the Rockies (PADD 4) and the Midwest (PADD 2) where heavy and SCO refining capacity exists.
• The potential exists in Asia and the Gulf Coast...substantially knocking out heavy Mexican and Venezuelan imports in the US Gulf Coast.
• But due to regulatory and environmental hurdles, PADD III access has been postponed and thereby tightness has been created – and too much light sweet in the market exacerbating this tightness.
• The U.S. imports a significant amount of SCO as well as heavy crude oil from Canada...SCO could play an important role in blending and meeting desired production of distillate.
• Canadian crude fights for capacity with Bakken crude along the Enbridge line (Bakken crude ends up in Clearbrook and all of the PADDs)---as Bakken crude has moved to rail, Canadian price discounts have eased slightly.
Canadian Imports and Potential Markets

Source: CAPP Crude Oil Forecast June 2012
Choke Points

Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software
U.S. Imports of Canadian Crude

Source: EIA
Where light sweet Bakken and heavy (blended bitumen) needs to go...

Source: AFPM map, EIA data for graph
Canadian Pipeline Export Options

- Kinder Morgan’s Transmountain line off BC coast - currently 300,000 b/d capacity-recent announcements to expand up to 800,000 b/d (early 2017)
- (Now Spectra) Platte line to Wood River 280,000 b/d-full
- Enbridge mainline system currently transporting over 1.5 mbd with potential capacity around 2.5 mbd—Northern Gateway off BC coast planned 525,000 b/d
- TransCanada’s Keystone 581,000 b/d-full—XL would add 700,000 b/d

Mostly full pipelines creates need for XL and Gateway opportunities for rail

Source: Canadian Energy Pipeline Association
East Coast taking little Canadian Crude

- Mainly SCO, but some blended bitumen

Source: EIA
PADD II imports are almost all Canadian

Source: EIA
PADD III...has the cokers and is getting none of the crude

Source: EIA
ALL Imports into the Rockies are from CANADA

Source: EIA
PADD V also has the cokers...taking some Canadian

Source: EIA
PADD II will be importing more HEAVY crude...

....absorbing more Canadian crude and pushing out light sweet Bakken crude

<table>
<thead>
<tr>
<th>Refinery</th>
<th>Year</th>
<th>Crude Demand Impact MBPD</th>
<th>Light</th>
<th>Heavy</th>
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<tbody>
<tr>
<td>COP/Cenovus Wood River</td>
<td>2012</td>
<td>-95</td>
<td></td>
<td>+130</td>
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<tr>
<td>Marathon/Detroit</td>
<td>2013</td>
<td>-65</td>
<td></td>
<td>+80</td>
</tr>
<tr>
<td>BP/Whiting</td>
<td>2013</td>
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<td></td>
<td>+260</td>
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<td>BP/Husky Toledo</td>
<td>2015</td>
<td>-45</td>
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<td>+60</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td>-425</td>
<td></td>
<td>+530</td>
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Source: John Auers Turner Mason Argus Americas Crude Summit Jan 2012;;; map using Enbridge data from NDPA
U.S. Imports by API Gravity

Source: EIA
Knocking Out Waterborne Imports

• Growth in domestic crude oil production will largely be light sweet crude oil from tight/shale oil formations such as the Bakken and Eagle Ford.
• If the current rates of growth are maintained, light sweet crude imports into the U.S. will be displaced in the next couple of years.
• By year end light sweet imports into the Gulf should stop. Bakken should be looking for another coastal home too!
• More imports into the U.S. will be pushed out over the coming years as refiners blend this light sweet crude to meet their specifications (helping to displace medium API gravity imports). The majority of what the U.S. is importing is heavy, medium, and medium and light sour crudes. The demand for heavy crudes in the U.S. should be met by the Canadian oil sands.
Blending Prospects

<table>
<thead>
<tr>
<th></th>
<th>West Texas Sour</th>
<th>50% Cold Lake/ 50% North Dakota Light</th>
<th>Value, $/Bbl¹</th>
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<tbody>
<tr>
<td>API Gravity</td>
<td>29.0</td>
<td>31.6</td>
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<tr>
<td>Sulfur, wt %</td>
<td>1.9</td>
<td>2.0</td>
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<tr>
<td>Yields, vol %</td>
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<tr>
<td>- naphtha (IBP-450°F)</td>
<td>35.8</td>
<td>39.2</td>
<td>$103</td>
</tr>
<tr>
<td>- distillate (450°F- 650°F)</td>
<td>20.7</td>
<td>16.4</td>
<td>$121</td>
</tr>
<tr>
<td>- gas oil (650°F- 1000°F)</td>
<td>25.8</td>
<td>23.7</td>
<td>$110</td>
</tr>
<tr>
<td>- residuum (1000°F+)</td>
<td>17.7</td>
<td>20.6</td>
<td>$92</td>
</tr>
</tbody>
</table>

1 Based on mid-December prices

Source: Dennis Sutton Marathon, Argus Americas Crude Summit Jan 2012; Continental Resources 2013 Investor Presentation
U.S. Exports of Finished Petroleum Products

- About 1 mbd distillate
- 500,000 b/d finished motor gasoline
- 500,000 b/d petroleum coke

Source: U.S. Energy Information Administration
Rail
From Wellhead to Railbed

- Over 500,000 b/d of crude are moving by rail out of the Williston Basin
- Close to 200,000 b/d of spare pipeline capacity in ND (estimated)
- Bakken crude making it to all US coasts (and all PADDs)
- East Coast refinery beginning to take heavy oil sands crude via rail
- About 1.9 mbd (million barrels a day) of crude oil and petroleum products are moving by rail in the US and Canada
- Statoil leasing 1,000 railcars; Exxon leasing 2,000 railcars
- 80,000 plus b/d of Canadian crude are moving by rail
  - Many smaller oil sands companies are putting entire production on rail
Spare Capacity in North Dakota

Source: NDPA
Crude Pipeline Infrastructure

Severely limited due to lack of Keystone XL and lack of historical build out to the coasts

Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software
Rail Infrastructure

Can get to the markets, pipeline can’t

Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software
Major rail companies in the U.S. and Canada are moving hundreds of thousands of barrels of crude each day. The Bakken is clearly the leader in this space, but more Canadian crude is beginning to move by rail as crude chases better prices at premium markets.

Source: Images directly from BNSF, CP, and CN websites
Optionality of Rail to Move Bakken and Canadian Crude

Source: EPRINC map using ArcGis
Over 1.9 mbd of crude oil and product are moving by rail in both U.S. and Canada.

AAR estimates 740,000 barrels of oil are moving each day via rail in the U.S. and Canada.

Source: Association of American Railroads. Weekly Railroad Traffic

crude petroleum and all products of petroleum refining (liquefied gases, asphalt, fuel oil, lubricating oil, jet fuel, etc.)

Note: Data are weekly average originations for each month, are not seasonally adjusted; crude petroleum and all products of petroleum refining (liquefied gases, asphalt, fuel oil, lubricating oil, jet fuel, etc.); one carload holds 30,000 gallons (or 714.3 barrels).
North American Rail Map

- New markets
- Diversification
- Neat Barrels
- Nimble- Quickly adjustable
- Optionality for Canadian and U.S. crude, NGLS, and other petroleum products

Source: Watco Companies LLC, Presentation Bakken Product Markets and Take-Away Denver Jan 31-Feb 1 2012
Major Regulatory Issues and Hurdles

- Oil prices
- Environmental Concerns
- Water Usage
- Regs on Federal Land-Fracking
- Infrastructure Delays-PERMITTING
- Lack of prudent policy making, not fully grasping the positive benefits and understanding of the bigger picture
Conclusions

• This is a petroleum renaissance. The U.S. is the largest producer of gas in the world and quickly becoming one of the lowest cost energy producers in the world
• US and Canadian oil and liquids production is surging
• Pipelines are being built, but right now their exists tightness—need for Gateway, XL, and Costal options for US and Canadian crude
• Rail is a serious option for US producers distanced from refining centers
• Rail could be an alternative shipping method for oil sands producers as they look to diversify their options and secure stable prices—markets exist where pipeline doesn’t (especially with XL delay and Gateway uncertainty)
• Blended bitumen needs to get to the Gulf and potentially PADD V
• Bakken light sweet needs to get to East Coast PADD I (as well as PADD V) ....only so much light sweet can be sent to Cushing and down into Gulf
• Rail in the long-term...it is going to be there, but the question is “how much”?...pipelines?