The Shale Boom
Heard Around the World

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November 5, 2013
Is this the wrong question?

“Unlike the immediate benefits that American consumers and businesses have seen from low natural gas prices, at the gasoline pump, it has been pretty much business as usual. While the U.S. economy may be benefiting from declining oil imports, prices at the pump have remained consistently high.” He adds, “this Committee is going to explore why so many consumers have not benefitted from these new lower cost sources of crude oil.”

-U.S. Senator Ron Wyden, Senate hearing on gasoline prices, July 16, 2013
North American Oil Production

July U.S. Oil Production
7.5 mbd

Source: EIA
EPRINC’s Forecast for Major U.S. Shale Plays

EPRINC forecasts an additional 1.5 mbd by 2022

Source: HPDI data with EPRINC forecast estimates
CAPP 2013 Updated Production Forecast

Over 3 mbd increase by 2029

- Mining
- In Situ
- Conventional Light
- Conventional Heavy

Source: CAPP
EPRINC U.S. Forecast vs. Others

Current Shale Oil Play Production

Source: NDPA, HPDI
U.S. Rig Count

Source: Baker Hughes
Current Shale Oil Play Production

**Bakken**
- New-well oil production per rig
  - 2007: 200 barrels/day, 250 rigs
  - 2013: 400 barrels/day, 250 rigs

**Eagle Ford**
- New-well oil production per rig
  - 2007: 200 barrels/day, 350 rigs
  - 2013: 500 barrels/day, 350 rigs

**Bakken**
- New-well gas production per rig
  - 2007: 1,000 thousand cubic feet/day, 250 rigs
  - 2013: 3,000 thousand cubic feet/day, 250 rigs

**Eagle Ford**
- New-well gas production per rig
  - 2007: 1,000 thousand cubic feet/day, 350 rigs
  - 2013: 3,000 thousand cubic feet/day, 350 rigs

Source: EIA
Source: HPDI September 2013, Past 90 Days
U.S. Federal Land Map

Source: NationalAtlas.gov
U.S. Total Imports, U.S. Production, U.S. Canadian Imports

Source: EIA

Canadian Imports 2.5 mbd
U.S. Import Portfolio Shifting

Source: EIA, ENI World Oil Book
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, several other planned expansions
- **TransCanada’s** Keystone 581,000 b/d-full—XL would add 700,000 b/d, Energy East Pipeline Project 500 to 800k

Nearly full pipelines creates need for XL and Gateway→opportunities for rail

Source: Canadian Energy Pipeline Association
Market Saturation

Source: CAPP Crude Oil Forecast June 2013
Pipeline Choke Points

Source: EPRINC Choke Point Map using Hart ArcGIS Mapping software

- Canadian Crude
  - WCS-Heavy
  - Syncrude-Synthetic

- Bakken
  - Crude-Light Sweet

- Guernsey Choke Point

- Niobrara
  - Crude-Light Sweet

- Clearbrook/Superior
  - Choke Point

- Cushing Choke Point

- Permian
  - Crude-Light Sweet

- Gulf Coast
  - Choke Point

- Eagle Ford
  - Crude-Light Sweet

- California refineries are a natural fit for heavy Canadian crude, but there are currently no pipeline options available. Both Washington and California have begun taking some volumes of Bakken crude over the past few years.

- There is severe pricing pressure on Canadian and Bakken crude due to their distance from market and lack of pipeline optionality. The majority of Canadian crude must flow through the midwest corridor, but Bakken crude has the optionality of rail.

- Over the past few years more and more domestic and Canadian crude has been pushed into Cushing without efficient outlets to the coasts.

- East coast refineries are the natural home for Bakken light sweet crude, but there is currently no pipeline access to receive this oil. Rail is currently transporting both Bakken and Canadian crude to these refineries.

- Recent pipeline projects and expansions have begun opening Cushing to the Gulf and sending Permian crude to the Gulf. With an onslaught of Eagle Ford, Permian, and now Cushing crude, the Cushing bottleneck is moving to the Gulf Coast.
Where light sweet Bakken and heavy (blended bitumen) needs to go...

Total Coking Capacity vs. Atmospheric Crude Distillation Capacity by PADD

Cokers = Heavy refining capability

Source: AFPM map, EIA data for graph
Canadian vs. Total Foreign Imports by PADD

PADD I
- East Coast (PADD 1) Total Foreign Imports
- East Coast (PADD 1) Imports from Canada

PADD II
- Midwest (PADD 2) Total Foreign Imports
- Midwest (PADD 2) Imports from Canada

PADD III
- Gulf Coast (PADD 3) Total Foreign Imports
- Gulf Coast (PADD 3) Imports from Canada

PADD IV
- Rocky Mountain (PADD 4) Total Foreign Imports
- Rocky Mountain (PADD 4) Imports from Canada

PADD V
- West Coast (PADD 5) Total Foreign Imports
- West Coast (PADD 5) Imports from Canada

Source: EIA Data
Regional Pricing Disparities

• Western Canadian Select -$33 to WTI

Source: Flint Hills, EIA, CME Group, and estimates
Cushing Stocks vs. WTI Brent Differential

Source: EIA
Price of Canadian Crude Imports

- U.S. production surge
- Lack of adequate outbound capacity to refining centers
- Market saturation

Source: EIA

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).”
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
Williston Basin Crude Transportation

Williston Basin Production: 955,000 b/d
North Dakota: 875,000 b/d
South Dakota: 5,000 b/d
Eastern Montana: 75,000 b/d

Tesoro Refinery: 68,000 b/d

Truck to Canadian Pipeline: 12,000 b/d

Rail: 670,000 b/d

Pipeline: 241,000 b/d

Source: NDPA, EPRINC Estimates
Potential Issues, Hurdles, and Regulatory Concerns

- Oil prices
- Water Usage
- Oil spills (rail and pipeline)
- Environmental Concerns
- Regs on Federal Land-Fracking
- Infrastructure Delays
- PERMITTING
- Lack of prudent policy: failing to connect what is happening on the ground to what is understood in Washington
- Costs incurred
U.S. Transportation Fuel Demand

Weekly U.S. Product Supplied of Distillate Fuel Oil (Thousand Barrels per Day)
Weekly U.S. Product Supplied of Kerosene-Type Jet Fuel (Thousand Barrels per Day)
Weekly U.S. Product Supplied of Finished Motor Gasoline (Thousand Barrels per Day)
U.S. Auto-Fleet Fuel Economy

Source: U.S. Energy Information Administration, based on the Environmental Protection Agency (EPA), National Highway Transportation Safety Administration (NHTSA), and University of Michigan Transportation Research Institute (UMTRI)

Note: EPA and NHTSA estimates reflect model years, while UMTRI estimates reflect calendar years.
U.S. Liquid Fuels Consumption

Source: Short-Term Energy Outlook, October 2013

The Silent Disruption

EVENTS LEADING TO NEW EXPECTATIONS

- Positive expectations
  - Yukos-Kremlin takes control of Russian oil development
  - Continuing civil strife in Sudan, Nigeria
  - Oil development in Iraq delayed
  - Iraq invasion: outlook positive for new oil field rehabilitation

- Expectations shift
  - Russia takes over Sakhalin II; Chavez nationalizes projects
  - Outlook positive for expanded output from Nigeria, Mexico, Venezuela, Russia, Alaska’s North Slope

- Negative expectations
  - Nigeria rebels impair output
  - US Congress continues ban on ANWR and offshore development
  - OPEC excess capacity remains limited

Global production, million b/d

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OPEC Spare Capacity

OPEC Surplus Crude Oil Production Capacity

Source: Short-Term Energy Outlook, October 2013

Note: Shaded area represents 2002-2012 average (2.5 million barrels per day)
World Liquid Fuels Balance

World Liquid Fuels Production and Consumption Balance

Source: Short-Term Energy Outlook, October 2013

Implied stock change and balance (right axis)
World production (left axis)
World consumption (left axis)
Non-OPEC Production Growth

Non-OPEC Crude Oil and Liquid Fuels Production Growth

(million barrels per day)

Source: Short-Term Energy Outlook, October 2013

Iran: -1.5 mmbd exports
WTI Price

Weekly Cushing, OK WTI Spot Price FOB (Dollars per Barrel)
## Non-FTA LNG Export Approvals

Applications Received by DOE/FE to Export Domestically Produced LNG from the Lower-48 States (as of September 10, 2013)

All Changes Since August 7, 2013 Update Are In Red

<table>
<thead>
<tr>
<th>Company</th>
<th>Quantity</th>
<th>FTA Applications (Docket Number)</th>
<th>Non-FTA Applications (Docket Number)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sabine Pass Liquefaction, LLC</td>
<td>2.2 Bcf/d</td>
<td>Approved (10-85-LNG)</td>
<td>Approved (10-111-LNG)</td>
</tr>
<tr>
<td>Freeport LNG Expansion, L.P. and FLNG</td>
<td>1.4 Bcf/d</td>
<td>Approved (10-160-LNG)</td>
<td>Approved (10-161-LNG)</td>
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<tr>
<td>Liquefaction, LLC</td>
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<td></td>
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<tr>
<td>Lake Charles Exports, LLC</td>
<td>2.0 Bcf/d</td>
<td>Approved (11-59-LNG)</td>
<td>Approved (11-59-LNG)</td>
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<tr>
<td>Carib Energy (USA) LLC</td>
<td>0.03 Bcf/d: FTA</td>
<td>Approved (11-71-LNG)</td>
<td>Under DOE Review (11-141-LNG)</td>
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<td></td>
<td>0.01 Bcf/d: non-FTA</td>
<td>Approved (11-115-LNG)</td>
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<tr>
<td>Dominion Cove Point LNG, LP</td>
<td>1.0 Bcf/d</td>
<td>Approved (11-115-LNG)</td>
<td>Under DOE Review (11-128-LNG)</td>
</tr>
</tbody>
</table>

**Approved**

6.6 bcf/d approved thus far
GLOBAL IMPACT: ETHYLENE CAPACITY

Global Capacity: 156 million tpa ethylene
At risk: 14 million tpa ethylene
Criteria: Liquid feed crackers smaller than 0.5 million tpa

Source: KBC Energy Economics

October 2013
Conclusions

• Shale (gas and oil) having a beneficial and tangible impact in the U.S.
  • Refineries reopening in the U.S. vs. closing in Europe
  • Economic growth, stimulus, some manufacturing returning
• North America may soon be oil self-sufficient
• Plus and minuses for the rest of the world
  • Europe – competitiveness harmed for gas/NGL based industries, but LNG more abundant
    • Lower oil price path
  • Middle East and Asia will become more interdependent
  • Enabled U.S. Iran policy???
• LNG exports important, but perhaps more important is that the U.S. will not be a large importer
• Could be 2008, or worse, all over again.