Challenges and Opportunities of the North American Petroleum Renaissance

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About EPRINC

• Founded in 1944

• Not-for-profit organization that studies energy economics and policy issues in the oil, natural gas, and petroleum product markets

• Provides objective and technical analysis on a wide range of energy issues

• Funded largely by the private sector and occasional U.S. government contracts

www.eprinc.org
EPRINC Embassy Series

- Engagement with Washington’s energy policy community

- Collaboration among the diplomatic community to provide both an interesting venue and constructive policy discussion

- The series offers an opportunity to gain a greater understanding of U.S. energy policy in an era of expanding U.S. supplies of oil and gas
Recent and Upcoming Projects/Events

• Pipelines, Trains, and Trucks

• RINs around the Rosy
  – EPA Administrator app – will be released shortly for iOS / iPhone

• Department of Defense contract: Global Implications of the North American Petroleum Renaissance

• Clingengdael Presentation

• Presentations at Chatham House and Imperial College London

• Next Embassy Event

• Collaborative research efforts with the University of Texas on petroleum exports

• Williston Basin Petroleum Conference Presentation
Importance of the North American Lens

Source: Wood Mackenzie (includes NGLs)
Outline

1. Breakdown of U.S. and Canadian Oil Production

2. Infrastructure Challenges in Moving Rising Volumes of North American Crude Oil

3. Regulatory Concerns

Source: EIA
North American Oil Production and Forecast

Source: EIA, Canadian CAPP forecast, EPRINC U.S. forecast, EPRINC Mexico, and EPRINC estimates

Avg 2013 Oil Production

U.S. 7.4 mbd
Canada 3.3 mbd
Jan 2014 EPRINC’s Forecast for Major U.S. Shale Plays

EPRINC forecasts an additional 2.5 mbd by 2020

Source: HPDI data with EPRINC forecast estimates
Canadian Long-Term Production Forecast

Source: Canadian Association of Petroleum Producers

Over 3 mbd increase by 2030

- Mining
- In Situ
- Conventional Light
- Conventional Heavy
U.S. Total Imports, U.S. Production, U.S. Canadian Imports

Source: EIA
U.S. Activity
 Permit Activity

Source: HPDI January 18 2014, Past 90 Days
Drilling Then and Now

Source Rocks and Reservoir Rocks

Accumulations

Figure 11-2 Migration of oil and gas in a sedimentary basin

Figure I-1 Generation of oil and gas

Source: From PIECE Course Workbook, Mark J Kaiser, Houston, July 2008, “Introduction to USA Petroleum Industry”
North American Potential...Shale Oil Plays
So how much oil is there...?

<table>
<thead>
<tr>
<th>Bakken Reserve Estimates</th>
<th>Barrels</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995 USGS</td>
<td>151 million</td>
</tr>
<tr>
<td>2008 USGS</td>
<td>4.3 billion</td>
</tr>
<tr>
<td>2010 NDIC</td>
<td>Add 1.9 billion (Three-Forks Addition)</td>
</tr>
<tr>
<td>January 2011 ND State Officials</td>
<td>11 billion (North Dakota alone)</td>
</tr>
<tr>
<td>Continental Resources</td>
<td>20 billion</td>
</tr>
<tr>
<td>....Pending USGS Update</td>
<td>???? billion</td>
</tr>
</tbody>
</table>

Source: EPRINC
State Production Trends

Source: EIA

North Dakota Field
Production of Crude Oil Mbbl/d

Alaska Field
Production of Crude Oil Mbbl/d

Colorado Field
Production of Crude Oil Mbbl/d

California Field
Production of Crude Oil Mbbl/d

New Mexico Field
Production of Crude Oil Mbbl/d

Texas Field
Production of Crude Oil Mbbl/d
U.S. Rig Count

Source: Baker Hughes
Part of the U.S. story

Source: NationalAtlas.gov
The Soaring Eagle Ford
Eagle Ford Wells

Source: HPDI Nov 2013
Eagle Ford Production

Source: HPDI Nov 2013
The Prolific Permian Basin
Permian Basin Production 1.38 mbd

Source: HPDI Oct 2013
EPRINC November Revised Permian Forecast

Source: EPRINC
Bakken: The Case Study
Williston Basin Production

Source: NDIC
Bakken Drilling

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

Source: Continental Resources Inc., Corporate Presentation, 2012.
Decline Rates

Source: HPDI, Bakken
Infrastructure Challenges
Pipeline Choke Points

Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software
All Canadian Pipeline Export Options are Full

- **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, several other planned expansions, light oil access +400,000 b/d

- **TransCanada’s** Keystone 581,000 b/d-full—XL would add 700,000 b/d, Energy East Pipeline Project 500 to 800k

Source: Canadian Energy Pipeline Association
Market Saturation

Source: CAPP Crude Oil Forecast June 2013

Sources: CAPP, CA Energy Commission, EIA, Statistics Canada
Where light sweet Bakken and heavy (blended bitumen) needs to go...

Source: AFPM map, EIA data for graph
Regional Pricing Disparities

- Western Canadian Select -$18.50 to WTI

Source: Flint Hills, EIA, CME Group, and estimates
The Rise of Rail
Daily Crude by Rail Shipment in U.S. and Canada

Source: AAR; Crude and petroleum product includes liquefied gases, asphalt, fuel oil, lubricating oil, jet fuel, etc. U.S. operations exclude U.S. operations of CN and CP. Canadian operations include CN and CP and their U.S. operations. One carload holds 30,000 gallons (or 714.3 barrels).
Pipeline and Rail

• Severely limited due to lack of Keystone XL and lack of historical build out to the coasts – system designed to import into the Gulf and move up

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

Source: EPRINC Maps using Hart Energy data and ArcGIS Mapping software
North Dakota Crude Oil Transport

January 2012 Estimates

- Pipeline Export: 58%
- Tesoro Refinery: 10%
- Truck to Canadian Pipelines: 7%
- Other: 25%

November 2013 Estimates

- Estimated Pipeline Export: 71%
- Tesoro Refinery: 22%
- Truck to Canadian Pipelines: 6%
- Estimated Rail: 1%

Source: North Dakota Pipeline Authority
Crude by Rail Accidents

- July 6, 2013, a run-away train crashed and exploded in Lac-Mégantic, Quebec, killing 47 people and destroying parts of the town.
- November 8, 2013, about 12 cars derailed in a unit train of 90 cars carrying crude oil near Aliceville, Alabama (45 miles SW Tuscaloosa). Nobody was injured, but three of the cars exploded.
- December 30, 2013, a train hauling grain derailed near Casselton, (SE) ND hitting a 106 car unit train of crude oil which caused 18 crude tank cars to derail causing a massive explosion and fireball.
- January 7, 2014, a Canadian National train jumped tracks in Plaster Rock, New Brunswick. 15 cars derailed and caught fire. The train was carrying propane and crude oil from Western Canada.
- January 20, 2014, a CSX train derailed in Pennsylvania on a railroad bridge and close a busy expressway (Schuylkill), but did not leak any crude oil.

Refineries Benefit
Refinery Acquisition Cost of Crude Oil

Source: EIA

- East Coast (PADD 1) Crude Oil Composite Acquisition Cost by Refiners $/bbl
- Midwest (PADD 2) Crude Oil Composite Acquisition Cost by Refiners $/bbl
- Rocky Mountain (PADD 4) Crude Oil Composite Acquisition Cost by Refiners $/bbl
- West Coast (PADD 5) Crude Oil Composite Acquisition Cost by Refiners $/bbl
- Gulf Coast (PADD 3) Crude Oil Composite Acquisition Cost by Refiners $/bbl
- Brent
Refinery Utilization by PADD

Source: EIA

- East Coast (PADD 1) Percent Utilization of Refinery Operable Capacity %
- Midwest (PADD 2) Percent Utilization of Refinery Operable Capacity %
- Gulf Coast (PADD 3) Percent Utilization of Refinery Operable Capacity %
- Rocky Mountains (PADD 4) Percent Utilization of Refinery Operable Capacity %
- West Coast (PADD 5) Percent Utilization of Refinery Operable Capacity %
Regulatory Concerns
Potential Issues, Hurdles, and Regulatory Concerns

• Oil prices
• Water Usage – Fracking and Recycling
• Oil spills (rail and pipeline)
• Environmental Concerns
• Regs on Federal Land-Fracking
• Infrastructure Delays - PERMITTING
• Costs incurred from such delays
• Crude Oil Exports
Natural Gas Flaring

Source: NDPA