

A Fine Line between Numerator and Denominator

“There is a fine line between a numerator and a denominator”, Yogi Berra

Many things change during an industry downturn, but one goal always remains: a need to reduce cost per produced barrel of oil equivalent, or in short: lowering \$/BOE. As Yogi Berra so thoughtfully pointed out, lowering \$/BOE can be achieved in two ways: by reducing cost while maintaining production, or by boosting production while controlling cost. This paper describes a scoping methodology to lower \$/BOE in various areas of the DJ Basin.

As a first step to help understand how we should lower \$/BOE in the DJ, Liberty mines and QCs public data for completion and production specifics. Secondly, we add petrophysical parameters that help understand the impact of geology on production. Then, we look at trends in a simplistic bi-variate analysis and conduct a deeper look at production trends through multi-variate analysis (MVA).

On a side note – MVA is a “dumb” analysis. A multi-variate analysis model could come up with potential correlations between parameters – for example between the treater’s shoe size and well productivity – but it may not follow any physical logic. Another potential problem associated with MVA is that it is not great at predicting beyond the parameter range in the dataset; in other words “it cannot predict what has not been done”. For these two reasons, Liberty generally recommends a cross-check with a “smart” physical model – a calibrated fracture growth model tied to a reservoir model matched to actual production.

As a final analysis step in the paper, we conduct a "bang for your buck" analysis. We incorporate the cost to achieve a completion change and determine the most cost-effective method to achieve a production increase. The table below shows areas in green representing the relative increase in well cost associated with the most effective completion lever to boost production by 10%.

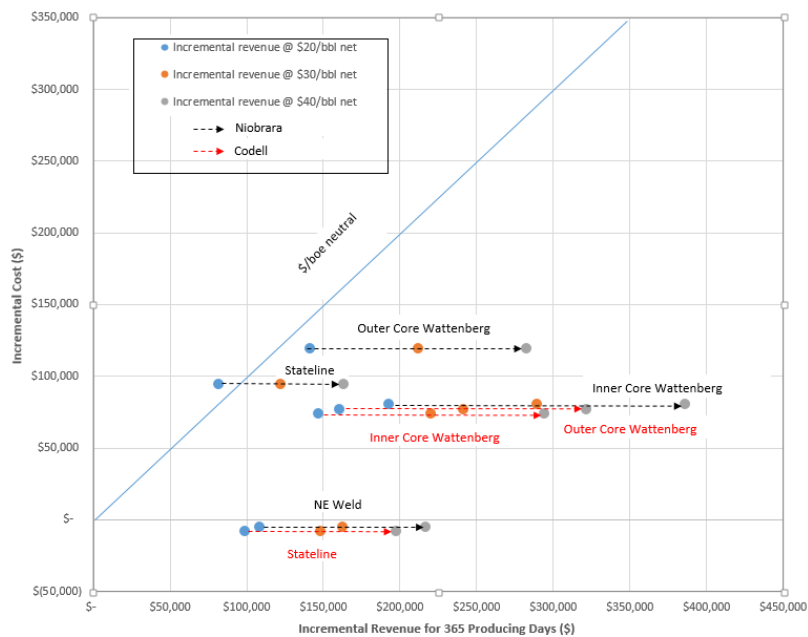
DJ Basin Well Cost Sensitivity Summary	% Well Cost Increase to Increase Production by 10%							
	Completion Unit	Inner Core - Niobrara	Inner Core - Codell	Outer Core - Niobrara	Outer Core - Codell	NE Weld Niobrara	Stateline Niobrara	Stateline Codell
Normalized BOE Per Foot Production Metric		365-day	180-Day	365-day	180-Day	180-Day	365-Day	180-Day
Completion Flag	/flag							
Cemented/Open Flag	/flag							**
Fluid Type	/PPG					-0.2%		-0.2%
ft/Stage	/ft/stage			5.6%	2.2%	2.7%		
Stages/1000 ft	/stages/1000 ft			5.6%	2.2%	2.7%		
Max Rate/ft	/bpm/ft							
Proppant Vol/ft	/lbs/ft	2.3%	2.1%	4.6%	5.3%		2.7%	
Fluid Vol/ft	/bbl/ft			3.4%		0.9%		2.2%

**Can only get to 4% increase by moving to cemented liner

This table shows the typical cost for DJ areas to increase 365-day or 180-day production by 10%. The results in the table shows there are no “silver bullets” for the most economic production improvements in the DJ Basin – the solution to improve production in the best possible way is not the same everywhere in the DJ Basin. In Inner Core Wattenberg, the better and higher GOR wells are helped more by placing more proppant. This focus on conductivity may also indicate that higher-quality proppant might do better in this area. In the Outer Core Wattenberg area proppant mass increases have a positive impact on production, but more economic levers for production improvements are increases in fluid volume and stage intensity.

Spending a few % extra on well cost for completion improvements can boost production by 10% and reduces \$/BOE.

The figure to the right shows incremental cost versus incremental revenue after 365 producing days for Niobrara and Codell wells in different DJ areas. The three incremental revenue scenarios represent net revenues for the operator after all incremental costs associated with production operations, water disposal, gathering and marketing expenses, oil tax, gas tax and royalties have been subtracted from the oil and gas sales price. All suggested fracture design changes aiming to increase production by 10% easily reduce \$/BOE for a 365-day incremental production metric.



For the lifetime of DJ wells the incremental revenue gains are expected to far outstrip the incremental well costs. Since operators deal with large "sunken" cost from a drilled well, the upsides associated with little changes in completion practices are often dramatic. Spending a few % extra on well cost for completion improvements can boost production by 10% and reduces \$/BOE by more than double the well cost increase. We would make Yogi proud.

More information

SPE Paper 180217, “The Impact of Petrophysical and Completion Parameters on Production in the Denver-Julesburg Basin”, by F. Miller et al.