

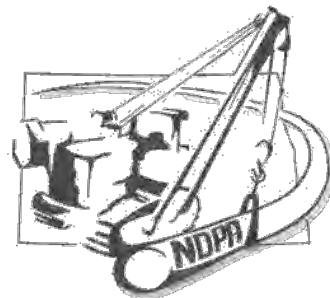
# **Bakken Production Optimization Program 2.0 Annual Members Meeting**

**Justin J Kringstad**

*Geological Engineer*

*Director*

*North Dakota Pipeline Authority*



**August 7, 2018**

# Presentation Outline

- **Economics**
- Current Activity and oil transportation dynamics
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- North Dakota natural gas production
  - Flaring and gas capture
  - Natural gas liquids
- Pipeline construction update



## **Objective**

Define where the Bakken/Three Forks system may be economic in the current 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.

Neither the State of North Dakota, nor any agency, officer, or employee of the State of North Dakota warrants the accuracy or reliability of this product and shall not be held responsible for any losses related to its use.



# Key Economic Assumptions

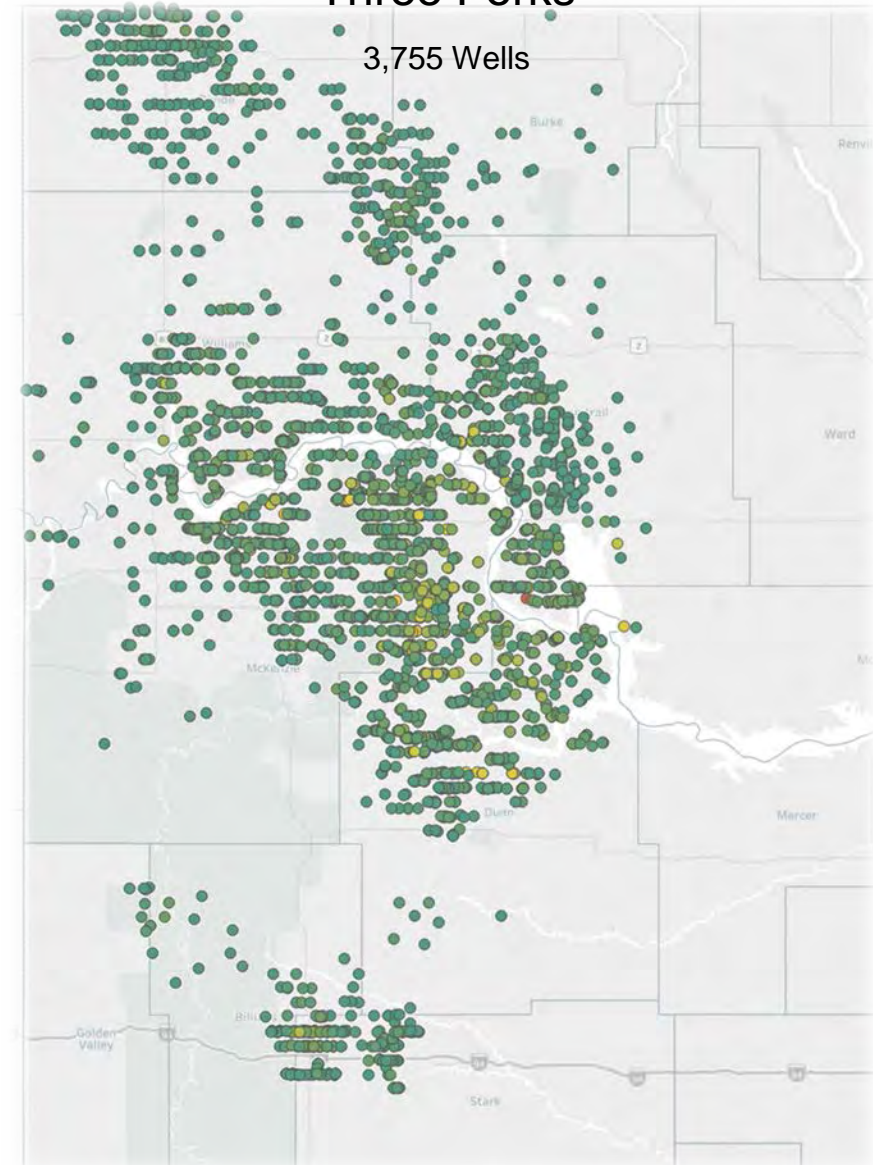
- \$6-\$8 Million Well Costs
- \$63/BBL & \$6.00/MCF Wellhead Pricing
- 1/6 Royalty
- Zero Flaring
- Assumed 10-20% IRR to drill (calculated after production taxes and royalties)
- No Tax Incentives Included
- Production rate is 30-day average
- All Bakken/Three Forks wells drilled in 2008+



# Peak Month Minimum - 200 BOPD

Three Forks

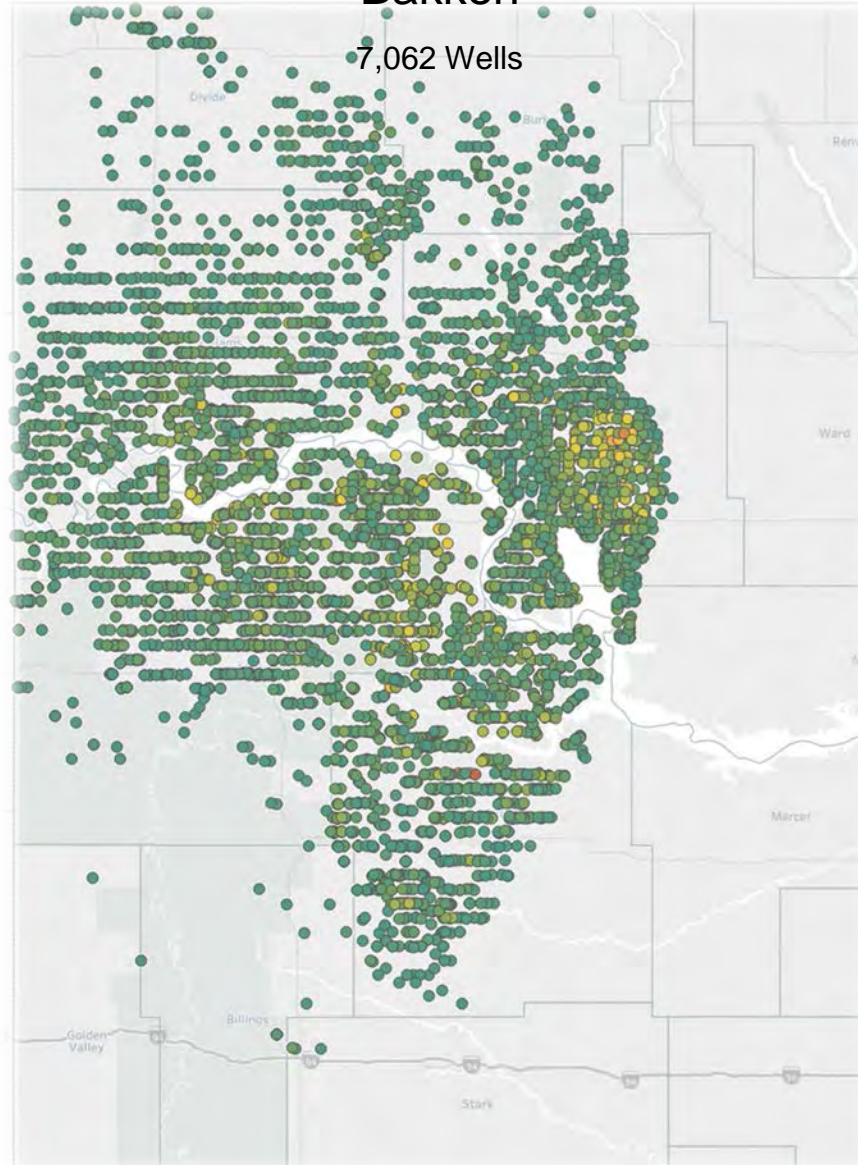
3,755 Wells



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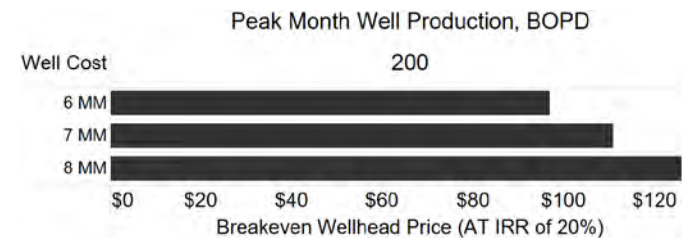
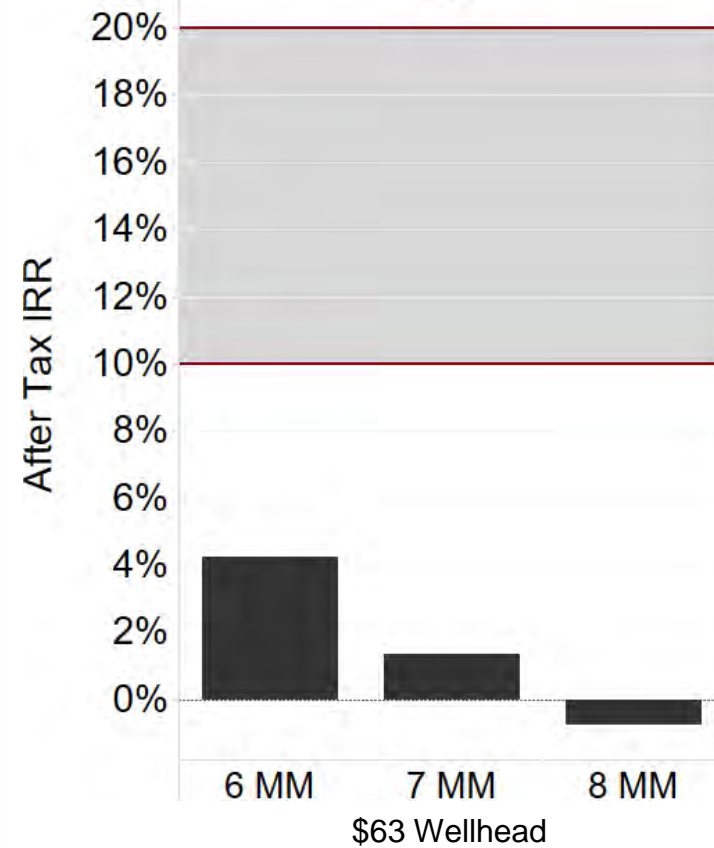
Bakken

7,062 Wells



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Peak Month BOPD / Well Cost  
200

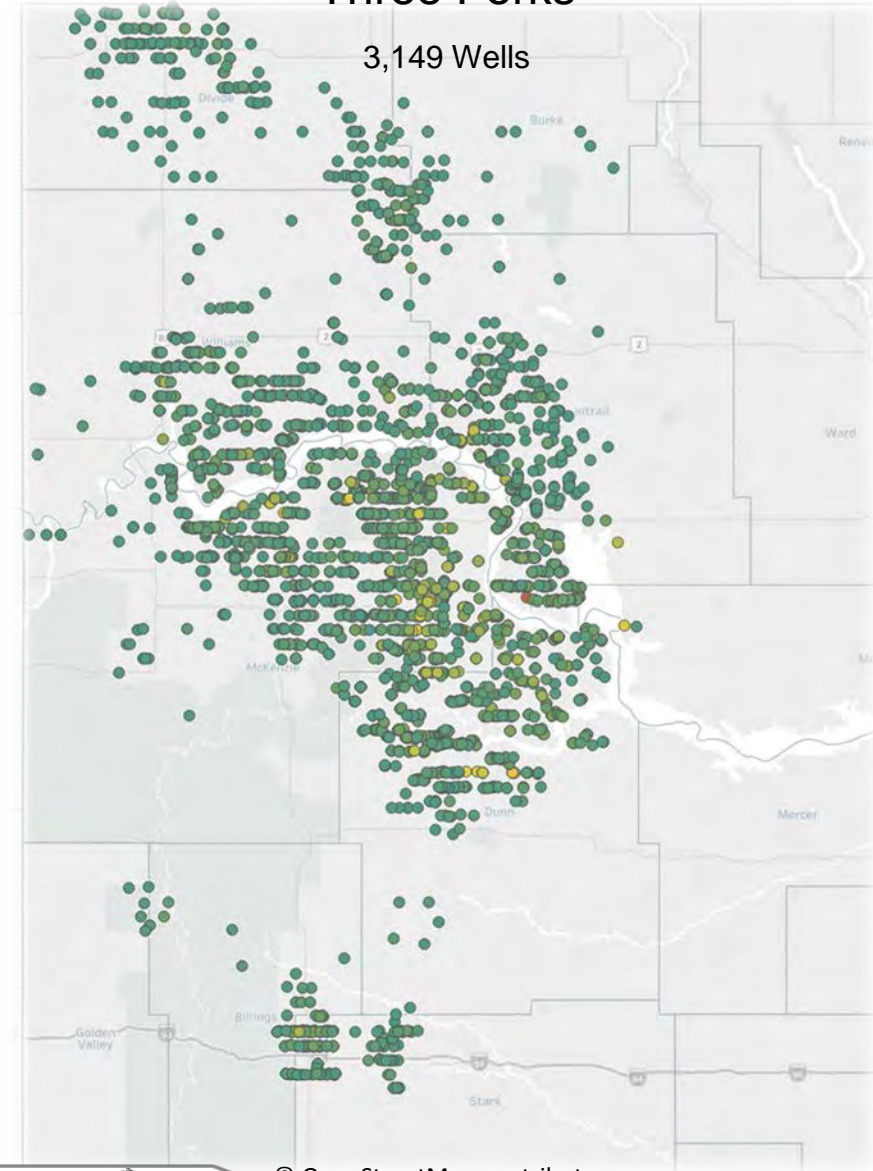




# Peak Month Minimum - 300 BOPD

## Three Forks

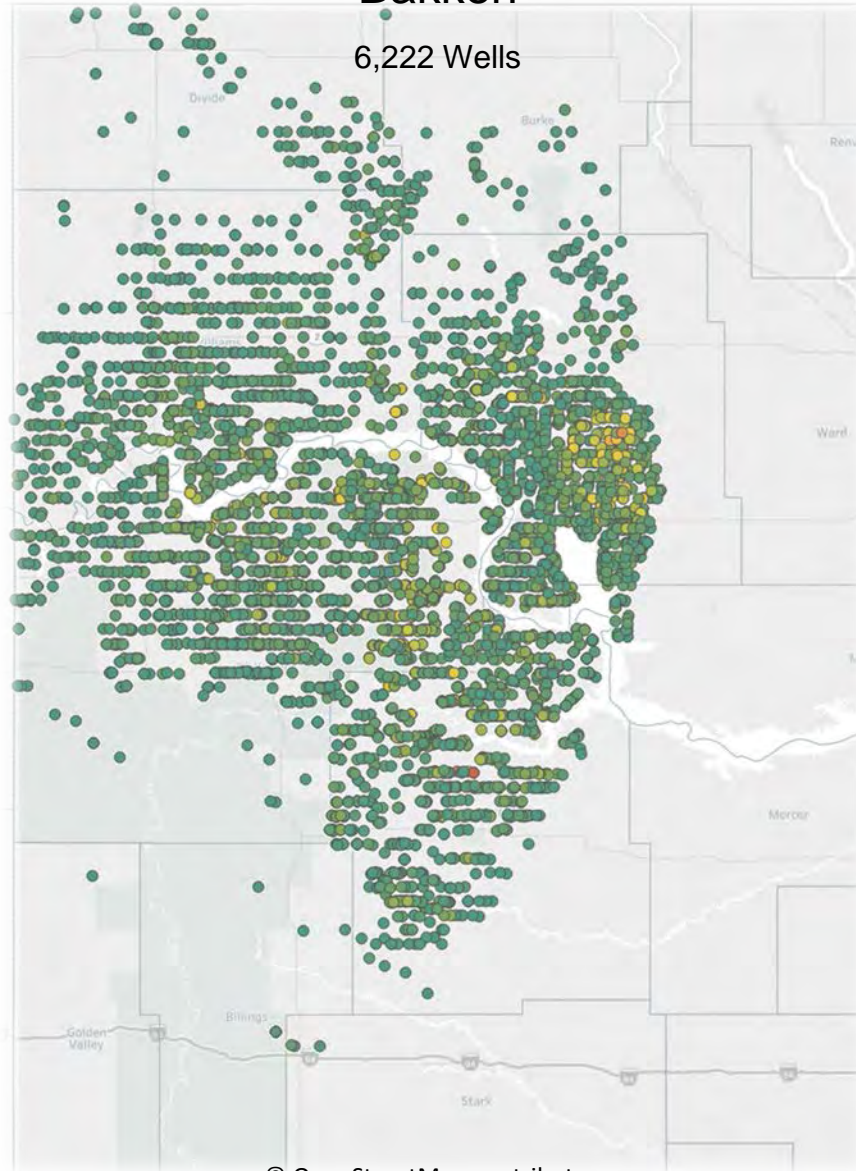
3,149 Wells



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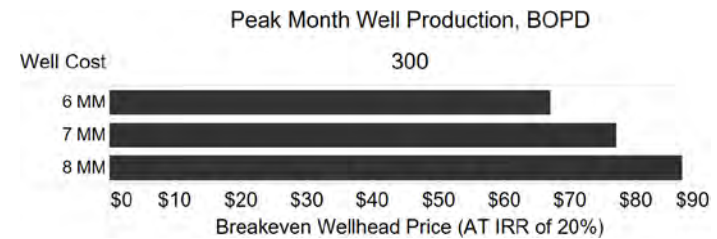
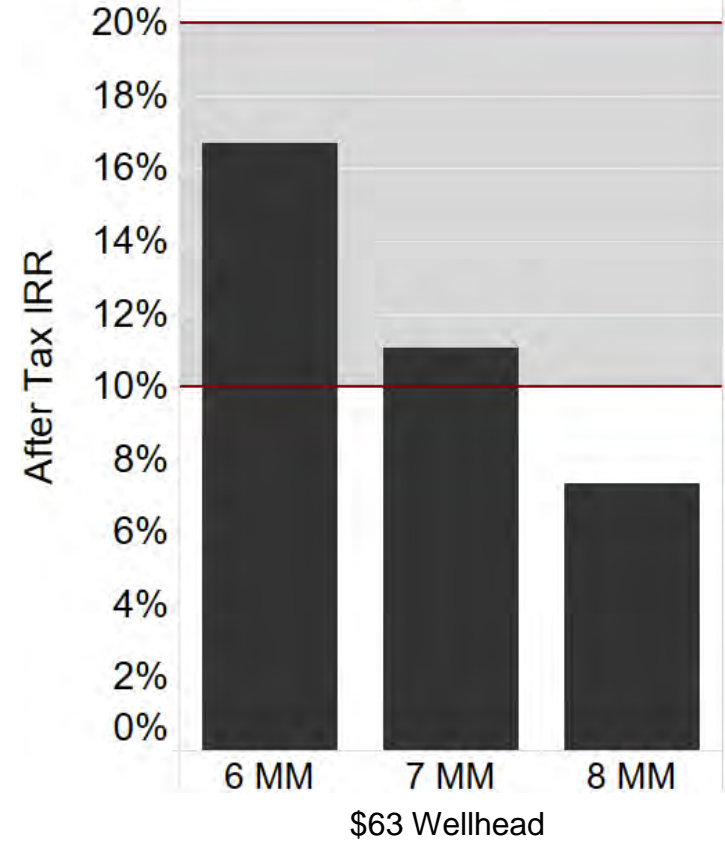
## Bakken

6,222 Wells



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Peak Month BOPD / Well Cost  
300

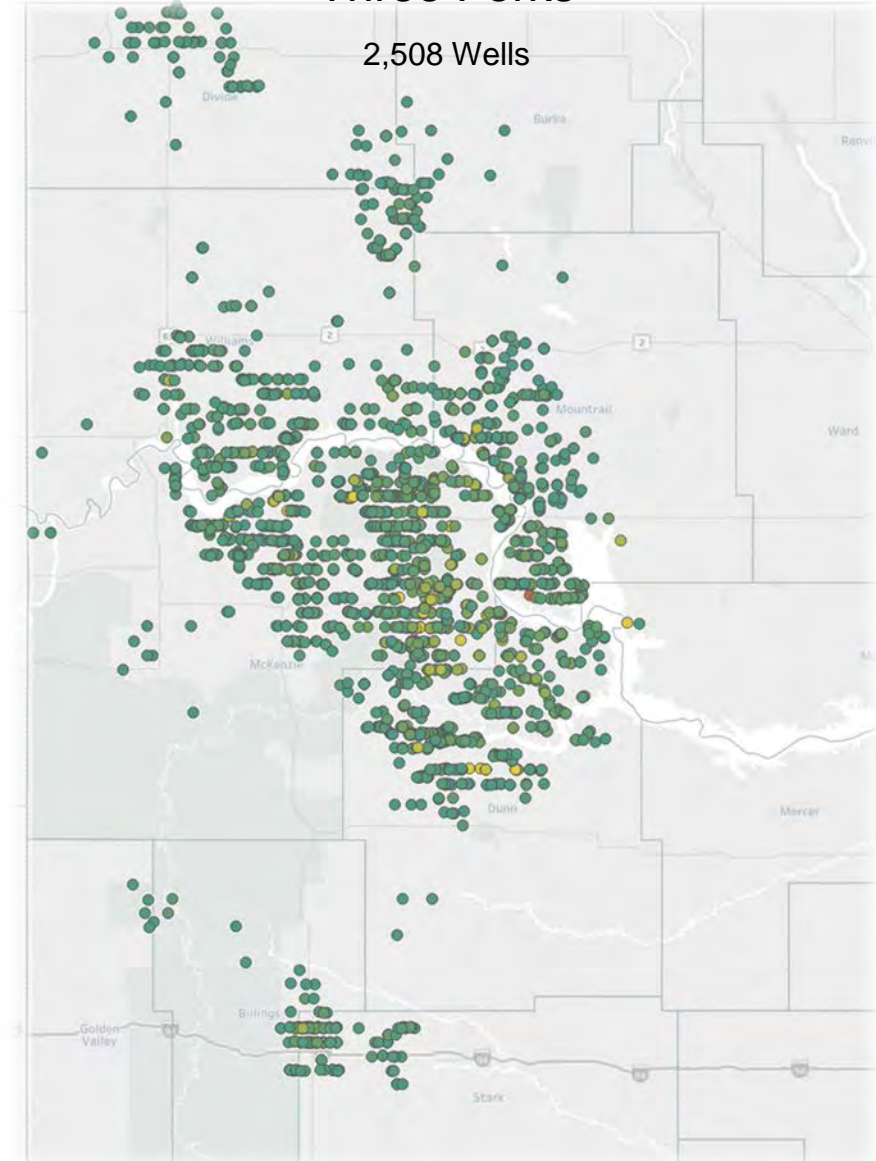




# Peak Month Minimum - 400 BOPD

Three Forks

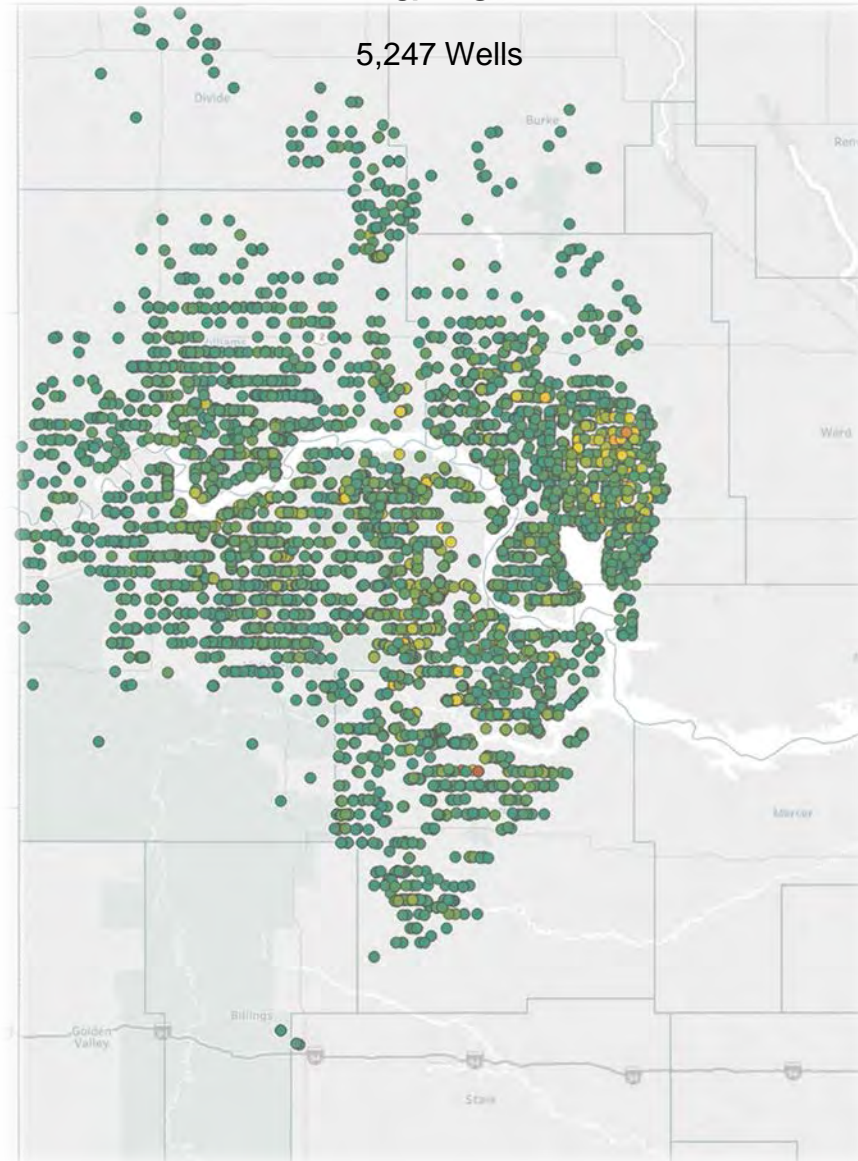
2,508 Wells



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Bakken

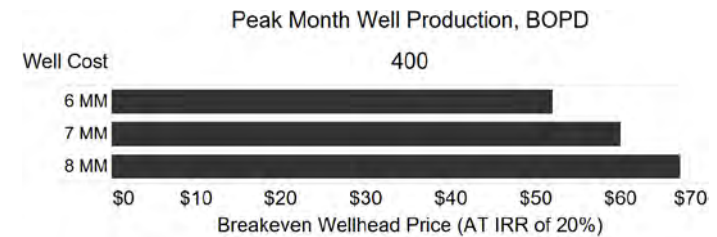
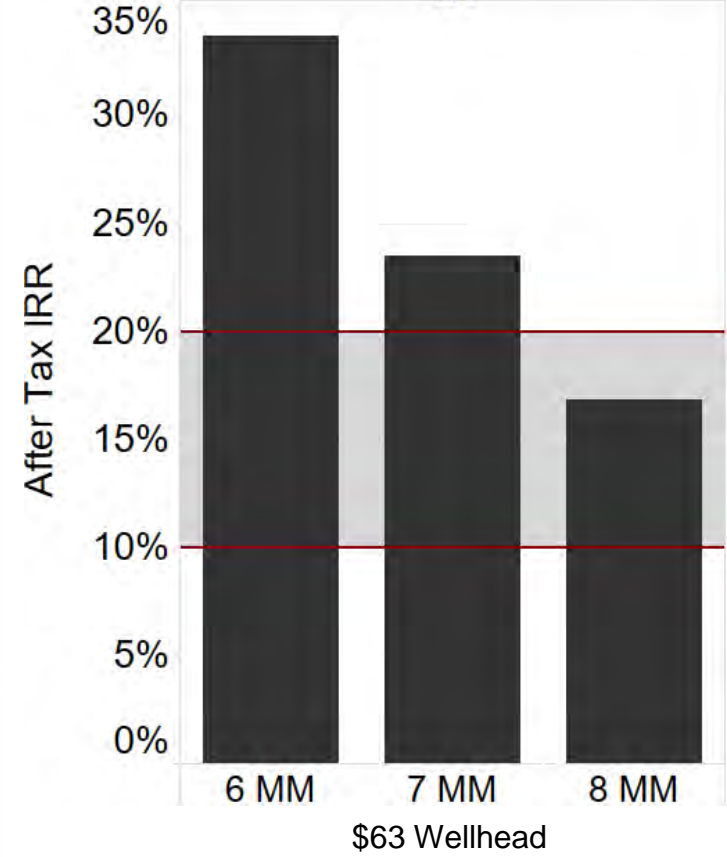
5,247 Wells



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Peak Month BOPD / Well Cost

400

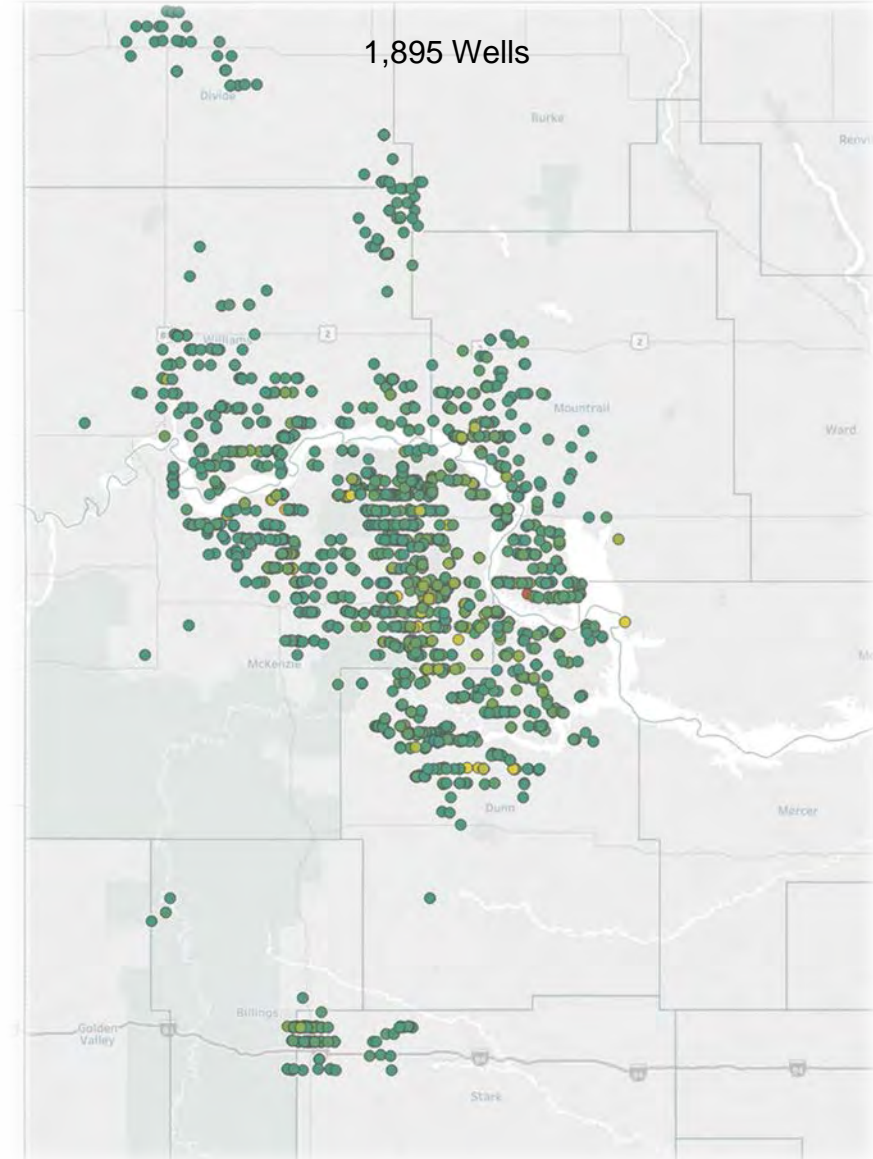




# Peak Month Minimum - 500 BOPD

## Three Forks

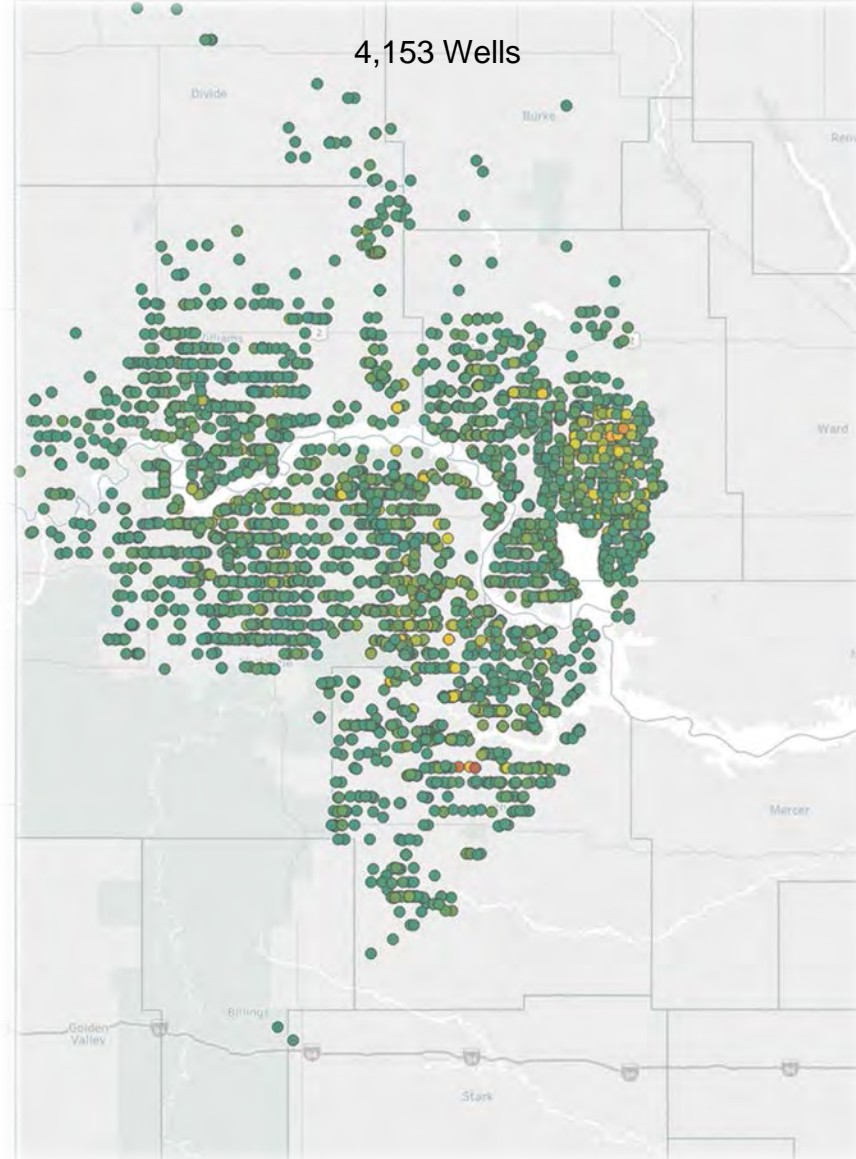
1,895 Wells



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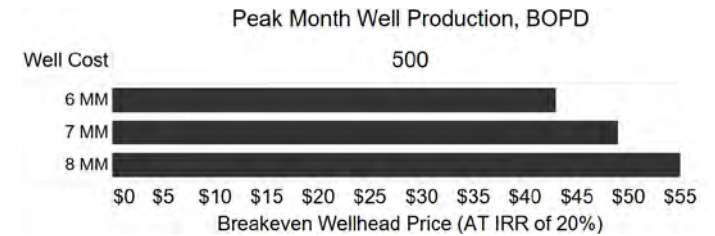
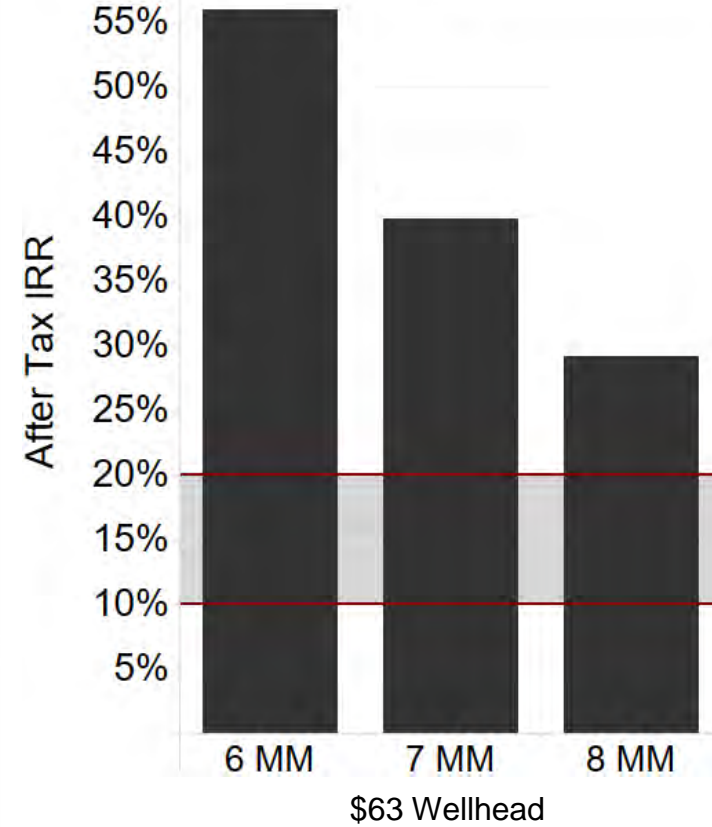
## Bakken

4,153 Wells



© OpenStreetMap contributors

Peak Month BOPD / Well Cost  
500

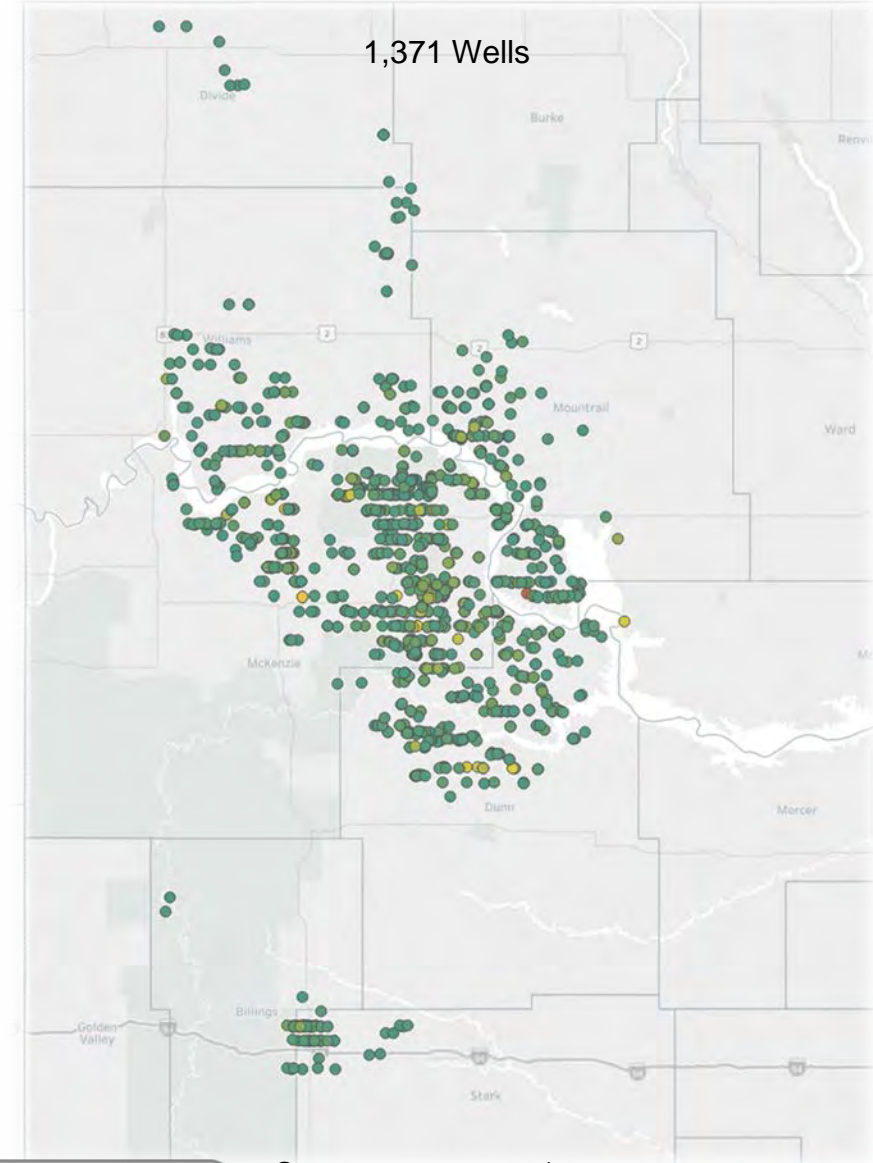




# Peak Month Minimum - 600 BOPD

## Three Forks

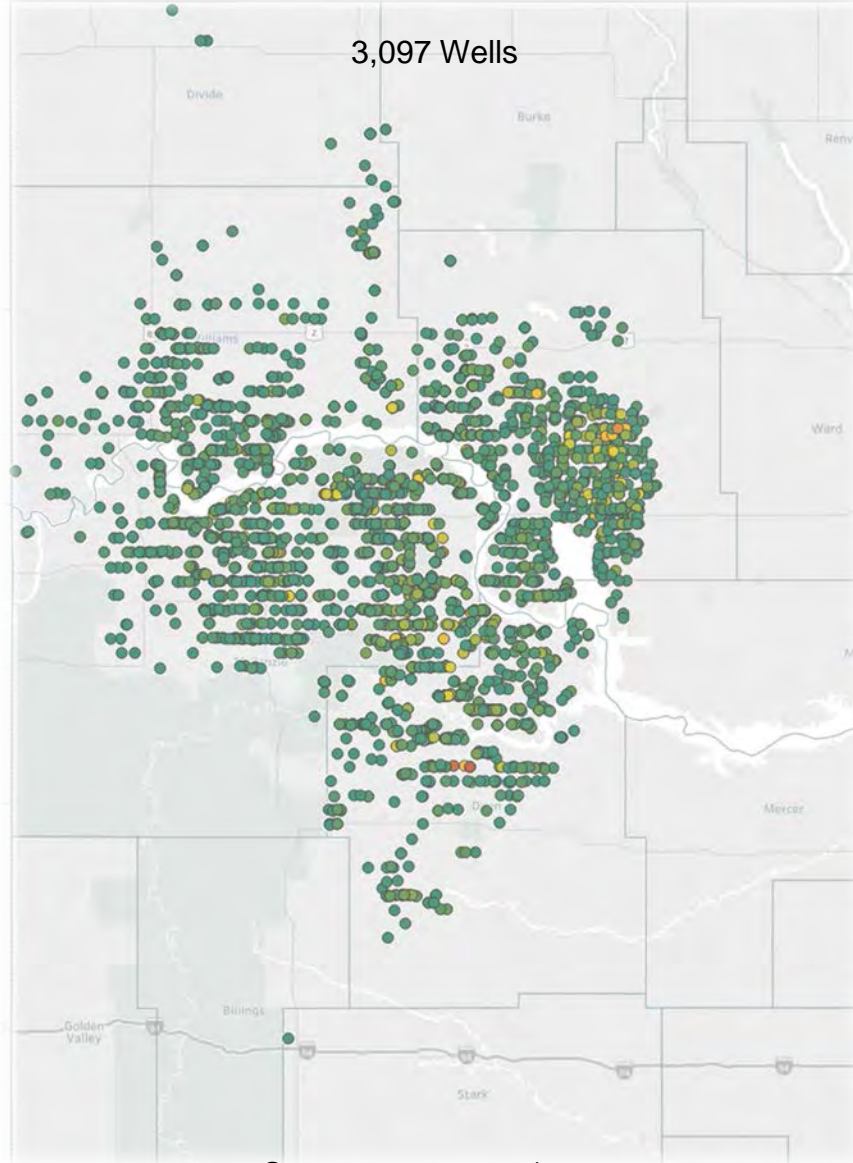
1,371 Wells



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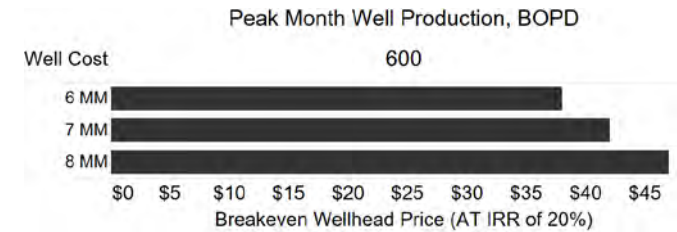
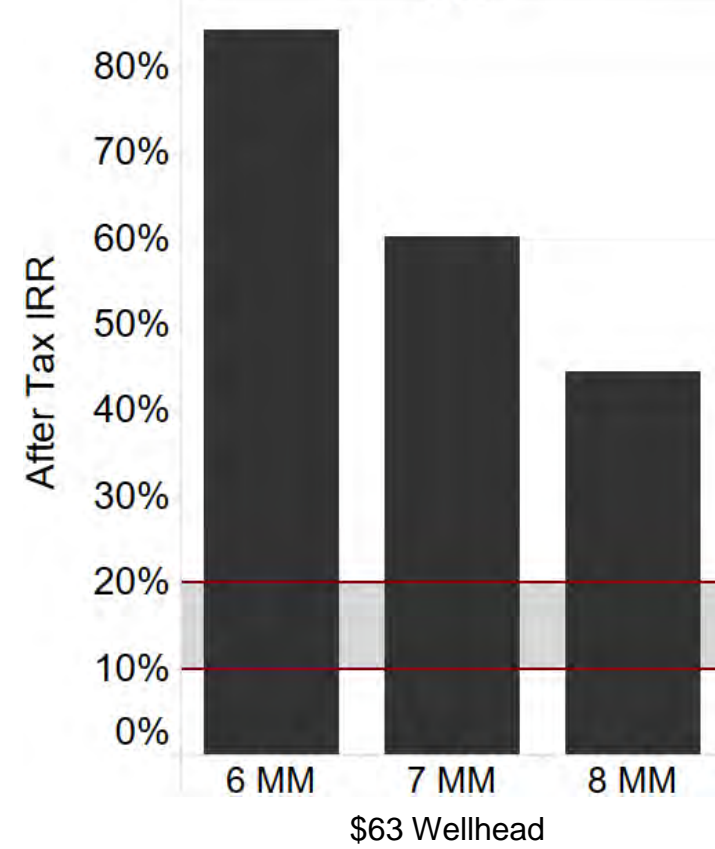
## Bakken

3,097 Wells



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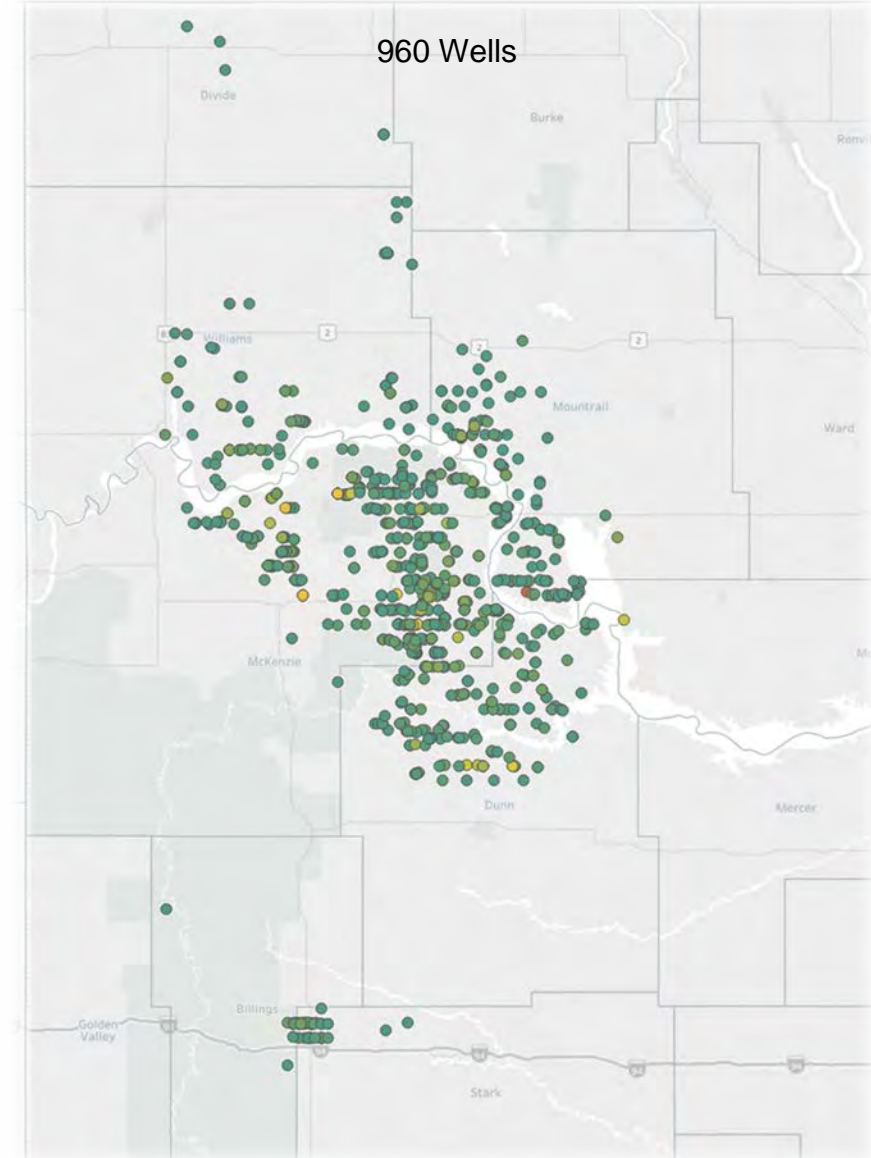
Peak Month BOPD / Well Cost  
600



# Peak Month Minimum - 700 BOPD

Three Forks

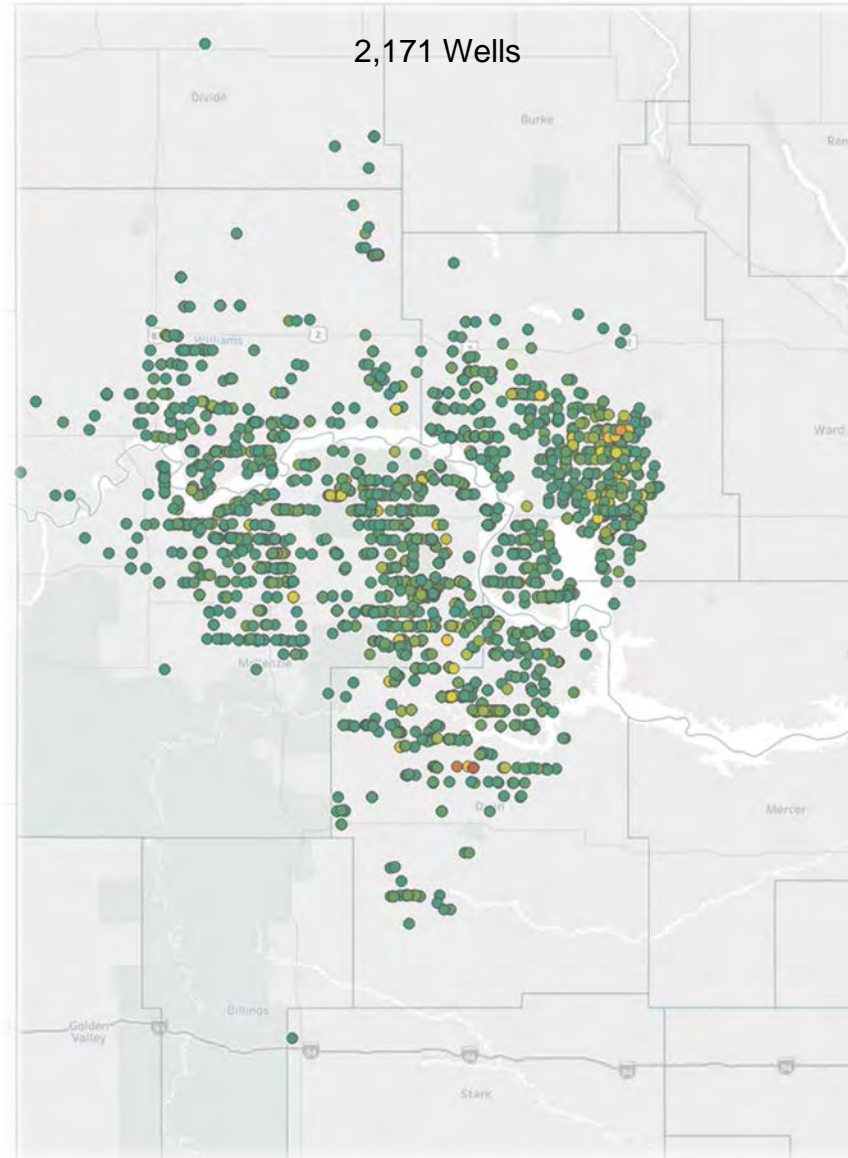
960 Wells



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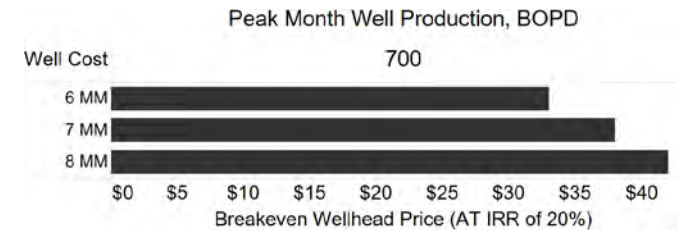
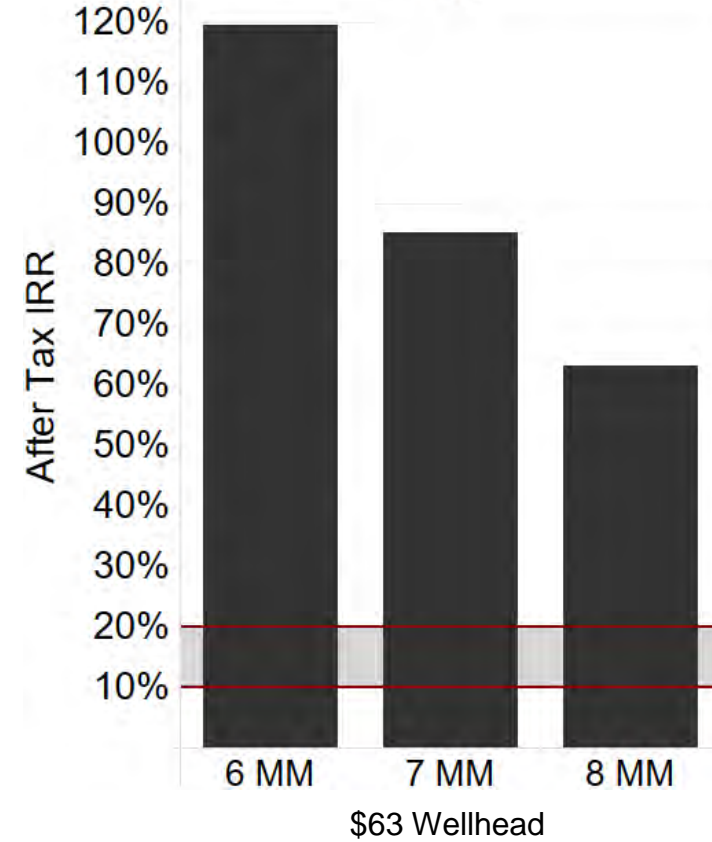
Bakken

2,171 Wells



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Peak Month BOPD / Well Cost  
700

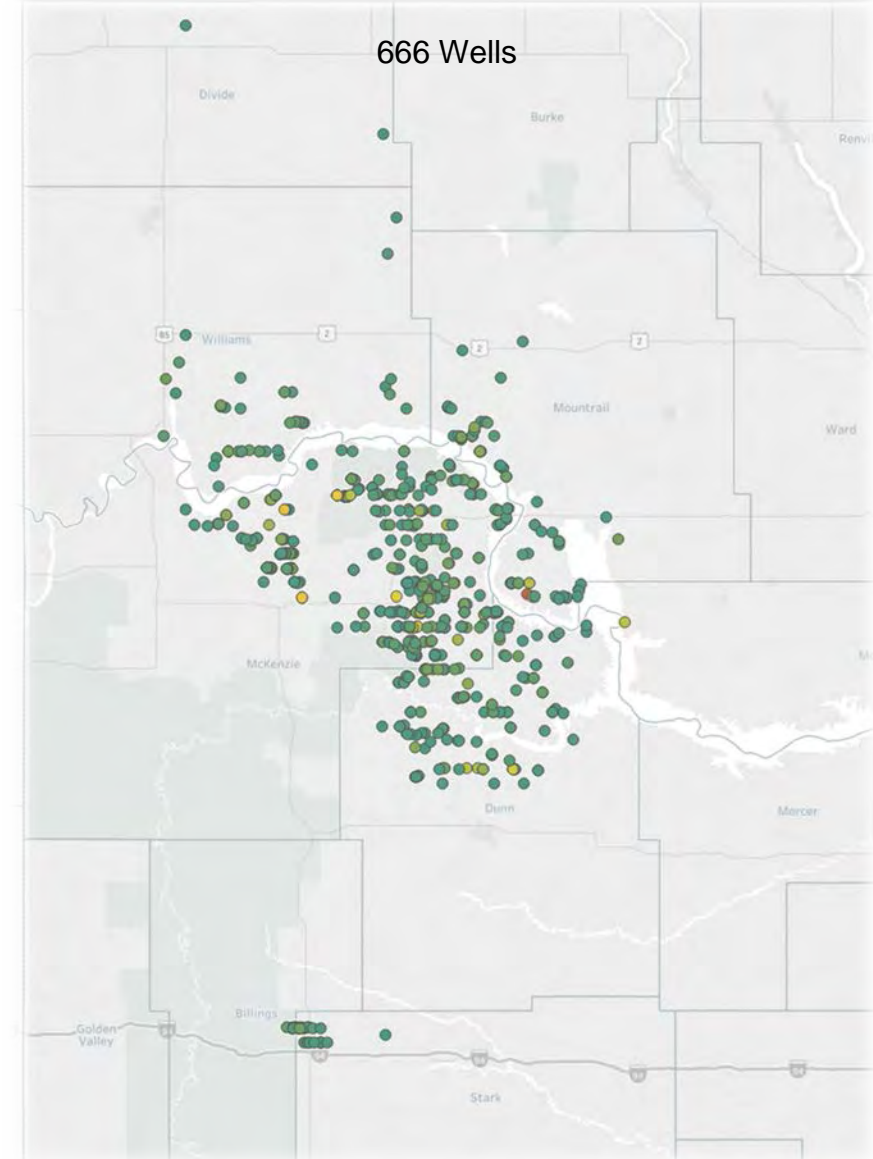




# Peak Month Minimum - 800 BOPD

Three Forks

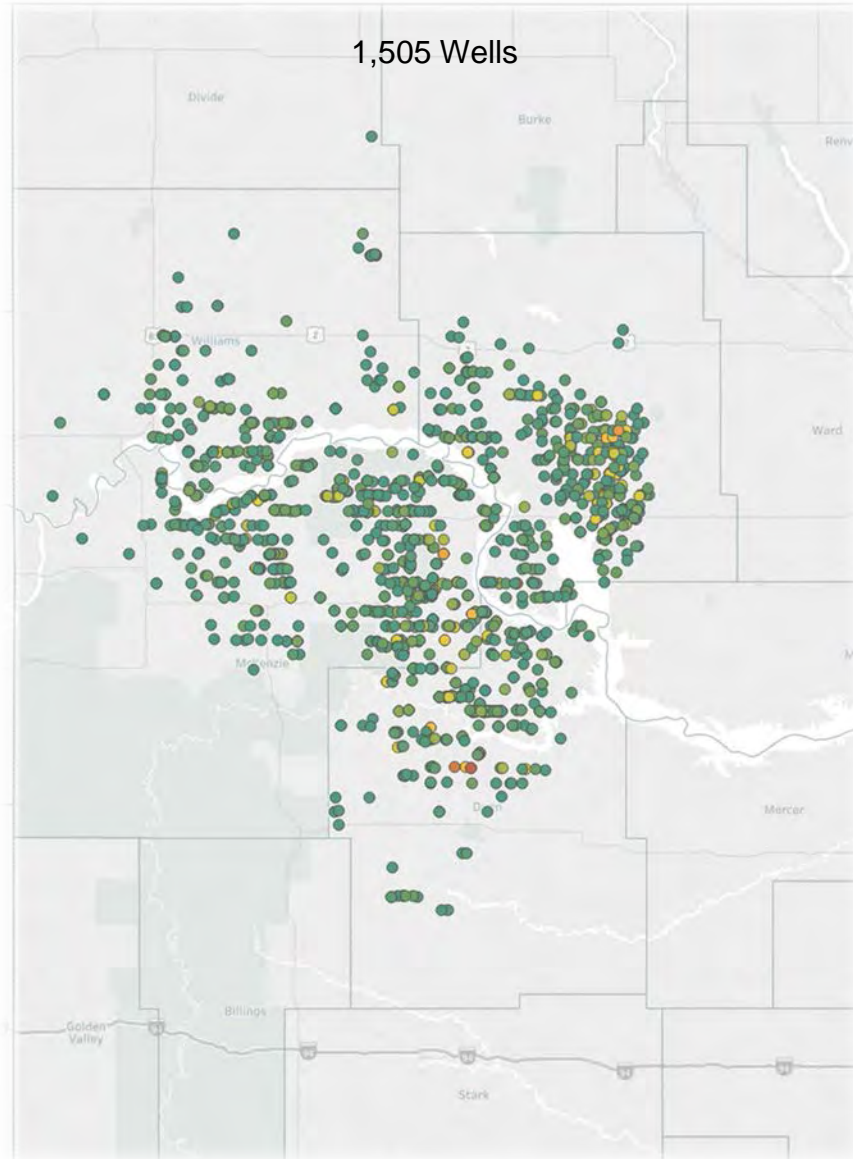
666 Wells



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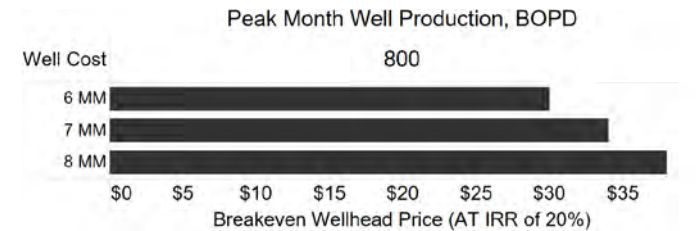
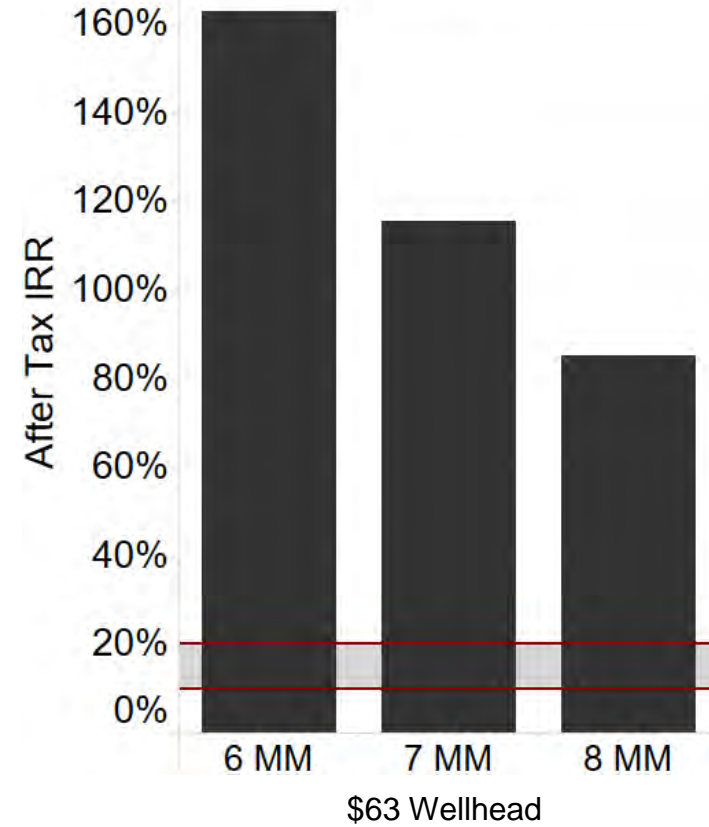
Bakken

1,505 Wells



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Peak Month BOPD / Well Cost  
800

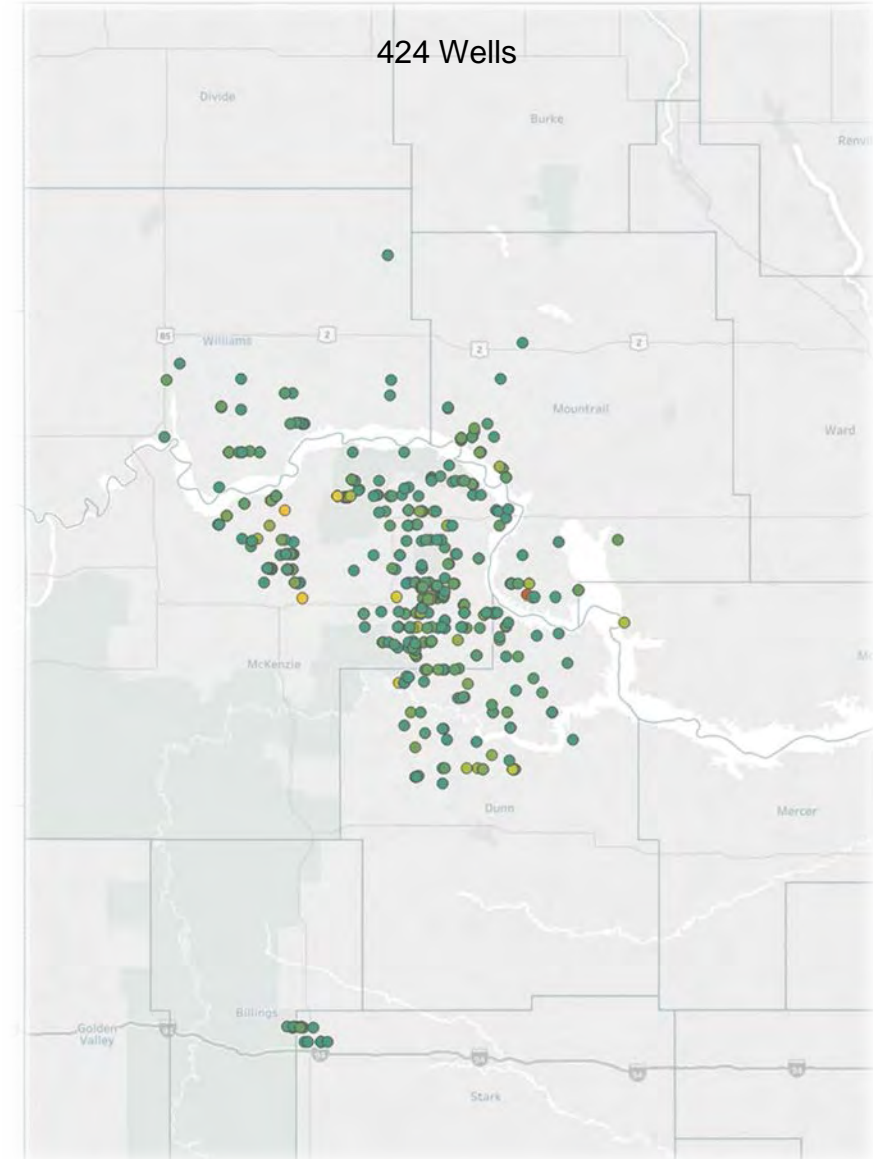




# Peak Month Minimum - 900 BOPD

## Three Forks

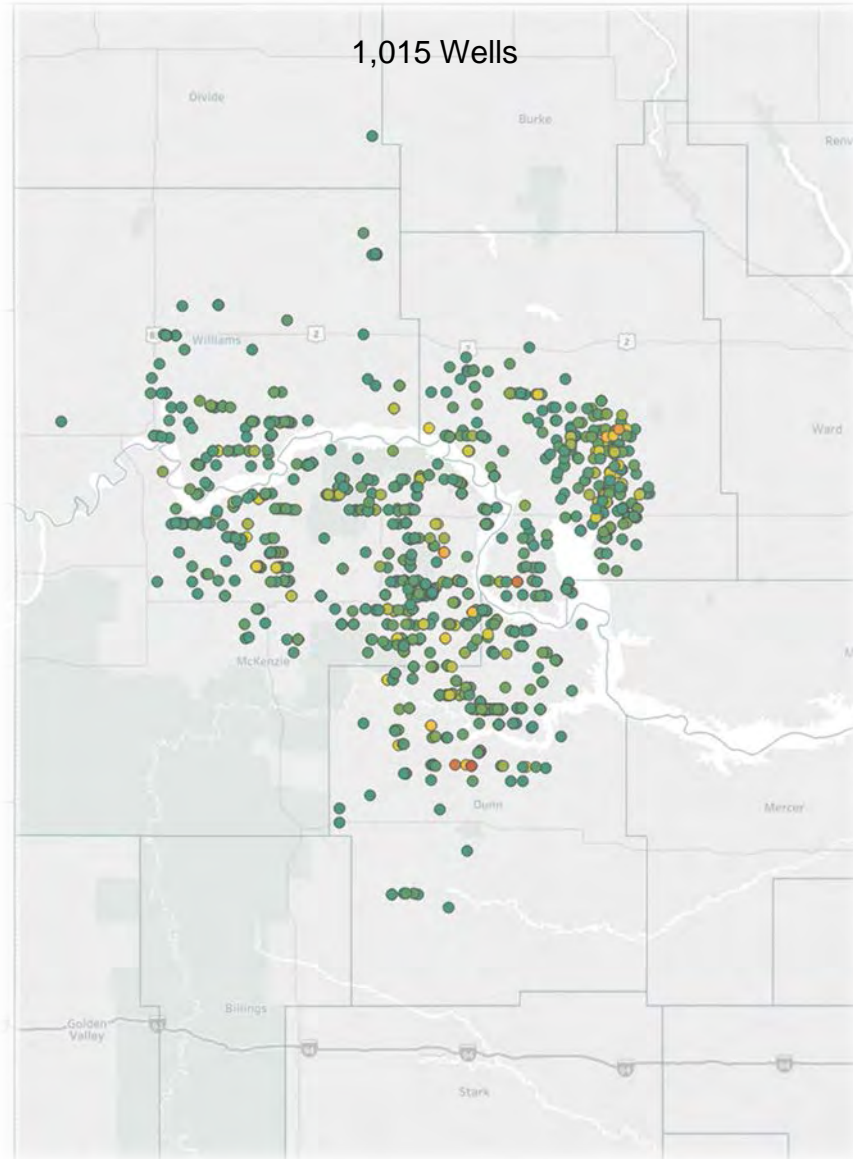
424 Wells



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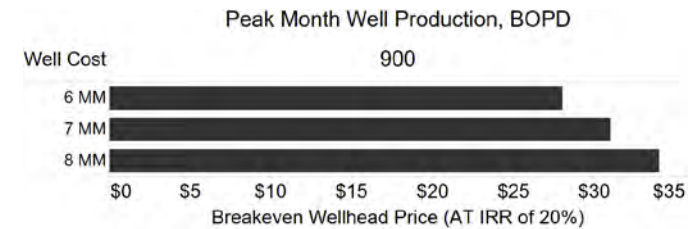
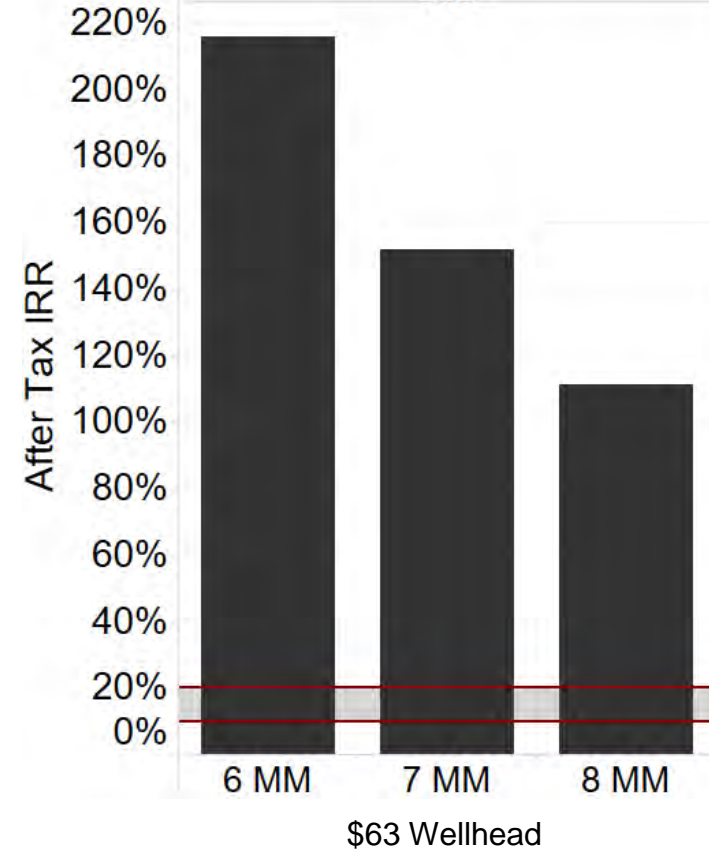
## Bakken

1,015 Wells



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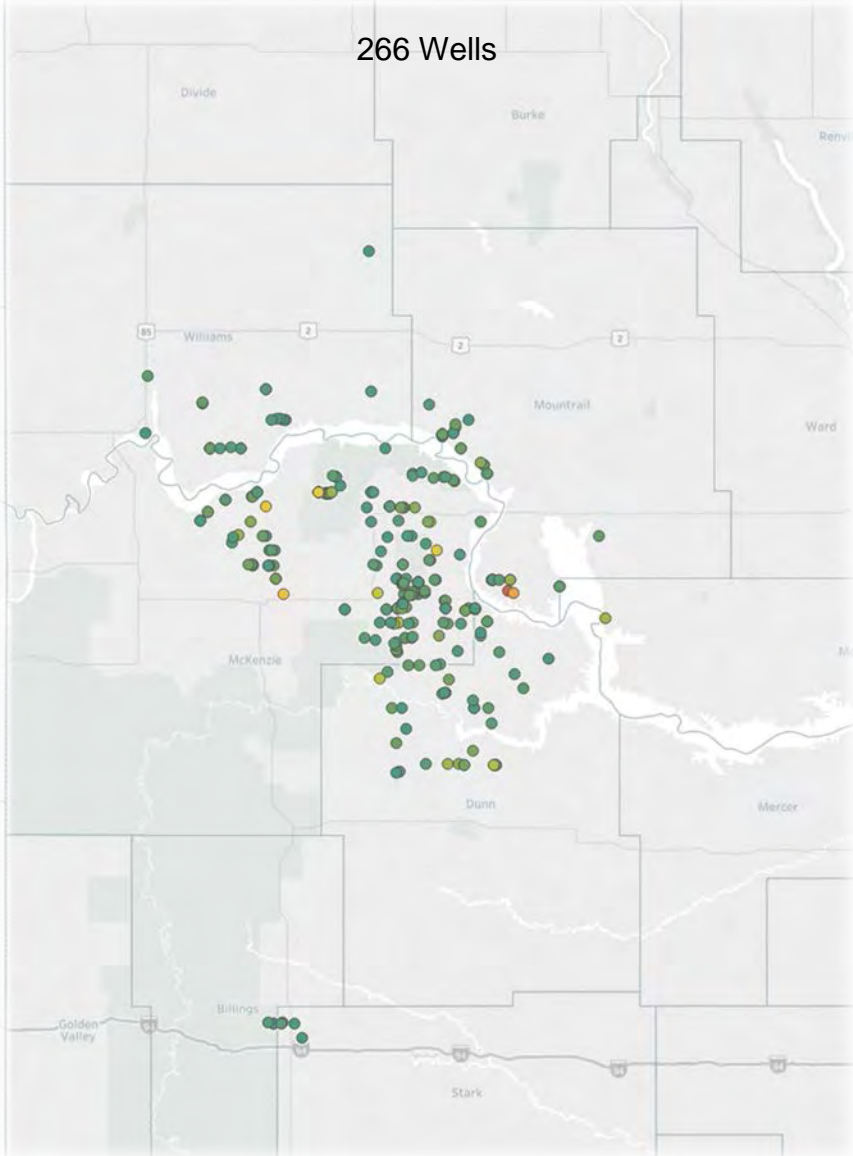
Peak Month BOPD / Well Cost  
900



# Peak Month Minimum – 1,000 BOPD

Three Forks

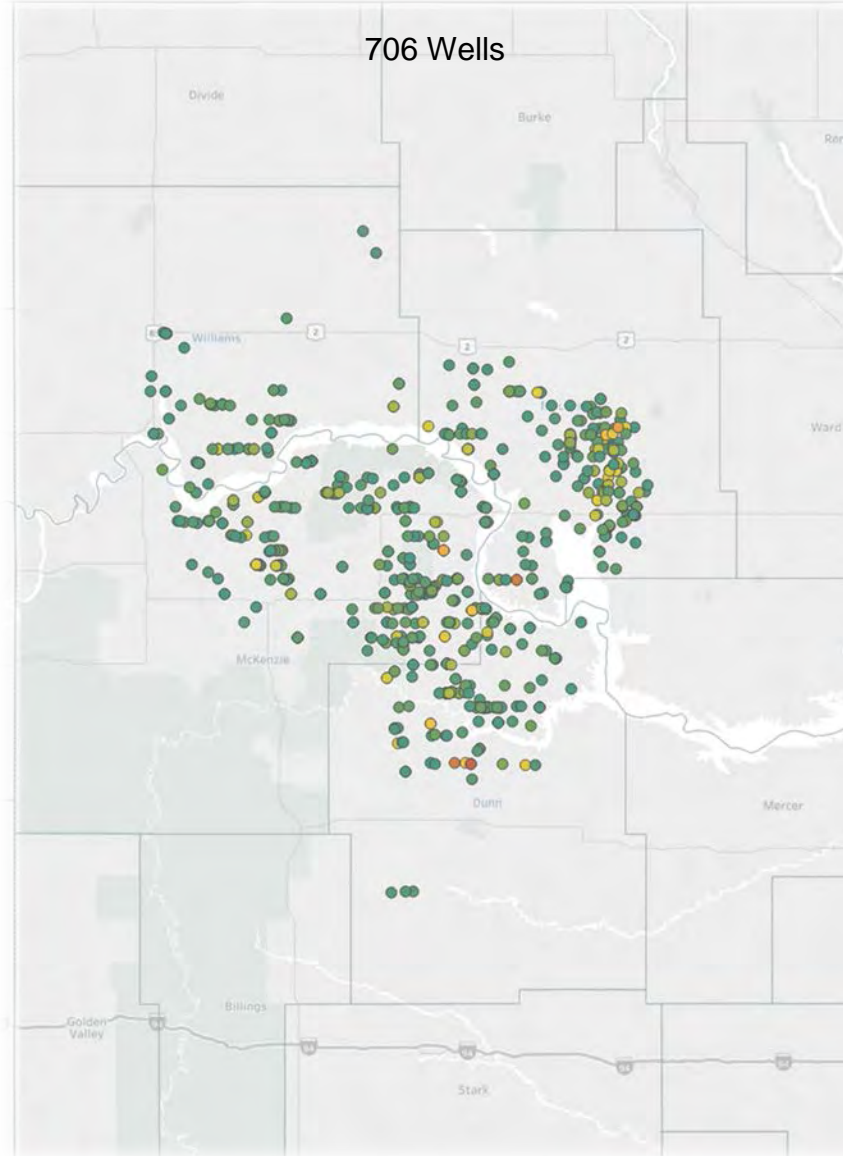
266 Wells



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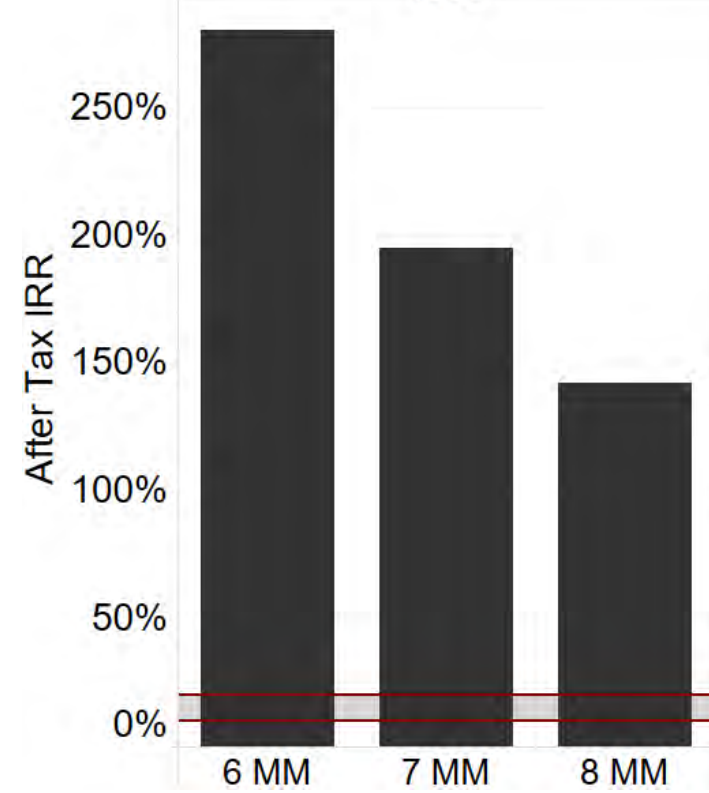
Bakken

706 Wells

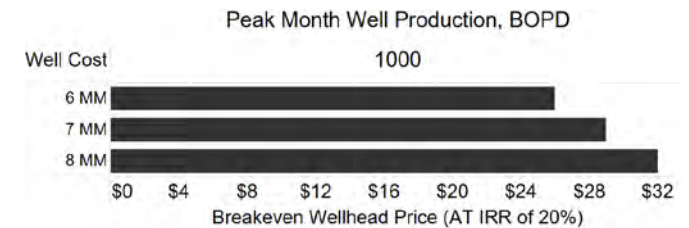


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Peak Month BOPD / Well Cost  
1000



\$63 Wellhead

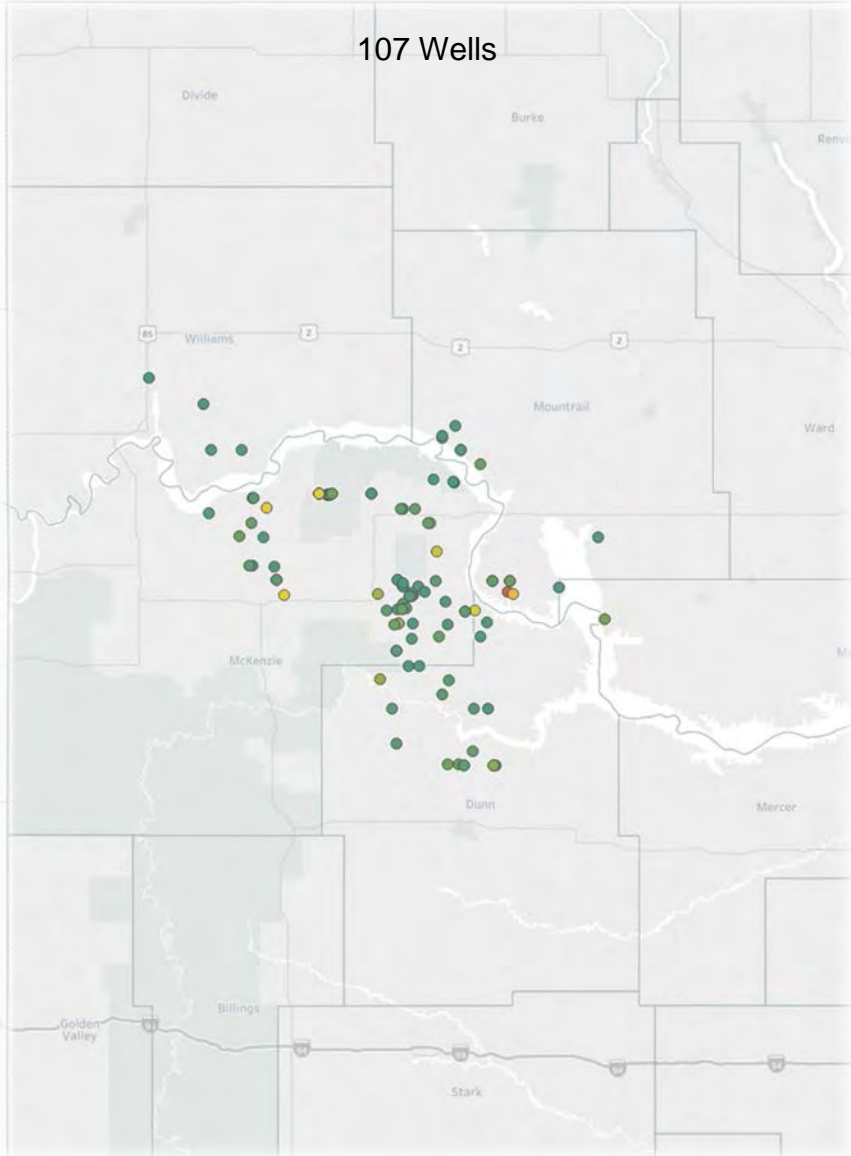




# Peak Month Minimum – 1,250 BOPD

## Three Forks

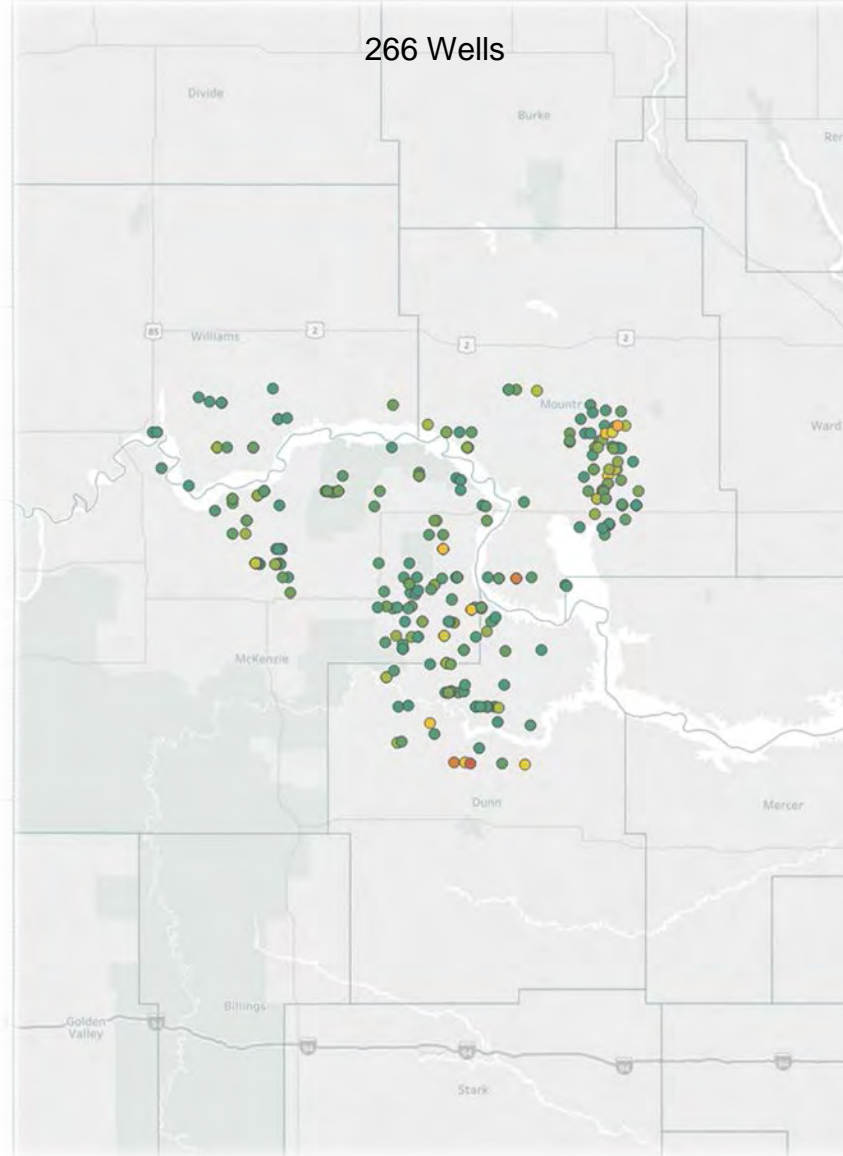
107 Wells



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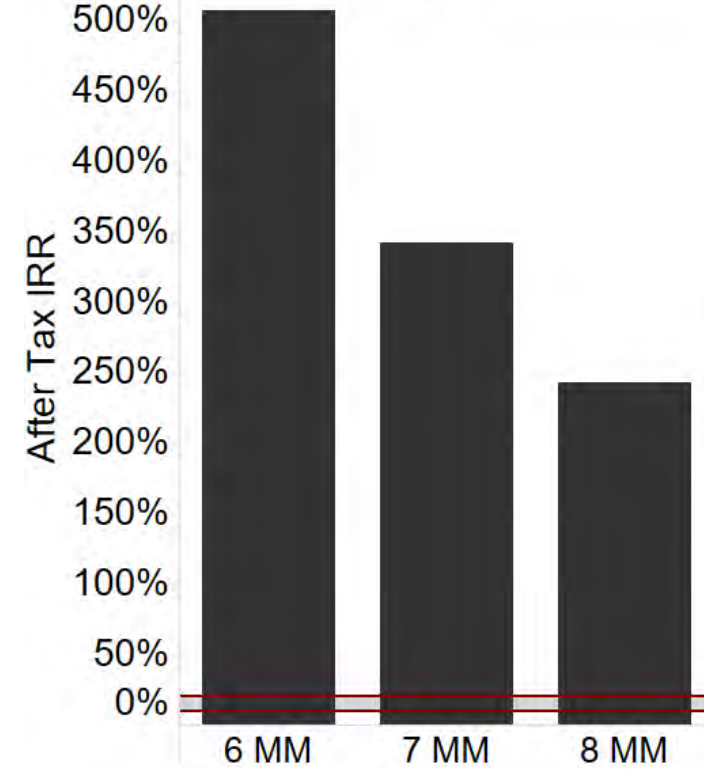
## Bakken

266 Wells



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Peak Month BOPD / Well Cost  
1250



\$63 Wellhead

Peak Month Well Production, BOPD

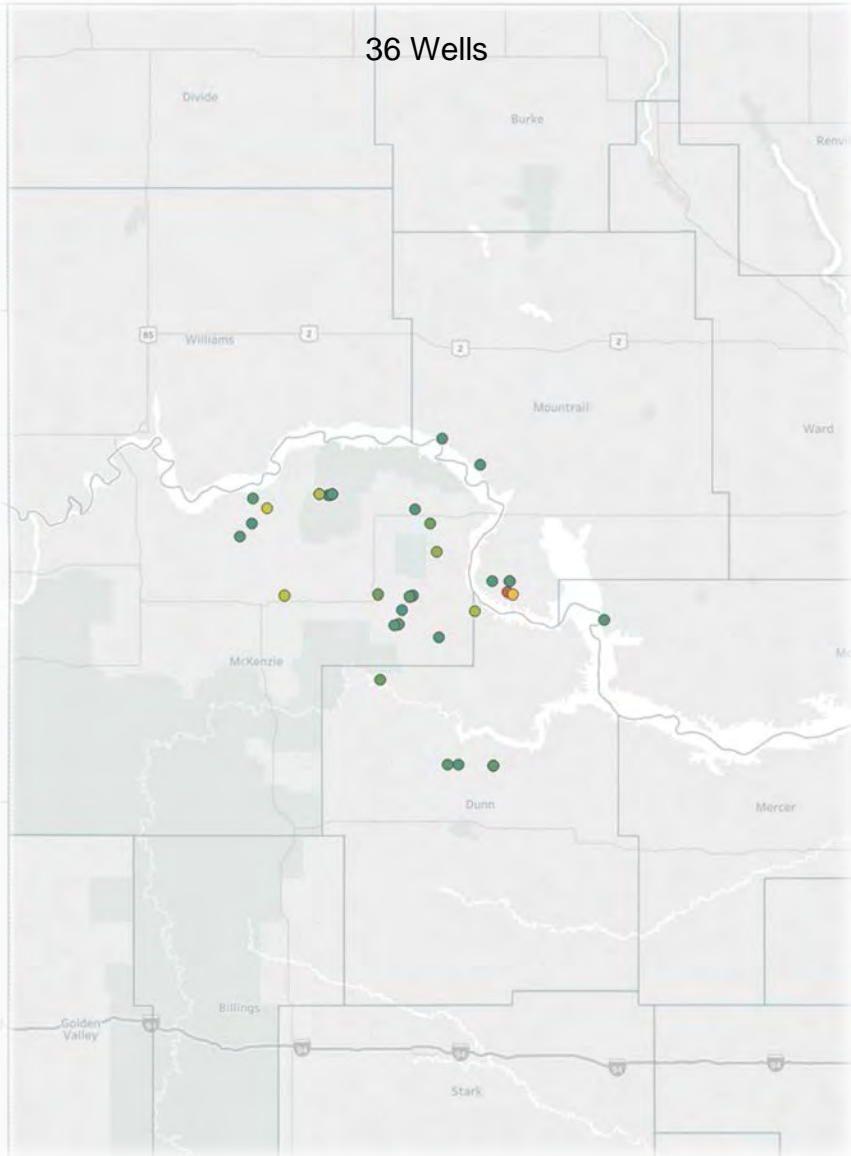




# Peak Month Minimum – 1,500 BOPD

Three Forks

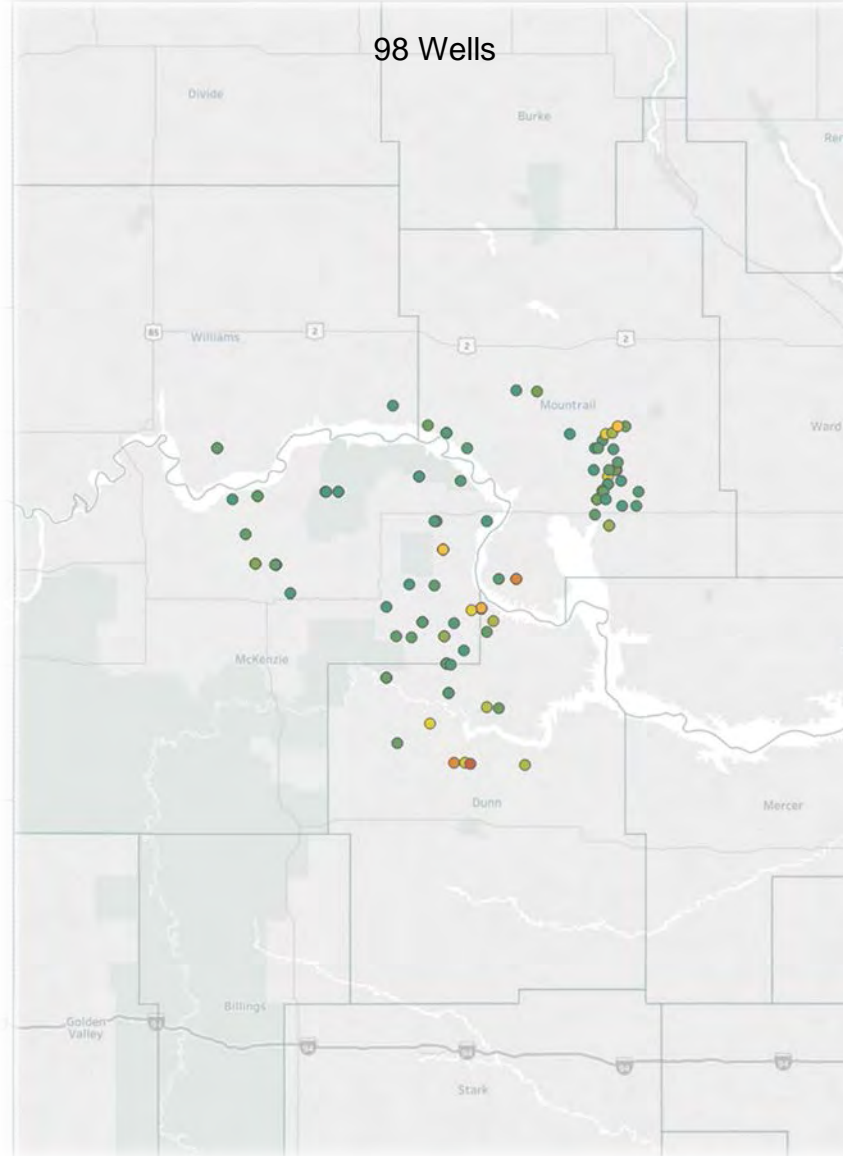
36 Wells



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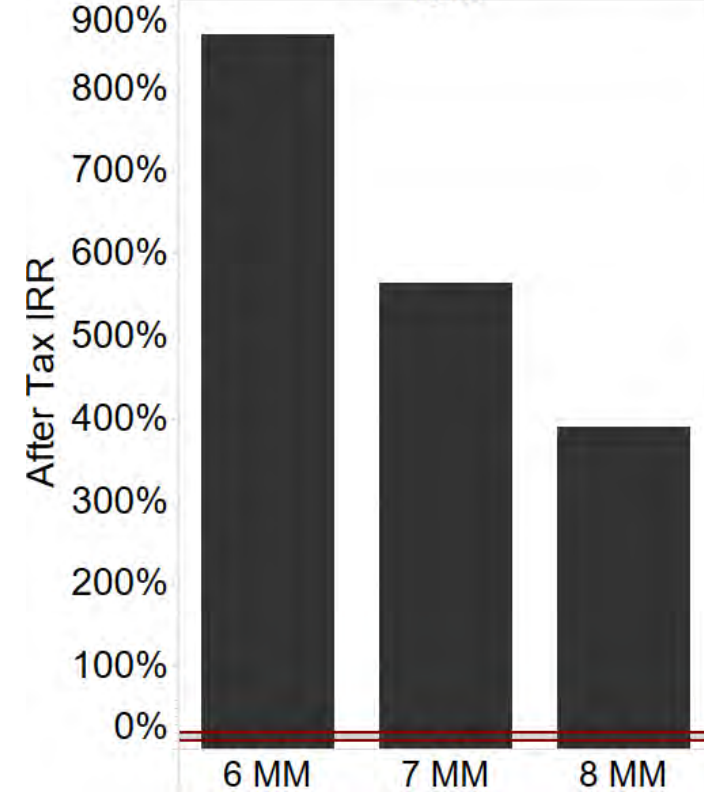
Bakken

98 Wells



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Peak Month BOPD / Well Cost  
1500



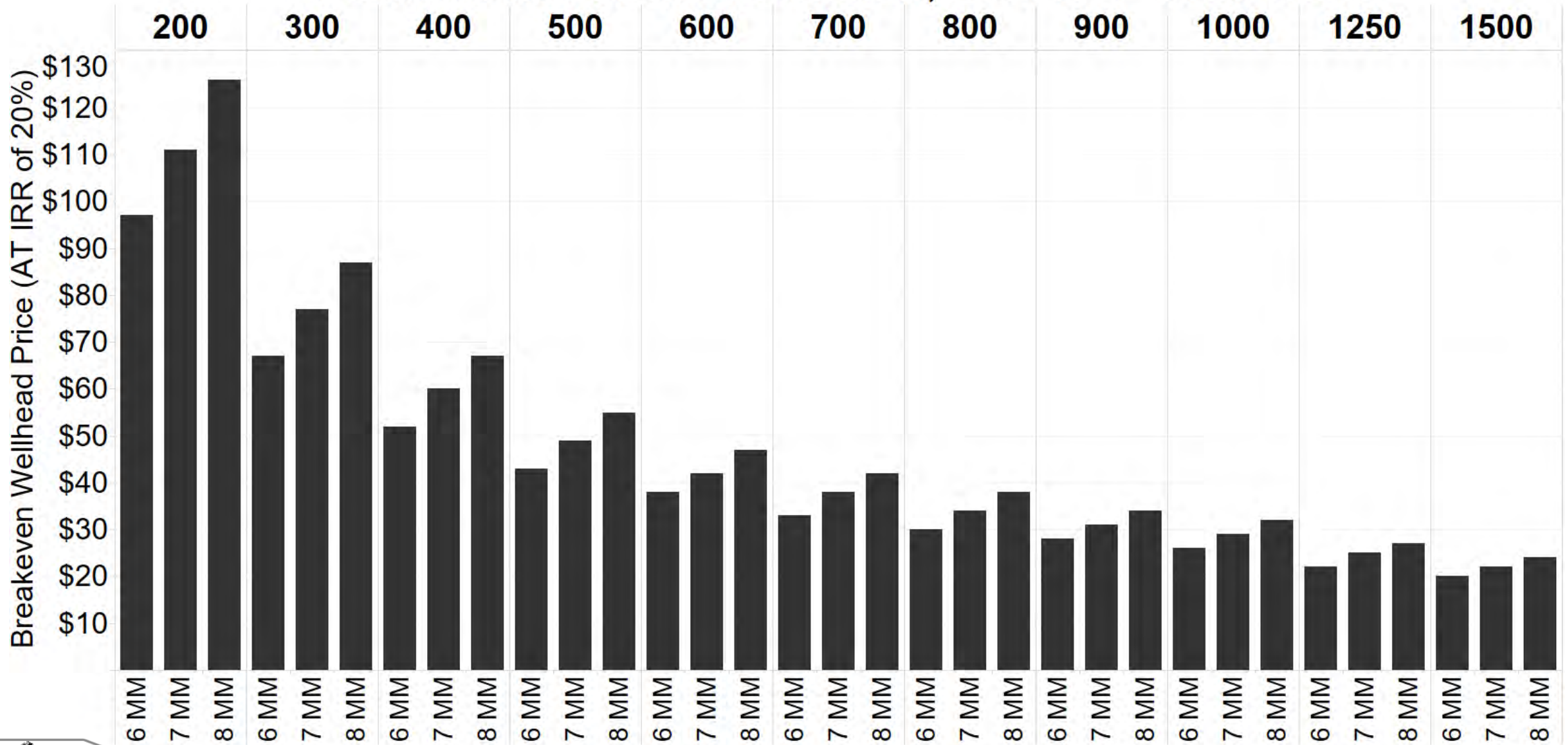
\$63 Wellhead

Peak Month Well Production, BOPD



# Breakeven Summary

Peak Month Well Production, BOPD / Well Cost



# Bakken Breakeven Analysis

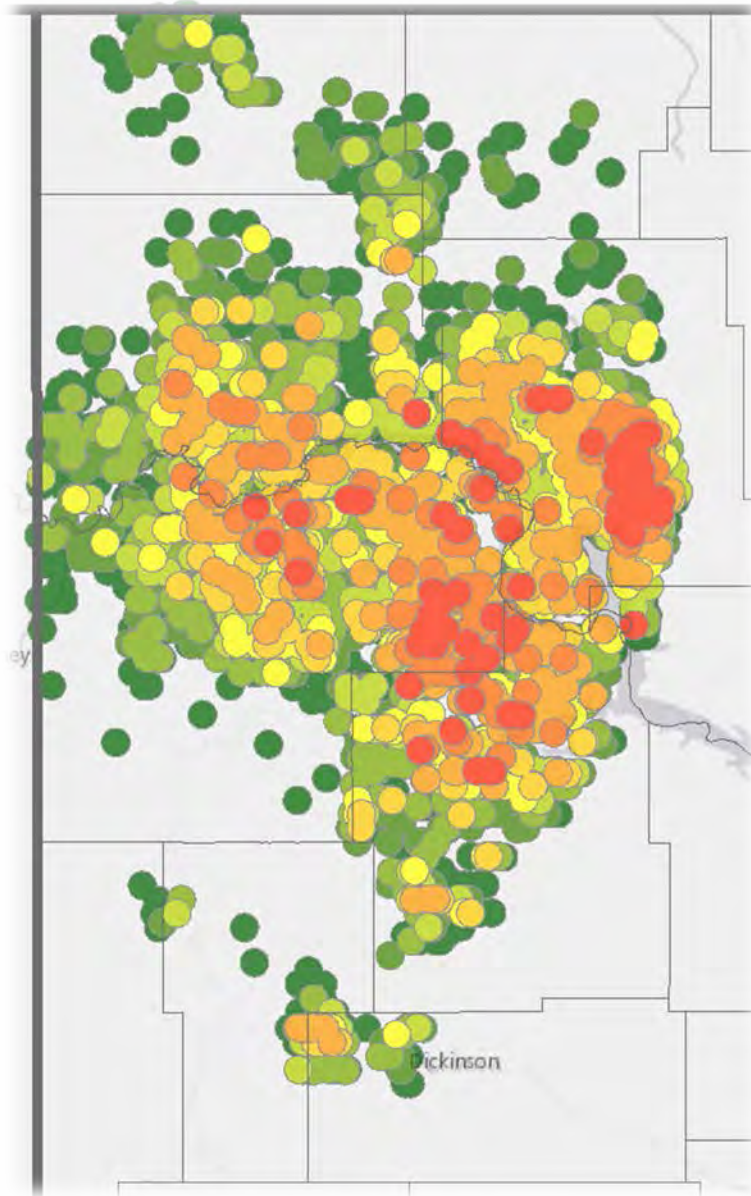
## Important Considerations

- Breakeven areas were determined by neighboring well performance and are expected to expand as new completion technology is applied in areas outside “the core.”
- Just because an area is considered “economic” **does not mean that it is the most economic** option for the industry participant(s). Competition for capital continues to exist inside and outside the region.





# Bakken Breakeven Price Range (20% IRR)



Bakken Breakeven Prices  
\$6 - \$8 Million  
Completed Wells Cost

- \$58-\$73
- \$49-\$61
- \$43-\$52
- \$39-\$48
- \$36-\$43
- \$34-\$40
- \$32-\$38
- \$28-\$33
- \$26-\$30

Background Map: Esri, HERE, DeLorme, MapmyIndia, ©  
OpenStreetMap contributors, and the GIS user community

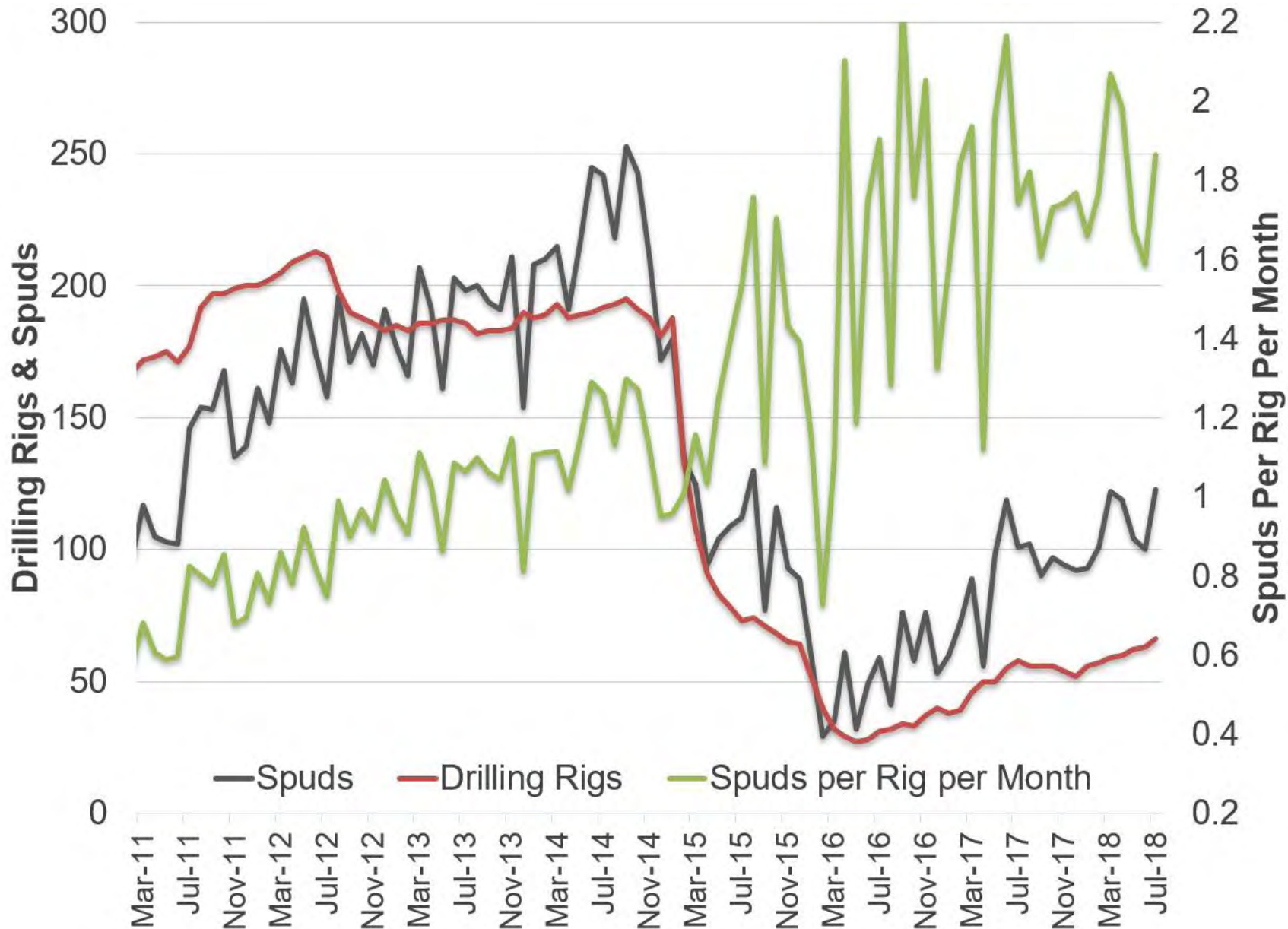


# Presentation Outline

- Economics
- **Current Activity and oil transportation dynamics**
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- North Dakota natural gas production
  - Flaring and gas capture
  - Natural gas liquids
- Pipeline construction update

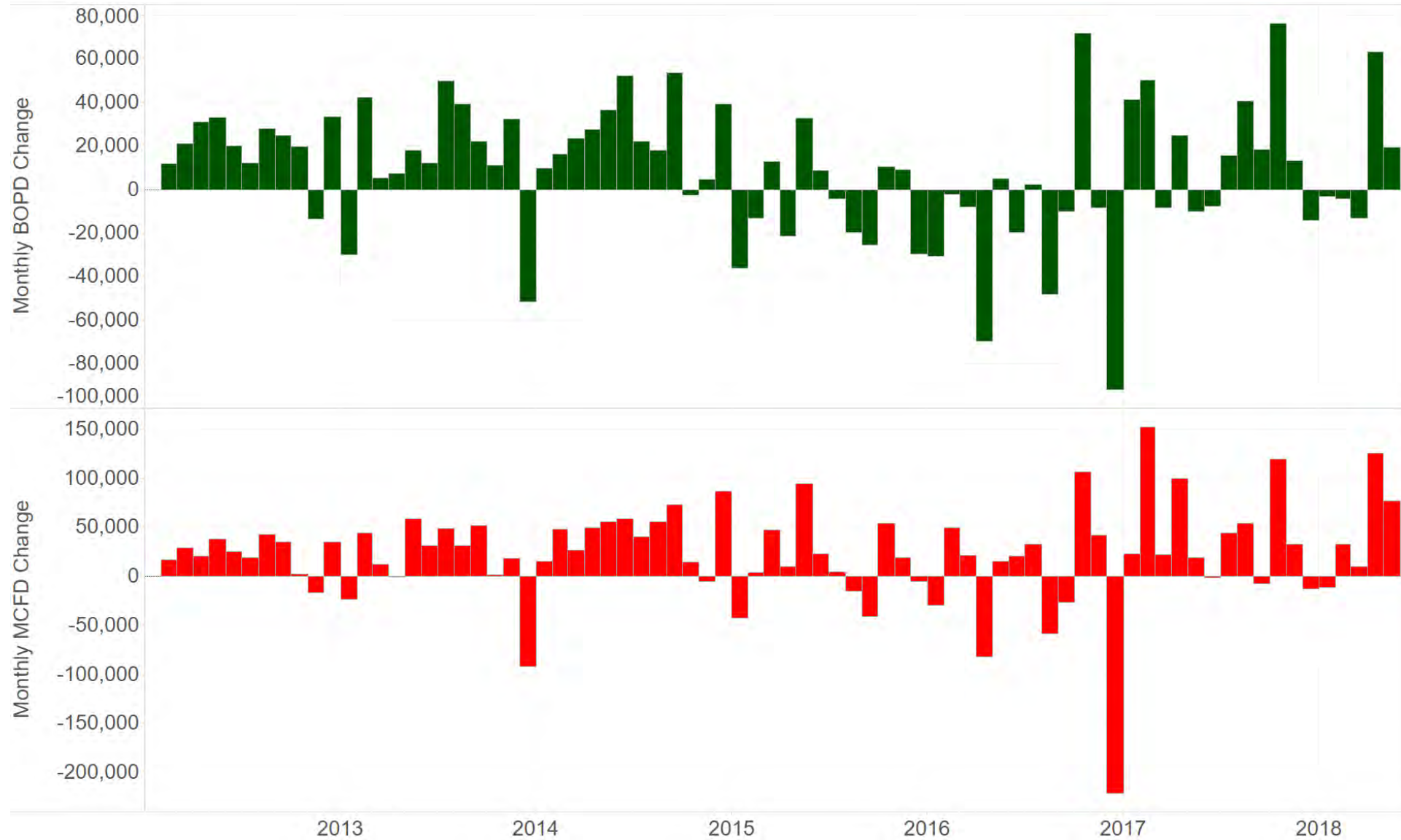


# North Dakota Drilling Activity

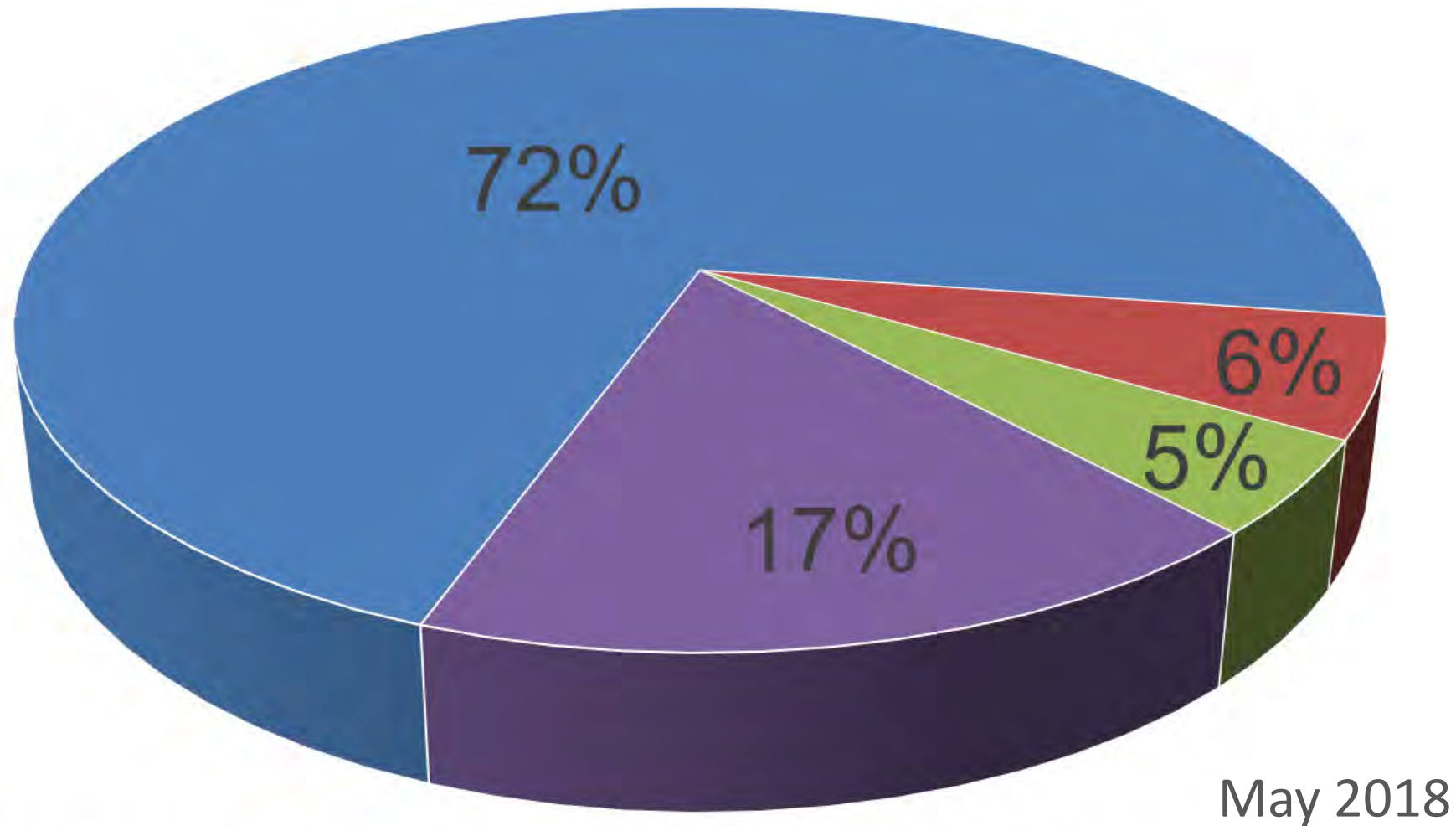




# Monthly Production Change



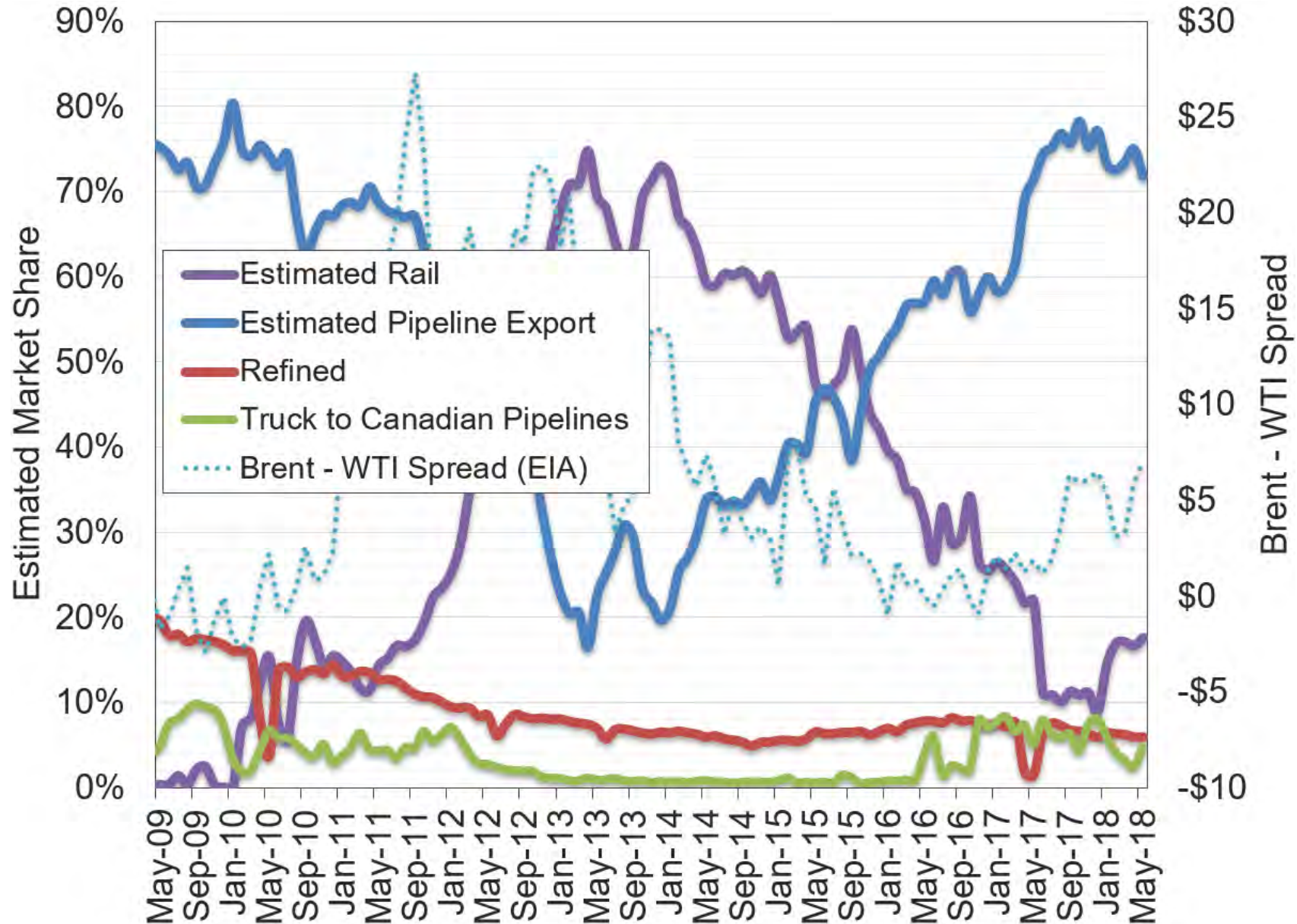
# Estimated Williston Basin Oil Transportation



- Pipeline Export
- Refined
- Truck to Canadian Pipelines
- Estimated Rail



# Estimated Williston Basin Oil Transportation

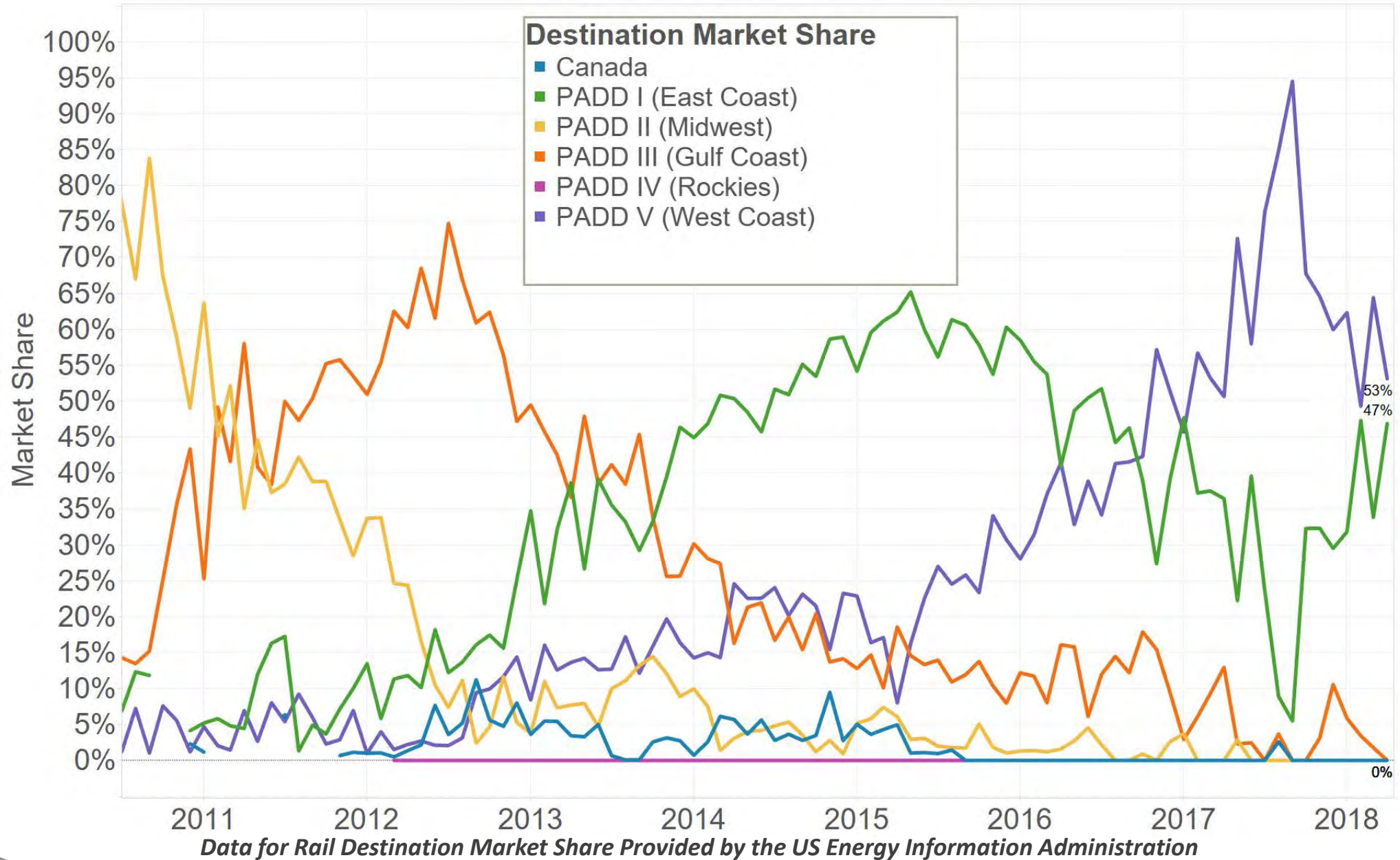




# Estimated ND Rail Export Volumes

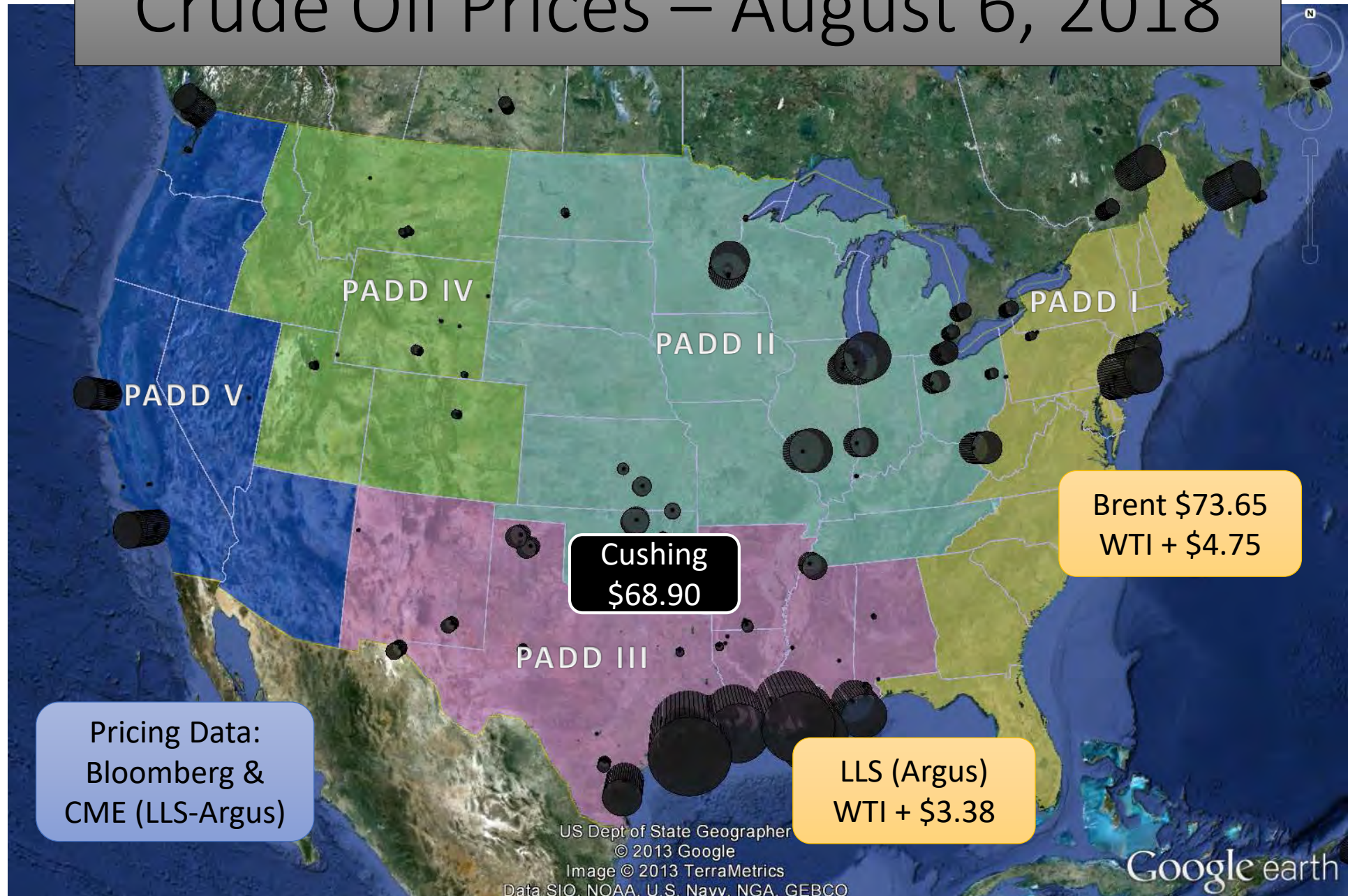


# Rail Destinations Market Share (April 2018)





# Crude Oil Prices – August 6, 2018



Pricing Data:  
Bloomberg &  
CME (LLS-Argus)

Cushing  
\$68.90

Brent \$73.65  
WTI + \$4.75

LLS (Argus)  
WTI + \$3.38

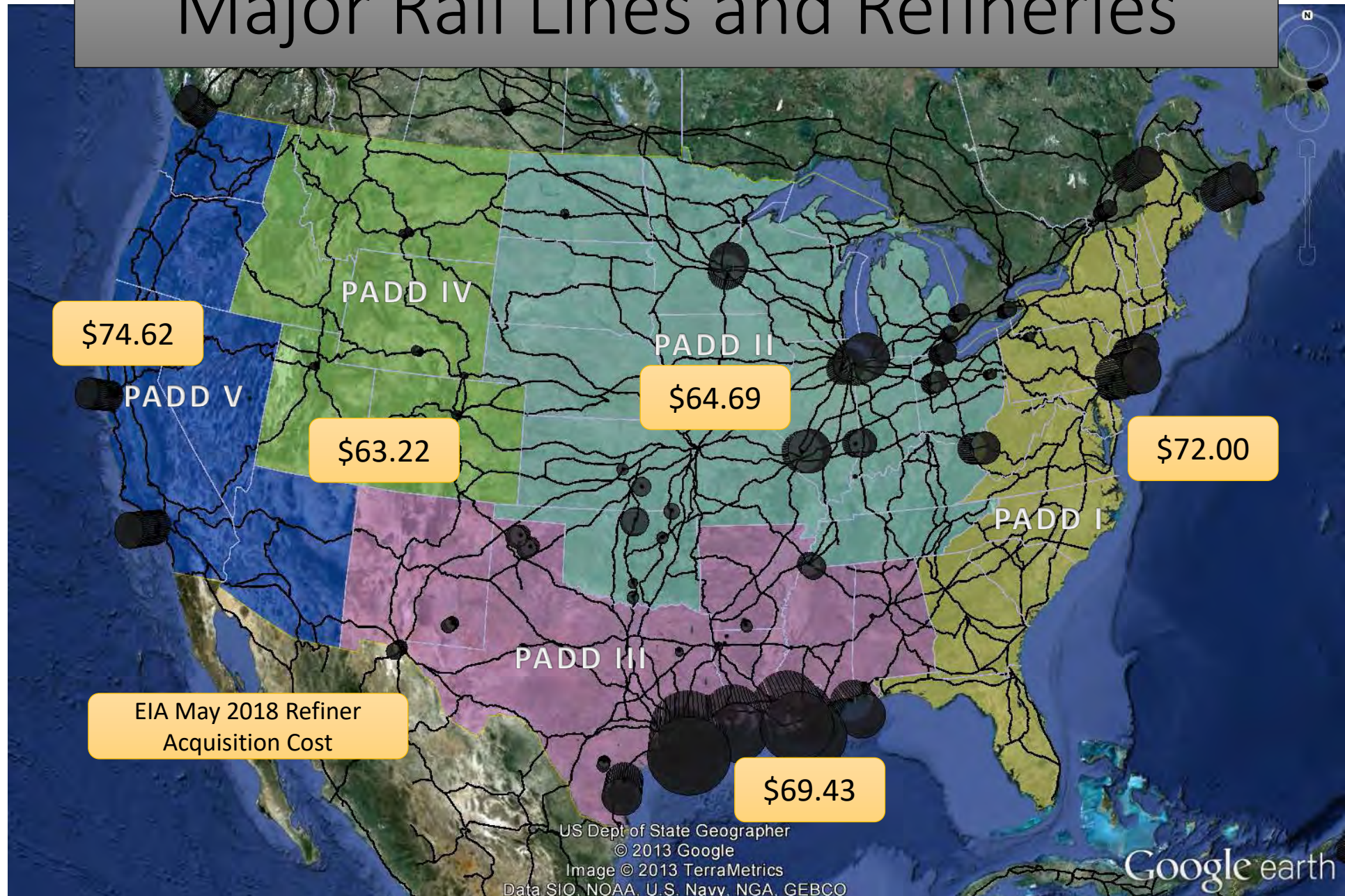
US Dept of State Geographer  
© 2013 Google  
Image © 2013 TerraMetrics  
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth





# Major Rail Lines and Refineries



# Presentation Outline

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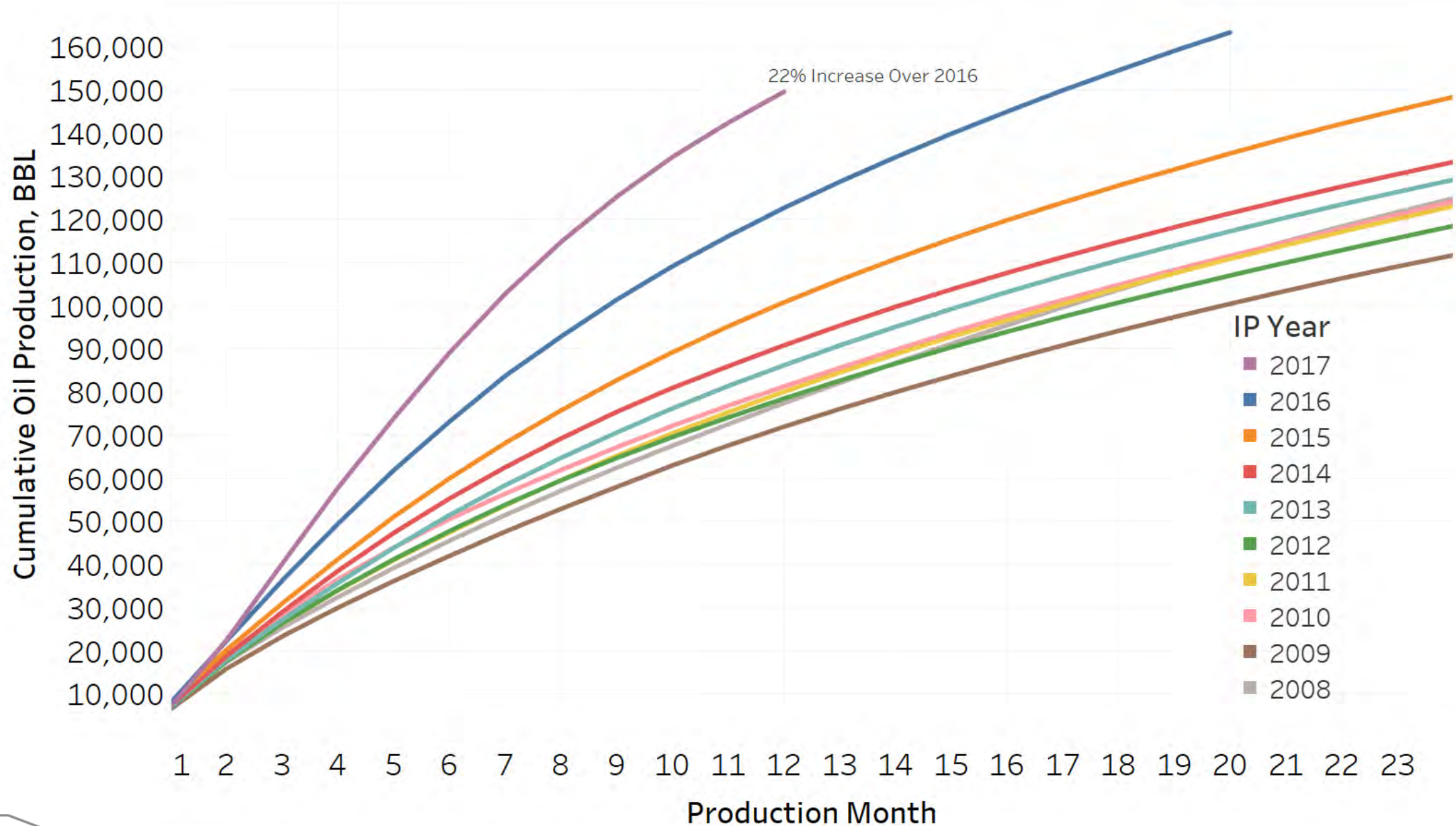


# North Dakota Oil Differential

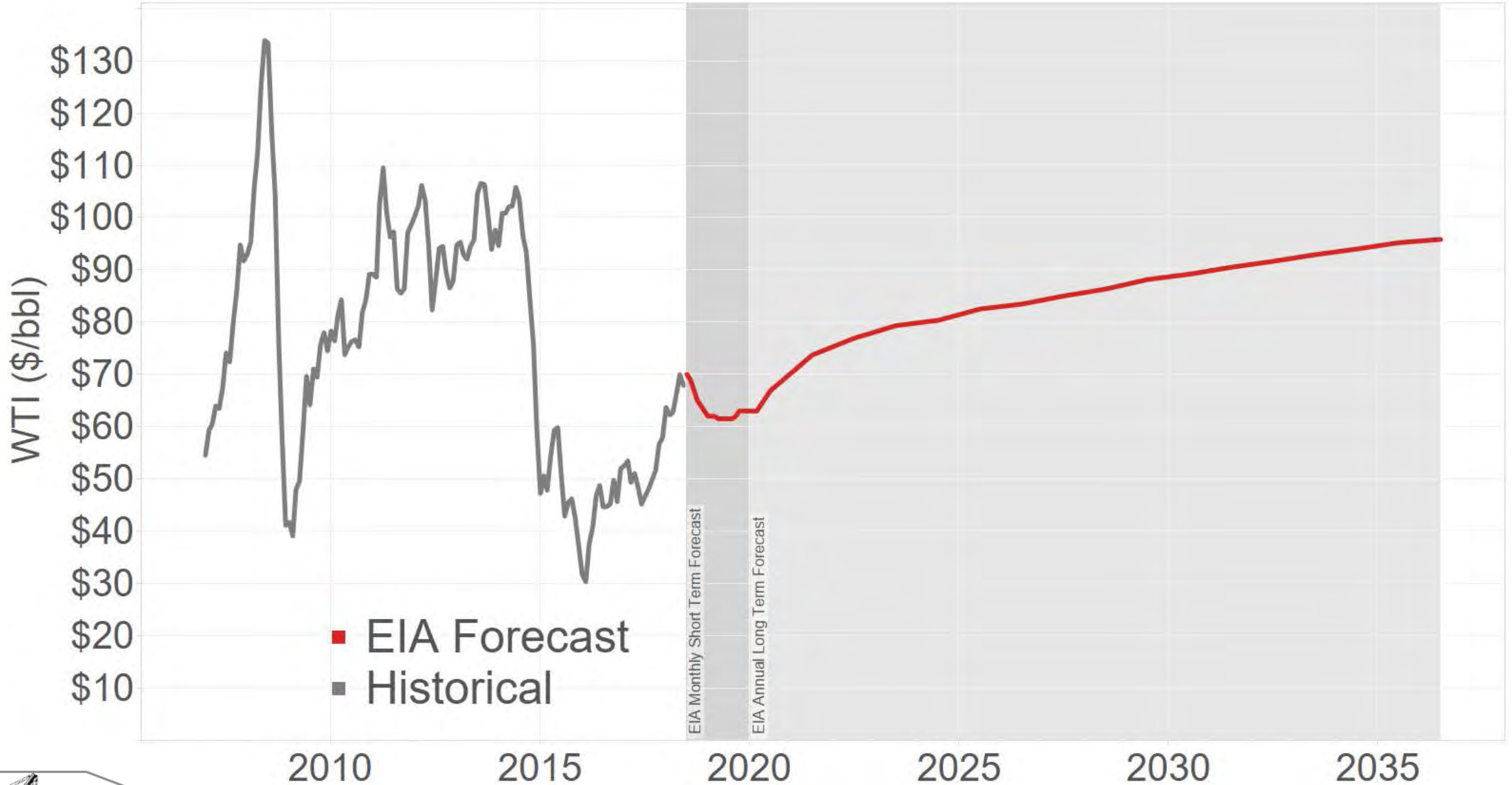




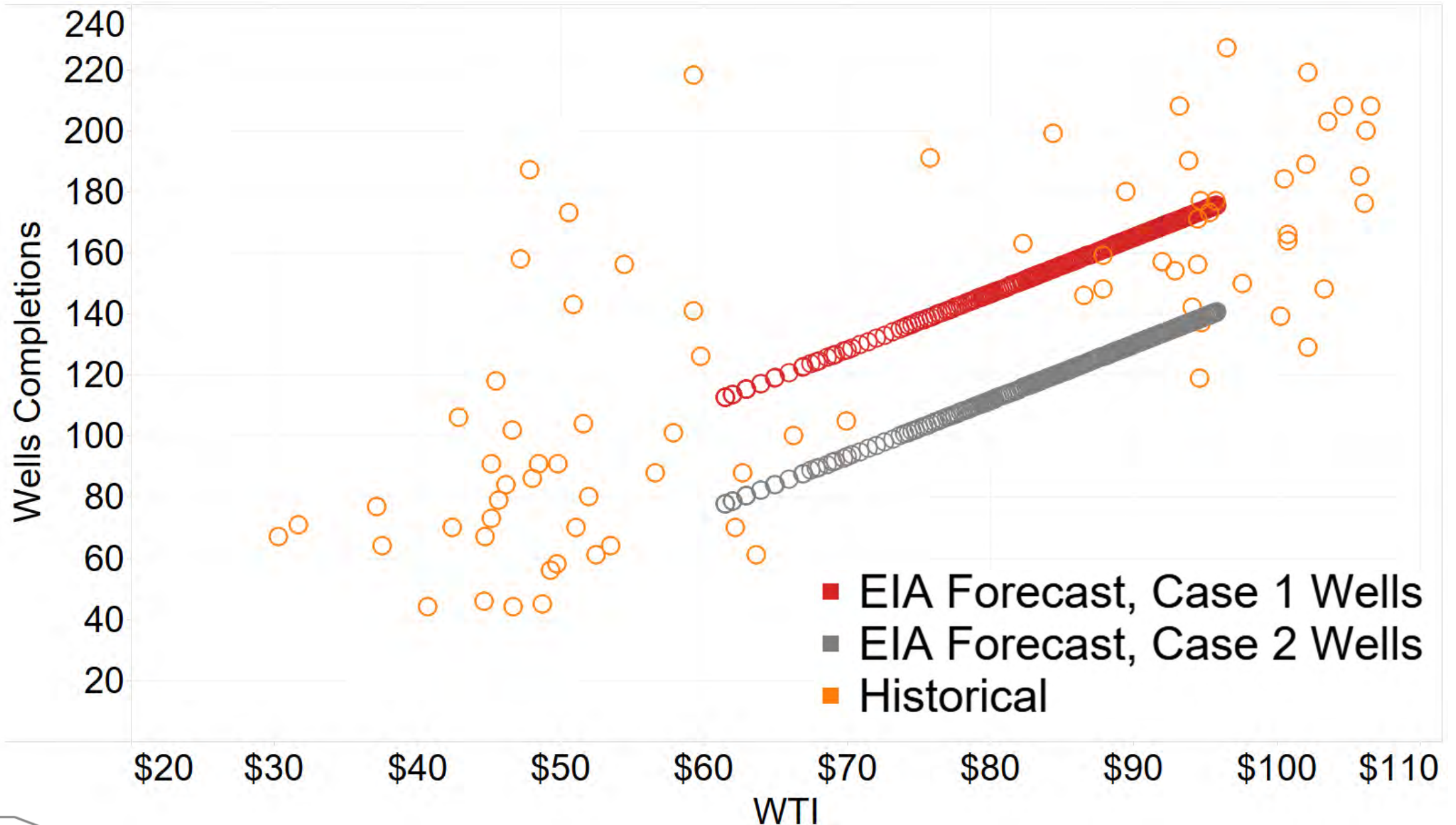
# Statewide Oil Performance



# DOE-EIA Forecasted Oil Price



# Forecasting Activity vs. Price

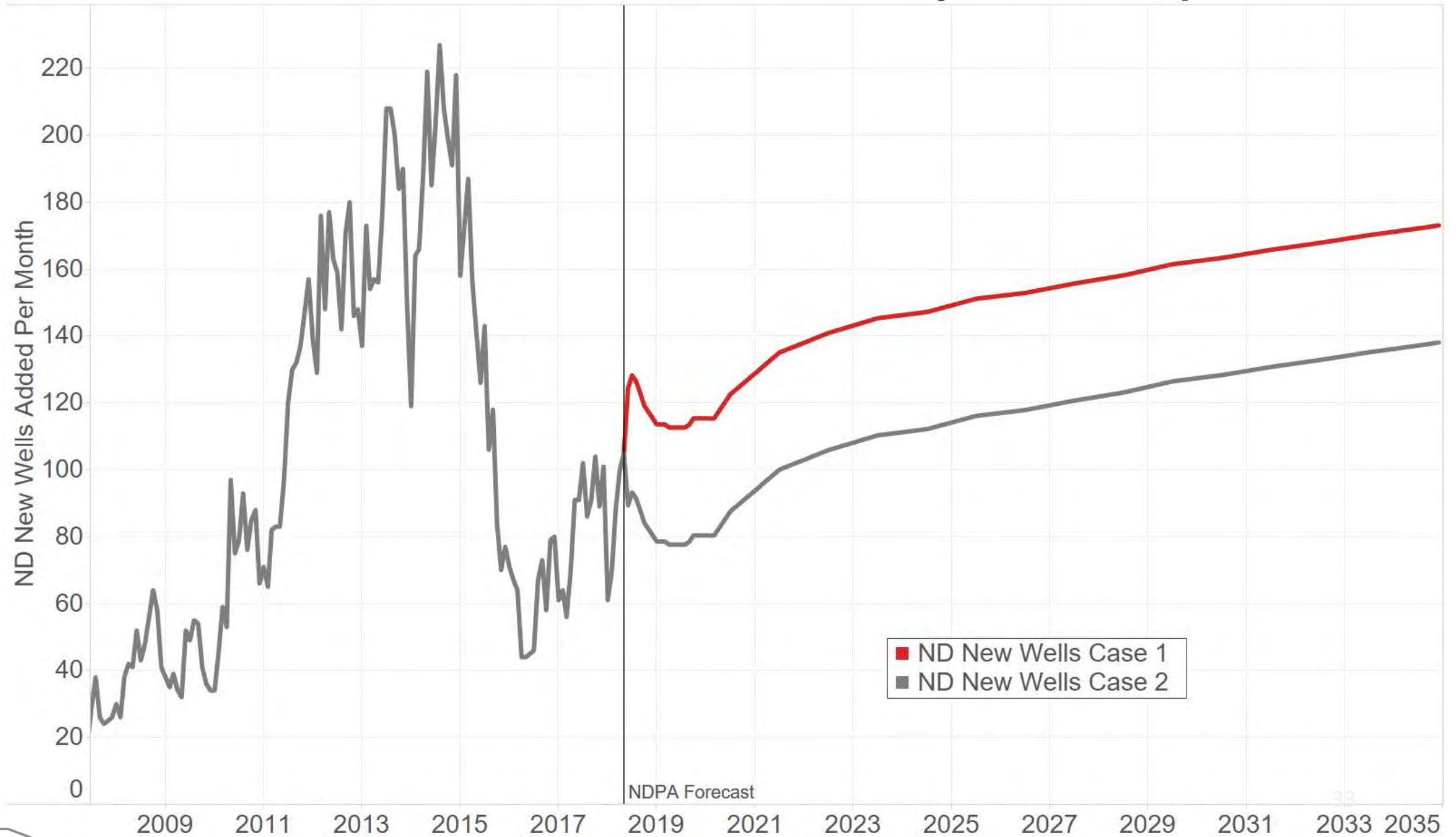


- EIA Forecast, Case 1 Wells
- EIA Forecast, Case 2 Wells
- Historical





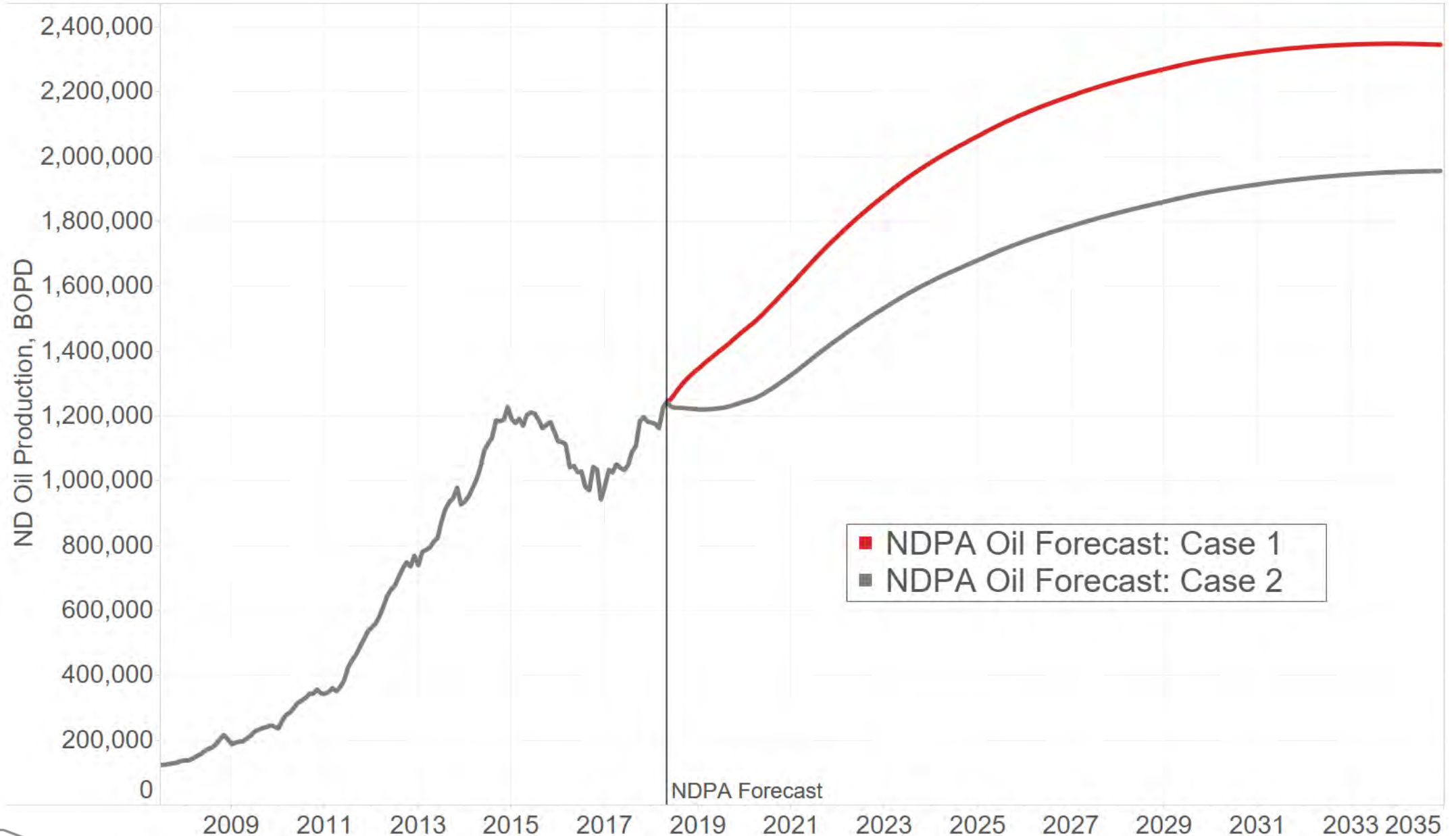
# North Dakota Forecast Activity Assumptions



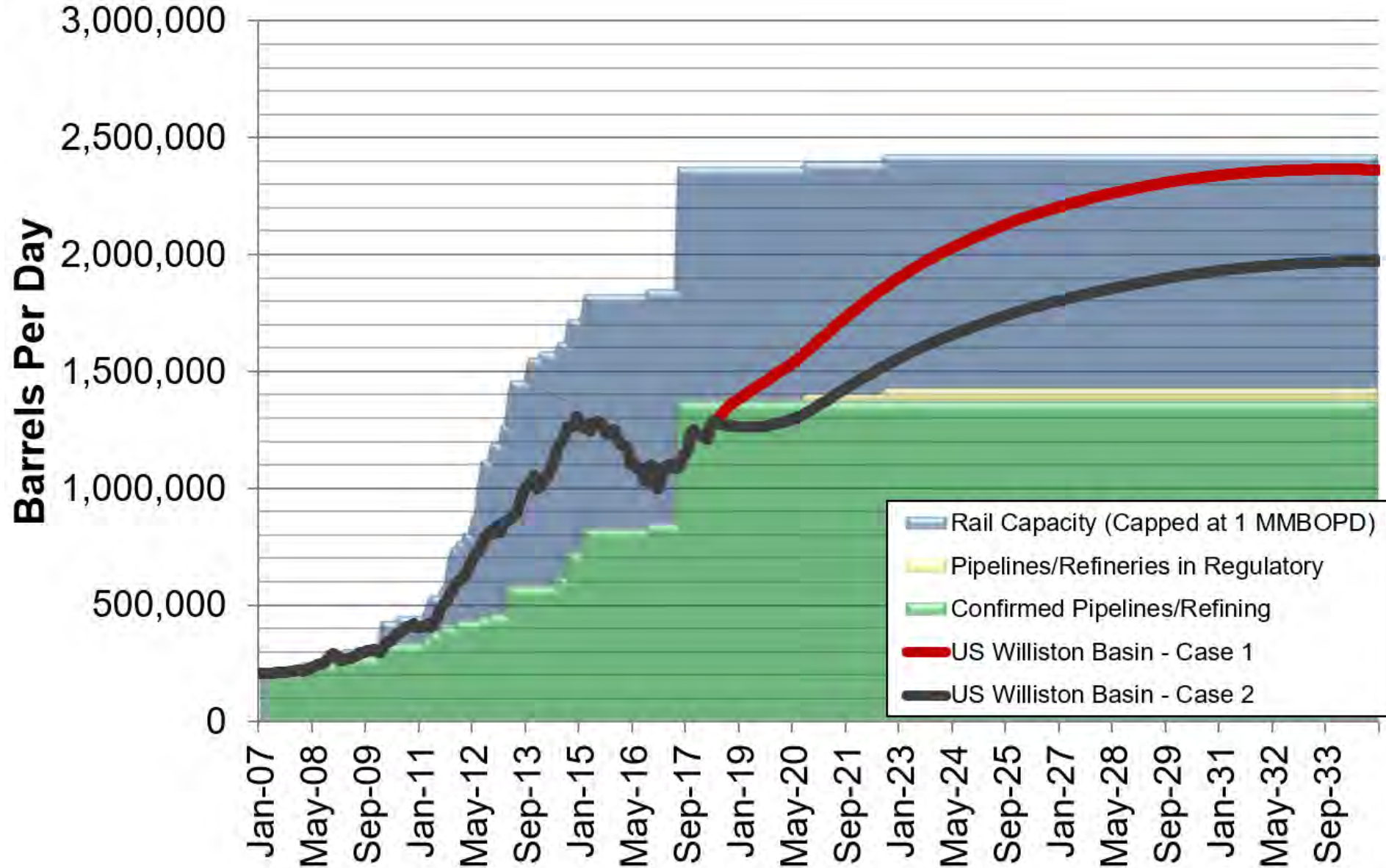
33



# North Dakota Oil Production Forecast



# 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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- Pipeline construction update



# Natural Gas Update



## Production

- Technology
- Markets



## Gathering

- Capacity
- Connections



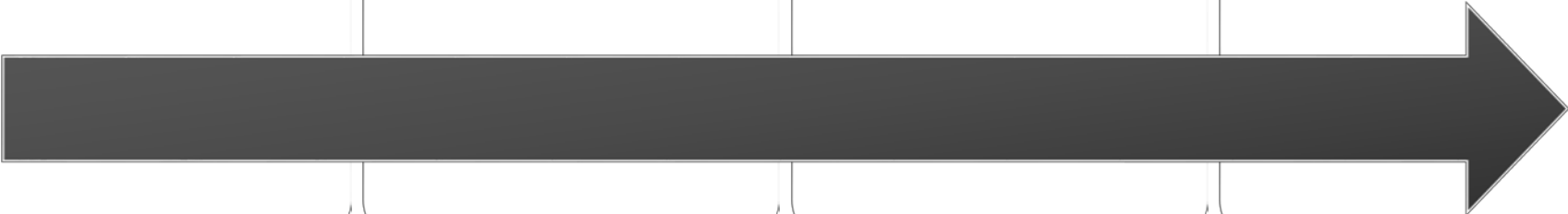
## Processing

- Capacity
- Location



## Transmission

- Dry Gas
- Natural Gas Liquids



# Natural Gas Update



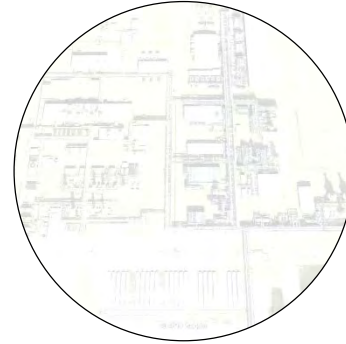
## Production

- Technology
- Markets



## Gathering

- Capacity
- Connections



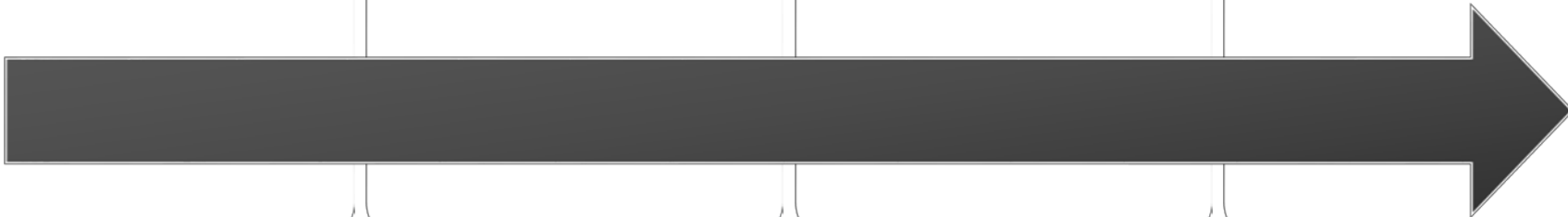
## Processing

- Capacity
- Location



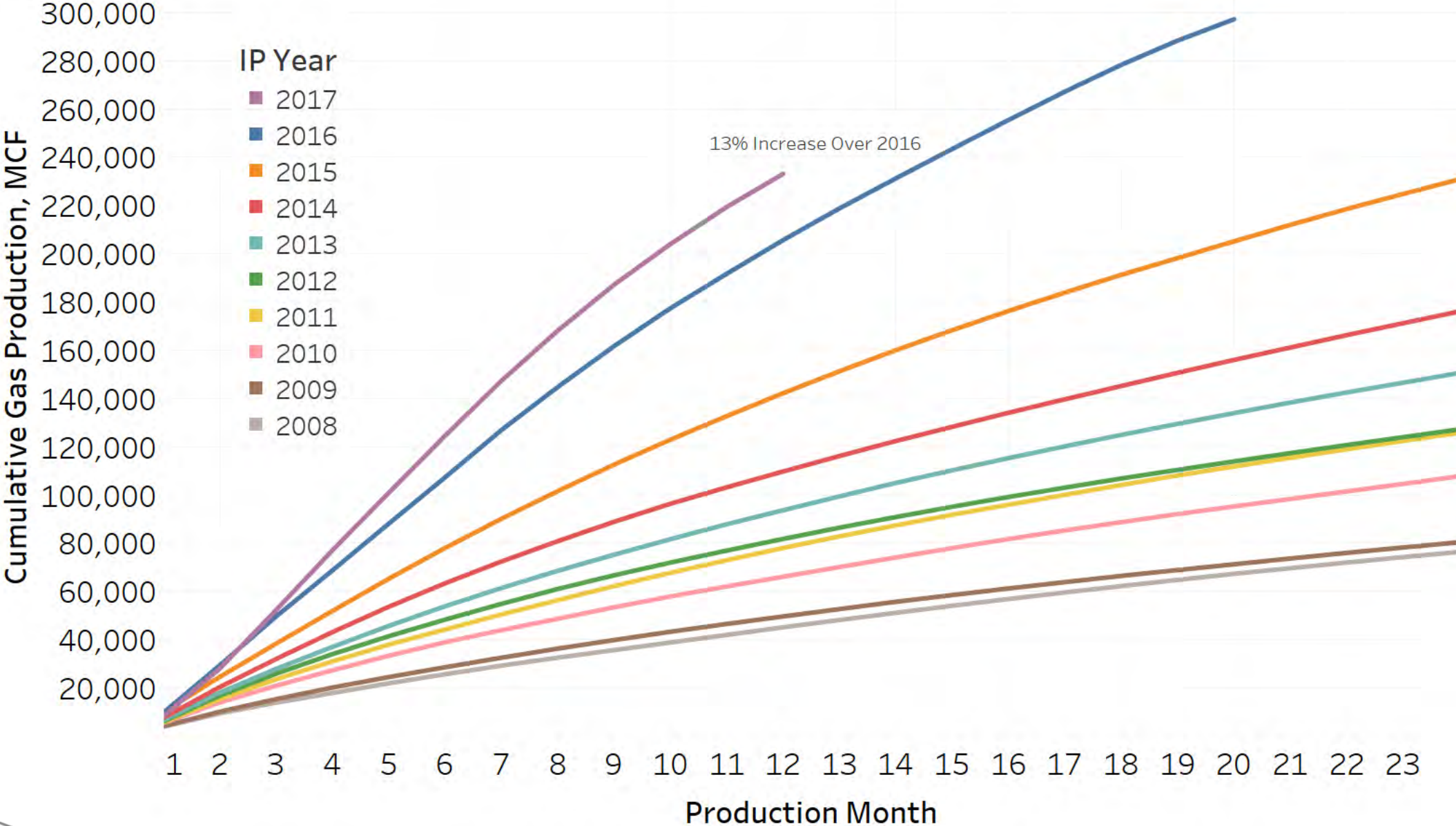
## Transmission

- Dry Gas
- Natural Gas Liquids

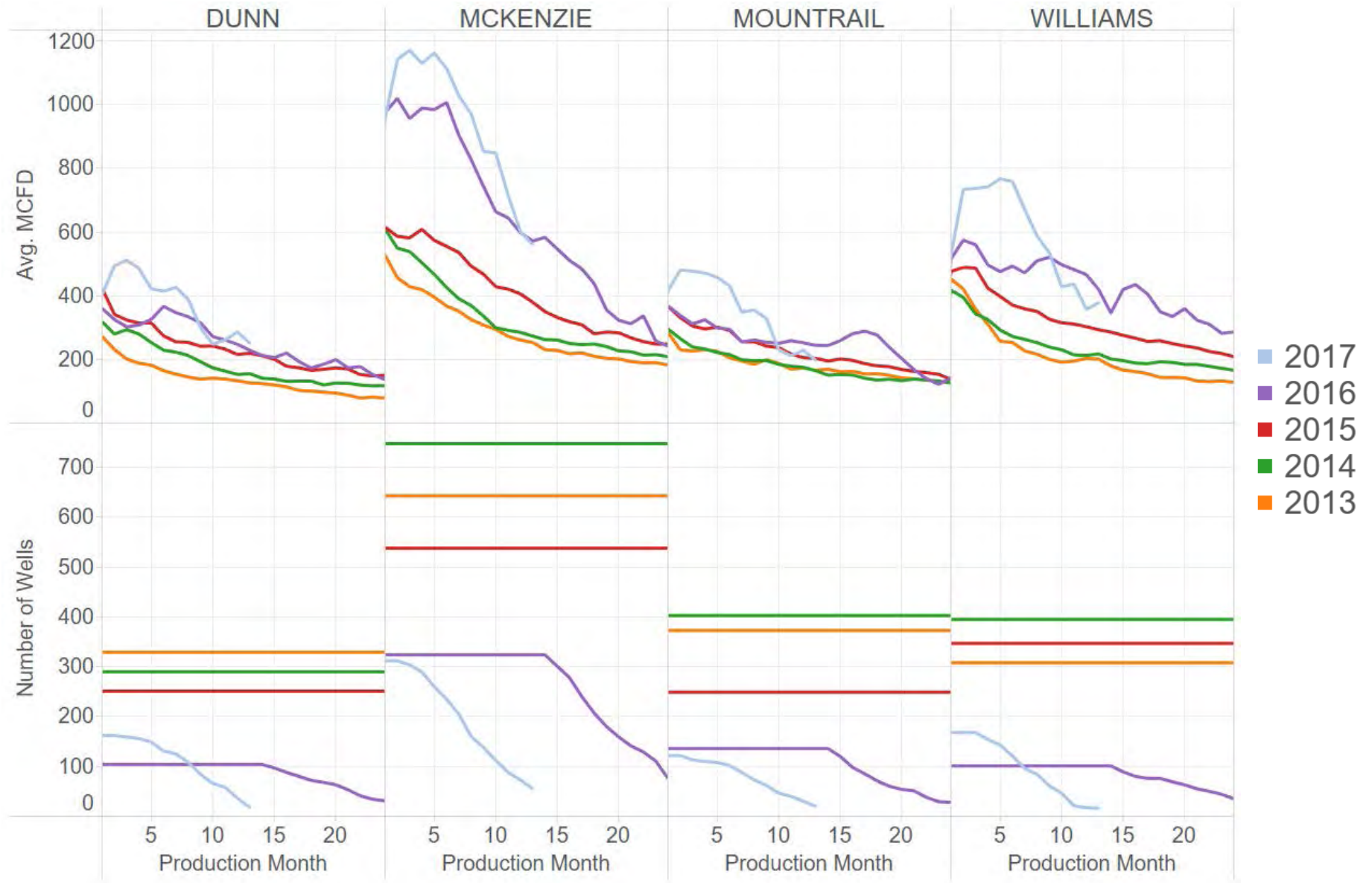




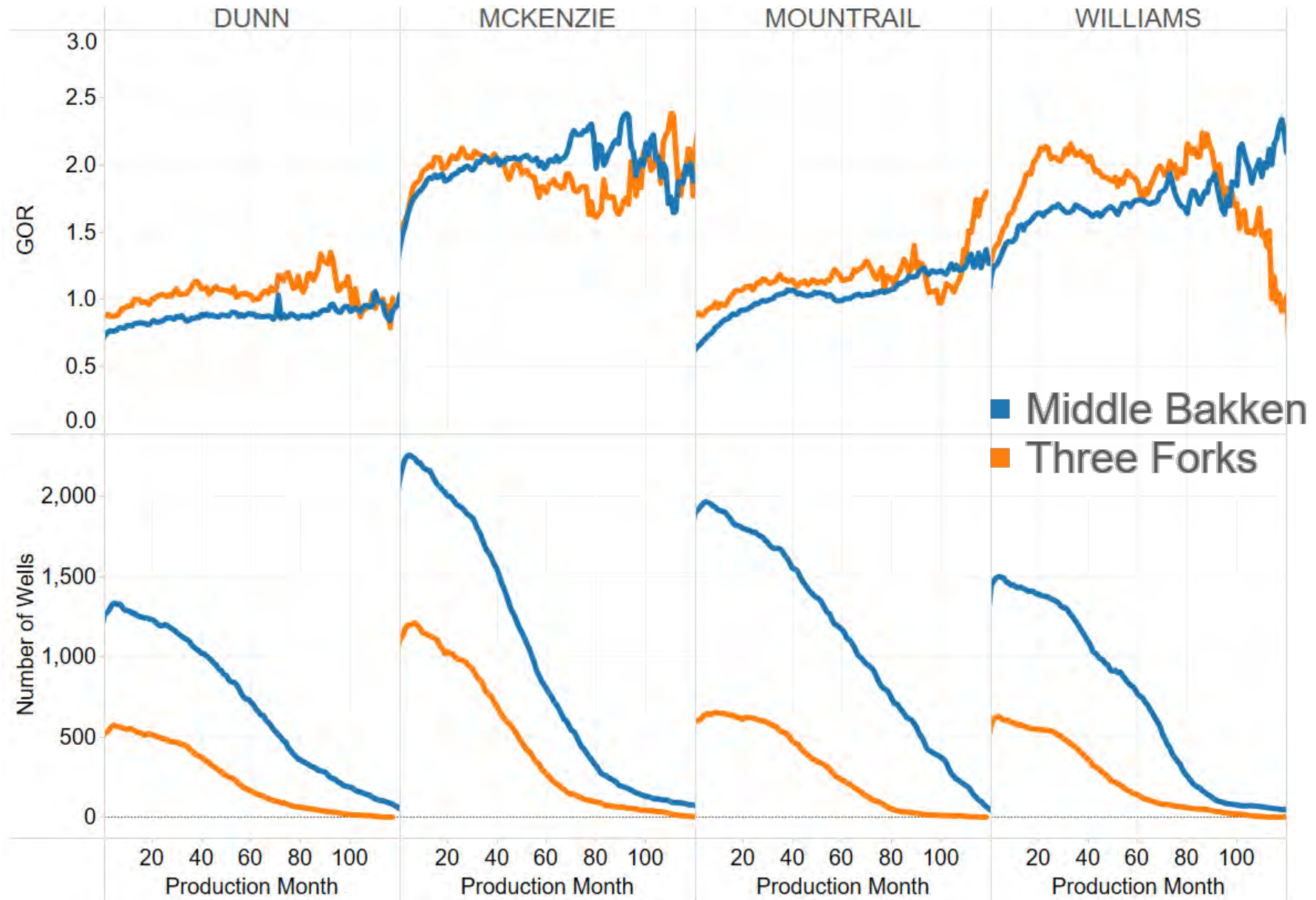
# Statewide Gas Performance



# Bakken and Three Forks Well Performance

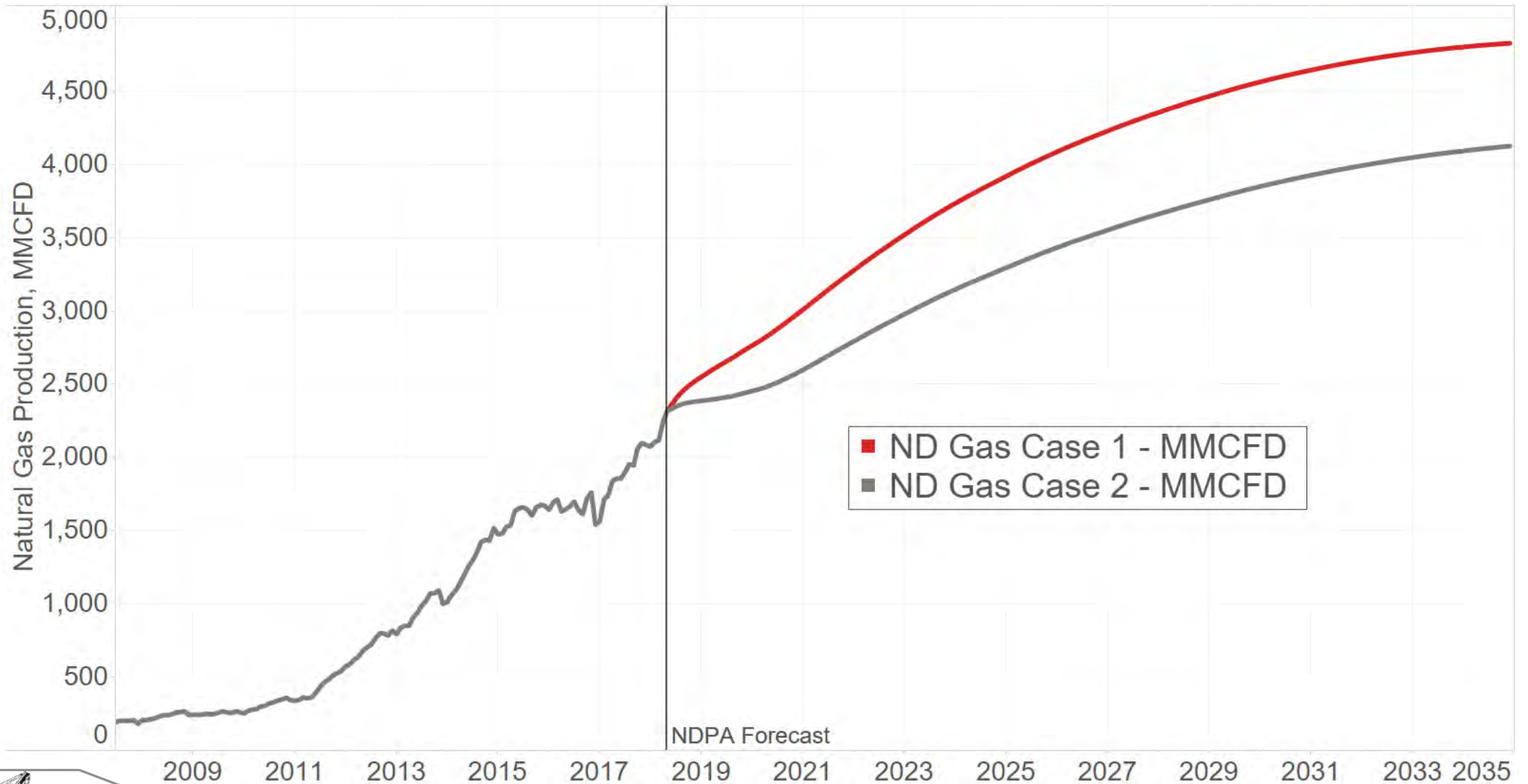


# Bakken and Three Forks Gas Oil Ratio

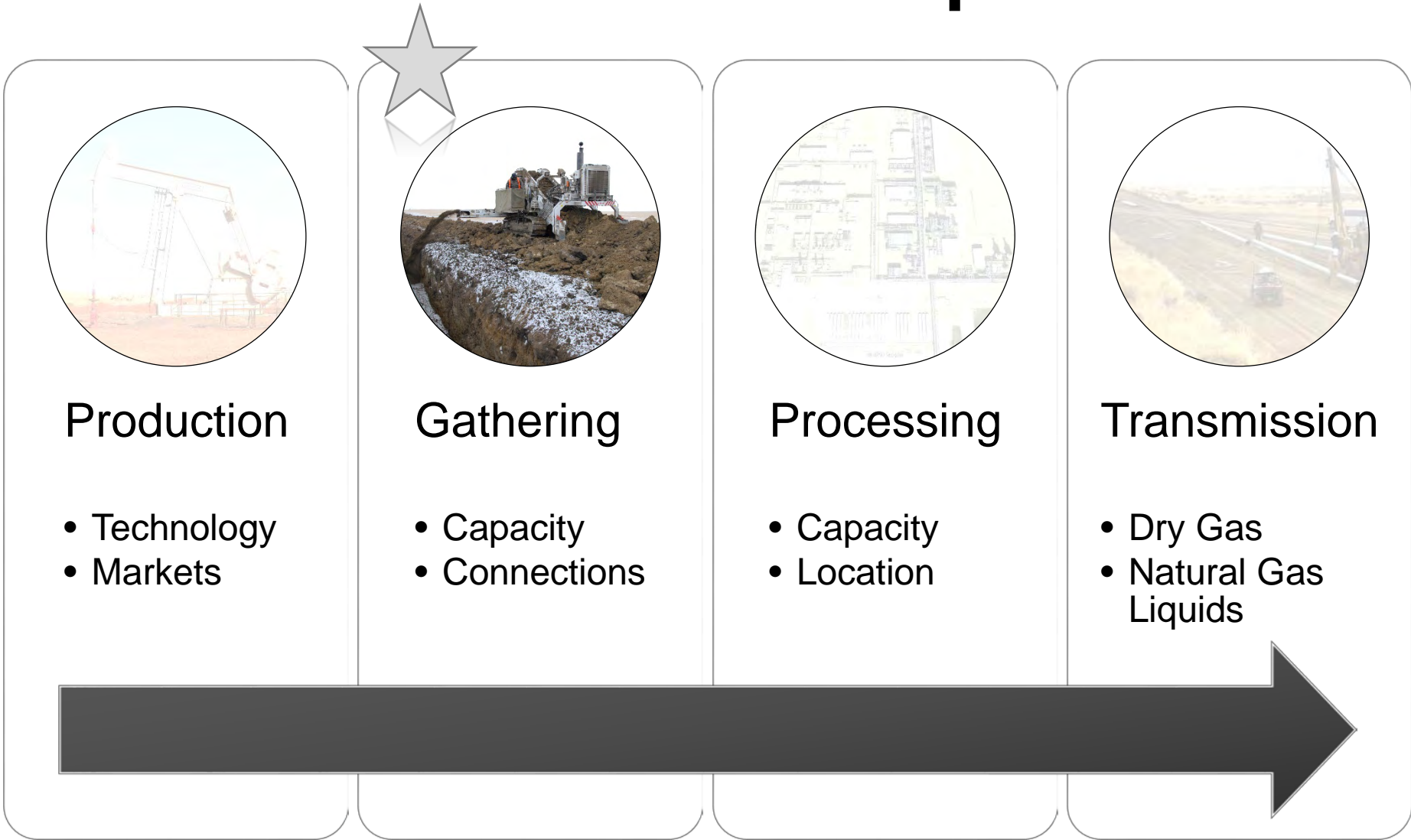




# NDPA North Dakota Gas Production Forecast

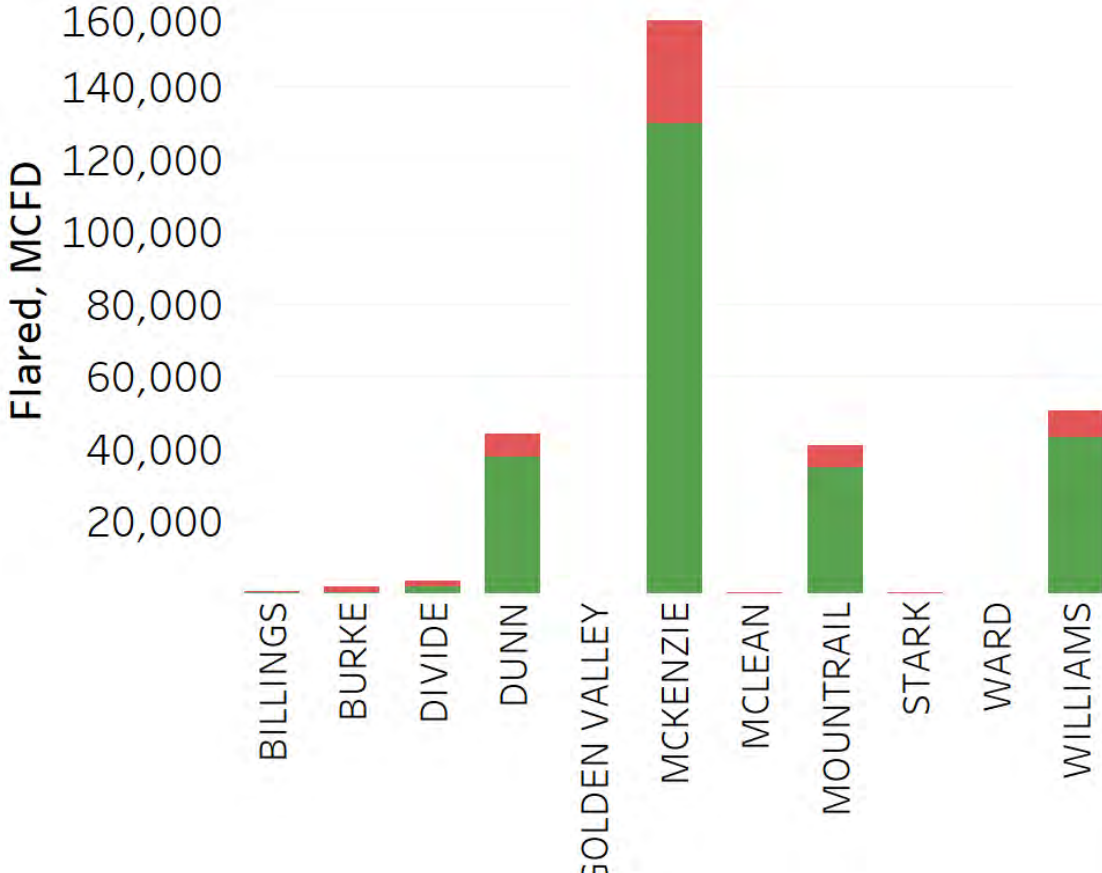
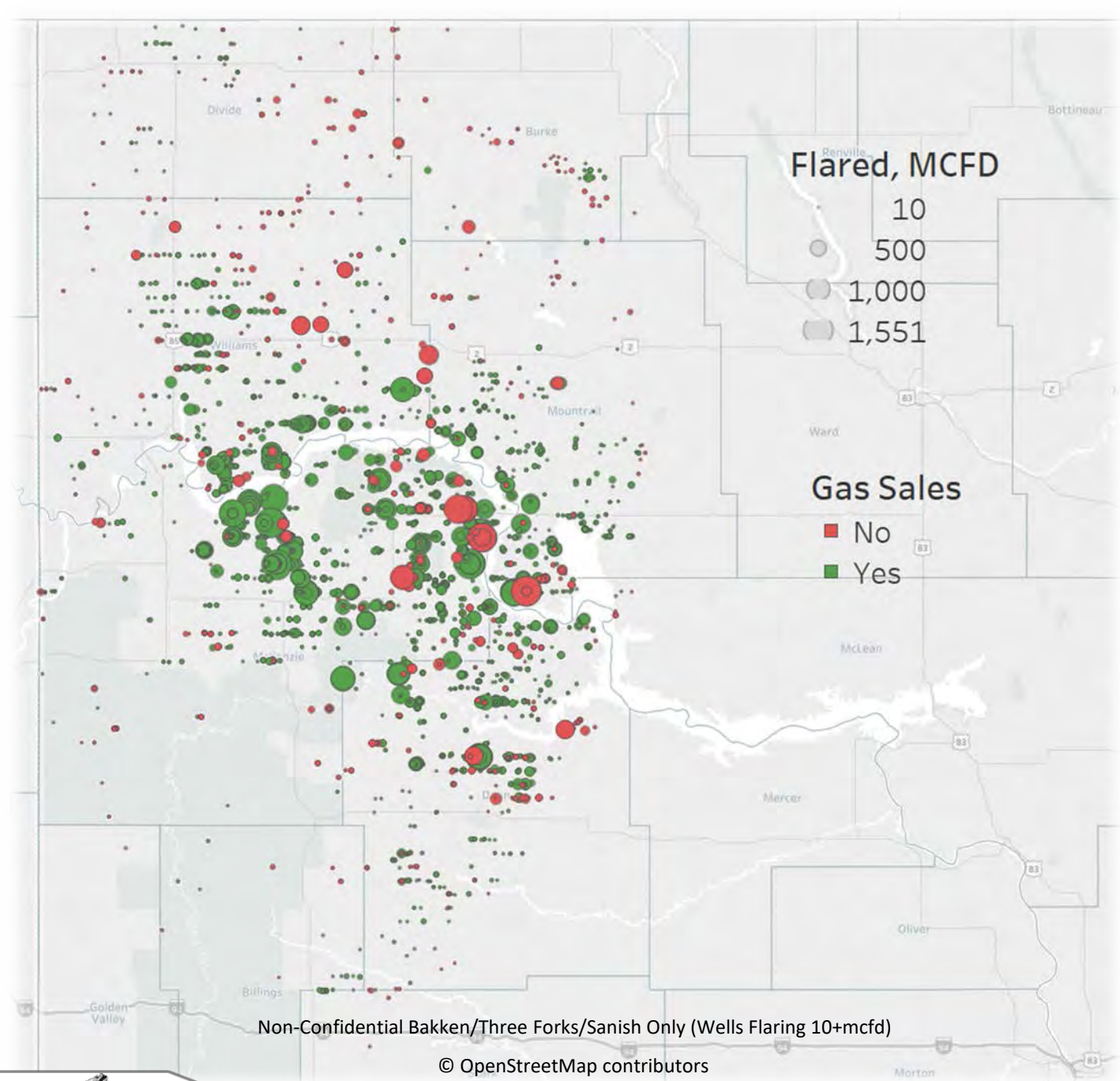


# Natural Gas Update



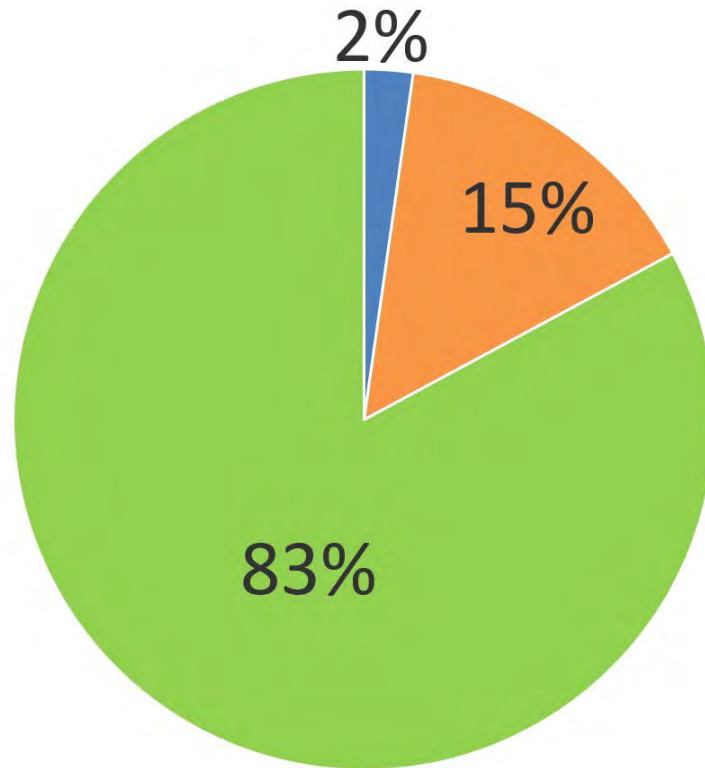
# Solving the Flaring Challenge

April 2018





# Solving the Flaring Challenge



Statewide

**GREEN** – % of gas captured and sold  
**Blue** – % flared from zero sales wells  
**Orange** – % flared from wells with at least one mcf sold.

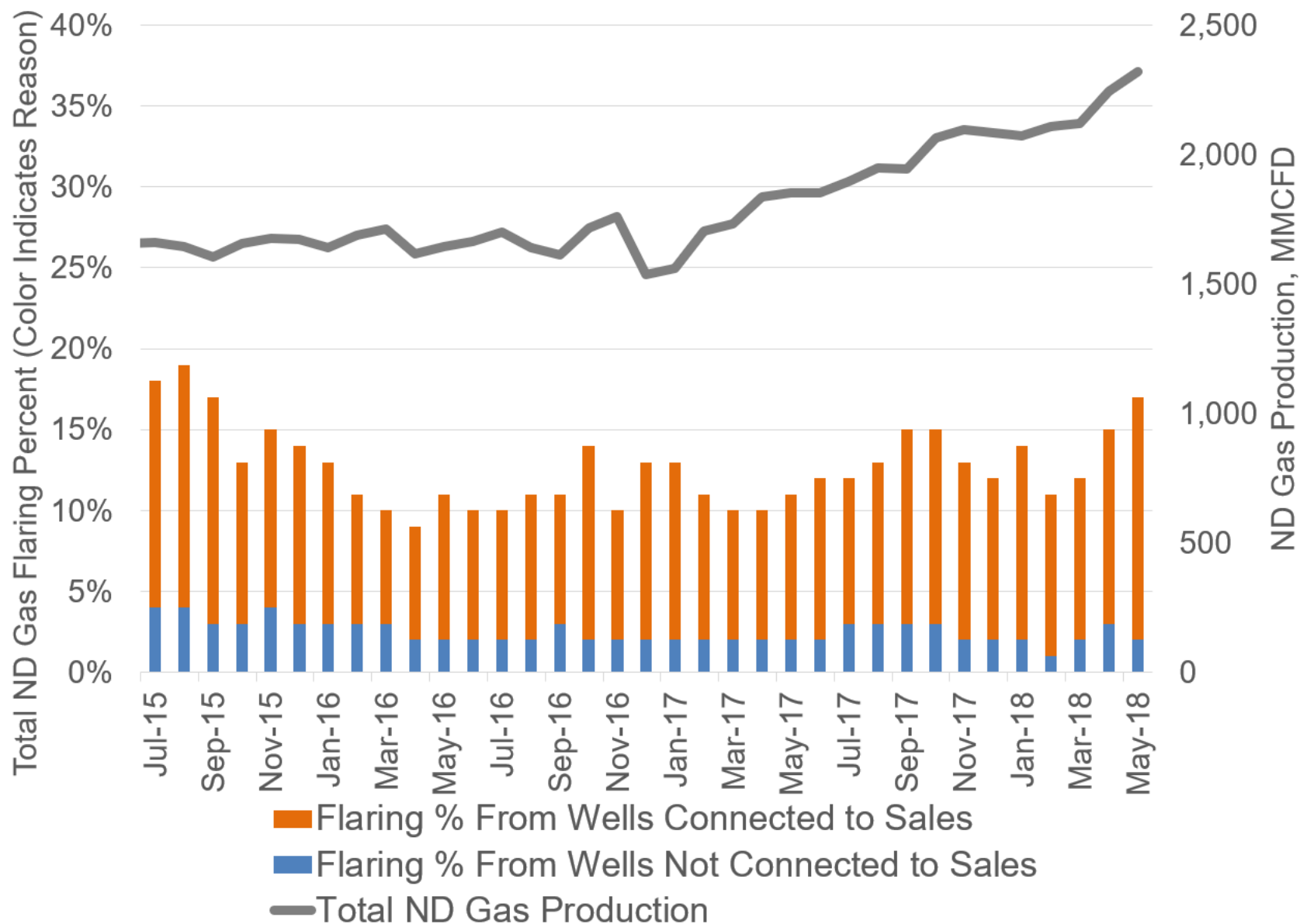
## Simple Terms

**Blue** – Lack of pipelines  
**Orange** – Challenges on existing infrastructure

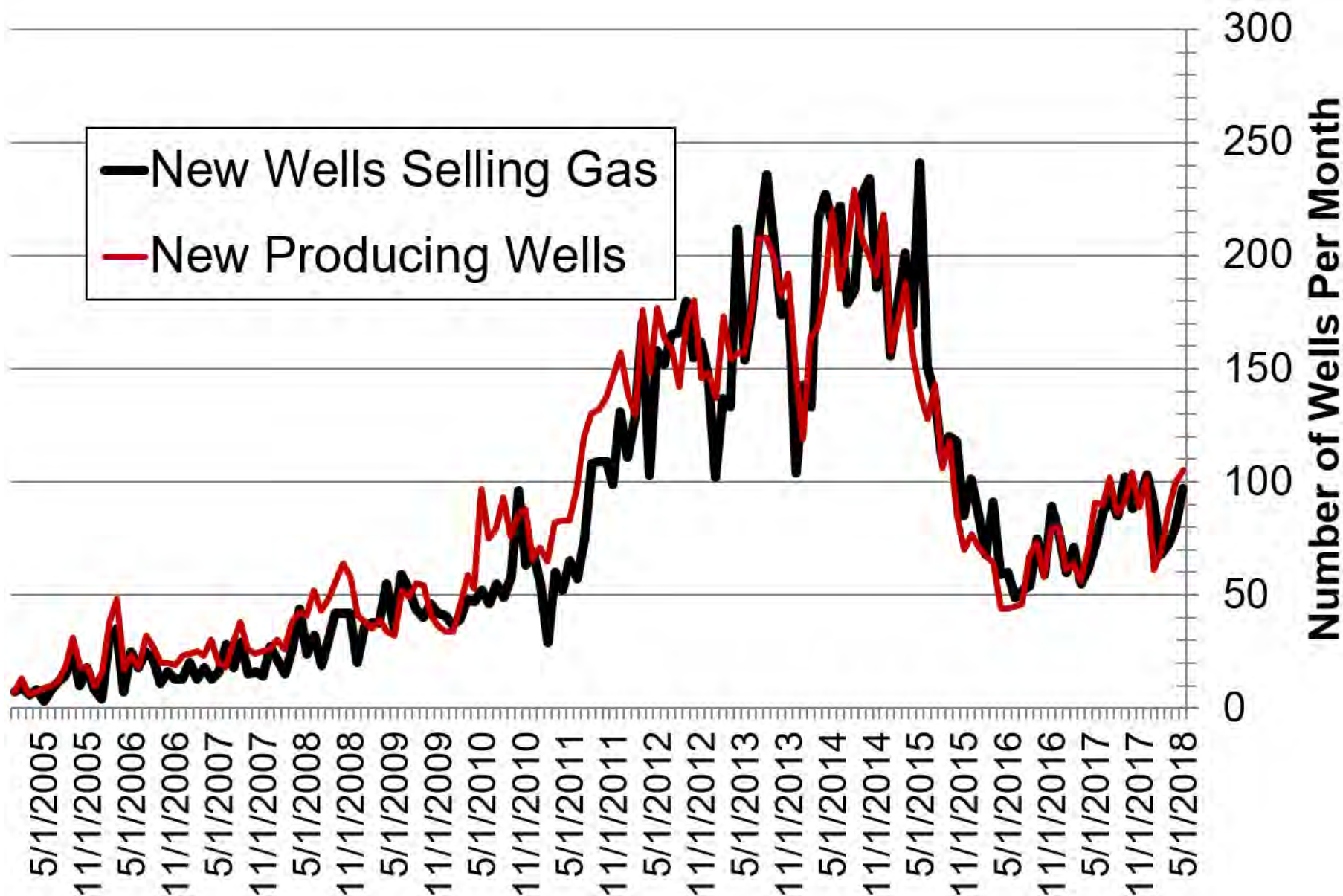
May 2018 Data – Non-Confidential Wells



# Solving the Flaring Challenge

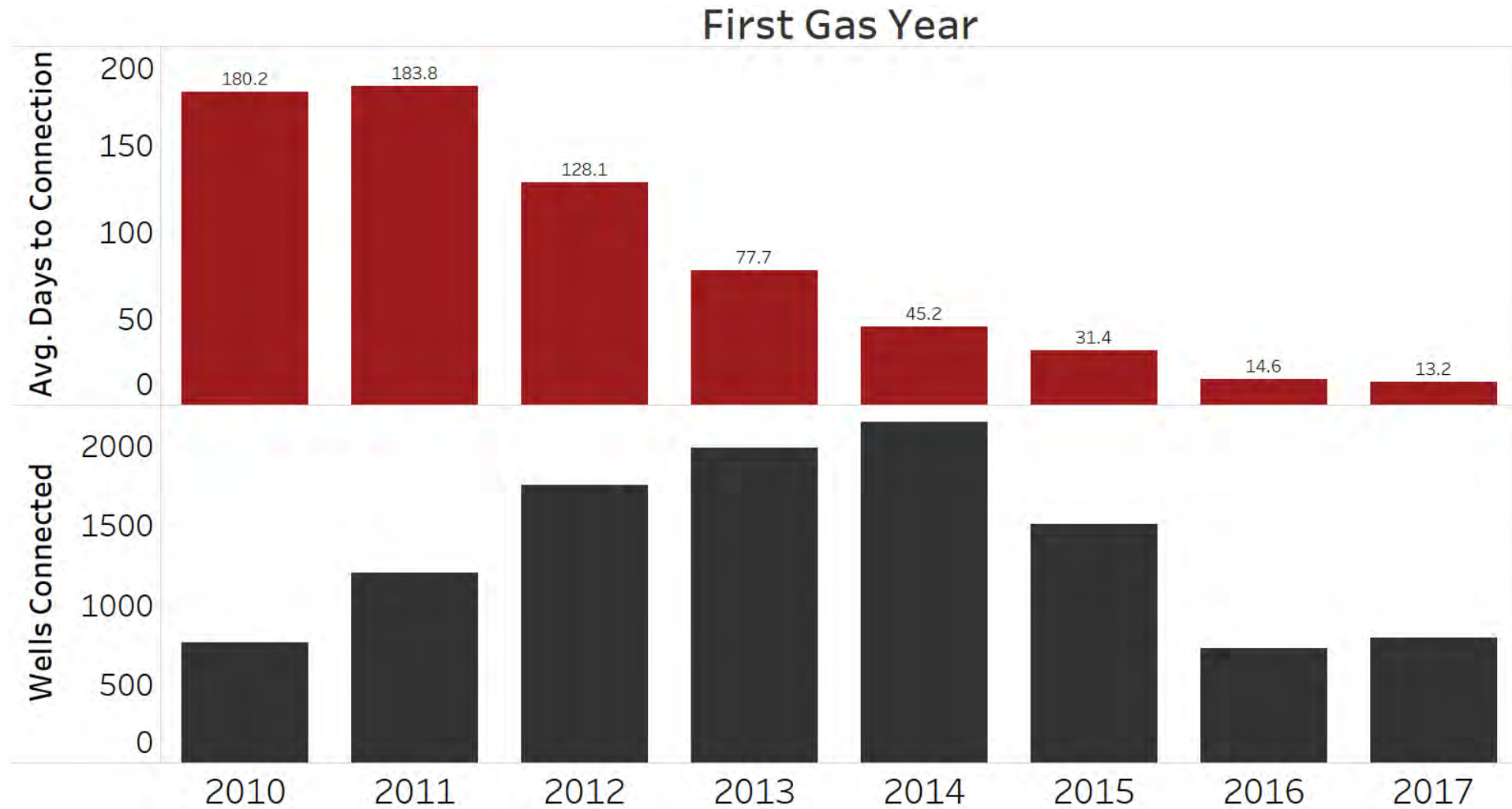


# Solving the Flaring Challenge

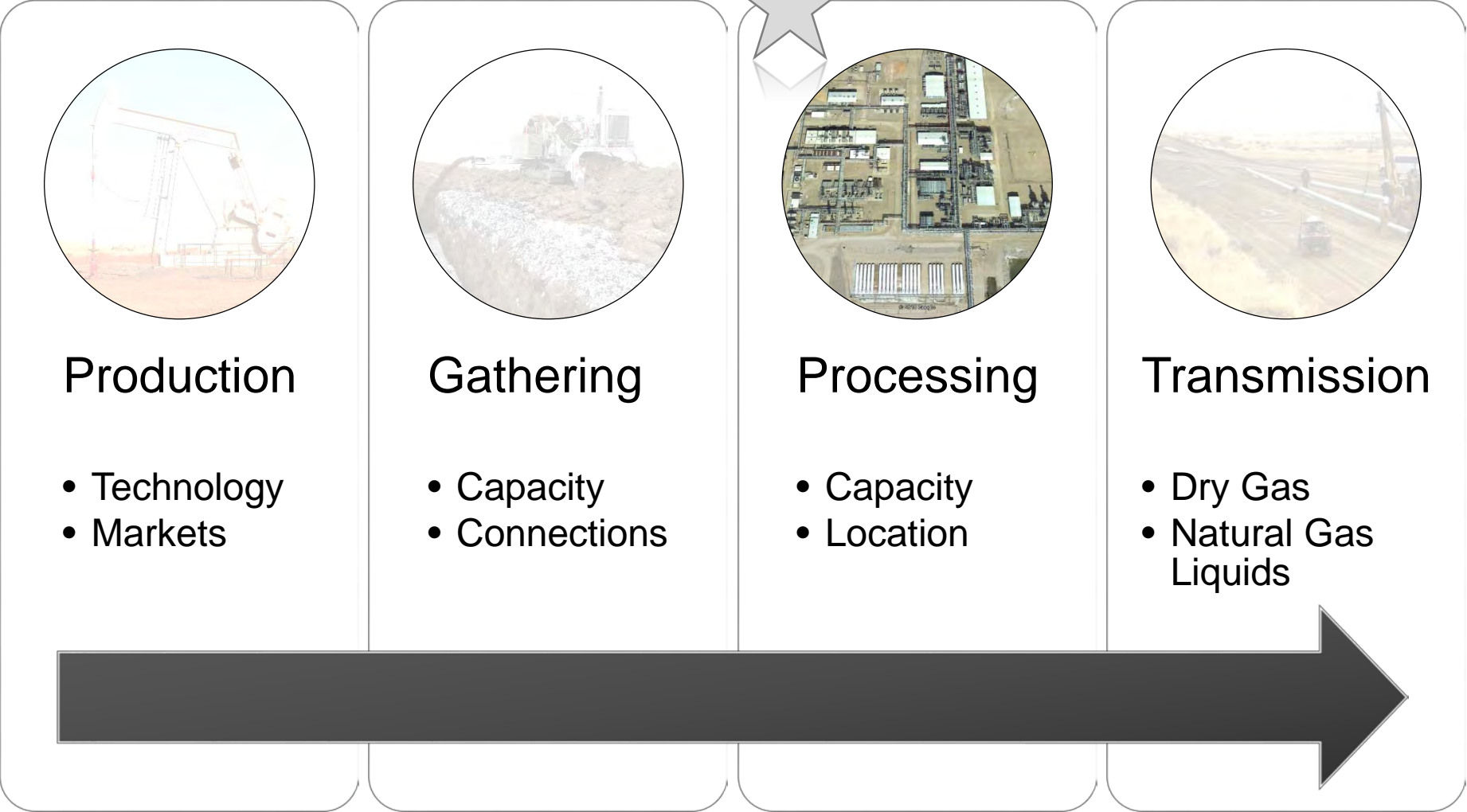




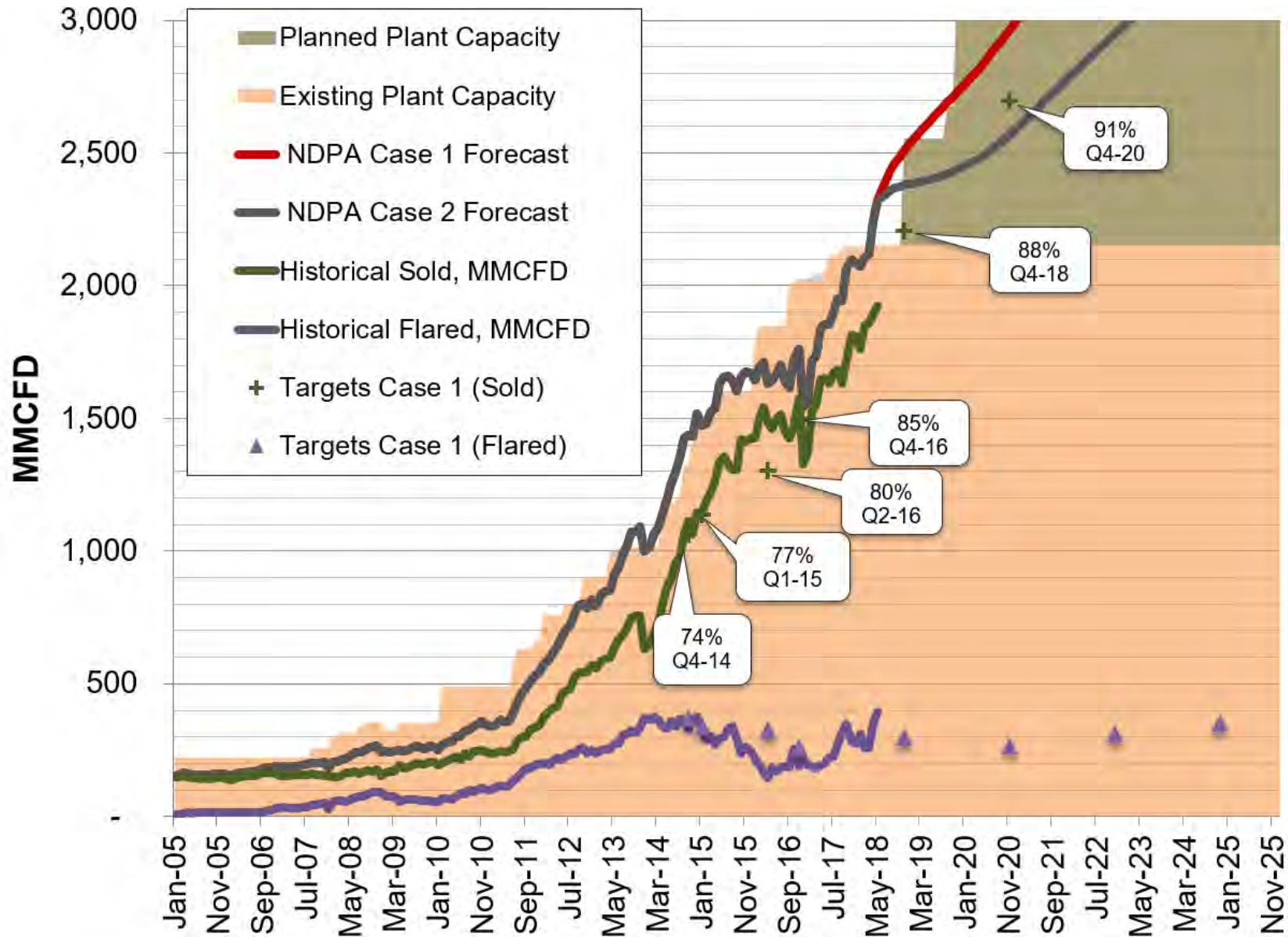
# Days to Connect to Gas Gathering



# Natural Gas Update

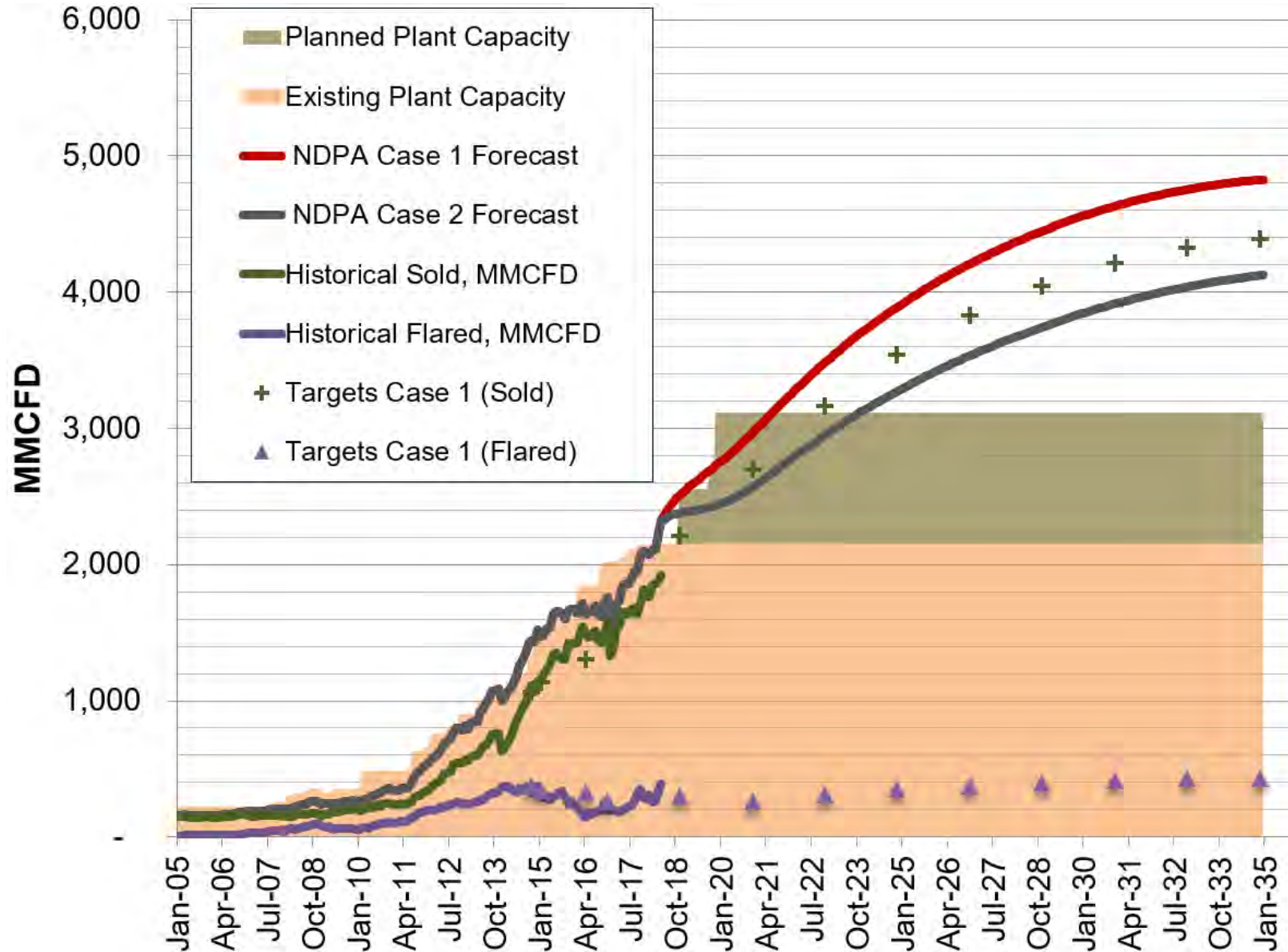


# Solving the Flaring Challenge

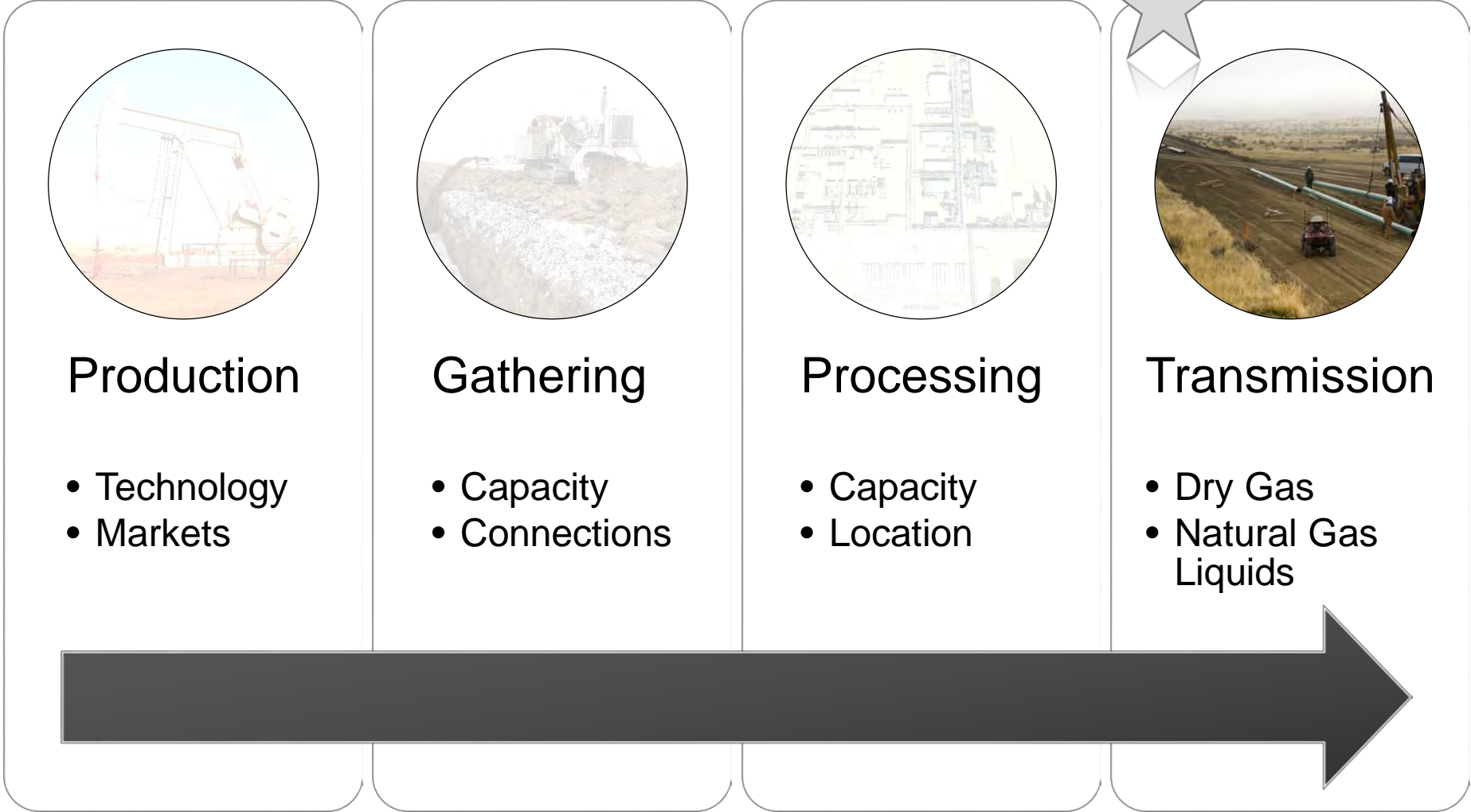




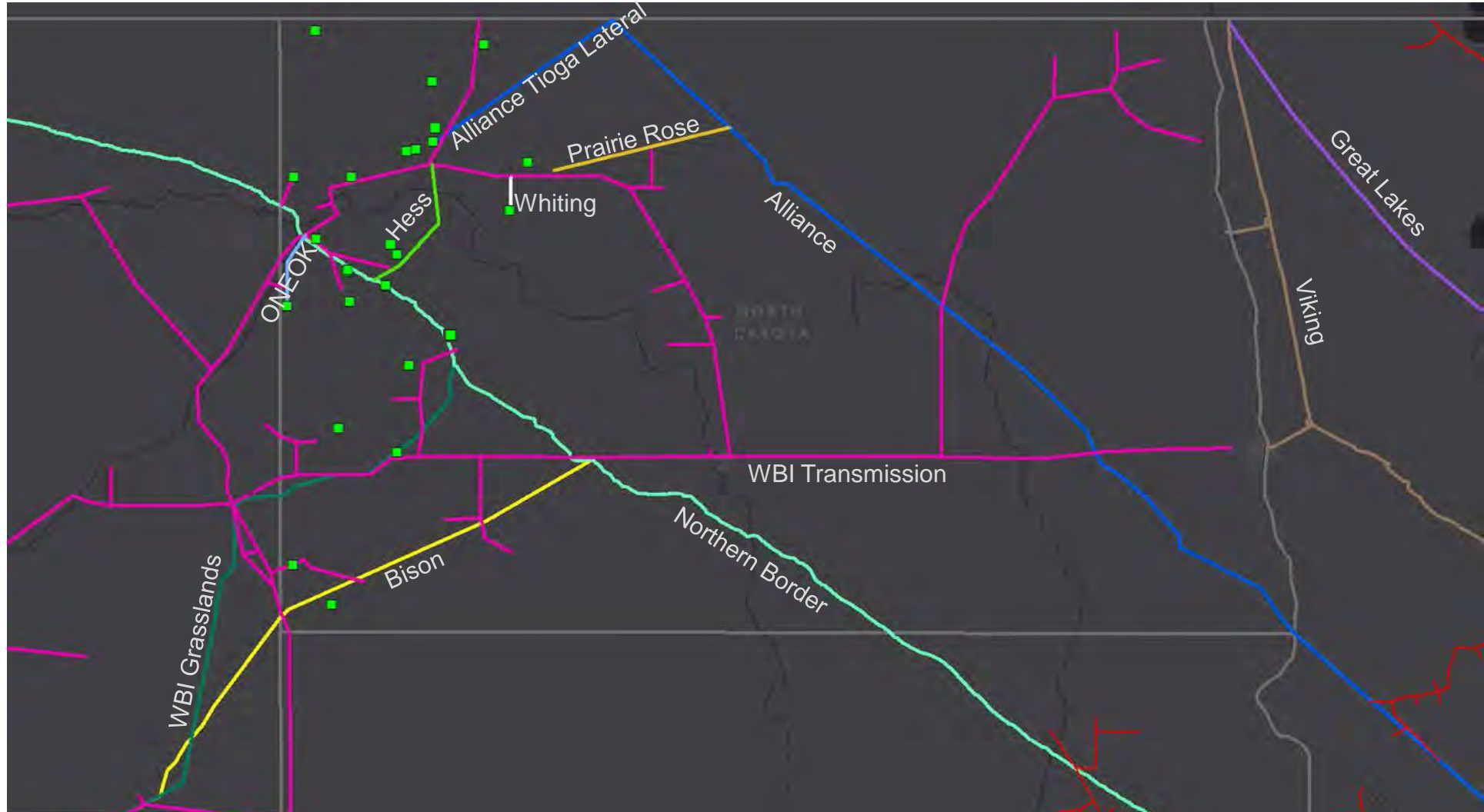
# Solving the Flaring Challenge



# Natural Gas Update



# Major Gas Pipeline and Processing Infrastructure





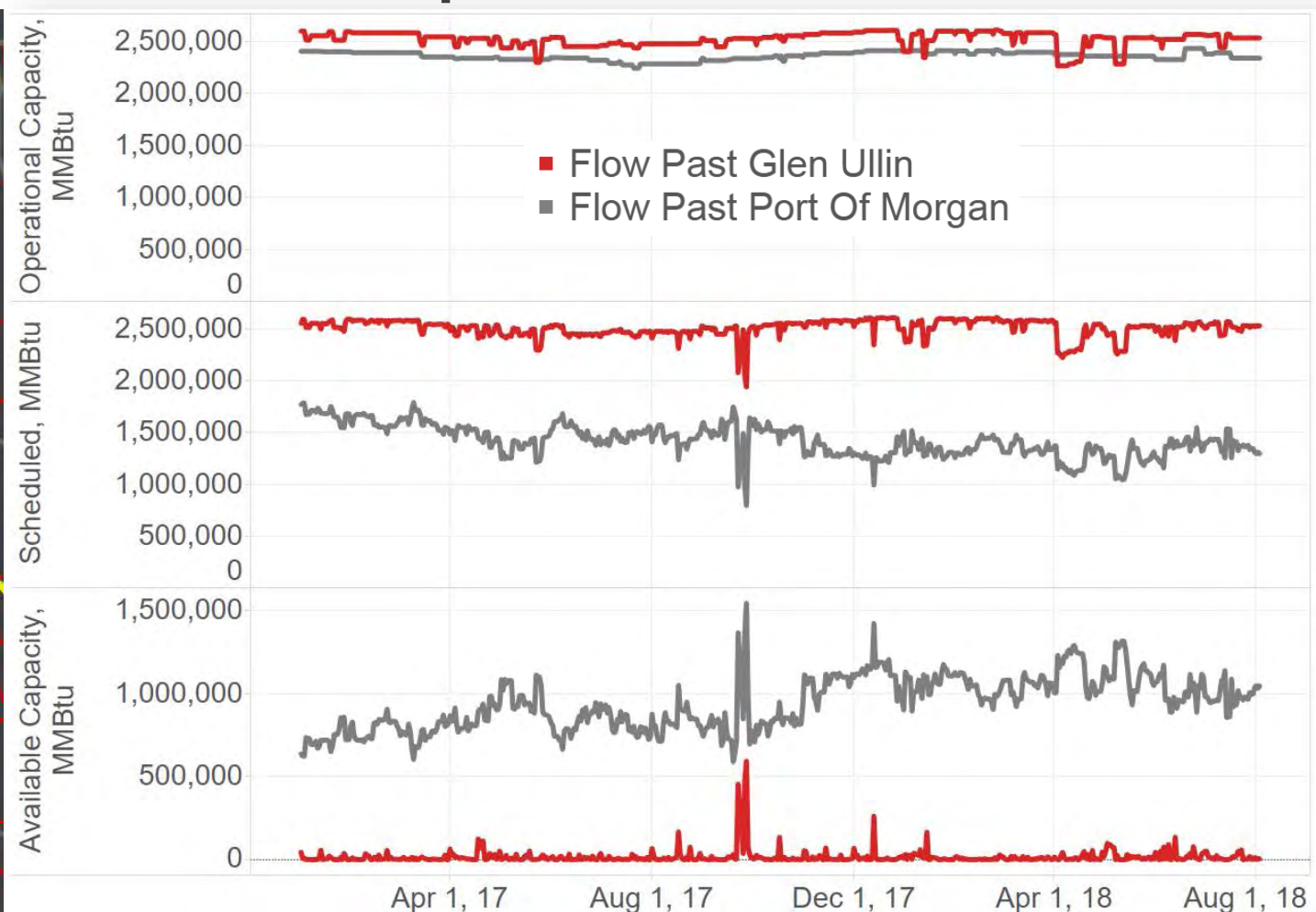
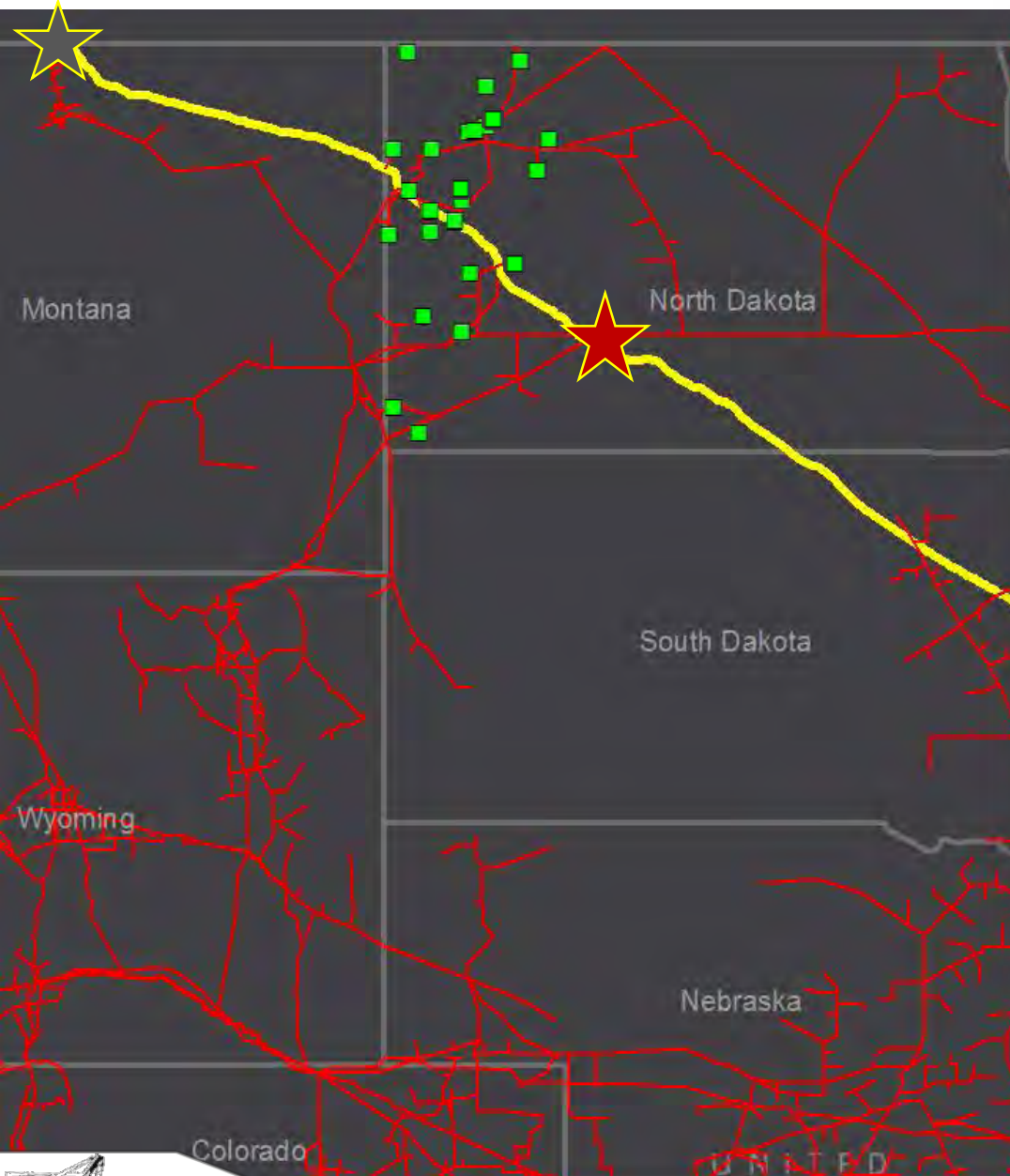
# Northern Border Pipeline

- 42" Pipeline
- Carries Canadian (Port of Morgan) and Domestic Gas
- Receives Gas From ND Plants, WBI Transmission Interconnections, and WY Pipelines (Bison & Grasslands)
- Midcontinent Deliveries



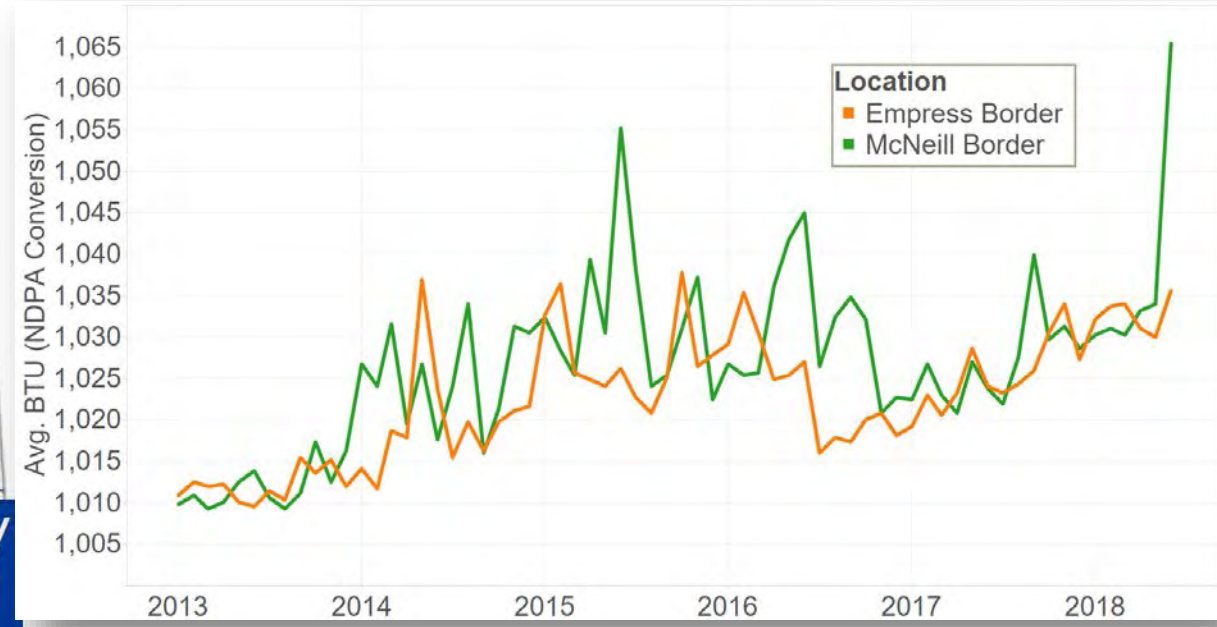
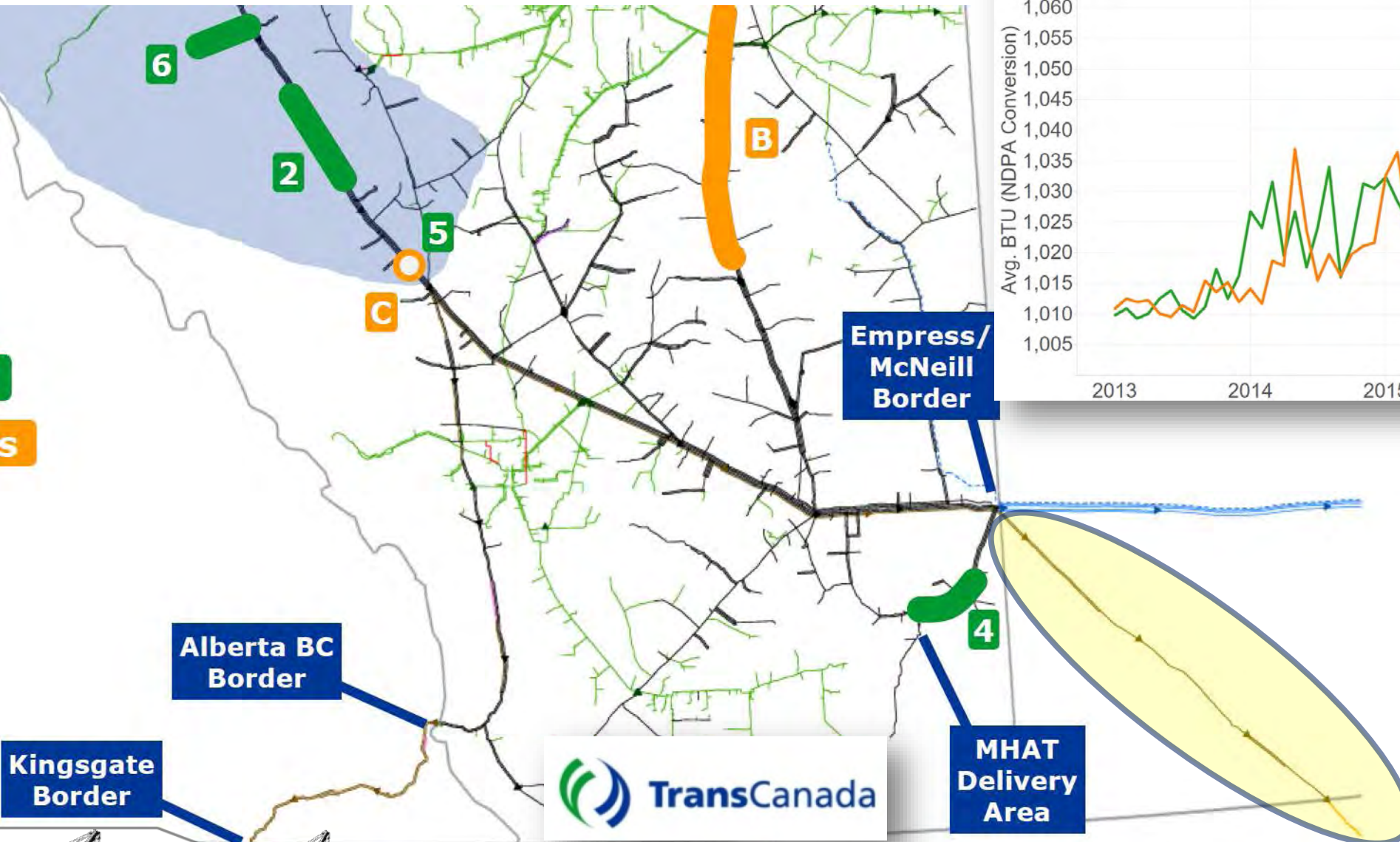


# Northern Border Pipeline





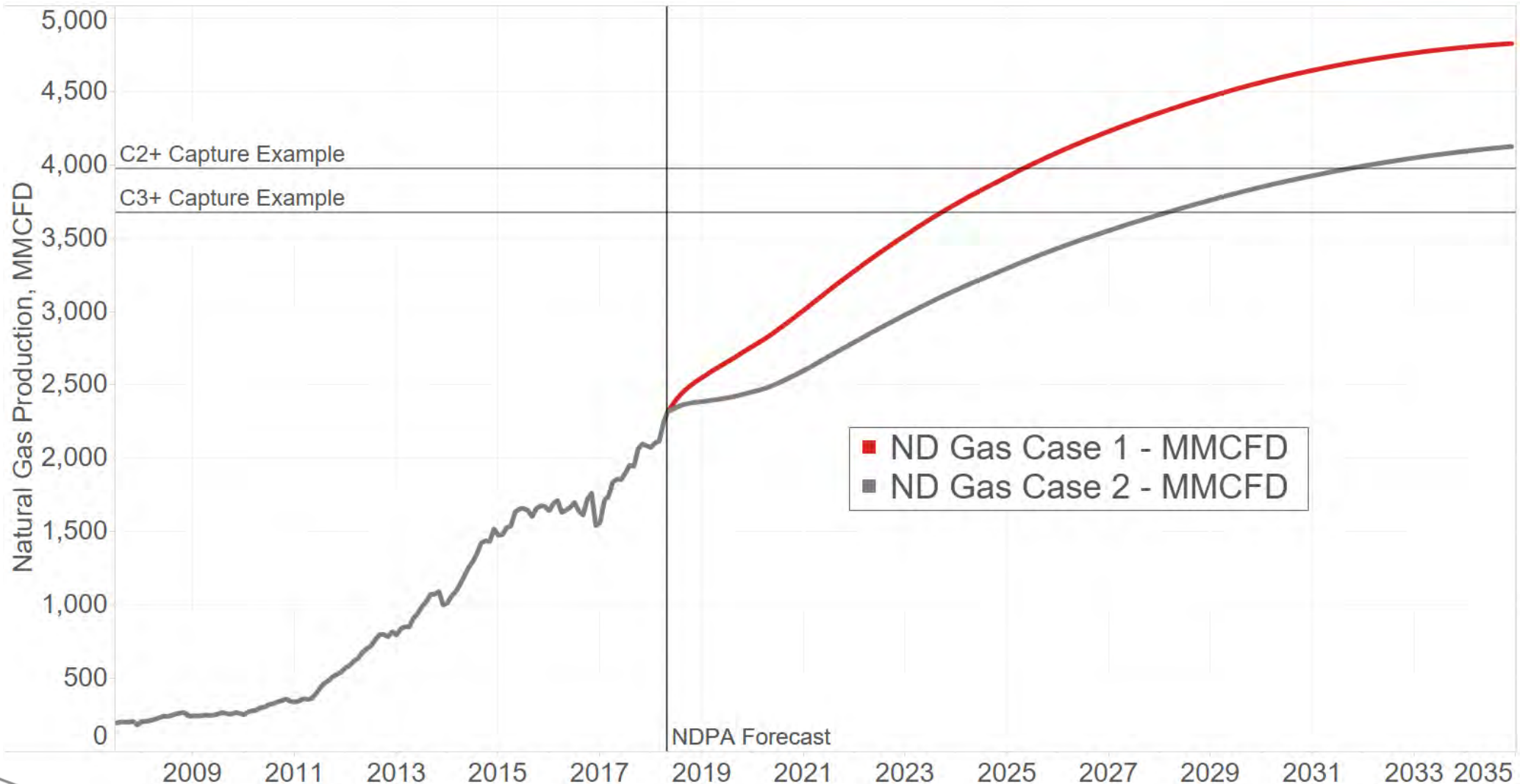
# Foothills Pipeline





# Simplified Example NB Calculations

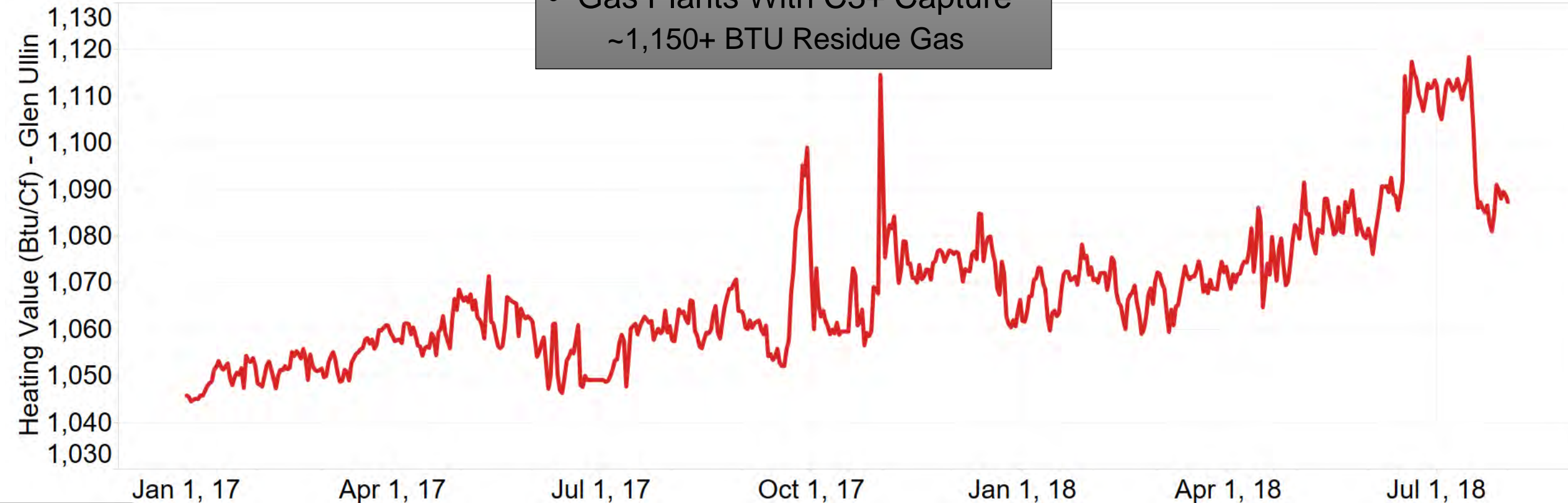
Conclusion: **IF** no other gas export options open and all other deliveries on other pipelines stay static, ND gas production could increase 1.36-1.66 BCFD (from May-18) before Northern Border is 100% Bakken production. **BTU management becomes increasingly important for Bakken residue gas.**



# Simplified Example NB Calculations

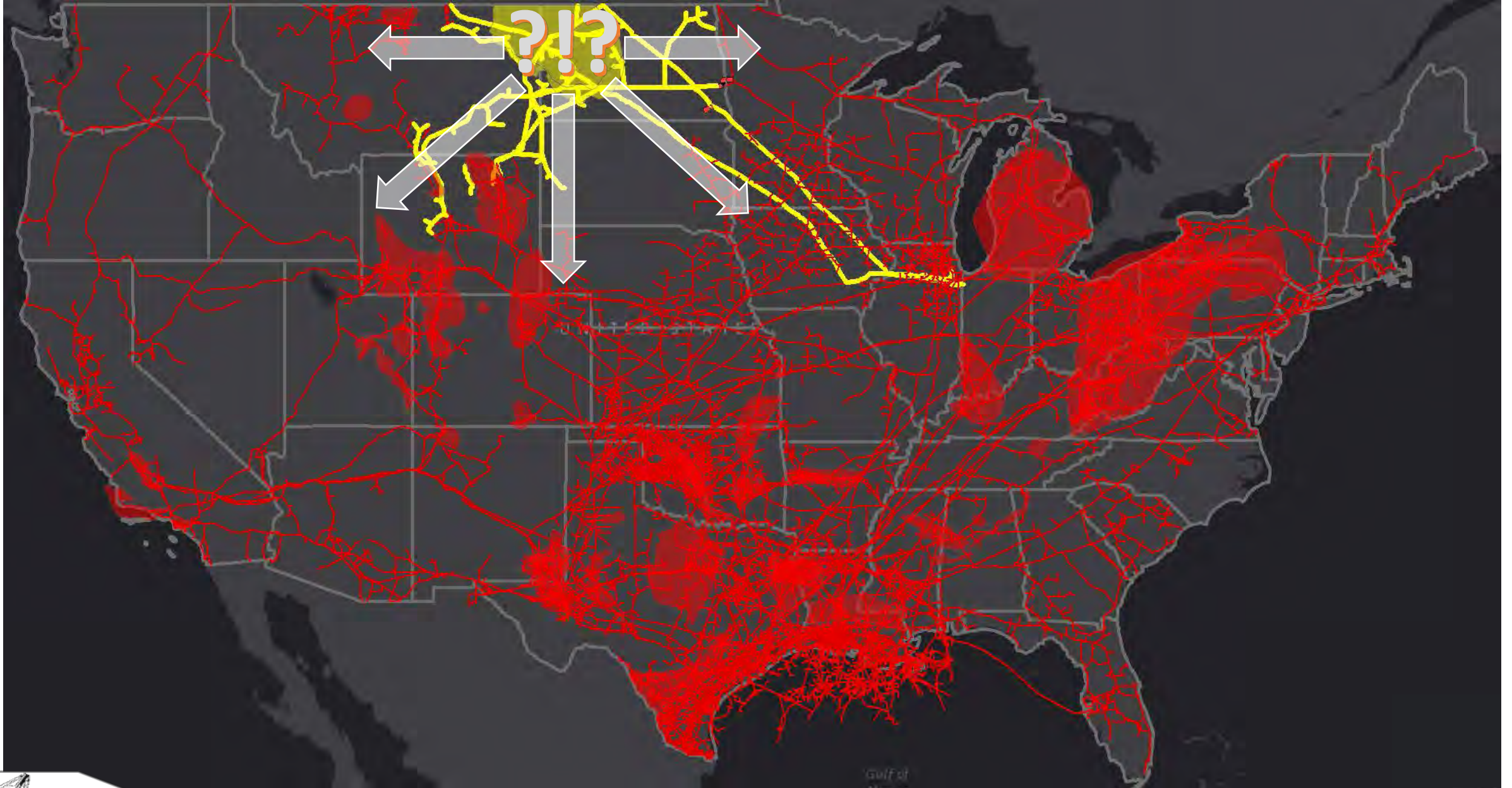
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- Gas Plants With C2+ Capture  
~1,010+ BTU Residue Gas
- Gas Plants With C3+ Capture  
~1,150+ BTU Residue Gas



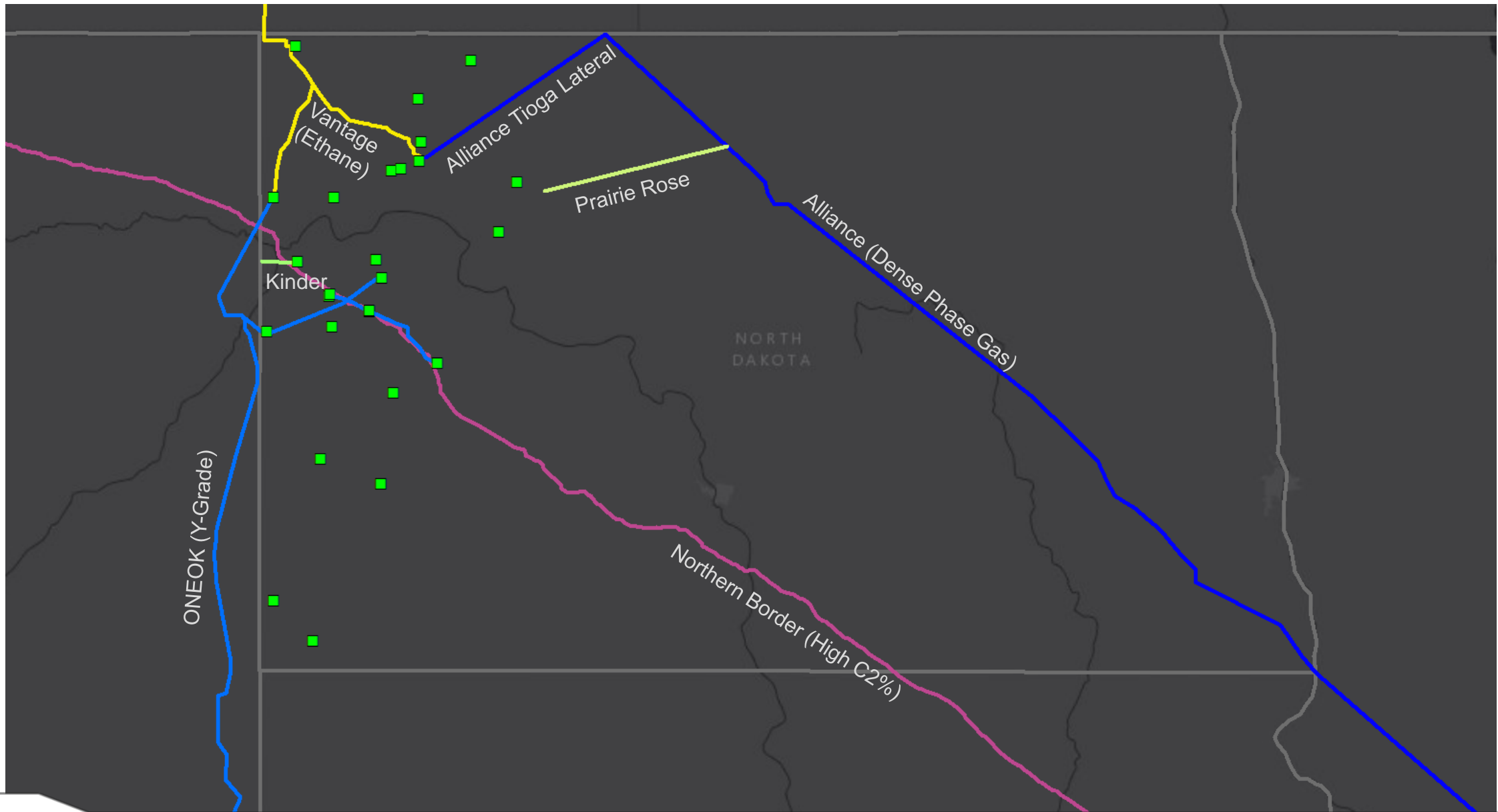


# Now What?



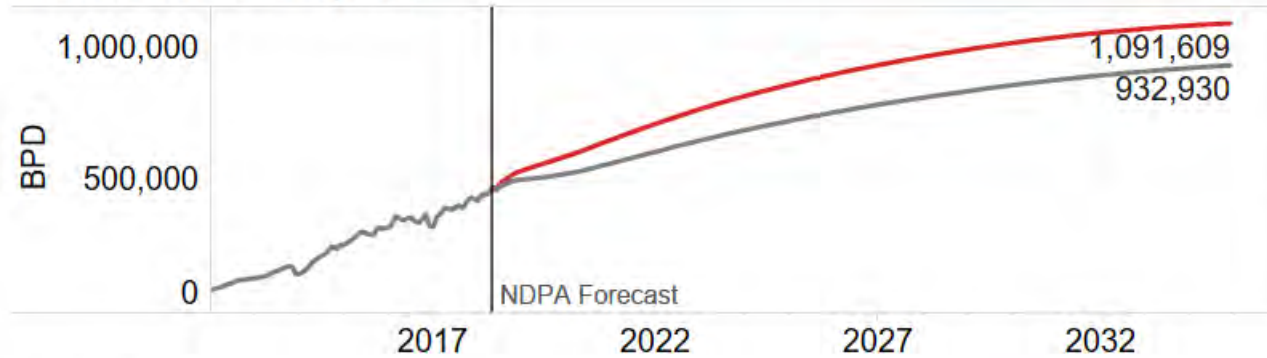


# Regional NGL Infrastructure

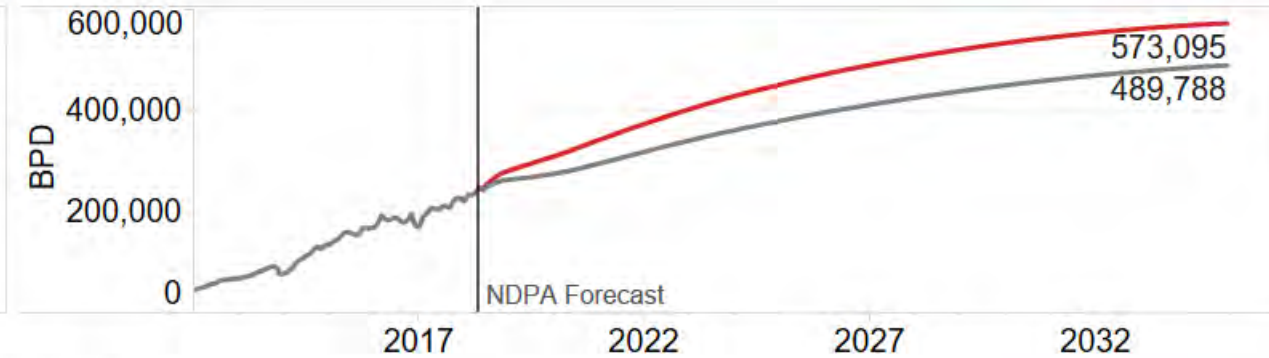


# North Dakota Captured\* NGL's

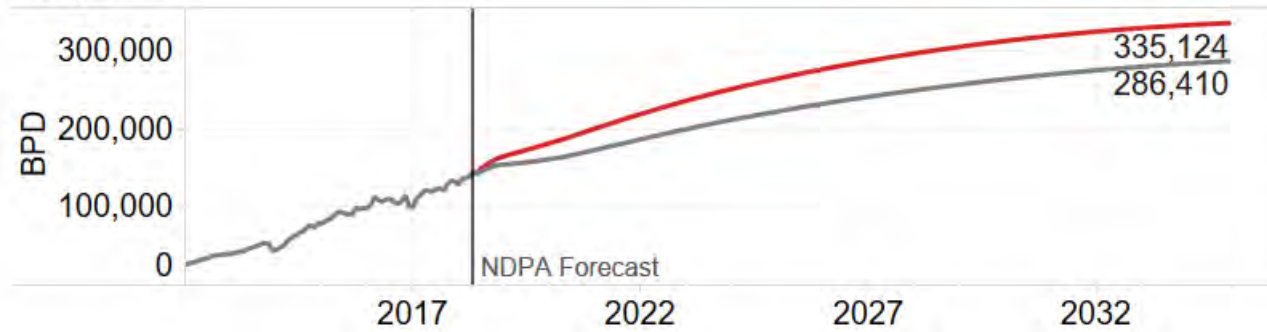
All Natural Gas Liquids



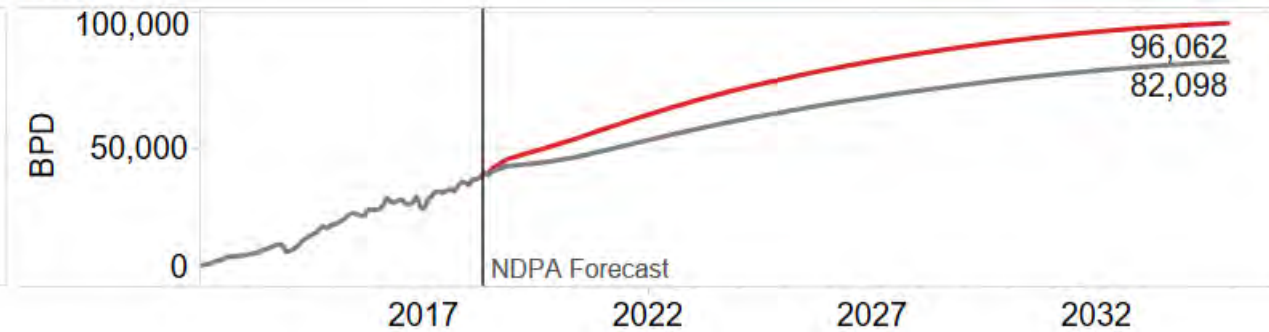
Ethane



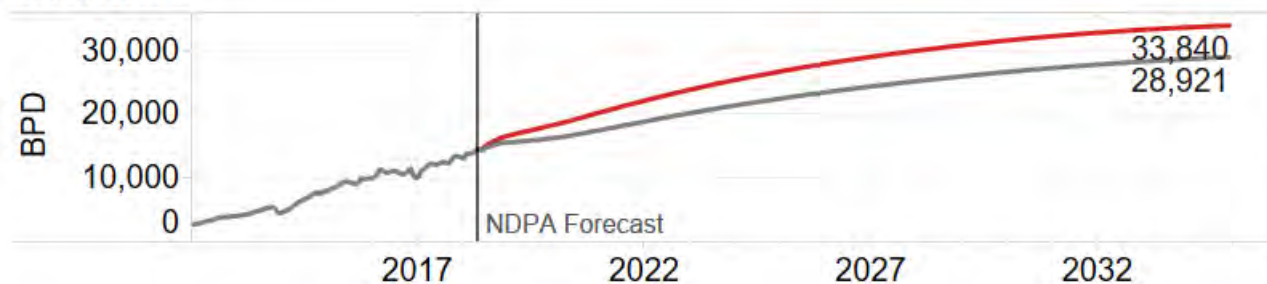
Propane



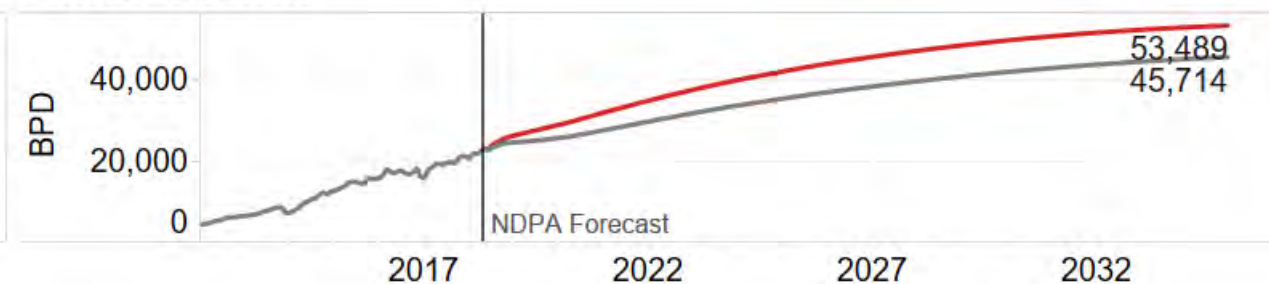
Butane



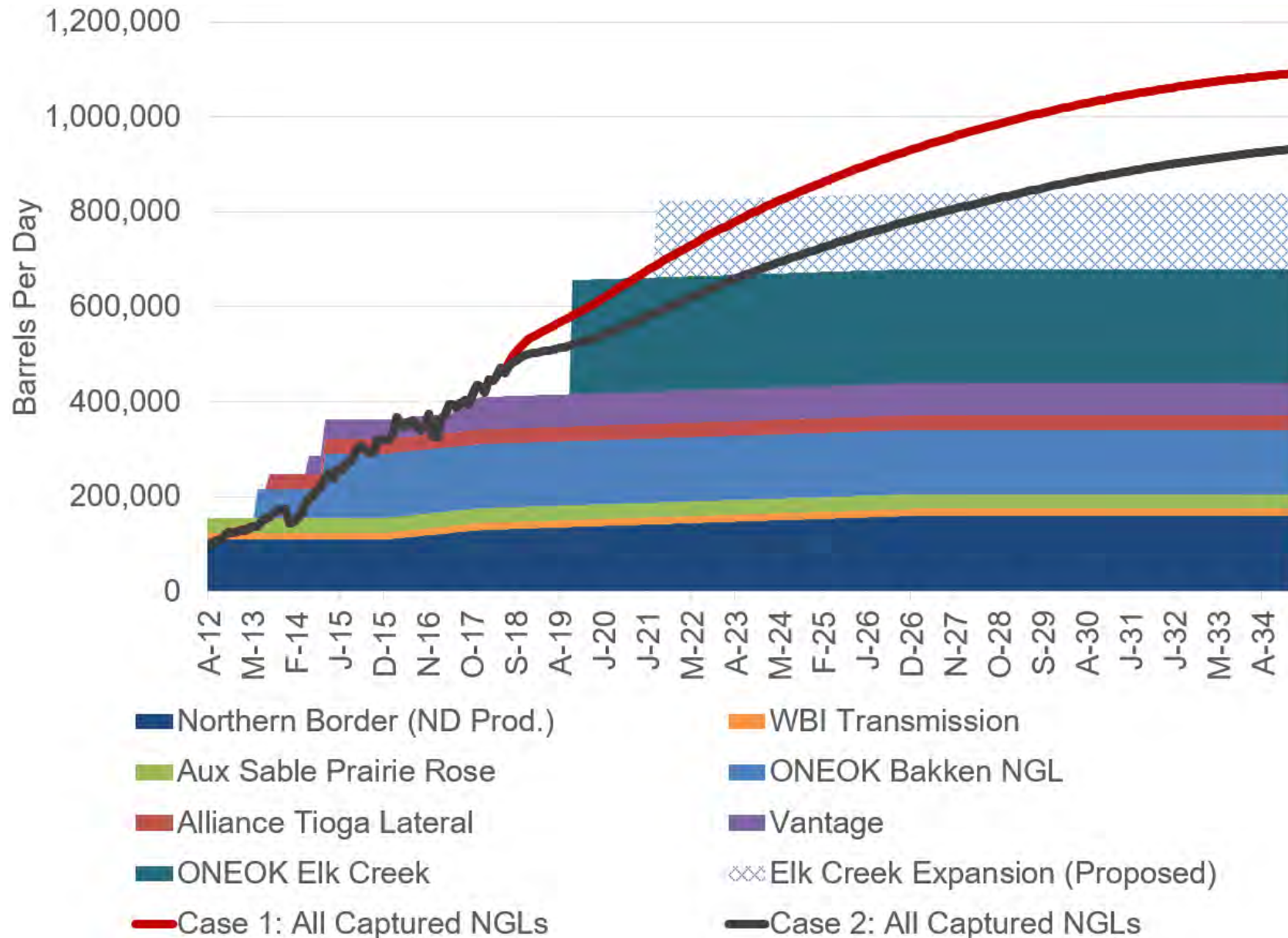
Isobutane



Natural Gasoline



# NGL Pipeline Takeaway Options



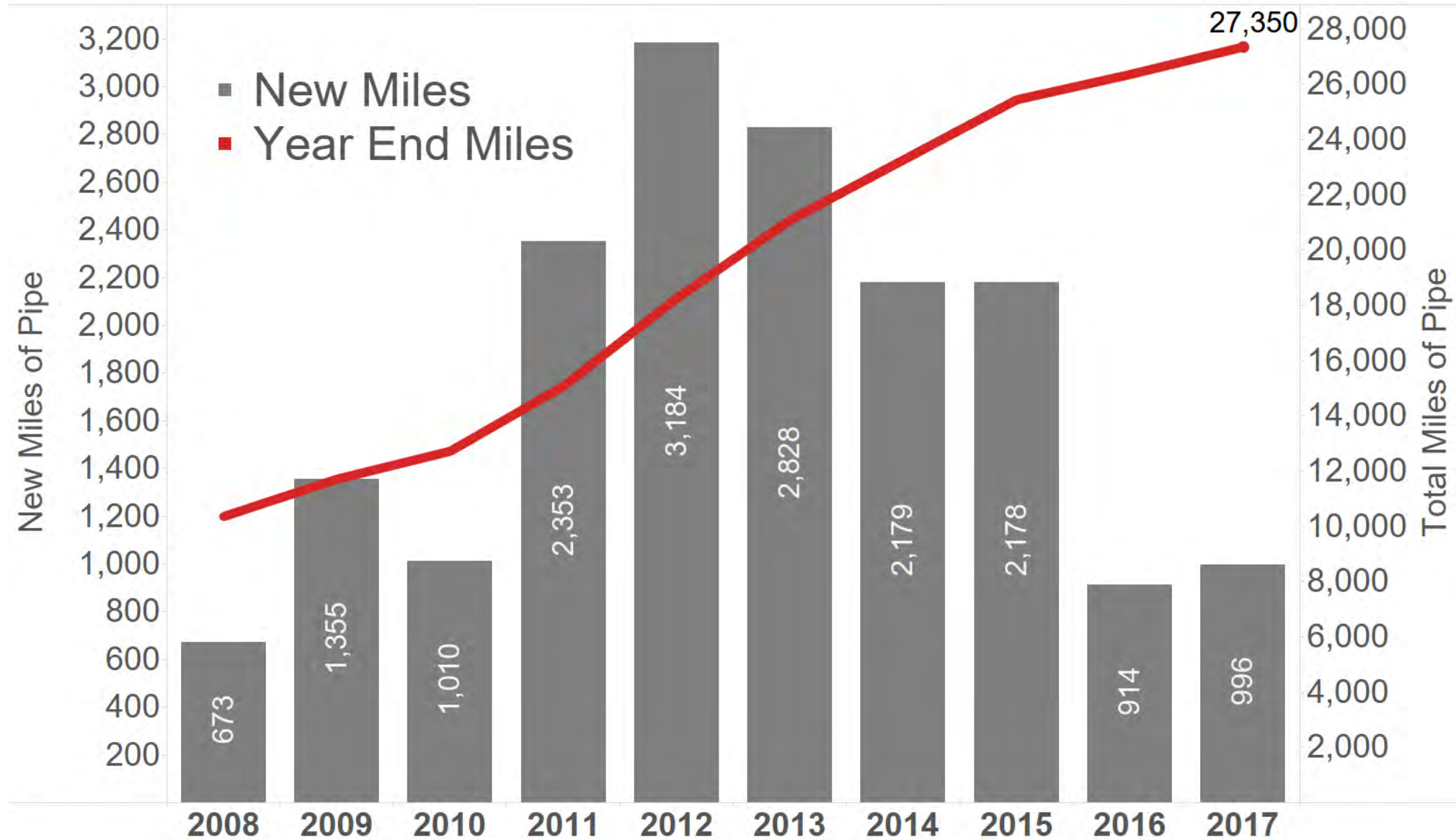


# Presentation Outline

- Economics
- Current Activity and oil transportation dynamics
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- North Dakota natural gas production
  - Flaring and gas capture
  - Natural gas liquids
- **Pipeline construction update**



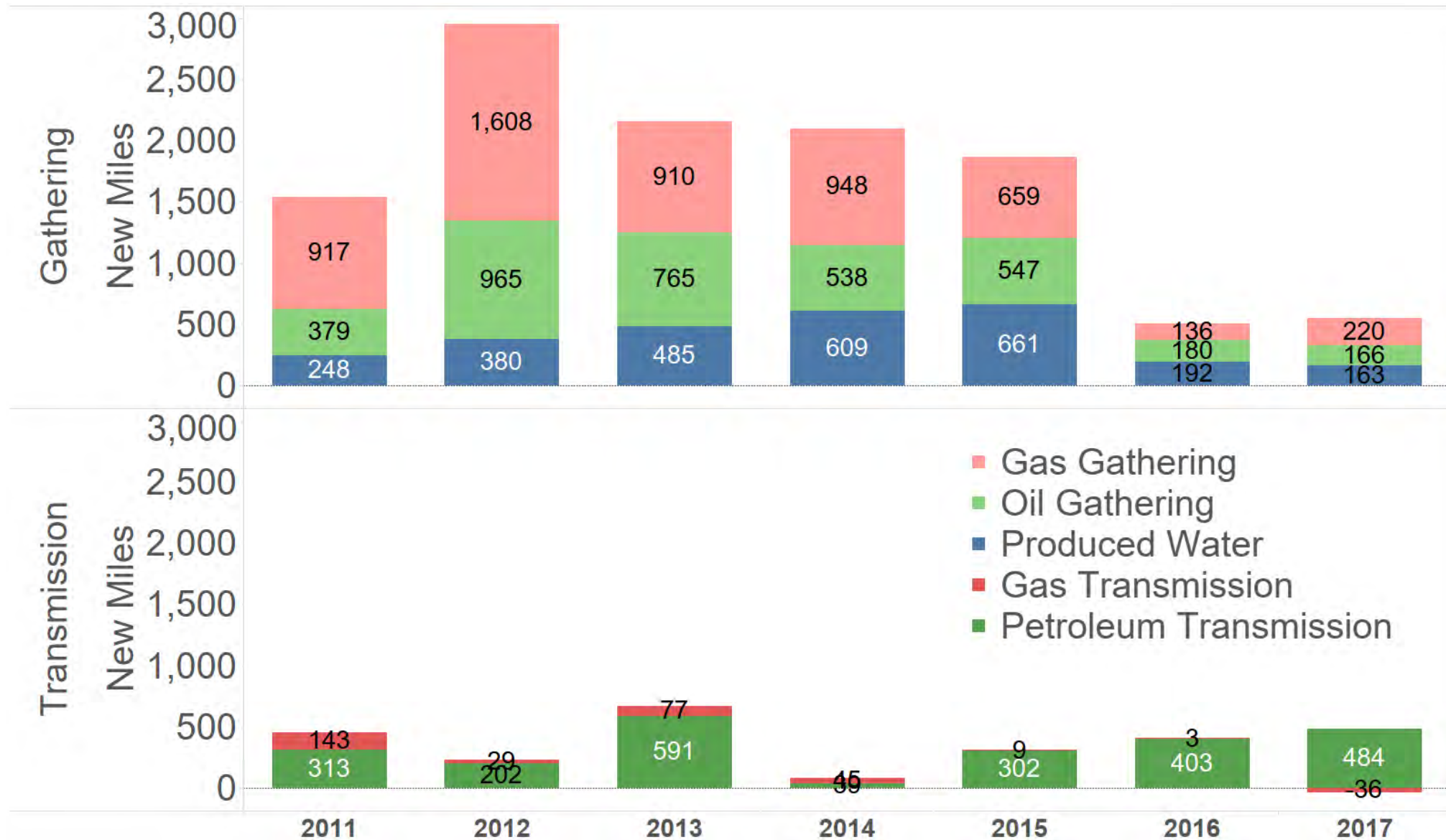
# North Dakota Pipeline Construction



Sources: NDIC & PHMSA



# North Dakota Pipeline Construction

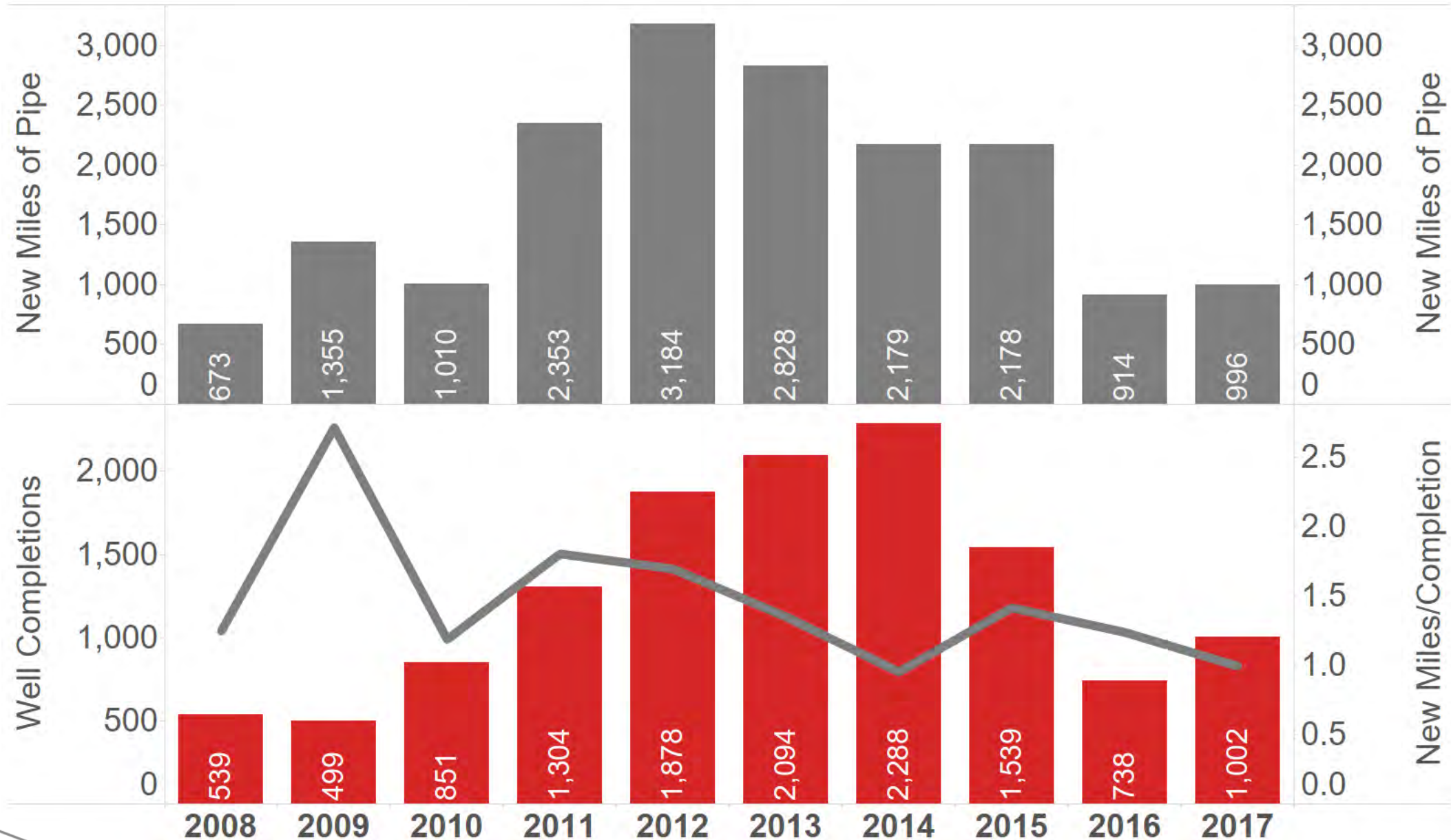


Sources: NDIC & PHMSA





# New Miles and Well Completions



# Contact Information

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[www.northdakotapipelines.com](http://www.northdakotapipelines.com)



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