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INDUSTRIAL COMMISSION OF NORTH DAKOTA PIPELINE AUTHORITY

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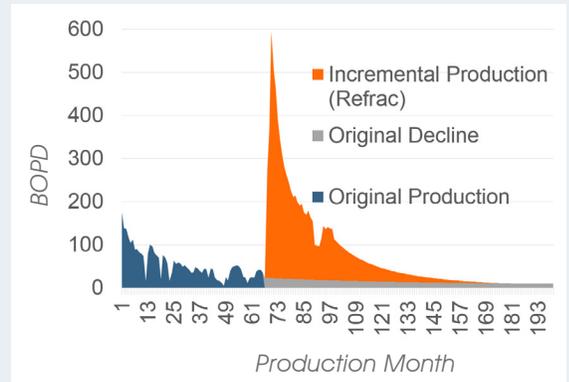
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A LOOK AT REFRACS IN NORTH DAKOTA

The process of recompleting, or refracing, an existing Bakken – Three Forks well may be the next big step to increase oil and gas recovery rates in the state. A refrac is the practice of hydraulic fracturing an existing well that has already been hydraulically fractured at some earlier time period. Refracs are not new to the industry, as there is significant experience over the last decades around the world. However, due to the relatively young nature of Bakken development, the technique has had limited testing in the region.



During the first half of 2017, the Pipeline Authority conducted research to determine what data exists on refracs in the state. Just over 140 wells were identified as being refraced over the last several years.

The data revealed the following points of interest:

- Typical wells targeted for refrac were between four and five years old and utilized completion techniques now considered outdated.
- Almost half of the refraced wells were in Dunn County.
- On average, the production of the well after the refrac was higher than the original well performance.
- There were examples found where the refraced wells did not perform significantly better after refracing.
- The Pipeline Authority has identified almost 2,000 wells drilled between 2007-2011 that are positioned to be potential refrac candidates in the near future.
- Of the wells examined, none were refraced more than once, a practice that is not uncommon outside of North Dakota.

NORTH DAKOTA — Production Numbers

⌘ www.pipeline.nd.gov

Average Daily Oil Production, BOPD

Apr. 17	May. 17	Jun. 17
1,050,476	1,040,995	1,032,495

Average Daily Gas Production, MMCFD

Apr. 17	May. 17	Jun. 17
1,836	1,854	1,850

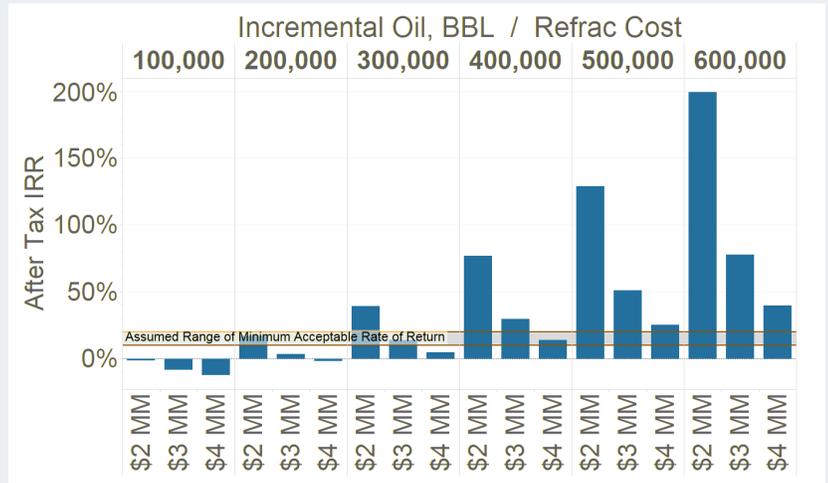
Average Rig Count

Apr. 17	May. 17	Jun. 17
50	50	55

As of August 14, 2017, there are 57 active rigs in North Dakota.

ECONOMICS OF REFRACS

The Pipeline Authority performed a high level exercise to try and determine the economics of refracing using incremental oil and gas production as the guide. As seen in the sample refrac production chart (front page), the orange colored production can be considered incremental production due to the refrac operation around month 68. In this example, the well is estimated to have 250,000+ barrels of incremental oil production from the refrac. The bar chart is a guide created to understand the economics of refracing in a \$40/bbl (wellhead) price environment. The economics were run using 100,000-600,000 barrels of incremental production and refrac costs of \$2-\$4 million.



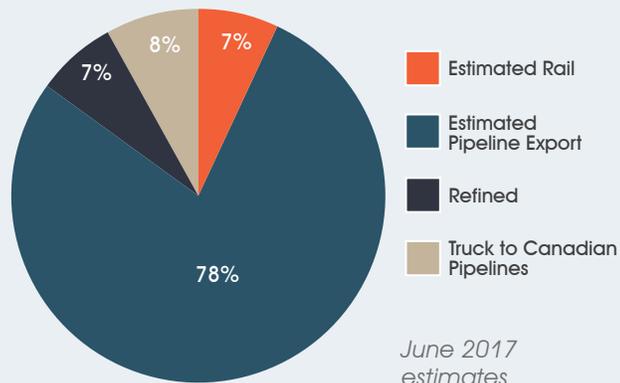
North Dakota Pipeline Authority

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NEXT STEPS

Refracs have the potential to significantly alter the production profile for wells in the state. The Pipeline Authority is going to continue working to better understand how local and statewide transportation needs shift in the case that hydraulic fracturing crews are added or reallocated to refrac operations. More detailed information on the topic of refracs is available on the "Presentations" page of the NDPA website.

Estimated Williston Basin Oil Transportation



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