INNOVATIONS ENABLING SUSTAINED PERMIAN GROWTH

MCCOMBS ENERGY INITIATIVE CONFERENCE – PERMIAN 2025

David Baldwin
February 8, 2019
U.S. Oil and Liquids Production

- Conventional Oil Decline
- Shale Oil Revolution

US Oil and Liquids Production (MMBOE per Day)

- 40 Year Decline
- 9% CAGR

The University of Texas at Austin Energy Institute
U.S. Oil and Liquids Production: Permian

Permian Liquids Production

US Oil and Liquids Production (MMBOE per Day)

U.S. Oil and Liquids (less Permian since Sept 08)  Permian Oil and Liquids since Sept 08
## North American Impact on Global Supply

### Oil and Liquids

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2018</th>
<th>CAGR</th>
<th>Increm. Ex Iraq / Iran</th>
</tr>
</thead>
<tbody>
<tr>
<td>US &amp; Canada</td>
<td>13.1</td>
<td>21.9</td>
<td>6.6%</td>
<td>80%</td>
</tr>
<tr>
<td>Iraq &amp; Iran</td>
<td>6.6</td>
<td>9.5</td>
<td>4.7%</td>
<td>26%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>68.5</td>
<td>67.8</td>
<td>-0.1%</td>
<td>-6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>88.2</td>
<td>99.2</td>
<td>1.6%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Natural Gas

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2018</th>
<th>CAGR</th>
<th>Increm. Ex Iraq / Iran</th>
</tr>
</thead>
<tbody>
<tr>
<td>US &amp; Canada</td>
<td>16.2</td>
<td>19.9</td>
<td>2.6%</td>
<td>88%</td>
</tr>
<tr>
<td>Iraq &amp; Iran</td>
<td>4.1</td>
<td>5.8</td>
<td>4.4%</td>
<td>40%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>38.3</td>
<td>37.1</td>
<td>-0.4%</td>
<td>-28%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>58.6</td>
<td>62.8</td>
<td>0.9%</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Oil, Liquids, and Natural Gas

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2018</th>
<th>CAGR</th>
<th>Increm. Ex Iraq / Iran</th>
</tr>
</thead>
<tbody>
<tr>
<td>US &amp; Canada</td>
<td>29.3</td>
<td>41.8</td>
<td>4.5%</td>
<td>82%</td>
</tr>
<tr>
<td>Iraq &amp; Iran</td>
<td>10.7</td>
<td>15.3</td>
<td>4.6%</td>
<td>30%</td>
</tr>
<tr>
<td>Rest of World</td>
<td>106.8</td>
<td>104.9</td>
<td>-0.2%</td>
<td>-12%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>146.8</td>
<td>162.0</td>
<td>1.2%</td>
<td>100%</td>
</tr>
</tbody>
</table>
U.S./Canada vs. Russia vs. Saudi Arabia

<table>
<thead>
<tr>
<th></th>
<th>Natural Gas Price ($/ MMBTU)</th>
<th>Crude Oil Price ($/BBL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Shale</td>
<td>$10.00</td>
<td>$100.00</td>
</tr>
<tr>
<td>Post Shale</td>
<td>3.00</td>
<td>50.00</td>
</tr>
</tbody>
</table>

Annual Savings = $3 Trillion
4% of Global GDP
THE "SHALE PATH" TO US ENERGY INDEPENDENCE

US Energy Demand

Energy Production / Consumption (MMBOEPD)


Other
Solar
Wind
Geothermal
Hydroelectricity

Nuclear
Coal
Natural Gas
Oil and Liquids
WHY / HOW
Old - Conventional

New - Unconventional

<table>
<thead>
<tr>
<th></th>
<th>Old</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wells/Section</td>
<td>32</td>
<td>4</td>
</tr>
<tr>
<td>Pay / Well</td>
<td>100’</td>
<td>10,000’</td>
</tr>
<tr>
<td>Reservoir Exposure</td>
<td>3200’</td>
<td>40,000’</td>
</tr>
</tbody>
</table>

- 1/8th the number of wells
- 10x reservoir exposure

Source: Energy of North Dakota
COSTS ARE FALLING.....
("EFFICIENCY")

[Chart showing average horizontal drilling costs from 2012 to 2017, with a steady decline in costs.]
...AND WELLS ARE MUCH MORE PROLIFIC
(“PRODUCTIVITY!”)
...AND LATERALS ARE GETTING LONGER
(“RESERVOIR EXPOSURE”)

AVERAGE U.S. HORIZONTAL WELLBORE LENGTH

<table>
<thead>
<tr>
<th>Year</th>
<th>Wellbore Lateral Length (FT.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>6727</td>
</tr>
<tr>
<td>2015</td>
<td>7155</td>
</tr>
<tr>
<td>2016</td>
<td>7677</td>
</tr>
<tr>
<td>2017</td>
<td>8034</td>
</tr>
<tr>
<td>2018</td>
<td>8378</td>
</tr>
</tbody>
</table>
Efficiency and Productivity Impact on Breakeven

\[
\text{Breakeven Prices ($/BBL)} = \frac{\triangle \text{Efficiency} \times \triangle \text{Service Costs}}{\triangle \text{Productivity} \times \triangle \text{Reservoir Exposure}}
\]

<table>
<thead>
<tr>
<th>Unit</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Efficiency”</td>
<td>(Days/Well)</td>
<td>90%</td>
<td>90%</td>
<td>90%</td>
<td>95%</td>
<td>95%</td>
</tr>
<tr>
<td>“Service Costs”</td>
<td>($/Days)</td>
<td>90%</td>
<td>85%</td>
<td>120%</td>
<td>110%</td>
<td>100%</td>
</tr>
<tr>
<td>“Productivity”</td>
<td>(BBLS/Foot)</td>
<td>105%</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
</tr>
<tr>
<td>“Lateral Length”</td>
<td>(Feet)</td>
<td>110%</td>
<td>110%</td>
<td>110%</td>
<td>105%</td>
<td>105%</td>
</tr>
</tbody>
</table>

“Breakeven Price”

- $100/BBL
- $71/BBL
- $45/BBL
- $40/BBL
- $36/BBL
- $30/BBL
TECHNOLOGIES DRIVING EFFICIENCY GAINS ("EFFICIENCY!")

PAD DEVELOPMENT

DUAL OR "ZIPPER" COMPLETIONS OPERATIONS

A

B

LOCAL SAND

LARGE DIAMETER COILED TUBING

Sources: Statoil, Natural Gas Industry B.
TECHNOLOGIES DRIVING PRODUCTIVITY GAINS ("PRODUCTIVITY!")

GREATER PROPPANT LOADING

TIGHTER STAGE SPACING

GEOSTEERING

COMPLETION TOOLS
TECHNOLOGIES ENABLING LONGER LATERALS
(“RESERVOIR EXPOSURE”)

HIGH SPEC RIGS

ROTARY STEERABLE SYSTEMS

Step-Change MWD Survey Accuracy Improvement
DrillComm™ Universal MWD Link
K-Pivot™ Sub/Stab BHA for Push or Point-Bit Steering
Integrated LWD Automated GeoSteering
Reliable Economical RSS with Proportional Steering, Cruise Control, & High Dogleg
Downhole Automated Coordinate Steering

HIGH TORQUE MUD MOTORS

PDC BITS

Sources: American Oil & Gas Reporter, Kinetic Upstream Technologies, Drilling Formulas, Ulterra
Shale 3.0 – Field/Cube Development Challenges

Ideal

Reality
SUSTAINING THE REVOLUTION...2020 AND BEYOND

FRAC OPTIMIZATION

AUTOMATION

ADVANCED LEARNING

DECARBONIZATION
ENERGY INNOVATION...NEXT 50 YEARS

• Big 3...Energy, Technology, Healthcare

• Entrepreneurial

• Global, Diverse Business

• 21st Century....“Sustainable Development”