

North Dakota Natural Gas Update



Justin J Kringstad

Geological Engineer

Director

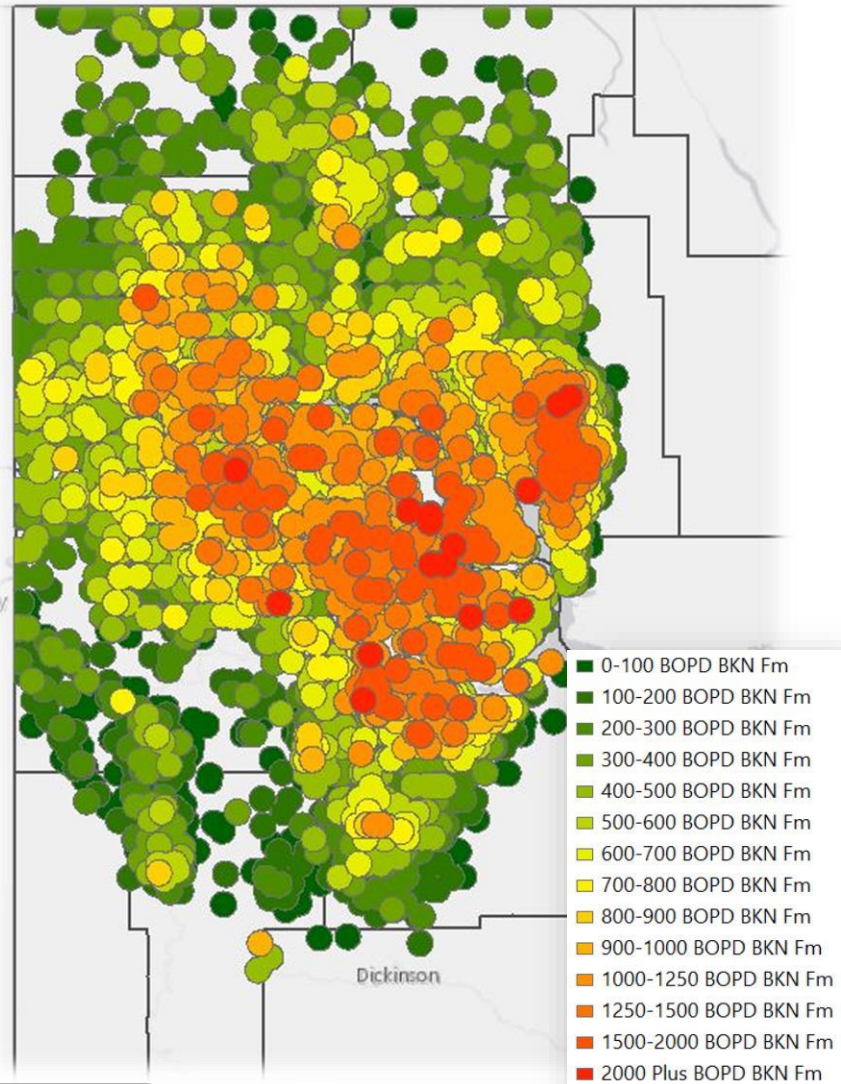
North Dakota Pipeline Authority

July 29, 2021

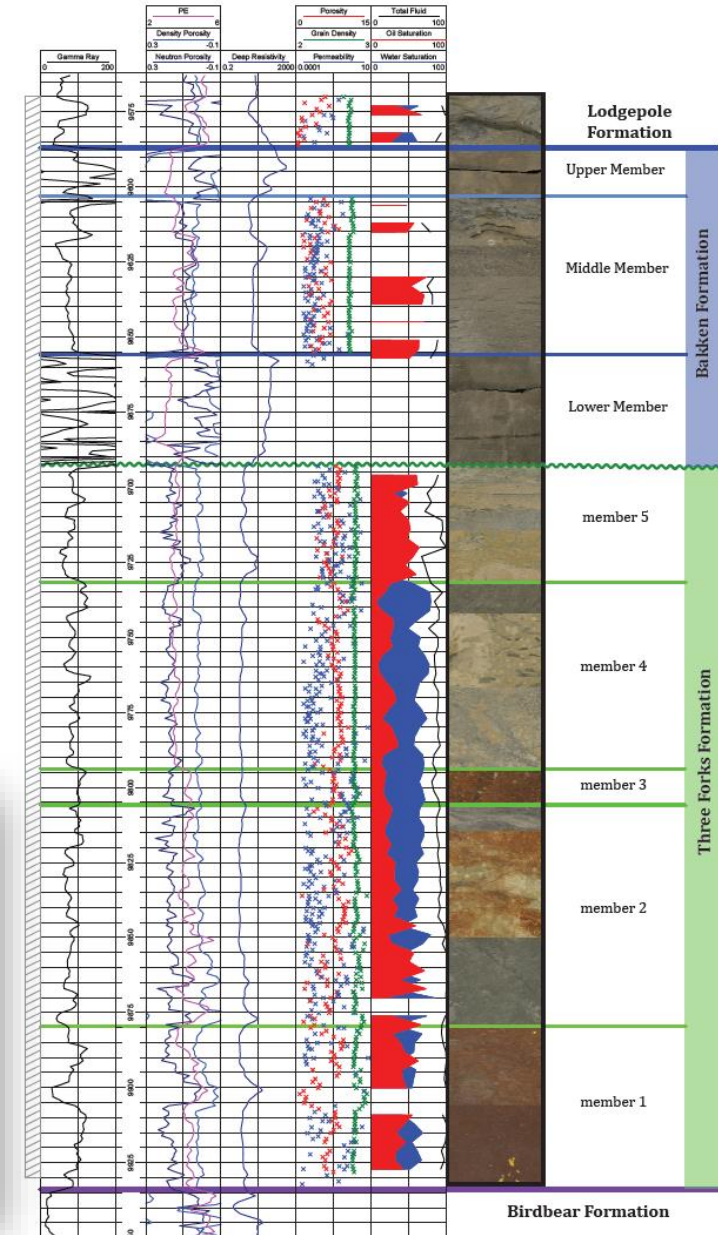
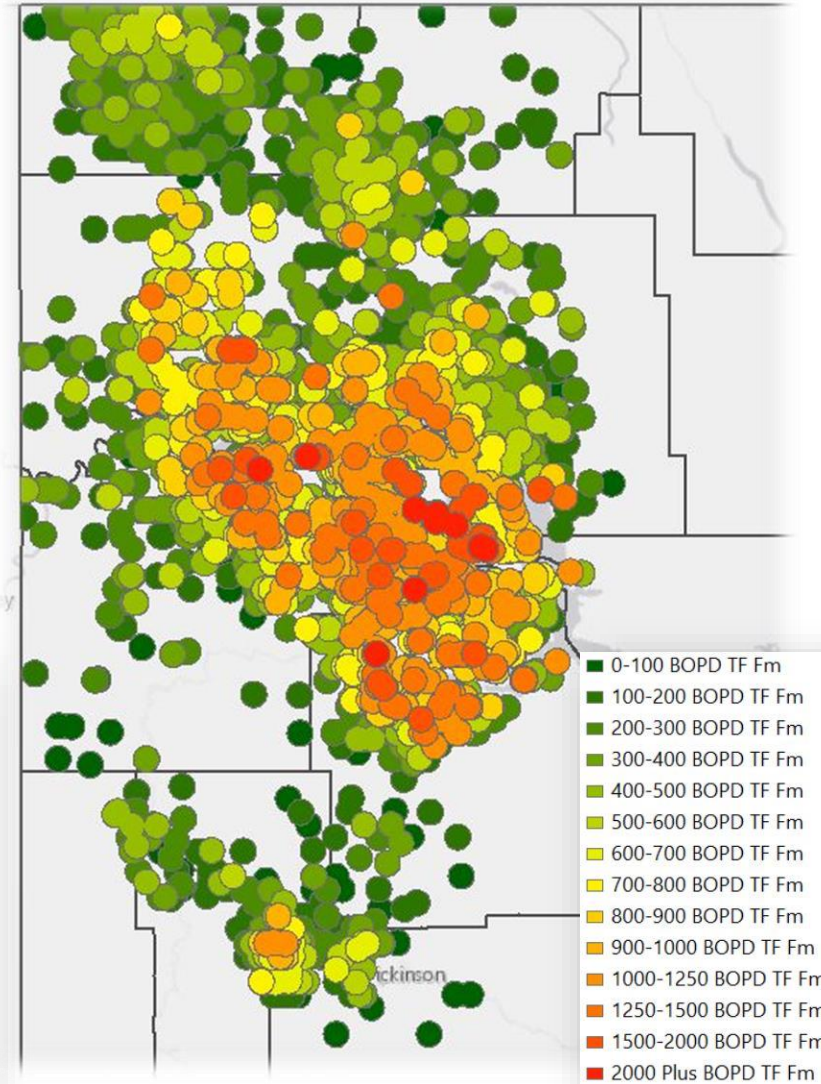


Bakken & Three Forks Formations

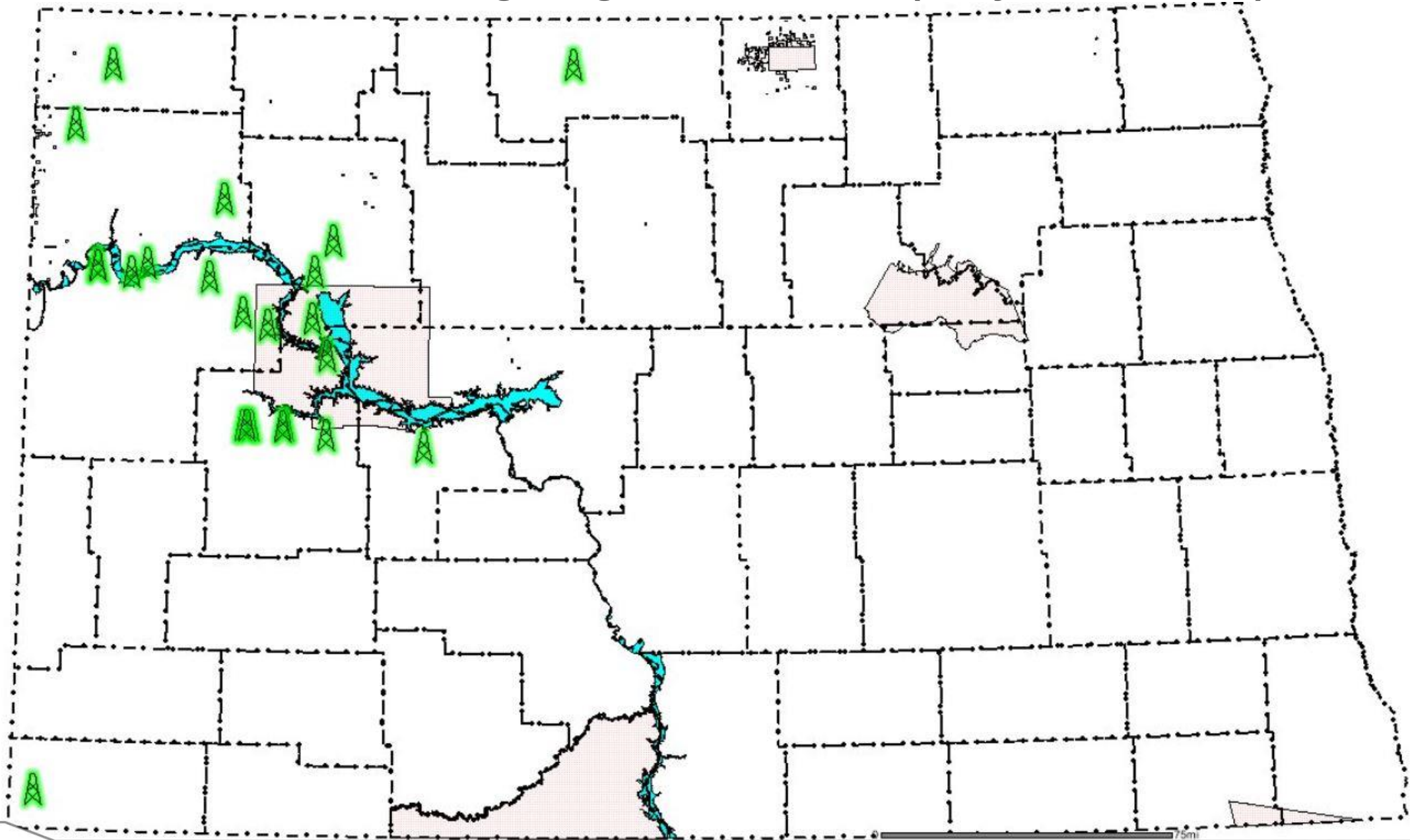
Bakken Formation



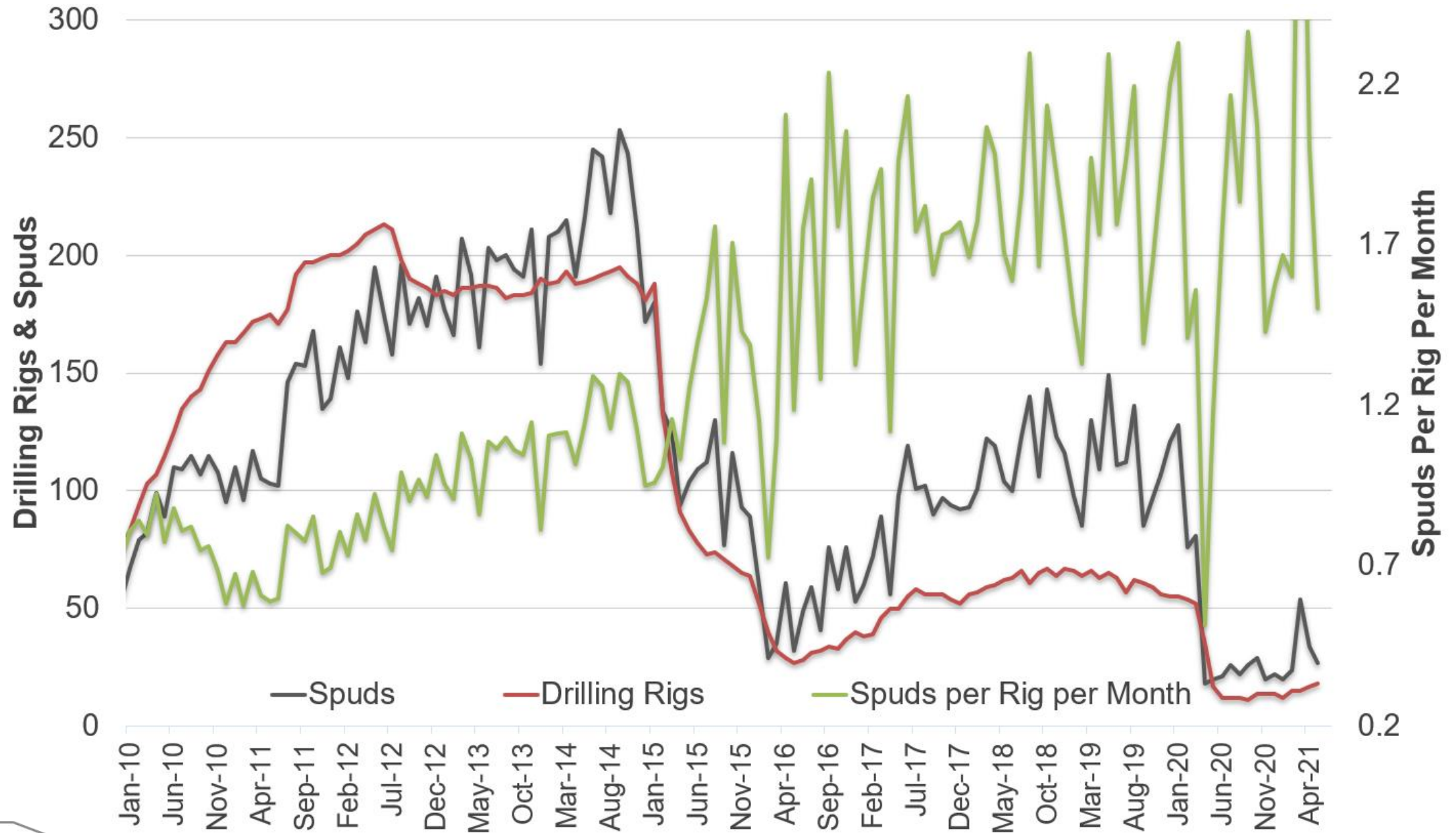
Three Forks Formation



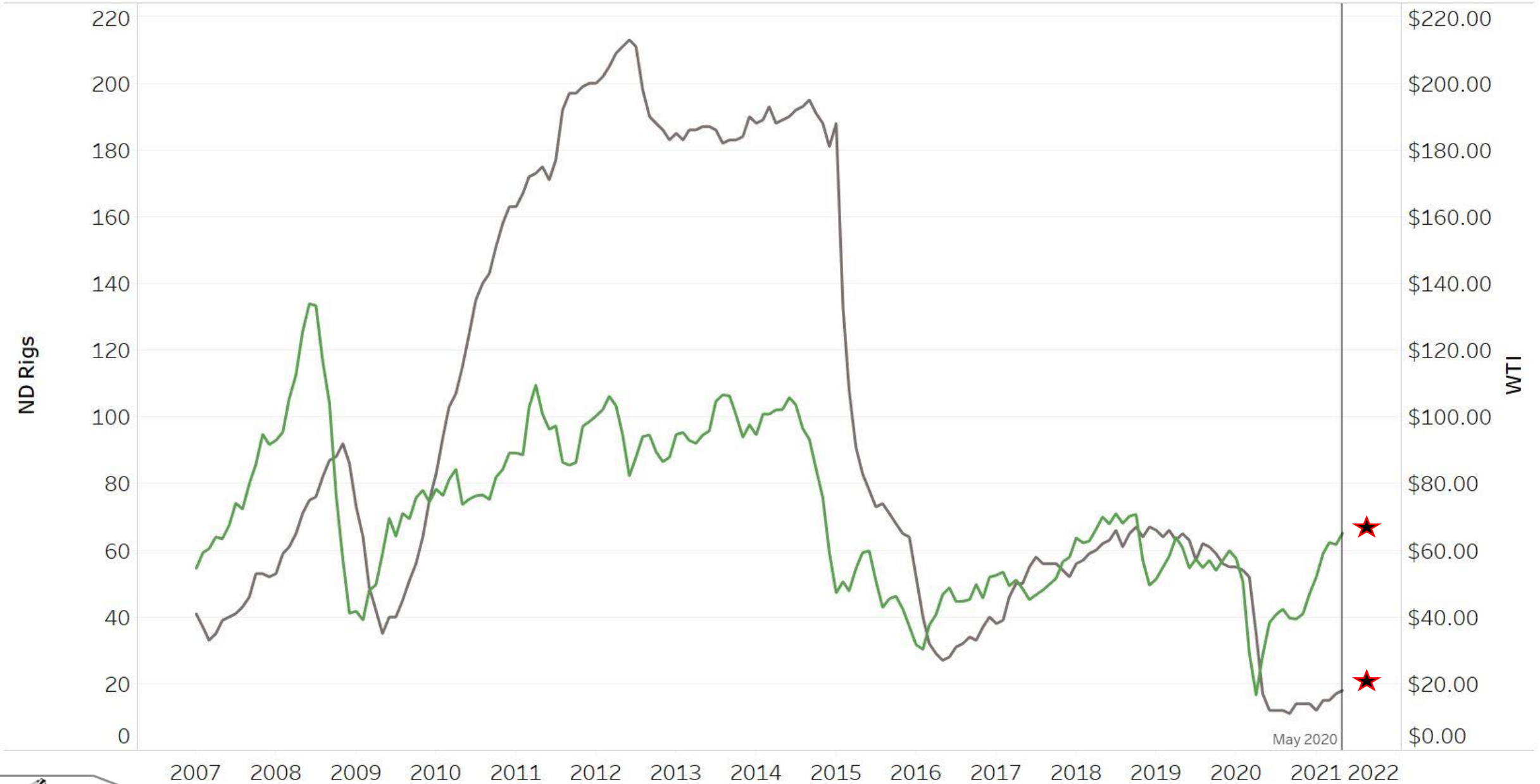
Current Drilling Rig Fleet – 23 (July 29, 2021)



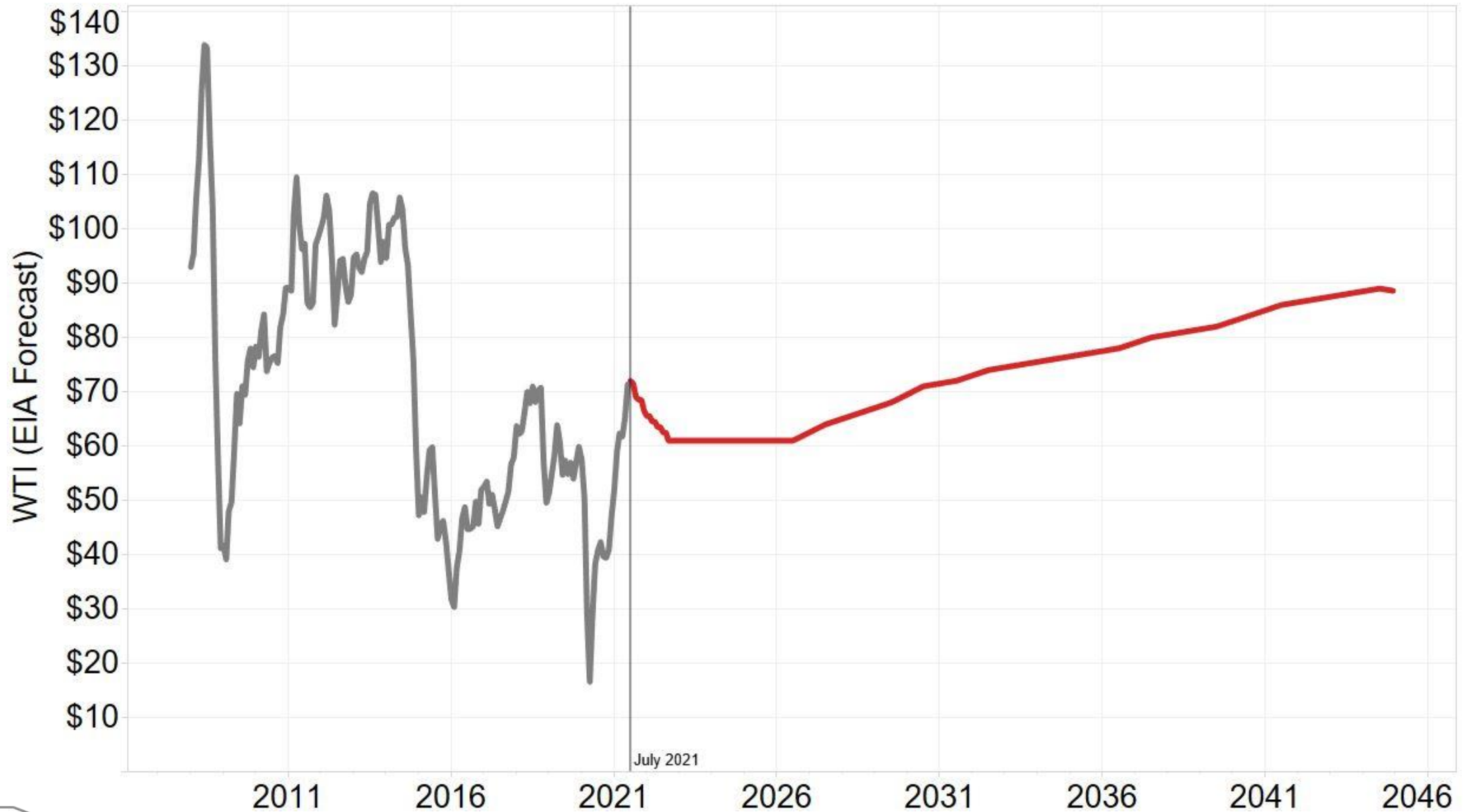
North Dakota Drilling Rig Efficiency



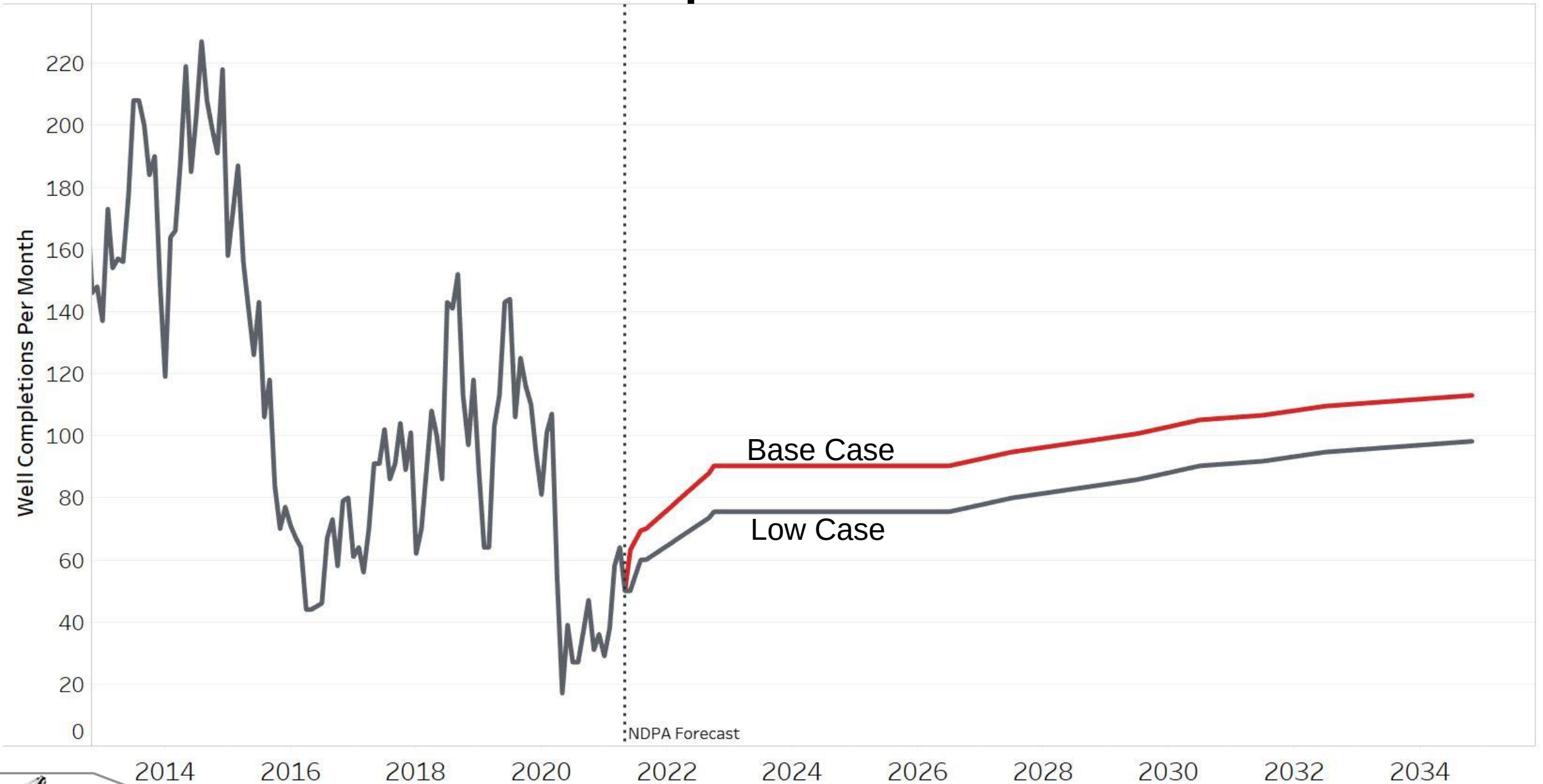
North Dakota Drilling Activity History



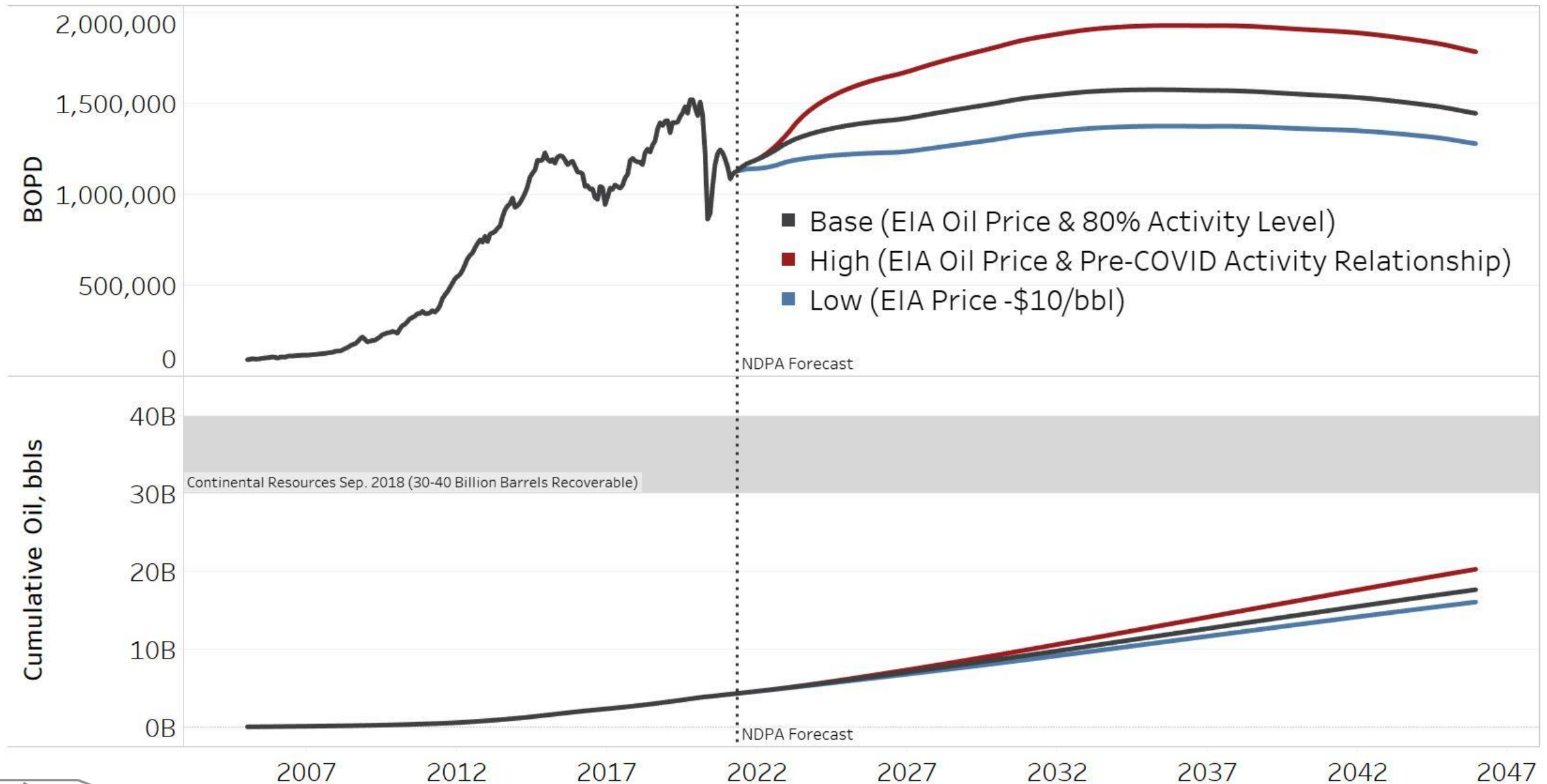
EIA Oil Price Outlook



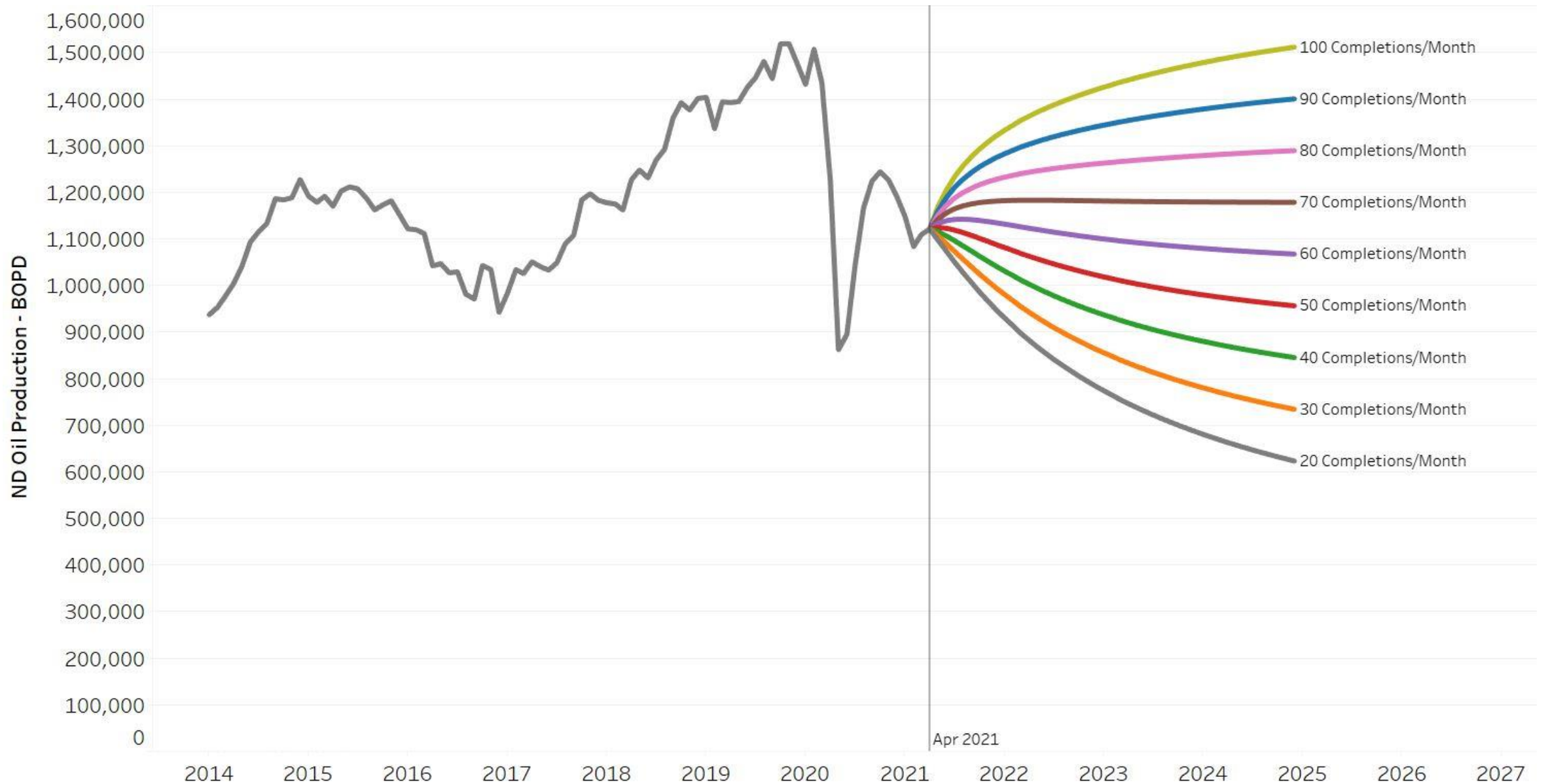
Well Completion Outlook



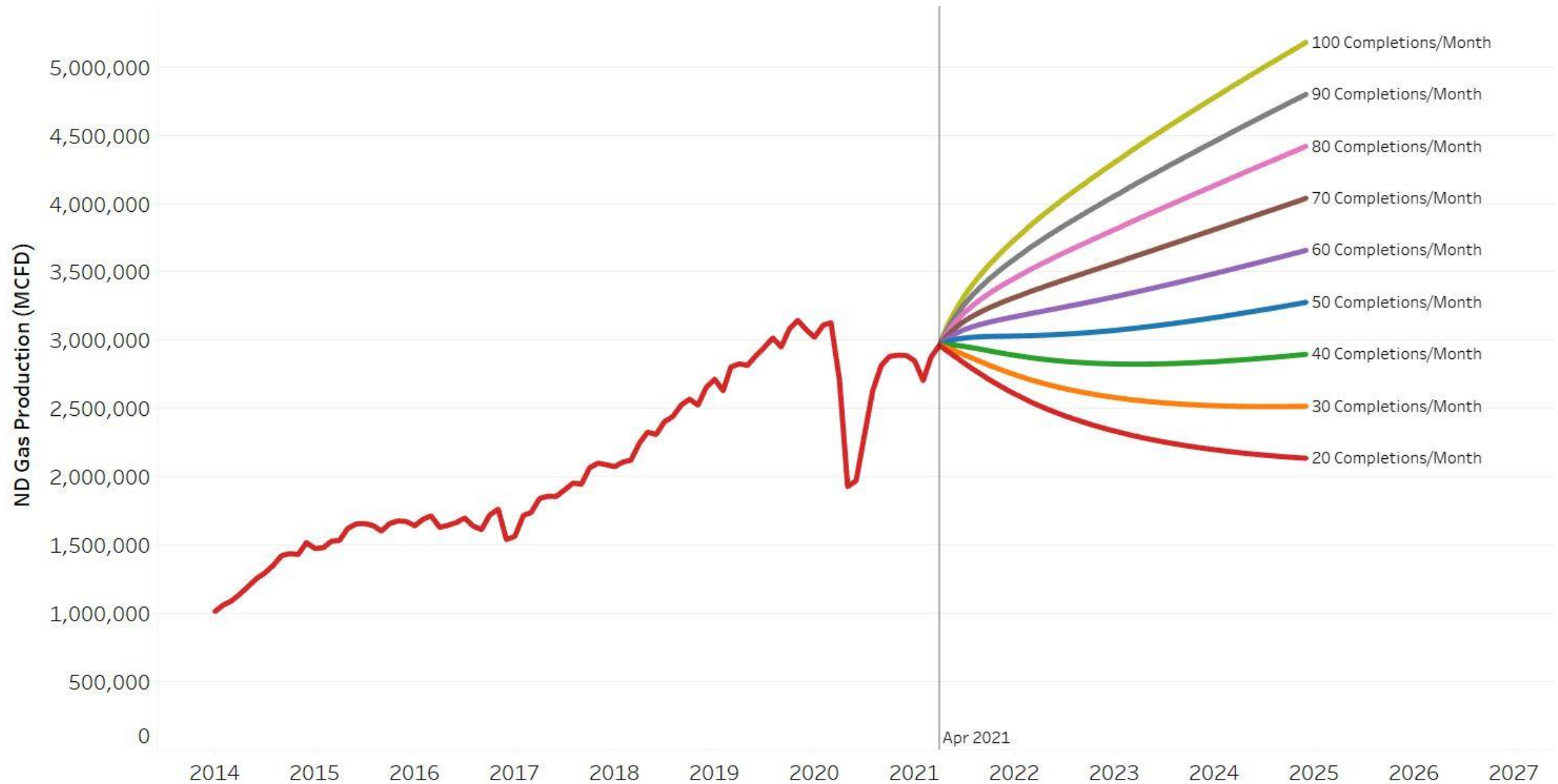
ND Oil Production: EIA Price Deck



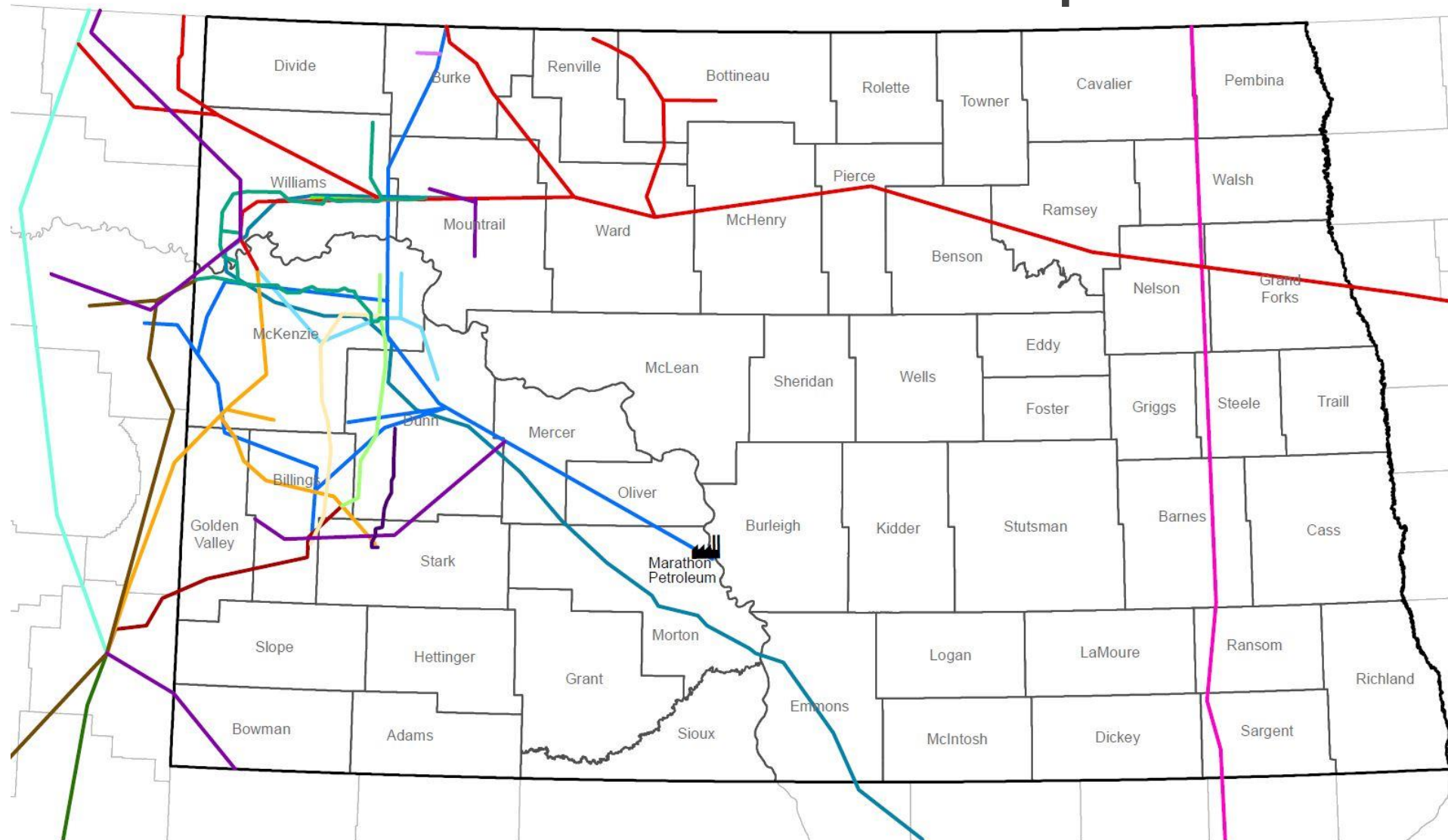
Monthly Completion Scenarios - Oil



Monthly Completion Scenarios - Gas



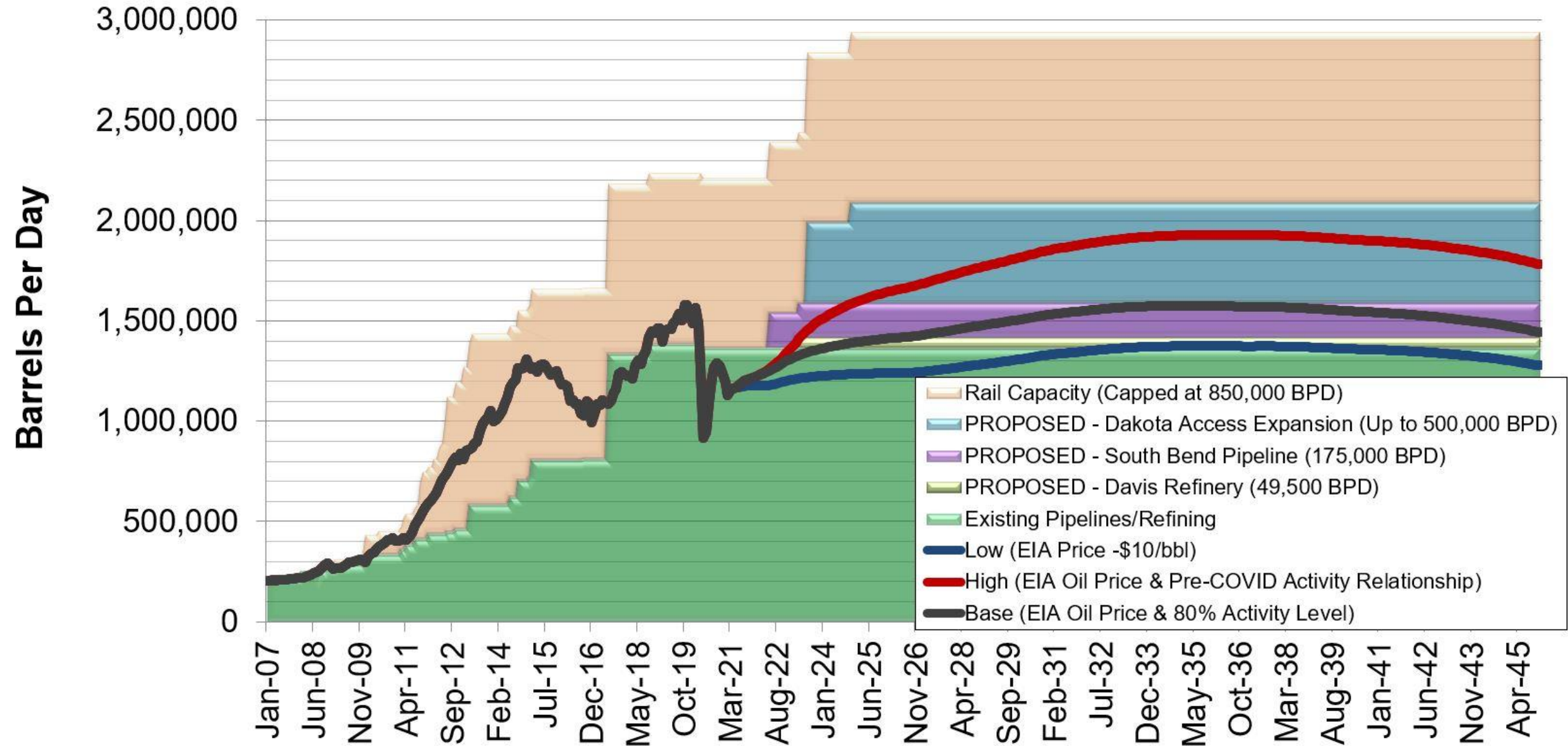
North Dakota Oil Transmission Pipelines



- | | | | | | |
|--------------------|-----------------|---------------|------------|-------------------|----------|
| Refinery | Basin Transload | Butte | Double H | Hiland | Bridger |
| Bakken Oil Express | Belle Fourche | Crestwood | Enbridge | Keystone Pipeline | Targa |
| BakkenLink | Bridger | Dakota Access | Four Bears | Little Missouri | Marathon |



Williston Basin Oil Production & Export Capacity, BOPD



Natural Gas Update



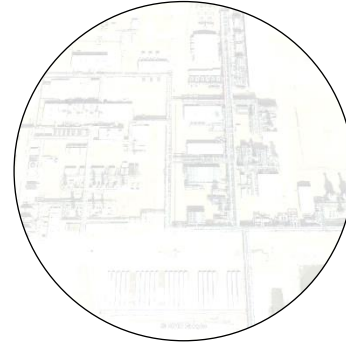
Production

- Technology
- Markets



Gathering

- Capacity
- Connections



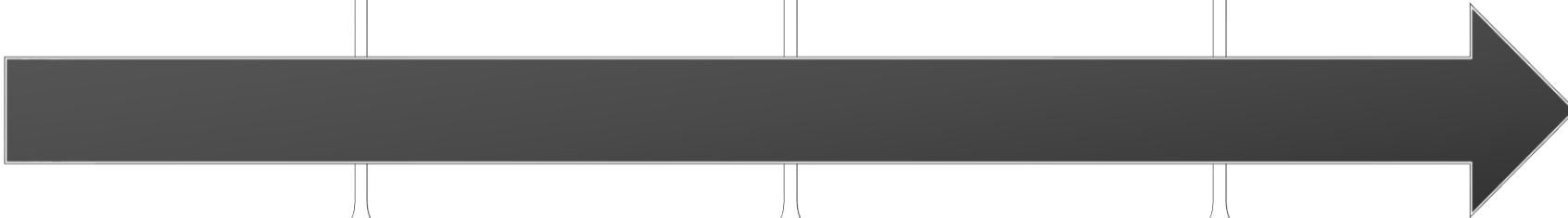
Processing

- Capacity
- Location



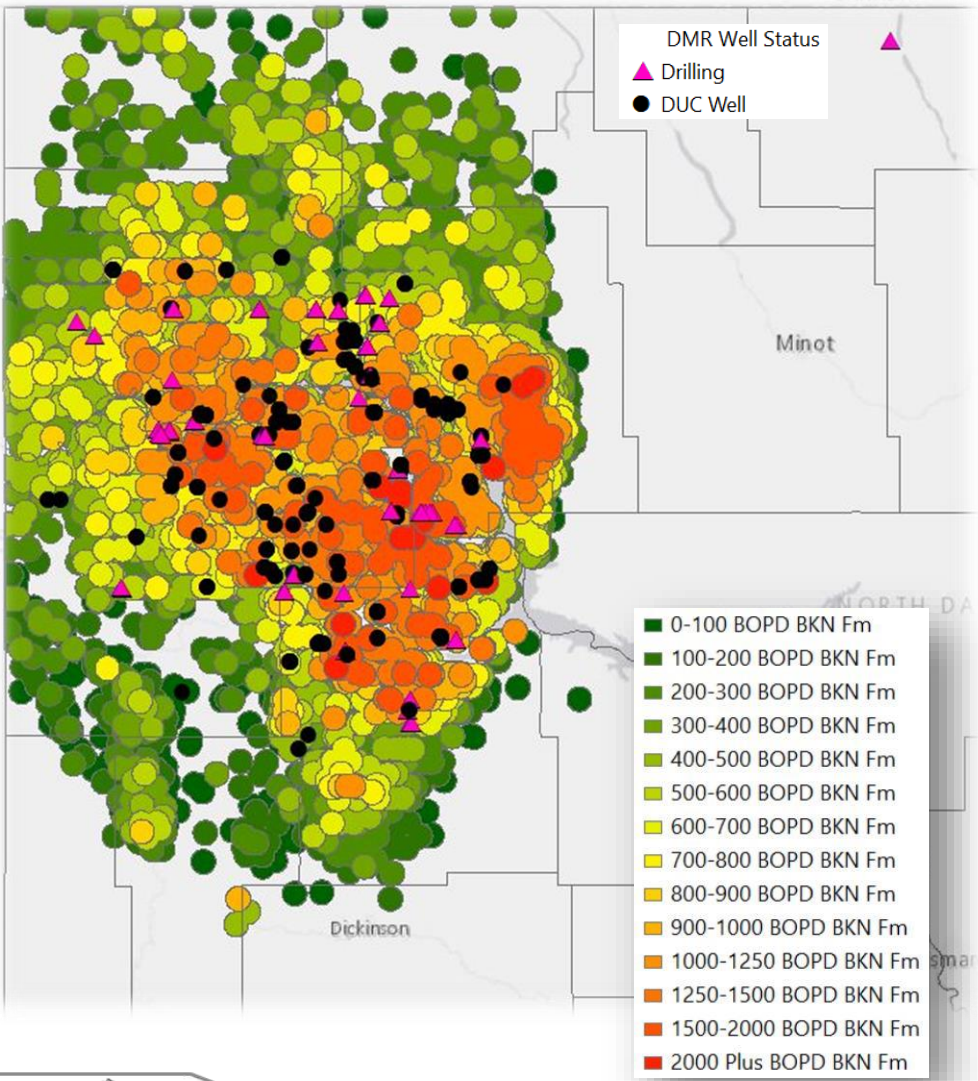
Transmission

- Dry Gas
- Natural Gas Liquids

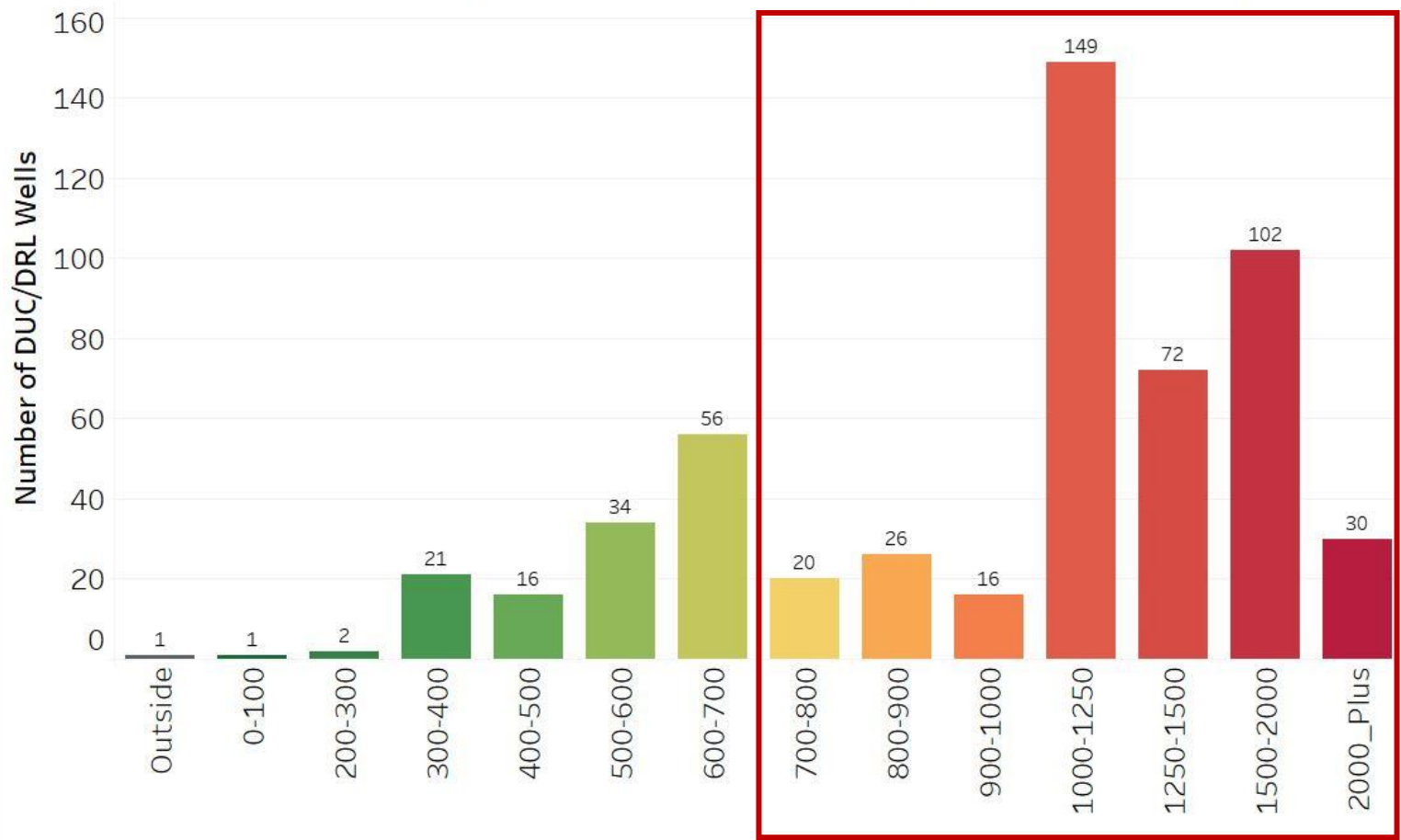


North Dakota Wells Waiting on Completion – April 2021

Bakken Formation



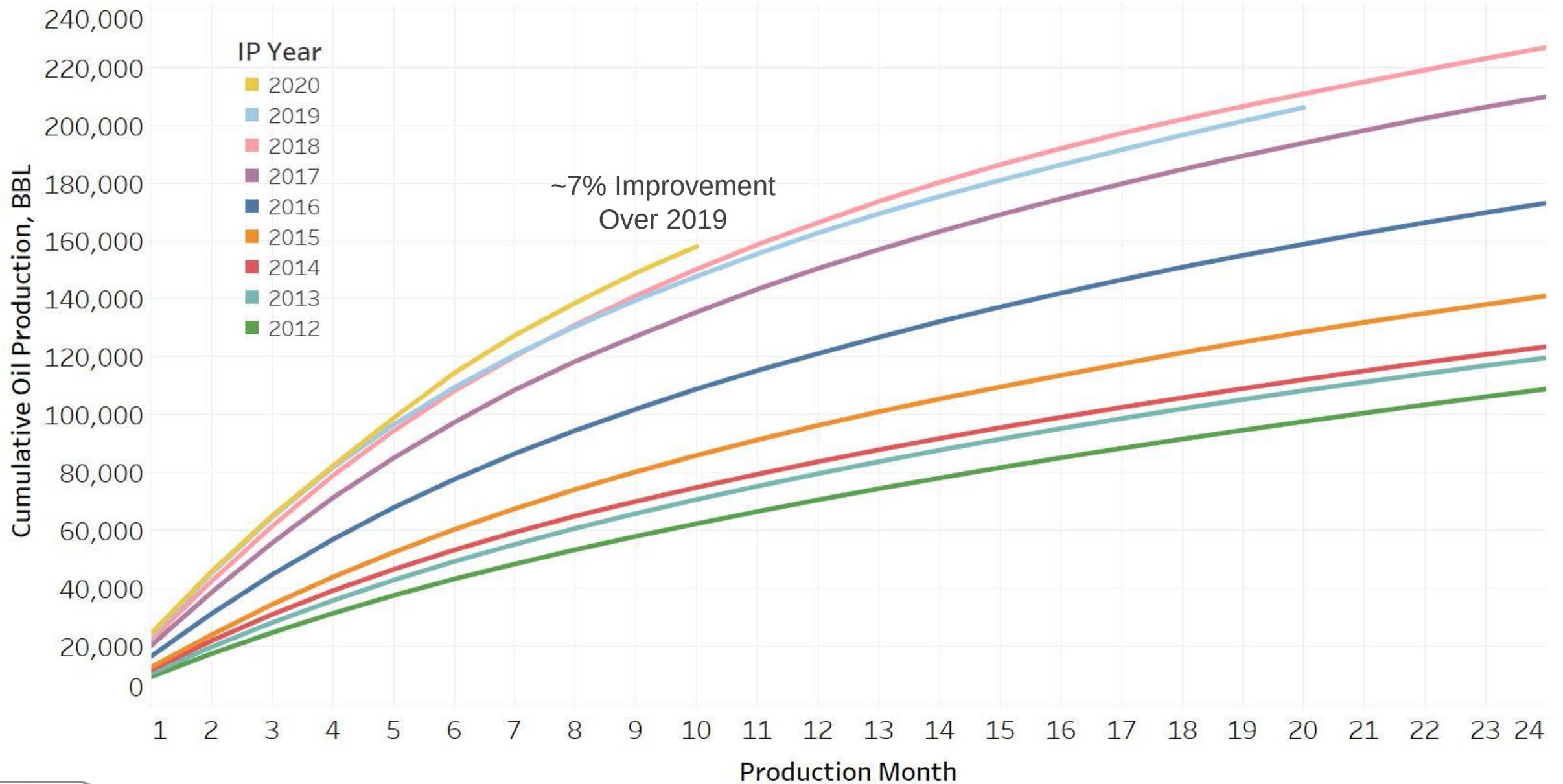
Bakken Geographic Production Zone (First Month BOPD)



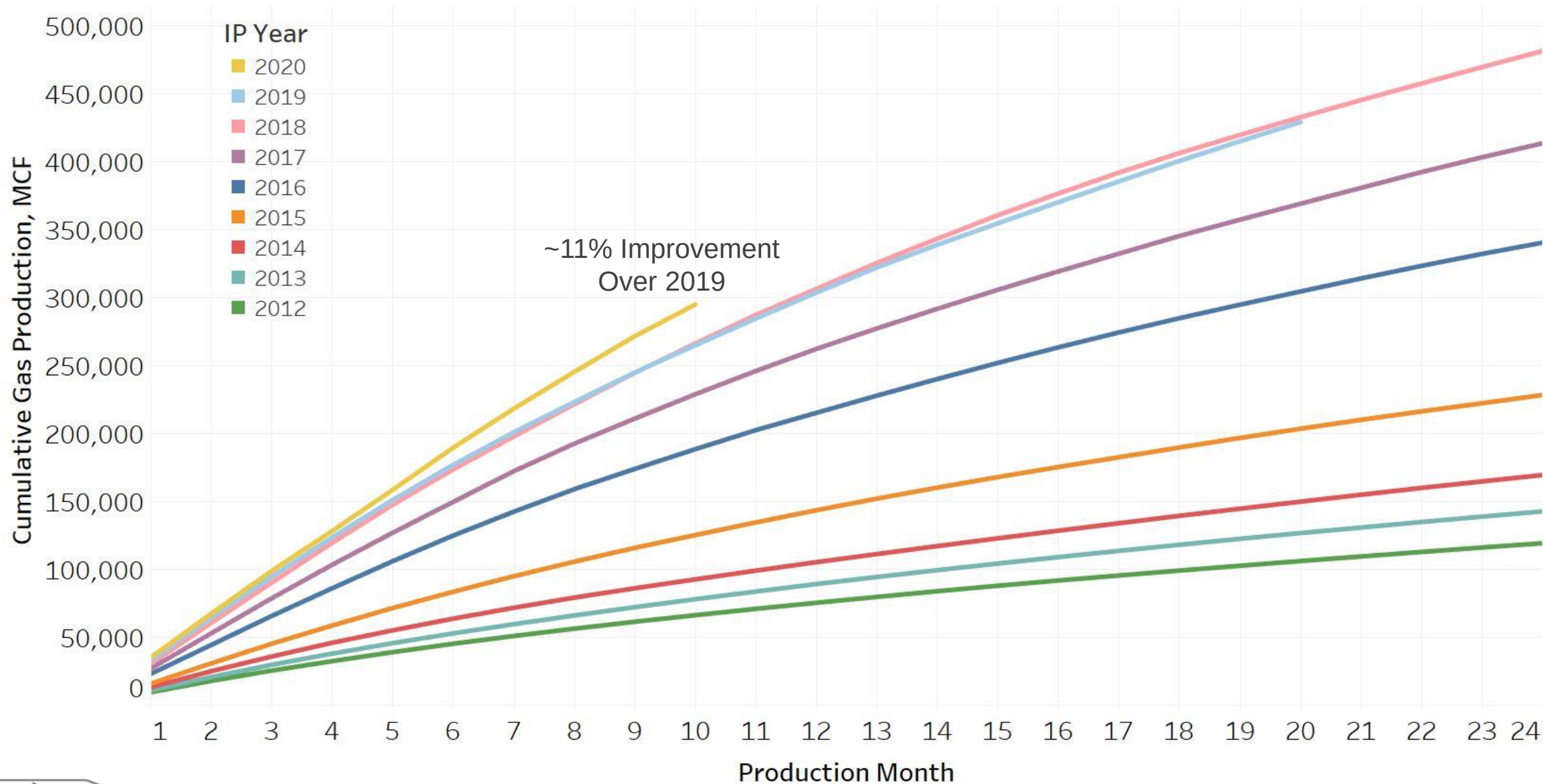
Most Attractive Acreage
in \$60+ WTI Environment



Statewide Bakken Oil Performance

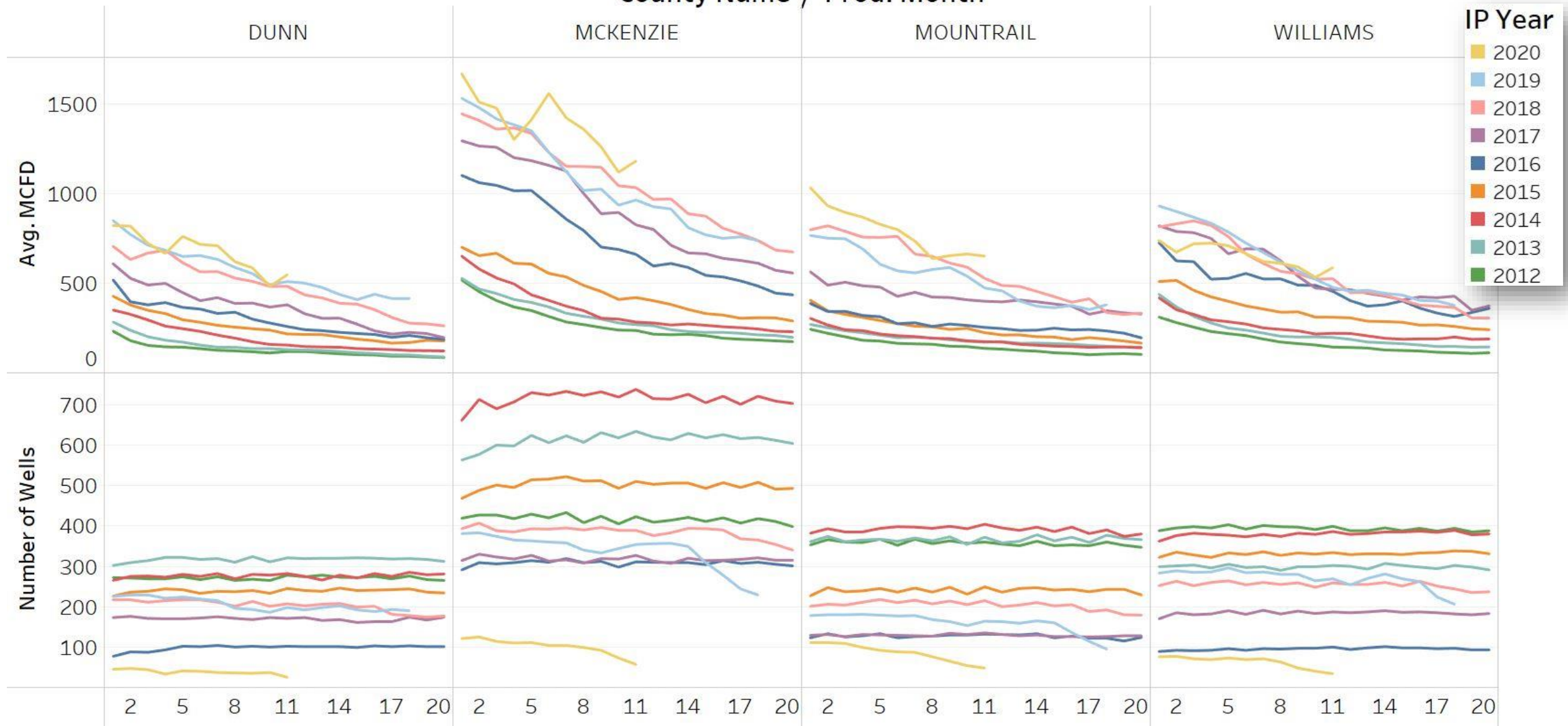


Statewide Bakken Gas Performance

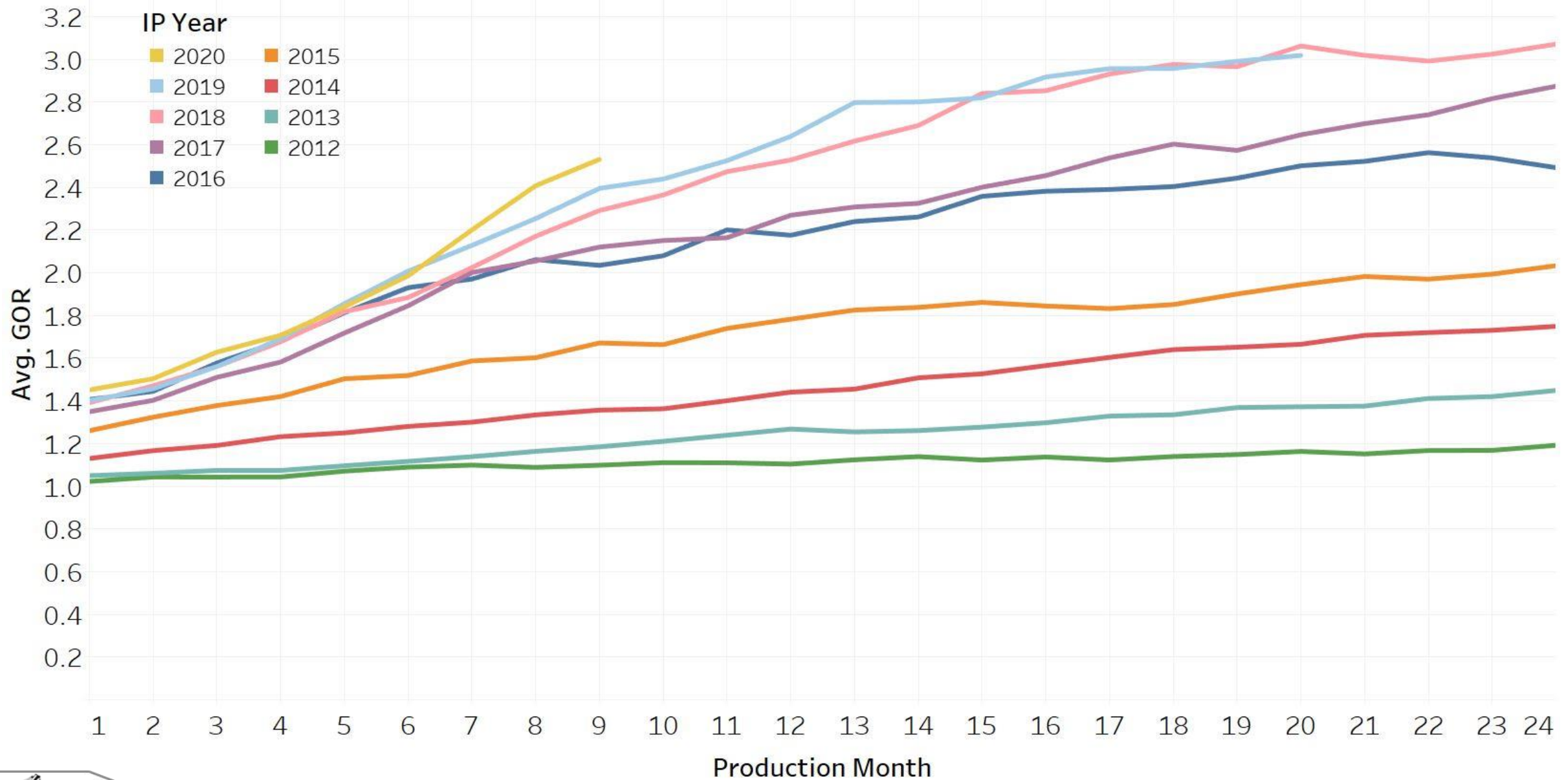


Core County Bakken Gas Performance

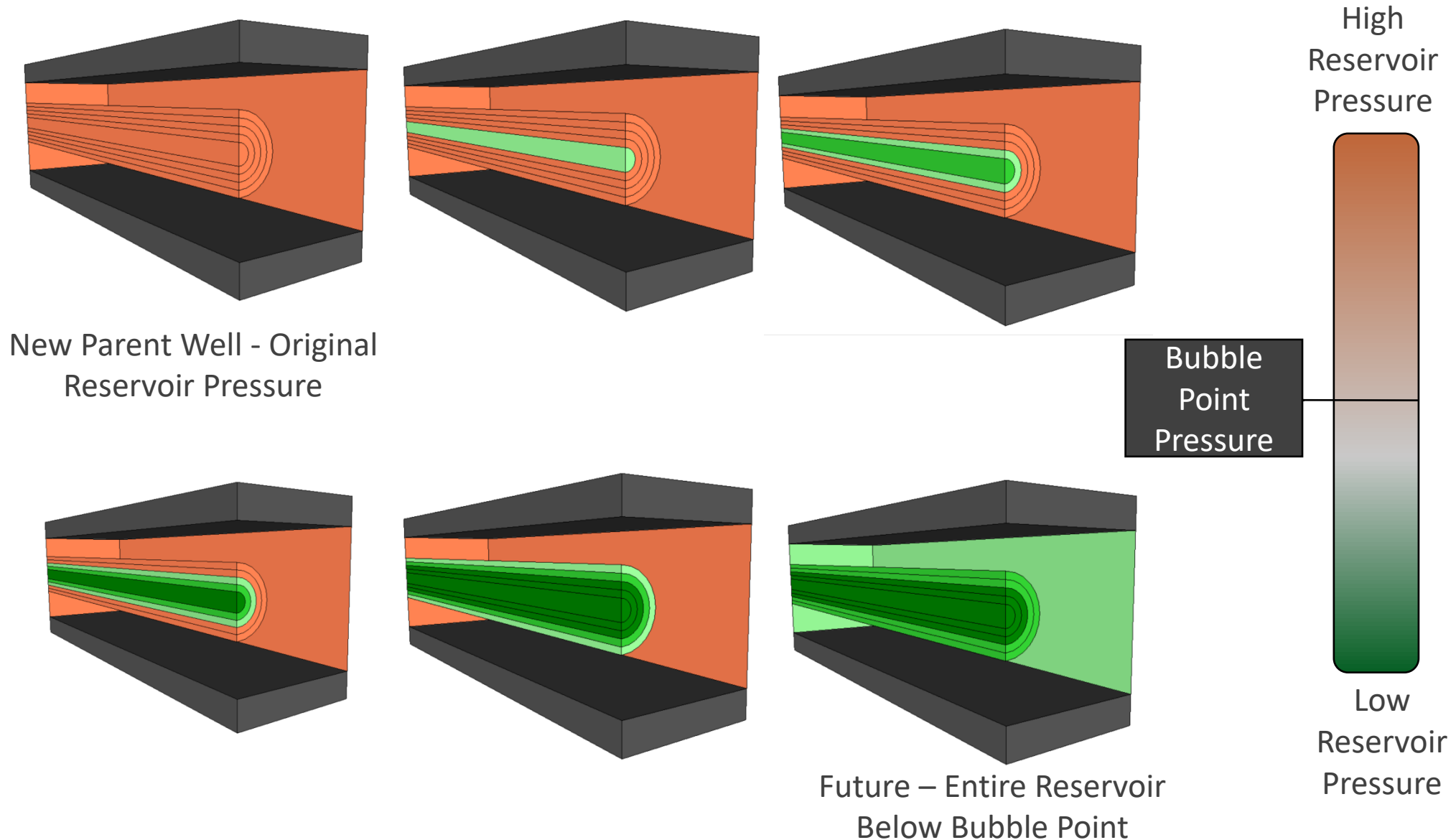
County Name / Prod. Month



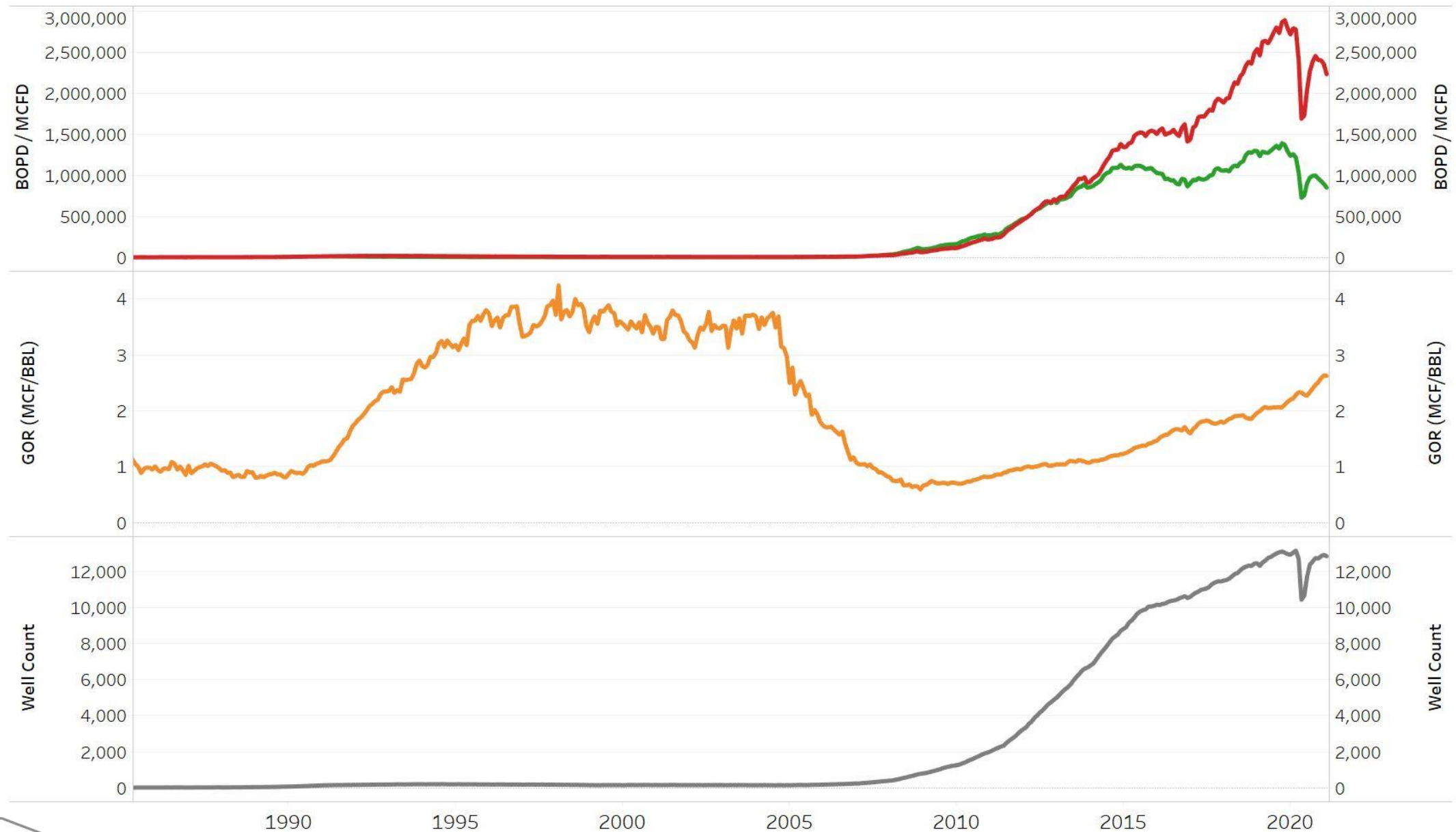
Statewide Bakken Gas/Oil Ratios



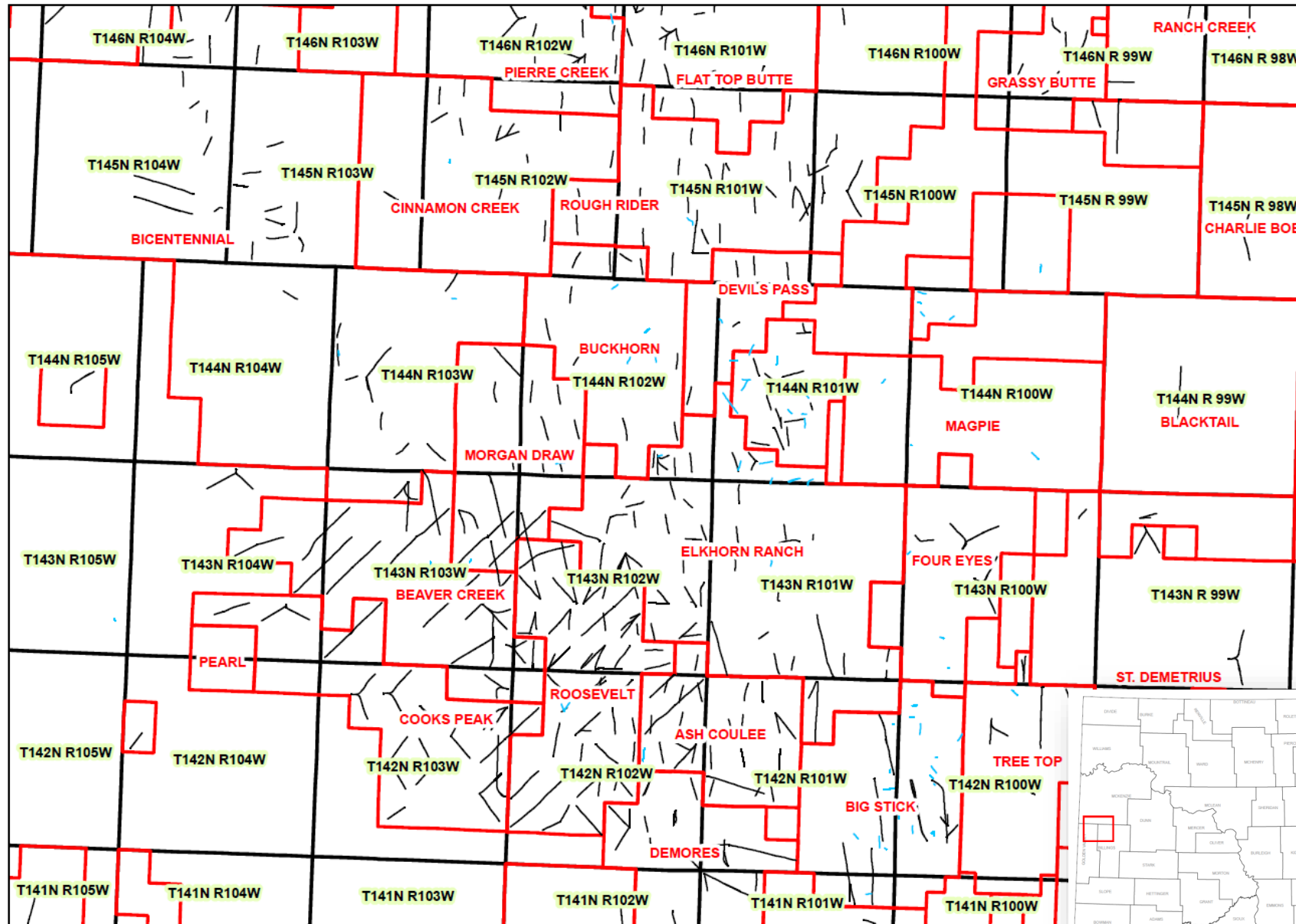
Statewide Bakken Gas/Oil Ratios



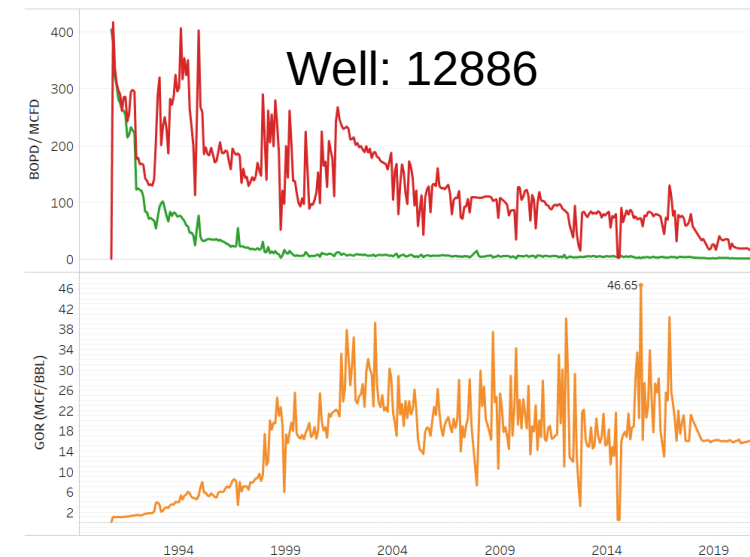
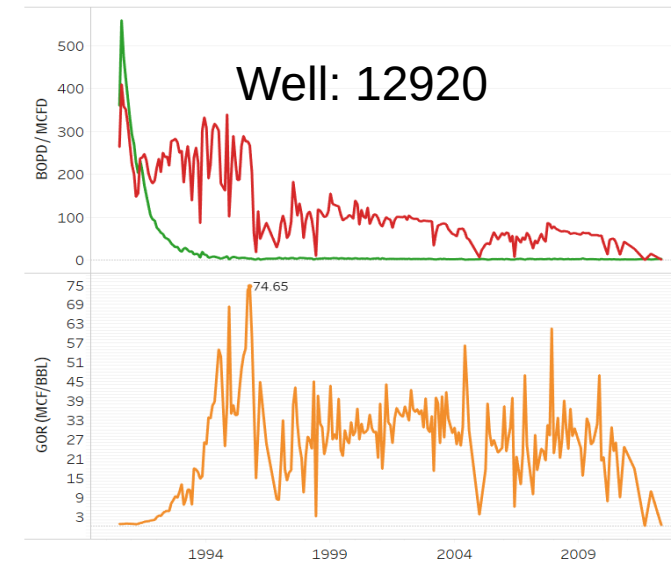
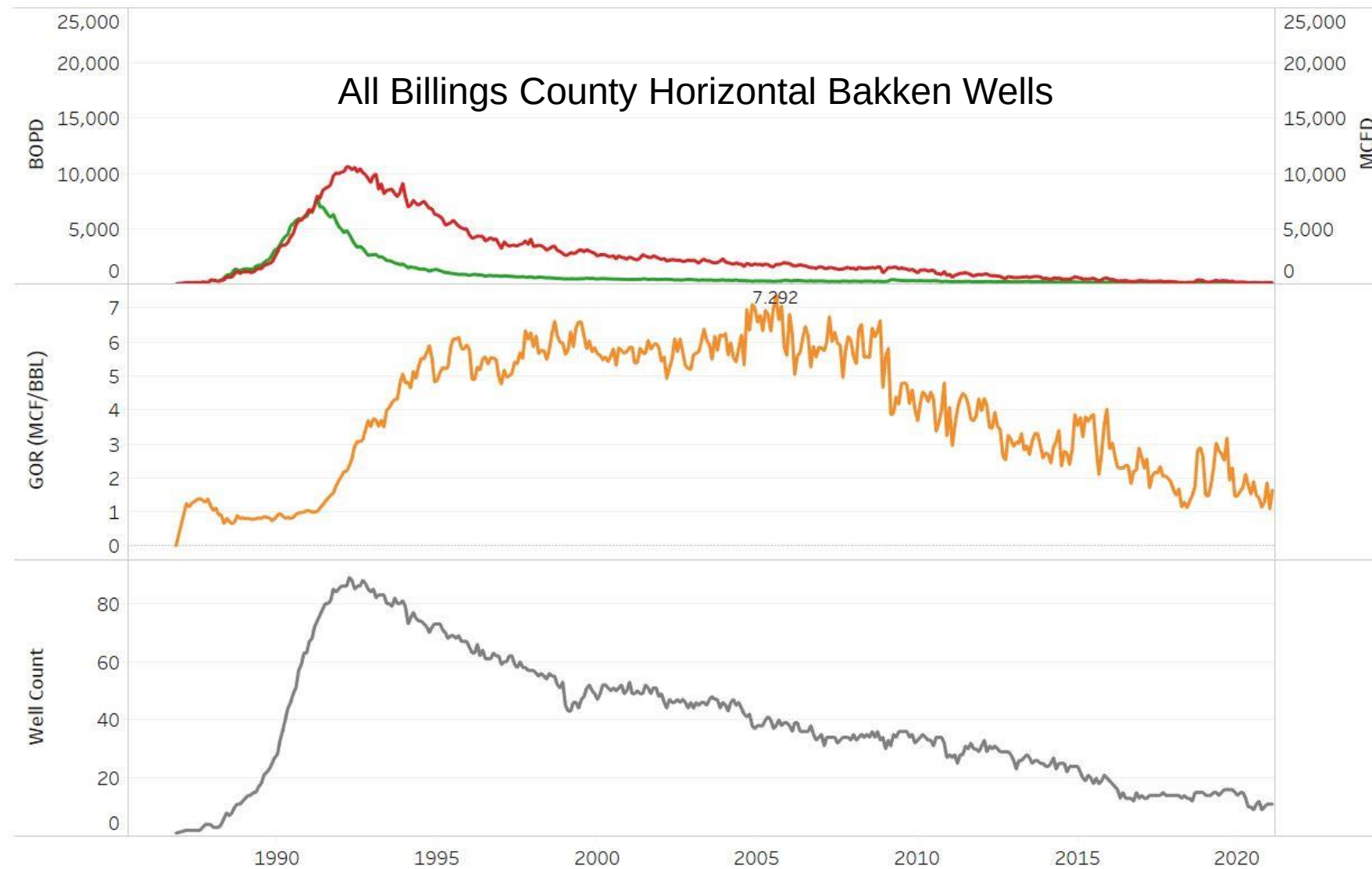
Statewide Bakken Production



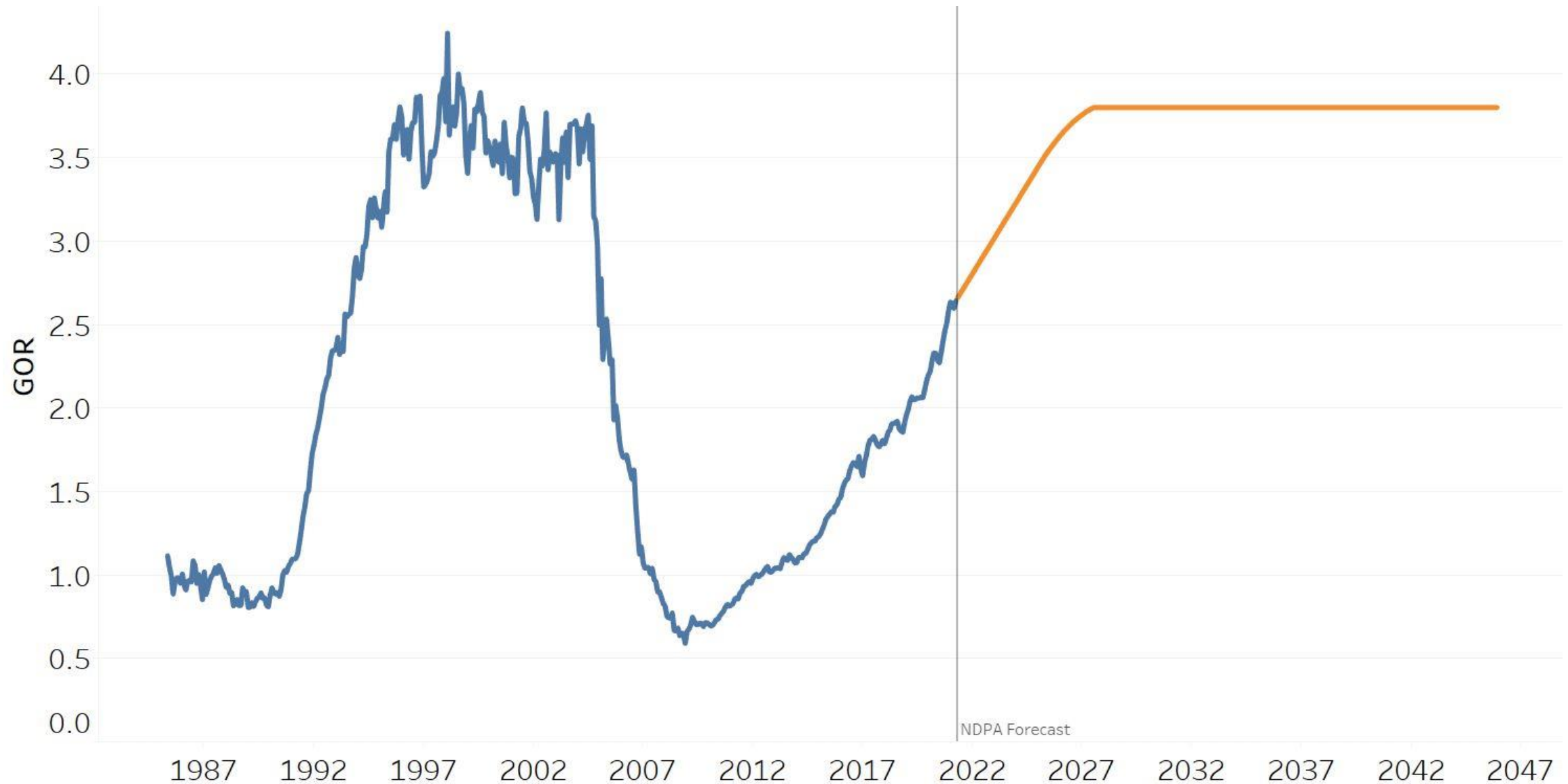
Back to the 90's...



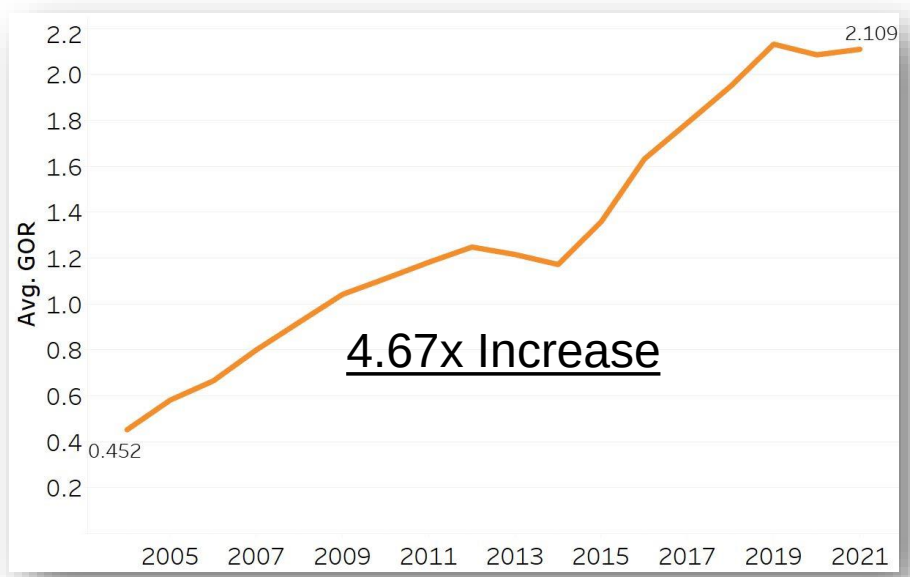
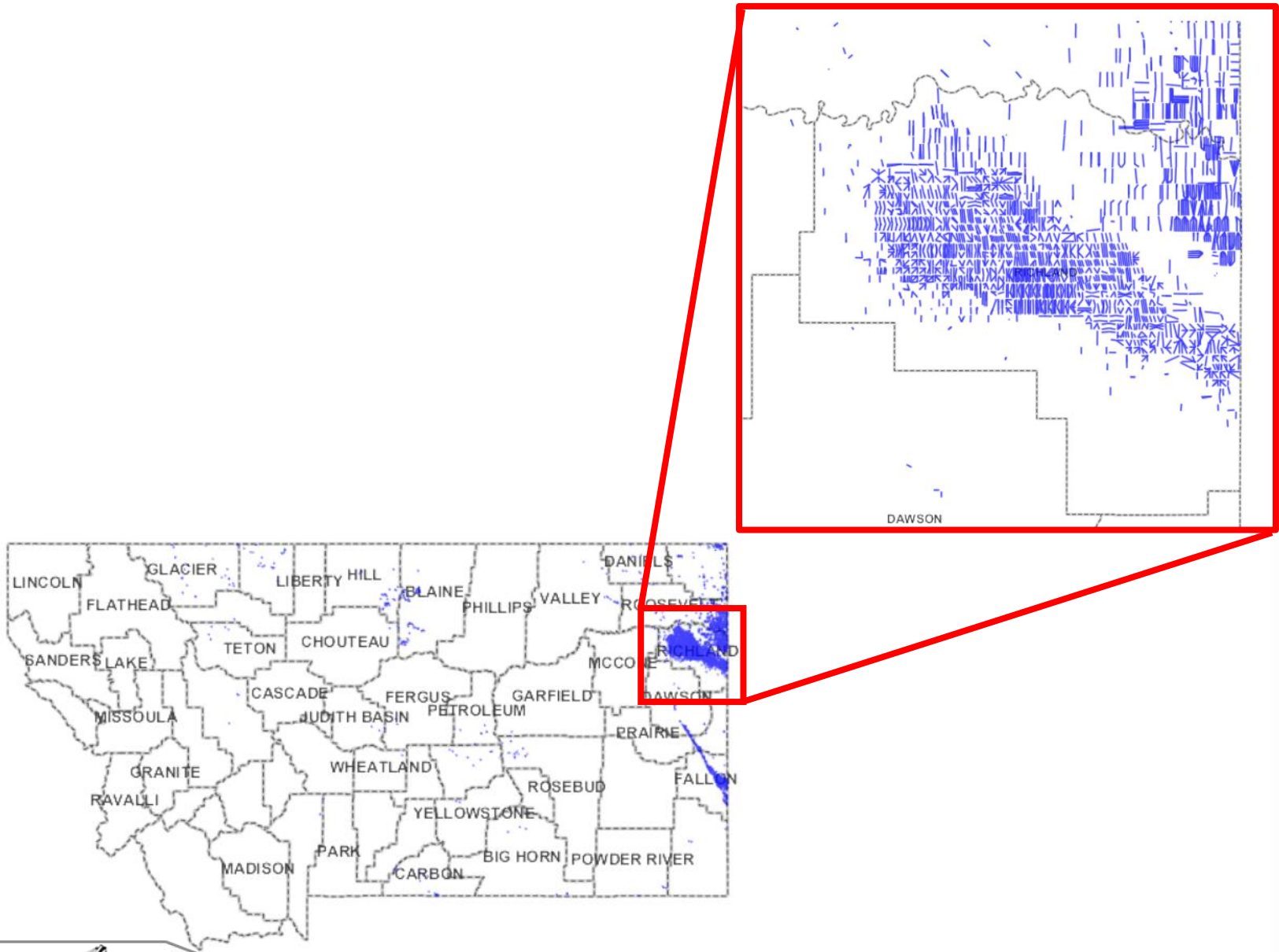
Back to the 90's...



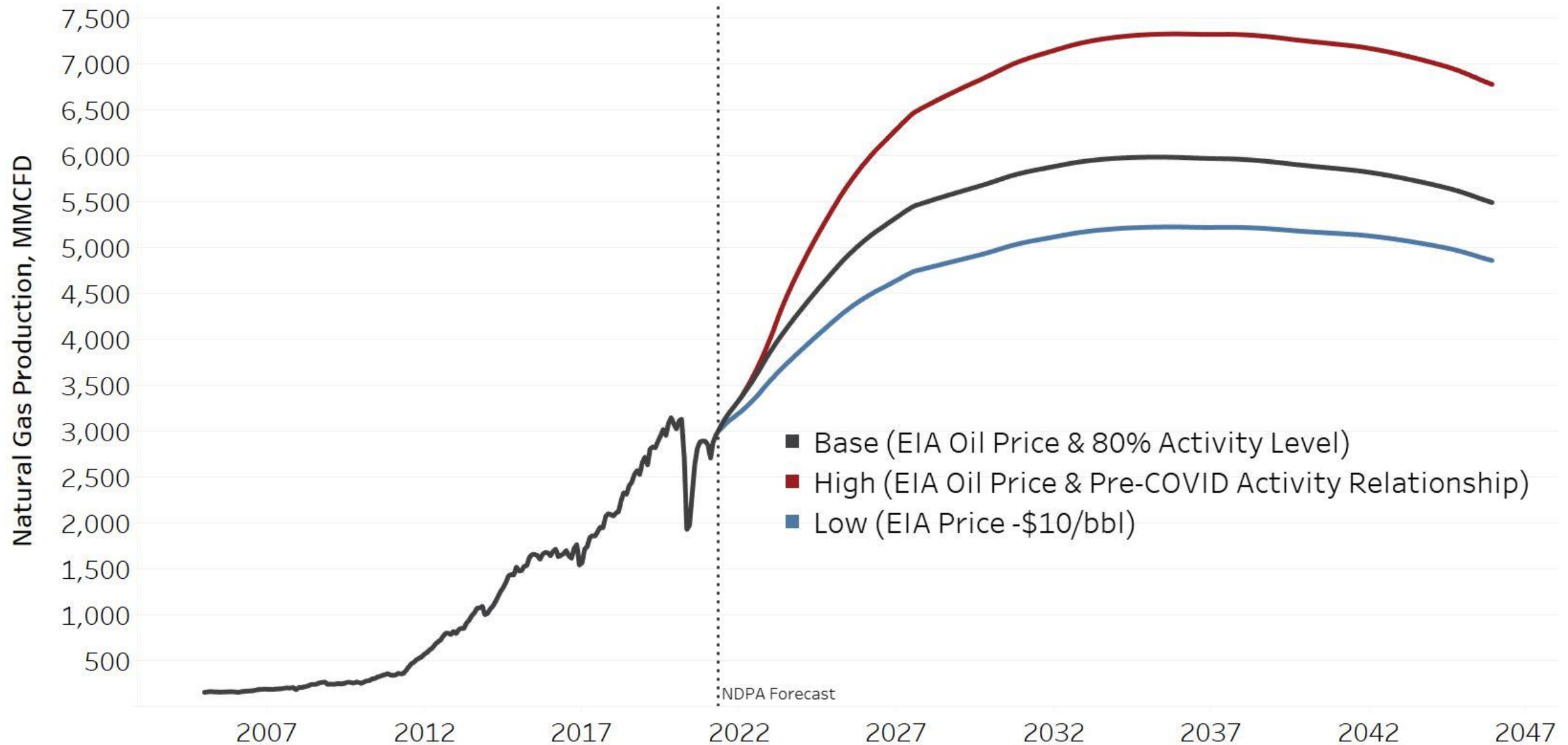
ND Gas Production: GOR Assumption



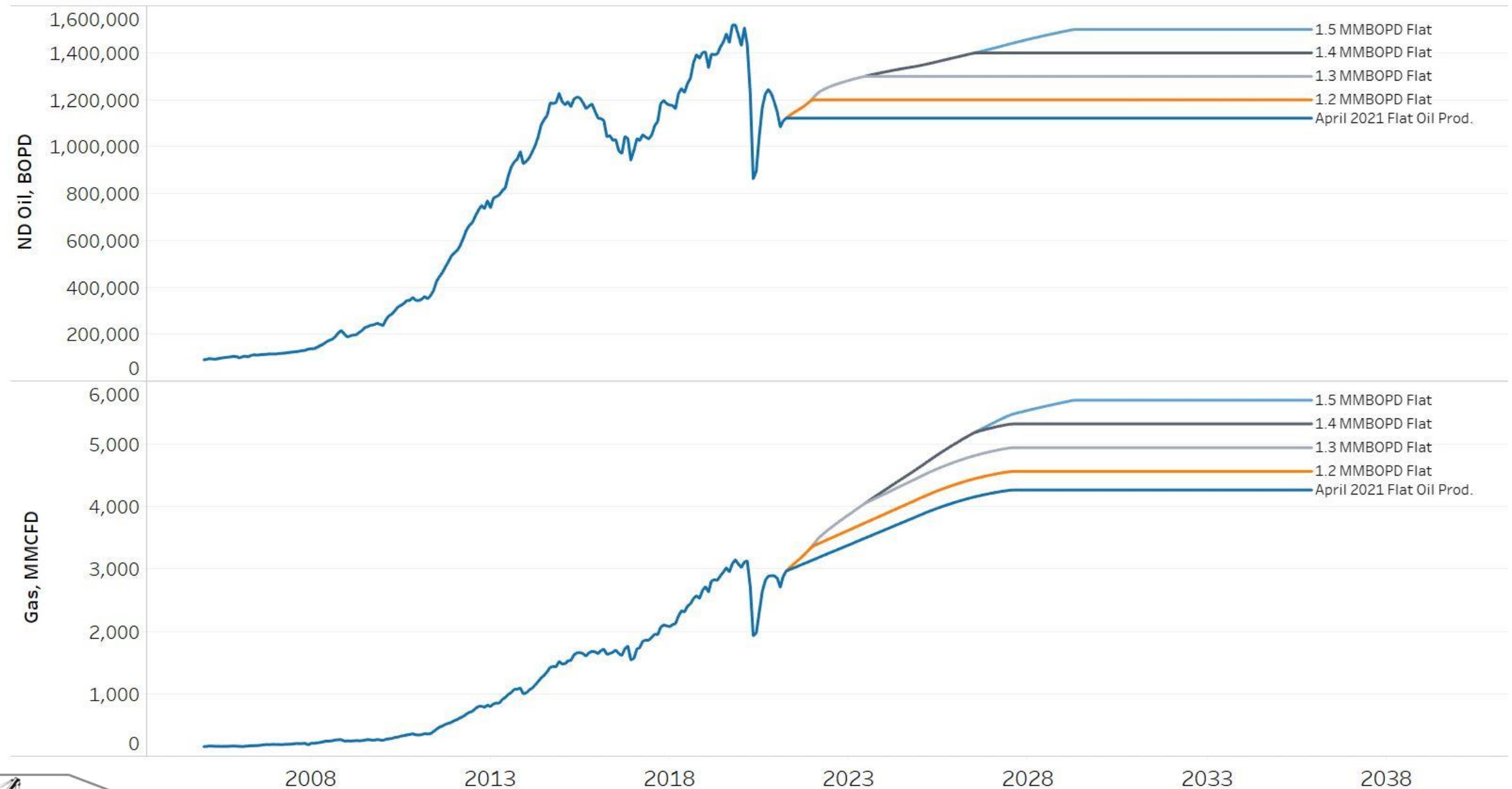
Elm Coulee Bakken GOR: Eastern Montana



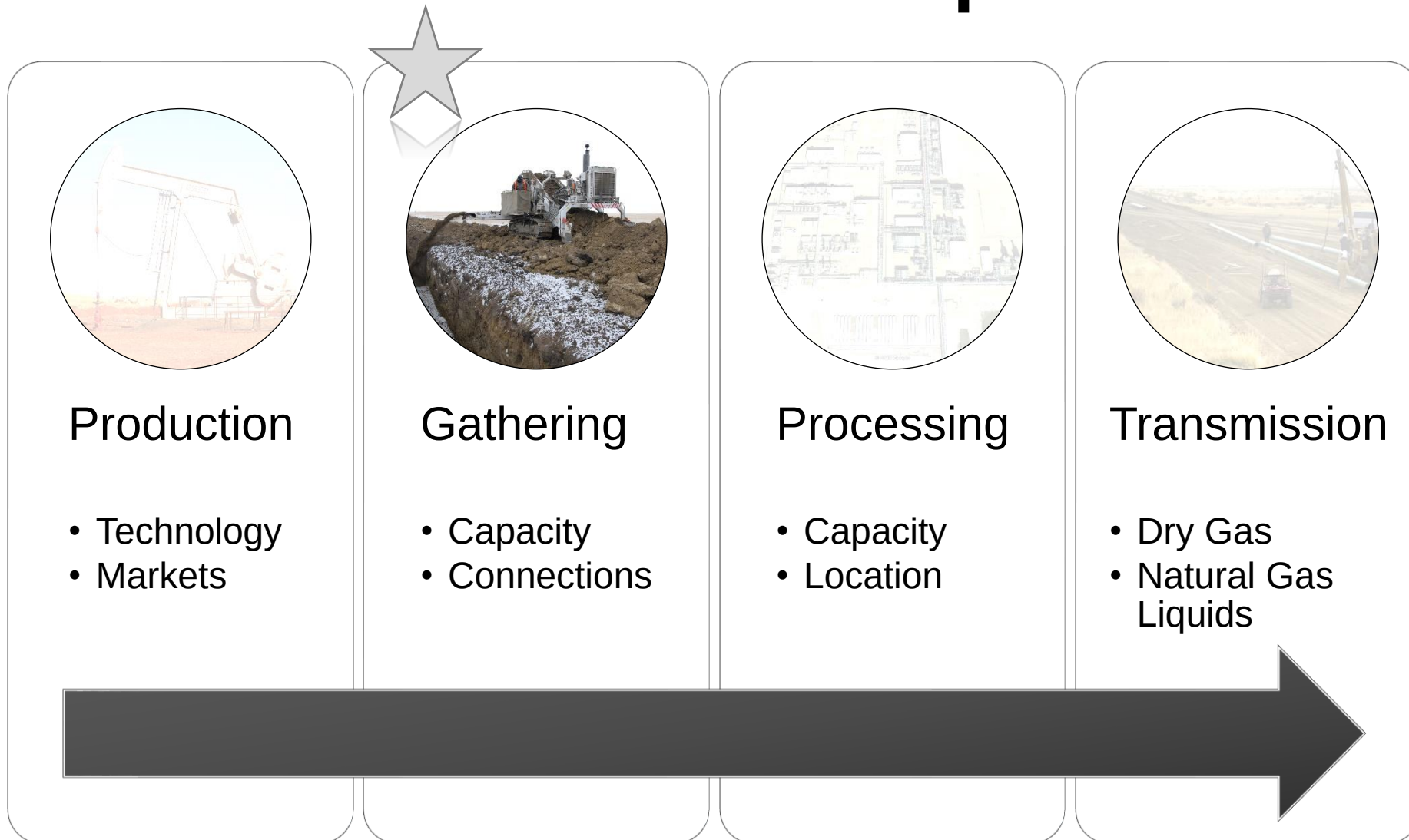
ND Gas Production: EIA Price Deck



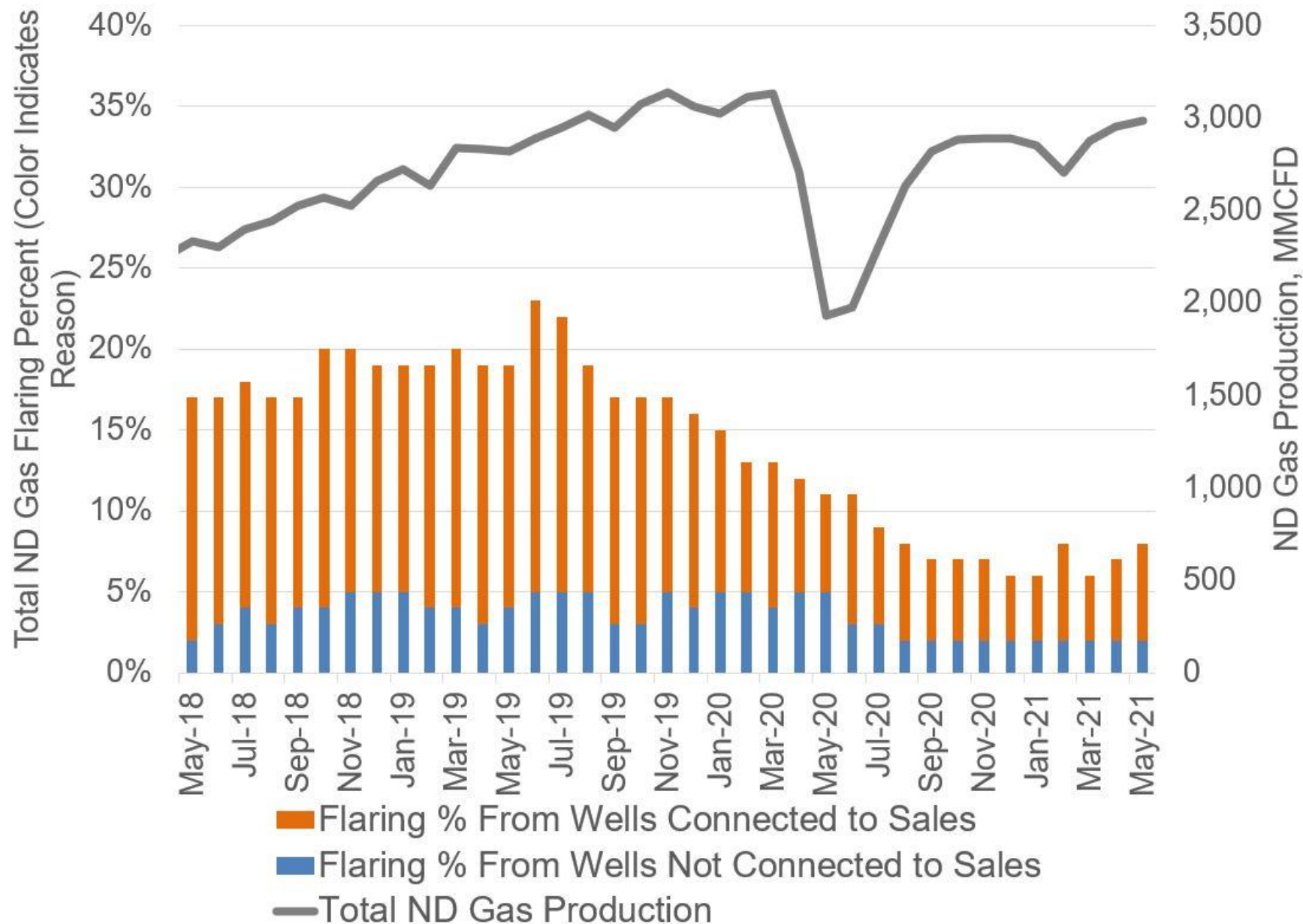
What if Oil Production Growth is Slower?



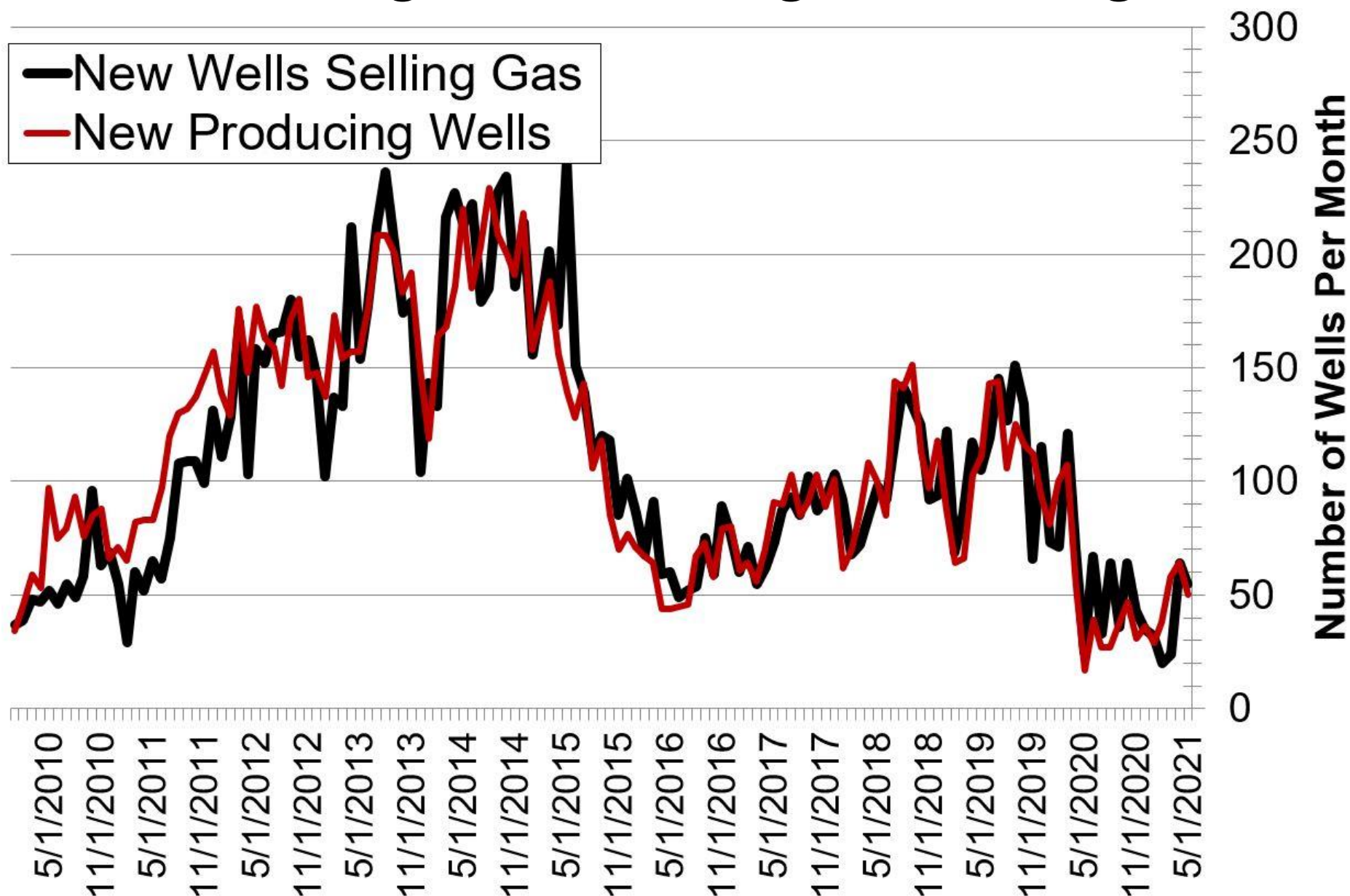
Natural Gas Update



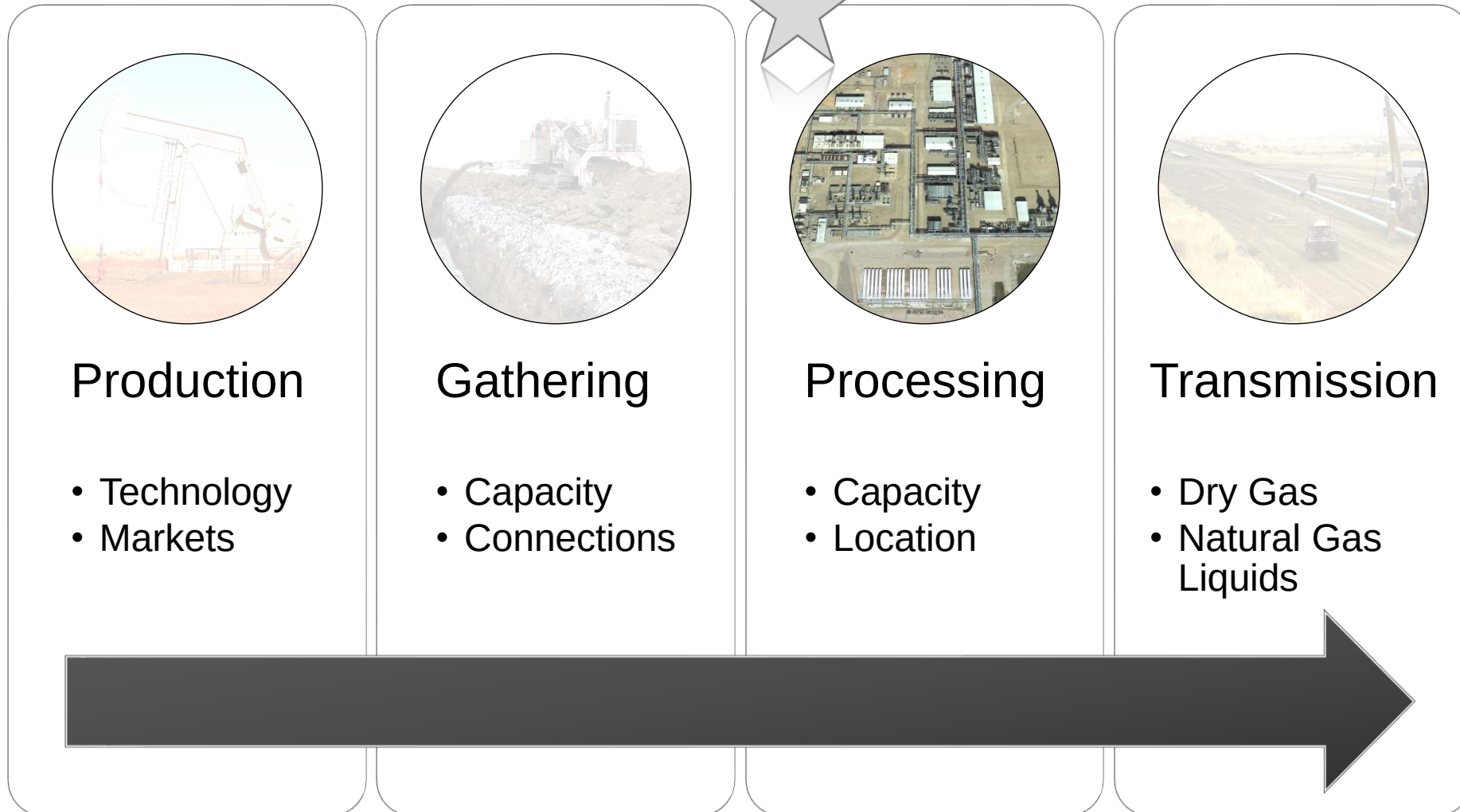
Solving the Flaring Challenge



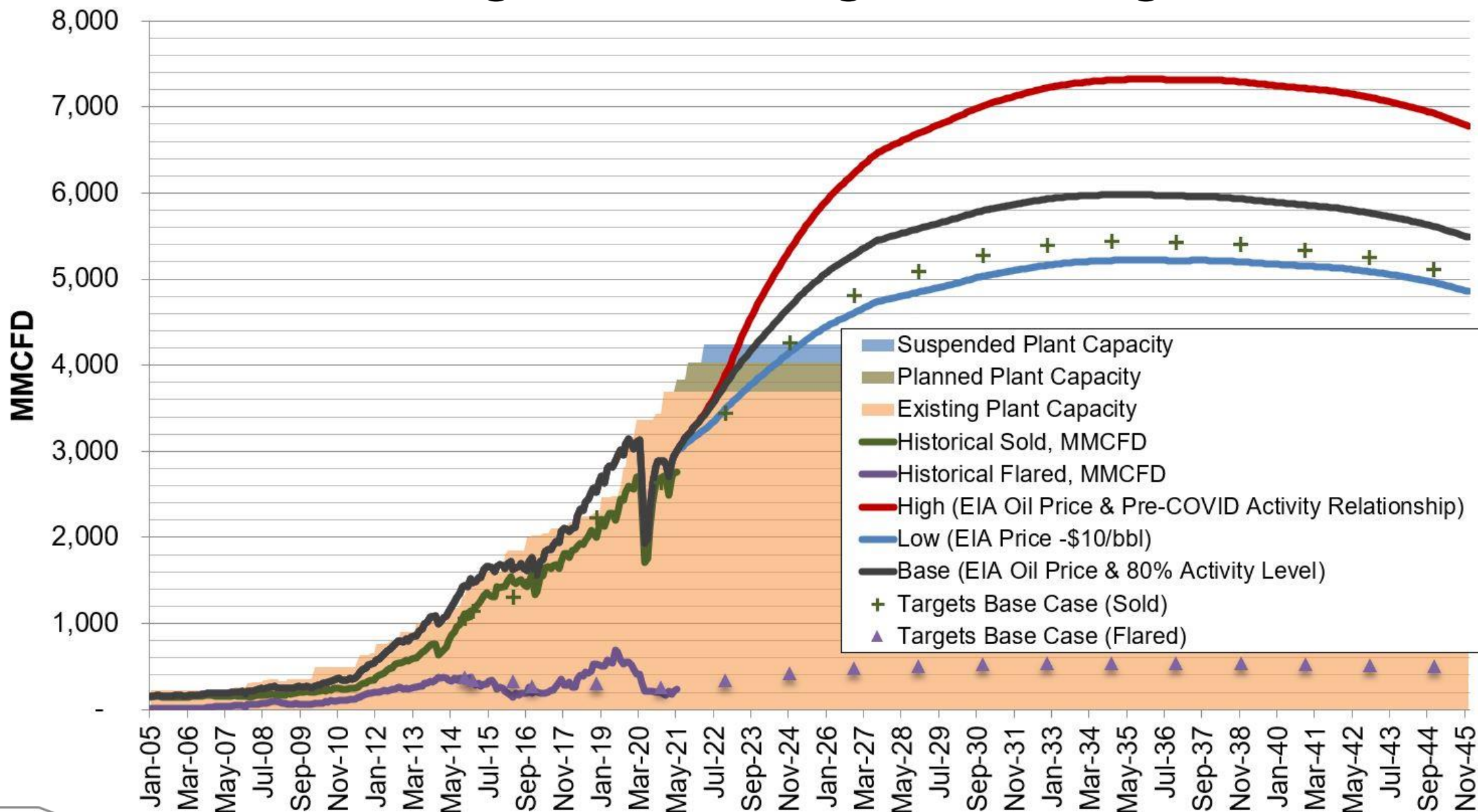
Solving the Flaring Challenge



Natural Gas Update

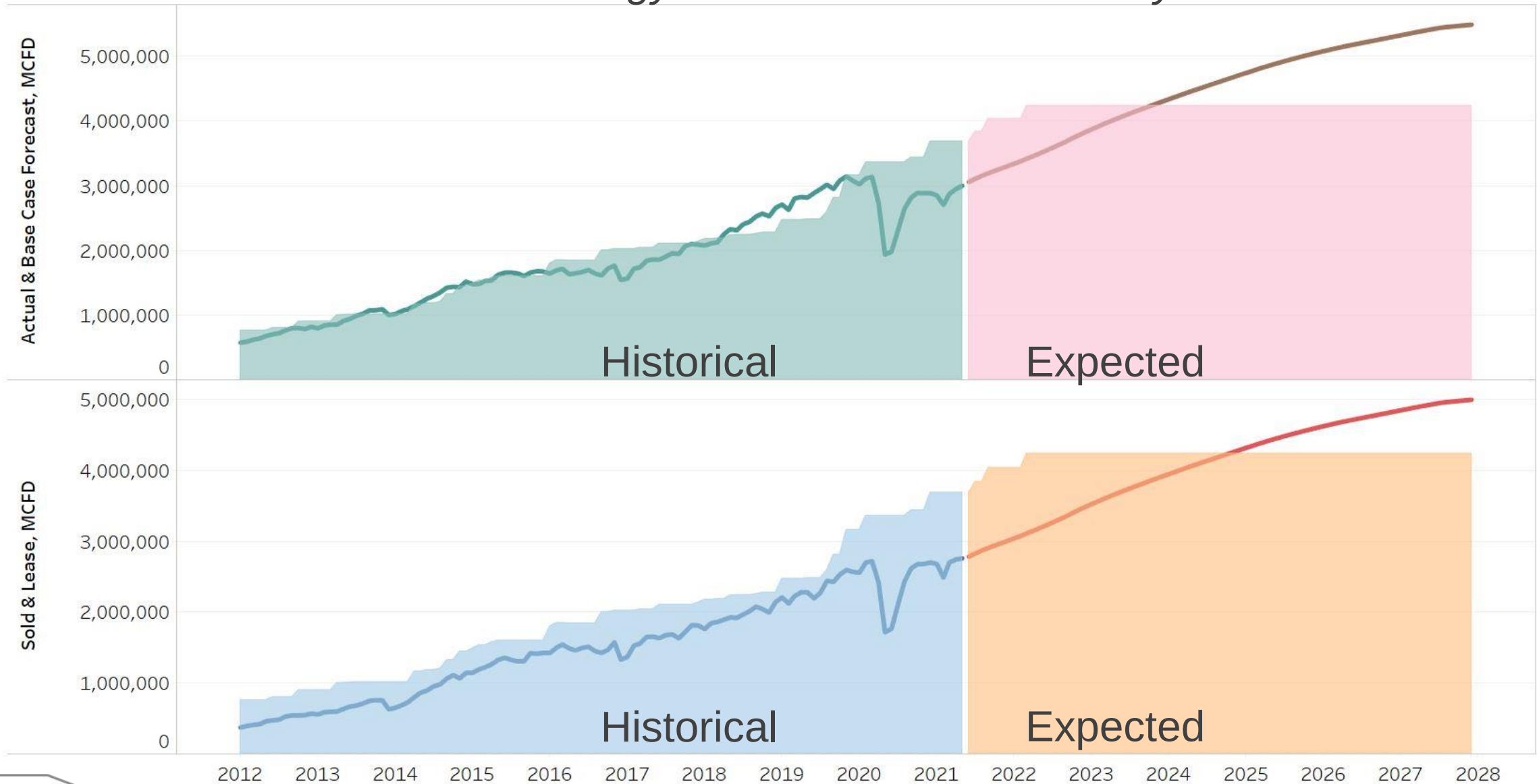


Solving the Flaring Challenge

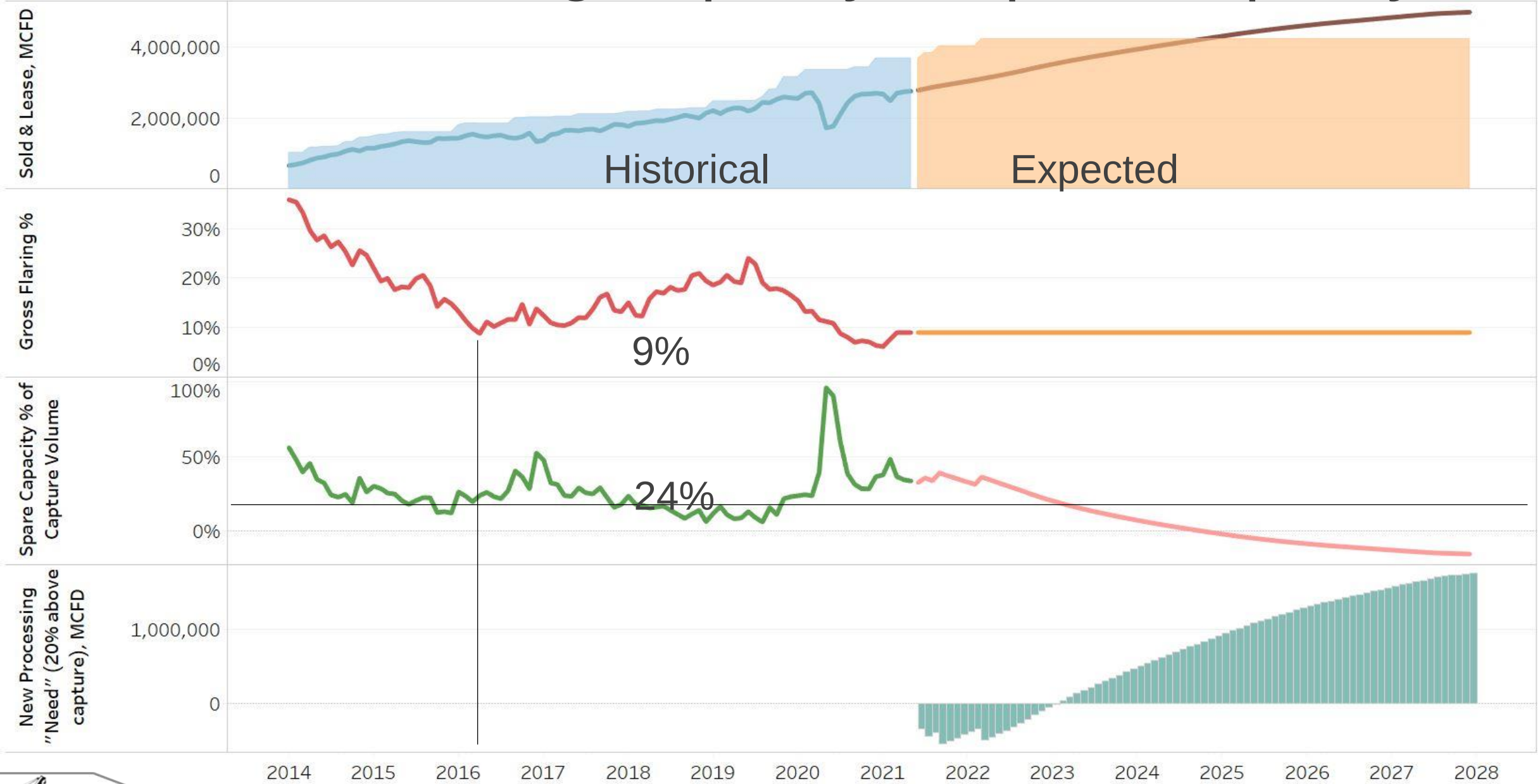


Gas Processing Capacity & Future Outlook

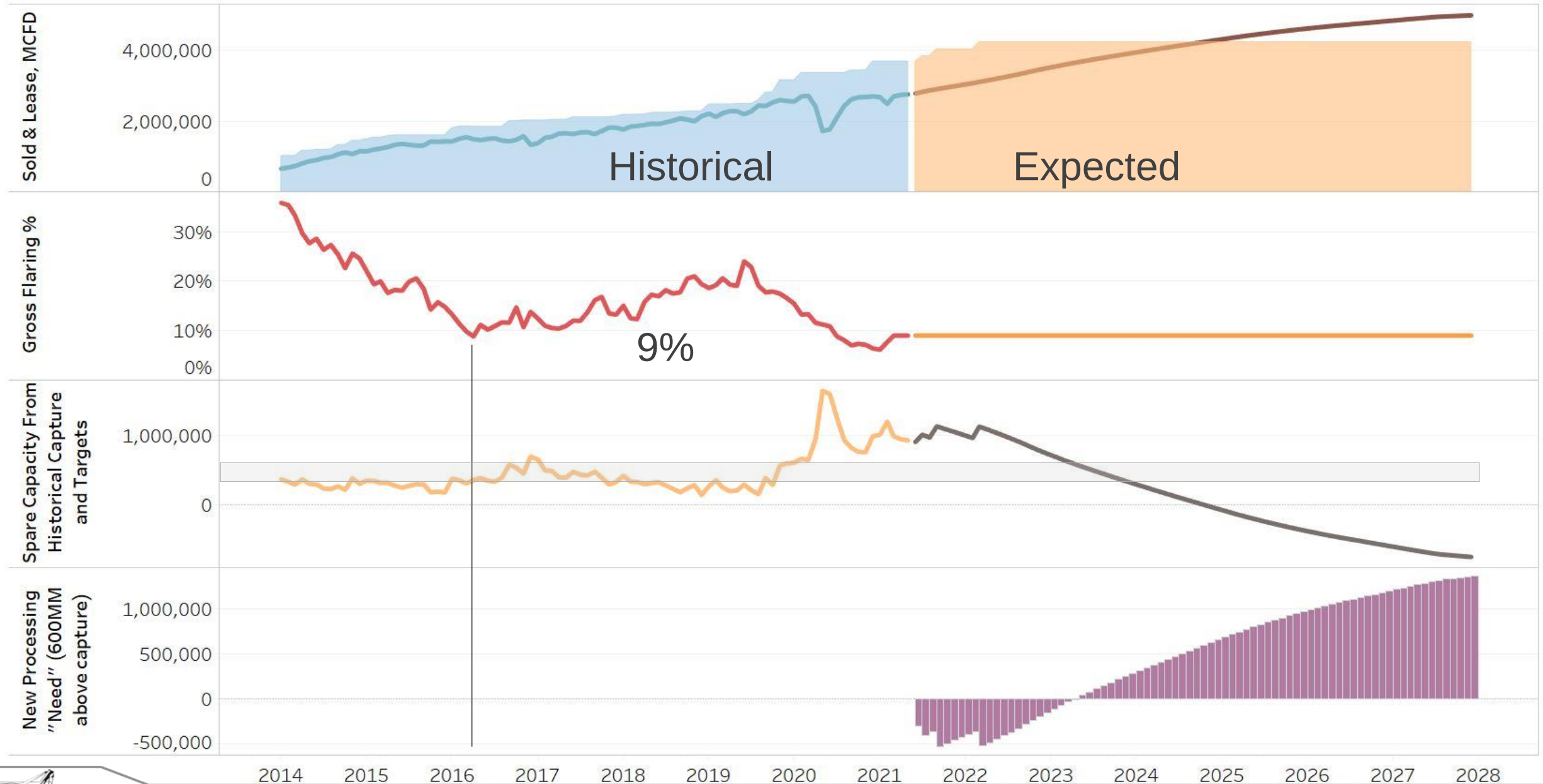
Assumes Current Technology – Enhanced Oil Recovery Not Included



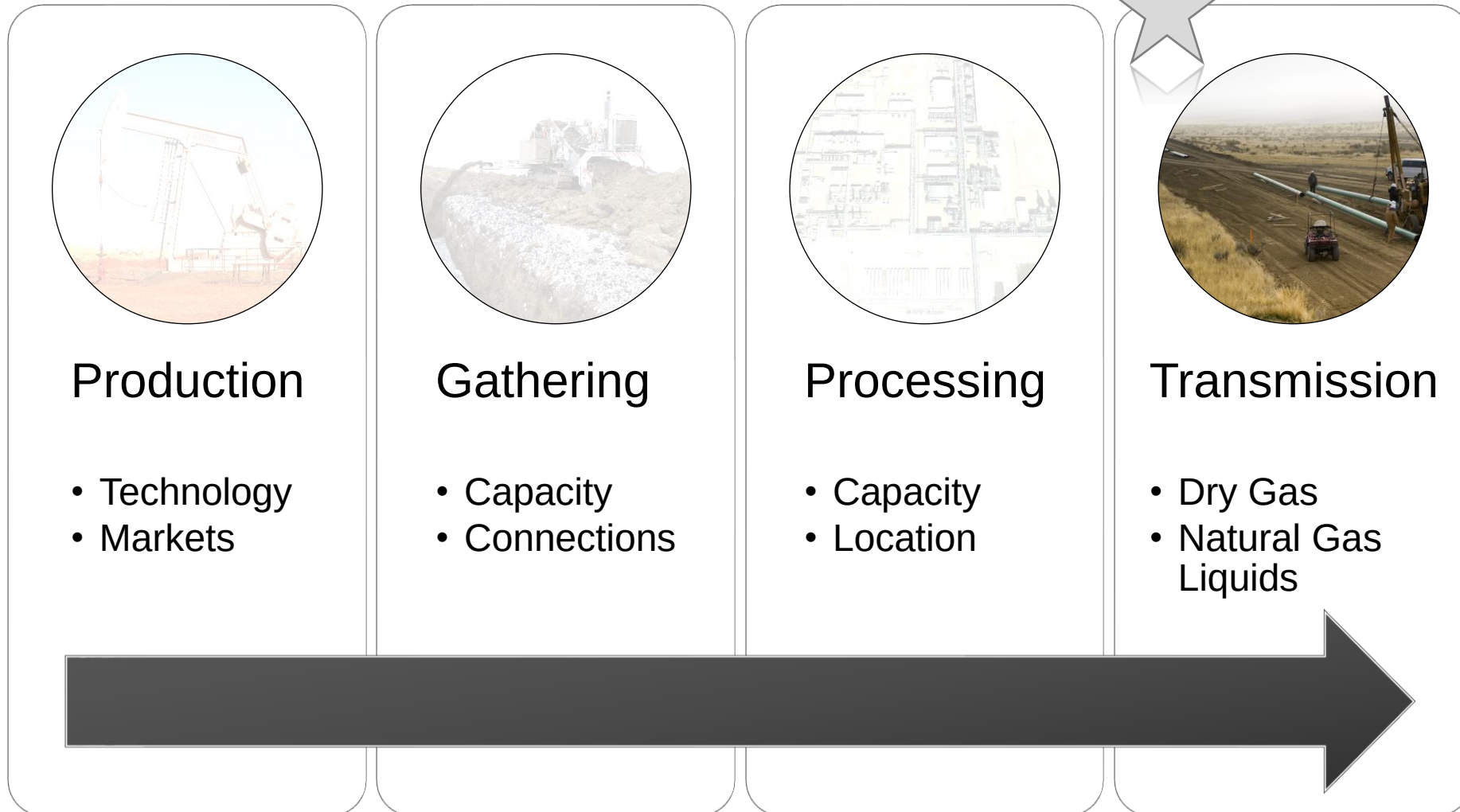
Gas Processing Capacity & Spare Capacity



Gas Processing Capacity & Spare Capacity



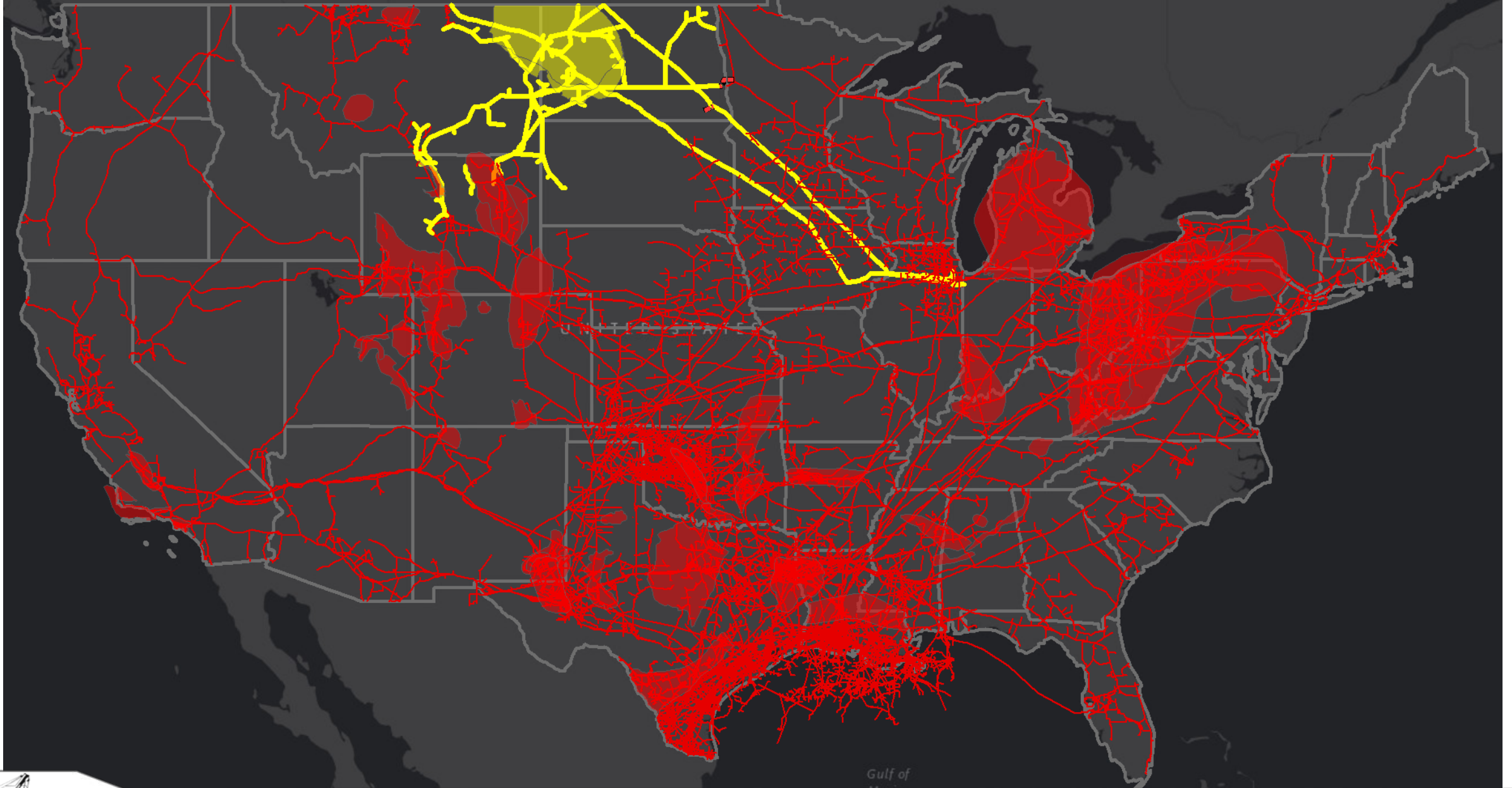
Natural Gas Update



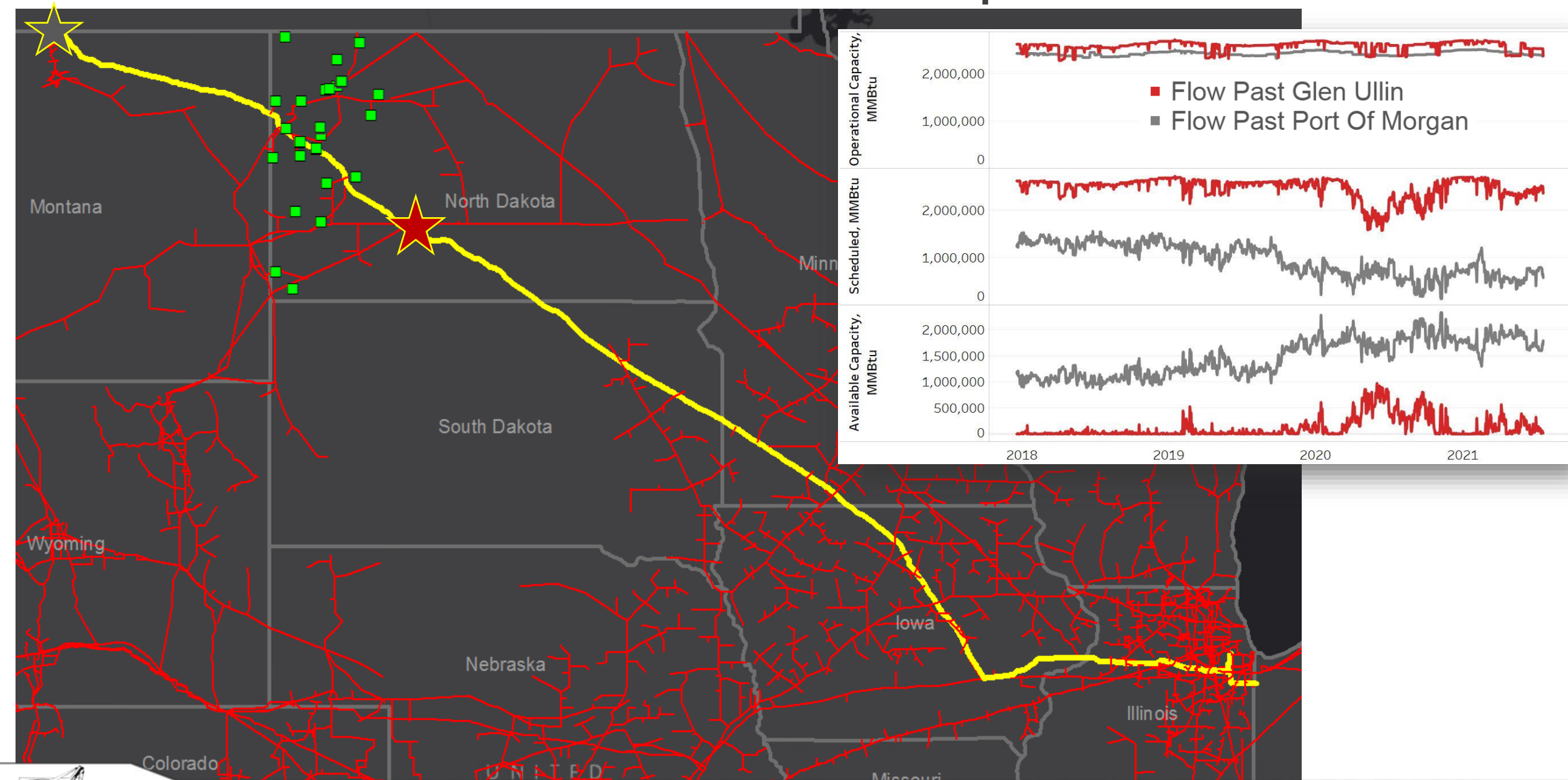
Major Gas Pipeline Infrastructure



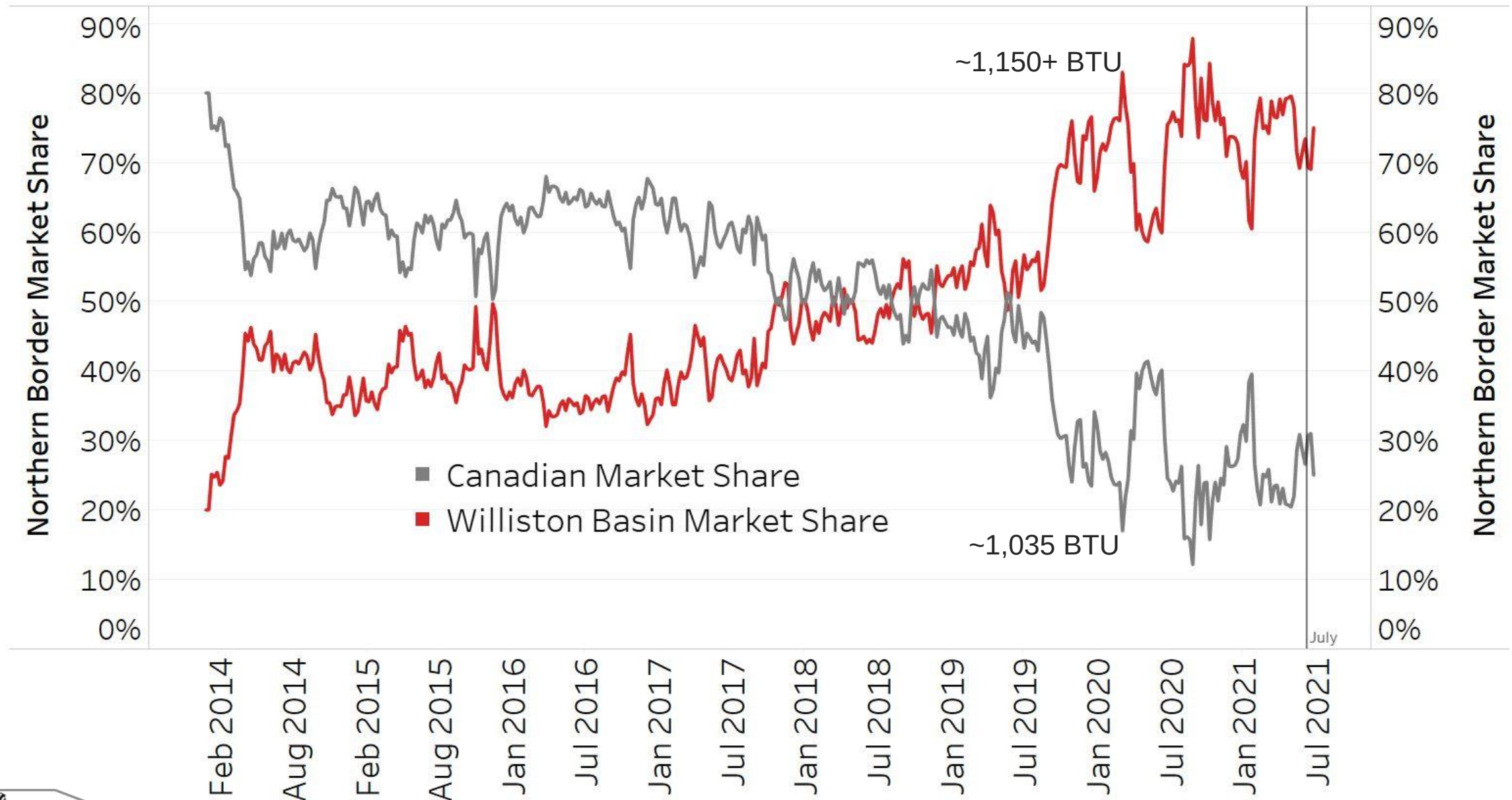
Bakken Natural Gas Infrastructure



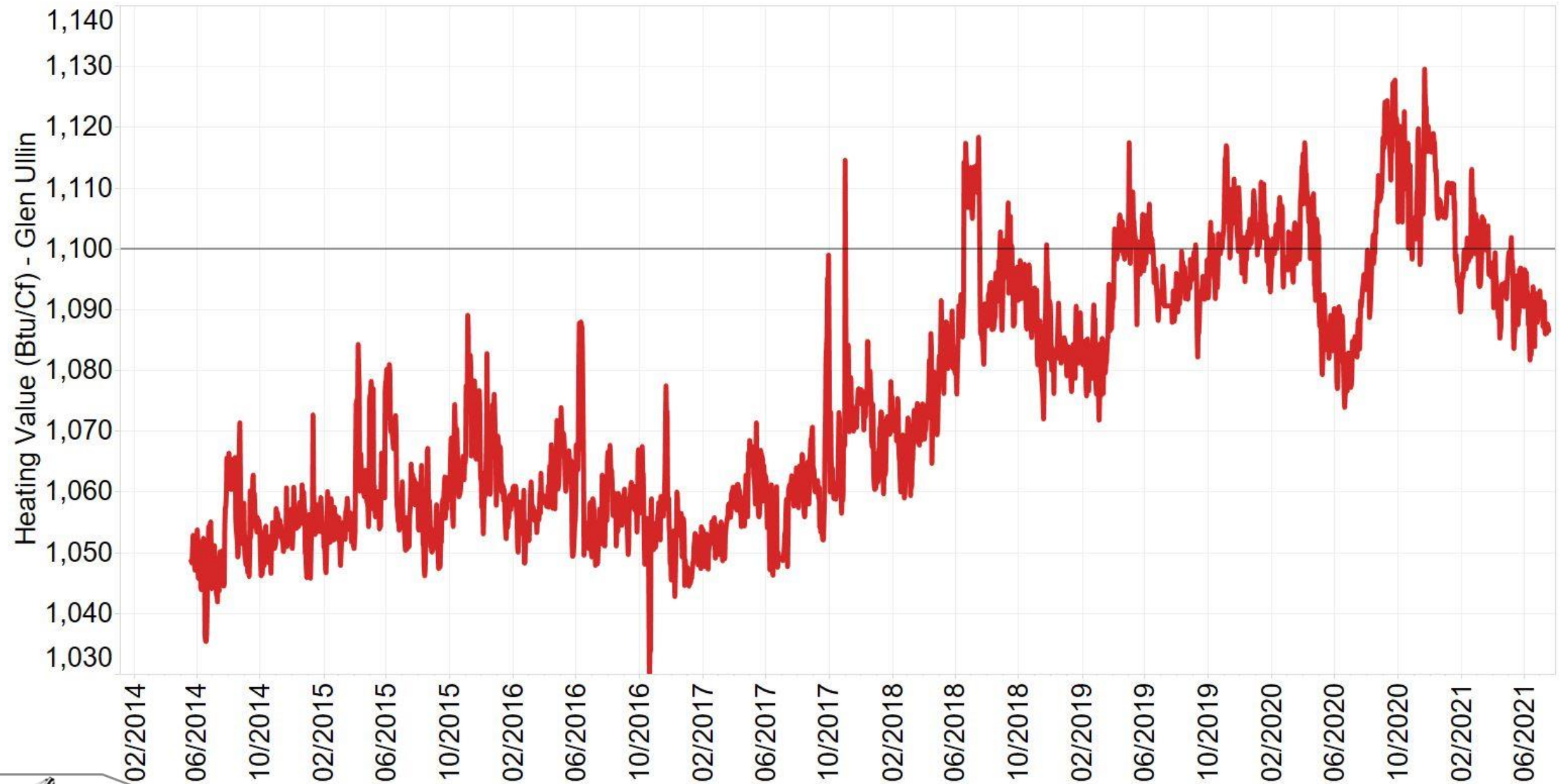
Northern Border Pipeline



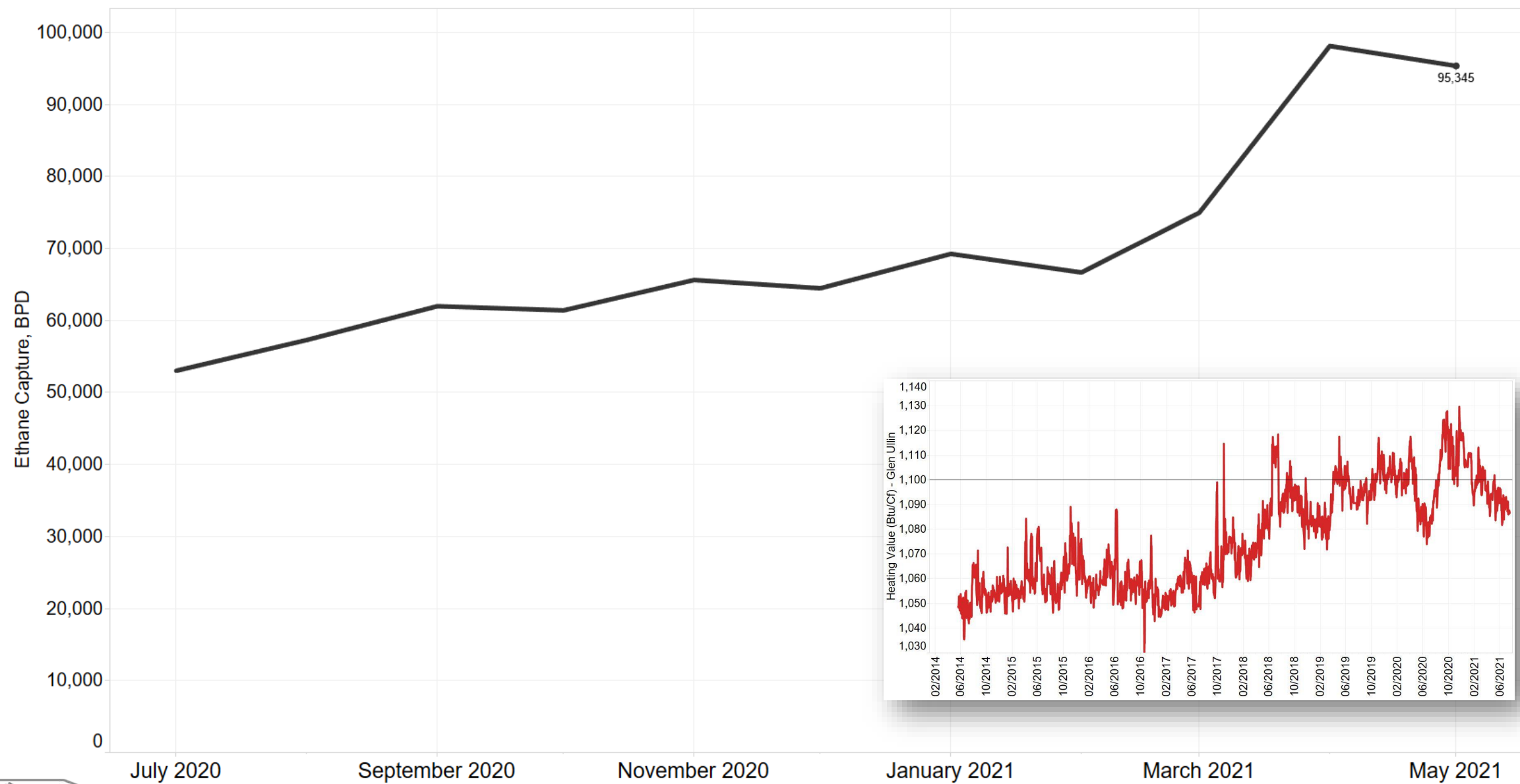
Northern Border Pipeline Market Share



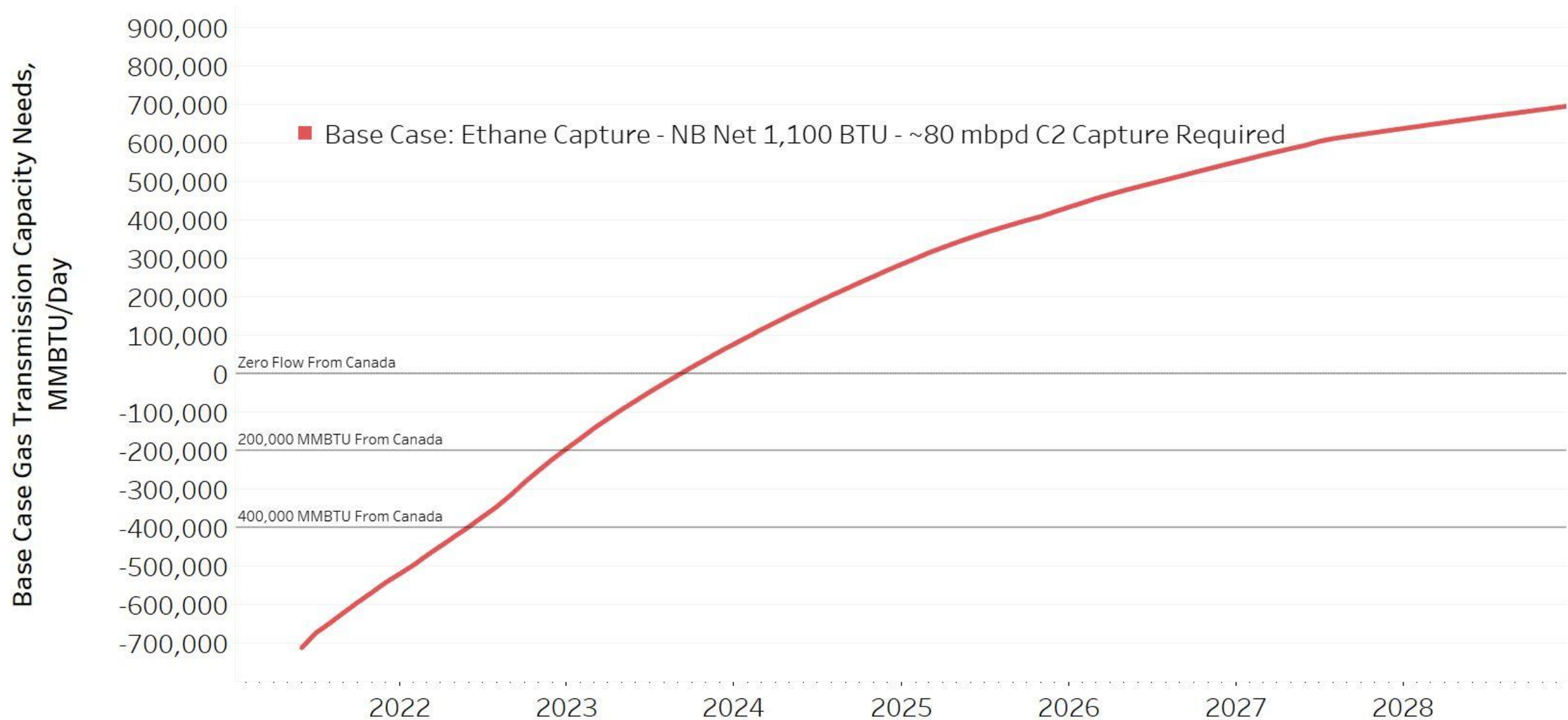
Northern Border BTU at Glen Ullin, ND



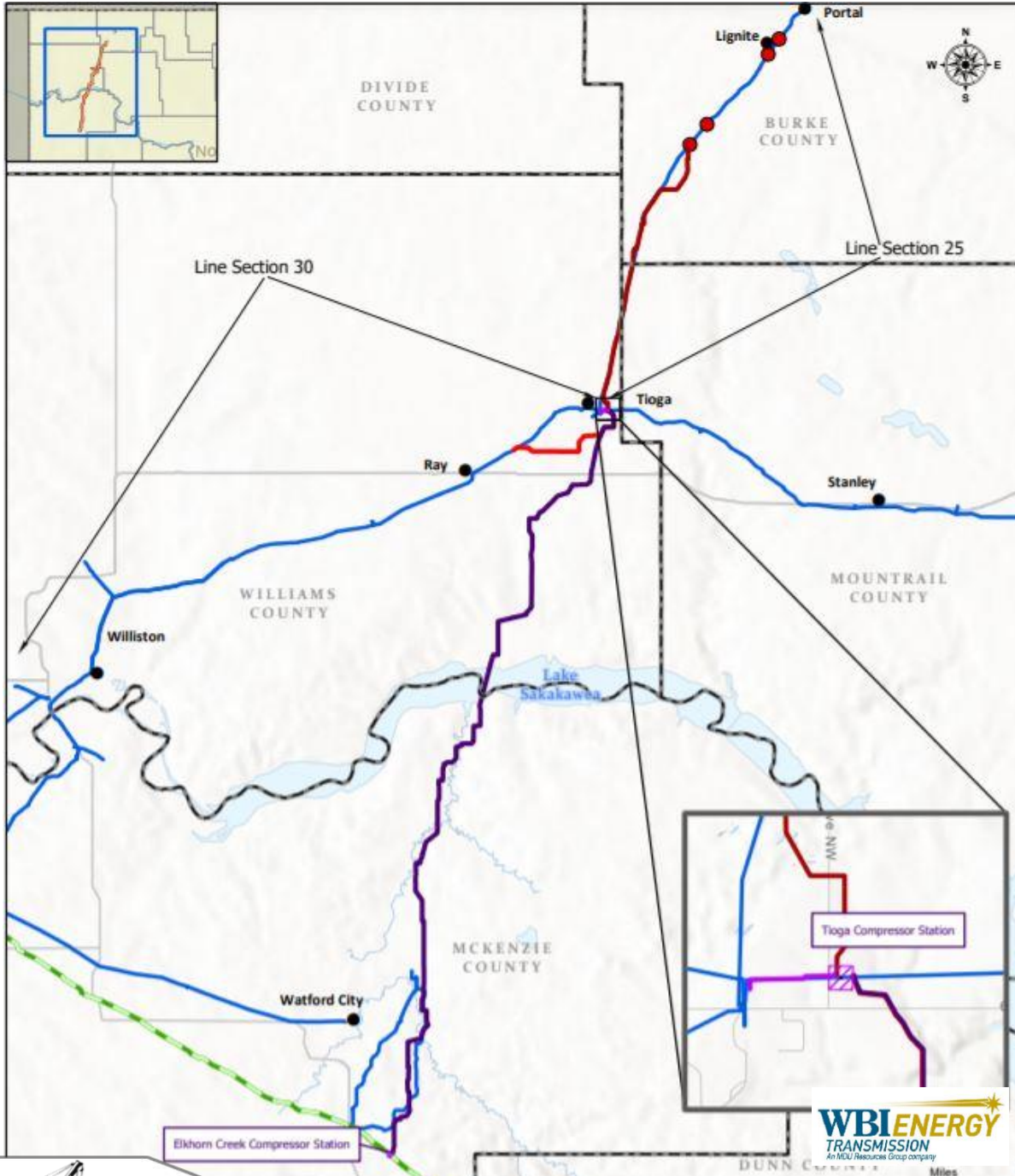
ND Ethane Capture Driving Northern Border BTU Lower



Northern Border – BTU Calculations*



WBI Energy – North Bakken Expansion Project

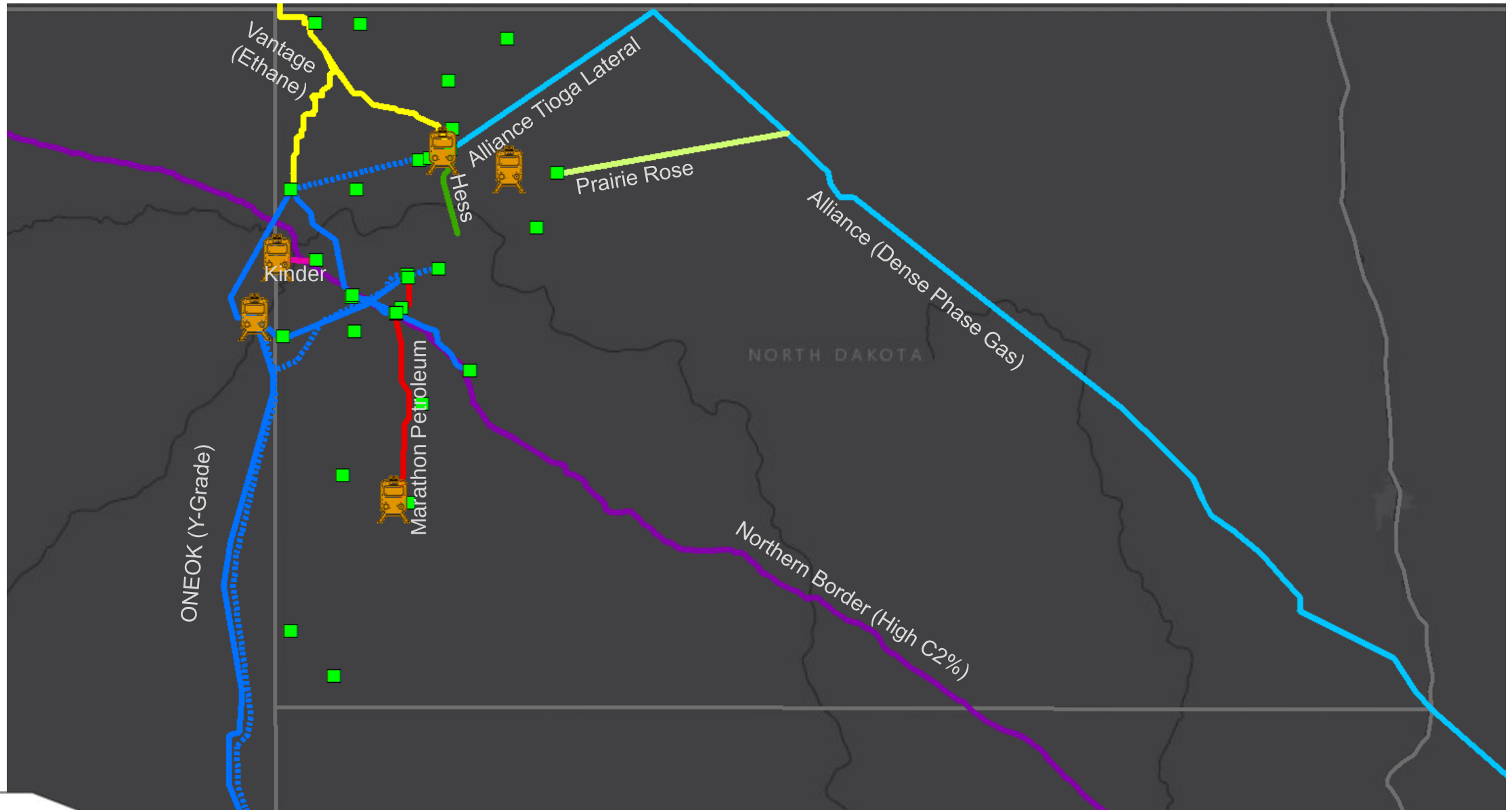


Project Highlights

- ~60 Miles - 24" Pipeline
- ~30 Miles - 12" Pipeline
- \$260+ Million
- Preliminary Capacity 250,000 MCFD
- Expandable to 375,000+ MCFD
- Q4 2021 Proposed Completion
- Residue Gas Service From North of Lake Sakakawea to Northern Border Pipeline in McKenzie County

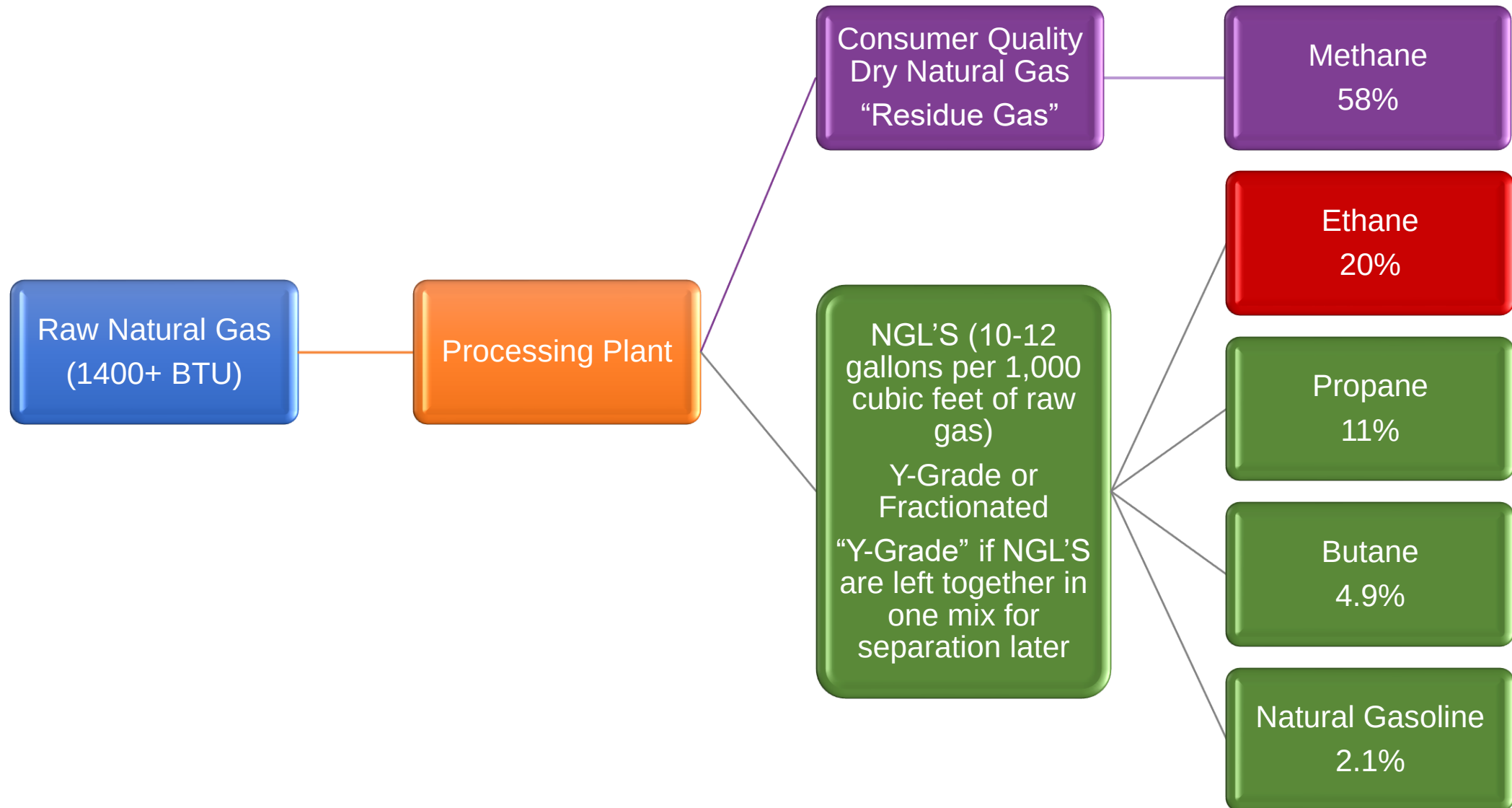


Regional NGL Infrastructure

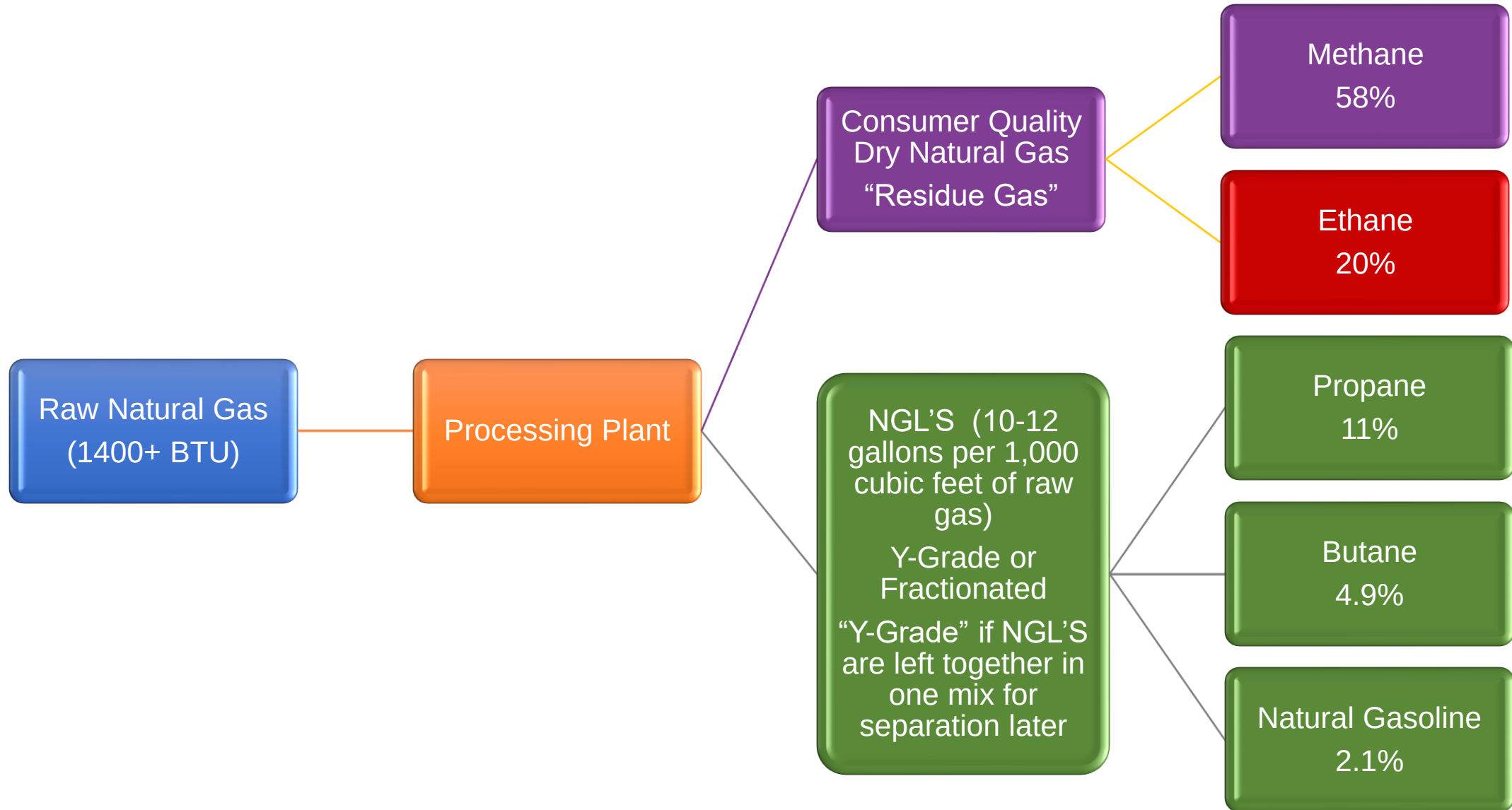


Bakken & Three Forks Natural Gas Liquids Chemistry

Natural Gas Processing – “Ethane Capture”



Natural Gas Processing – “Ethane Rejection”



NGL Chemistry Study - 2020



ASSESSMENT OF BAKKEN PETROLEUM SYSTEM PRODUCED GAS COMPOSITIONS

Final Report

(Project Period: October 15, 2019 – June 19, 2020)

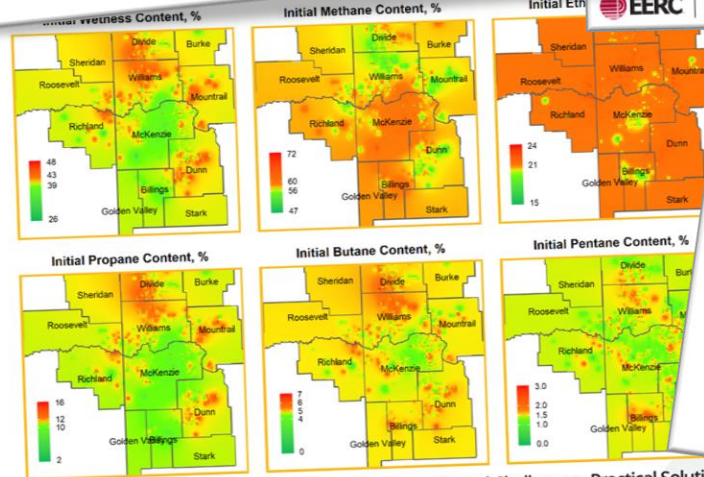
Prepared for:

Justin Kringstad

North Dakota Pipeline Authority
State Capitol, 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

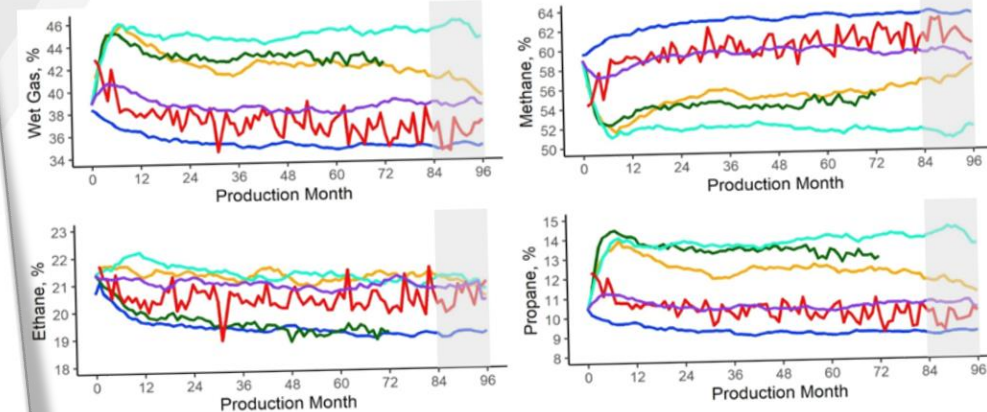
Spatial Patterns

- ❖ The highest methane concentrations occur in the core Bakken area, and the lowest levels occur in northern Williams and southern Divide counties.
- ❖ There is considerably less variation in ethane content across the BPS than with other NGLs.



Critical Challenges. Practical Solutions.

Temporal Patterns in Measured Gas Composition



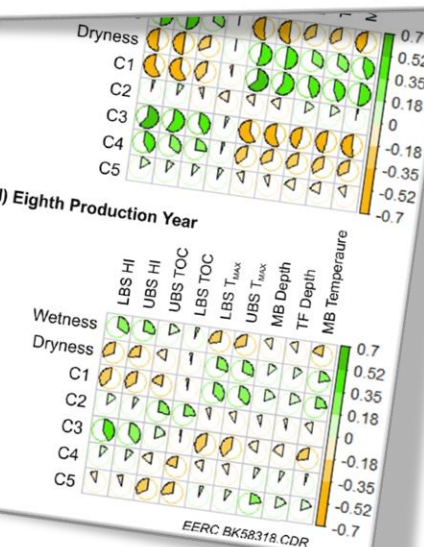
Divide Dunn-McKenzie Mountrail
Dunn McKenzie Williams

Critical Challenges. Practical Solutions.

c) Fifth Production Year



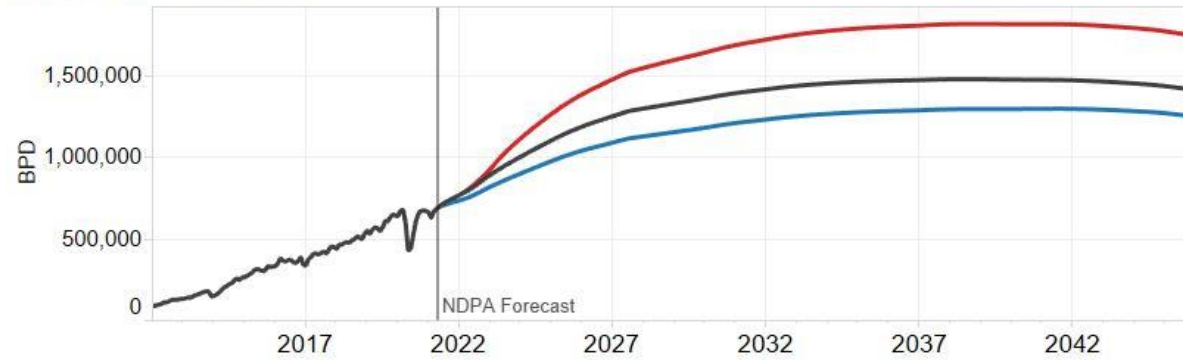
d) Eighth Production Year



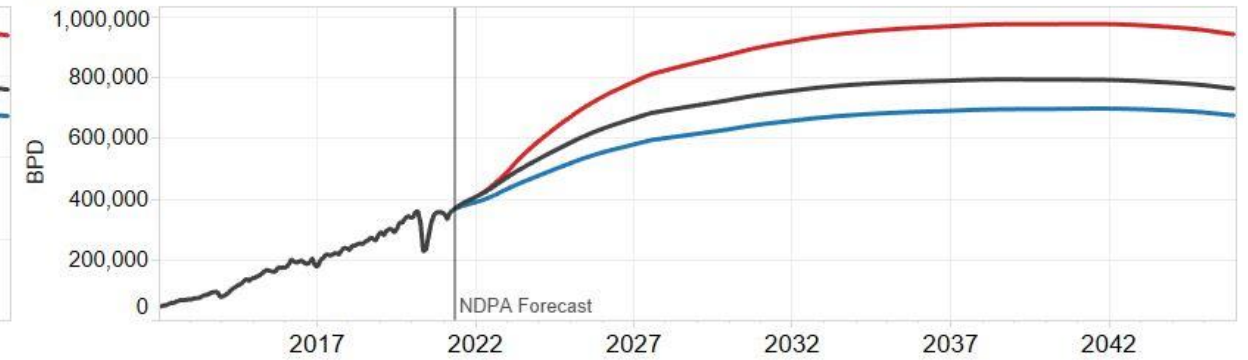
EERC BK58318.CDR

North Dakota Captured* NGL's

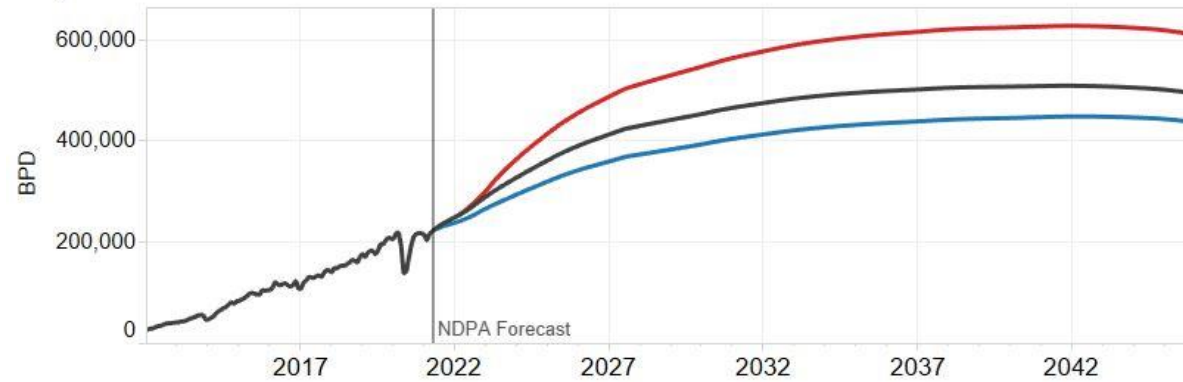
All Natural Gas Liquids



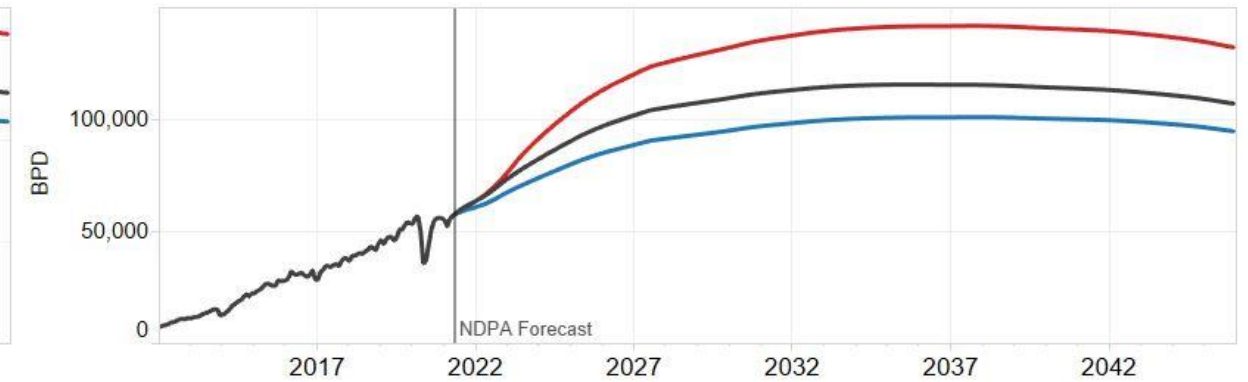
Ethane



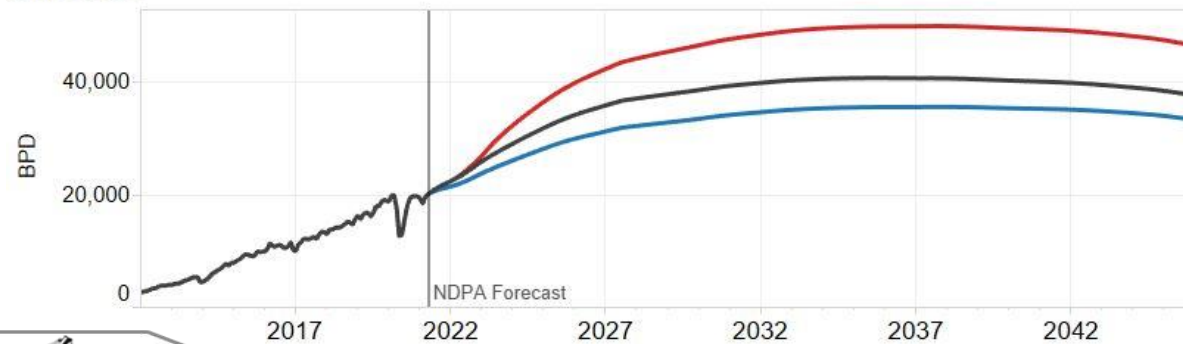
Propane



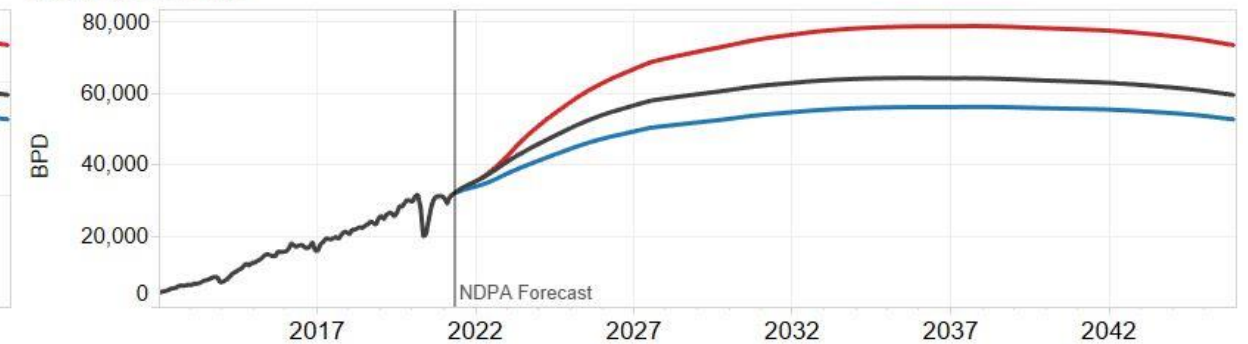
Butane



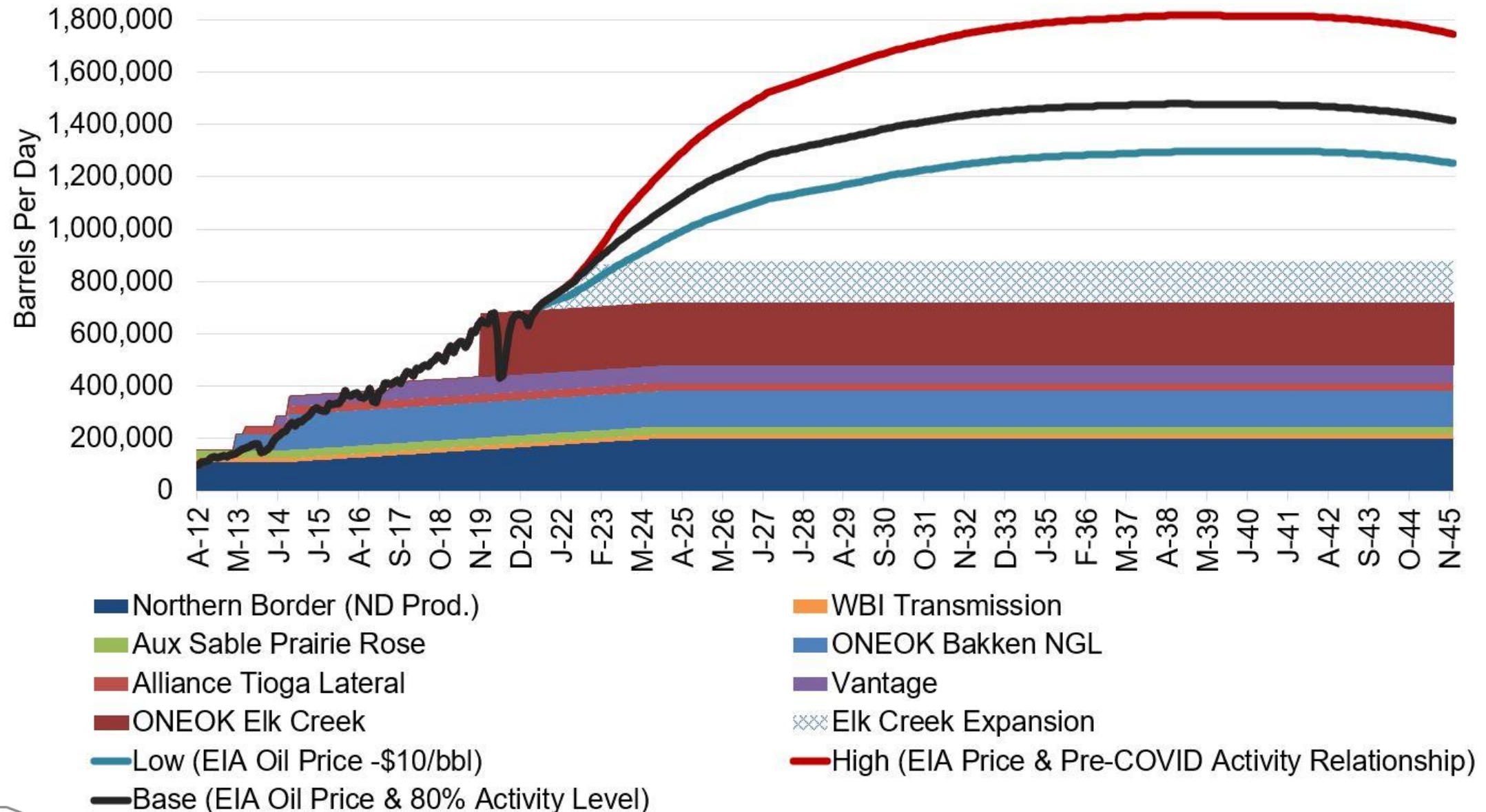
Isobutane



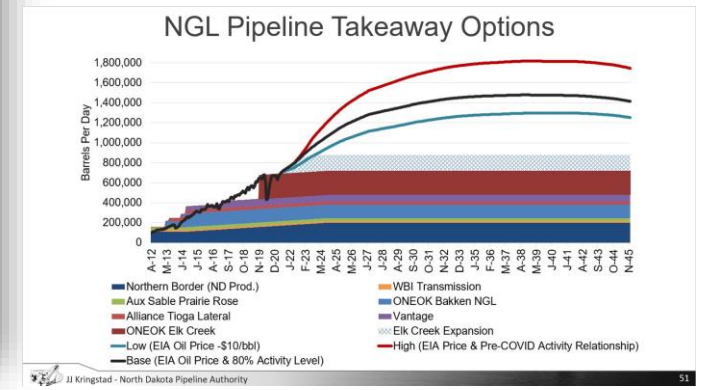
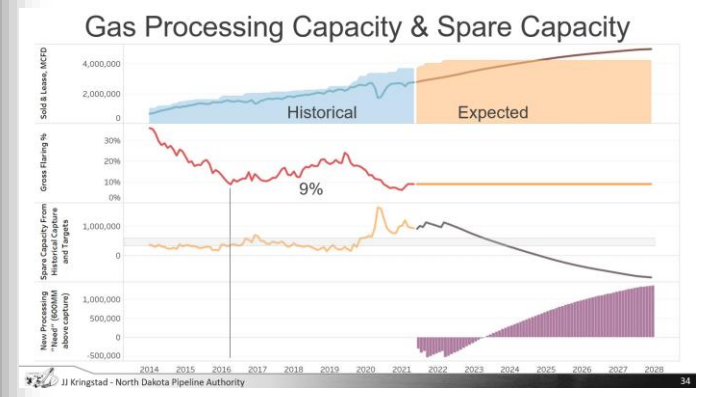
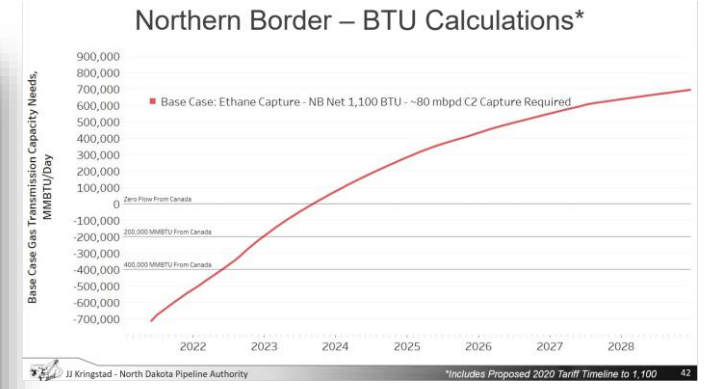
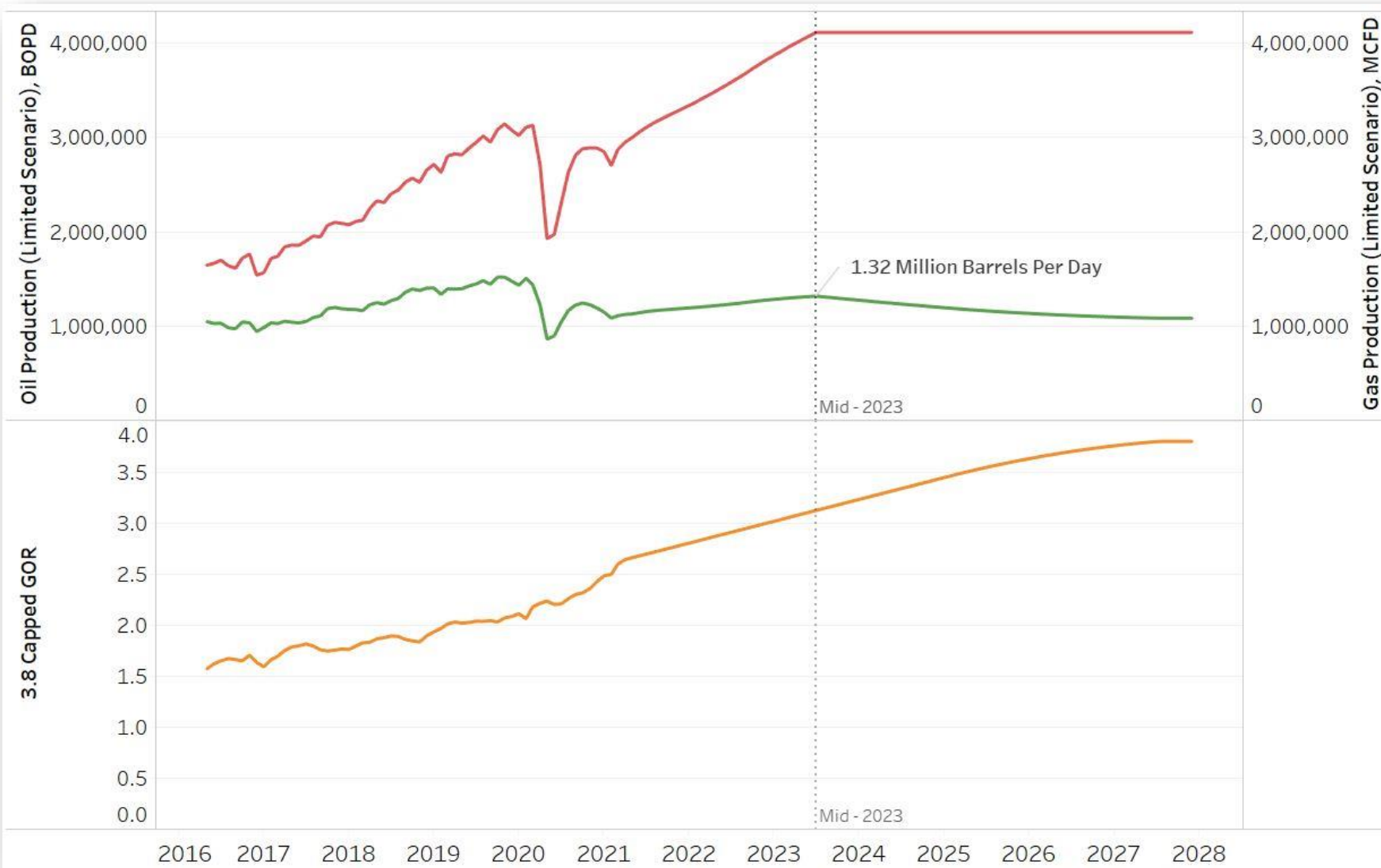
Natural Gasoline



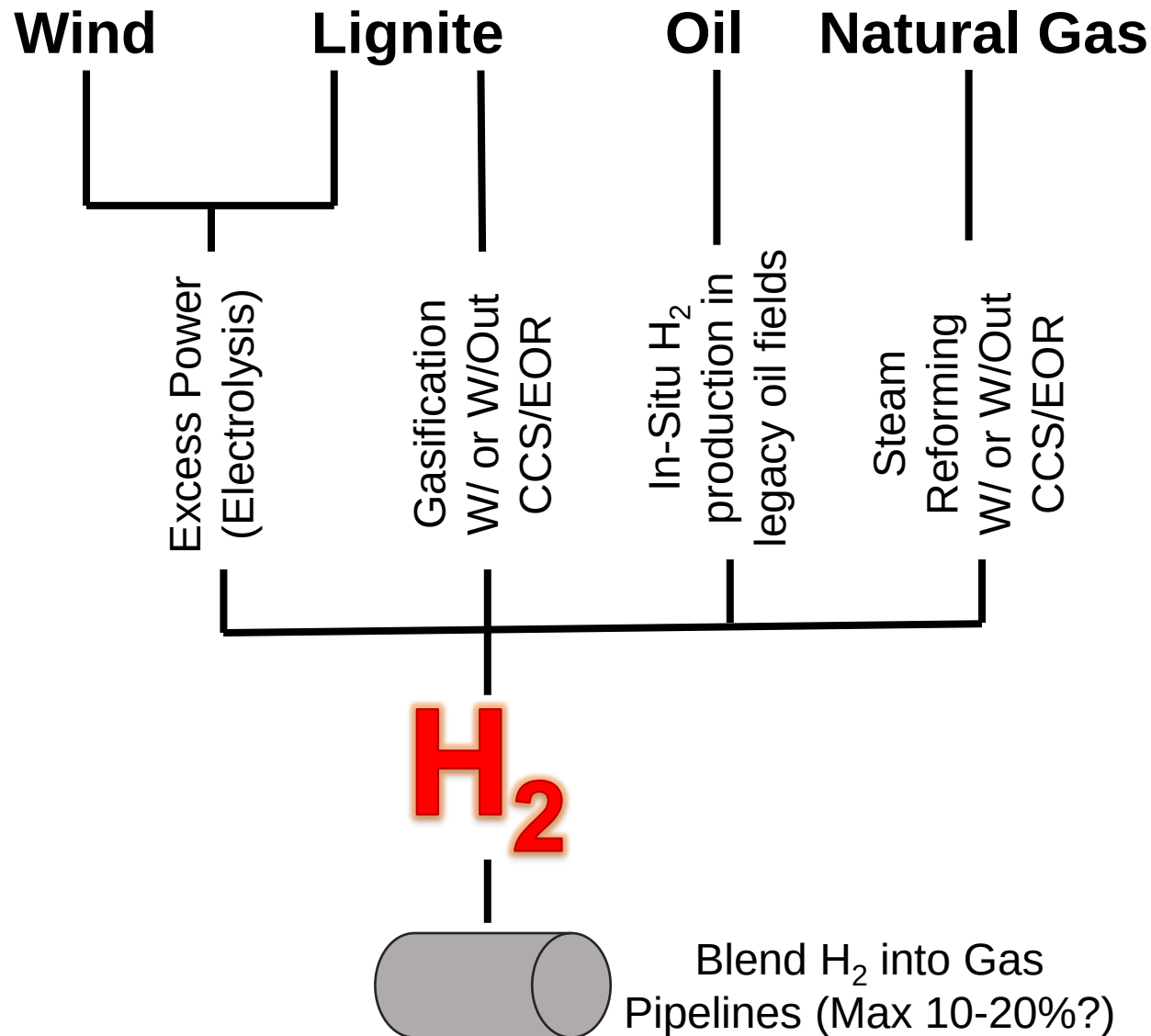
NGL Pipeline Takeaway Options



Additional Gas Capture Investments Are Necessary



Exploring Hydrogen Solutions



Electric Generation

- Large and Immediate Market for Excess Power in Regional Pipelines
- Excess Electrons Sold for H₂ BTU Value in Gas Markets
- Gas Pipelines Could Support Intermittent Deliveries
- Gasification Options for Lignite



Gas Pipelines & Petroleum

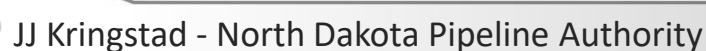
- Lowers Pipeline BTU
- Possible Support for Expansion Efforts
- Gas Marketing Advantages with Renewable or Carbon-Free Sources of H₂
- In-situ H₂ Production in Legacy Fields
- Natural Gas Steam Reforming W/CCS or EOR Options



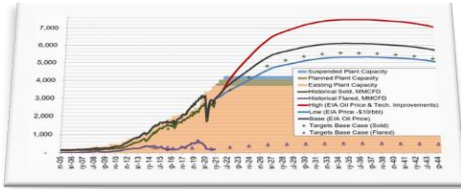
North Dakota

- Grows the "Energy Pie"
- Supports Current and Future Jobs
- First Step in Hydrogen Bridge for New Industries (Petchem, Fertilizer, Renewable Natural Gas, Vehicles, etc.)
- ESG Benefits





Rethinking Bakken Gas Processing



ND Gas Processing Plant 2.0
(Steam Reforming “Raw” Gas)

Raw Gas

H₂

- Pipeline Blending
- Ammonia/Fertilizer
- Power Generation

CO₂

- Sequester @ ~\$2.70/MCF gas eq. (\$50/ton 45Q)
- EOR @ ~\$1.89/MCF gas eq. (\$35/ton 45Q) + Sales Revenue
- New Buildout, Operation, & Sales of CO₂ Distribution Pipeline Network to Regional Oilfields

Concept
Only

Proposed CATCH Act (45Q Revisions)

Sequester @ ~\$4.59/MCF gas eq. & \$85/ton 45Q

EOR @ ~\$3.24/MCF gas eq. & \$60/ton 45Q



Contact Information

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Websites:

www.pipeline.nd.gov
www.northdakotapipelines.com



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