Bakken Well Economics & Production Forecasting

House Energy and Natural Resources
January 9, 2015

Justin J. Kringstad
Geological Engineer
Director, North Dakota Pipeline Authority
Rebuilding Oil & Gas Forecasts to Support Midstream Development
Crude Oil Prices – Jan. 7, 2015

Cushing
$48.65

Brent $51.05
WTI + $2.40

JJ Kringstad - North Dakota Pipeline Authority
Please view replay video on the Pipeline Authority website for full commentary of the following slides.
Objective
Define where the Bakken/Three Forks system is economic in a lower oil price environment.

Method
Analyze past well performance across the region and estimate well economics for various production levels.

Disclaimer
The goal of this work is not to imply individual company actions or intentions. All view expressed are strictly that of Justin J. Kringstad.

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Key Economic Assumptions

- $7-$9 Million Well Costs
- $45/BBL Wellhead Pricing
- 1/6 Royalty
- Zero Flaring
- Minimum 20% IRR to drill (calculated after production taxes and royalties)
- No Tax Incentives Included
- Production rate is 30-day average
- All Bakken/Three Forks wells drilled in 2008+
Peak Month Minimum 300 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

Well Cost
- 7 MM
- 8 MM
- 9 MM

$45 Wellhead

Breakeven Wellhead Price (AT IRR of 20%)
Peak Month Minimum 400 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

$45 Wellhead

Peak Month Well Production, BOPD

<table>
<thead>
<tr>
<th>Well Cost</th>
<th>7 MM</th>
<th>8 MM</th>
<th>9 MM</th>
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<tr>
<td>Breakeven Wellhead Price (AT IRR of 20%)</td>
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Peak Month Minimum 500 BOPD

Peak Month Well Production, BOPD

Well Cost

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<thead>
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<th>Well Cost</th>
<th>Peak Month BOPD</th>
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<tbody>
<tr>
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<td>8 MM</td>
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<td>9 MM</td>
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Breakeven Wellhead Price (AT IRR of 20%)

$45 Wellhead

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Peak Month Minimum
600 BOPD

Peak Month BOPD / Well Cost

After Tax IRR

7 MM
8 MM
9 MM

$45 Wellhead

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1,884 Wells
Peak Month Minimum
700 BOPD

Peak Month BOPD / Well Cost
700

After Tax IRR

$45 Wellhead

7 MM
8 MM
9 MM

Peak Month Well Production, BOPD

Well Cost
700
7 MM
8 MM
9 MM
$0 $5 $10 $15 $20 $25 $30 $35 $40 $45 $50 $55 $60

Breakeven Wellhead Price (AT IRR of 20%)
Peak Month Minimum
800 BOPD

Peak Month BOPD / Well Cost
800

After Tax IRR

$45 Wellhead

Peak Month Well Production, BOPD

Well Cost

7 MM
8 MM
9 MM

Breakeven Wellhead Price (AT IRR of 20%)

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Peak Month Minimum 900 BOPD

Peak Month BOPD / Well Cost

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Peak Month Minimum 1,000 BOPD

Peaks

Peak Month Well Production, BOPD

<table>
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Breakeven Wellhead Price (AT IRR of 20%)

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Peak Month Minimum 1,200 BOPD

Peak Month BOPD / Well Cost

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<td>Breakeven Wellhead Price (AT IRR of 20%)</td>
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<td>$15</td>
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Peak Month: 100-300 BOPD*

*Low production wells also occur in areas deemed “Core” or “Hot Spot”.

Risk is still present in most areas.

Mapped wells drilled 2012-2014
Summary of $45 Wellhead Oil
Breakeven Summary

Peak Month Well Production, BOPD / Well Cost

Breakeven Wellhead Price (AT IRR of 20%)
Options for drilling outside 800 BOPD footprint:

1) Prove location is viable in low price environment (lower costs, improved IP, etc.)

2) Move rig to better geology (inside or outside of basin)

3) Release rig

Peak Month Minimum 800 BOPD
800 BOPD Well Example

- $8 MM Well
- $45/bbl oil and $6/mcf gas
- AT IRR = 15%
- AT NPV (10) = $0.93 MM
- Simple Payback = 4.0 Years
Additional Considerations

• Can well costs come down further?
• Individual company budgets, cash flows, hedges, obligations, and management strategies
• Competition from other plays
• Completion technology continues to improve
  – Higher volumes of proppant and water
  – Higher density drilling success
Arguments

- Well economic assumptions too optimistic or conservative
  - Jump to lower or higher well performance footprints
- Some rigs are not drilling Bakken/Three Forks wells
  - No economics were run on wells in other formations
Next Steps

- Use the findings to refine crude oil and natural gas forecasts for the region
- Continue to monitor pricing, production, and technology to further enhance our understanding of well economics in North Dakota
Can We Learn from Natural Gas?

US Gas Drilling Rigs / Price

Source: EIA Data
Can We Learn from Natural Gas?

US Gas Production / Price

Source: EIA Data
Can We Learn from Natural Gas?

Natural Gas Gross Withdrawals and Production

Source: U.S. Energy Information Administration
Marcellus Reaction to Low Prices

Source: U. S. Energy Information Administration | Drilling Productivity Report
Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.
Forecasting Assumptions

Approximately 37% Slowdown

Approximately 50% Slowdown

Well Completions Per Month

Avg 30-Day IP Rate, BOPD

Case 1 Completions
Case 2 Completions
Case 1 Avg 30-Day IP
Case 2 Avg 30-Day IP

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Williston Basin Oil Production & Export Capacity, BOPD

Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.

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Forecasting Exercise – Hold Oct 2014 Production

- ND Oil Production, BOPD
- New Producing Wells
Forecasting Exercise – Hold Oct 2014 Production

- New Wells Producing
- New Well 30-Day IP, BOPD

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North Dakota Natural Gas Forecast, MMCFD

Production forecast is for visual demonstration purposes only and should not be considered accurate for any near or long term planning.
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