U.S. Bakken Shale Play: Update From The Field

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Breitling Oil and Gas North American Unconventional Resource Experience

- **CBM**
  - San Juan
  - Drunkards Wash Uinta
  - Powder River
  - Horseshoe Canyon
  - Manville

- **Shale**
  - Barnett
  - Haynesville
  - Muskwa
  - Montney
  - Austin
  - Anadarko
  - **Bakken**

- **Tight Gas**
  - Piceance
  - Anadarko
  - San Juan
  - Deep Basin
  - Uinta
  - Greater Green River
  - Lobo
  - Bossier
Pre-Bakken North Dakota Traffic Jam
Bakken Boom Traffic
Where Is the Bakken?

The Bakken Formation is a rock unit occurring deep in the Williston Basin.

Discovered in the 1950s in North Dakota.

Prolific, sustained production began in the 2000s.

Oil is currently produced from the Bakken Formation in:

- North Dakota
- Montana
- Saskatchewan
- Manitoba
The Williston Basin

2008

2012

7000 wells with 250+ new wells added monthly. Covering over 25,000 sq. mi.
History

1953 – 1960
- 56 vertical wells targeting both zones (209 BOPD avg IP)
- Some have cumulative production over 1,000,000 bbl oil to date

1961 – 1976
- Billings Nose “Bakken Fairway” on South west side of the Basin
- Bail out zone to Red River

1987 - 2005
- Horizontal drilling in the shale along the Fairway & Elm Coulee
- 225 wells: 86 BOPD IP yielding 145 MBOE

2006+
- Parshall Discovery Well
- 3,000 wells later……
Total Petroleum System

- **Generation**
- **Migration**
- **Entrapment**

Layers:
- Oil
- Water
- Gas
- Cap
- Seal Rock
- Reservoir Rock
- Source Rock

Temperatures:
- 120° F
- 350° F

Total Petroleum System
Bakken Well Specifications

4 Mile Hole
2 Miles Down – 2 Miles Out

Multiple fracture stages with a 500’ stimulation radius
How is Bakken Shale Production Possible?

- Recent advancements in technology have spurred tight oil production.
  - Horizontal drilling and completion
    - 8,000- to 10,000-ft laterals in the Bakken
  - Hydraulic fracturing
    - “Fracking” with a mixture of fluids and Proppants (sand & ceramic)
Steel casing lines the well and is cemented in place to prevent any communication up the wellbore as the fracturing job is pumped or the well is produced. Shallow formations holding fresh water that may be useful for farming or public consumption are separated from the fractured shale by thousands of feet of rock.
How Many “Bakkens” Are There?

North American Shale Plays
(as of March 2011)

Source: Energy Information Administration based on data from various published studies.
Updated: March 21, 2011
2013 Williston Basin tight oil production will be over 1,000,000 bpd.

Eagle Ford will be over 250,000 bpd.

2020 North American tight oil production could be over 3,000,000 bpd.

2050 North American tight oil production could be over 10,000,000 bpd.
Data on recoverable tight oil resources are not yet available for many states.
Commodity Advantage Favors Oil
Oil Prices vs 6:1 Equivalent Natural Gas Prices

![Diagram showing oil prices vs natural gas prices with a 6:1 ratio advantage for oil.](image-url)
High Value Oil Enhances Margins Relative to Natural Gas

Per Barrel of Oil Equivalent (6:1 Conversion)

\[ \text{NYMEX Crude Oil 12 mo. Strip} = \$85 / \text{Boe} \]
\[ \text{Drilling Finding Cost} = \$16 / \text{Boe} \]
\[ \text{NYMEX Equiv. Natural Gas 12 mo. Strip} = \$25 / \text{Boe} \]

Oil commodity advantage likely to persist for the next several years given the expected gas oversupply from gas shale plays.
Bakken Horizontal Play

New completion designs improves results… continually modeling and testing different types of stimulation
Horizontal Bakken Drilling Cost

2006
Rough Rider
- Total Well Cost: $3,500,000
- ~EUR: 127,000 Boe
- F&D Cost$/Boe: $34.45/Boe
- Pro-Swell Packers

2007
Ross
- Total Well Cost: $4,000,000
- 236,000 Boe
- F&D Cost$/Boe: $21.19/Boe
- Early Swell Packers

Late 2008
Ross
- Total Well Cost: $4,400,000
- 411,000 Boe
- F&D Cost$/Boe: $13.38/Boe
- More Fracs/Smaller Frac Intervals

Early 2009
Rough Rider
- Total Well Cost: $6,100,000
- 500,000 Boe
- F&D Cost$/Boe: $15.25/Boe
- Long Lateral/More Frac Intervals

Mid 2009
Ross
- Total Well Cost: $6,250,000
- 700,000 Boe
- F&D Cost$/Boe: $11.16/Boe
- More Fracs/Smaller Frac Intervals

Today
Rough Rider/Ross
- Total Well Cost: $6,300,000
- 4 Most Recent Wells: 3,540 Boepd; 2,513 Boepd; 3,394 Boepd; 3,807 Boepd
- 28-32 Frac Stages, ~350’/interval
- More Fracs/Smaller Frac Intervals
Oil production by monthly volume
How Much Bigger Can The Bakken Get?

Currently only 5%–10% recovery factor.

Enhanced oil recovery technologies may improve ultimate recovery.

Can CO₂ be a game changer in the Bakken?
Environmental Issues

- Multiple-stage fracking can require millions of gallons of water.

- The frack fluids may contain chemicals that have become the subject of public concern.

- Flaring has been a source of environmental criticism.

(100 MM CF/day)
Solutions

Environmental Issues

- Development and application of frack fluid recycling. Breitling is utilizing CLF.

- Reformulation of frack fluids to be more environmentally friendly. Breitling’s “EnviroFrac”

- Utilization of flare gas.
  - Infrastructure is catching up.
  - On-site and off-site uses for gas are developing.
Challenges - Public Perception Issues

Public Perception Issues

- The construction of thousands of well pads and truck traffic for the drilling and fracking of thousands of wells:
  - Wear and tear on roads and highways
  - Traffic jams in rural communities
  - Increased airborne dust
  - Adversely affect the “viewshed”
Solutions

• Increased use of technologies to drill multiple wells from a single pad:
  – Reduces the overall footprint of drilling operations. Breitling’s “Smart Pads”

• Construction of truck routes around outskirts of communities.

• Development and application of environmentally friendly dust control materials.
Statistics

By 2014

1450 to 2940 wells/year, with 2140 being expected.
  • 100 to 165 rigs running
  • This equates to **12,000 to 19,800 jobs**

10- to 20-year life span for the Bakken play
  • 21,250 new wells
  • This equates to **3000 to 3500 long-term jobs**
Current Economic Impact (cont).

North Dakota Middle Bakken

A single Bakken well over its lifetime is projected to:

- Produce more than 575,000 barrels of oil.
- Generate over $20 million net profit.
- Pay approximately $4,250,000 in taxes.
- Pay royalties of $6,900,000 to mineral owners.
- Pay salaries and wages of $1,550,000.
- Pay operating expenses of $1,900,000.
- 20+ year lifespan.
U.S. petroleum product exports exceeded imports in 2011 for first time in over six decades

Source: EIA, Petroleum Supply Monthly
Conclusions & Closing Comments

- The potential of Liquids-rich shales was discovered by a number of innovative firms that did not restrain themselves with conventional dogmas. (Sounds like the Shale Gas Revolution….)

- The resource contained in already discovered plays is vast (100+ Billion barrels), and includes more than just oil.
  - 44 Billion Barrels of Oil, 57 Billion Barrels of NGLs, with 300+ Tcf of Dry Gas in the liquids-rich plays alone.
  - More exists in undeveloped plays.

- The economic boost given these plays by high oil prices makes these plays very economic in a low gas price environment.

- Robust economics and highly productive wells allow for significant productive capacity.

- The Bakken is in its infancy. There will be decades of work ahead.
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