Perspectives on the Impact of Shale Gas and Tight Oil Production on the Global E&C Industry ...and Vice Versa

September 23, 2014
Today’s objectives

• Review the impact of U.S. shale gas and tight oil on the global energy markets

• Examine the role of E&C on the future evolution of the energy markets

• Highlight some of the challenges and implications for energy players and E&C service providers
U.S. natural gas market has experienced a “supply shock” driven by shale gas

- Shale gas is now the leading source of NG in the U.S.
- U.S. NG prices have decoupled from oil price producing widely divergent global gas prices by region
- Lower NG prices have led to domestic substitution and opened up international arbitrage opportunities

U.S. natural gas supply by type (BCF/D)

- Shale gas
- Conventional
- Tight gas
- CBM
- Imports

CAGR '00-'13
-2%
1%
4%
-4%
30%

Source: EIA AEP 2014
As a result of wet gas production, NGL volumes have surged.

- Lower NGL prices have significantly bolstered U.S. competitiveness and ushered in a U.S. petrochemicals manufacturing renaissance
  - Doubling of ethane cracking capacity
  - Quadrupling of LPG exports
  - Doubling of domestic methanol production
  - Resurgence of domestic ammonia production

Source: Wells Fargo Securities; EIA; ICF International; Bain Analysis
A “supply shock” is also underway in U.S. tight oil and crude sources are changing rapidly

- Tight oil is fastest growing source of crude oil supply
- U.S. price index (WTI) decoupled from other world indices
- Lower-priced U.S. tight oil displacing light imports
- U.S. has become a net exporter of refined products

Source: EIA AEO 2014; Deutsche Bank; Bentek; Wood Mackenzie; CAPP; Calgary Herald
Total U.S. oil & gas exploration and development capital expenditures beginning to slow

U.S. Oil & Gas Exploration and Development CapEx

2007-2013 11% CAGR

2013-2016 3% CAGR

Source: Based on Rystad, July 2014
Midstream companies are investing at historically high levels to capitalize on supply shifts

- **Supermajors** have historically had higher CapEx levels given end of “easy oil” and need to develop higher cost reserves (e.g., deepwater, oil sands, Arctic)

- **Midstream Maintenance Cycle** (2004-2007) relatively low levels of CAPEX driven primarily by maintenance projects

- **Midstream Infrastructure Supercycle** seeing dramatic increase in CAPEX driven by major expansion projects

Source: Company annual reports and investor presentations; Bain analysis
U.S. chemical industry planning increased CapEx as a result of shale gas-induced competitiveness

U.S. energy-related chemicals CapEx

<table>
<thead>
<tr>
<th>Year</th>
<th>CapEx (in $B)</th>
<th>CAGR ('13-'16)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>2014F</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2015F</td>
<td>13</td>
<td>43%</td>
</tr>
<tr>
<td>2016F</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

Source: IHS, “America’s New Energy Future: The Unconventional Oil and Gas Revolution and the U.S. Economy”
As a result of surge in CapEx, E&C revenues are up even as backlog continues to grow

E&C REVENUES IN INDUSTRIAL / PETROLEUM SEG. ARE ON THE RISE (UP 50% VS. 2009)...

Global E&C revenue in Petroleum / Industrial segment

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>212</td>
<td>321</td>
</tr>
</tbody>
</table>

CAGR (09-12) 15%

...AND SUPPORTED BY HEALTHY AND GROWING BACKLOG (ALSO UP 50% VS. 2009)

Oil & gas-related* backlog for major E&C players

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>37</td>
<td>38</td>
<td>38</td>
<td>50</td>
<td>54</td>
</tr>
</tbody>
</table>

CAGR (09-13) 10%

*Oil & gas-related includes upstream, midstream, downstream and petrochemicals
Note: CBI backlog in 2013 scaled 50% Engineering, Construction and Maintenance, 75% Fabrication, 100% technology, based on revenue analyst reports; assumes JEC backlog 2008-2010 is 35% O&G-related, given O&G-related share of backlog in 2011
Source: ENR; Credit Suisse, 2014 Engineering & Construction Outlook and various analyst reports; Bain analysis
Audience Response Question

Given the number of capital projects being built and planned across the entire oil and gas value chain, does the industry have the engineering and construction capacity to respond to these plans?

- Yes
- No
- Not sure
Survey of ECC Plenary session attendees

Given the number of capital projects being built and planned across the entire oil and gas value chain, does the industry have the engineering and construction capacity to respond to these plans?

- Yes 22%
- No 66%
- Not sure 12%

Source: Survey of ECC Plenary session attendees, Sep 2014, N = 800+
Think about the following question

What are the consequences of not delivering these major projects (roughly) on time and on budget?

Source: Survey of ECC Plenary session attendees, Sep 2014, N = 800+
Long-term forecasts vary widely

ALL FORECASTS EXPECT GAS PRODUCTION TO INCREASE

U.S. dry natural gas production (BCFD)

FORECASTS VARY ON IF AND WHEN OIL PRODUCTION WILL PEAK

U.S. crude oil production (MBD)

Note: EIA high and low cases based on the high and low resource scenarios; Crude oil production figures include lease condensate but exclude natural gas liquids; dry natural gas production figures exclude natural gas liquids; IHS CERA forecast excludes potential impact of Alaska LNG exports and assumes infrastructure production; IEA crude oil estimates based on excluding EIA NGL production forecast from IEA U.S. total liquids production forecast

Source: EIA 2014 AEO; IEA 2013 WEO; OPEC 10/13 article; IHS CERA; Bentek; Raymond James
Nearly all variability in these forecasts is driven by shale gas and tight oil.

**SHALE GAS DRIVES ~85% OF EIA FORECAST DIFFERENCE IN 2030**

- **US natural gas production (BCFD)**

- **2030 EIA Low**: 79.4 BCFD
- **Difference Low to High**: 31.3 BCFD
- **2030 EIA High**: 107.0 BCFD

**TIGHT OIL DRIVES ~90% OF EIA FORECAST DIFFERENCE IN 2030**

- **US crude production (MBD)**

- **2030 EIA Low**: 7.1 MBD
- **Difference Low to High**: 5.9 MBD
- **2030 EIA High**: 12.8 MBD

Source: EIA 2014 AEO, High and Low O&G resource cases
NGL prices have decoupled from oil but still support attractive well economics

NGL PRICES DECOUPLED FROM OIL IN ~2010

Historically, NGL prices closely followed oil. Since ~2010, NGL prices have separated from oil.

NGL PRICES STILL SUPPORT MORE ATTRACTIVE WELL ECONOMICS

Wet gas economics (forward 12-month strip)

- Ethane: 5.87
- Natural gasoline
- Normal butane
- Iso butane
- Propane: 3.80
- Methane
- Propane

Dry gas: $6/MCF

Source: Bloomberg; EIA; Enterprise Products Partners, L.P.; EPD Fundamentals and NYMEX, as of September 2013
Both shale oil and shale gas production are following steep learning curves (industry experience curves)

**SHALE GAS INDUSTRY EXPERIENCE CURVE**

Total cost of shale gas production (per BOE)

- **Slope = 86%**
- **R² = 0.87**

**TIGHT OIL INDUSTRY EXPERIENCE CURVE**

Total cost of tight oil production (per BOE)

- **Slope = 87%**
- **R² = 0.75**

Note: Estimated based on Rystad forecasts of unconventional shale oil and shale gas production and expenditures
Source: Rystad; Bain analysis
Low and high cases for U.S. shale gas production result in structurally different NG supply curves

2030 Low Shale Gas Production Scenario

Cost of production/import ($/MMBtu)

U.S. Demand = ~70 BCF/D

2030 High Shale Gas Production Scenario

Cost of production/import ($/MMBtu)

U.S. Demand = ~95 BCF/D

Source: EIA; IEA; Bain analysis
Global proposed LNG capacity additions have rated costs from $4 to $14 per MMBtu.

Note: Supply curve from Deutsche Bank, estimates for incremental demand through 2025 taken from Macquarie Research; ME = Middle East, AB = Alberta; PB = Papua Barat (Tangguh LNG in Indonesia). 1 BCF/D = 7.82 MTPA.

Source: Wood Mackenzie data; Deutsche Bank; Macquarie Research; Bain analysis.
Increased LNG exports from the U.S. could significantly flatten out the supply curve.

Cost Stack in LNG delivered to Tokyo Bay (with 12% IRR) (US$/MMBtu)

Note: 1 BCF/D = 7.82 MTPA
Source: Wood Mackenzie data; Deutsche Bank; Macquarie Research; Bain analysis
Substantial uncertainty exists around how much LNG the U.S. will ultimately export

Sources of Uncertainty

- **Global LNG demand**
  - Demand growth estimates nearly double total demand by 2025...
  - ...these demand projections are edging upwards

- **Competitive LNG supplies**
  - 50+ LNG facilities being built or planned; many with rated lower landed cost vs. U.S.
  - High variability of on-time, -budget threatens competitiveness of many of these projects

- **Global shale boom**
  - Based on reserves alone, shale has the potential to transform the energy markets in many countries
  - Every major non-North American shale resource holder has significant barriers to overcome (geology, infrastructure, regulation)
  - We do not expect a “global shale revolution” in next ~10 years

Note: Only liquefaction facilities are considered, approved facilities have been granted conditional / final approval by U.S. DOE but not necessarily by FERC

Sources: BP, BG, Department of Energy, Bloomberg, Platts
Low and high cases for U.S. tight oil production result in structurally different crude oil supply curves.

Source: EIA; IEA; Bain analysis
High U.S. tight oil production scenario could significantly alter global clearing price

Cost of production/import (2012 $/bbl)

Note: Crude demand forecast does not include condensates and liquids
Source: Rystad; IEA; Advanced Resources Int'l; BP Energy Outlook 2030; Bain analysis
Historically, over-supply situations have led to price declines between 30% and 70%.

<table>
<thead>
<tr>
<th>Year</th>
<th>Change in production (%)</th>
<th>Change in consumption (%)</th>
<th>Change in price (%)</th>
</tr>
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<tbody>
<tr>
<td>1986</td>
<td>7%</td>
<td>-0.8</td>
<td>-57%</td>
</tr>
<tr>
<td>1991</td>
<td>6%</td>
<td>-1.4</td>
<td>-42%</td>
</tr>
<tr>
<td>1998</td>
<td>4%</td>
<td>-0.3</td>
<td>-27%</td>
</tr>
<tr>
<td>2001</td>
<td>0%</td>
<td>-0.5</td>
<td>-31%</td>
</tr>
<tr>
<td>2008</td>
<td>-1%</td>
<td>-1.4</td>
<td>-69%</td>
</tr>
</tbody>
</table>

Source: EIA; IEA
Strategy in an environment of high uncertainty requires a scenario-based approach

Unprecedented level of uncertainty

- Competition between much more diverse energy sources
- Speed of expansion of shale gas and tight oil inside and outside of NA
- Speed and cost of infrastructure build out
- Change in domestic and international flows
- Speed and degree of demand substitution

WIN WHICHEVER SCENARIO MATERILIZES

Define/update scenarios
Build Integrated view
Define and track leading indicators
Quantify risks and develop mitigation strategies
Develop and adjust plans