The Bakken Boom

Bakken Shale Output-Supply Implications for North Dakota

Trisha Curtis
Research Analyst
EPRINC (Energy Policy Research Foundation, Inc)

New York Energy Forum
May 19th 2011
North Dakota 6% of US Production

March 2011 North Dakota Production 359,589 b/d

Bakken represents 75% of ND Production
Map of Williston Basin with Bakken and Three-Forks Formation

Source: EPRINC

Source: Julie LeFever Presentation
<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: Baker Hughes. All but 50 rigs nationwide are onshore.
Williston Basin Production

Source: North Dakota Pipeline Authority
Decline Rates

Source: Brigham Exploration via World Oil
....Decline Rates

Estimated EUR Range 500-700 Mboe*

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>500 Mboe</td>
<td>$8.7MM</td>
<td>2.0</td>
<td>59%</td>
<td>1.7</td>
<td>31.0</td>
</tr>
<tr>
<td>600 Mboe</td>
<td>$12.3MM</td>
<td>2.4</td>
<td>89%</td>
<td>1.2</td>
<td>33.1</td>
</tr>
<tr>
<td>700 Mboe</td>
<td>$15.9MM</td>
<td>2.8</td>
<td>&gt;100%</td>
<td>1.0</td>
<td>34.8</td>
</tr>
</tbody>
</table>

*BEXP Internal Estimates. 52/11 NYMEX Strip. Price differentials: $9.40/Bbl & 1.4 Gas Price Factor. $8.9MM CWC, $15,100/mo OPEX. Monthly average rate which given natural declines is less than IP rates.
Top North Dakota Producers in 2010

Source: Oil Patch Hotline March 24, 2011, Acreage data Wood Mackenzie
Company Notes

- **Brigham** maximum average production rate 652 b/d in 2009, up from 200s and mostly attributed to longer laterals (Bentek) and plans expansion and rig increases this year

- **Baker Hughes** installed 40 stage frac for **Whiting Petroleum** (Talkin’ the Bakken) “saving money by using the sliding sleeve frac method” done in 24 hours “rather than plug and perf” up to 7 days and twice the cost (Oil Patch Hotline)

- **EOG**, moving to longer laterals...some 14,000 ft. 10 rigs with 100% success rate throughout 600,000 acres.

- **Continental Resources**, 12 wells with 1,000 plus boe per day. 67% production growth year over year. Some positive Montana wells, just under 1000 boe per day. Assets west of Nesson Anticline being derisked and moving forward (for more than just Continental...promising for Bakken...play really coming into its own)

- **Occidental** ramp up investment in 2010 with $1.4 billion purchase in acreage (180) from private seller, plan to have twelve rigs running
Geology Matters

Source: Julie LeFever Presentation on Potential North Dakota production
Oil Production and Drilling in the Williston Basin

Current Rig Count
178

Source: NDPA with Oil Patch Hotline Numbers and Baker Hughes Interactive Rig Count iPad
Technology Matters

• Overtime companies in the Bakken have improved their techniques

• Only a few years ago frac stages were minimal, but now they are 30 plus with some trying to go as high as 60

• Typically, more fracturing means more production, but this also increases cost, usually more than paid for by the increased production

• Horizontal laterals now common in the Bakken and across the country were once around 4,000 ft and are now as long as 10-15,000 ft

• Studies have shown that permeability of the rock, completion best practices, and type of fracking fluids and components all matter in increasing production (Oil and Gas Investor).

• “…40 fracture stimulations are now pushing ultimate recovery figures to well over 600,000 and 700,000 barrels of oil.” (Oil Patch Hotline)
Potential Constraints

• **Severe weather** constraints in North Dakota with temperatures commonly seen below -40 degrees Fahrenheit and massive amounts of snow

• These weather constraints often cause producers to **shut-in wells** for a period of time until wells can be accessed and produced oil can be transported.

• The **cost of drilling** these wells has increased significantly over the years and is set to increase further as rising oil prices have triggered extending production in multiple shale plays throughout the US
…..Potential Constraints

• The cost of drilling and completing an oil well in North Dakota in 2009 according North Dakota Petroleum Association was $5.6 million….said to be almost double now

• With increased activity means increased demand for frac fluid, water, trucks, etc… all of which can incur delays and impact production. Companies have a **backlog of wells waiting completion**

• With the increasing costs of drilling, high oil prices are and will continue to be one of the most important factors in the success of rising production in the Bakken along necessary take-away capacity to prevent eroding prices
Price Differentials
Pipeline, Rail, and Truck

March 2011 for Williston Basin (ND, Eastern Montana, SD)

Pipeline: 348,401 b/d

Rail: 49,000 b/d

Truck: 27,563
### Planned Take-Away Capacity

<table>
<thead>
<tr>
<th>Transportation System Capacity, Barrels Per Day</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pipeline Transportation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butte Pipeline</td>
<td>92,000</td>
<td>104,000</td>
<td>118,000</td>
<td>118,000</td>
<td>118,000</td>
<td>118,000</td>
<td>118,000</td>
</tr>
<tr>
<td>Enbridge North Dakota</td>
<td>80,000</td>
<td>110,000</td>
<td>110,000</td>
<td>161,500</td>
<td>161,500</td>
<td>161,500</td>
<td>161,500</td>
</tr>
<tr>
<td>Tesoro Mandan Refinery</td>
<td>58,000</td>
<td>58,000</td>
<td>58,000</td>
<td>58,000</td>
<td>58,000</td>
<td>58,000</td>
<td>58,000</td>
</tr>
<tr>
<td>Enbridge Sweet Only</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>23,500</td>
<td>23,500</td>
<td>23,500</td>
</tr>
<tr>
<td>Enbridge Bakken Expansion</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>25,000</td>
<td>25,000</td>
<td>145,000</td>
</tr>
<tr>
<td>Butte Pipeline Expansion*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>32,000</td>
<td>32,000</td>
<td>32,000</td>
</tr>
<tr>
<td>Butte Loop*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Plains Bakken North*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>50,000</td>
<td>50,000</td>
</tr>
<tr>
<td>Keystone XL Interconnect*</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>100,000</td>
</tr>
<tr>
<td>Pipeline Only Total</td>
<td>230,000</td>
<td>272,000</td>
<td>286,000</td>
<td>337,500</td>
<td>418,000</td>
<td>518,000</td>
<td>738,000</td>
</tr>
</tbody>
</table>

*Project still in the proposed or internal review phase

Source: North Dakota Pipeline Authority

- **Tesoro** Mandan refinery expansion from 58 thousand to 68 thousand b/d
- **Canadian Pacific Railway** announces $100 million North Dakota investment (Talkin’ the Bakken)
- **Hess** train facility by 2012 part of $1.8 billion investment for capacity of 120,000 b/d
Why not Montana?

• North Dakota wants this oil. Despite housing shortages and road traffic, the tone in North Dakota is that oil is positive. Low unemployment (3.8%), high tax revenue, growth and sustainability.

• Today, Montana production is declining, but has promising drilling prospects in the Alberta Bakken and Heath play.

• **North Dakota Rig Count:** 177 (May 11, 2011 Source: ND Oil & Gas Division) **Eastern Montana Rig Count:** 9 (May 11, 2011 Source: Baker Hughes)

• The boom actually began in Montana, Elm Coulee field and was trying to replicated in North Dakota.

• In 2007 North Dakota cut taxes for one year to incentivize oil companies to move across the border.

• Federal Land: Montana 29.9% vs. 2.7 % North Dakota ….Oil Patch Hotline “Yates Raps BLM for 4 Year Permit Delay” in Wyoming
Systemic Impacts and Infrastructure Needs

Source: Baker Hughes Interactive Rig Count
Cushing Dilemma and Why it Matters to the Bakken

- Increased domestic production coupled with continually increasing Canadian imports and a non-adaptive pipeline system is building inventories in Cushing, Oklahoma, the pricing point for West Texas Intermediate on the NYMEX and eroding prices against Brent.

- Bakken crude is already at a severe discount given its distance from markets and its lack of infrastructure to move crude quickly to major refining centers.

Source: EIA
Canadian Imports

Source: EIA
US Cracking Margins

Source: Platts Data
Pipelines In and Out of Cushing 1988

Source: Info. From CME Group and Purvin and Gertz Study
Pipelines In and Out of Cushing 2009

Source: Info. From CME Group and Purvin and Gertz Study
Important Takeaways

• Access to mineral leases through a conducive regulatory environment with minimal Federal land and expedited permit processing

• Led by independents, many of which were shale gas players

• Constantly adapting and changing drilling and completion techniques necessary to match the growing knowledge of the geology (additional frac stages have raised ultimate recovery rates, increased efficiency)

• Continual developments in take-away capacity suggest that take-away capacity won’t be an impediment in expanding production (if the Bakken continues on this level of success)

• Success in the Bakken, high oil prices, and depressed natural gas prices have already lead to shale oil plays in the Eagle Ford, Niobrara, Spraberry etc…, Monterey, and others. The success of these plays, like the Bakken, will be determined by continual adaptation to the geology, application of the right technology, as well as the development of infrastructure needed to make the play economic