

# North Dakota Industrial Commission

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*Geological Engineer*

*Director*

*North Dakota Pipeline Authority*



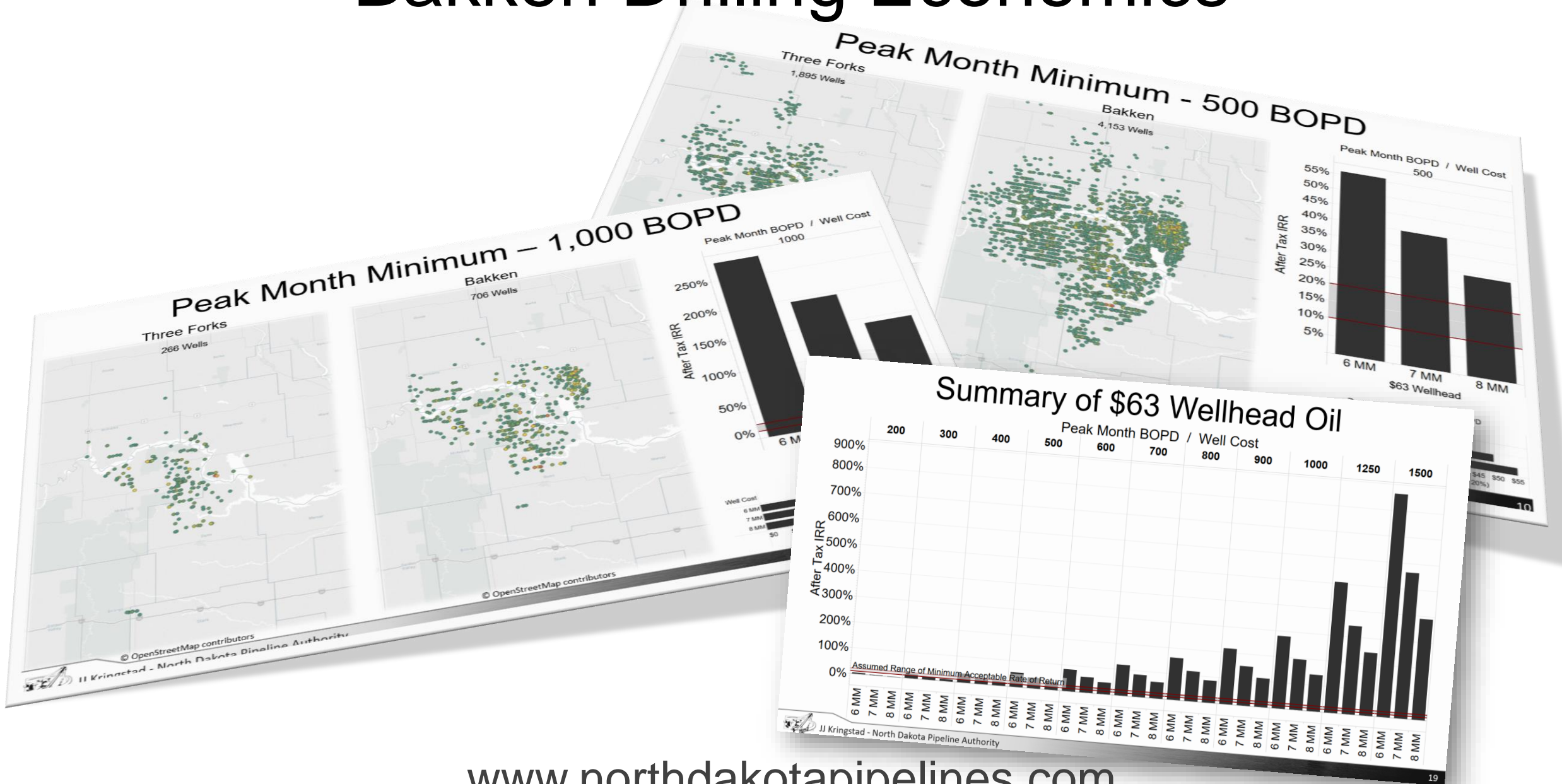
September 14, 2018

# Presentation Outline

- **Economics**
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- North Dakota natural gas production
  - Flaring and gas capture
  - Interstate Transmission
- Pipeline construction update



# Bakken Drilling Economics



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



# Understanding North Dakota's Bakken/Three Forks Potential\*

*\*Version 1.1*

*Updates & Modifications to Follow*

## **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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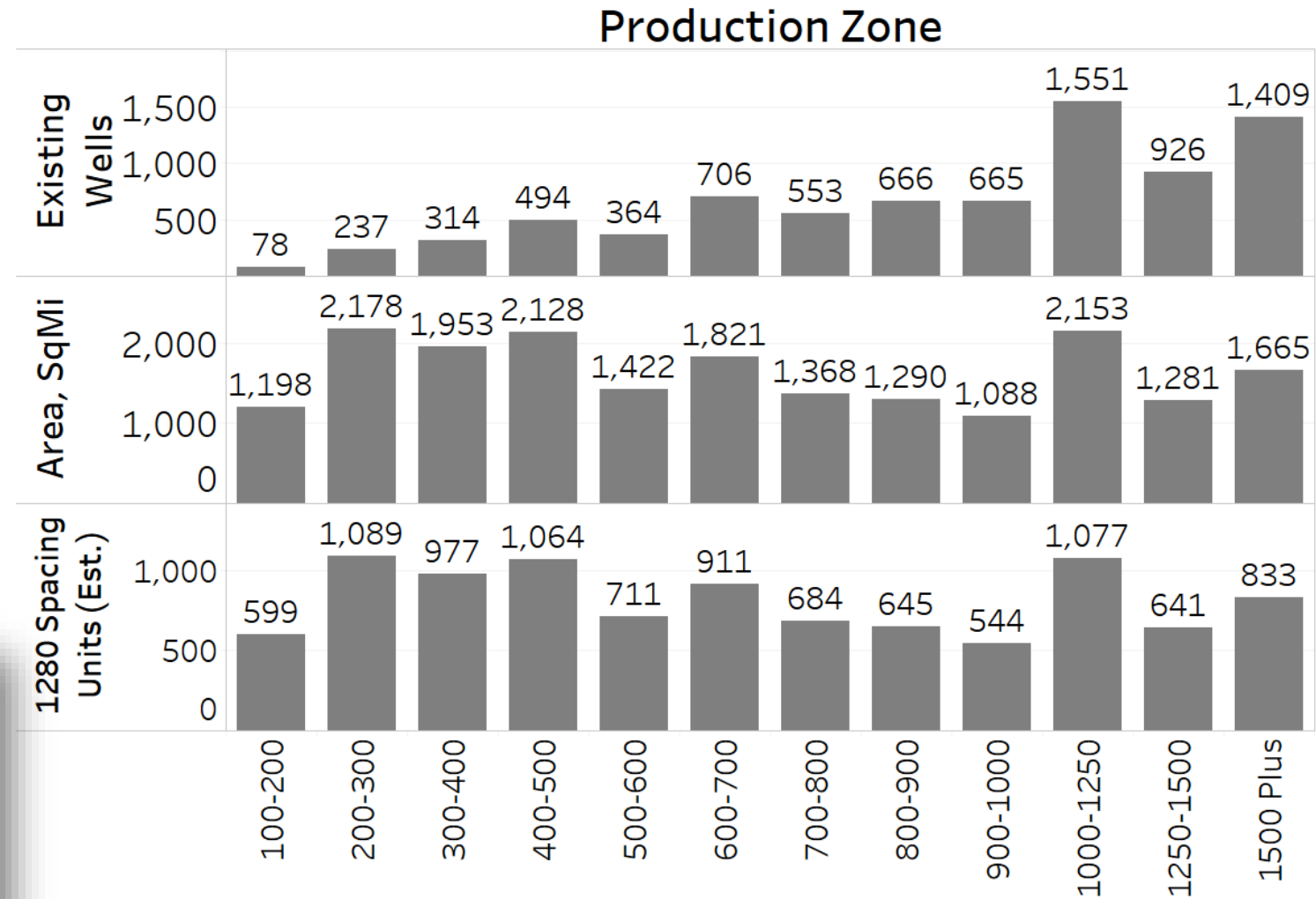
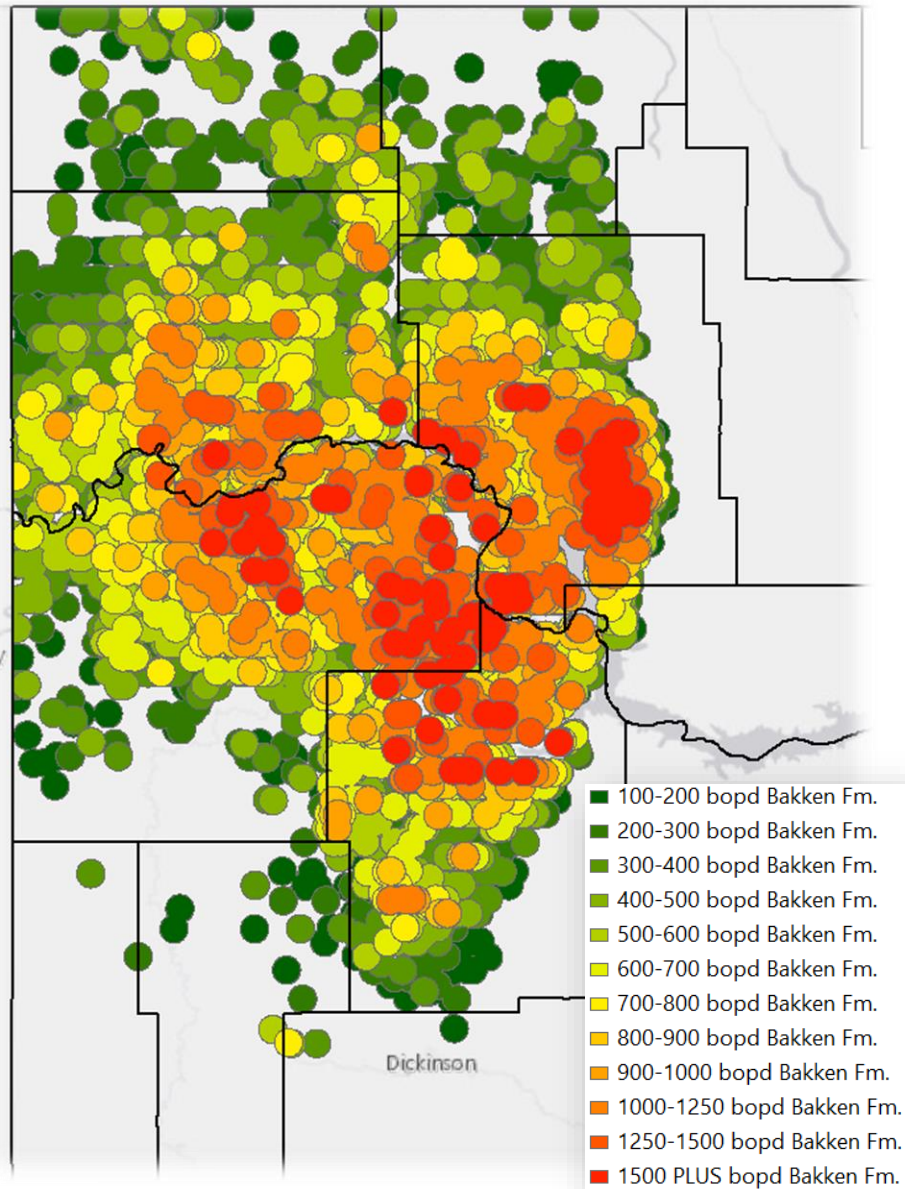
# Key Assumptions & Considerations

- Two mile production zone buffers are set by an individual well's "peak month minimum" performance. Not all existing wells within a production zone have performed at the zone's "peak month minimum" for a variety of reasons.
- High degree of uncertainty surrounding the future development patterns of the middle and lower Three Forks "Benches".
- High degree of economic uncertainty as infill development intensifies and deeper Three Forks benches are developed.
- This work will be updated as new information becomes available.

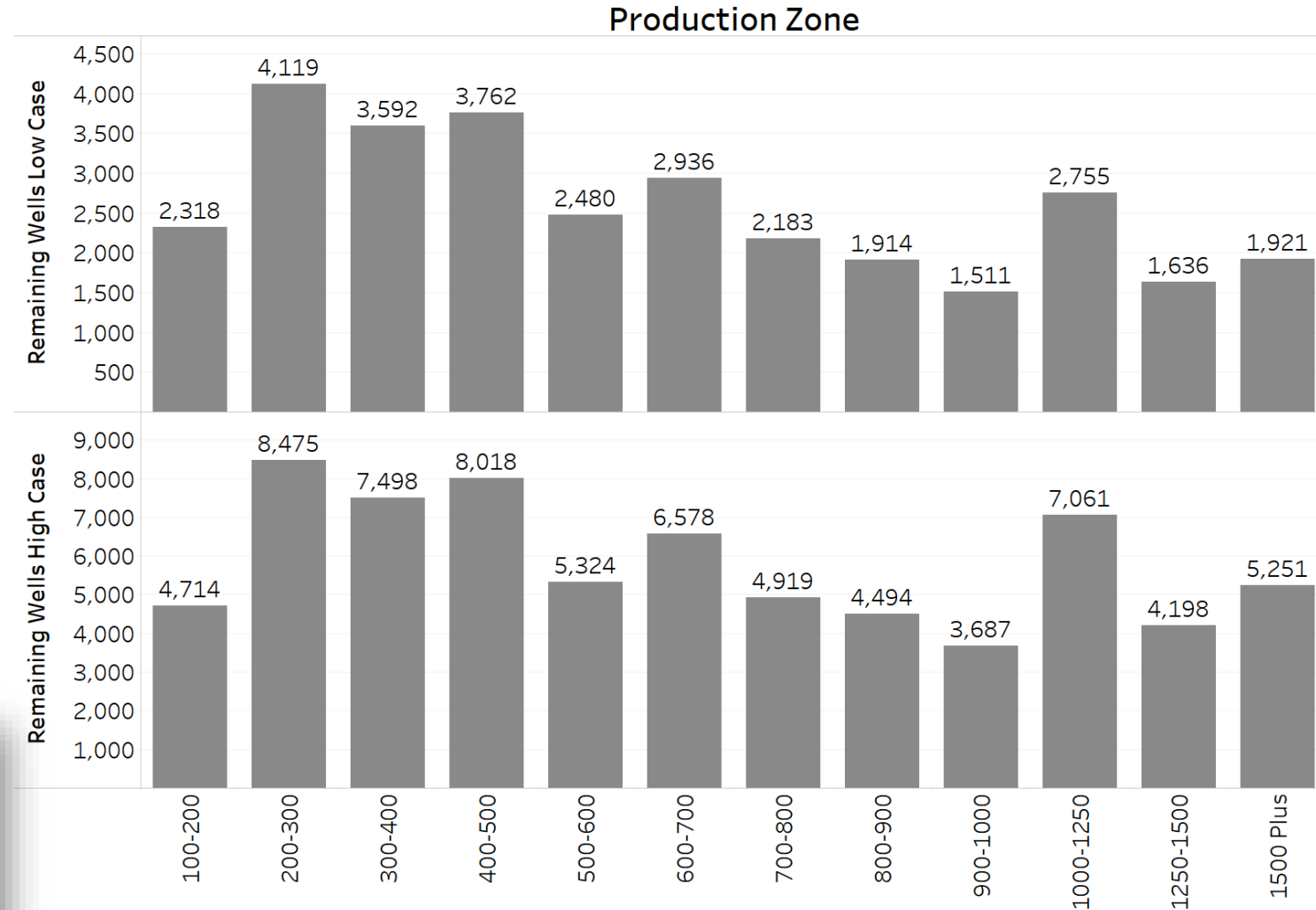
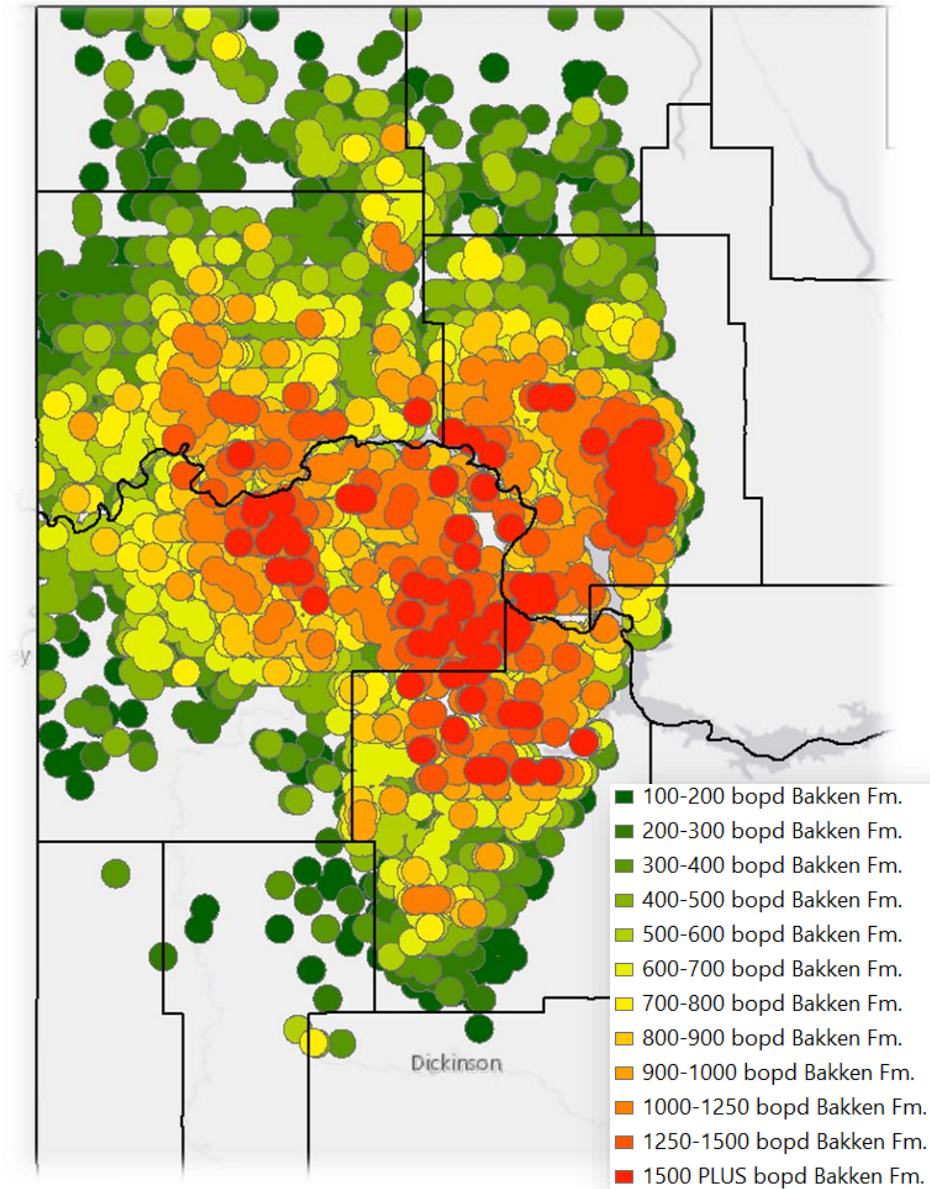




# Past Well Performance – Bakken Formation



# Remaining Wells\* – Bakken Formation



## \*Well Density Assumptions

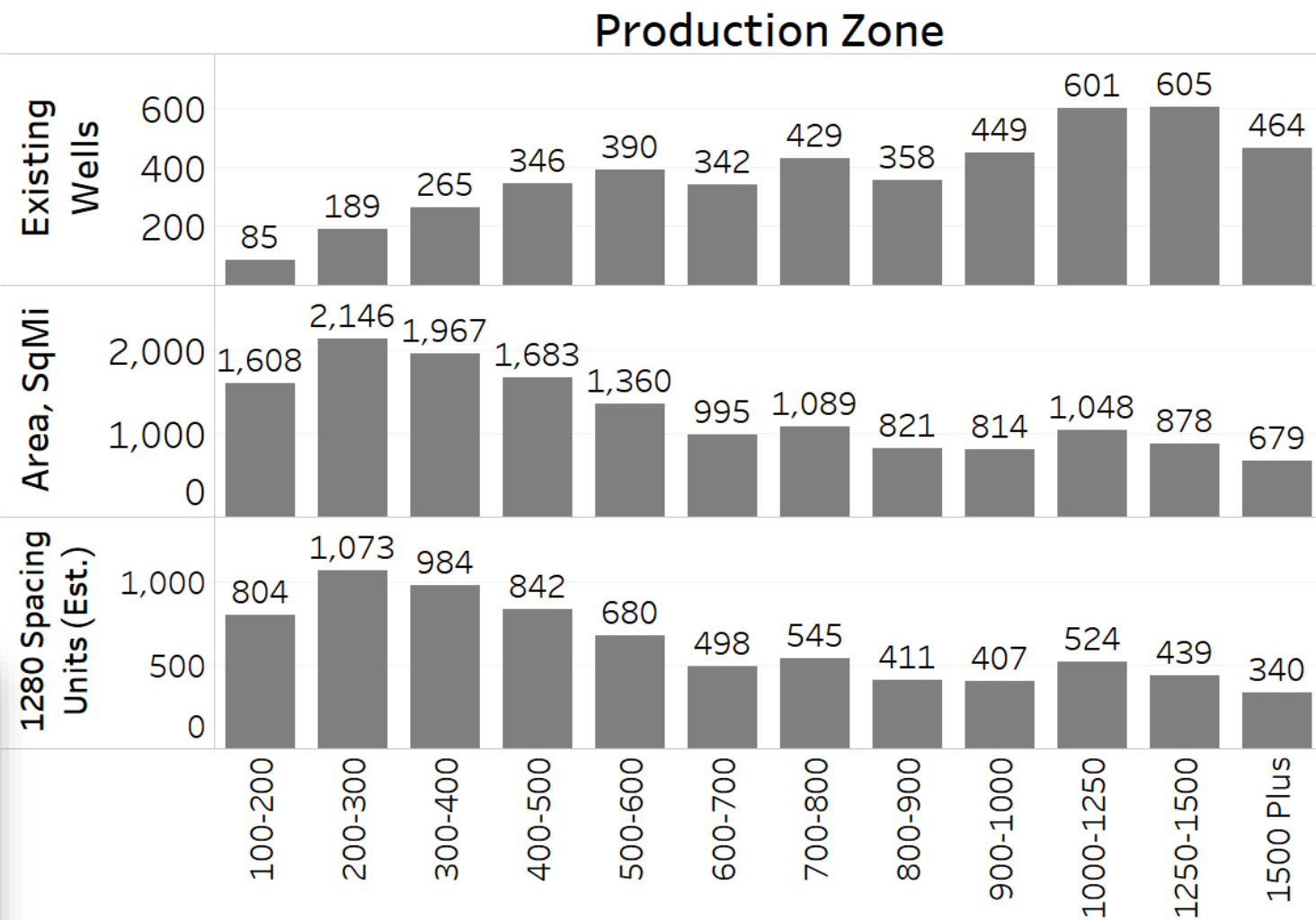
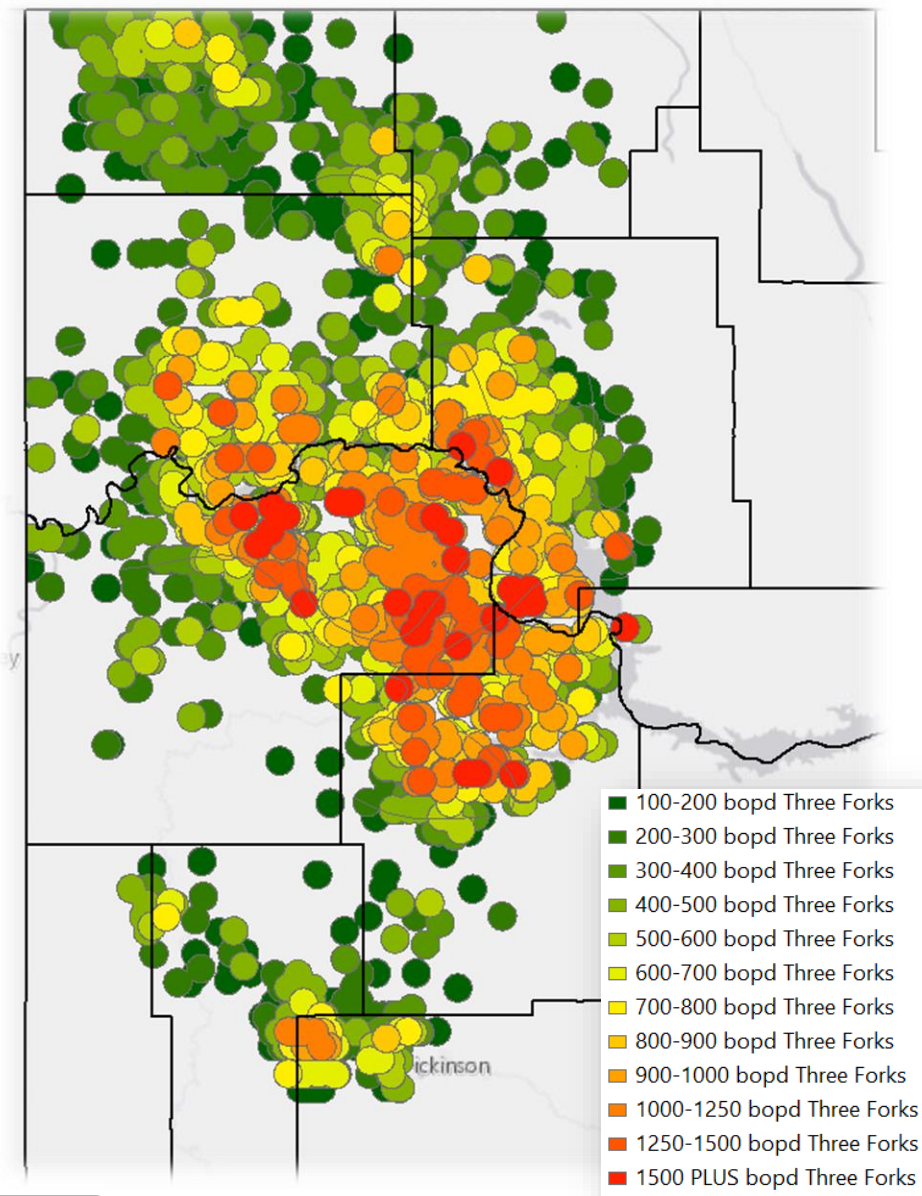
Low Case = 4 Wells In Bakken Formation

High Case = 8 Wells In Bakken Formation



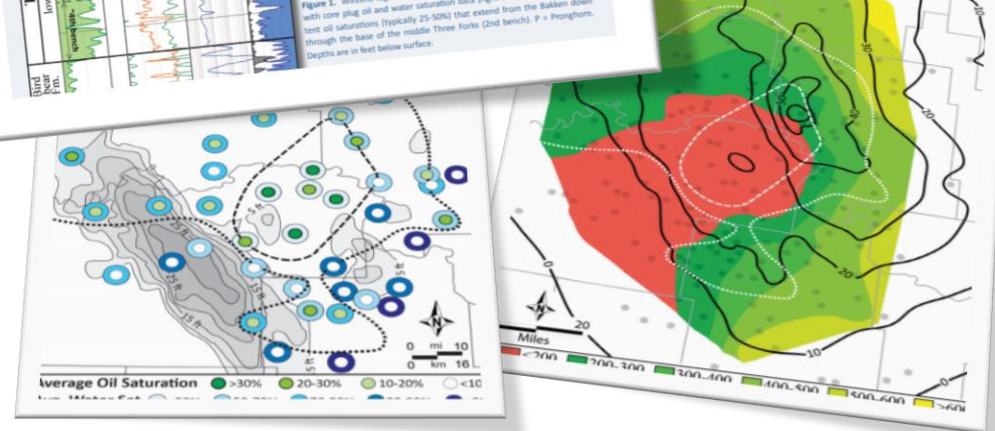
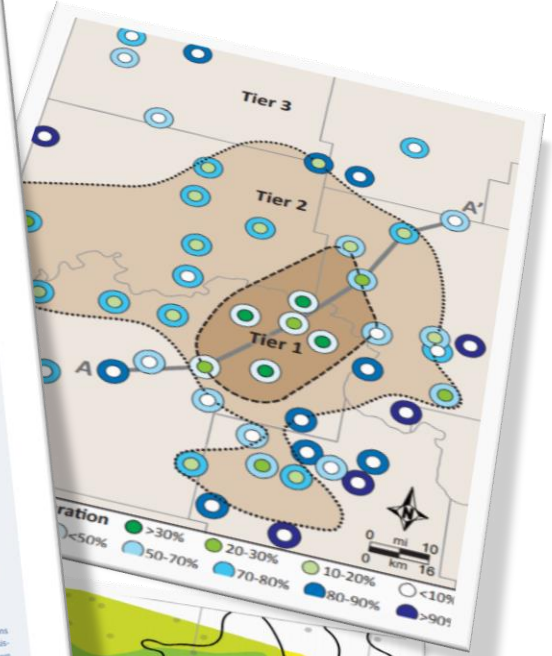
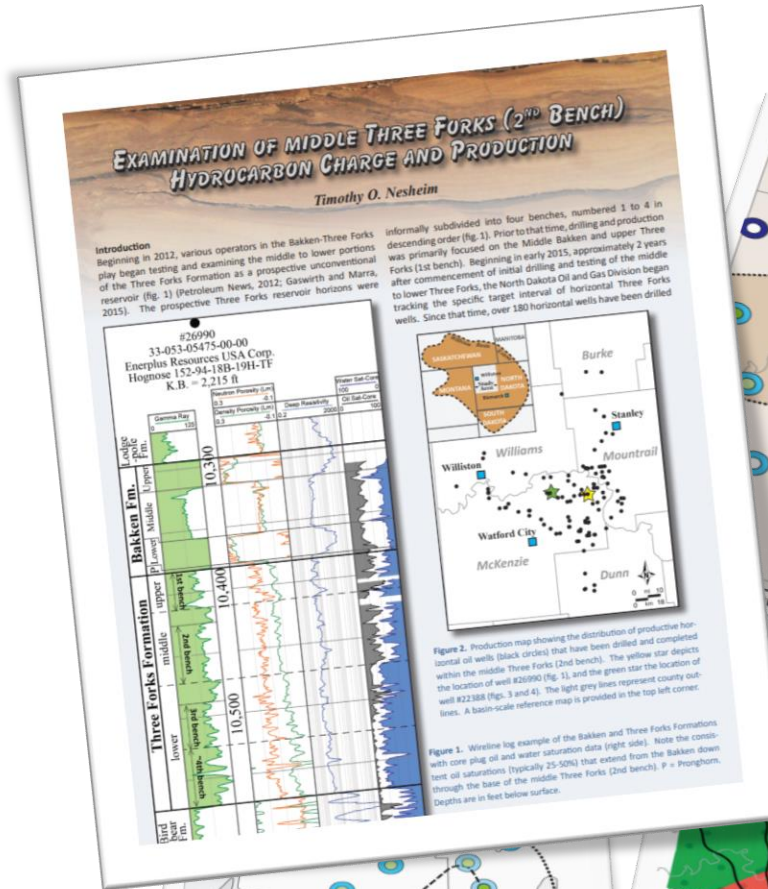
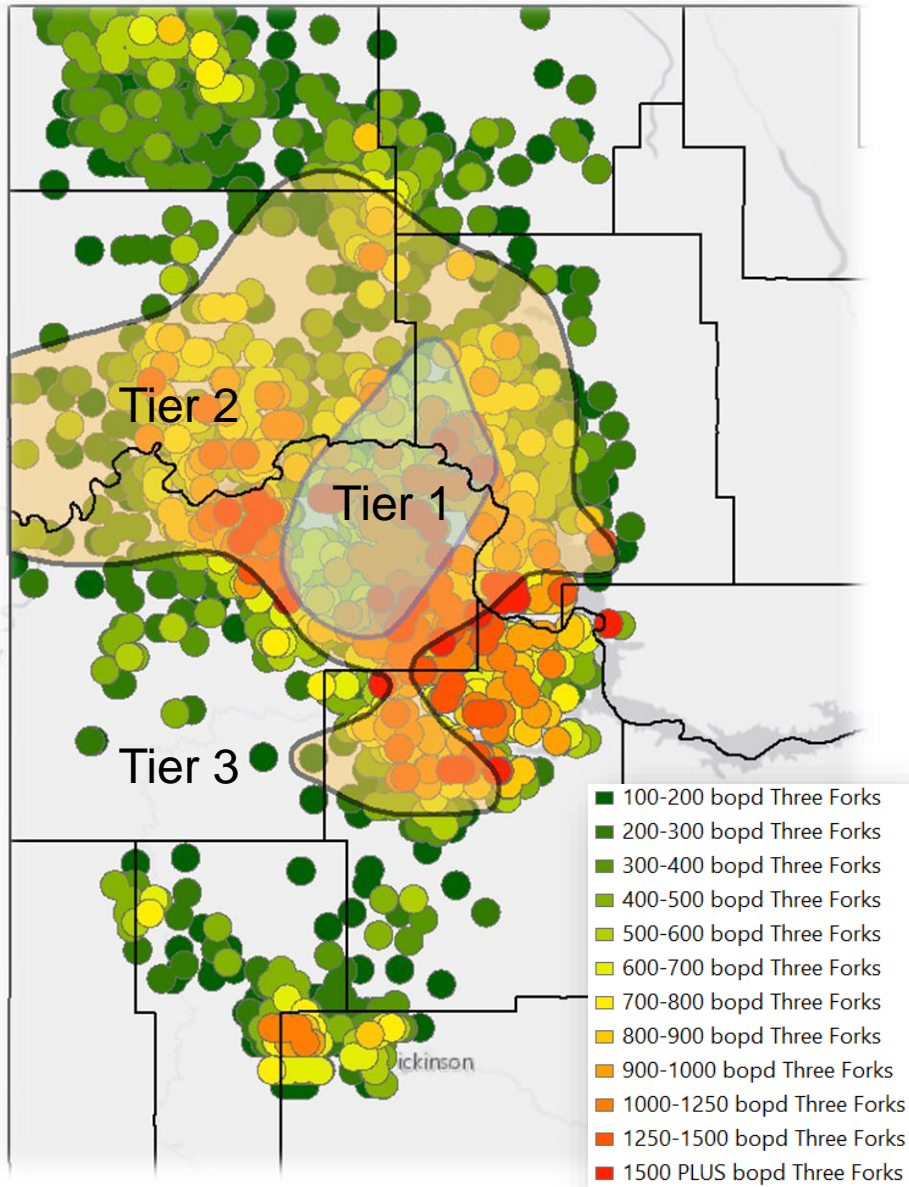


# Past Well Performance – Three Forks Formation

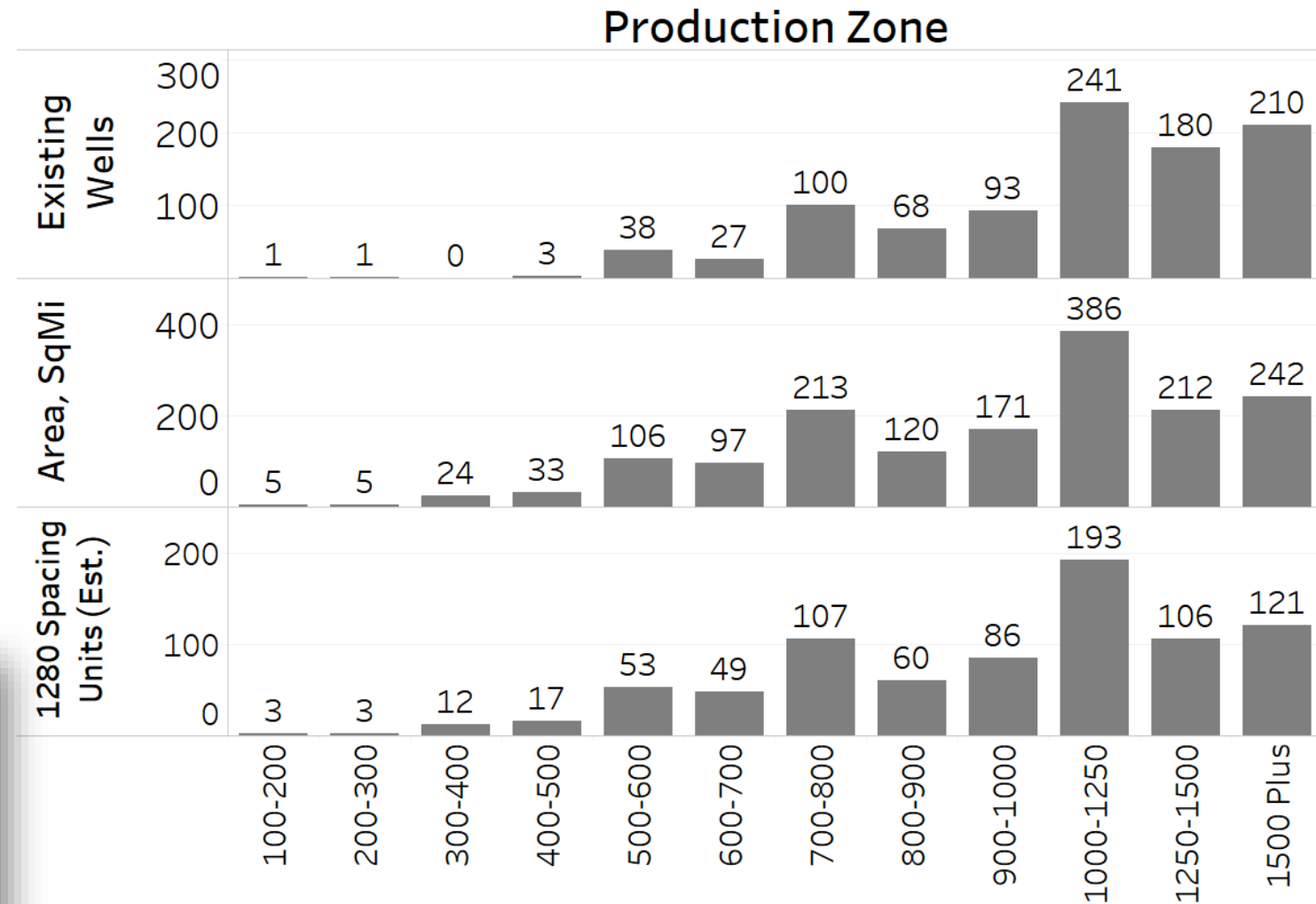
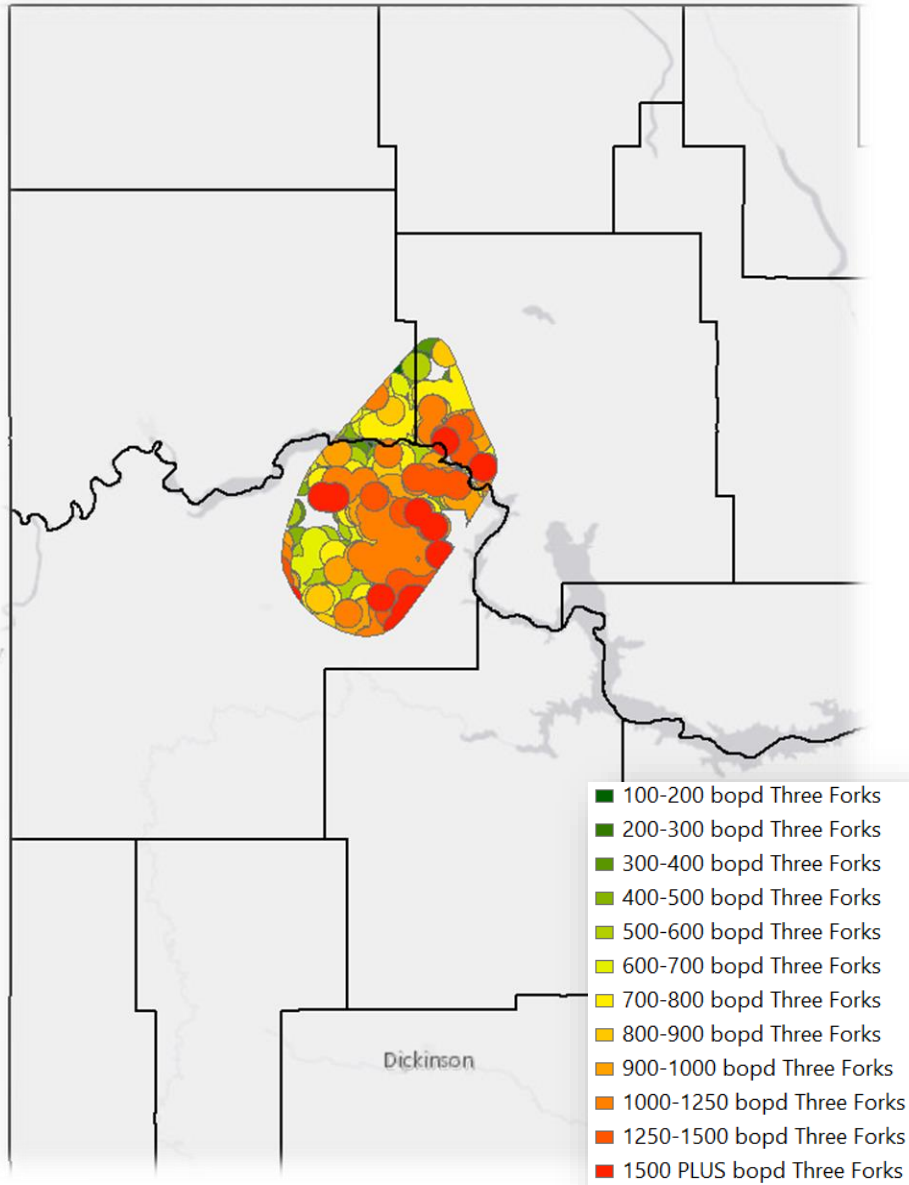




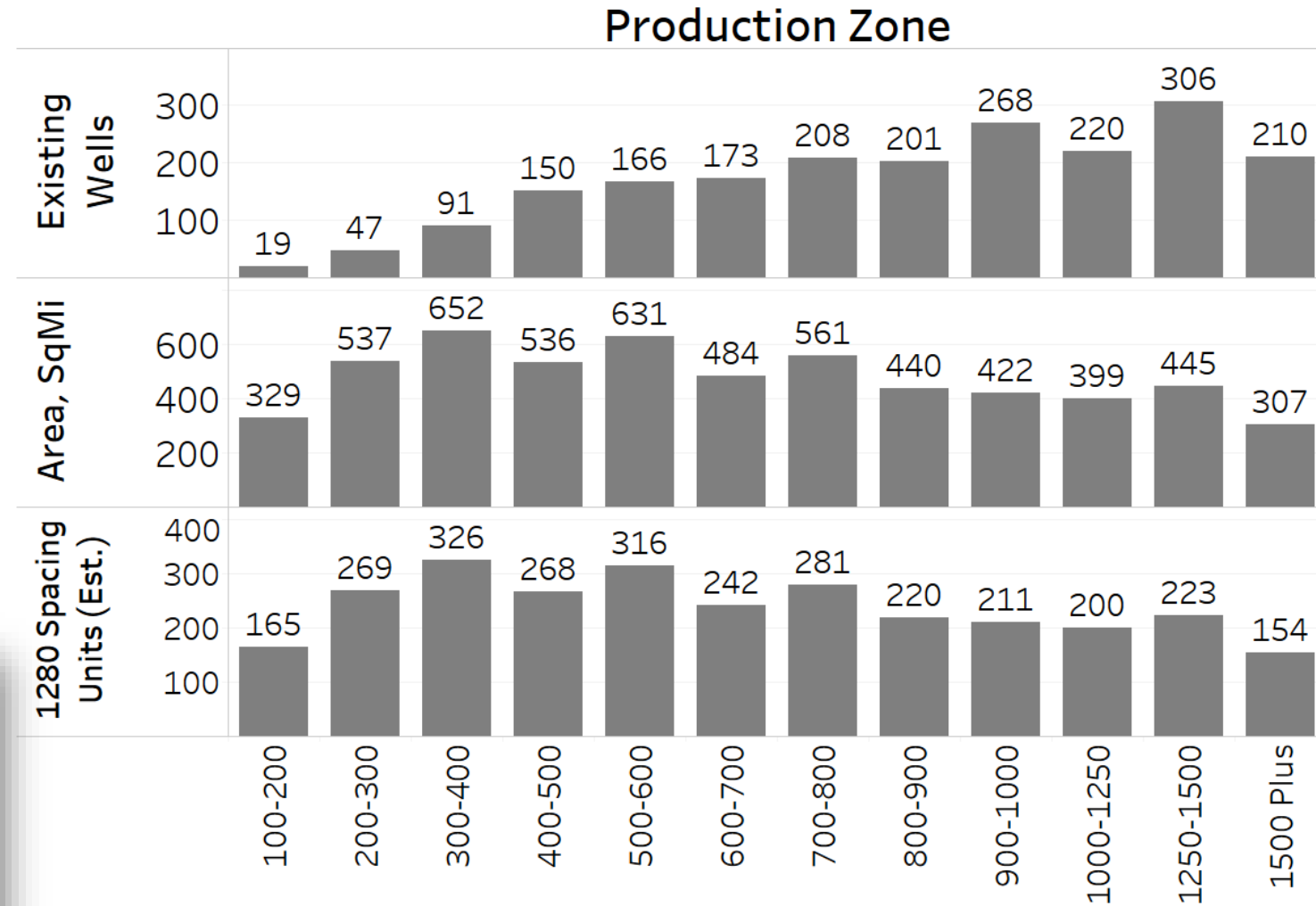
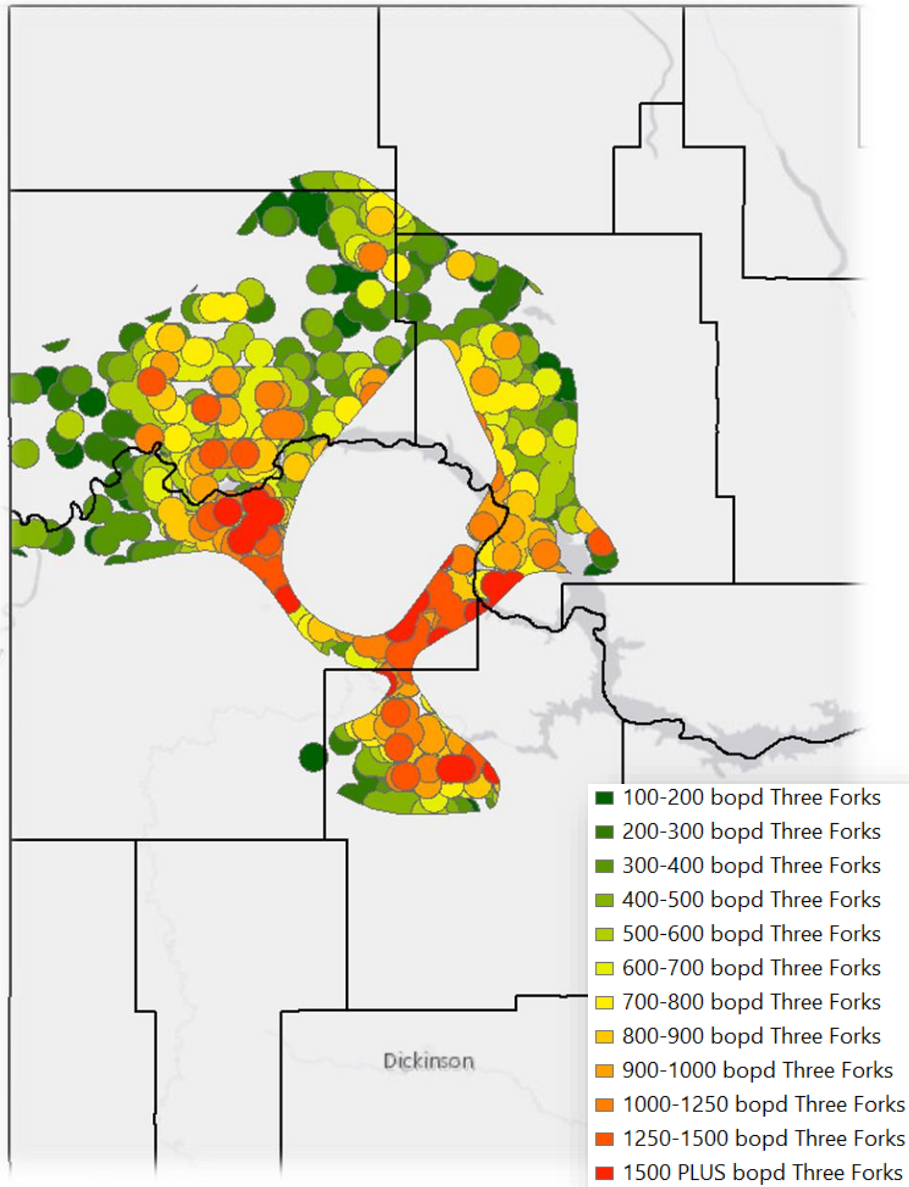
# Tim Nesheim (NDGS) Three Forks Work



# Past Well Performance – Three Forks Tier 1

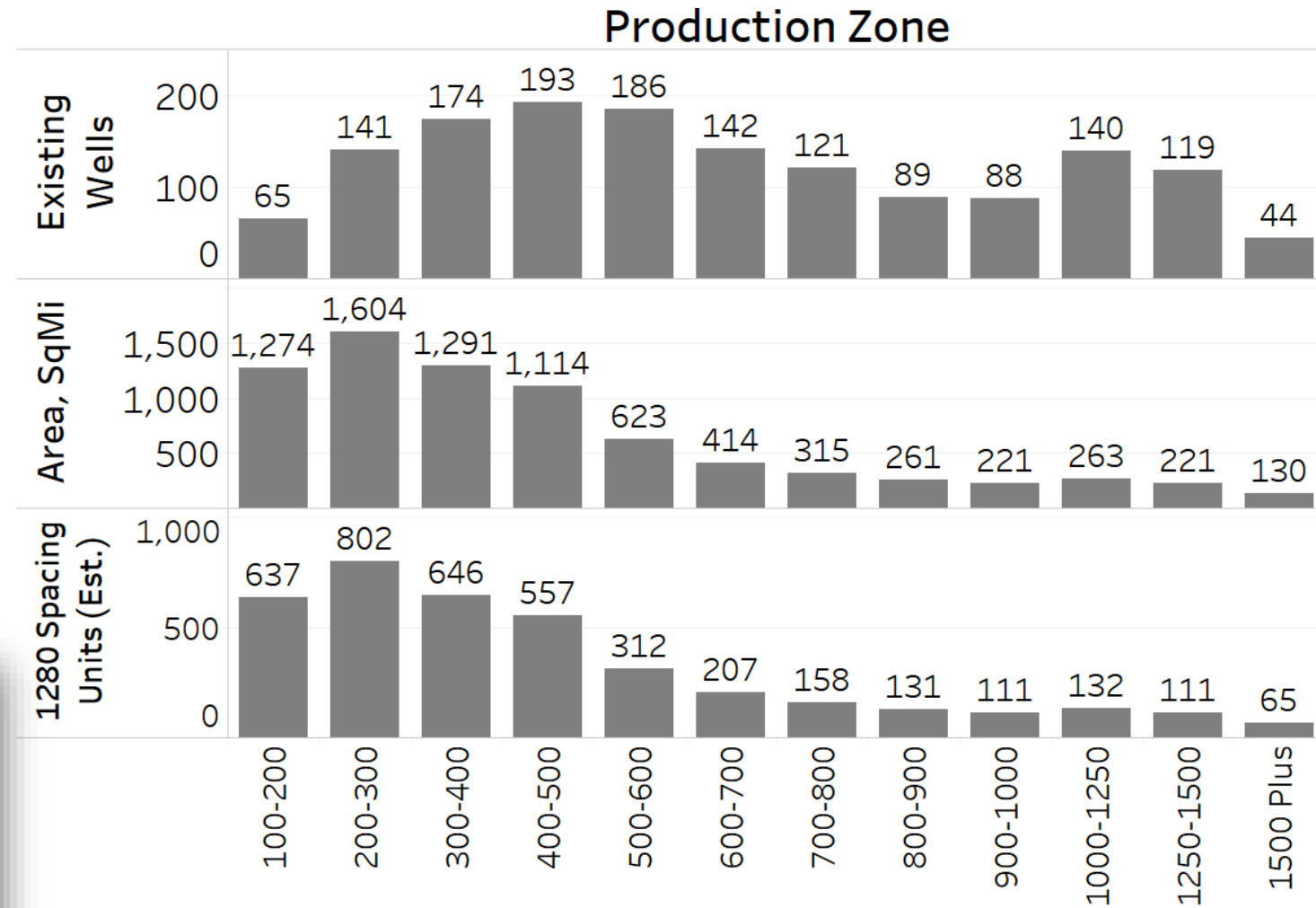
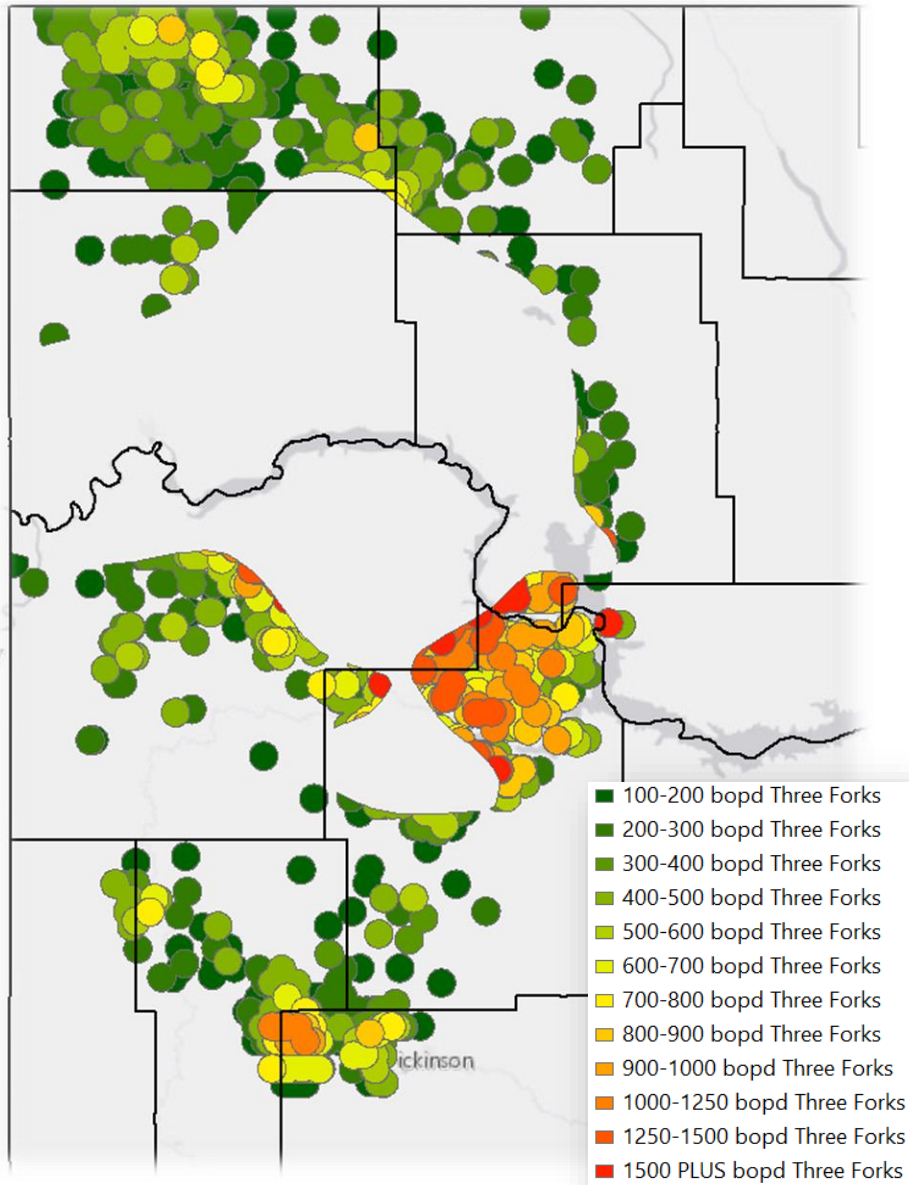


# Past Well Performance – Three Forks Tier 2



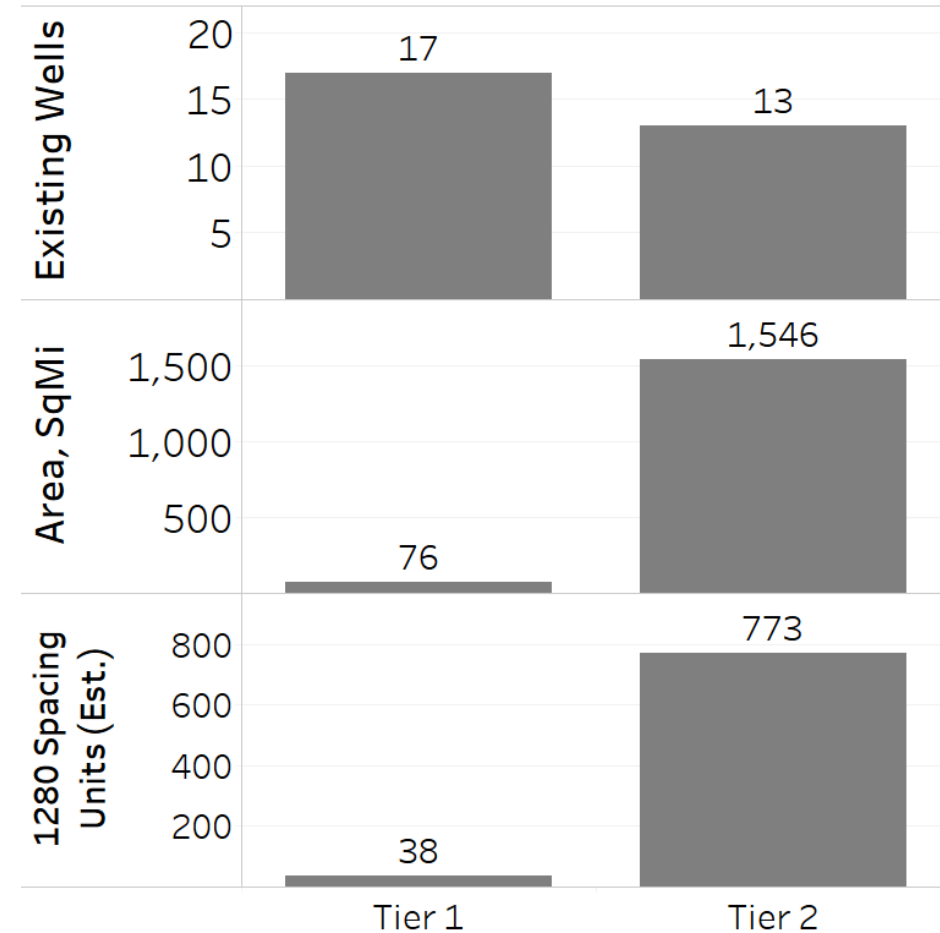
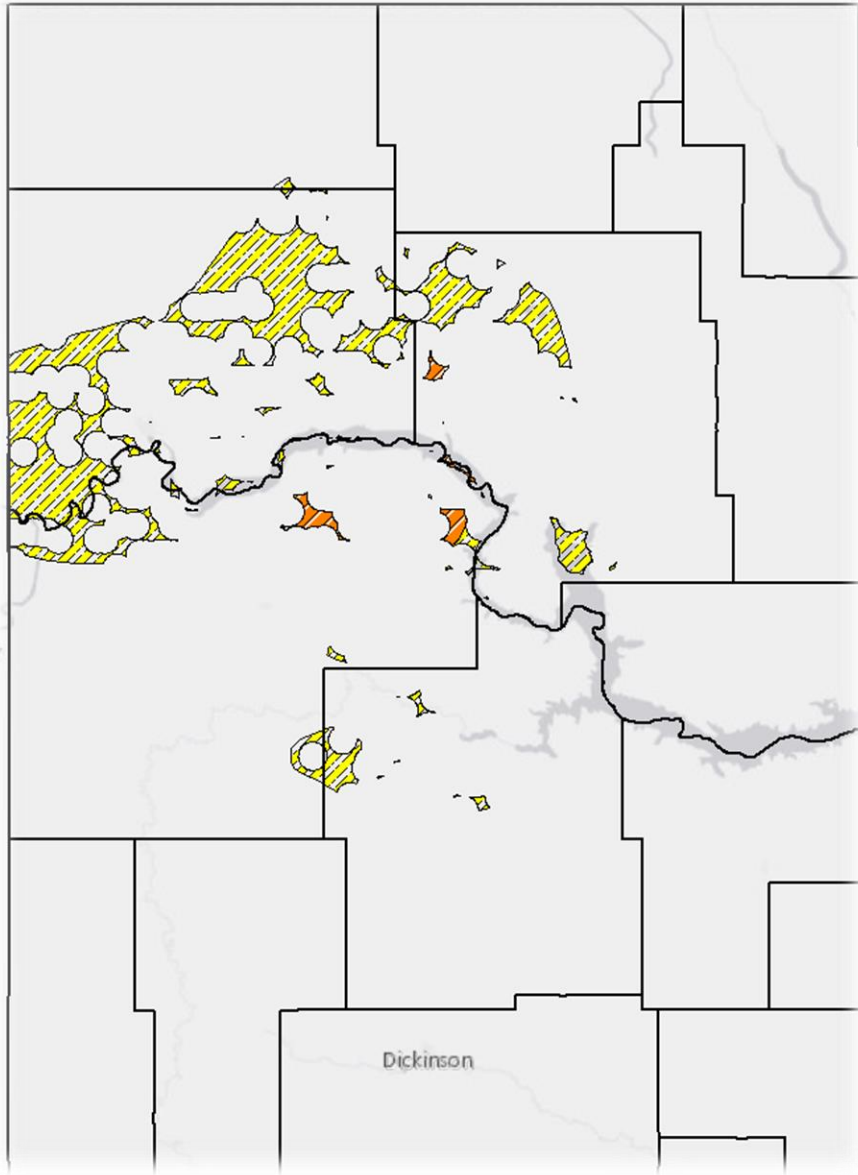


# Past Well Performance – Three Forks Tier 3





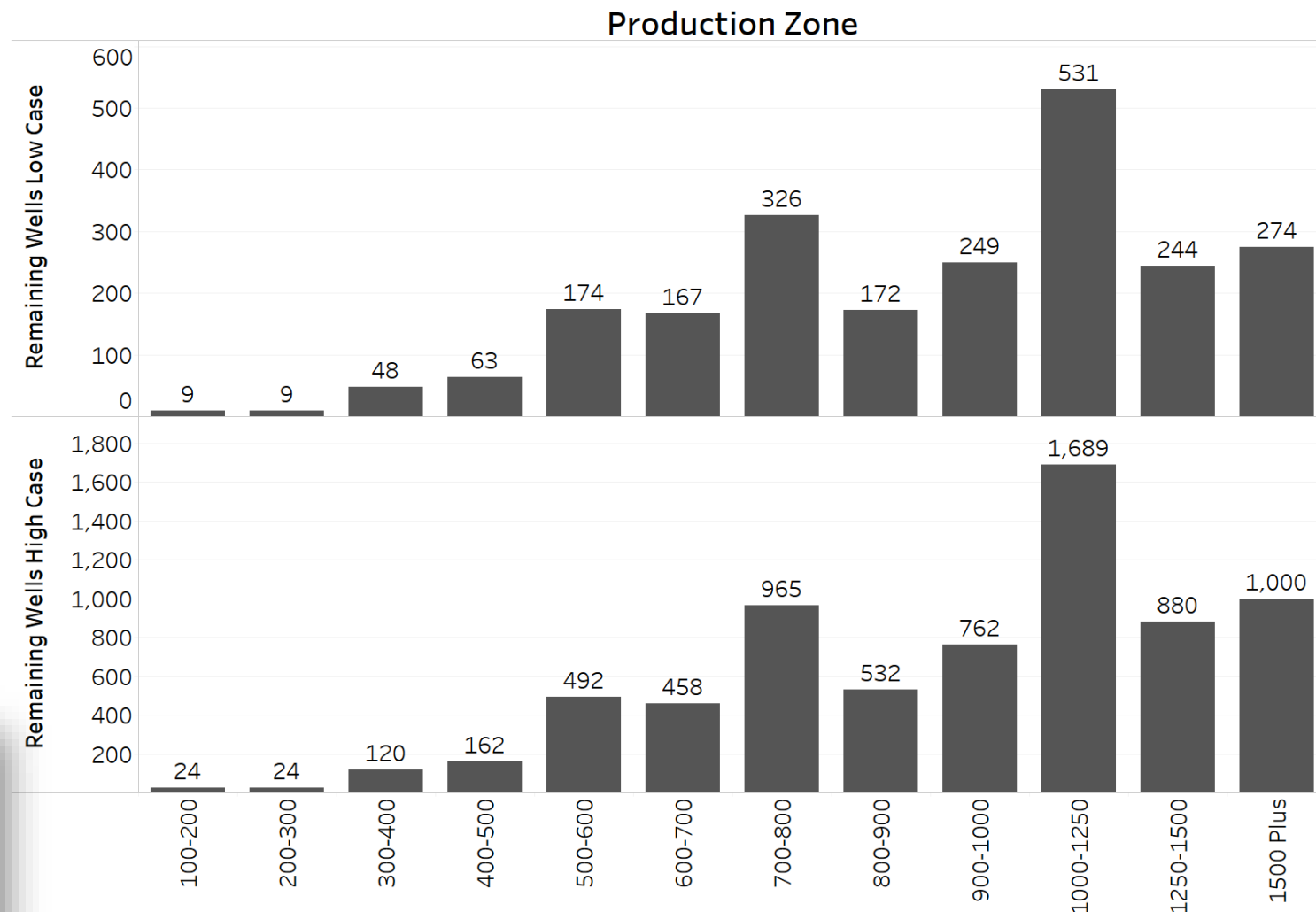
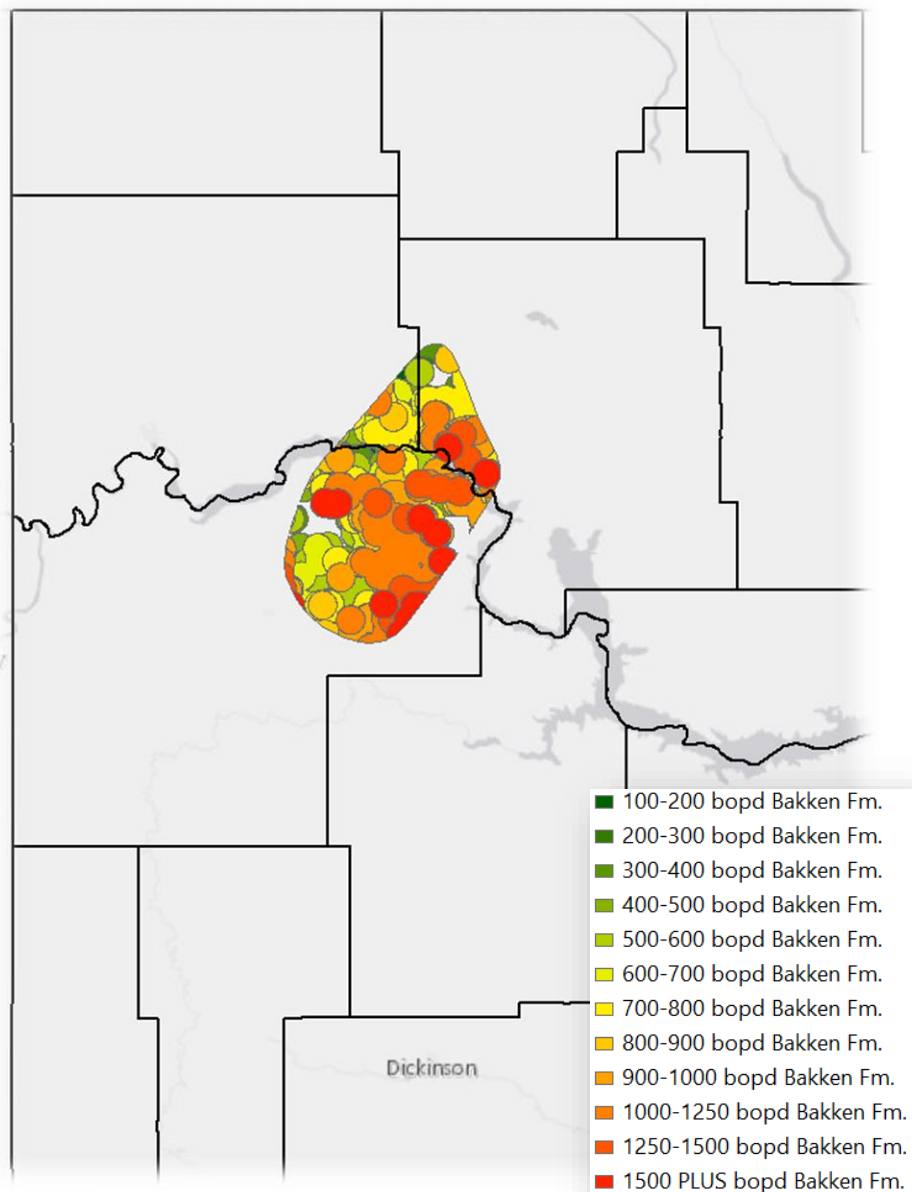
# “Empty” Three Forks Tier 1 & 2



**All Empty Regions Were Removed From Estimates/Calculations**



# Remaining Wells\* – Three Forks Tier 1

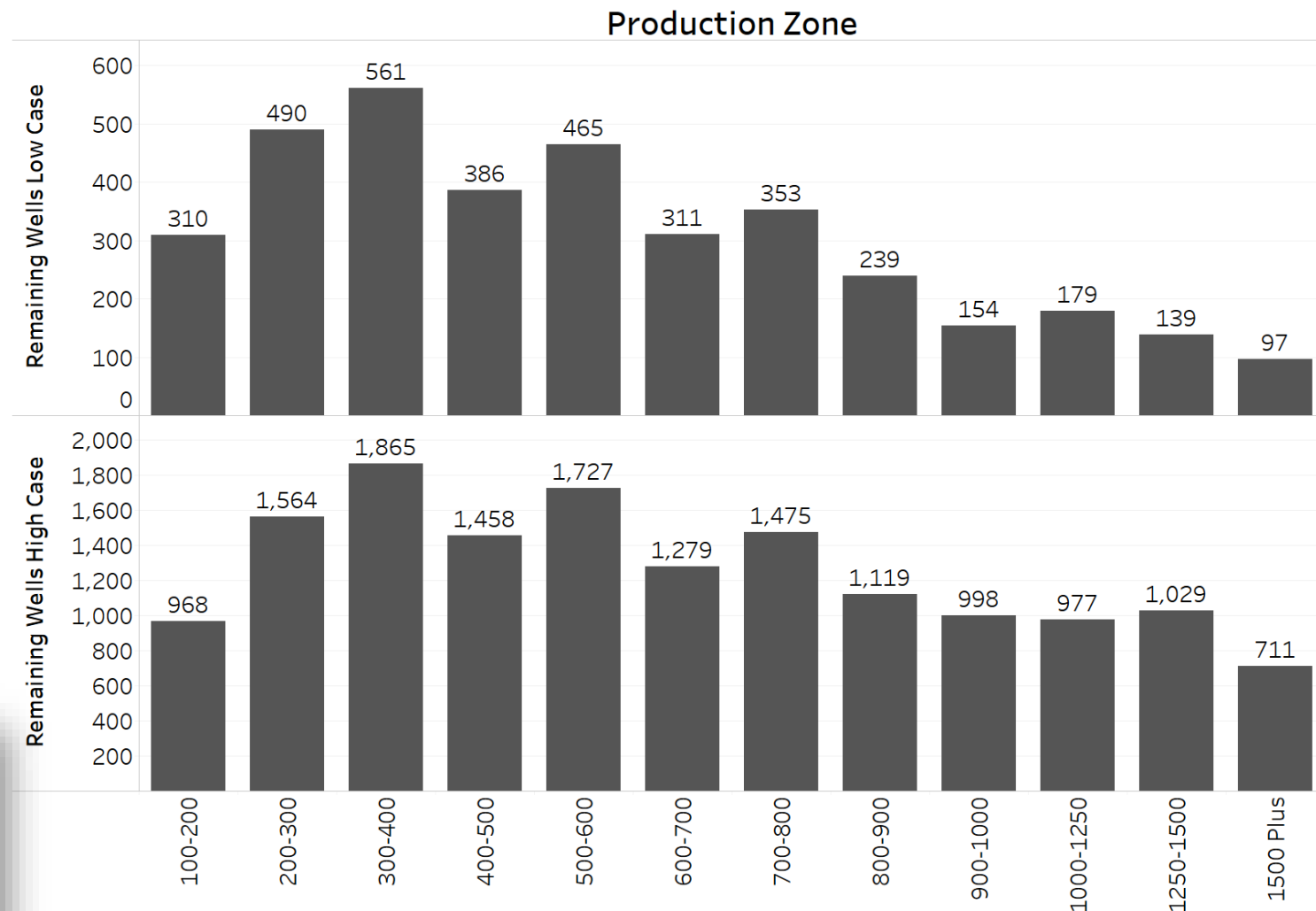
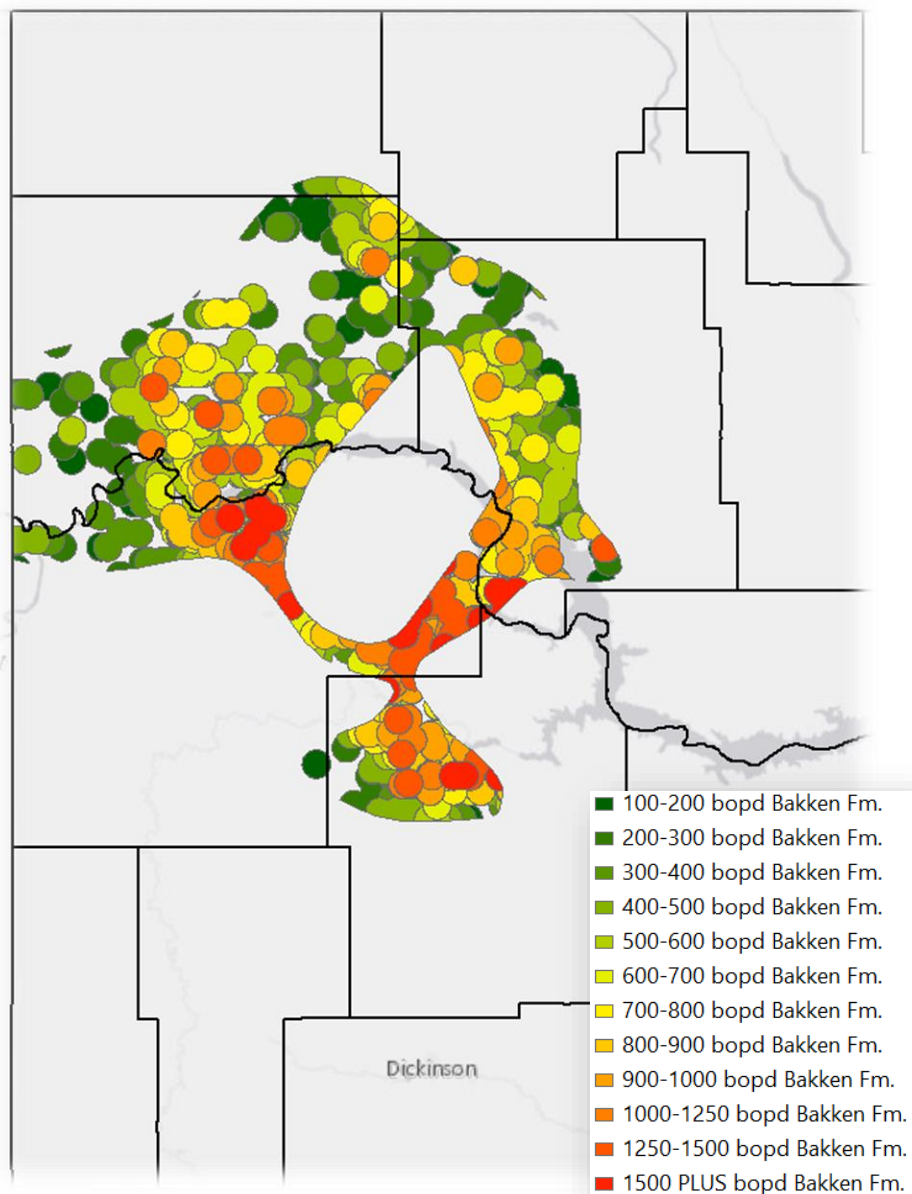


## **\*Well Density Assumptions**

Low Case = 4 Three Forks Wells Per DSU  
 High Case = 10 Three Forks Wells Per DSU



# Remaining Wells\* – Three Forks Tier 2



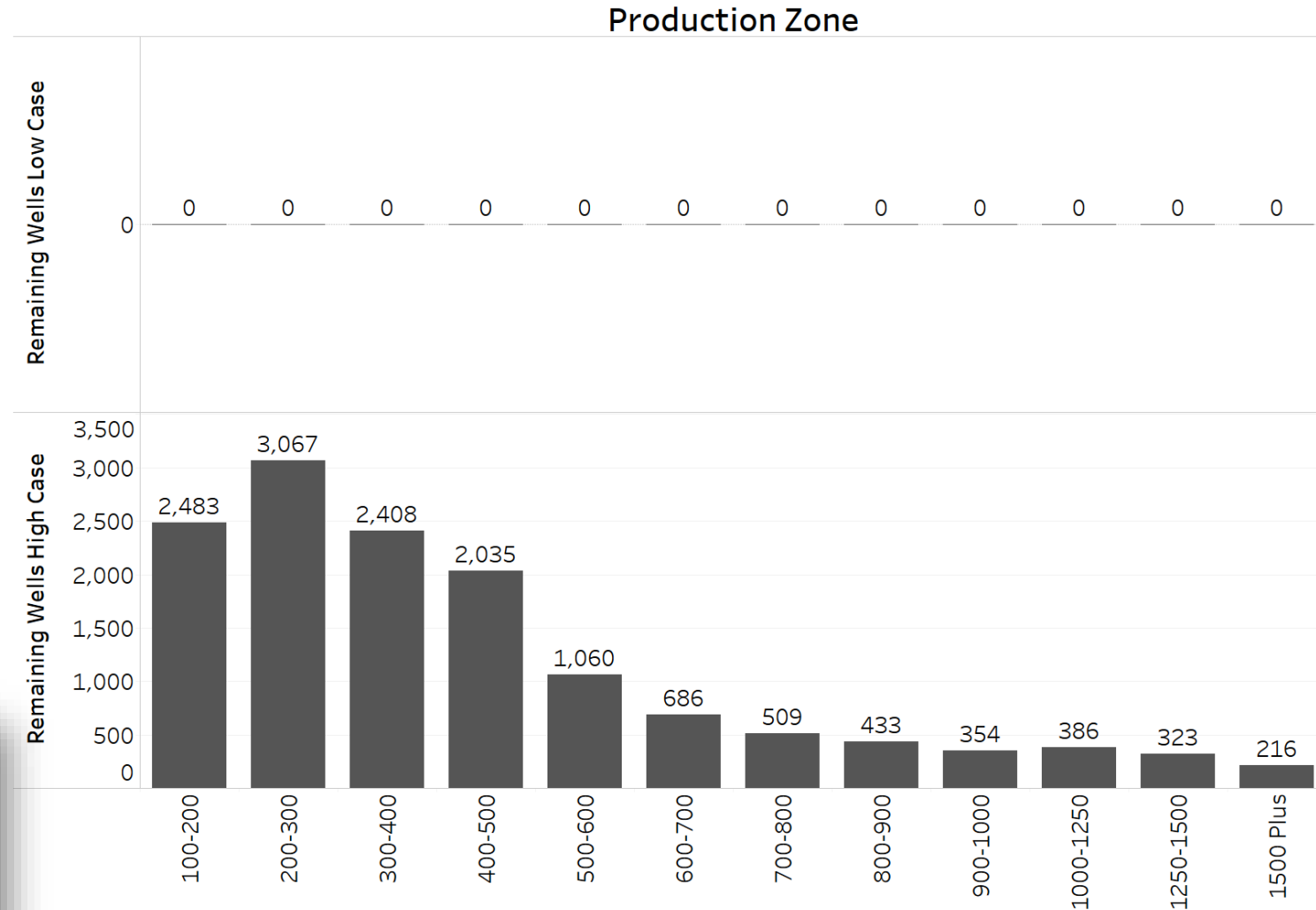
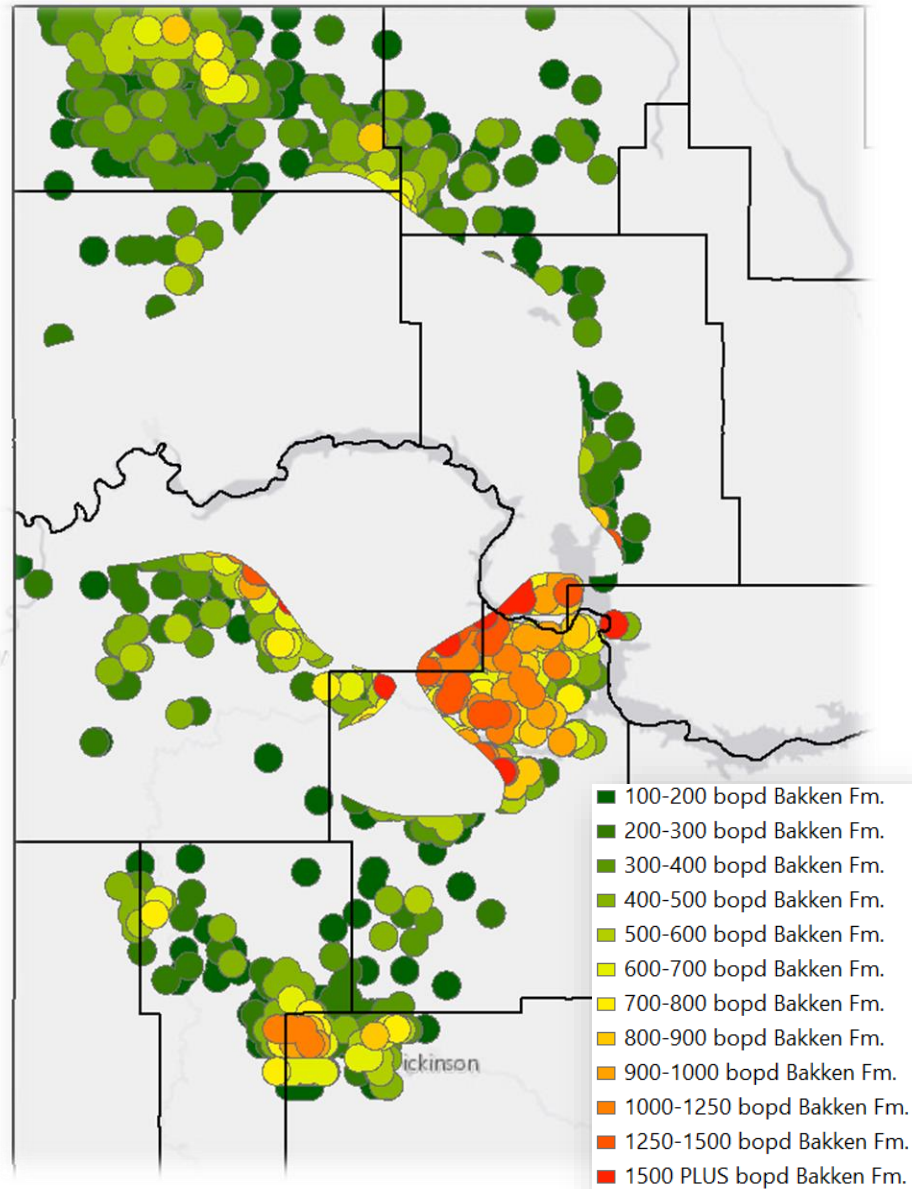
## \*Well Density Assumptions

Low Case = 2 Three Forks Wells Per DSU

High Case = 6 Three Forks Wells Per DSU



# Remaining Wells\* – Three Forks Tier 3



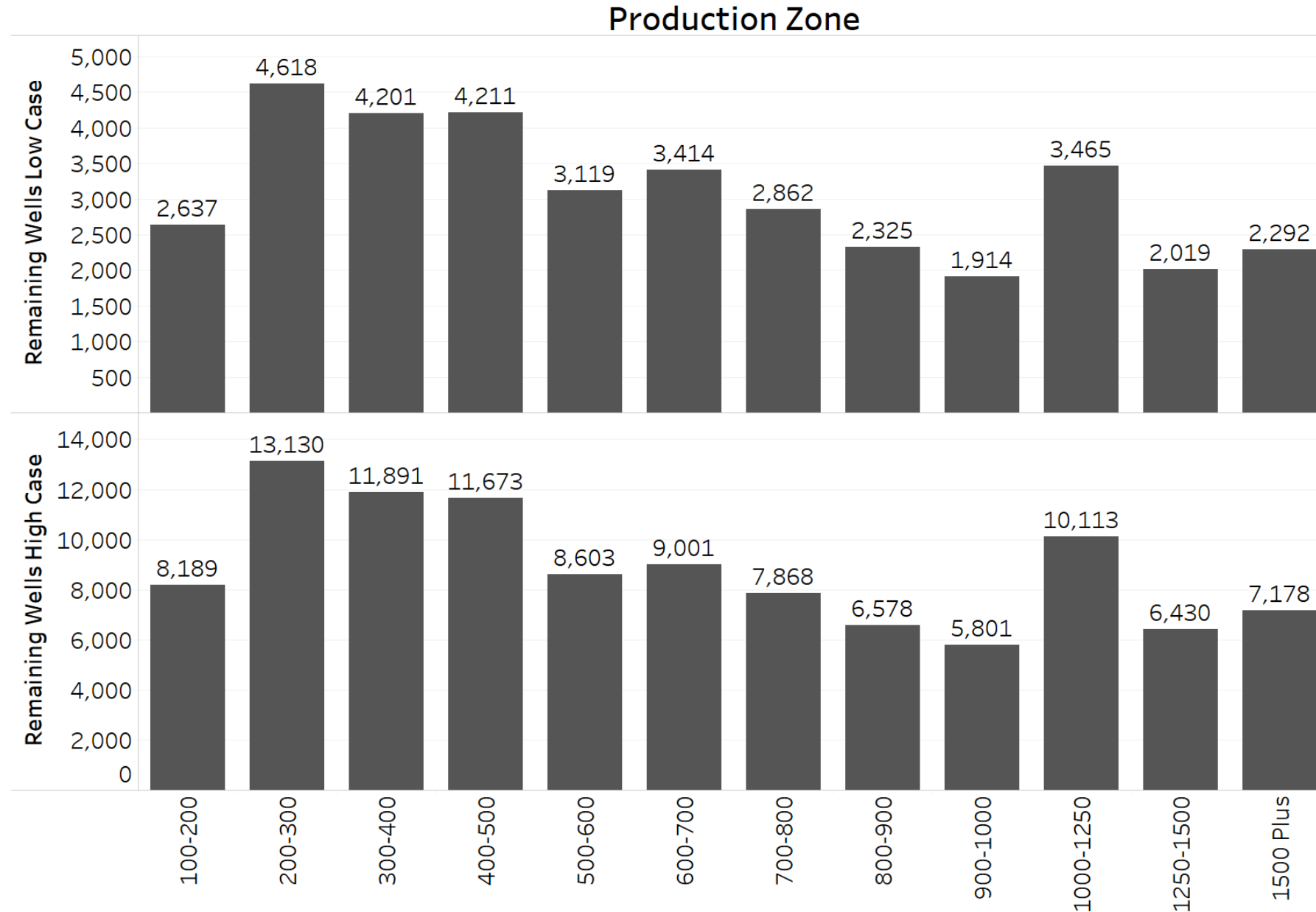
## \*Well Density Assumptions

Low Case = 0 Three Forks Wells Per DSU  
 High Case = 4 Three Forks Wells Per DSU



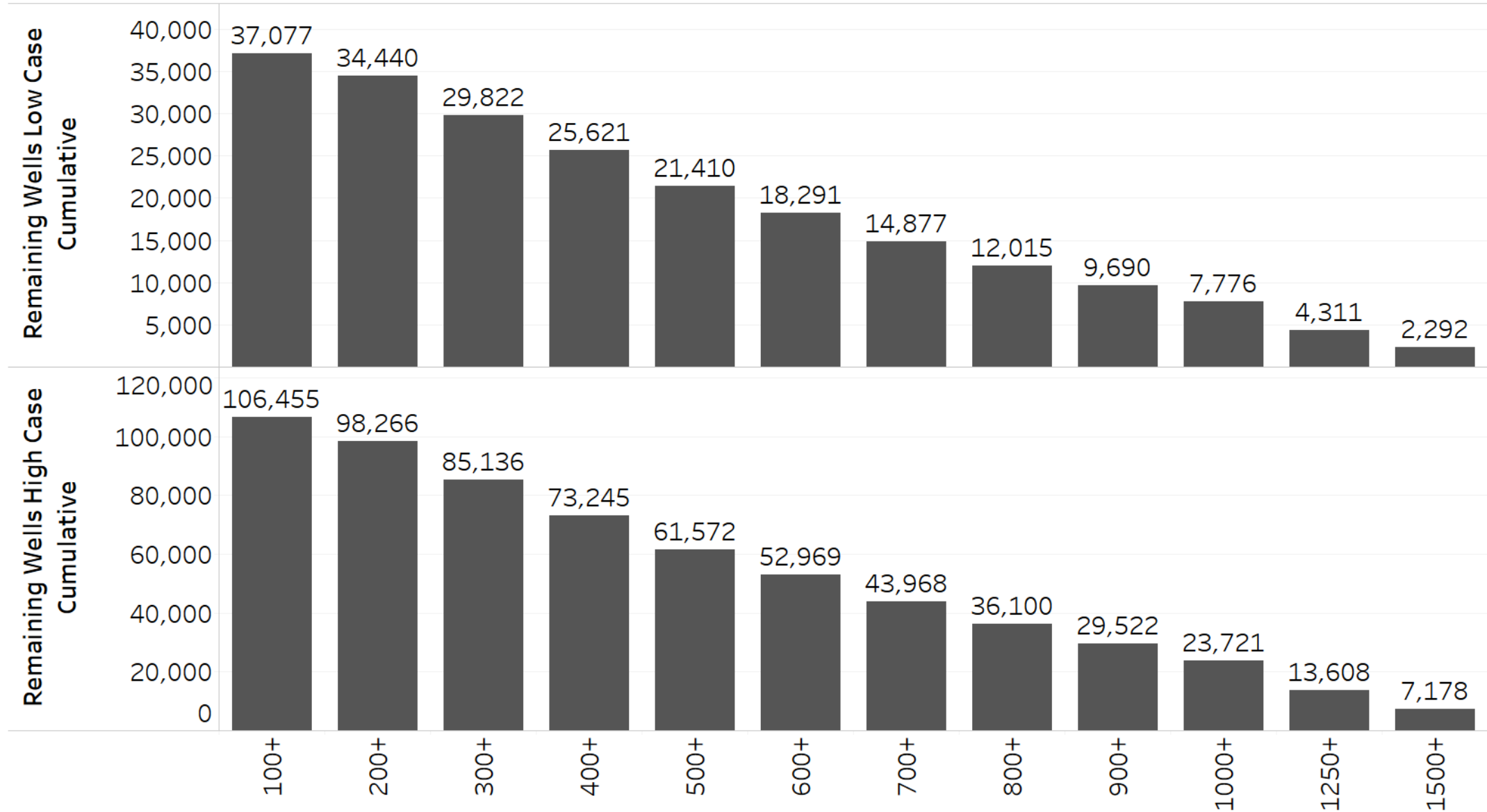


# Remaining Wells – All Bakken and Three Forks Tiers



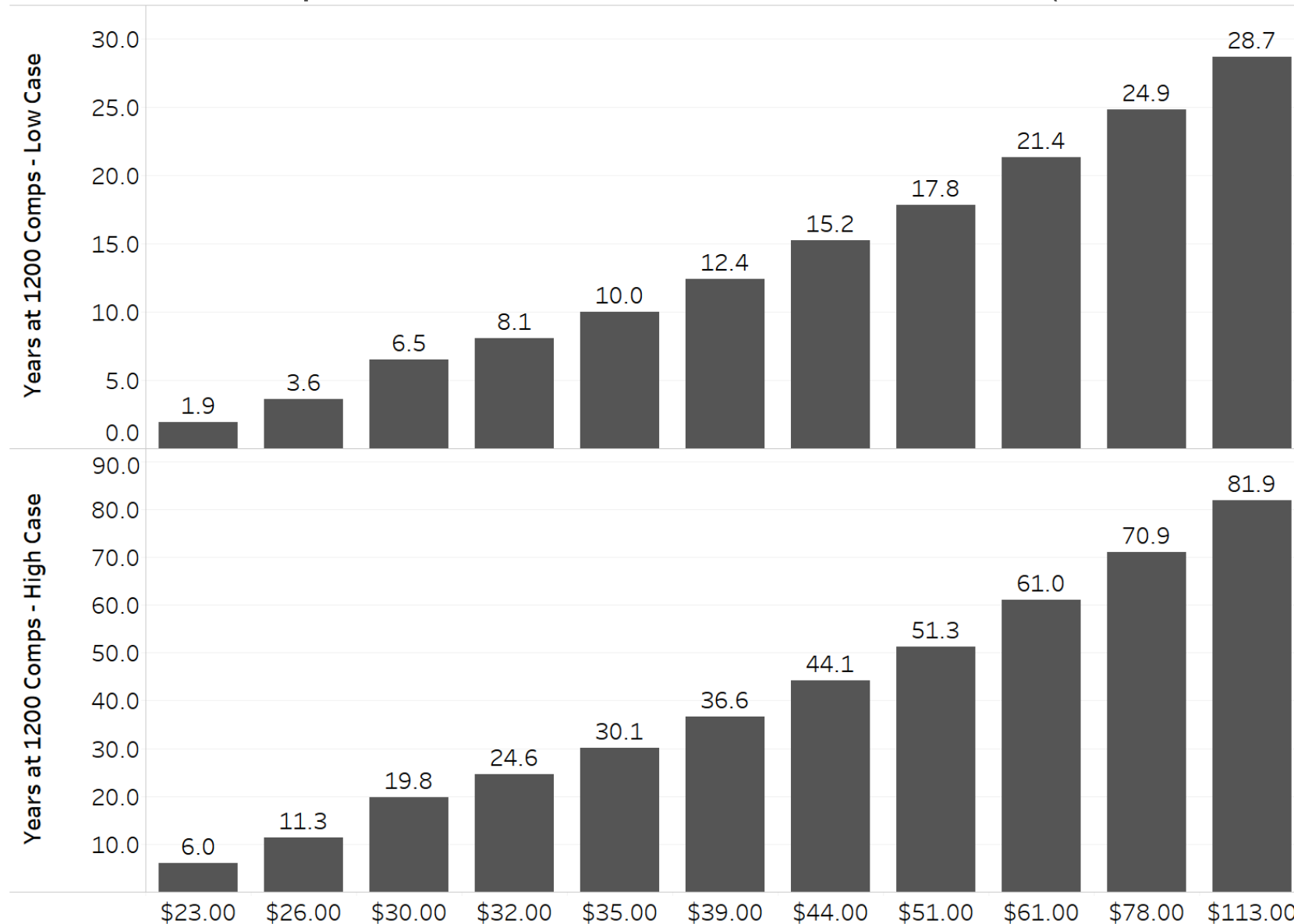
# Cumulative Remaining Wells – Peak Month Minimum BOPD

## Production Zone



# Years Remaining\* / Minimum Wellhead Oil Price

\*Assumes 1,200 Completions Per Year and \$7MM Well Costs (20% After Tax IRR)



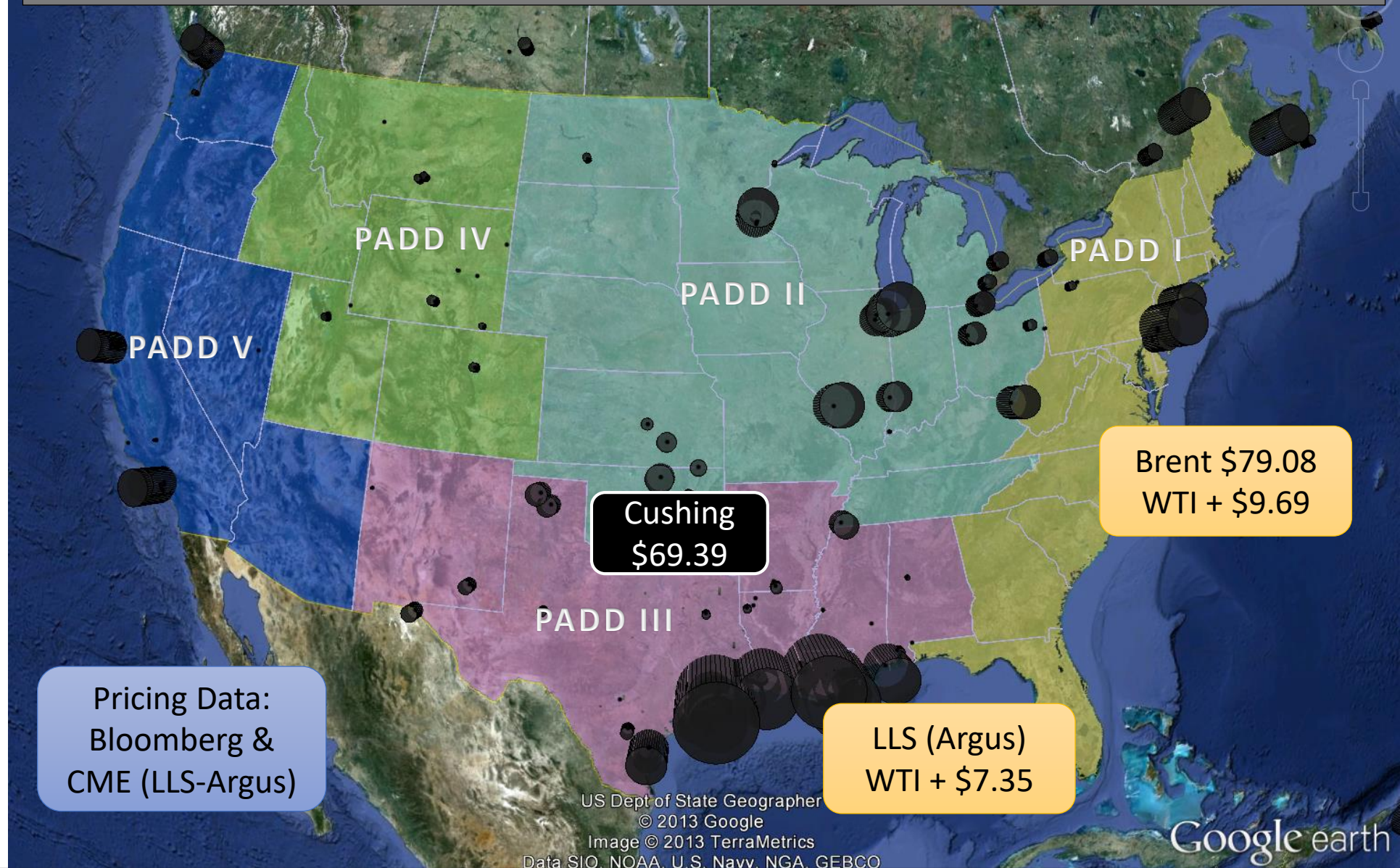
# Presentation Outline

- Economics
- **Understanding current and future oil production**
  - **Pricing update**
  - **Activity**
  - **Oil forecasts**
- North Dakota natural gas production
  - Flaring and gas capture
  - Interstate Transmission
- Pipeline construction update

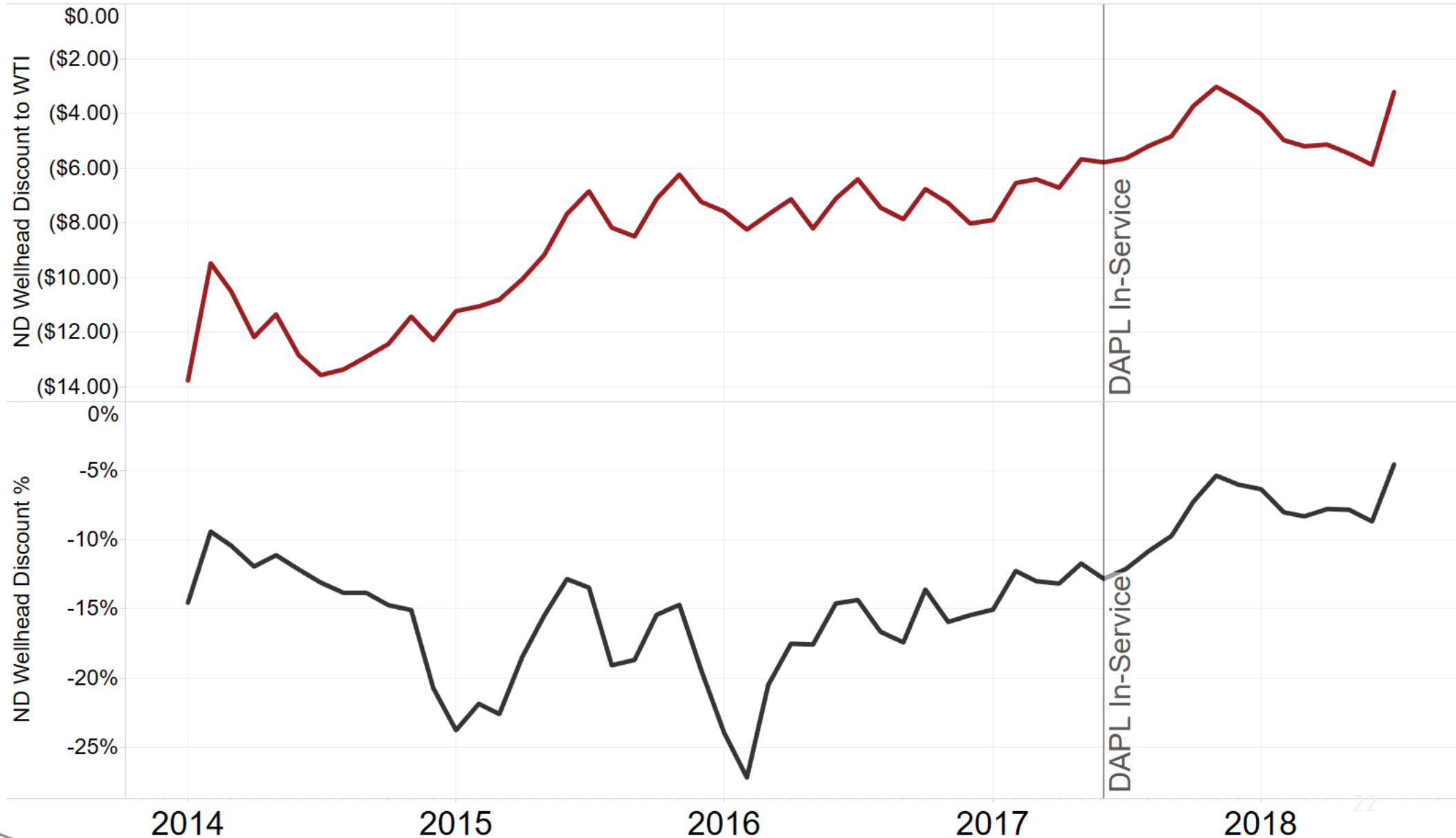




# Crude Oil Prices – Sep 13, 2018



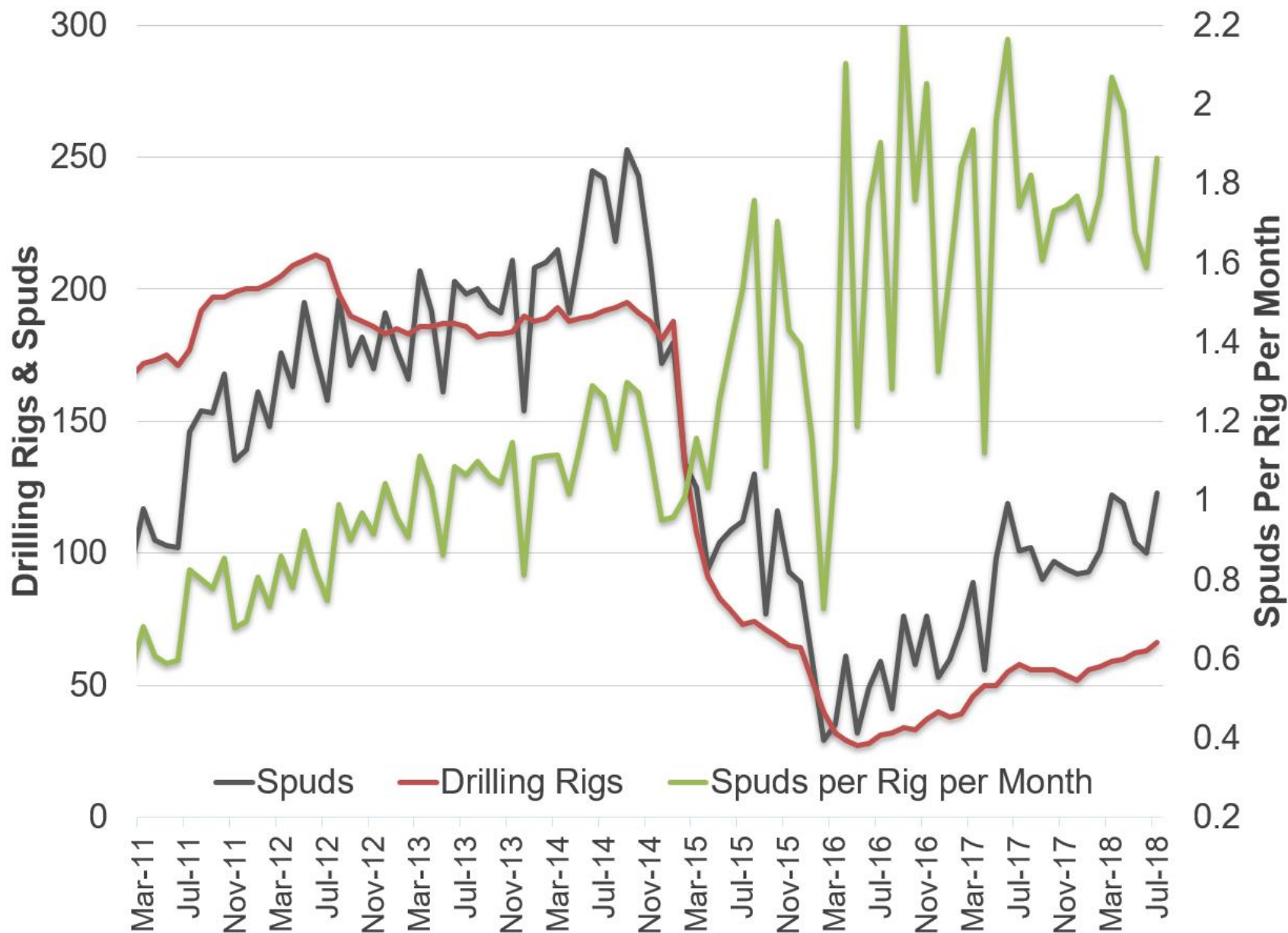
# North Dakota Oil Differential to WTI



22

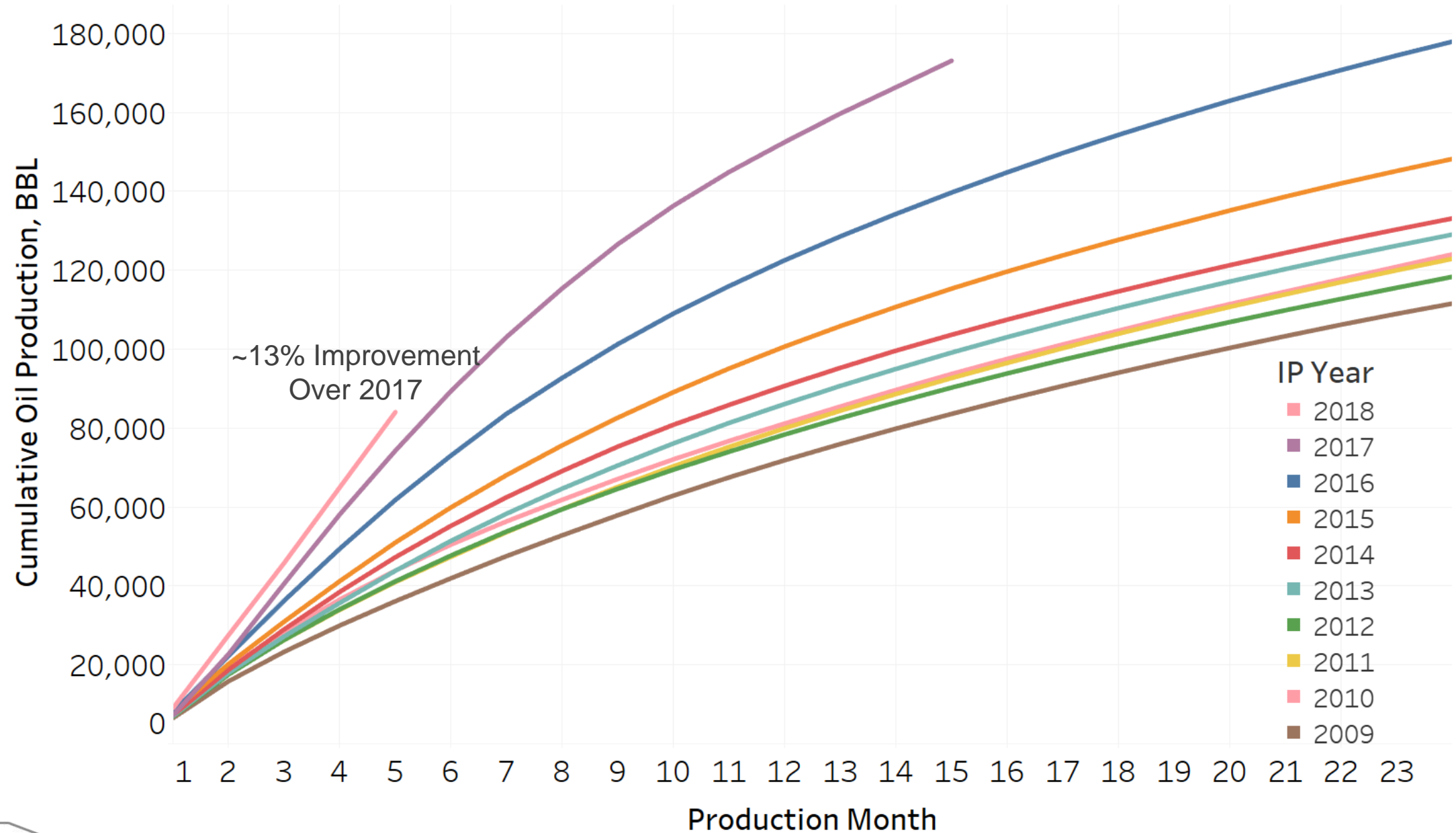


# North Dakota Drilling Activity



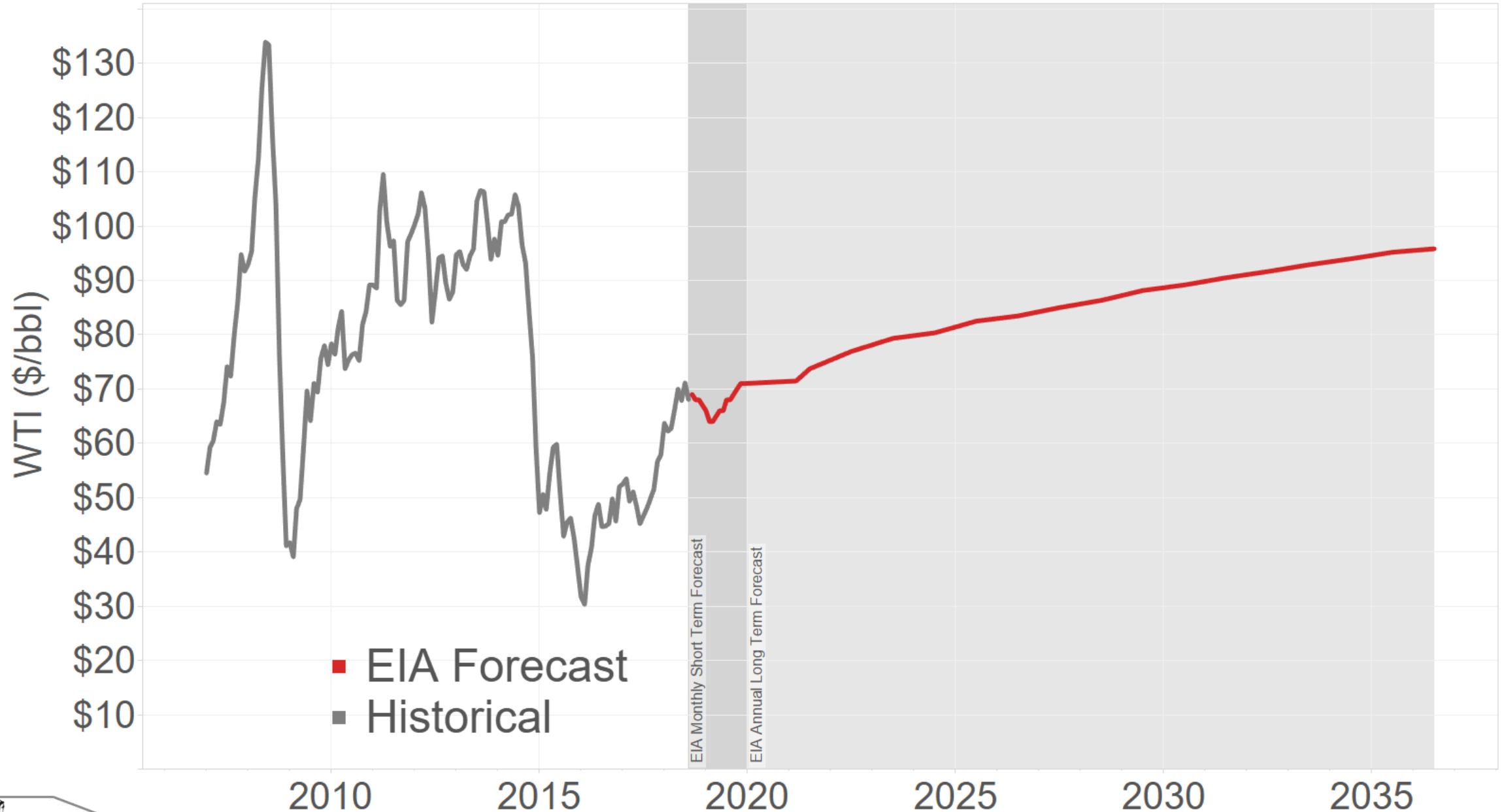


# Statewide Oil Performance

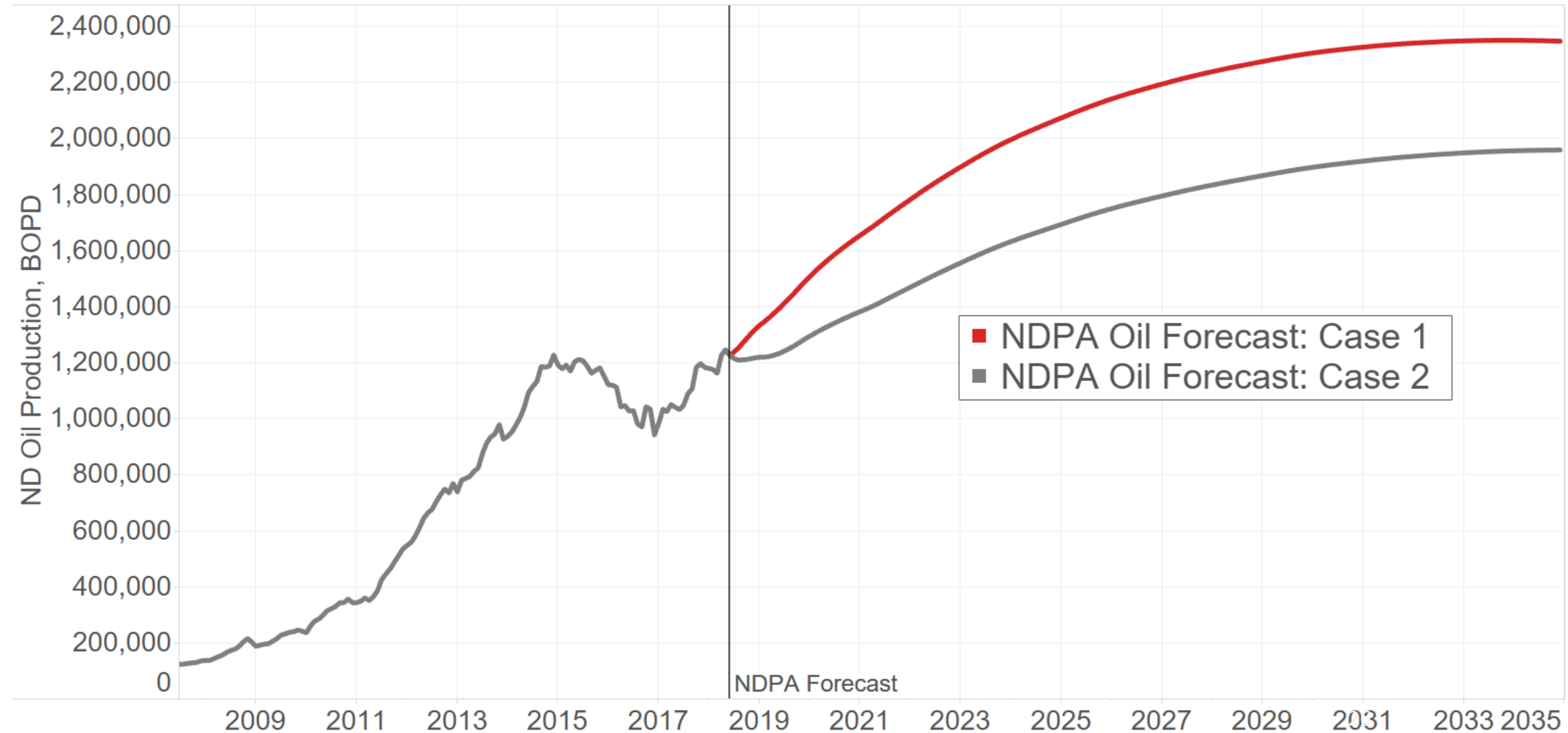




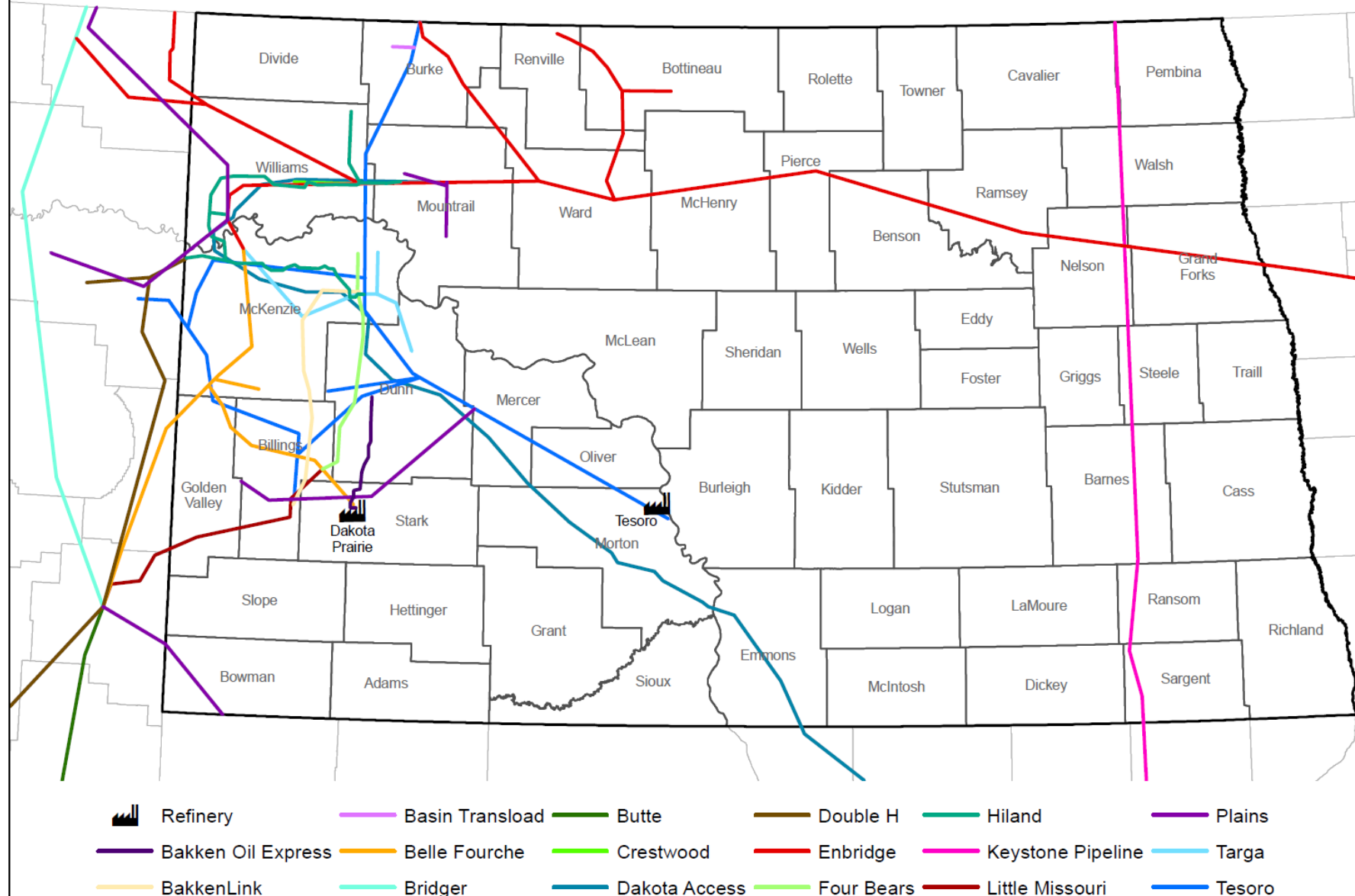
# DOE-EIA Forecasted Oil Price



# North Dakota Oil Production Forecast



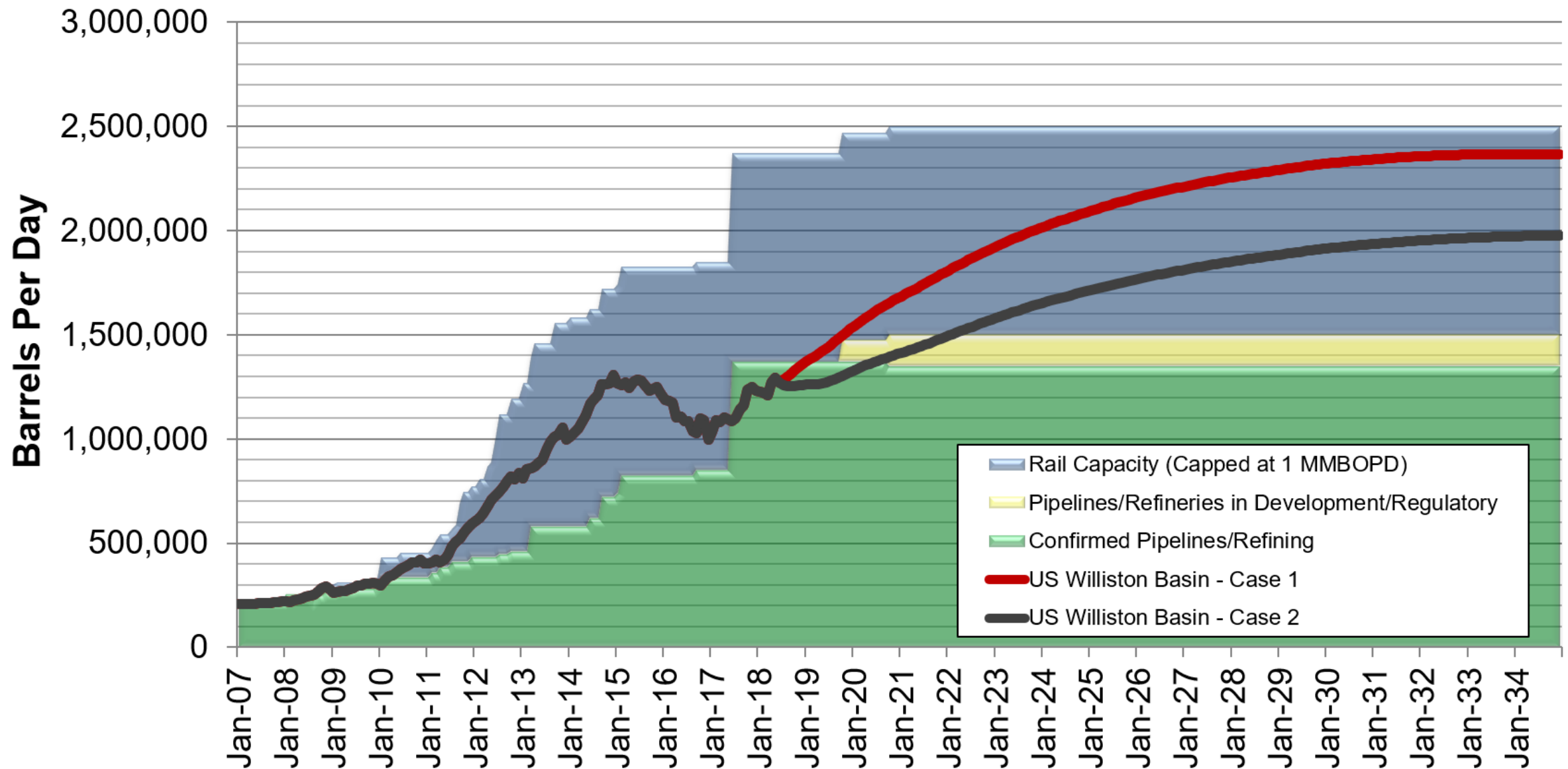
# North Dakota Crude Oil Pipelines



Date: 6/2/2017  
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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.*



# Presentation Outline

- Economics
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- **North Dakota natural gas production**
  - **Flaring and gas capture**
  - **Interstate Transmission**
- Pipeline construction update





# Natural Gas Update



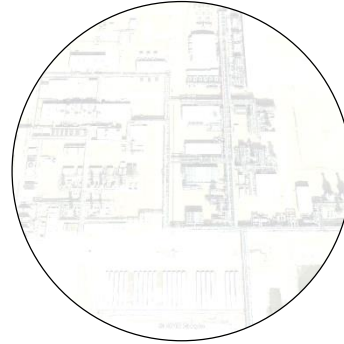
## Production

- Technology
- Markets



## Gathering

- Capacity
- Connections



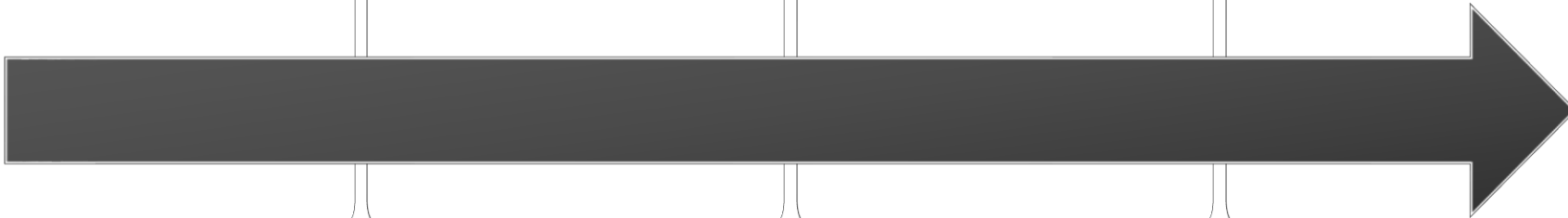
## Processing

- Capacity
- Location

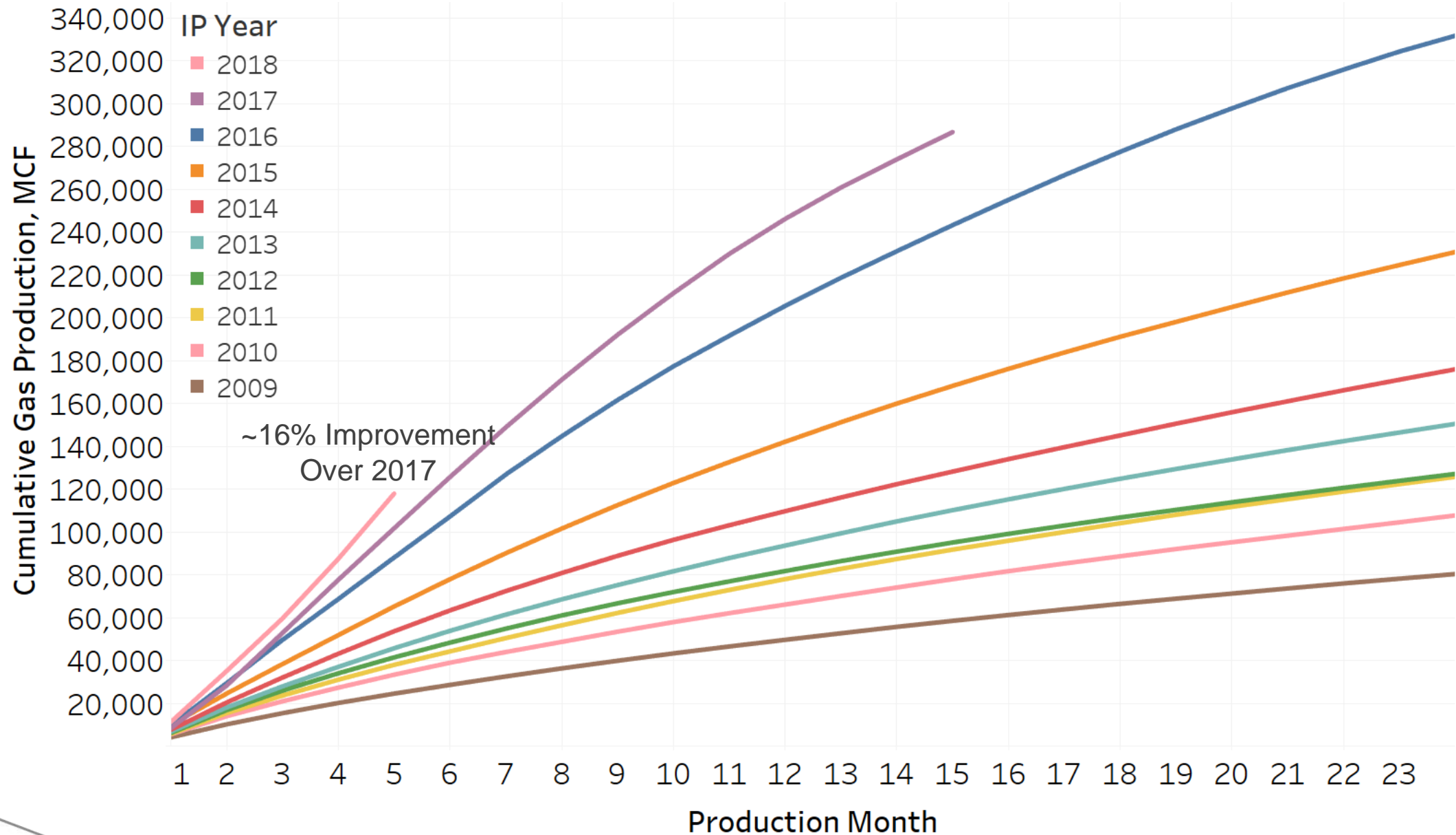


## Transmission

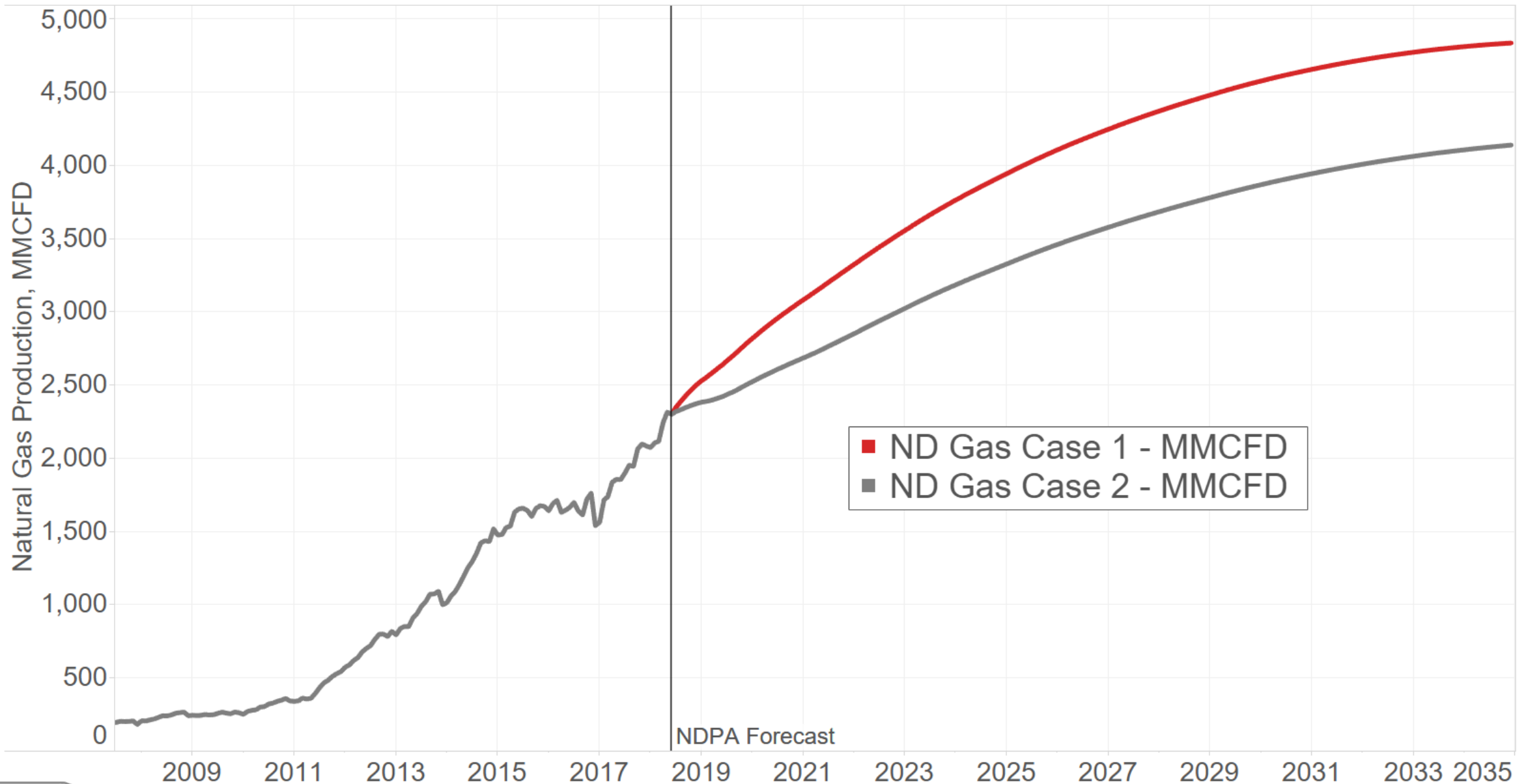
- Dry Gas
- Natural Gas Liquids



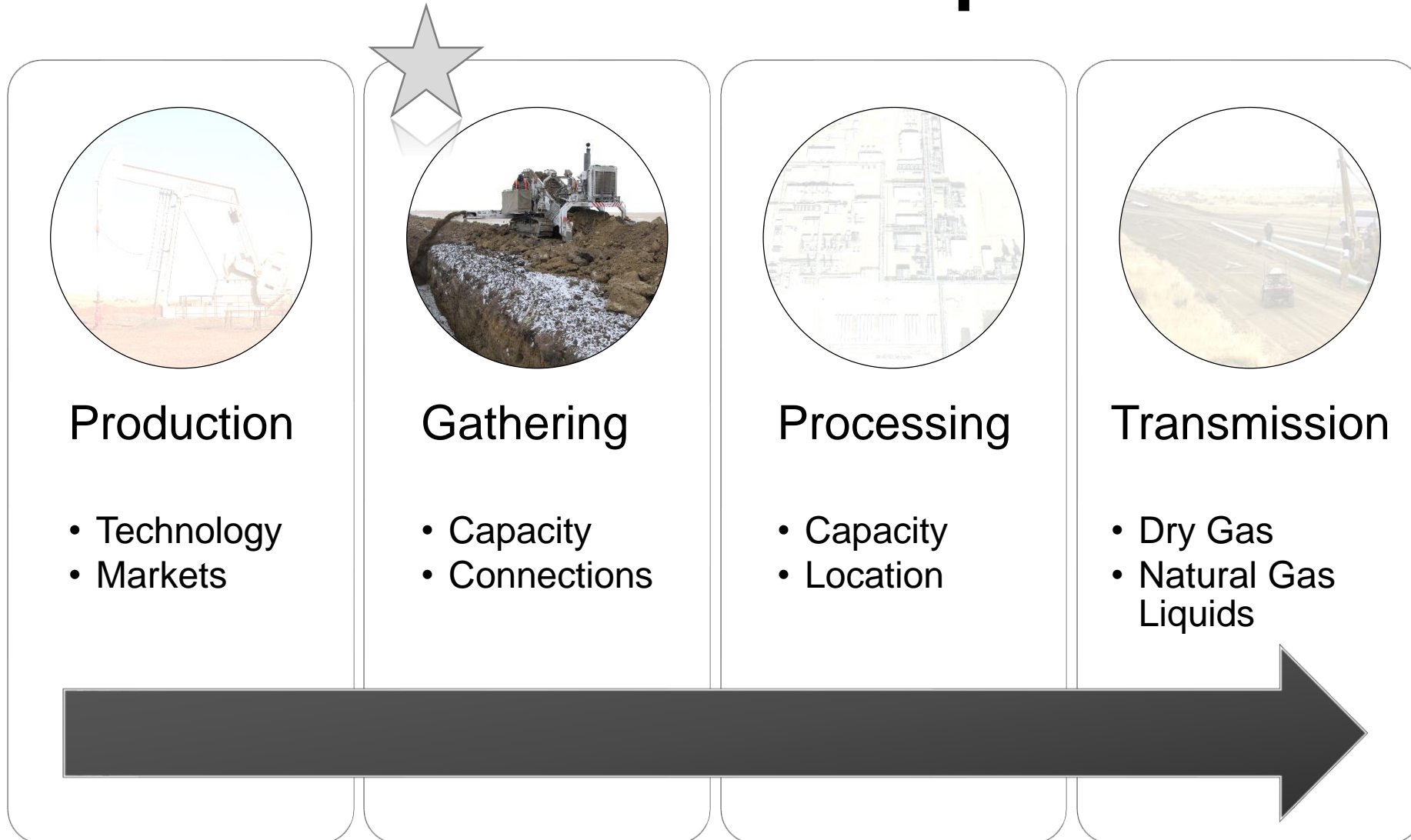
# Statewide Gas Performance



# NDPA North Dakota Gas Production Forecast

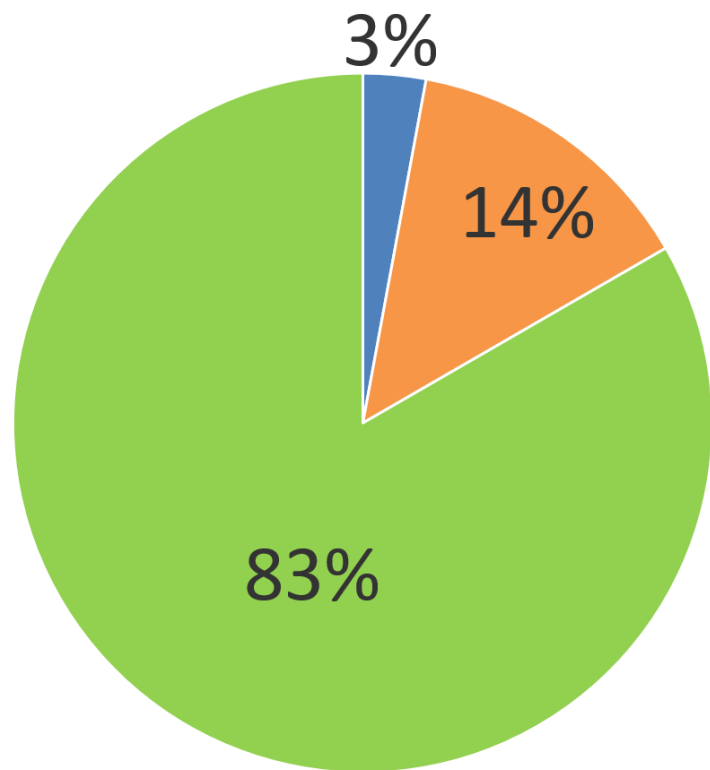


# Natural Gas Update





# 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.

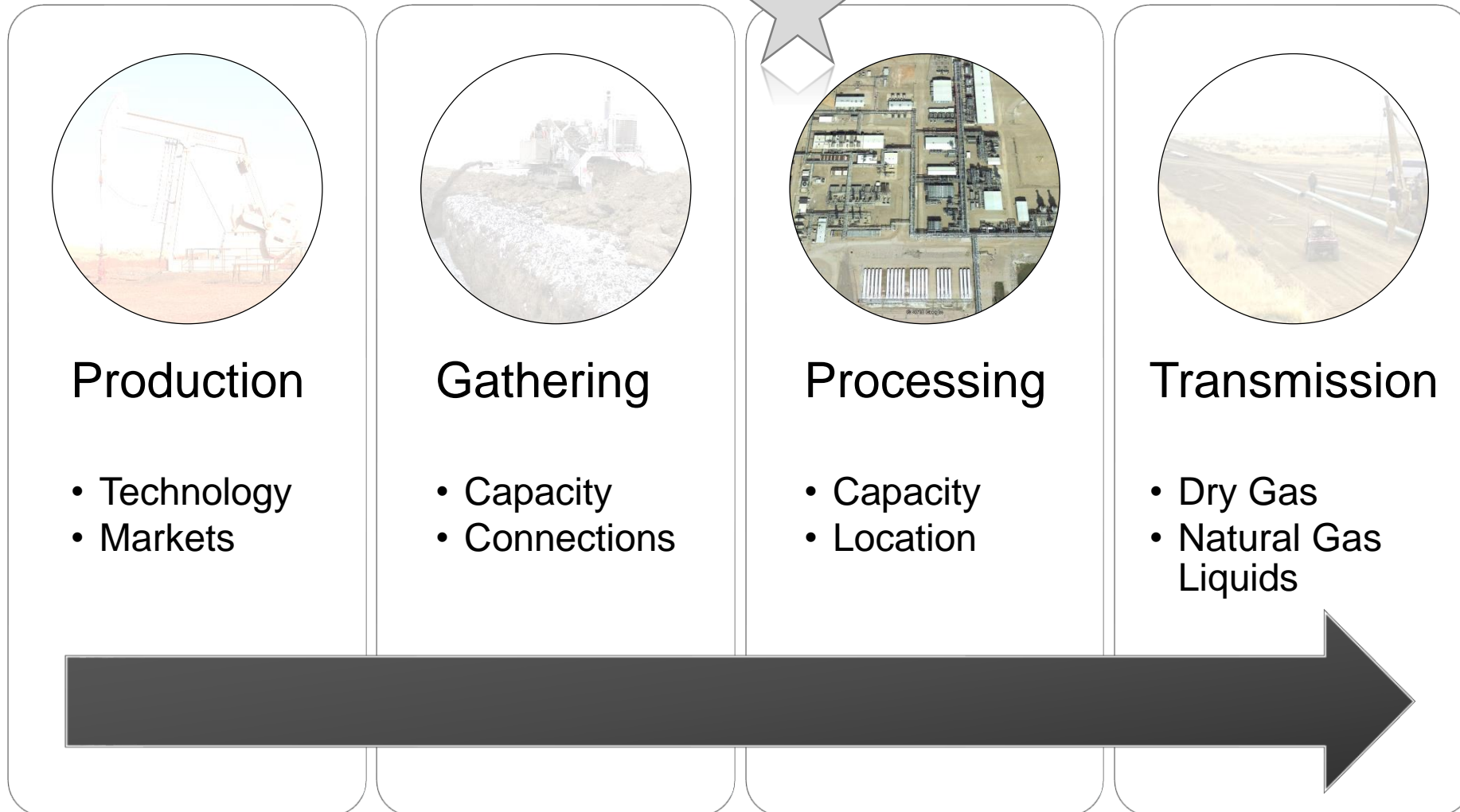
## Simple Terms

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

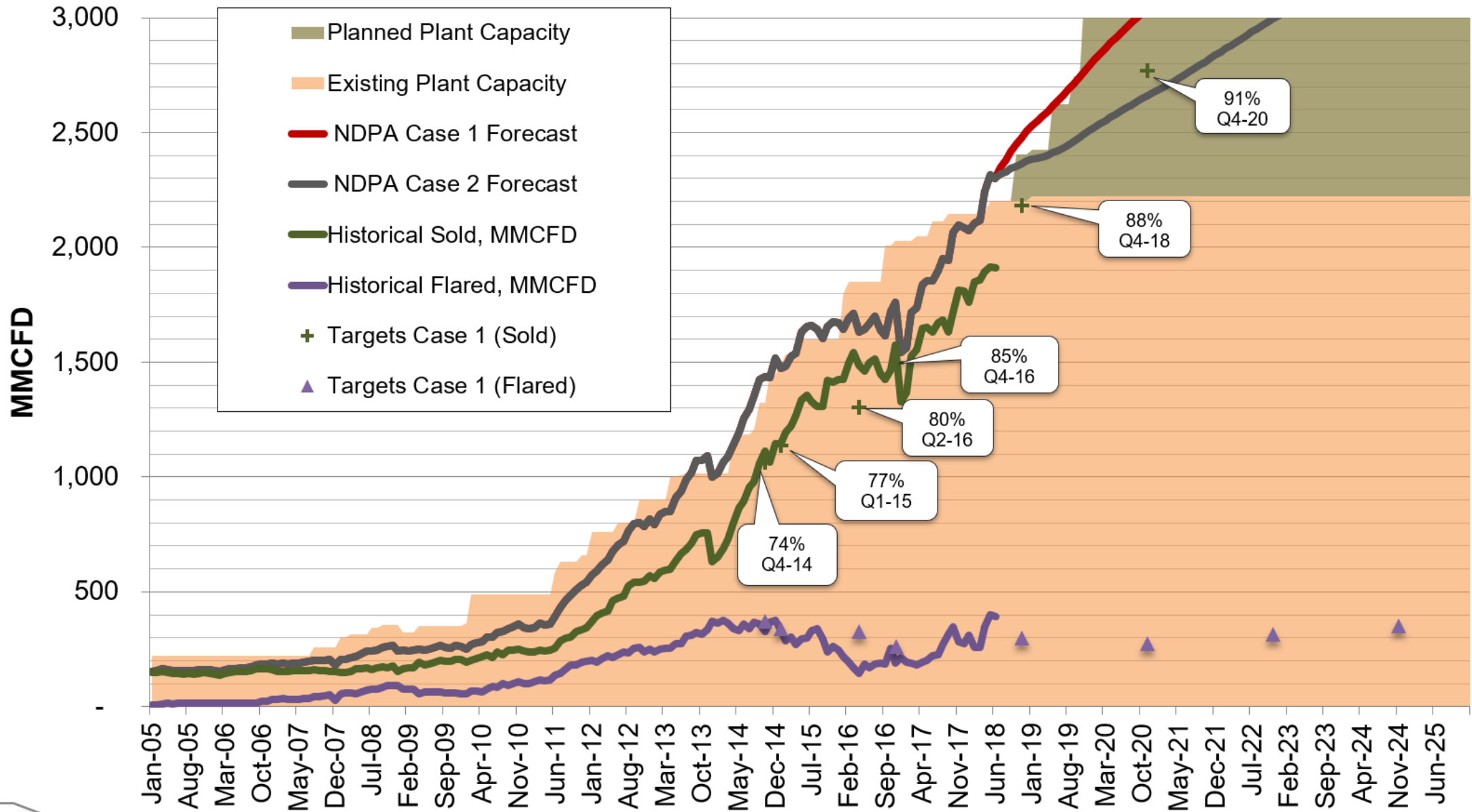
June 2018 Data – Non-Confidential Wells



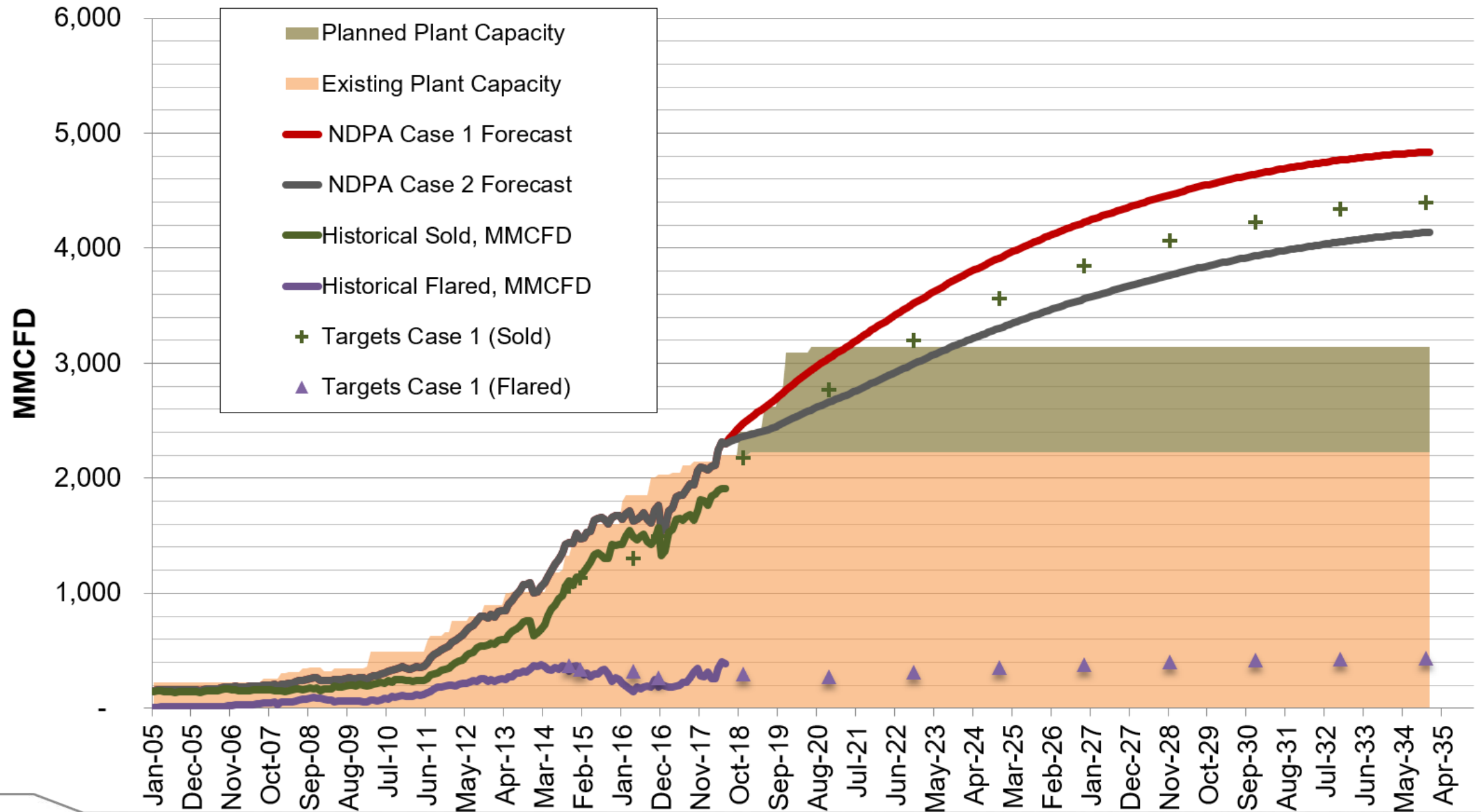
# Natural Gas Update



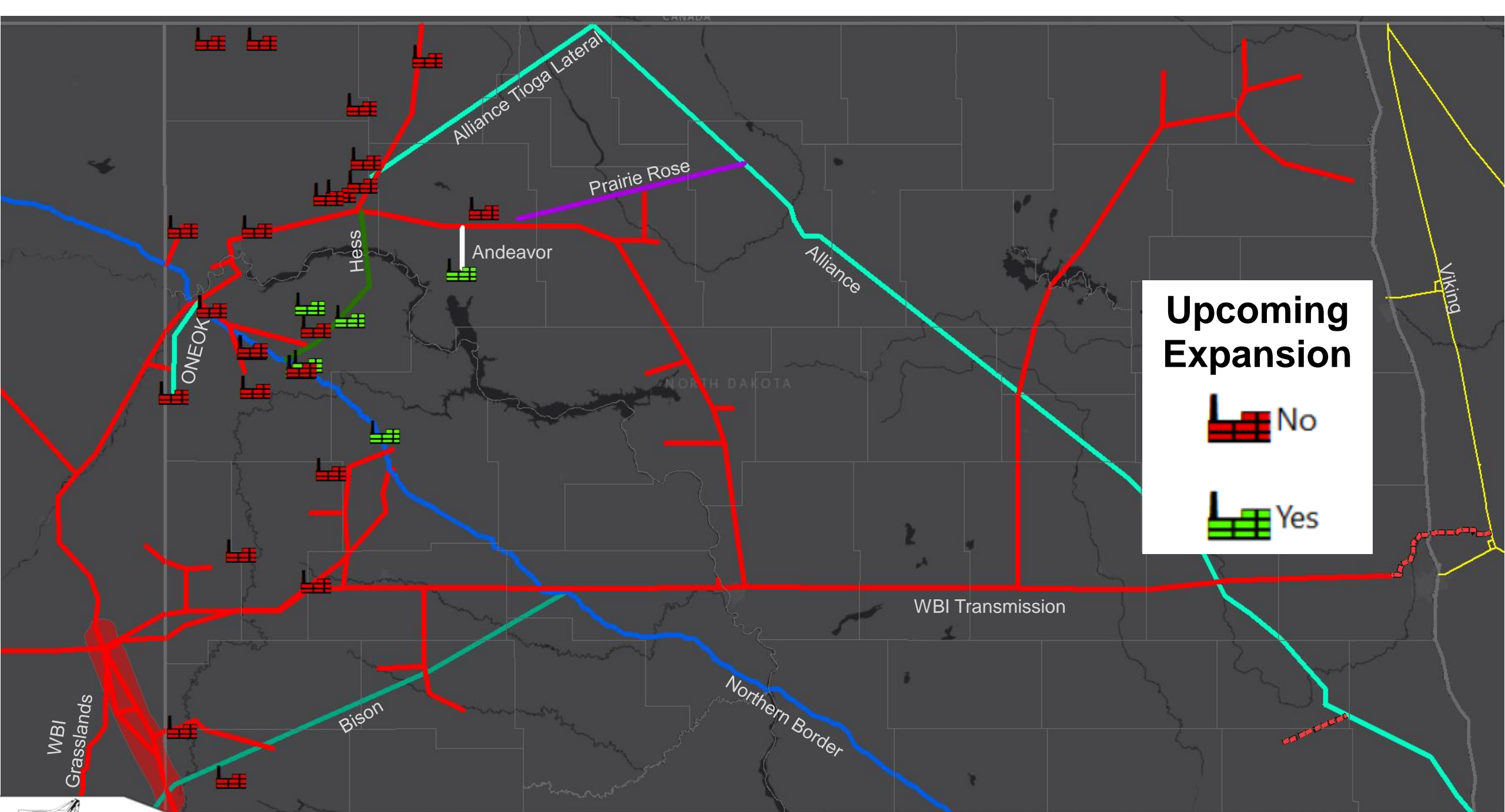
# Solving the Flaring Challenge




# Solving the Flaring Challenge

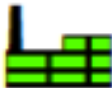




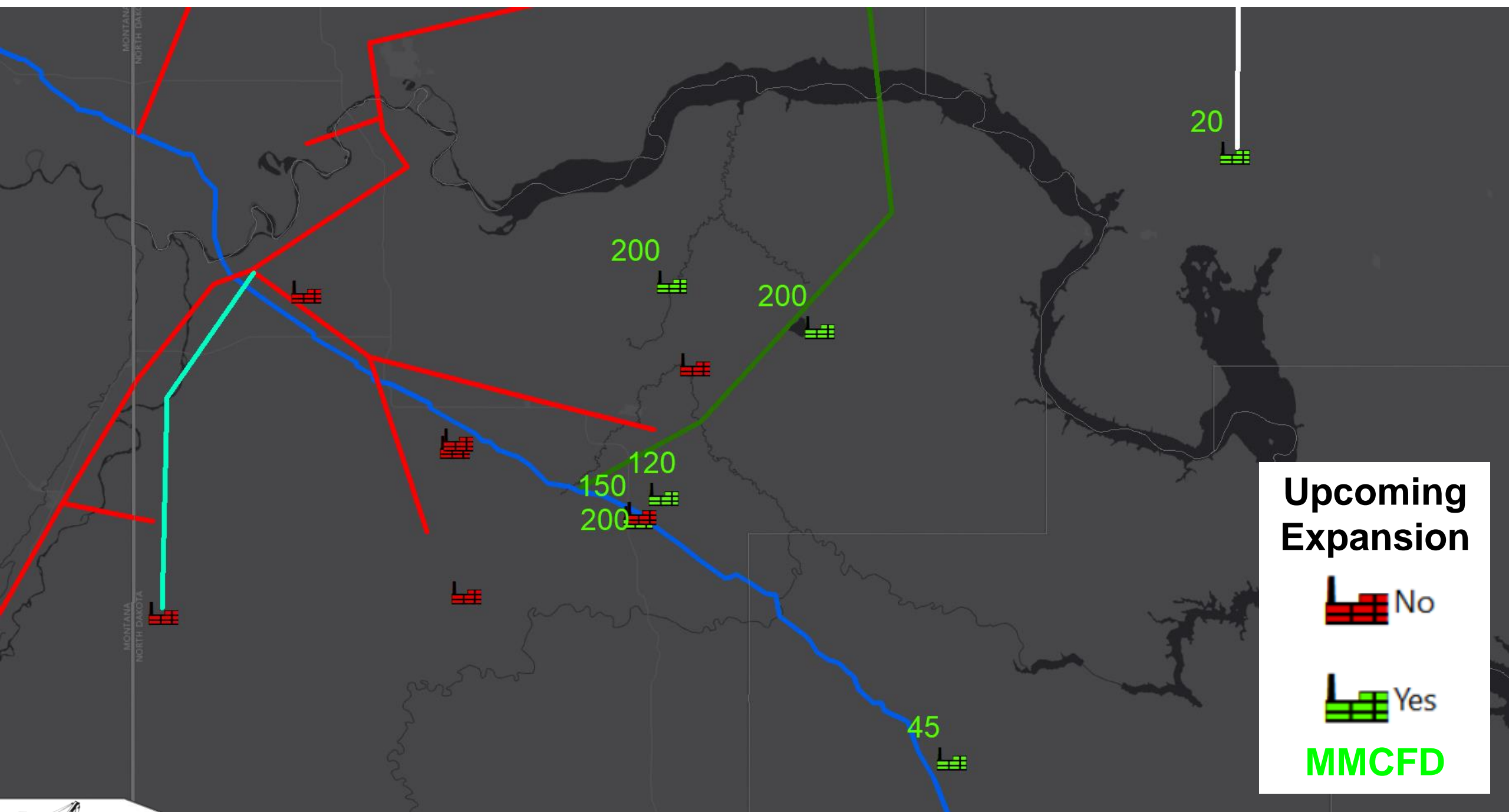


**Upcoming Expansion**

 No

 Yes





## Upcoming Expansion



**MMCFD**

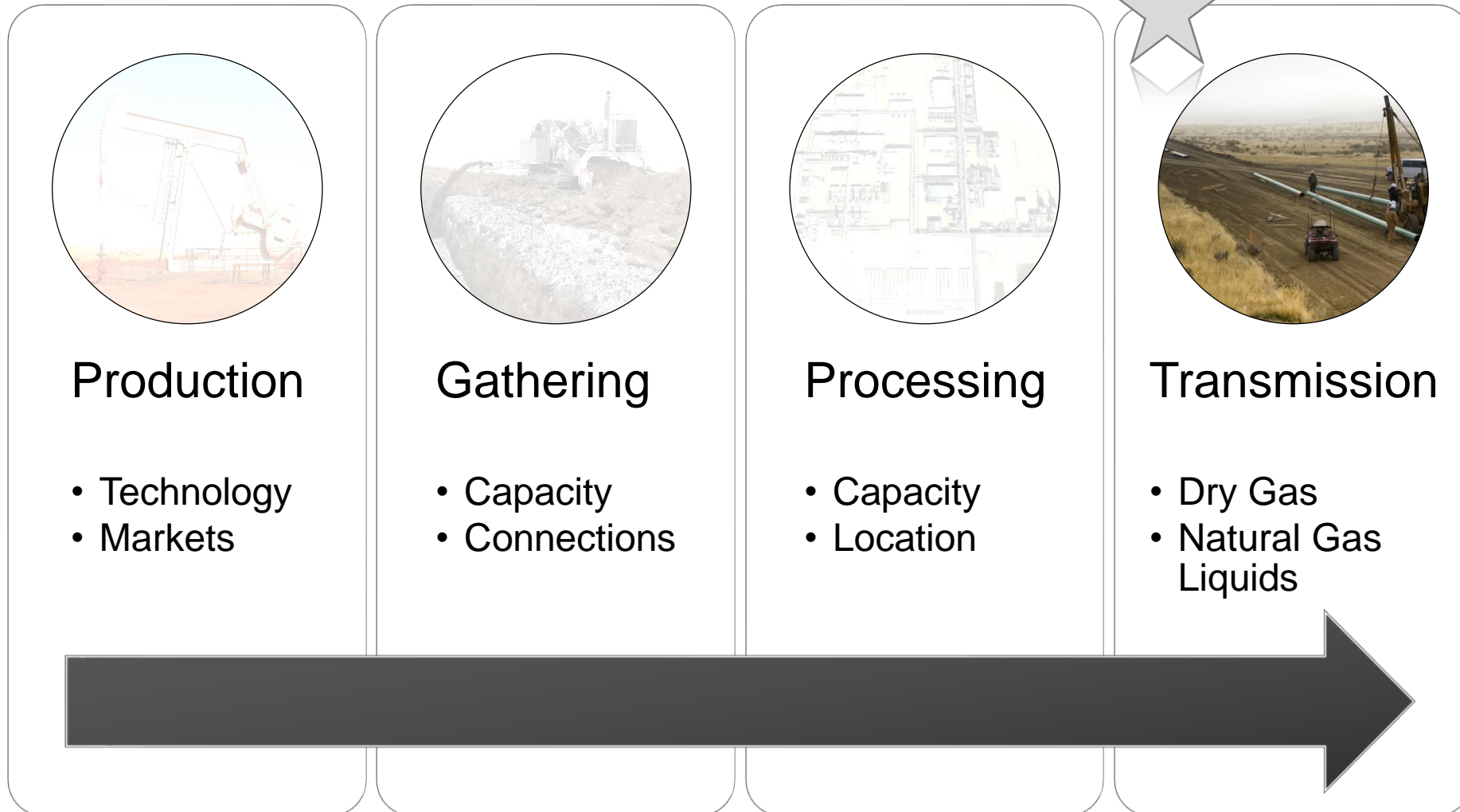


# Natural Gas Processing Capacity, Million Cubic Feet Per Day

Owner Company	Facility	County	2006	2008	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>North Dakota</b>															
ONEOK	Lignite	Burke	6	6	6	6	6	6	6	6	6	6	6	6	6
ONEOK	Marmath	Slope	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
ONEOK	Grasslands	McKenzie	63	90	90	90	90	90	90	90	90	90	90	90	90
ONEOK	Stateline I	Williams	NA	NA	NA	NA	100	100	100	100	100	120	120	120	120
ONEOK	Stateline II	Williams	NA	NA	NA	NA	NA	100	100	120	120	120	120	120	120
ONEOK	Garden Creek I	McKenzie	NA	NA	NA	NA	100	100	120	120	120	120	120	120	120
ONEOK	Garden Creek II	McKenzie	NA	NA	NA	NA	NA	NA	120	120	120	120	120	120	120
ONEOK	Garden Creek III	McKenzie	NA	NA	NA	NA	NA	NA	120	120	120	120	120	120	120
ONEOK	Lonesome Creek	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	200	200	200	200	200
<b>ONEOK</b>	<b>Demicks Lake</b>	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<b>200</b>	<b>200</b>
<b>ONEOK</b>	<b>Bear Creek</b>	Dunn	NA	NA	NA	NA	NA	NA	NA	NA	80	80	<b>130</b>	<b>130</b>	<b>175</b>
Petro Hunt	Little Knife	Billings	27	27	27	27	27	27	27	27	27	27	27	27	27
True Oil	Red Wing Creek	McKenzie	4	4	4	4	4	10	10	10	10	10	10	10	10
Sterling Energy	Ambrose	Divide	0.5	0.5	0.5	0.5	0.5	0.5	NA	NA	NA	NA	NA	NA	NA
EOG Resources	Stanley	Mountrail	NA	20	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*
Whiting Oil & Gas	Ray	Williams	NA	10	NA	NA	NA	NA	NA	10	10	10	10	10	10
<b>Andeavor</b>	<b>Robinson Lake</b>	Mountrail	NA	30	45	90	90	90	110	130	130	130	130	<b>150</b>	<b>150</b>
Andeavor	Belfield	Stark	NA	NA	NA	30	30	35	35	35	35	35	35	35	35
XTO - Nesson	Ray	Williams	NA	10	10	10	10	10	10	25	25	25	25	25	25
Hess	Tioga	Williams	110	110	110	110	110	110	250	250	250	250	250	250	250
<b>Targa/Hess JV</b>	<b>LM4</b>	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<b>200</b>	<b>200</b>
Kinder Morgan	Badlands	Bowman	4	40	40	40	40	40	40	40	40	40	40	40	40
Kinder Morgan	Norse	Divide	NA	NA	25	25	25	25	25	25	25	25	25	25	25
Kinder Morgan	Watford City	McKenzie	NA	NA	NA	50	90	90	90	90	90	90	90	90	90
<b>Kinder Morgan</b>	<b>Roosevelt</b>	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	50	50	50	<b>200</b>	<b>200</b>
Liberty Midstream Solutions	County Line	Williams	NA	NA	NA	NA	NA	NA	NA	NA	20	20	30	30	30
Summit Resources	Knutson	Billings	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**	NA**
Targa Resources	Badlands	McKenzie	NA	NA	NA	45	45	45	45	90	90	90	90	90	90
USG Midstream Bakken	DeWitt	Divide	NA	NA	NA	NA	NA	3	3	3	3	3	3	3	3
1804 Ltd	Spring Brook	Williams	NA	NA	NA	NA	NA	NA	NA	45	45	45	45	45	45
<b>Oasis</b>	<b>Wild Basin</b>	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	80	145	<b>345</b>	<b>345</b>	<b>345</b>
<b>Arrow Field Services</b>	<b>Arrow</b>	McKenzie	NA	NA	NA	NA	NA	NA	NA	NA	NA	30	30	<b>150</b>	<b>150</b>
Caliber Midstream	Hay Butte	McKenzie	NA	NA	NA	NA	NA	NA	10	10	10	10	10	10	10
<b>Aux Sable - Chicago, IL</b>															
Aux Sable	Prairie Rose	Mountrail	NA	NA	126	126	126	126	126	126	126	126	126	126	126
<b>Total, MMCFD</b>			<b>222.0</b>	<b>355.0</b>	<b>491.0</b>	<b>661.0</b>	<b>901.0</b>	<b>1,015.0</b>	<b>1,444.5</b>	<b>1,599.5</b>	<b>2,029.5</b>	<b>2,144.5</b>	<b>2,404.5</b>	<b>3,094.5</b>	<b>3,139.5</b>

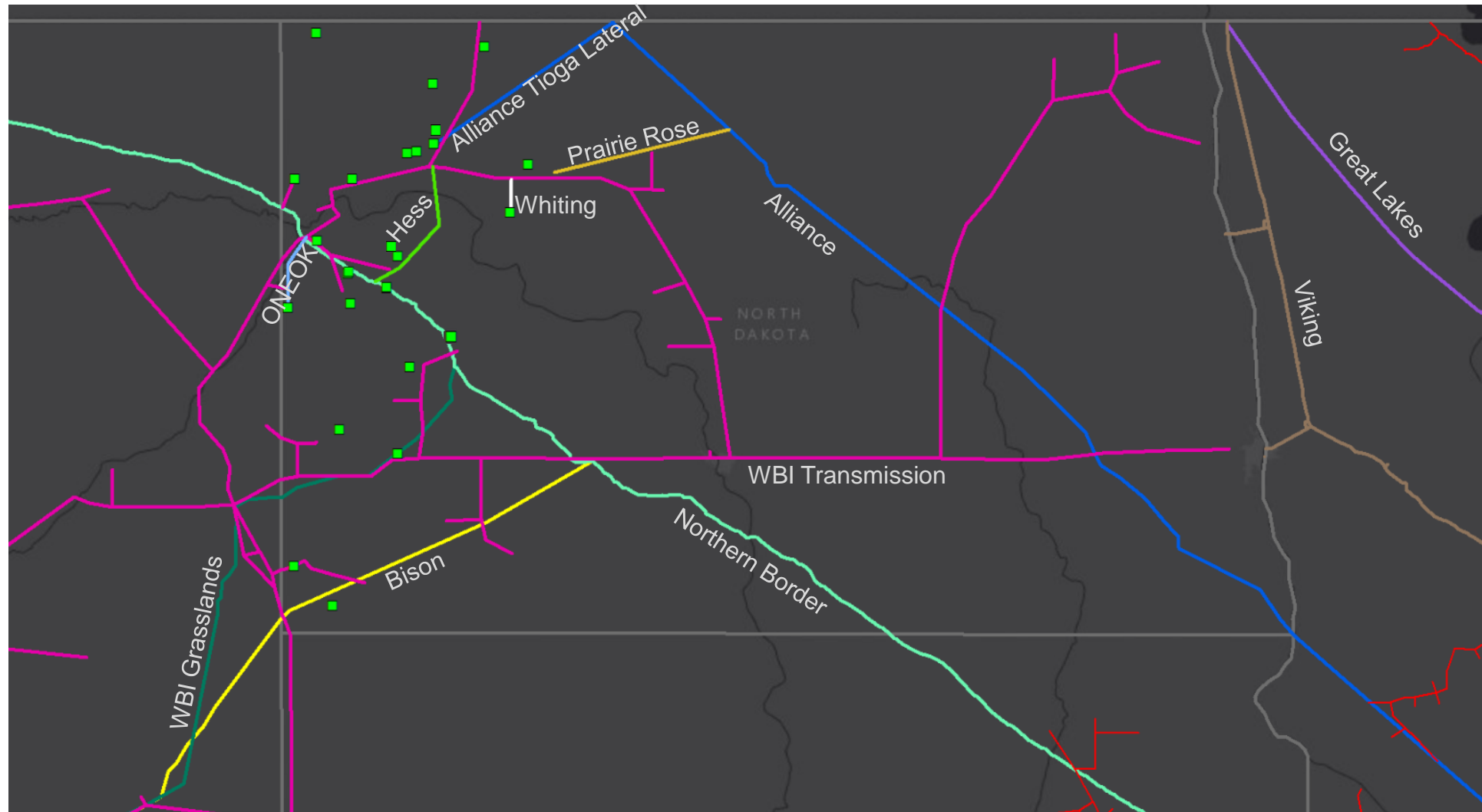


# Natural Gas Update



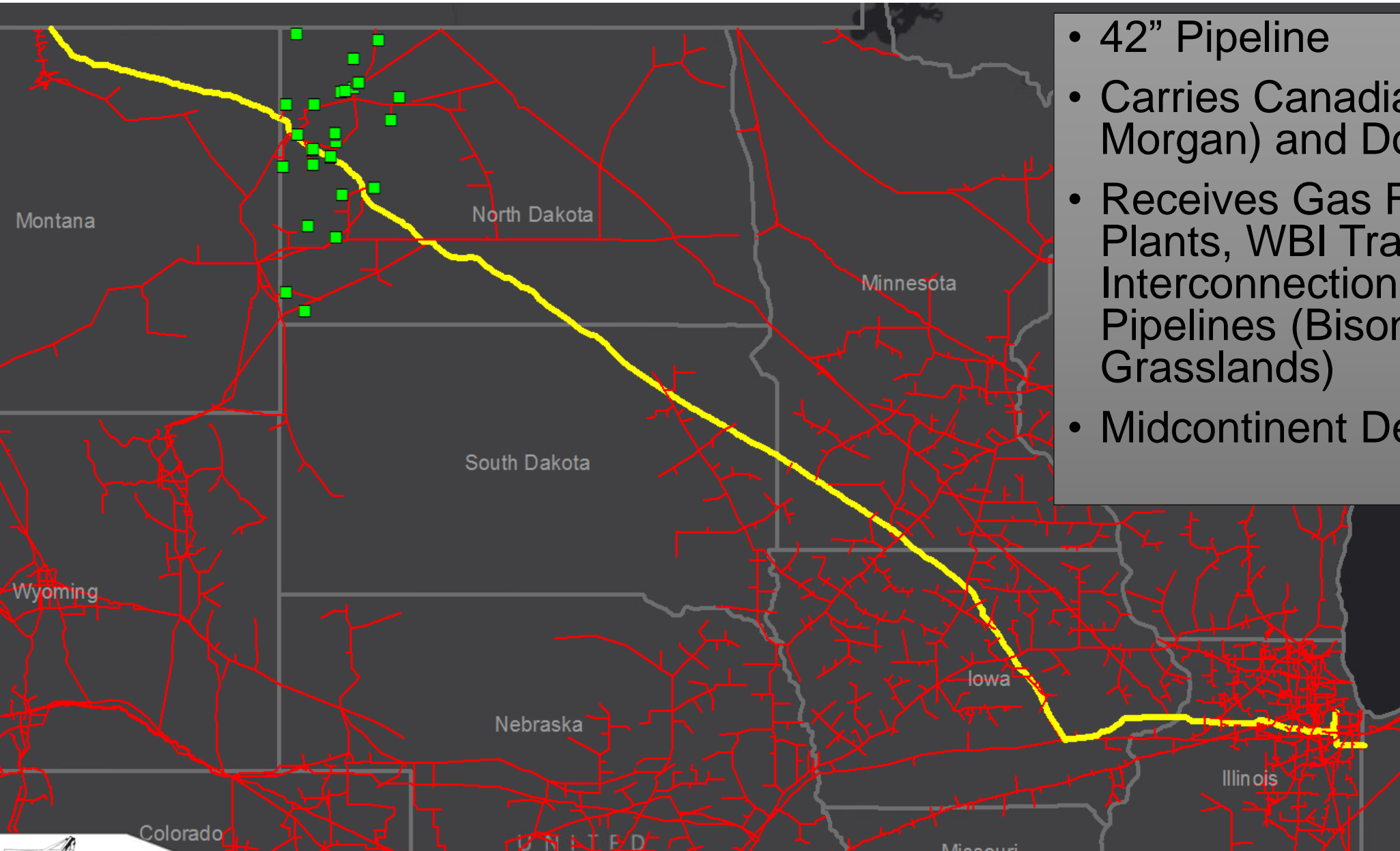


# Major Gas Pipeline and Processing Infrastructure

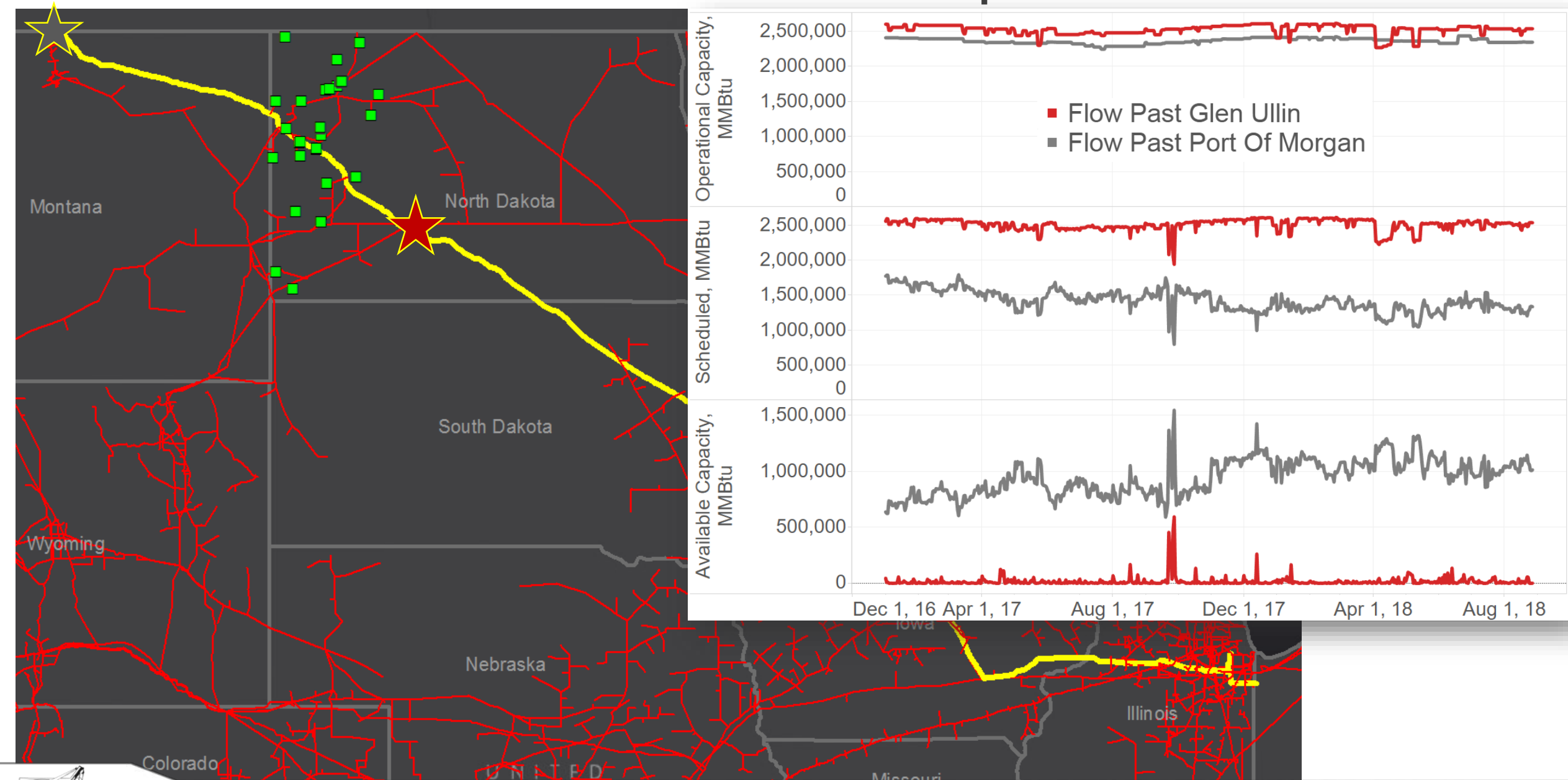


# Northern Border Pipeline

- 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

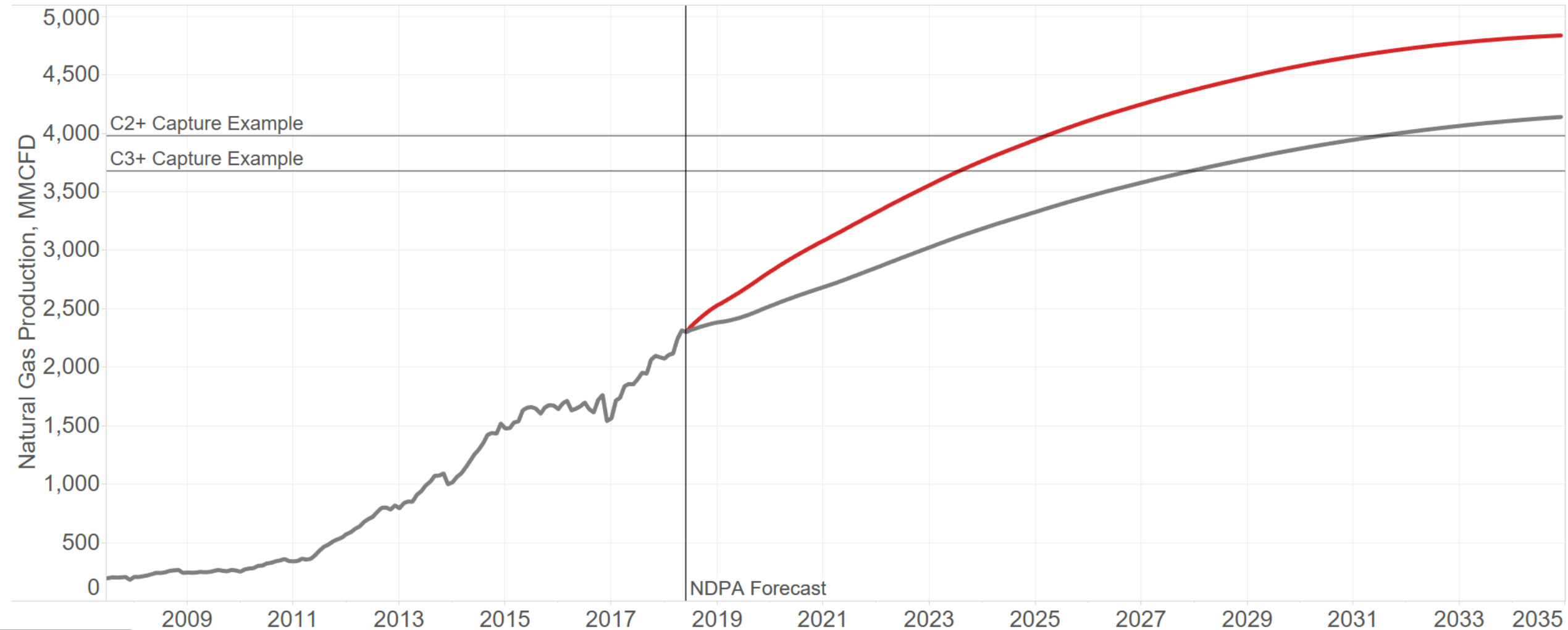


# Northern Border Pipeline

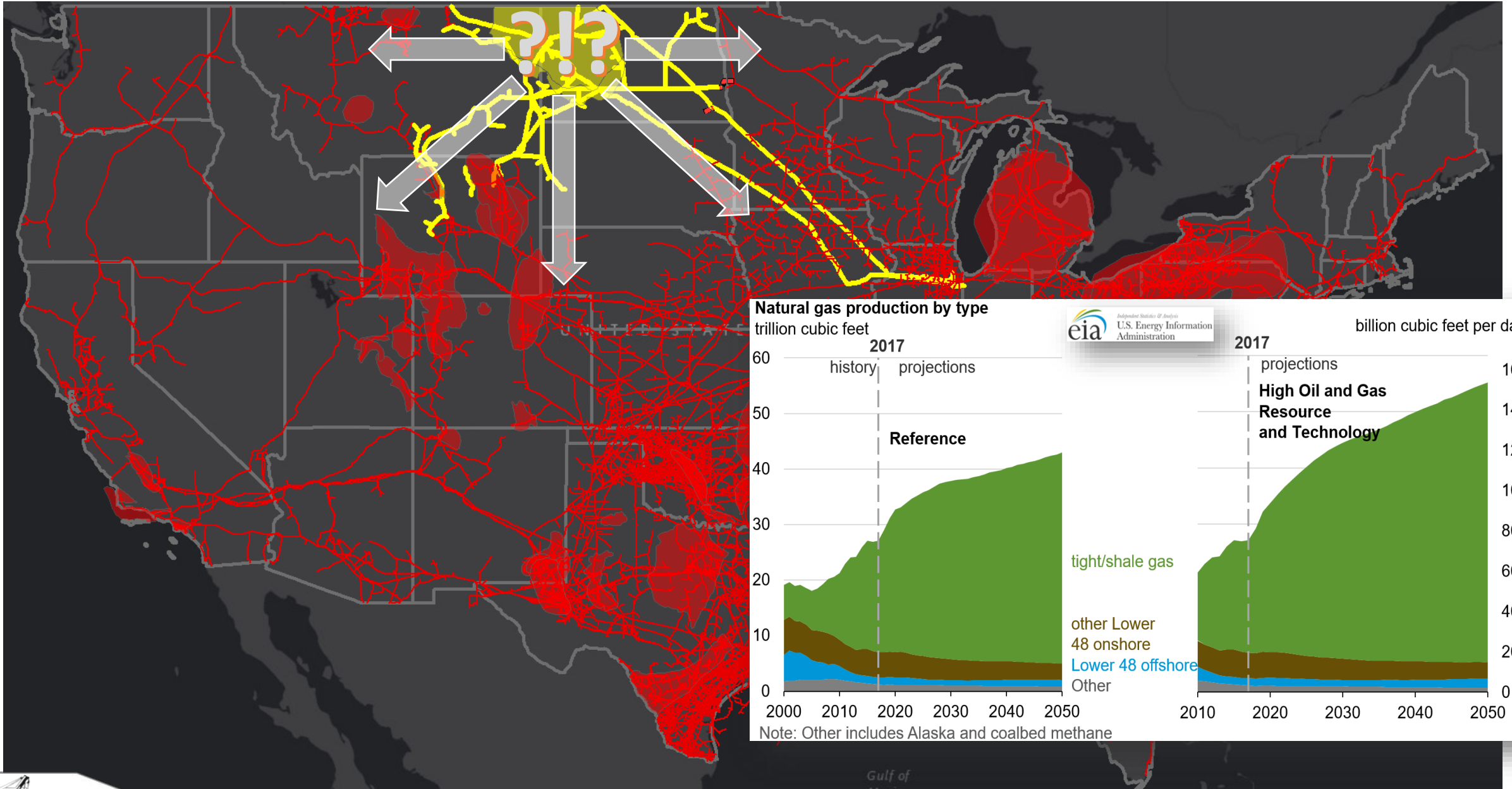


# Simplified Example NB Calculations

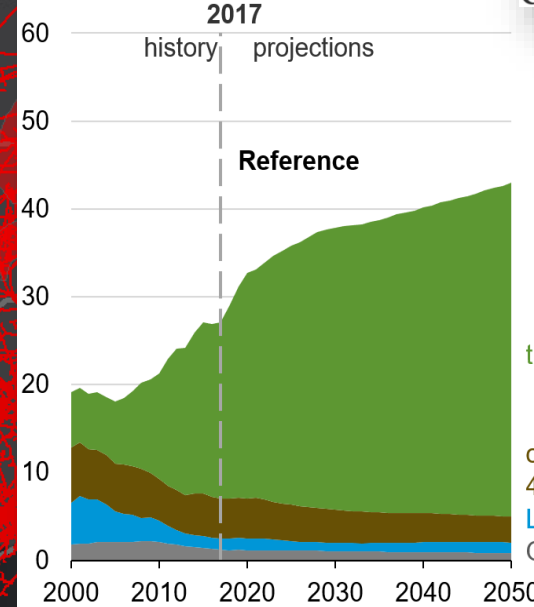
Conclusion: **IF** no other gas export options open and all other deliveries on other pipelines stay static, ND gas production could increase 1.38-1.68 BCFD (from June-18) before Northern Border is 100% Bakken production. **BTU management becomes increasingly important for Bakken residue gas.**



# Now What?



Natural gas production by type  
trillion cubic feet



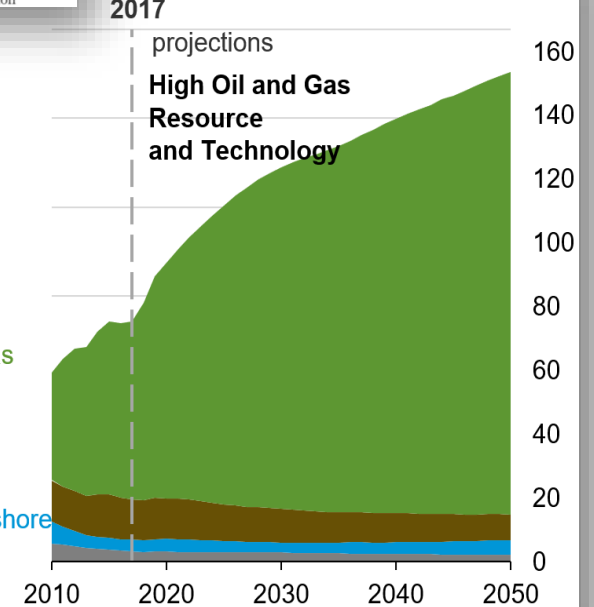
eia  
Independent Statistics & Analysis  
U.S. Energy Information  
Administration

2017

projections

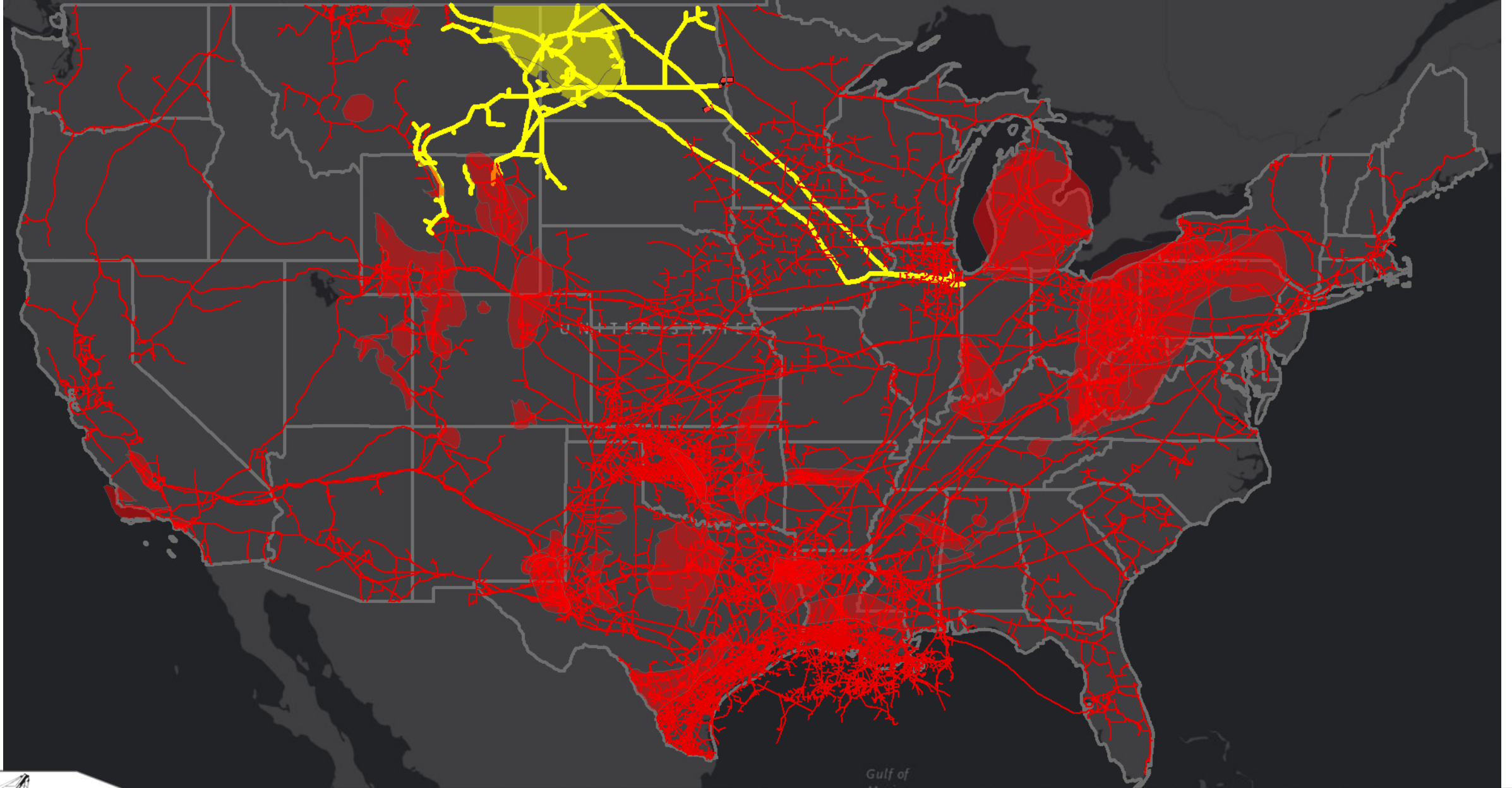
High Oil and Gas  
Resource  
and Technology

billion cubic feet per day

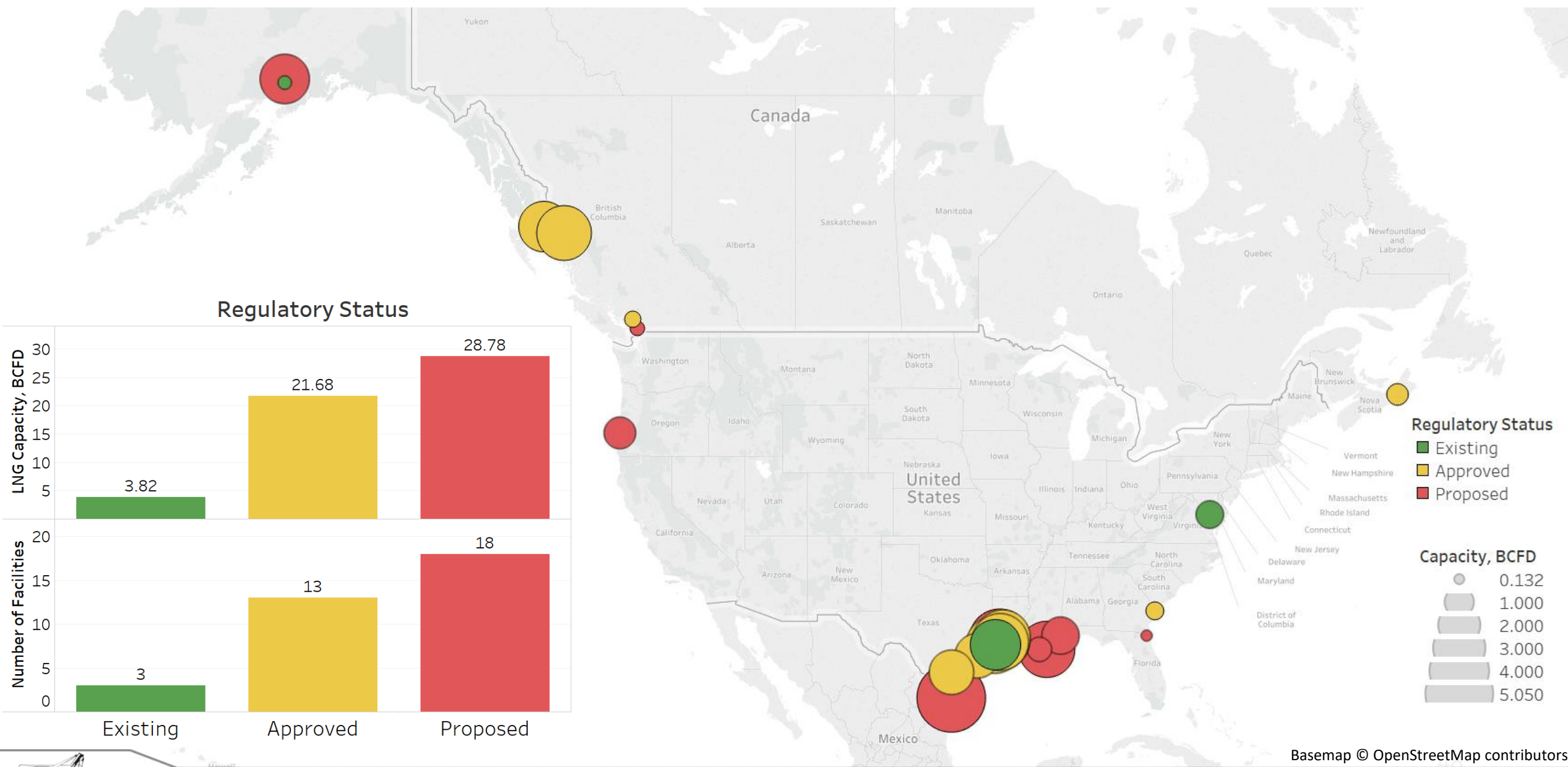




# LNG Exports to Benefit ND by Shifting Gas Flow

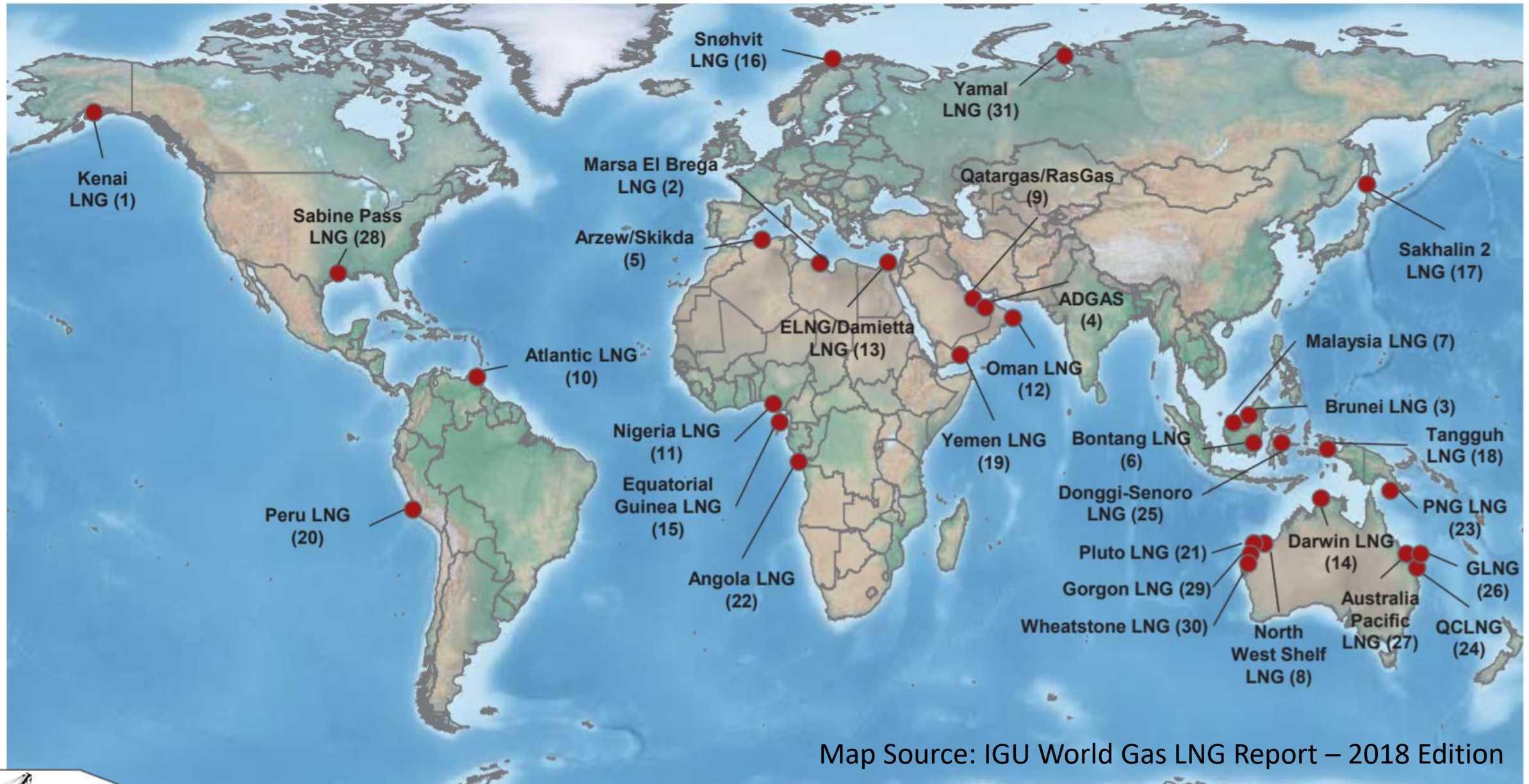


# LNG Exports to Benefit ND by Shifting Gas Flow





# Existing Global LNG Facilities

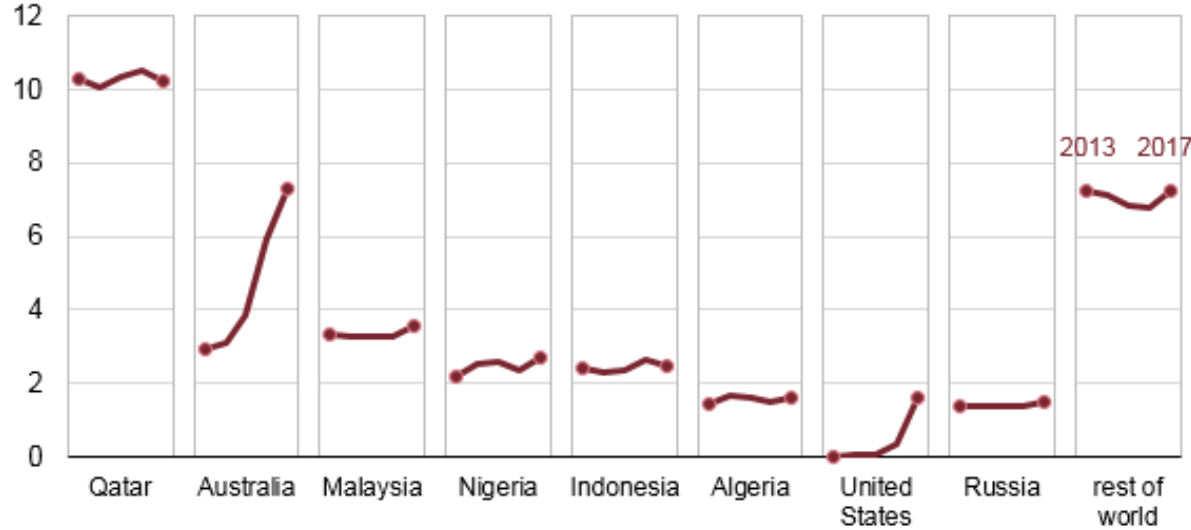


Map Source: IGU World Gas LNG Report – 2018 Edition

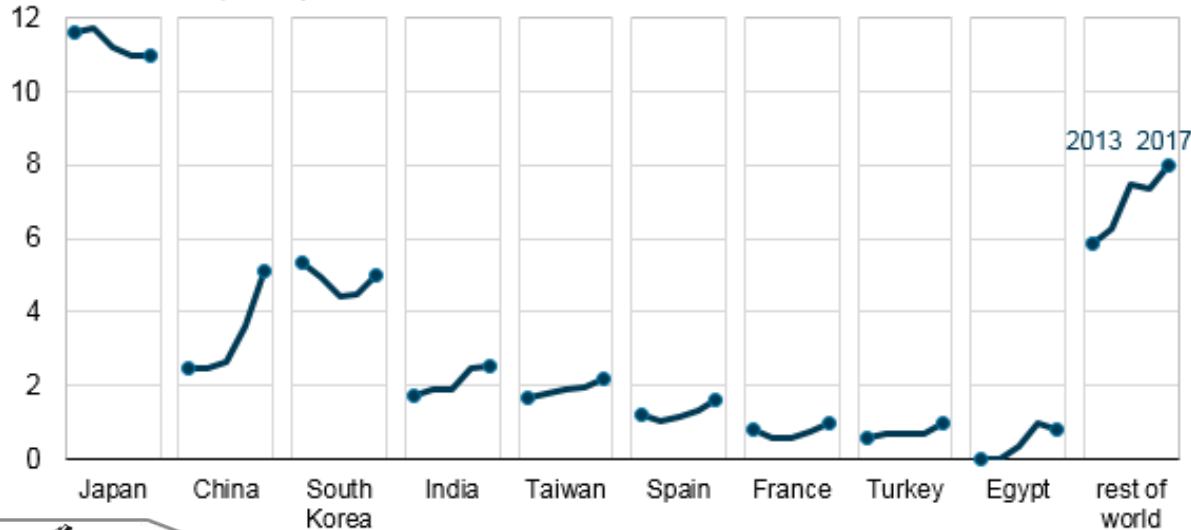


# Global LNG

Liquefied natural gas exports in selected countries (2013-2017)  
billion cubic feet per day



Liquefied natural gas imports in selected countries (2013-2017)  
billion cubic feet per day





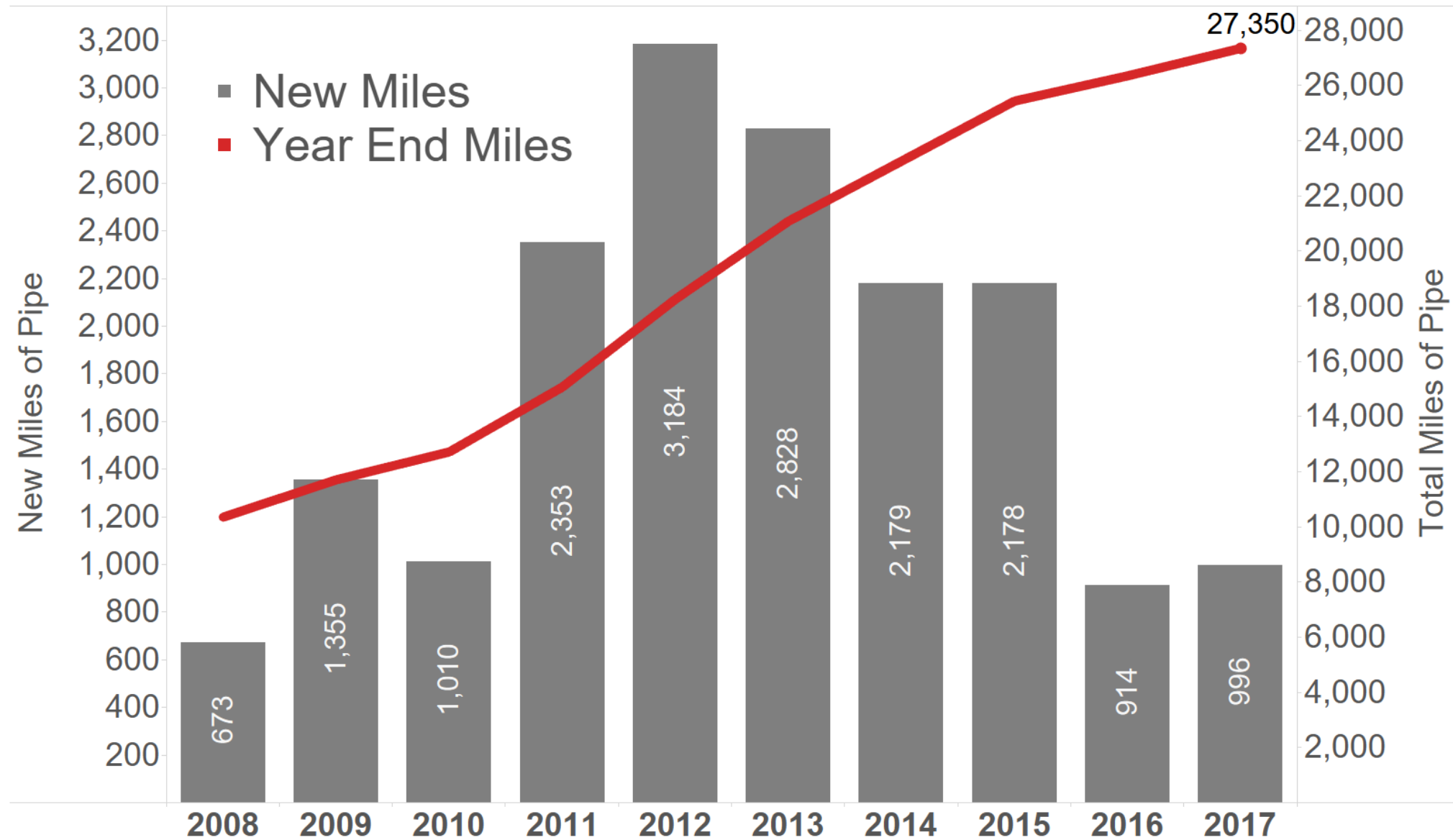
# Presentation Outline

- Economics
- Understanding current and future oil production
  - Pricing update
  - Activity
  - Oil forecasts
- North Dakota natural gas production
  - Flaring and gas capture
  - Interstate Transmission
- **Pipeline construction update**





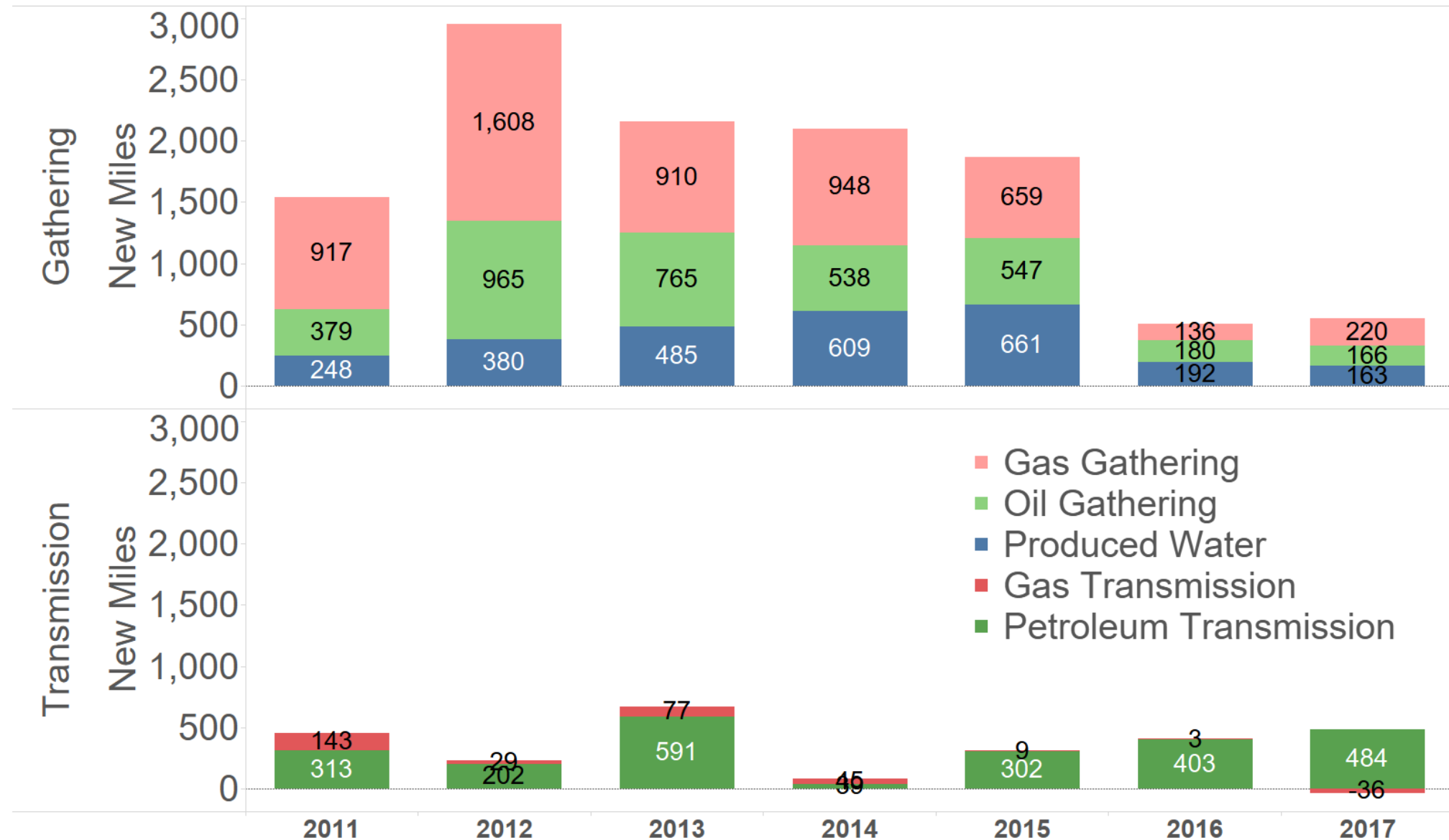
# North Dakota Pipeline Construction



Sources: NDIC & PHMSA



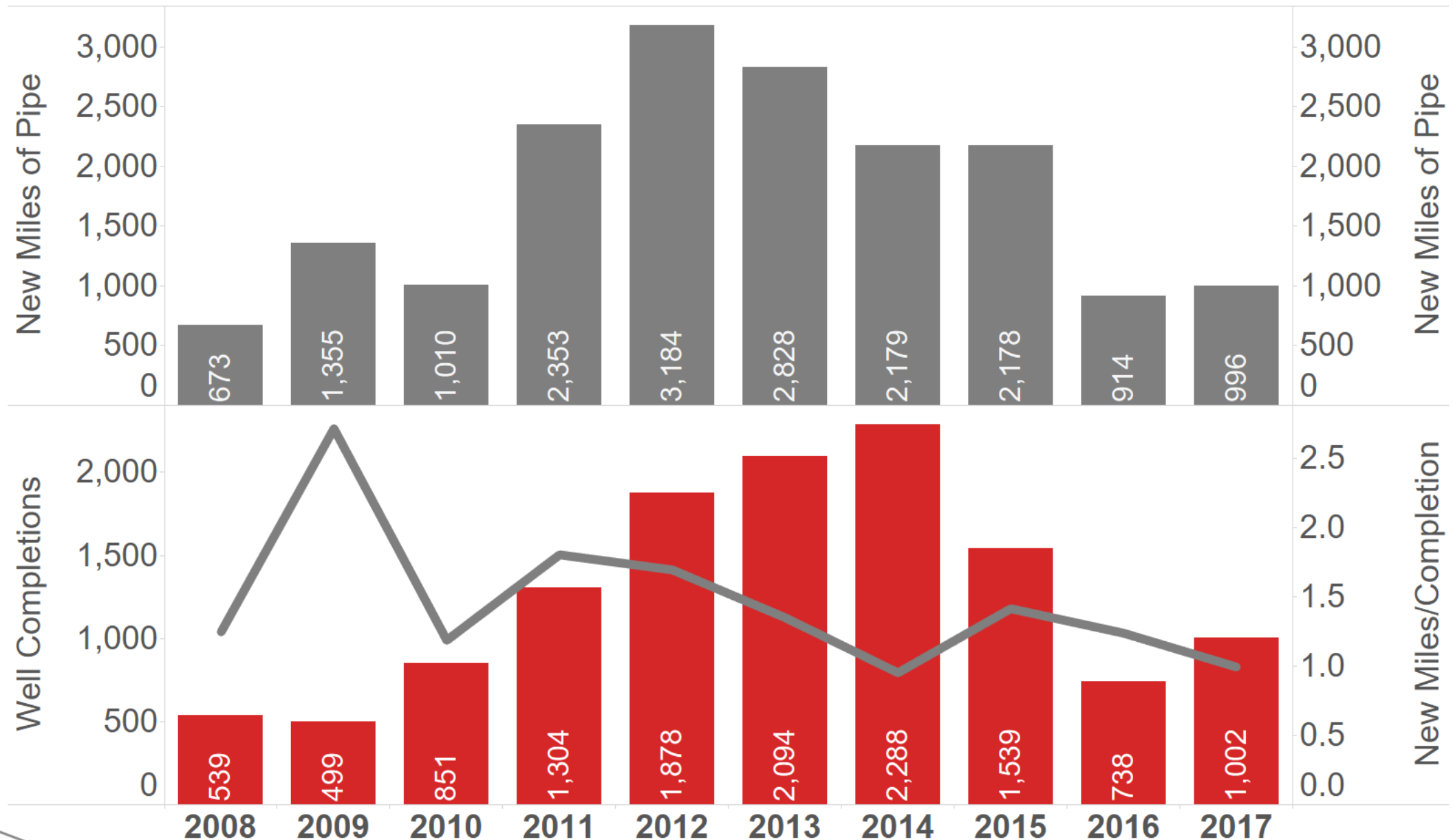
# North Dakota Pipeline Construction



Sources: NDIC & PHMSA



# New Miles and Well Completions



# Contact Information

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