

ND Petroleum Council Annual Meeting

Justin J. Kringstad

Geological Engineer

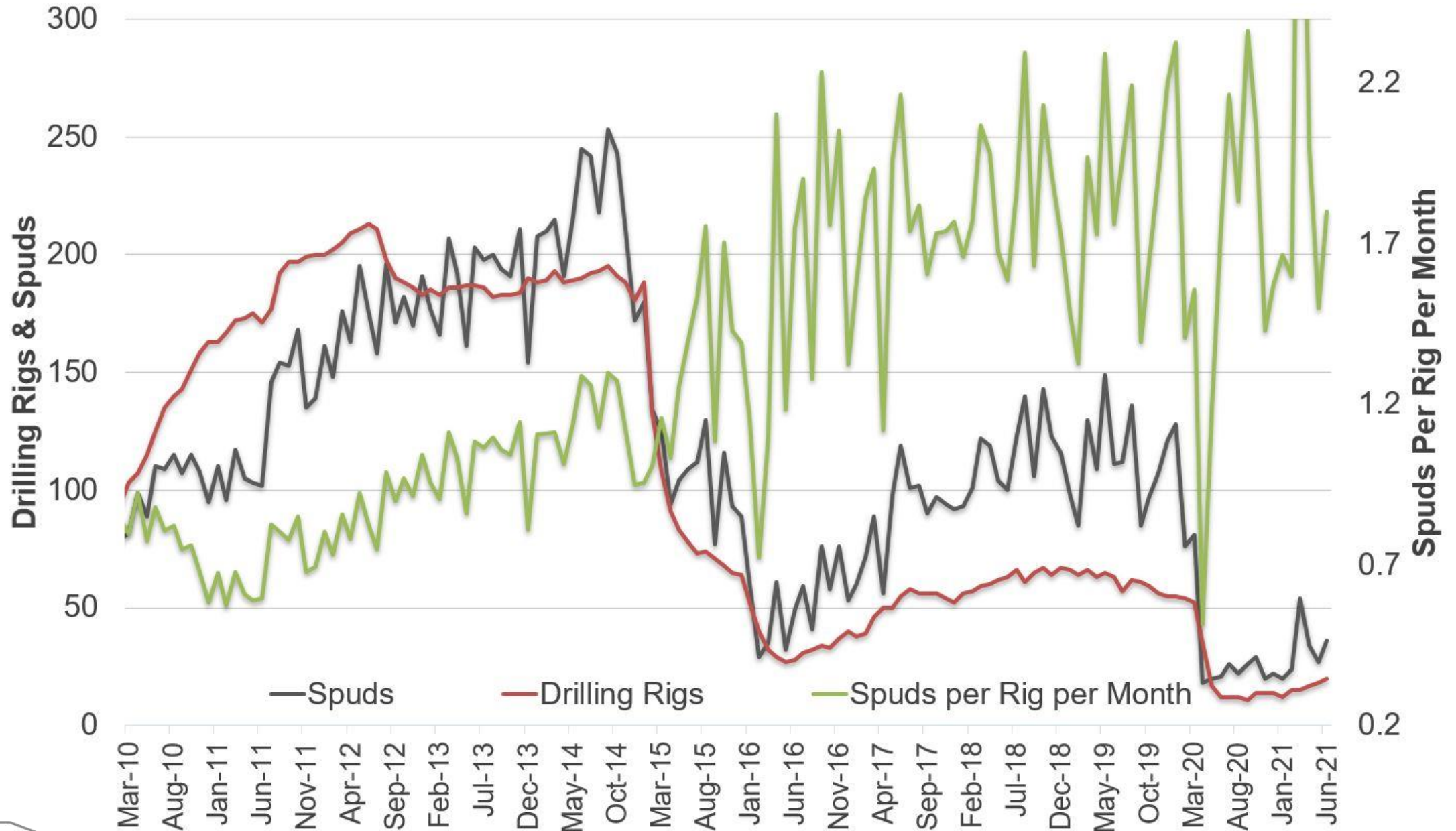
Director

North Dakota Pipeline Authority

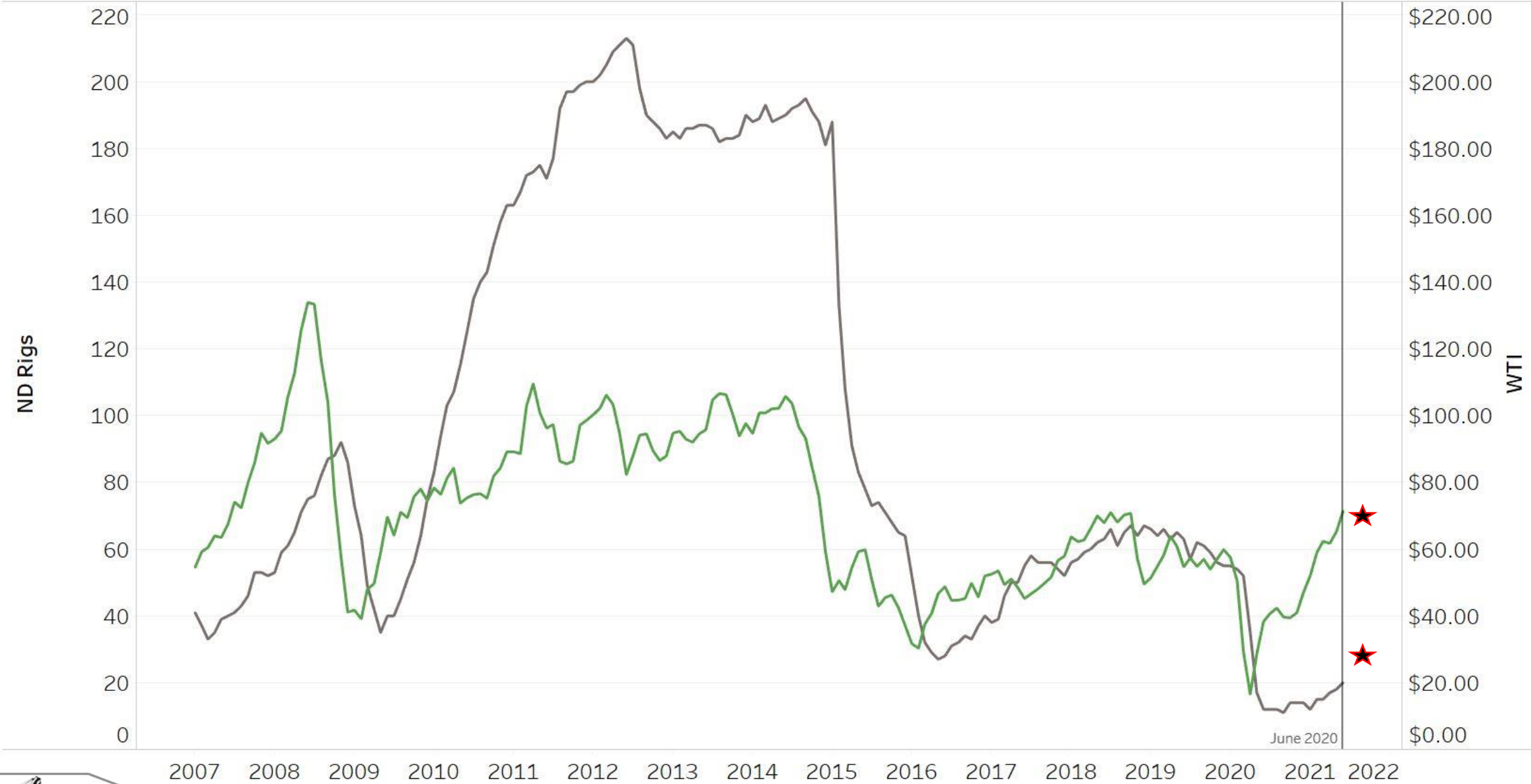


September 23, 2021

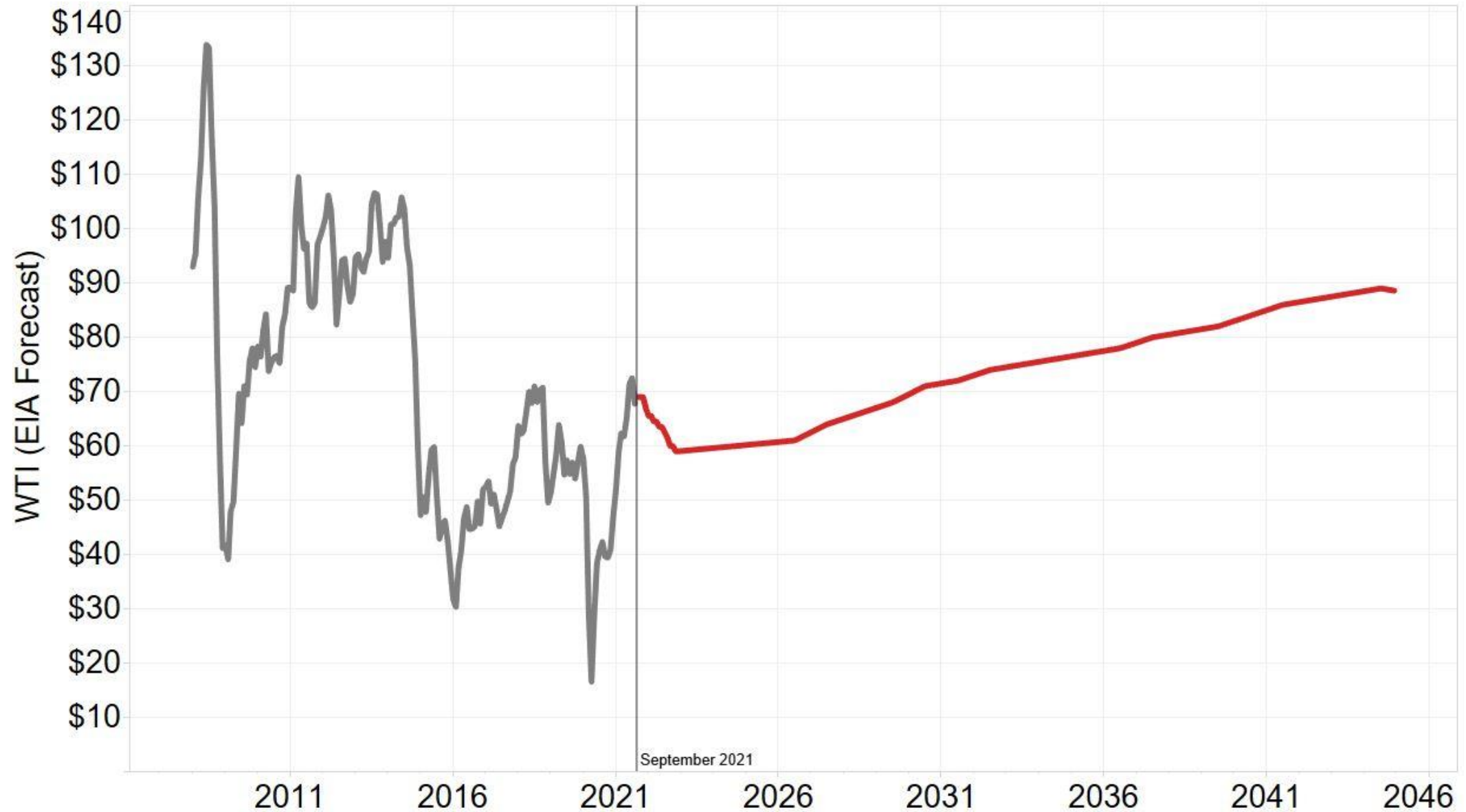
North Dakota Drilling Rig Efficiency



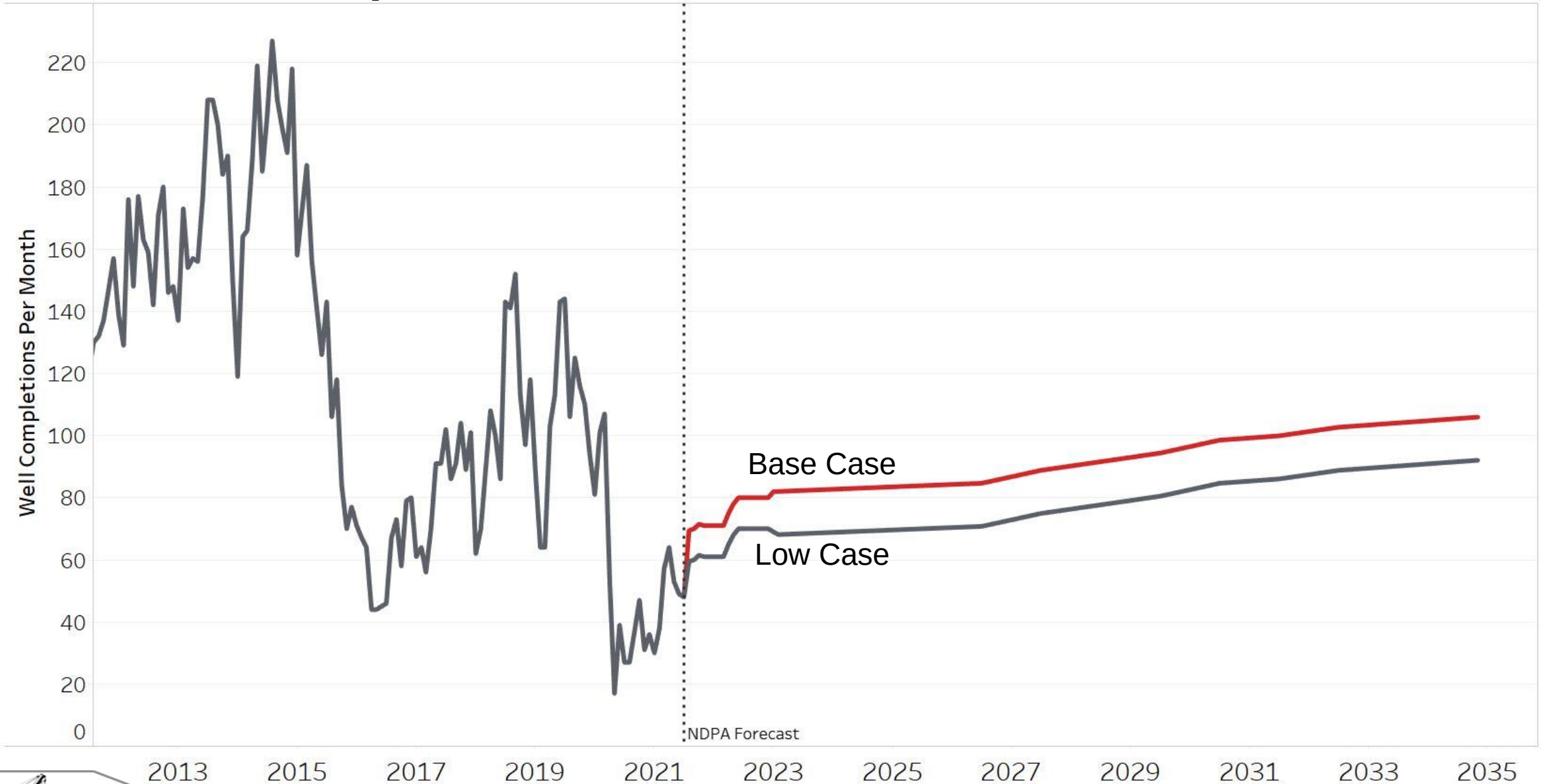
North Dakota Drilling Activity History



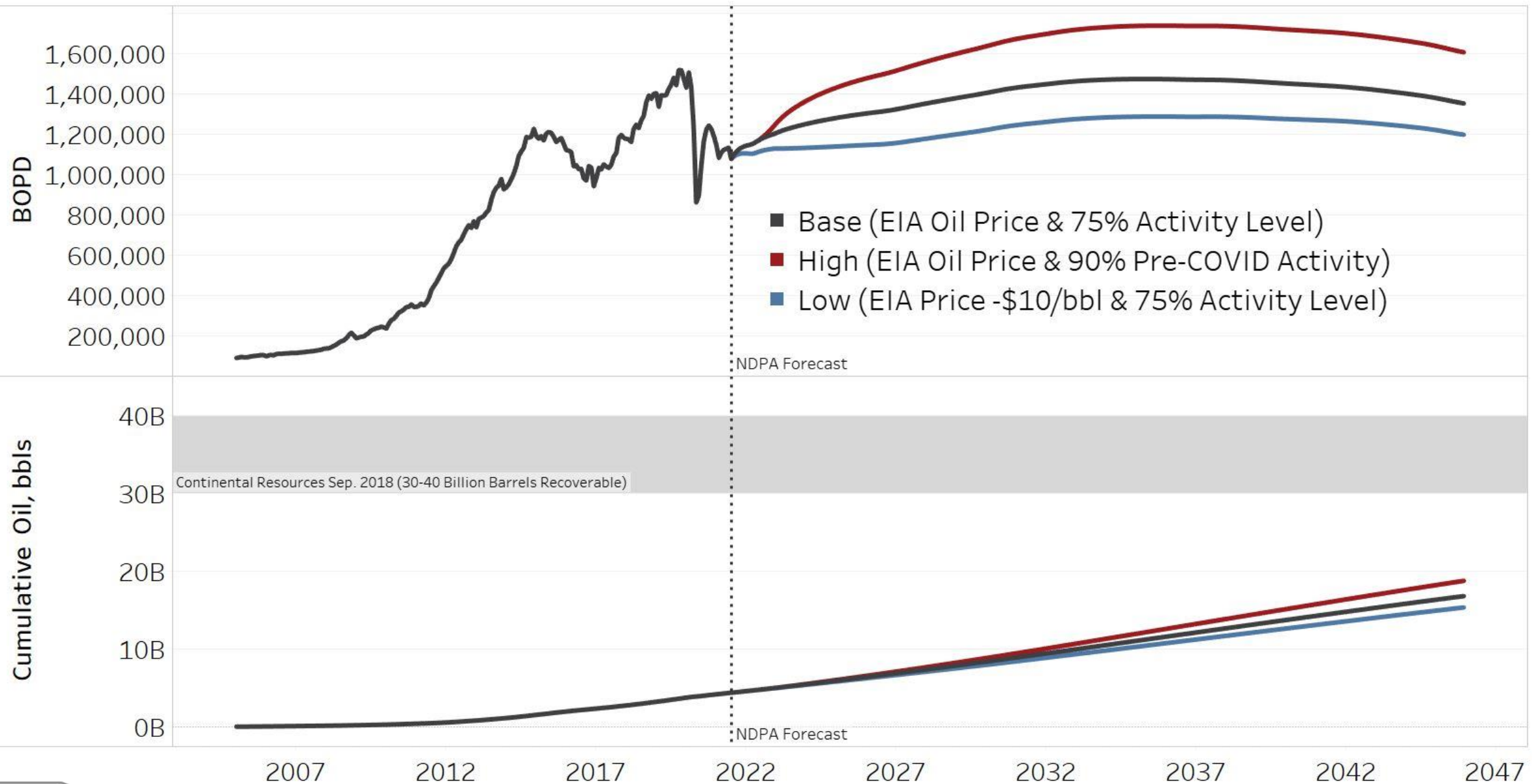
EIA Oil Price Outlook



Well Completion Forecast at EIA Price Deck



ND Oil Production: EIA Price Deck

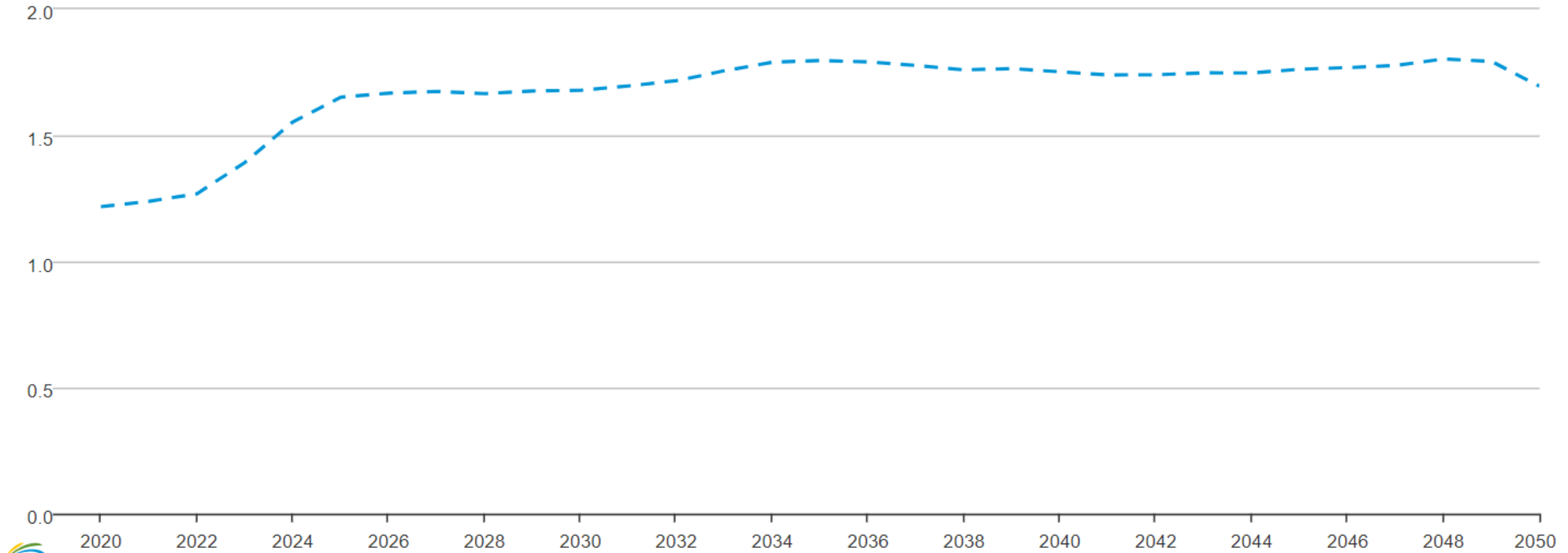


EIA Oil Production Forecast: Reference Case

Crude Oil: Production: Lower 48 Onshore: Northern Great Plains

Case: Reference case

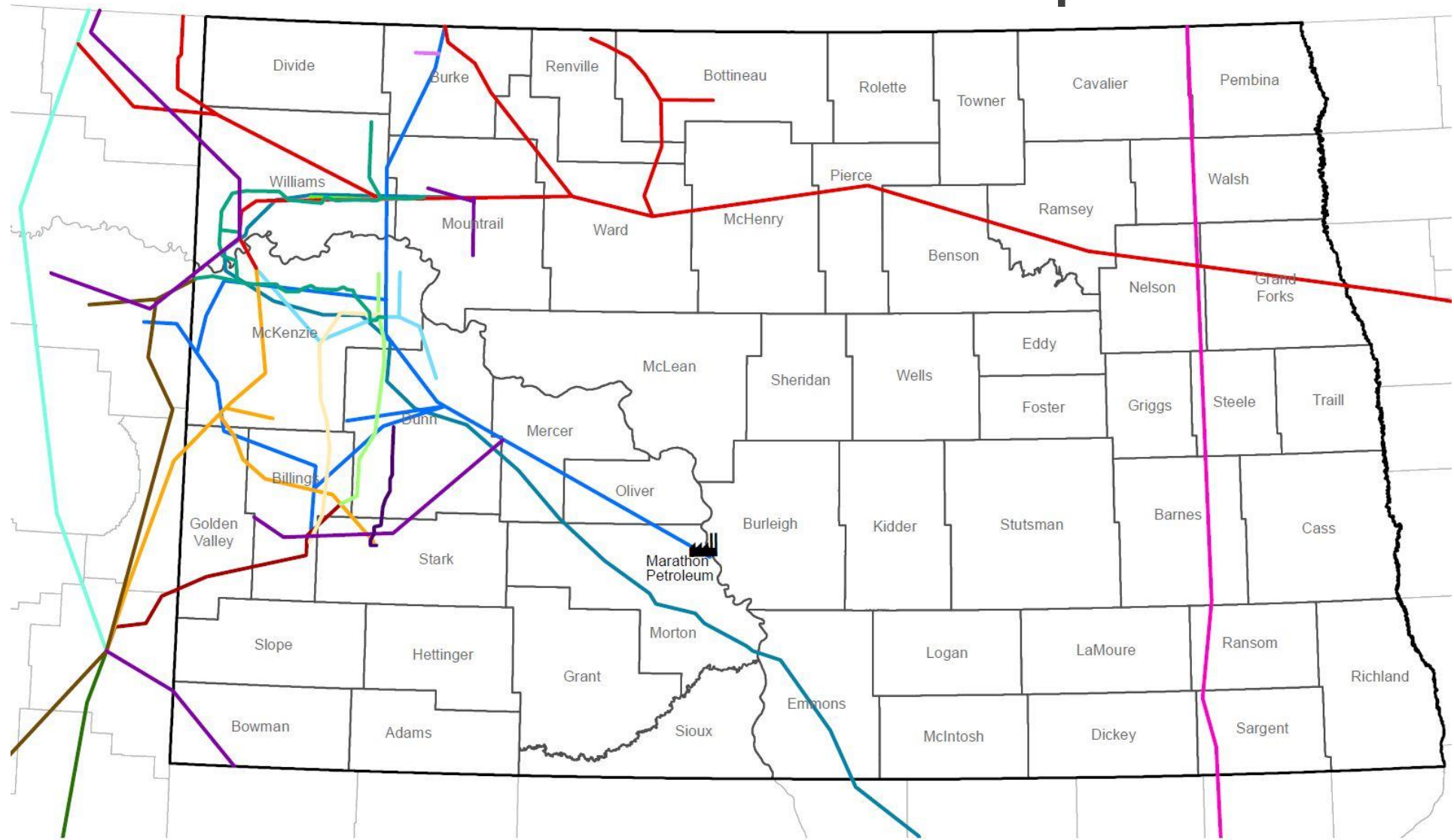
MMb/d



Source: U.S. Energy Information Administration



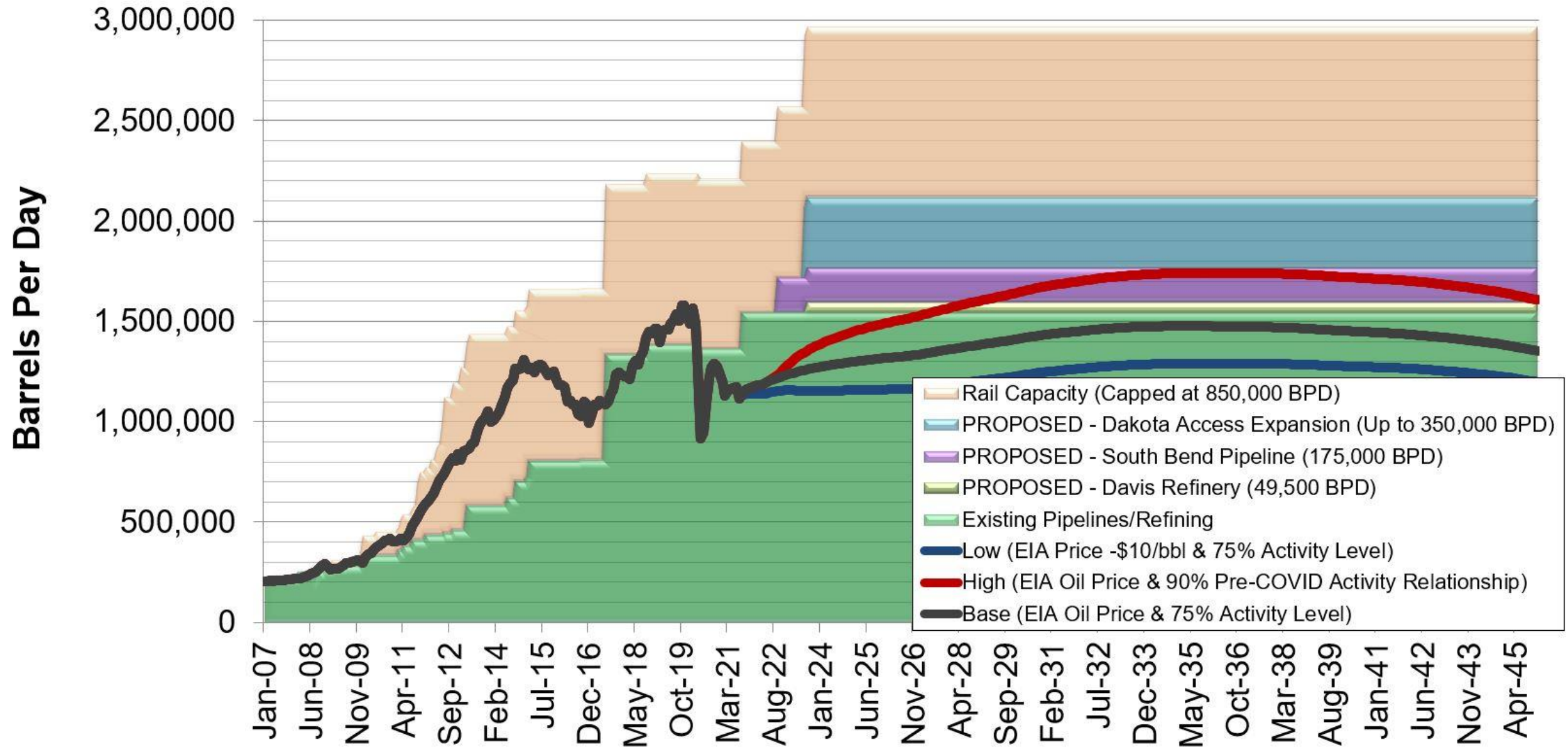
North Dakota Oil Transmission Pipelines



- | | | | | | |
|--------------------|-----------------|---------------|------------|-------------------|----------|
| 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



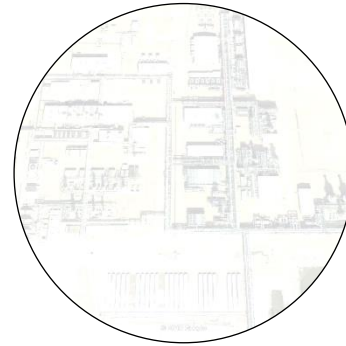
Production

- Technology
- Markets



Gathering

- Capacity
- Connections



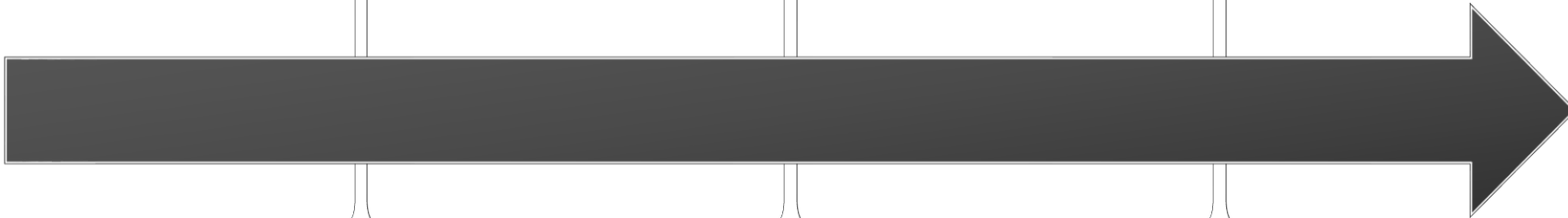
Processing

- Capacity
- Location

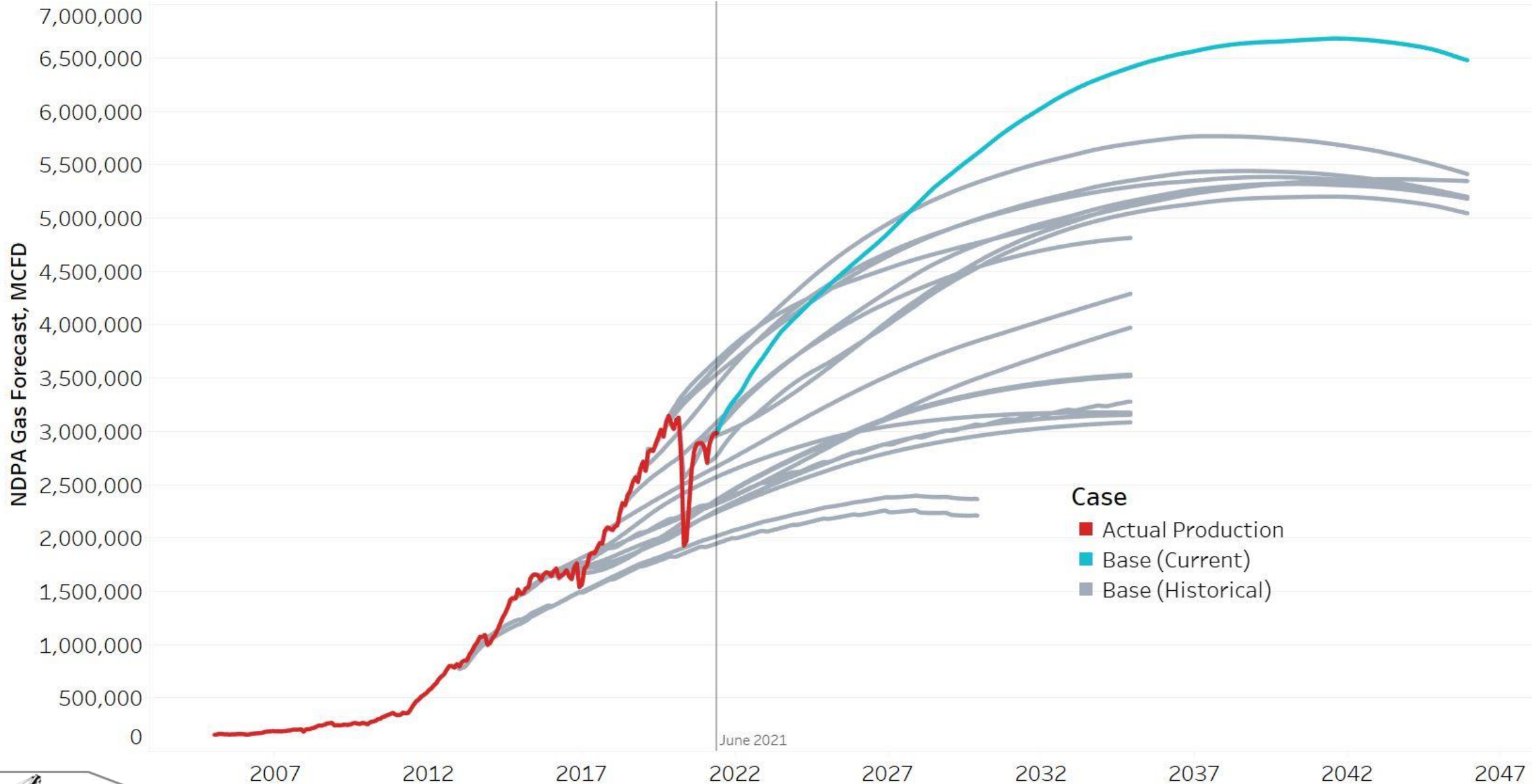


Transmission

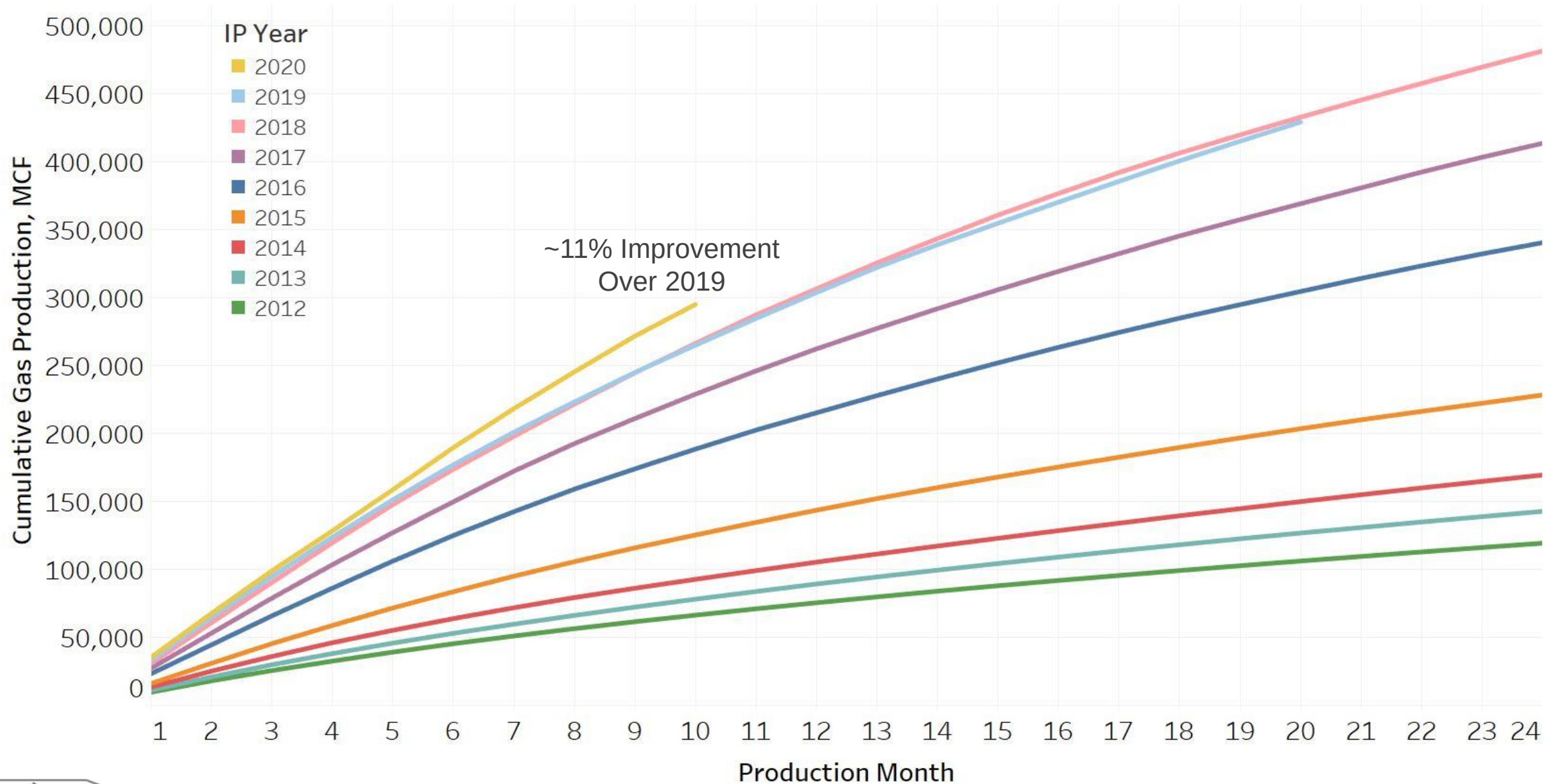
- Dry Gas
- Natural Gas Liquids



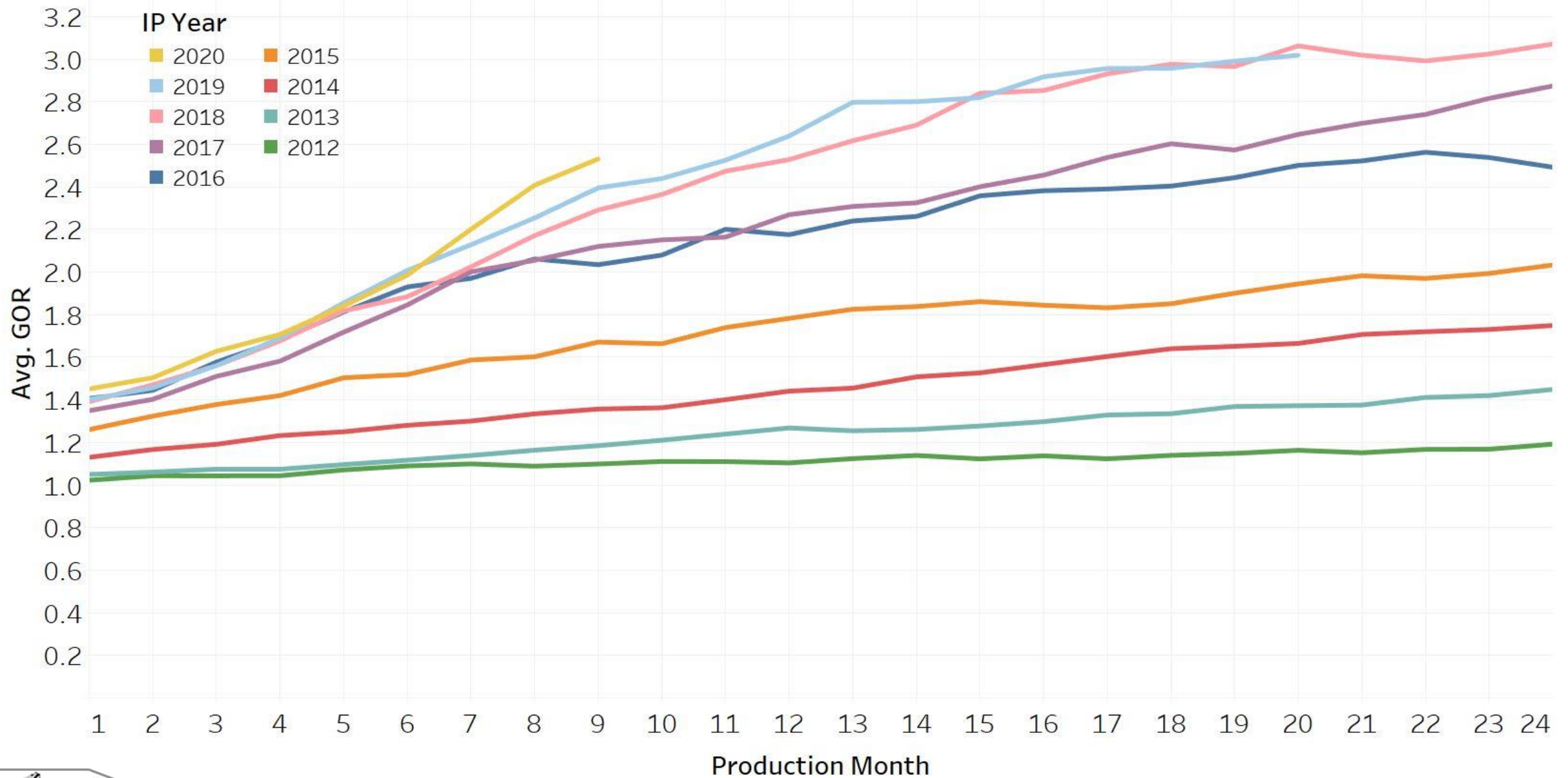
Where Did We(I) Go Wrong on Gas Forecasting?



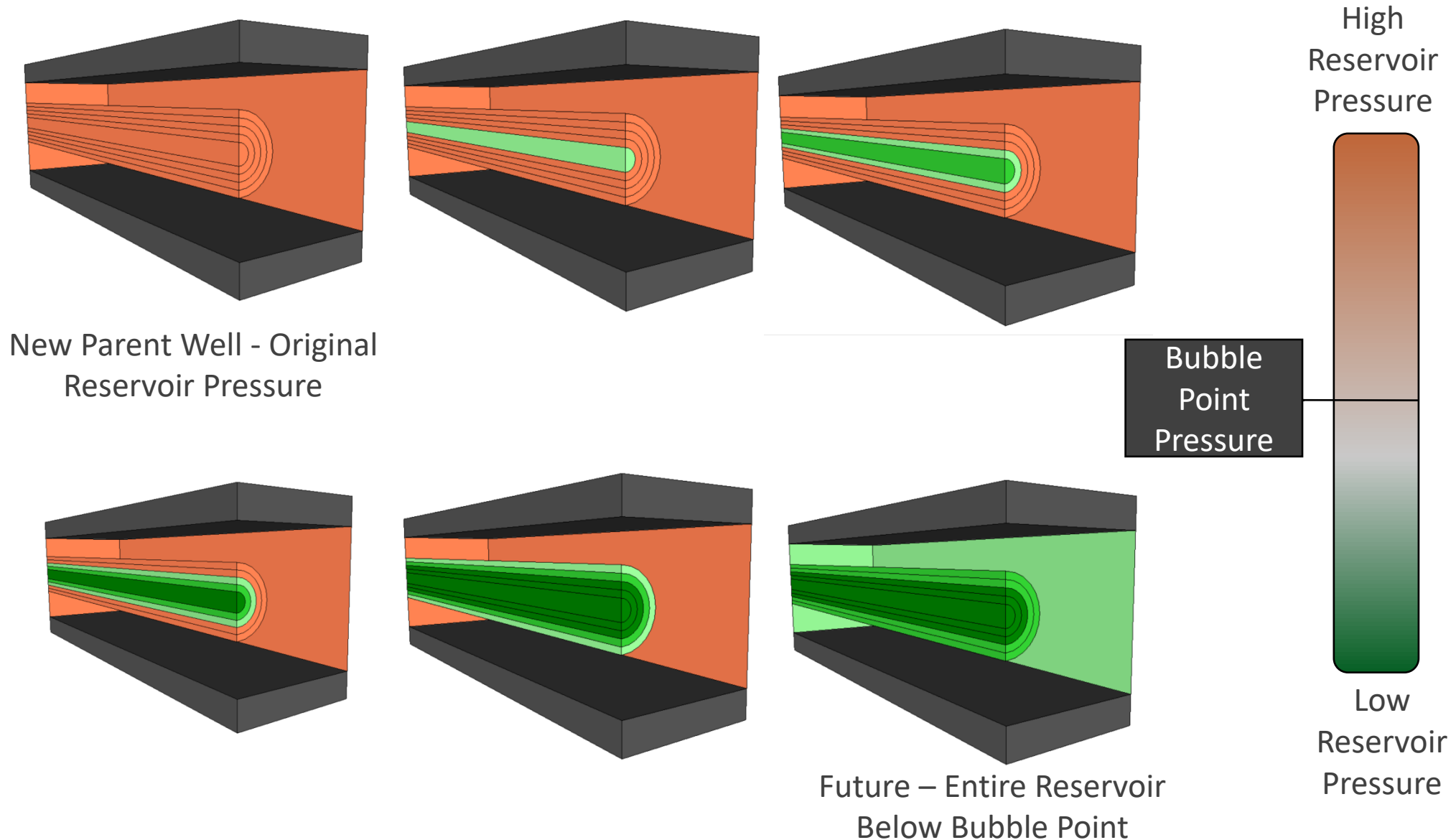
Statewide Bakken Gas Performance



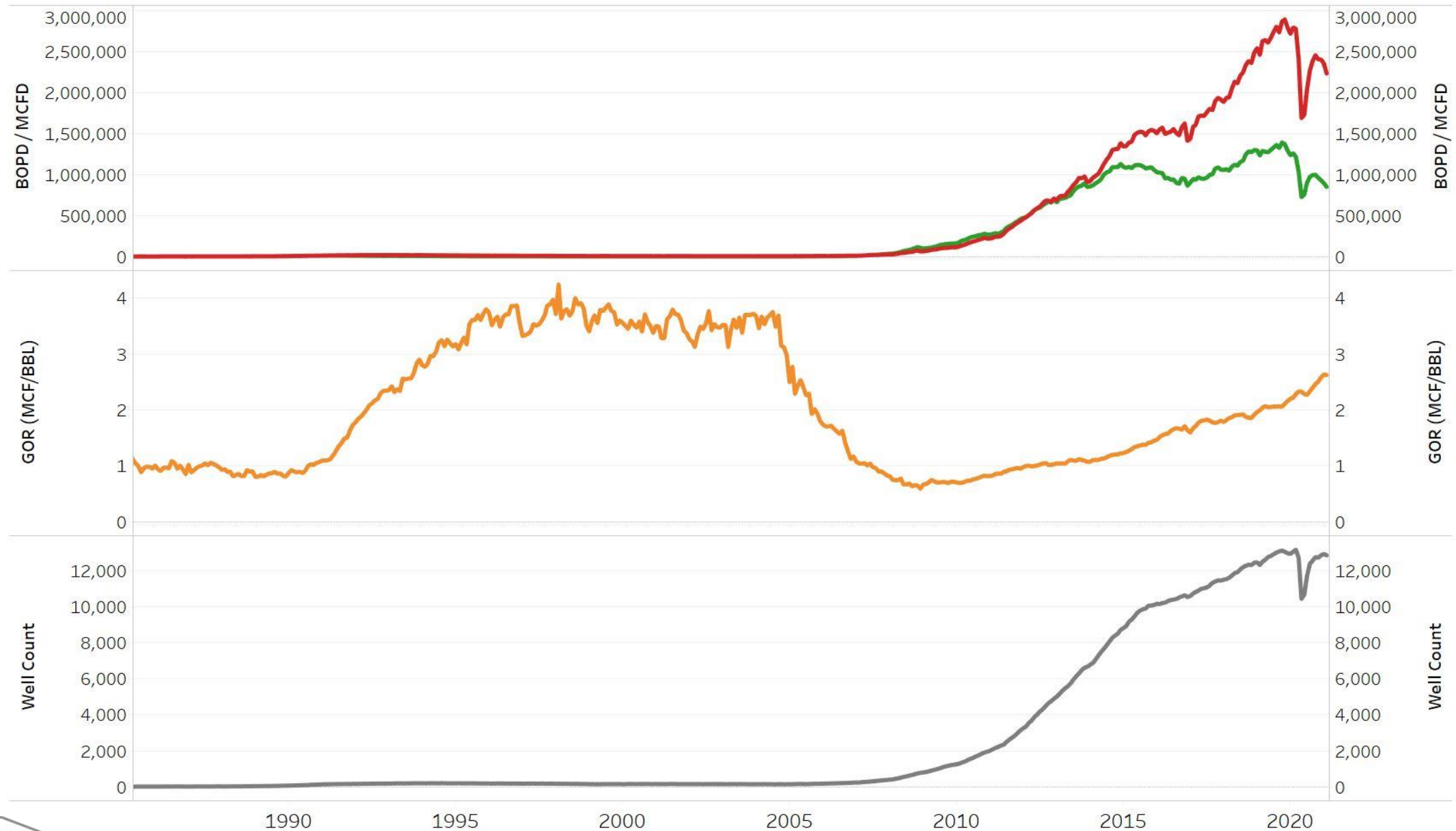
Statewide Bakken Gas/Oil Ratios



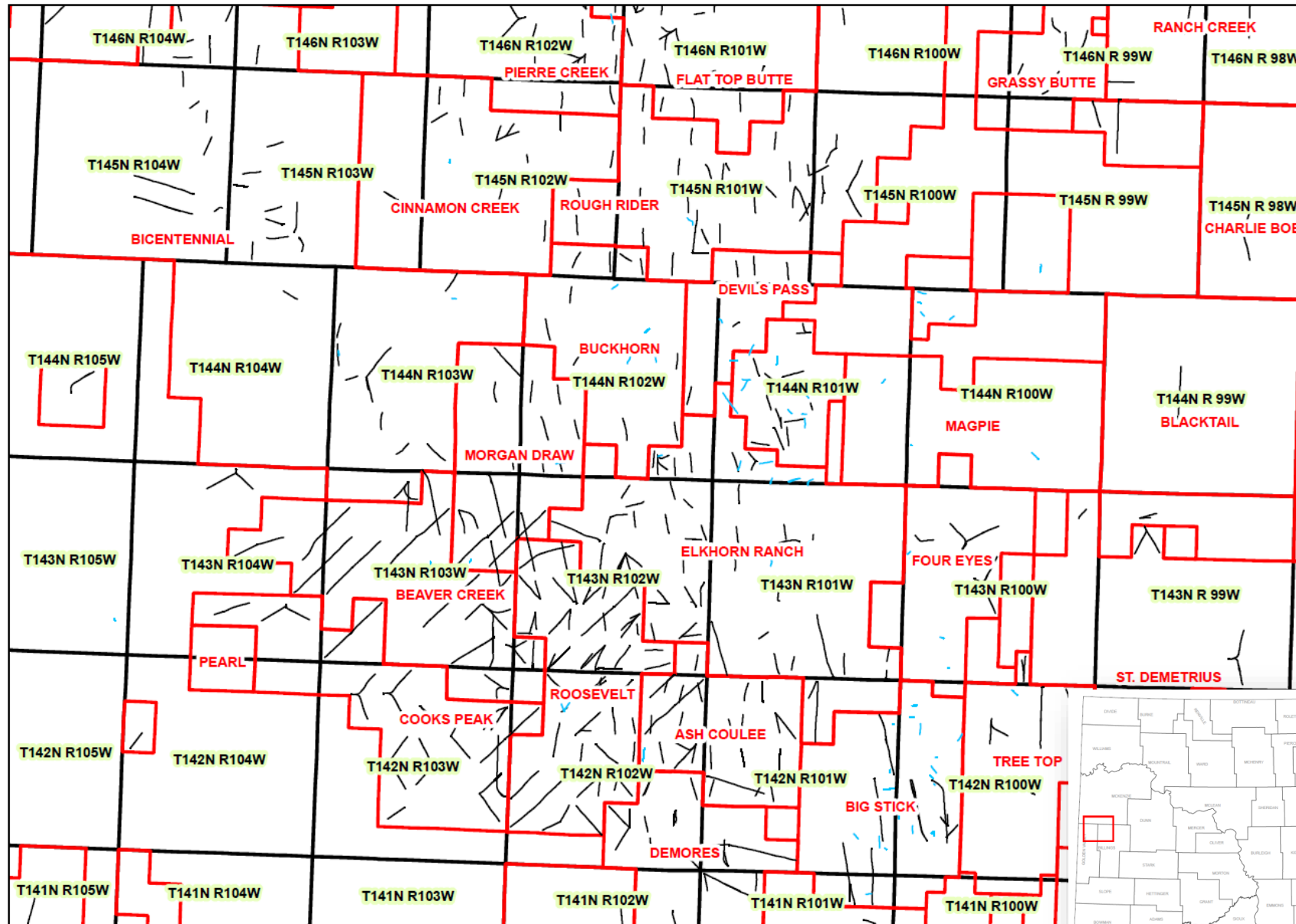
Statewide Bakken Gas/Oil Ratios



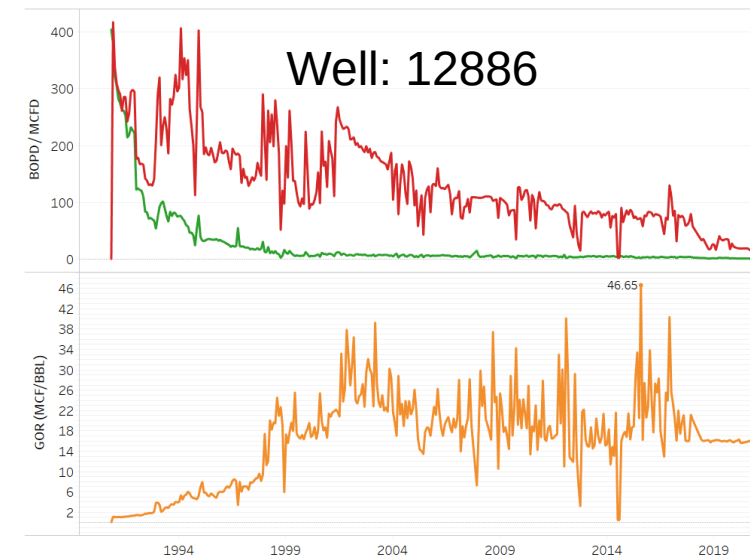
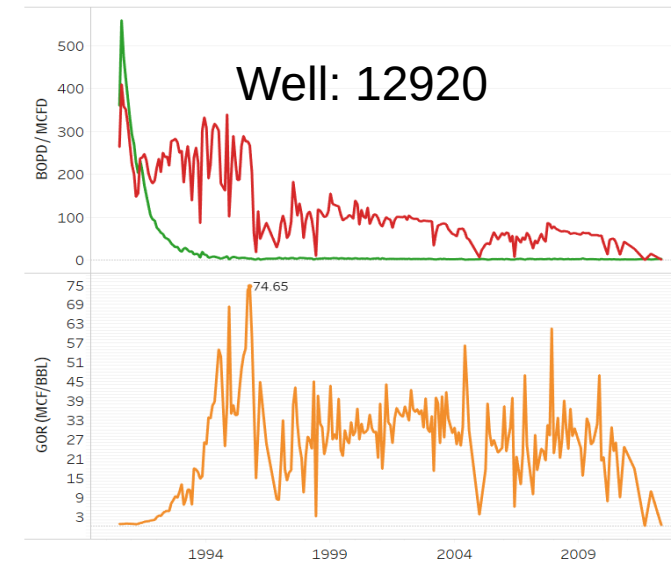
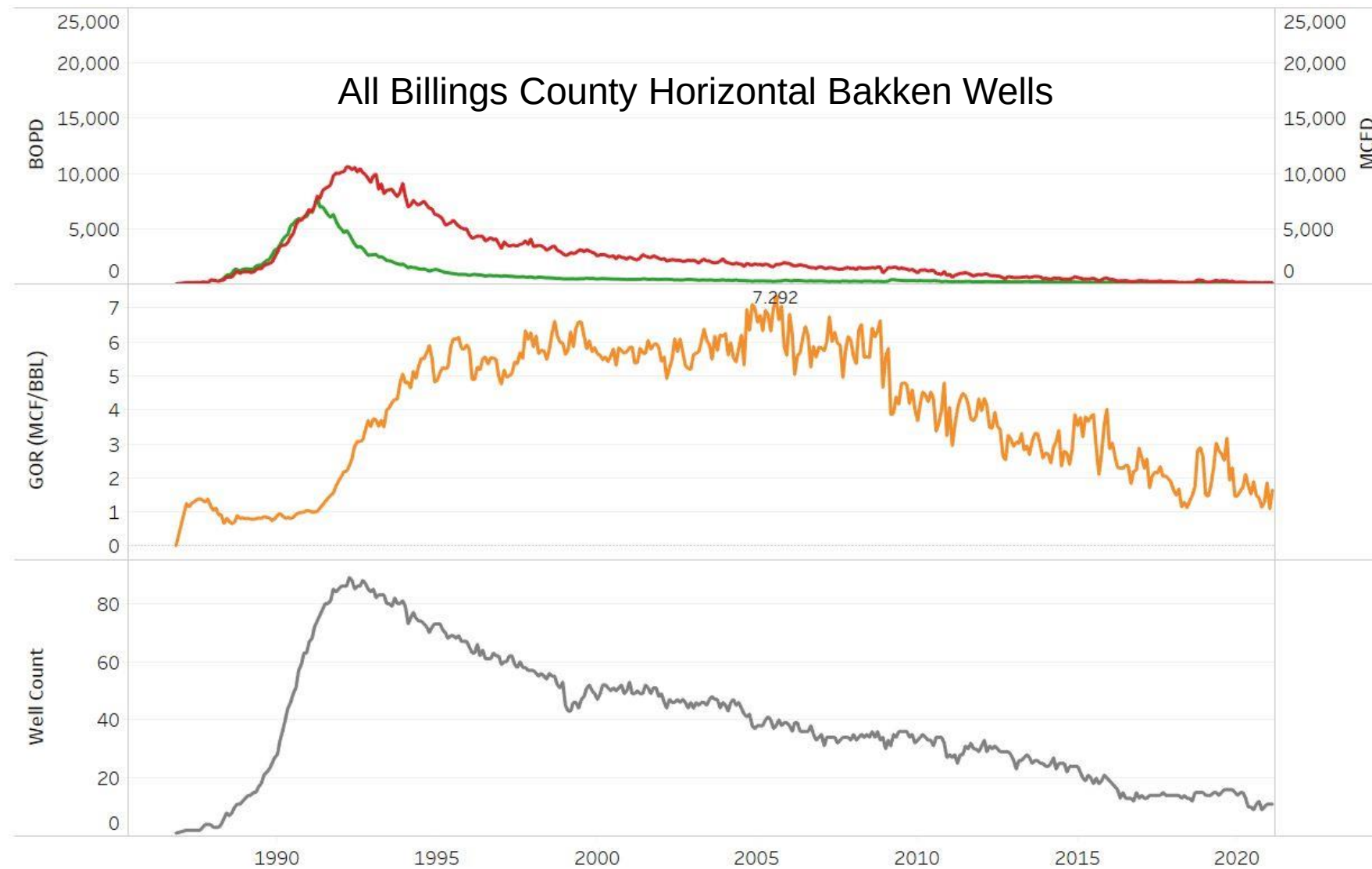
Statewide Bakken Production



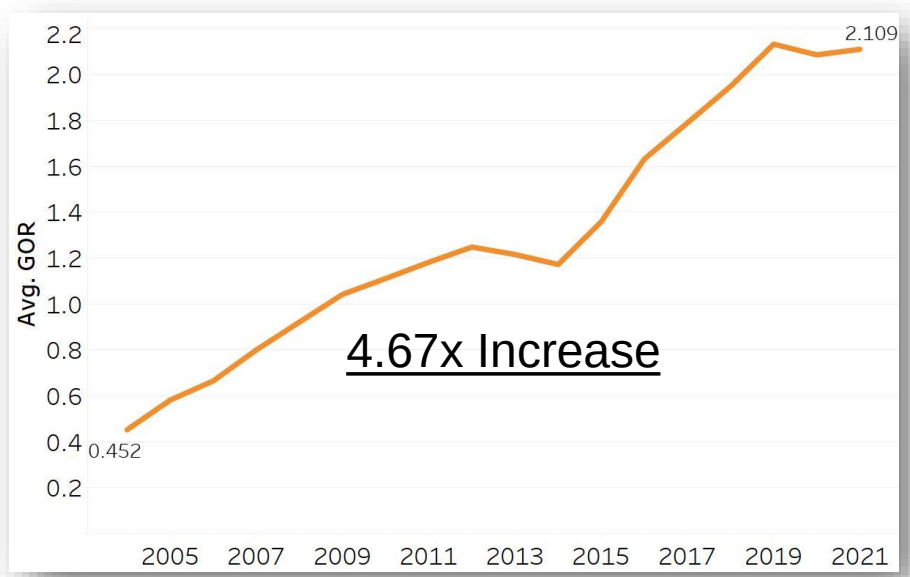
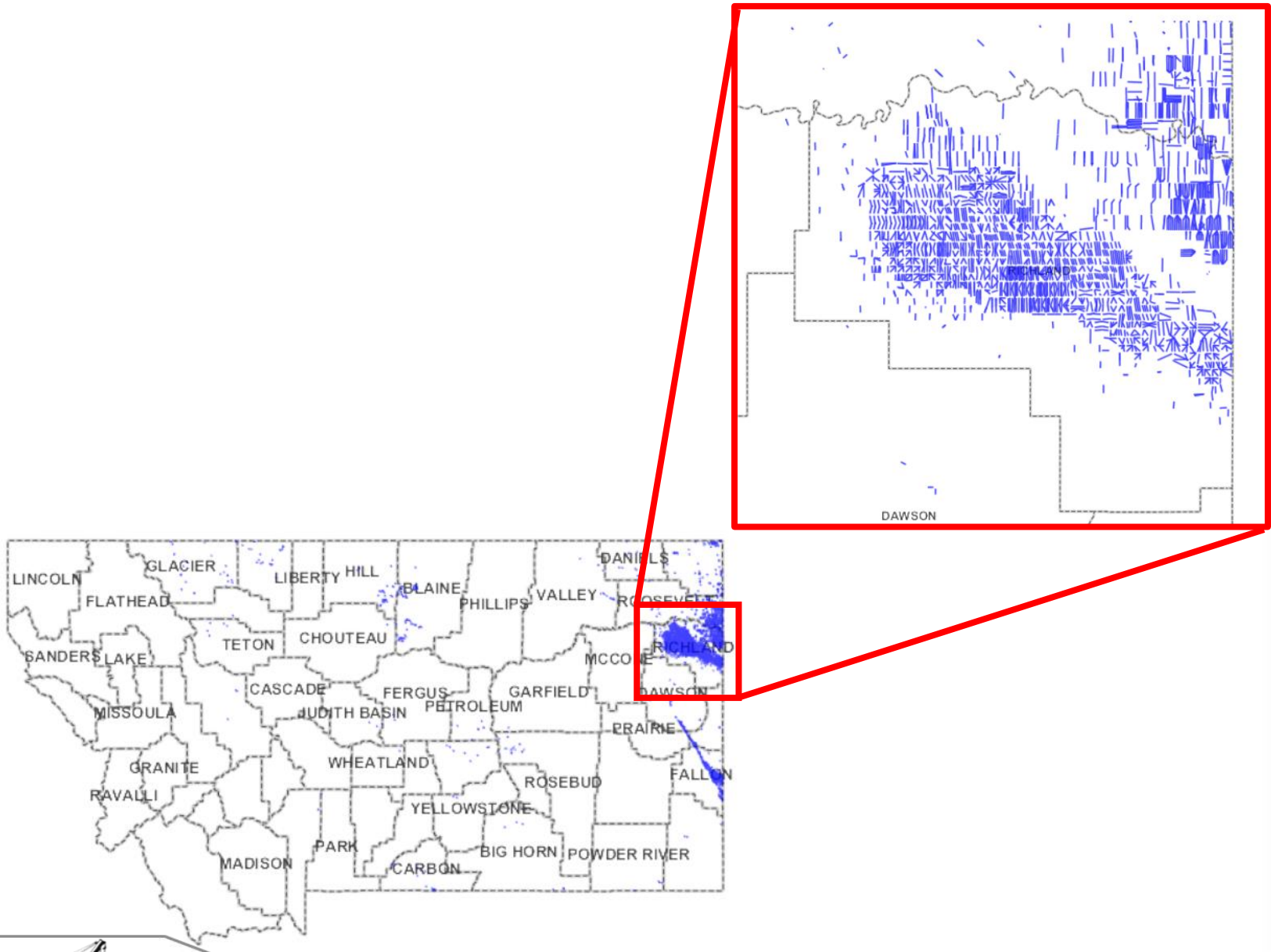
Back to the 90's...



Back to the 90's...



Elm Coulee Bakken GOR: Eastern Montana



New GOR Research Released: July 2021



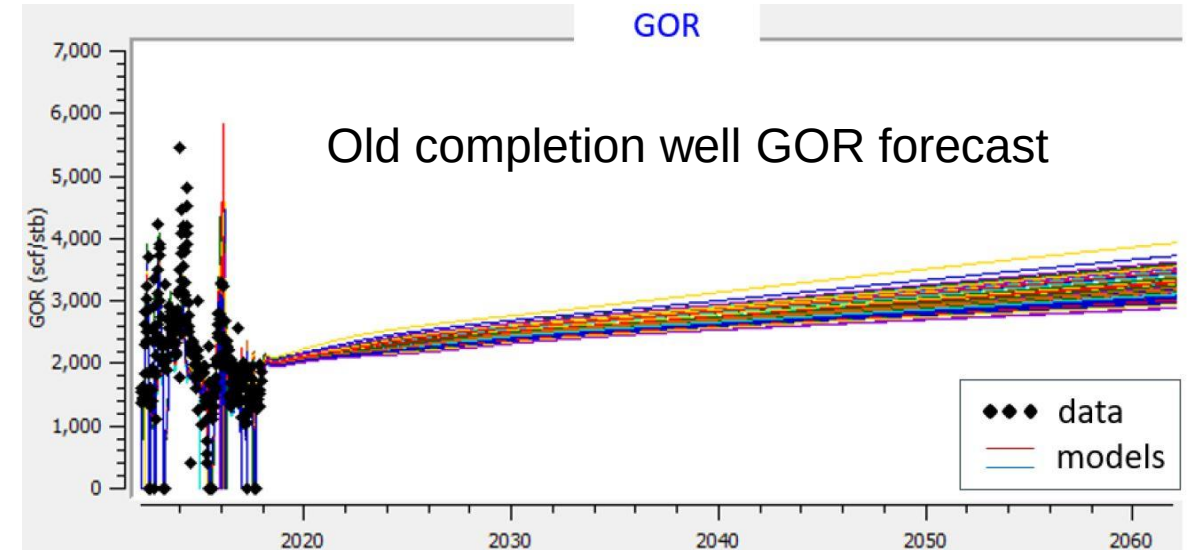
URTeC: 5358

Bakken Unconventional Well Gas-Oil Ratio (GOR) Behavior Characterization

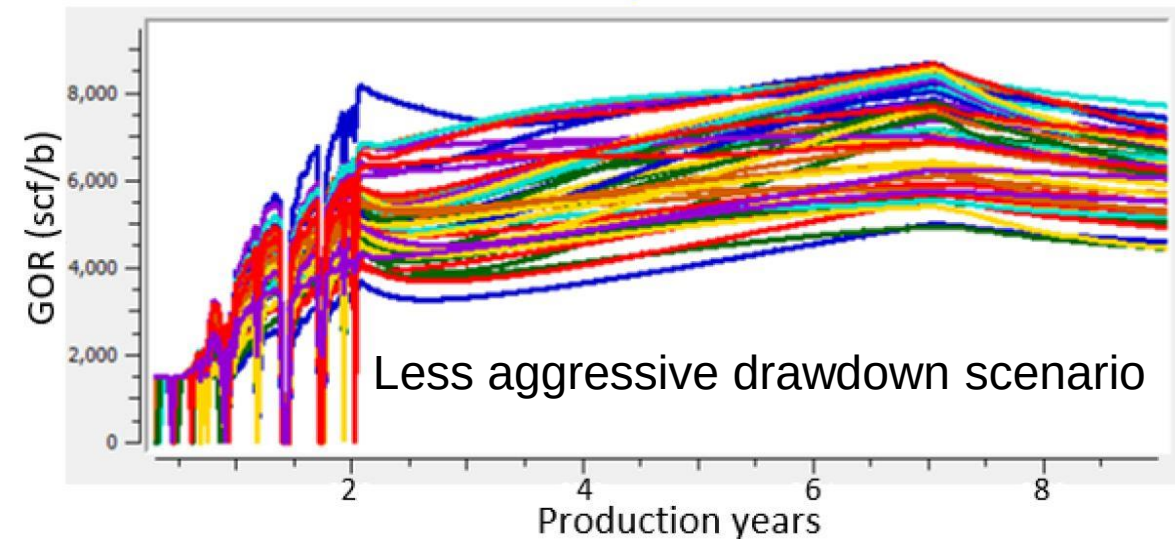
Yongshe Liu*, Brian Coffman, Nathan McMahan, Alisdair Farthing, ConocoPhillips.

Copyright 2021, Unconventional Resources Technology Conference (URTeC) DOI 10.15530/urtec-2021-5358

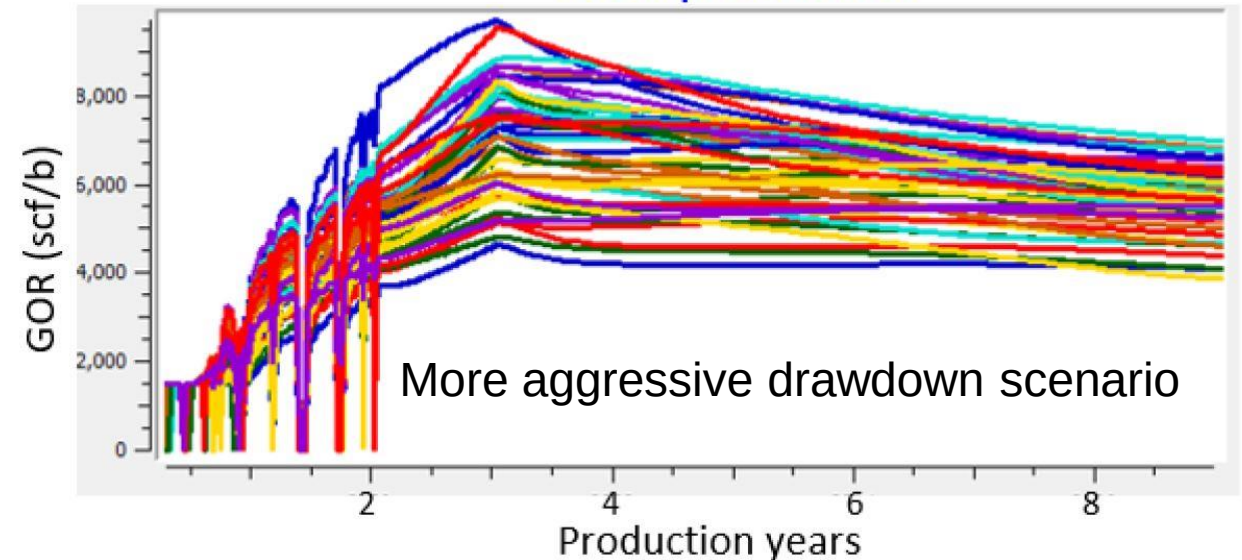
This paper was prepared for presentation at the Unconventional Resources Technology Conference held in Houston, Texas, USA, 26-28 July 2021.



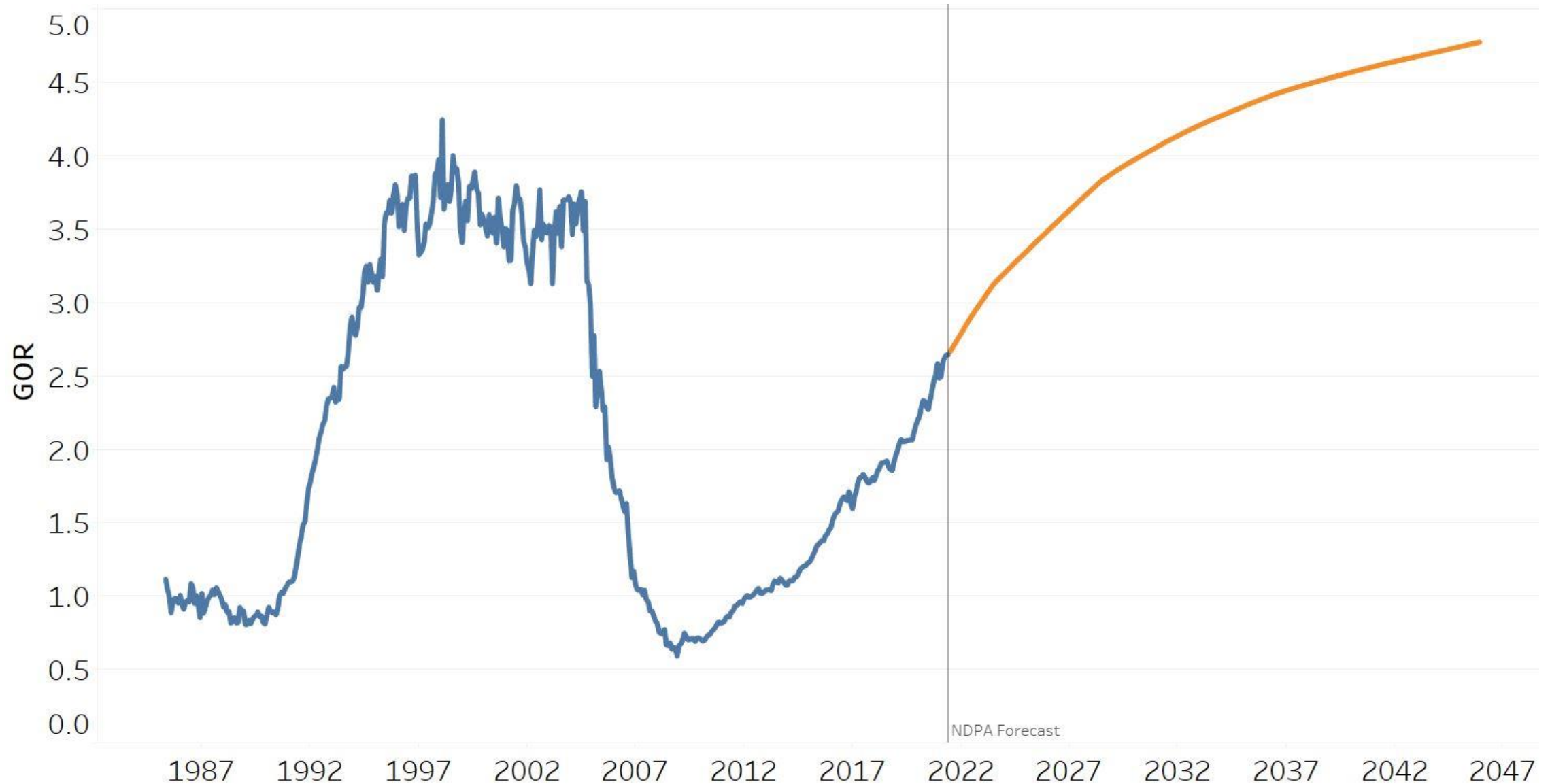
GOR prediction



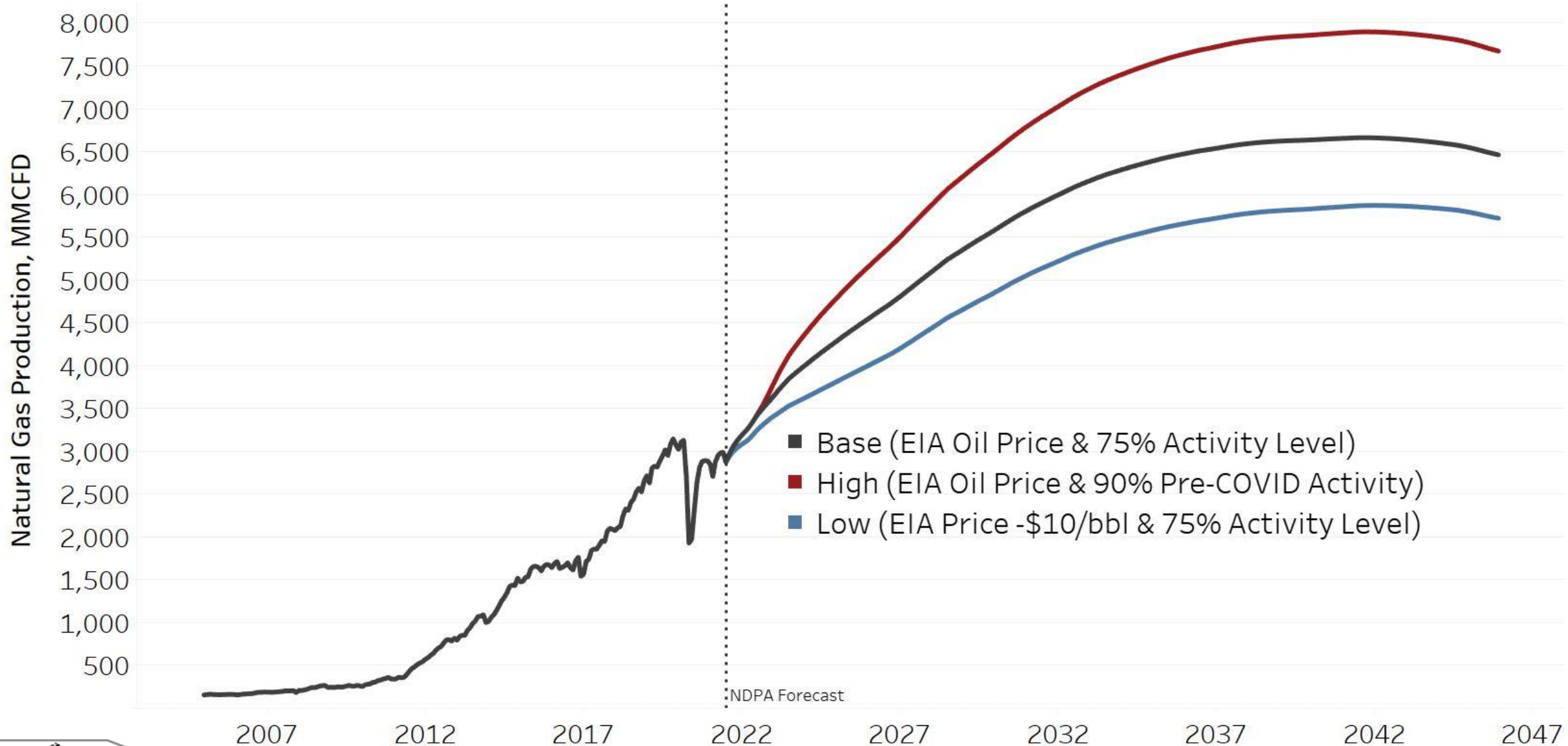
GOR prediction



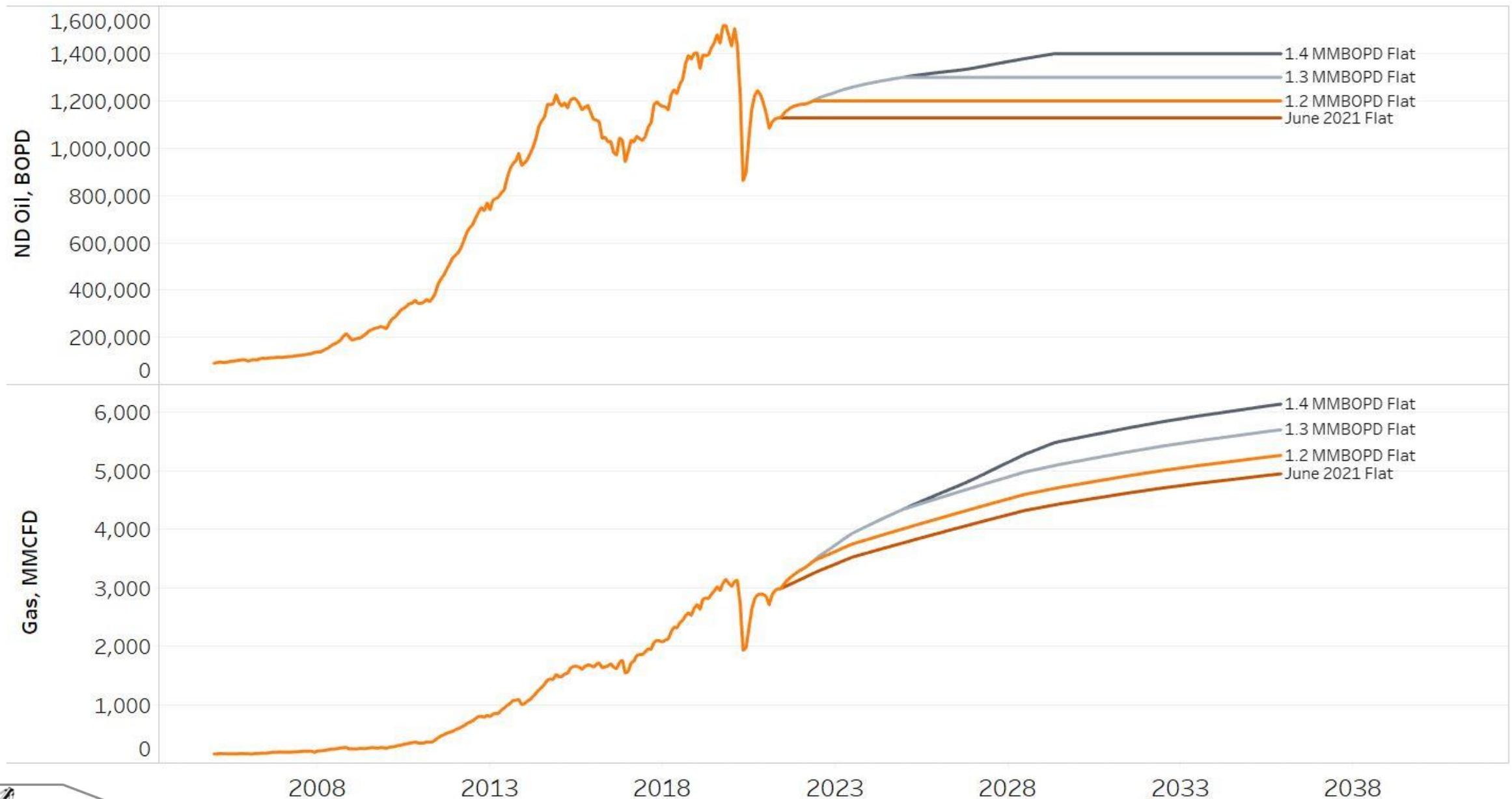
ND Gas Production: GOR Assumption



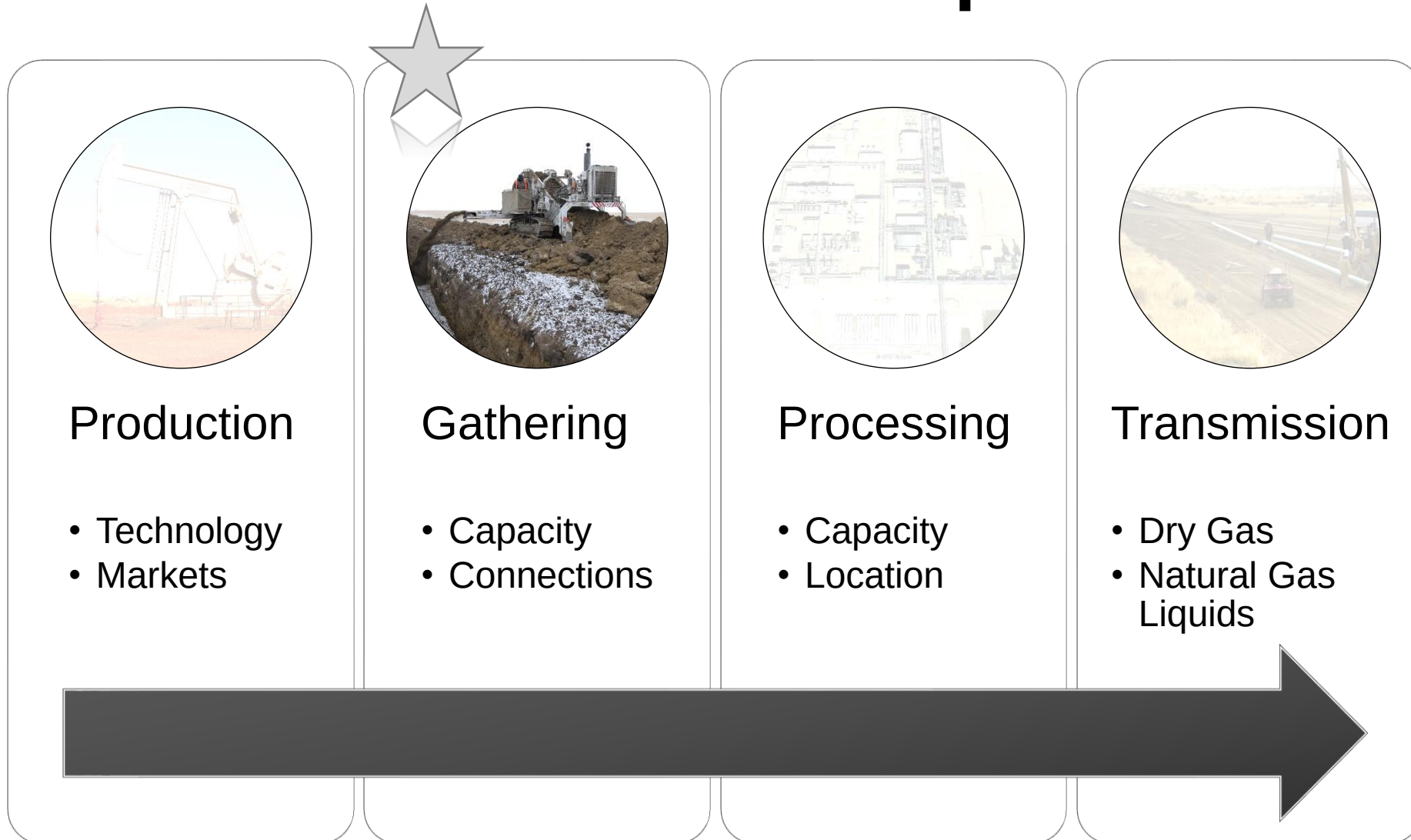
ND Gas Production: EIA Price Deck



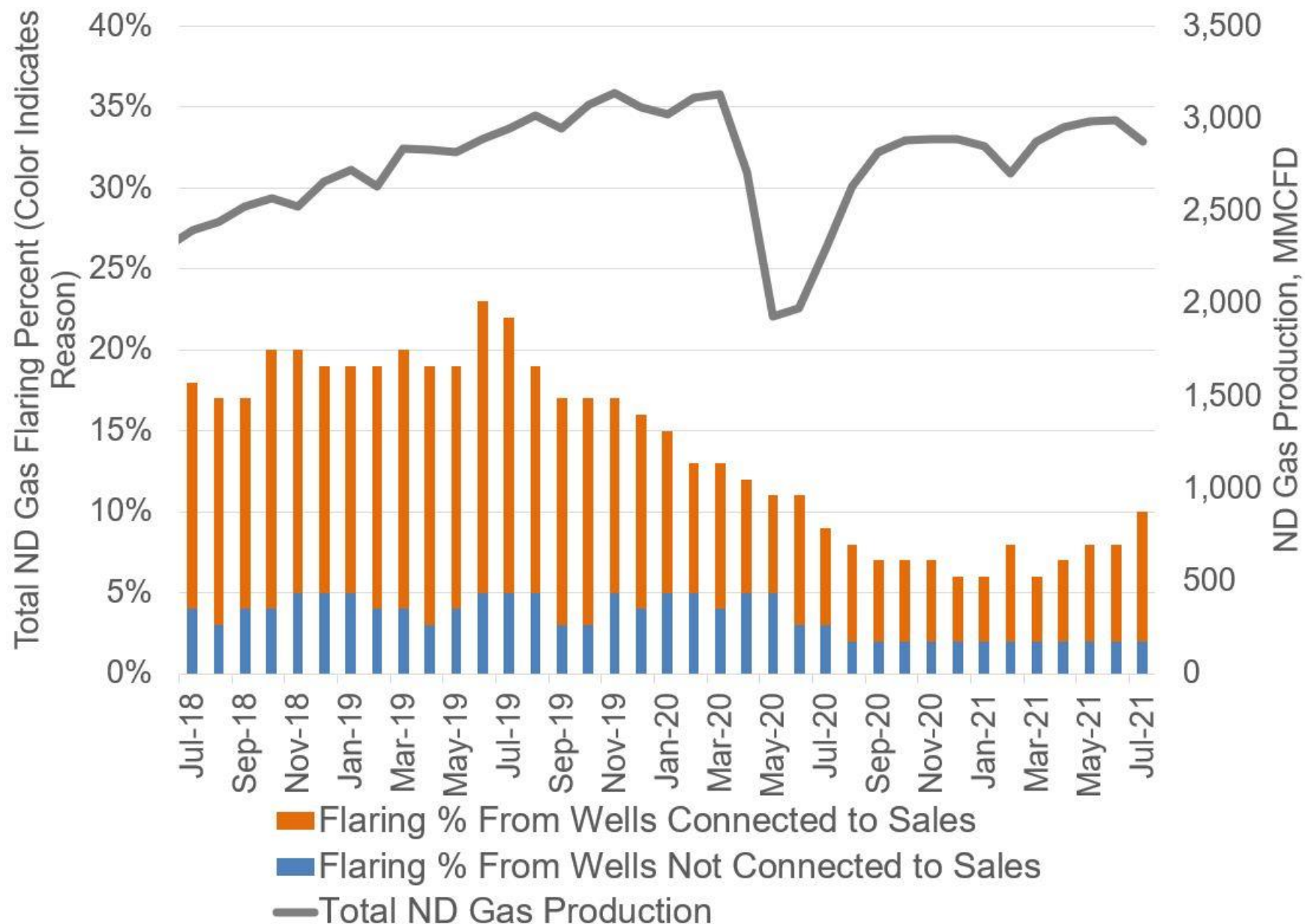
What if Oil Production Growth is Slower?



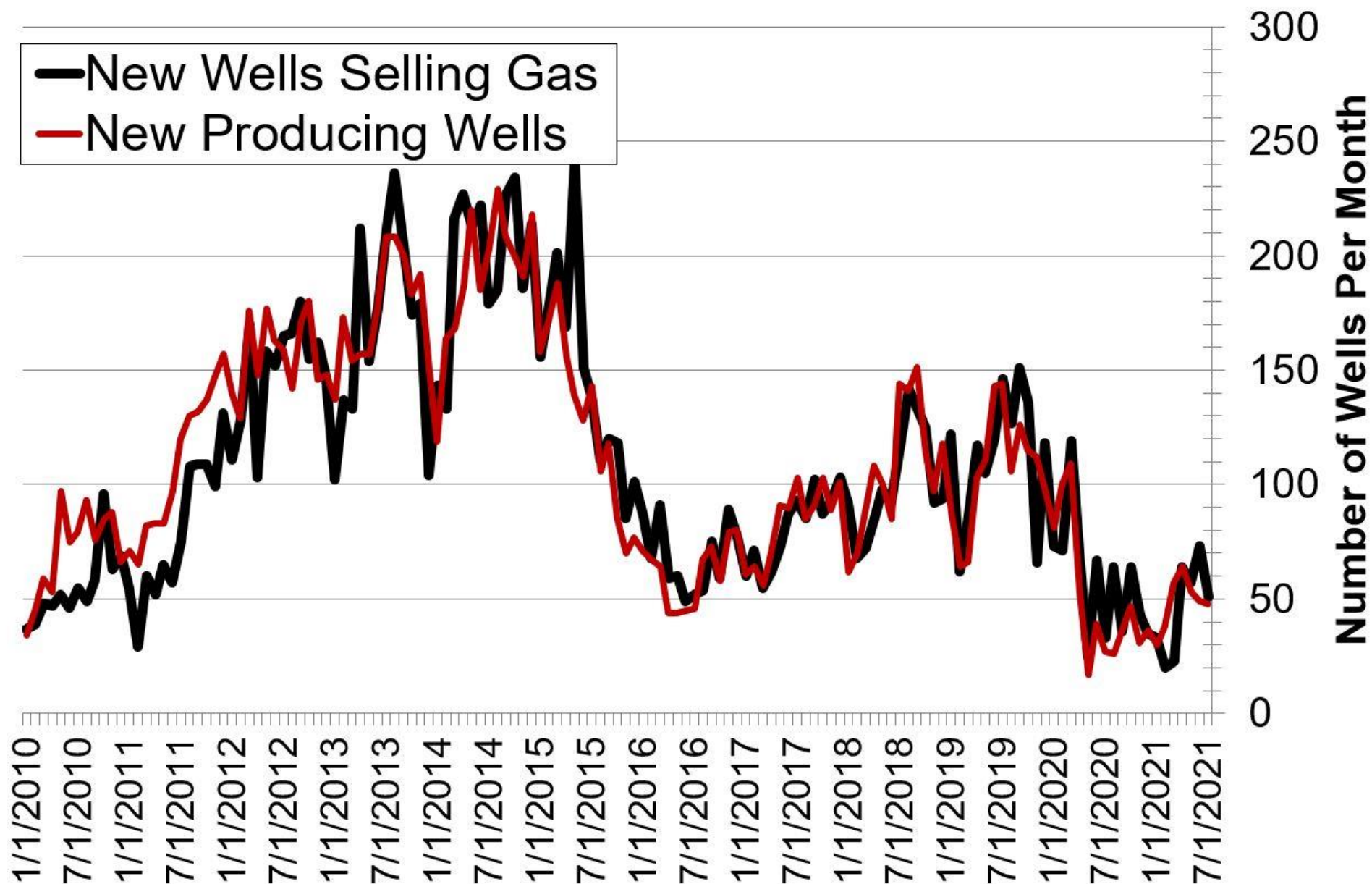
Natural Gas Update



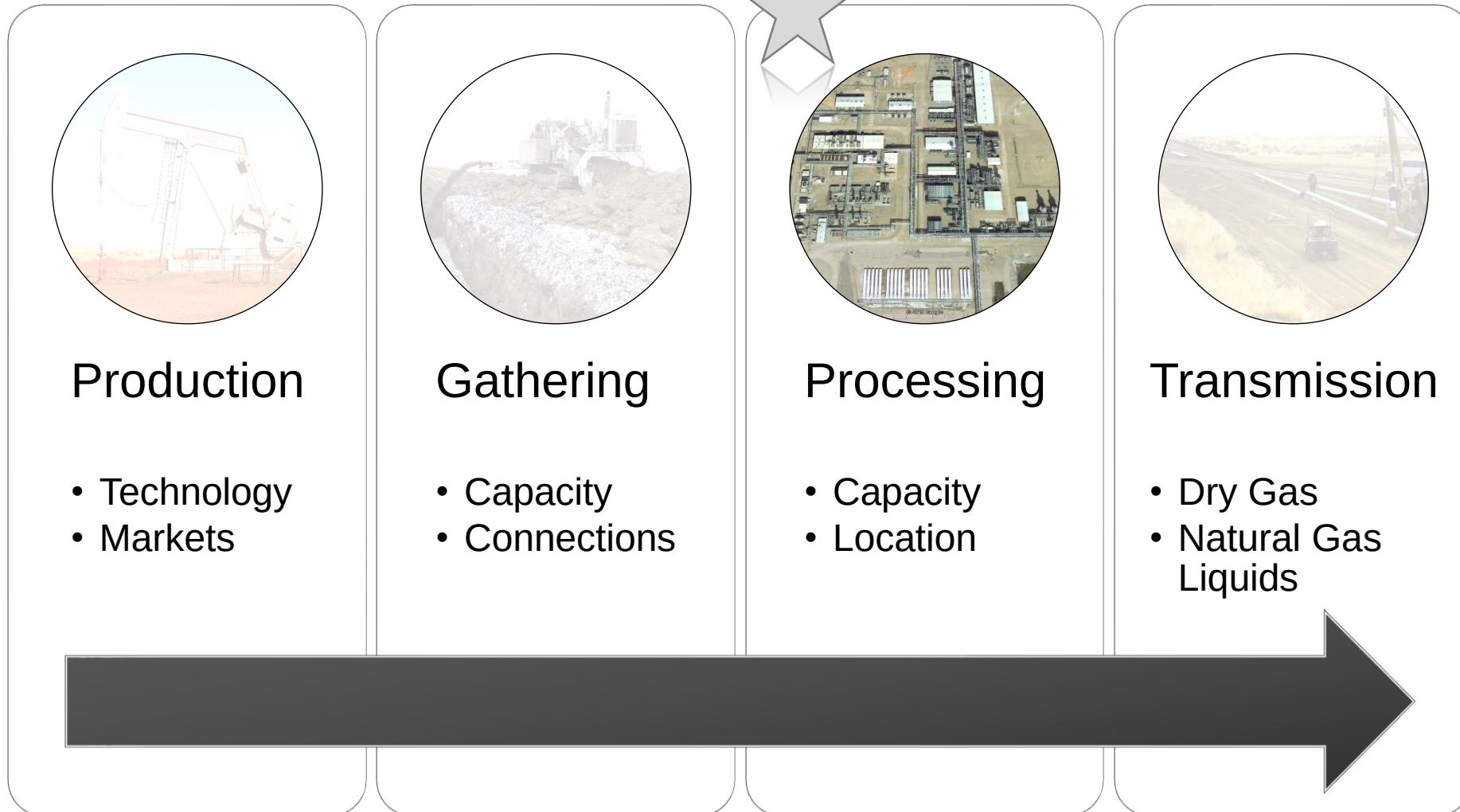
Solving the Flaring Challenge



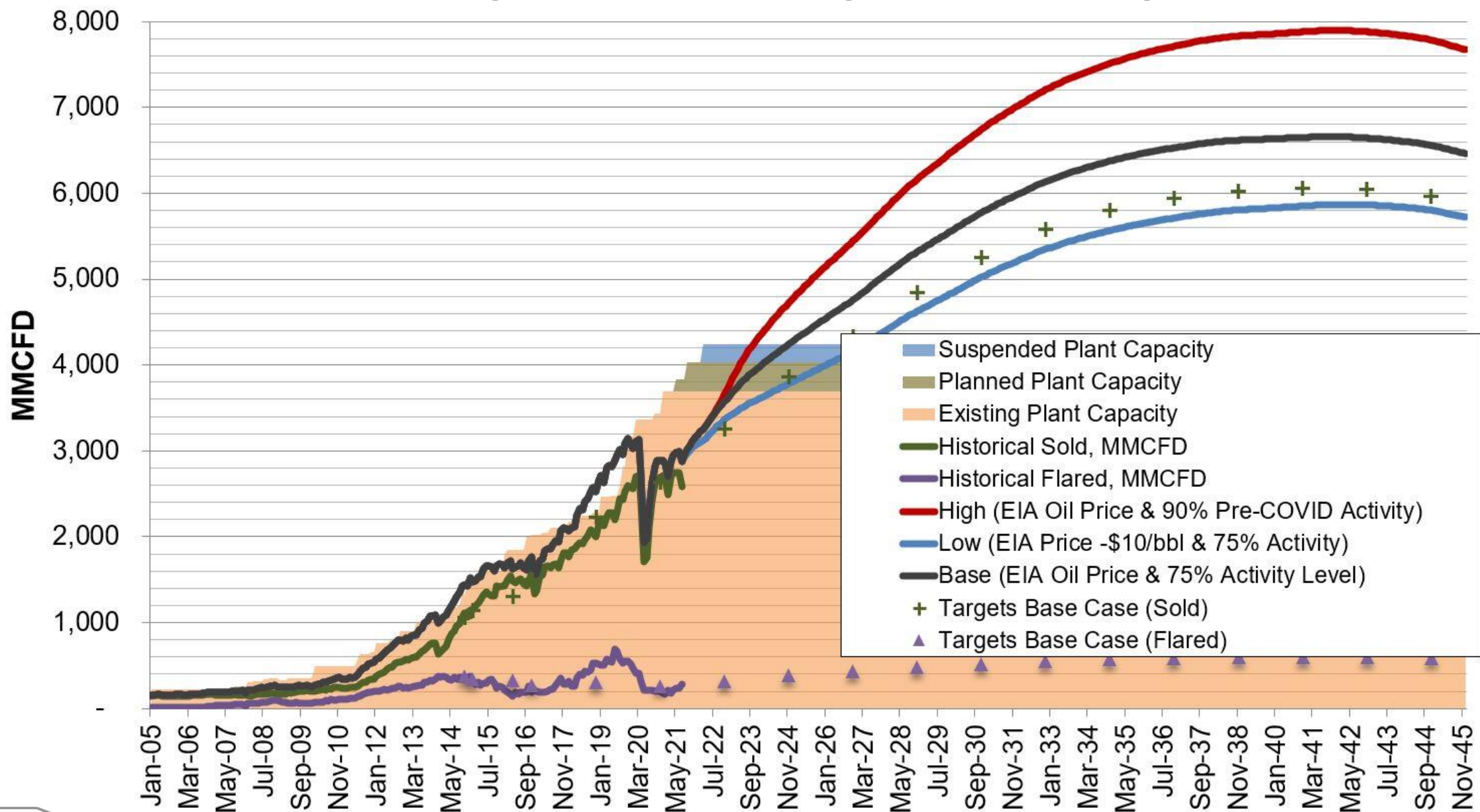
Solving the Flaring Challenge



Natural Gas Update

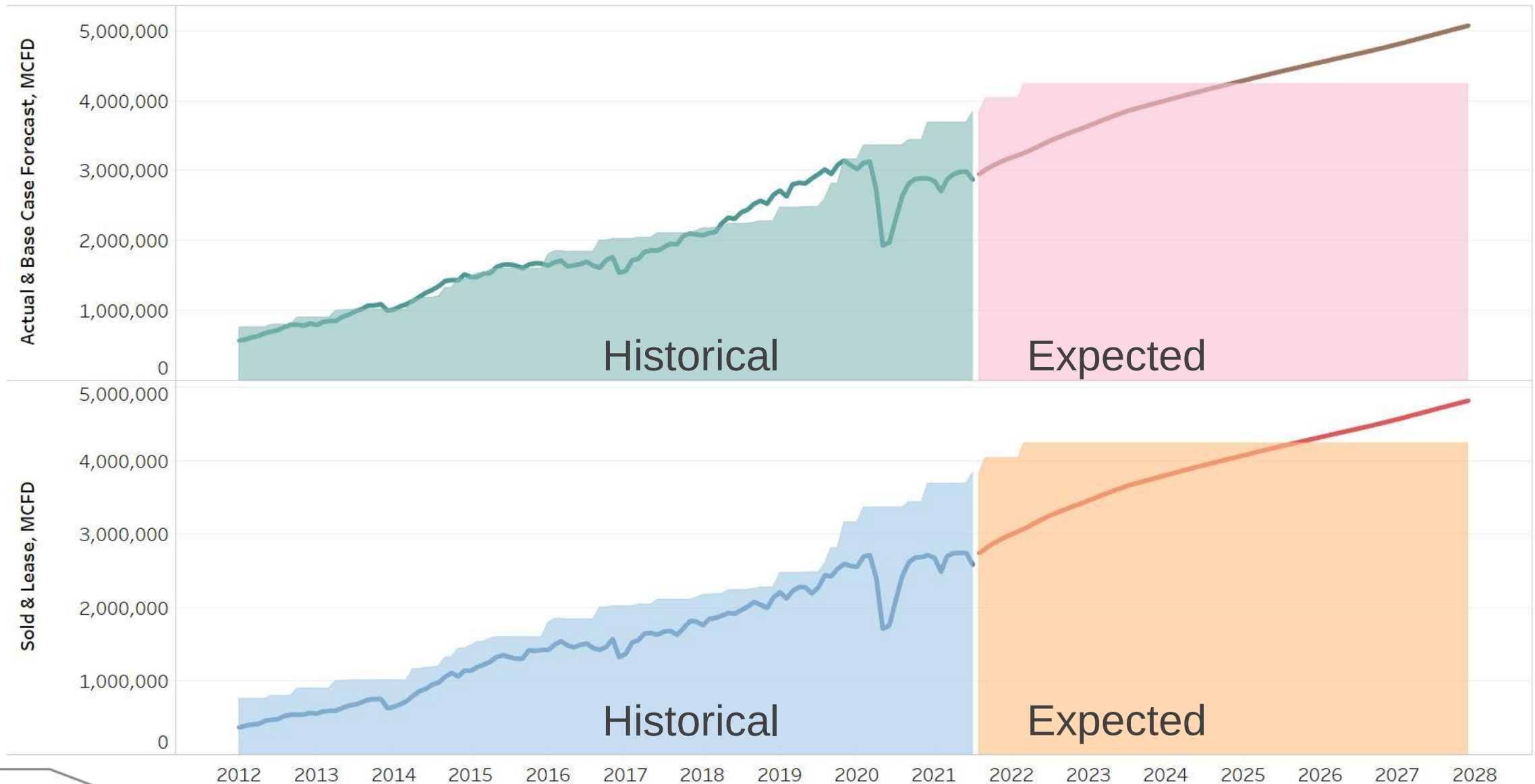


Solving the Flaring Challenge

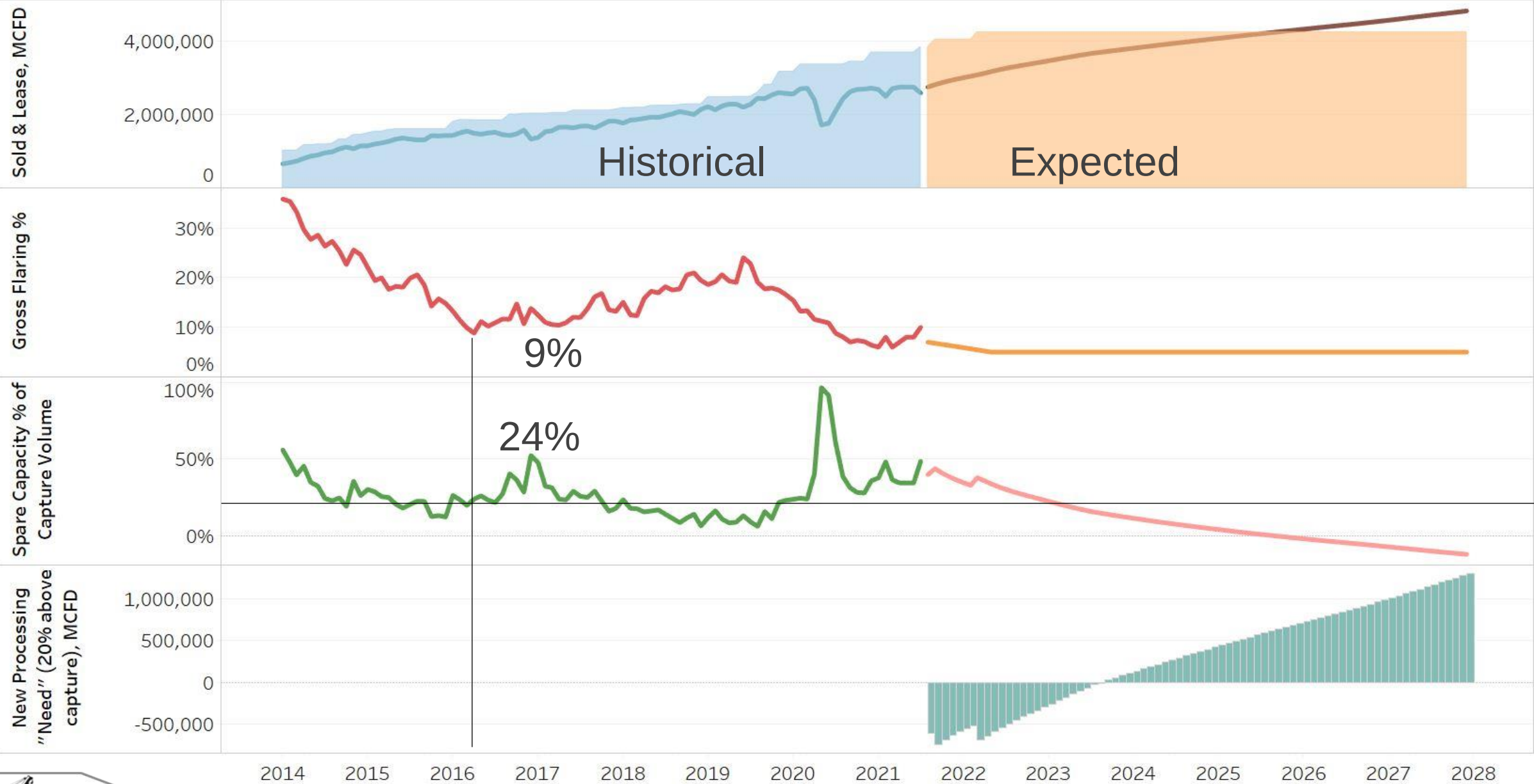


Gas Processing Capacity & Future Outlook

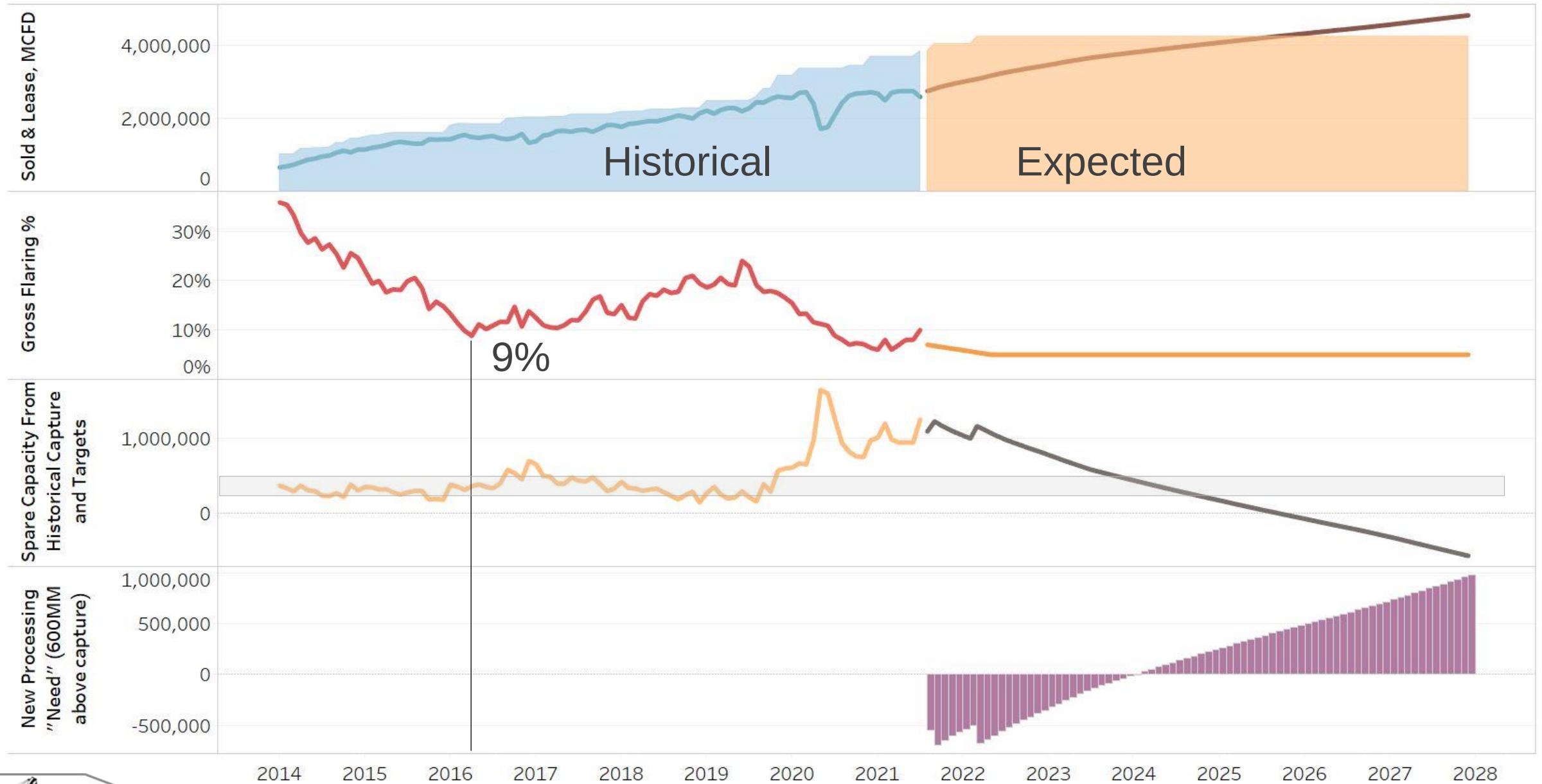
Assumes Current Technology – Enhanced Oil Recovery Not Included



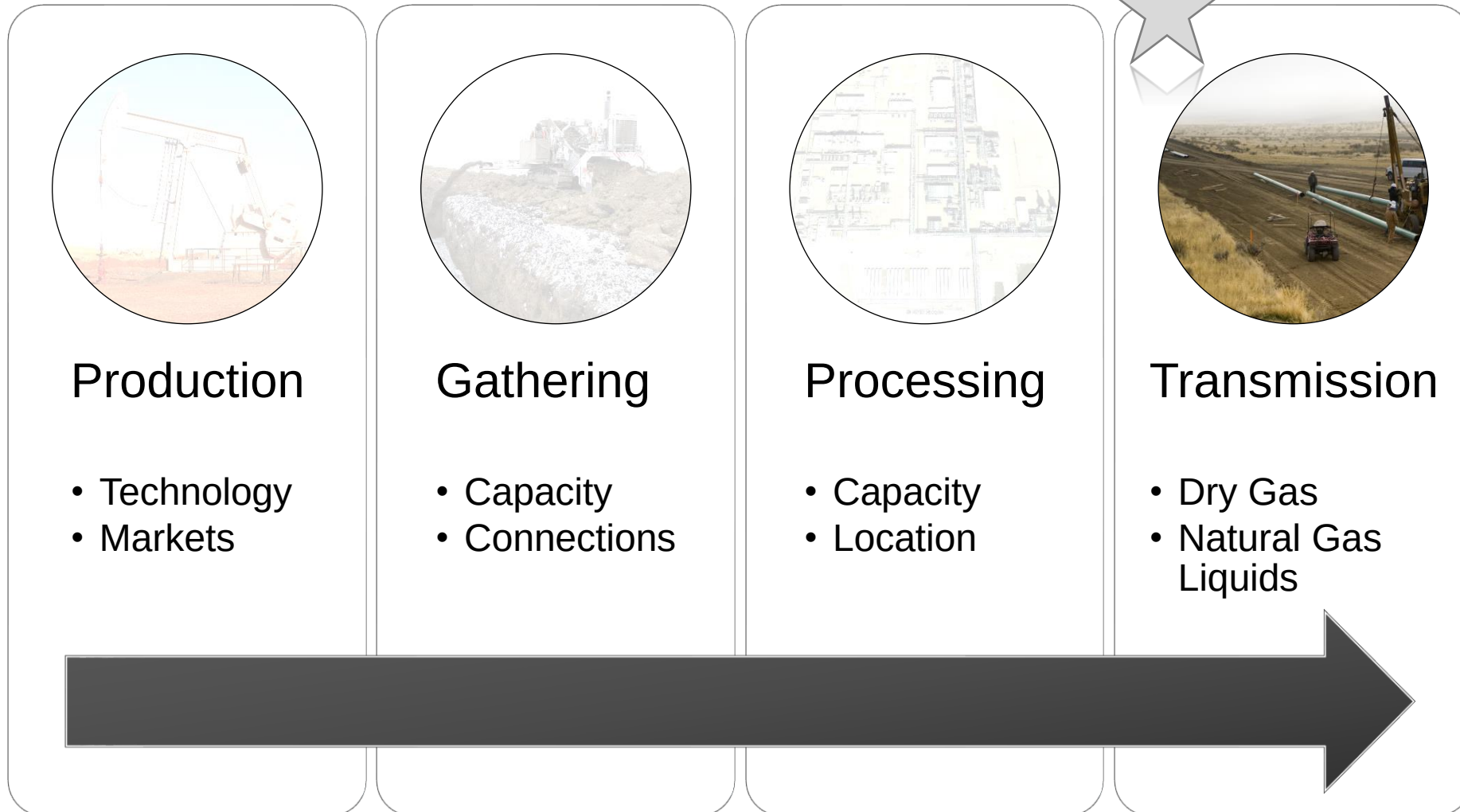
Gas Processing Capacity & Spare Capacity



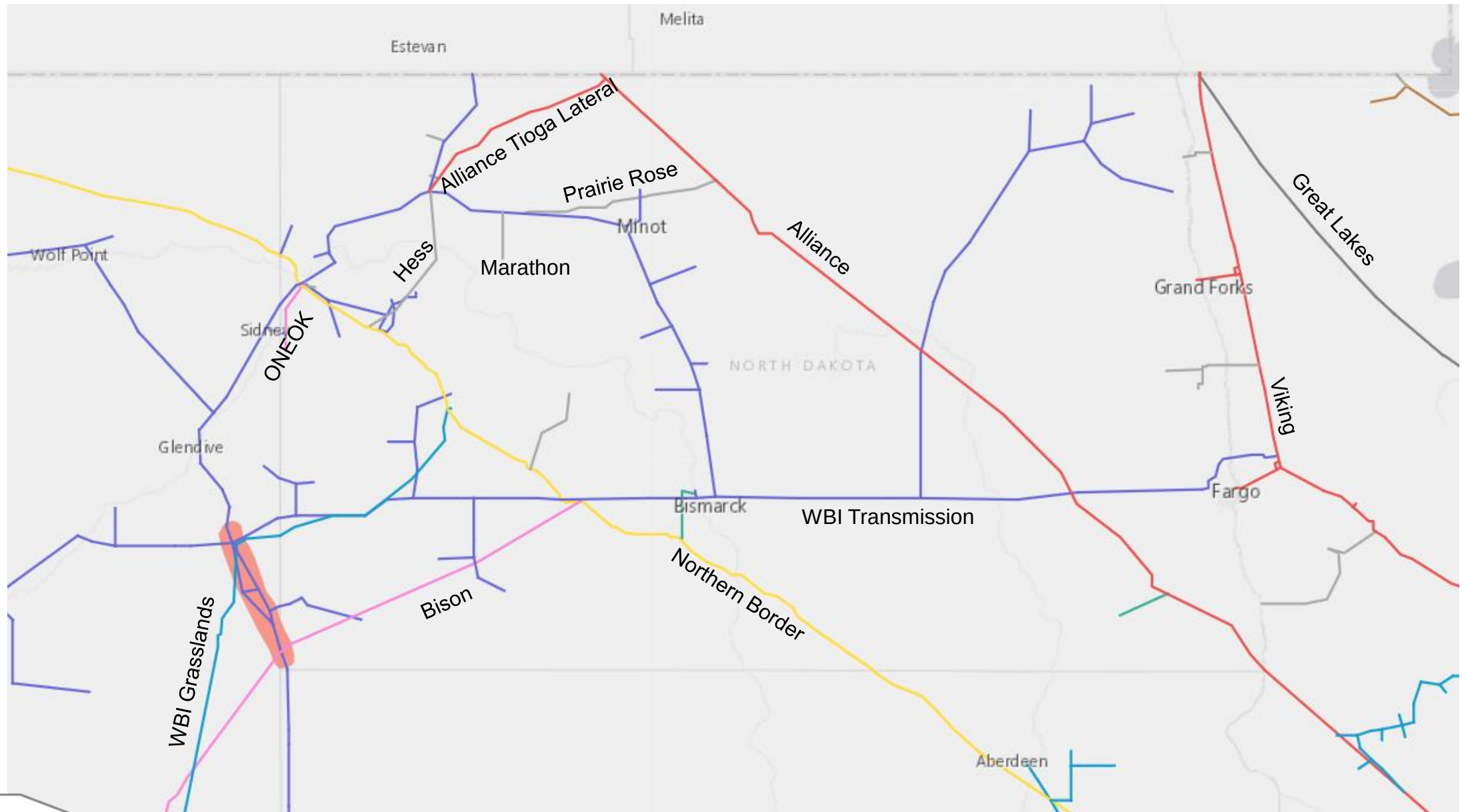
Gas Processing Capacity & Spare Capacity



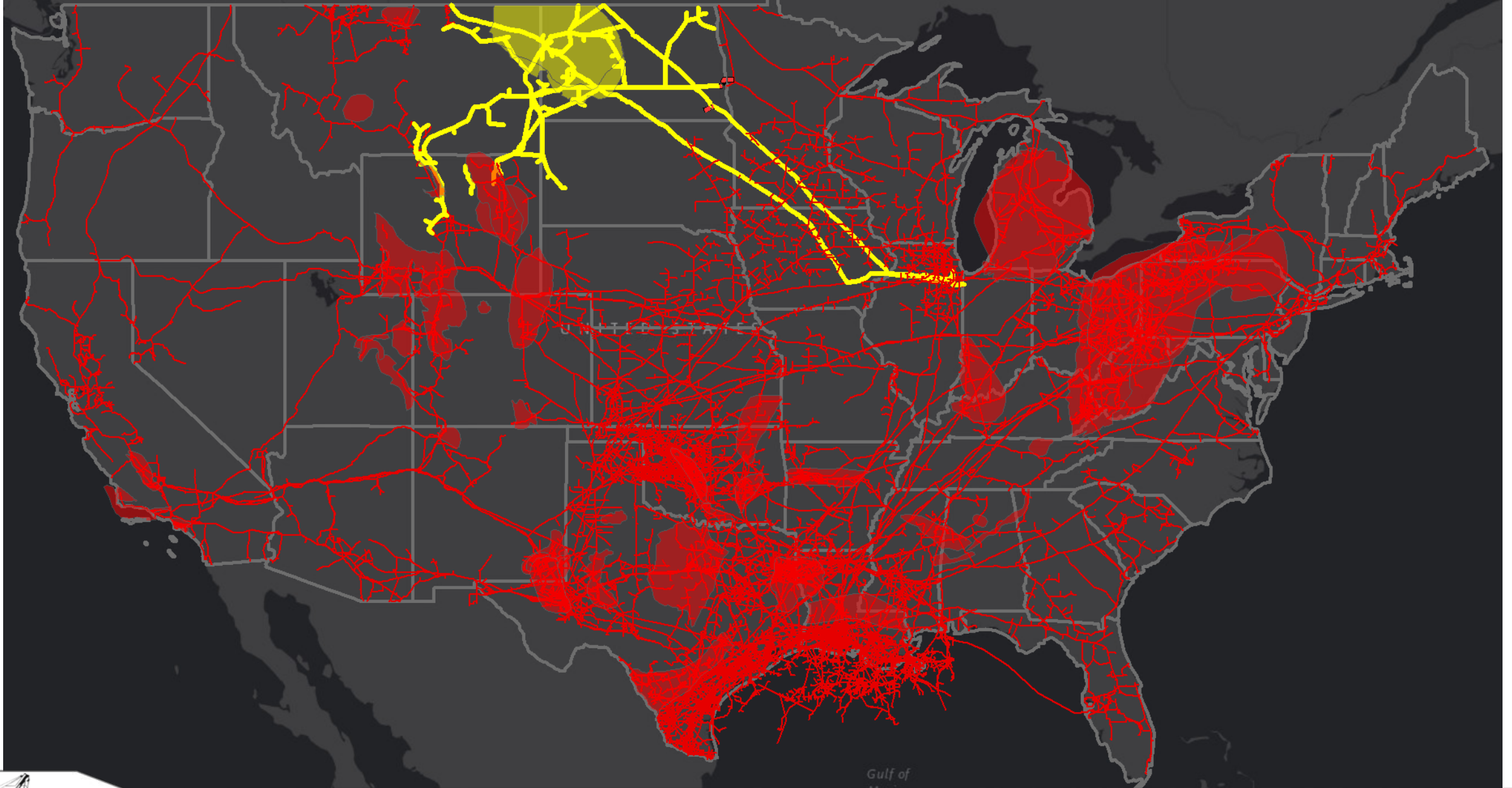
Natural Gas Update



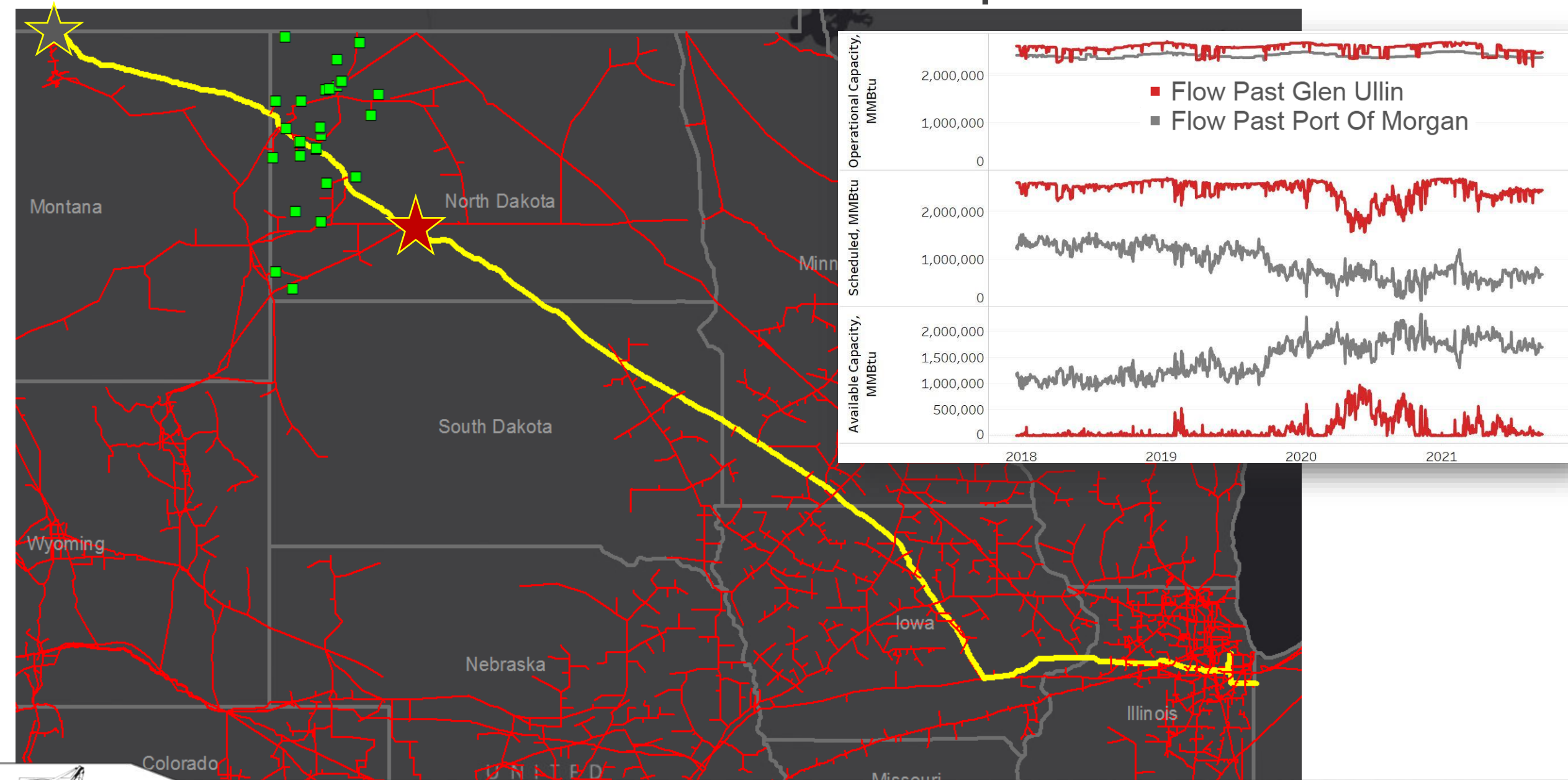
Major Gas Pipeline Infrastructure



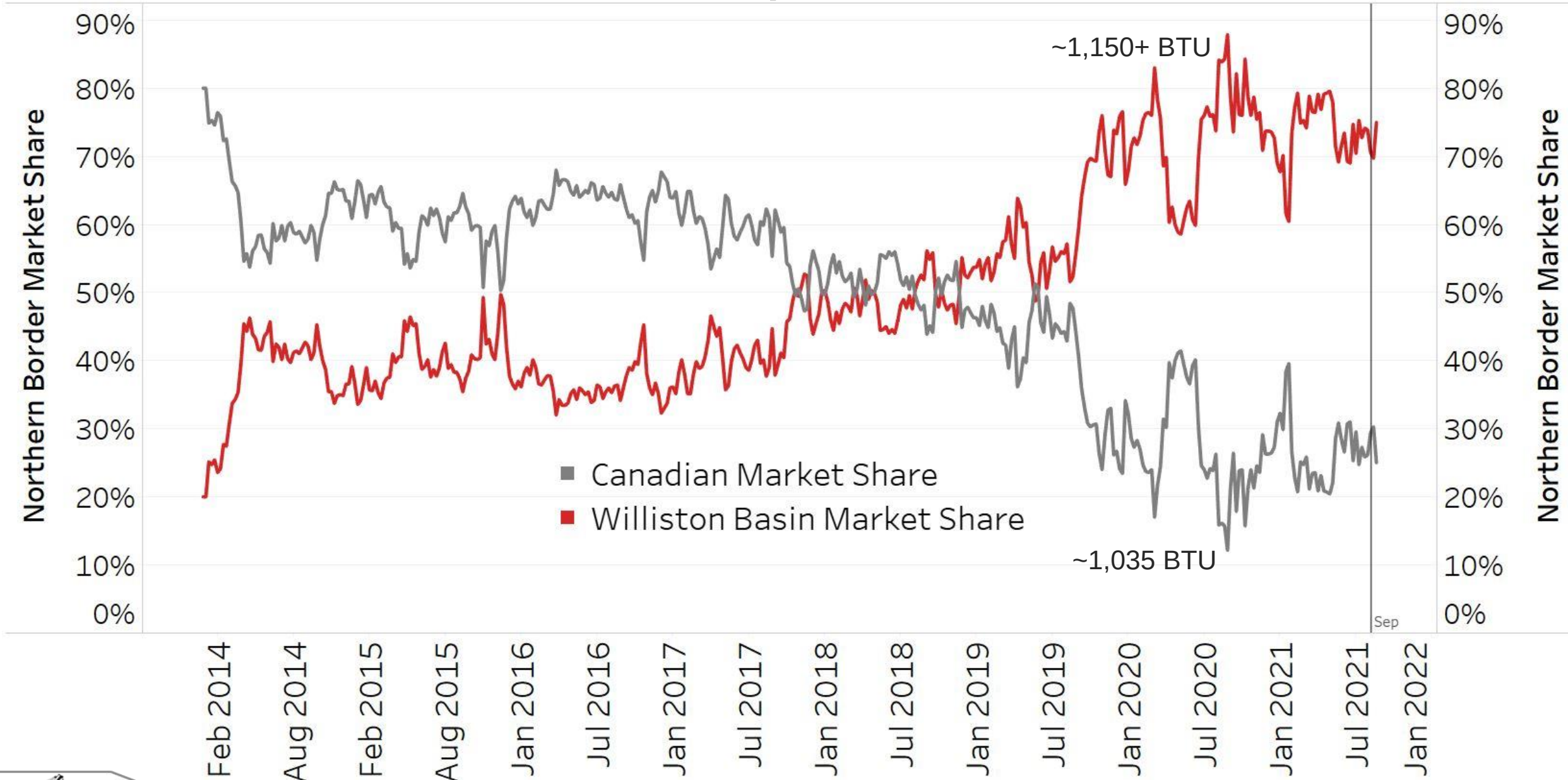
Bakken Natural Gas Infrastructure



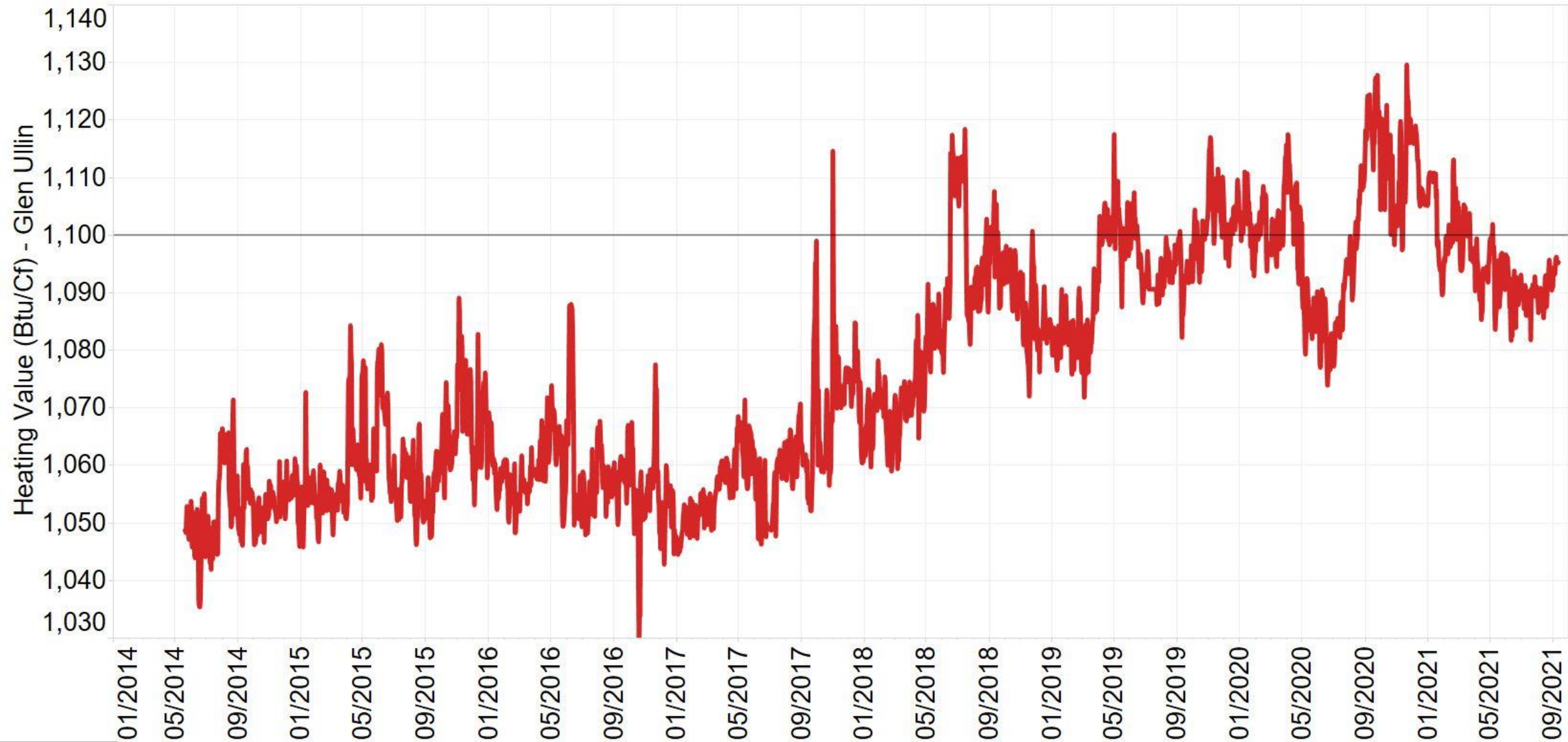
Northern Border Pipeline



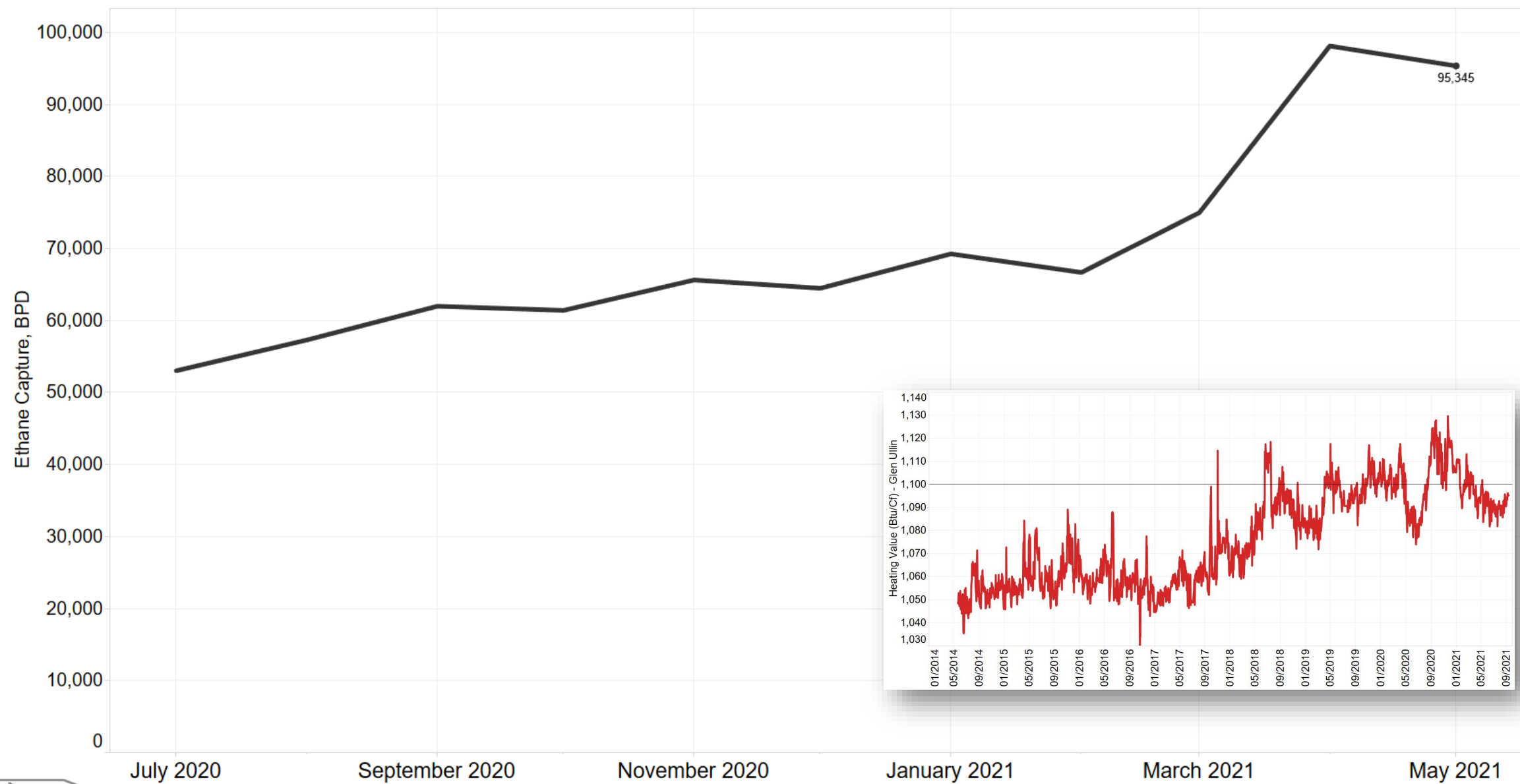
Northern Border Pipeline Market Share



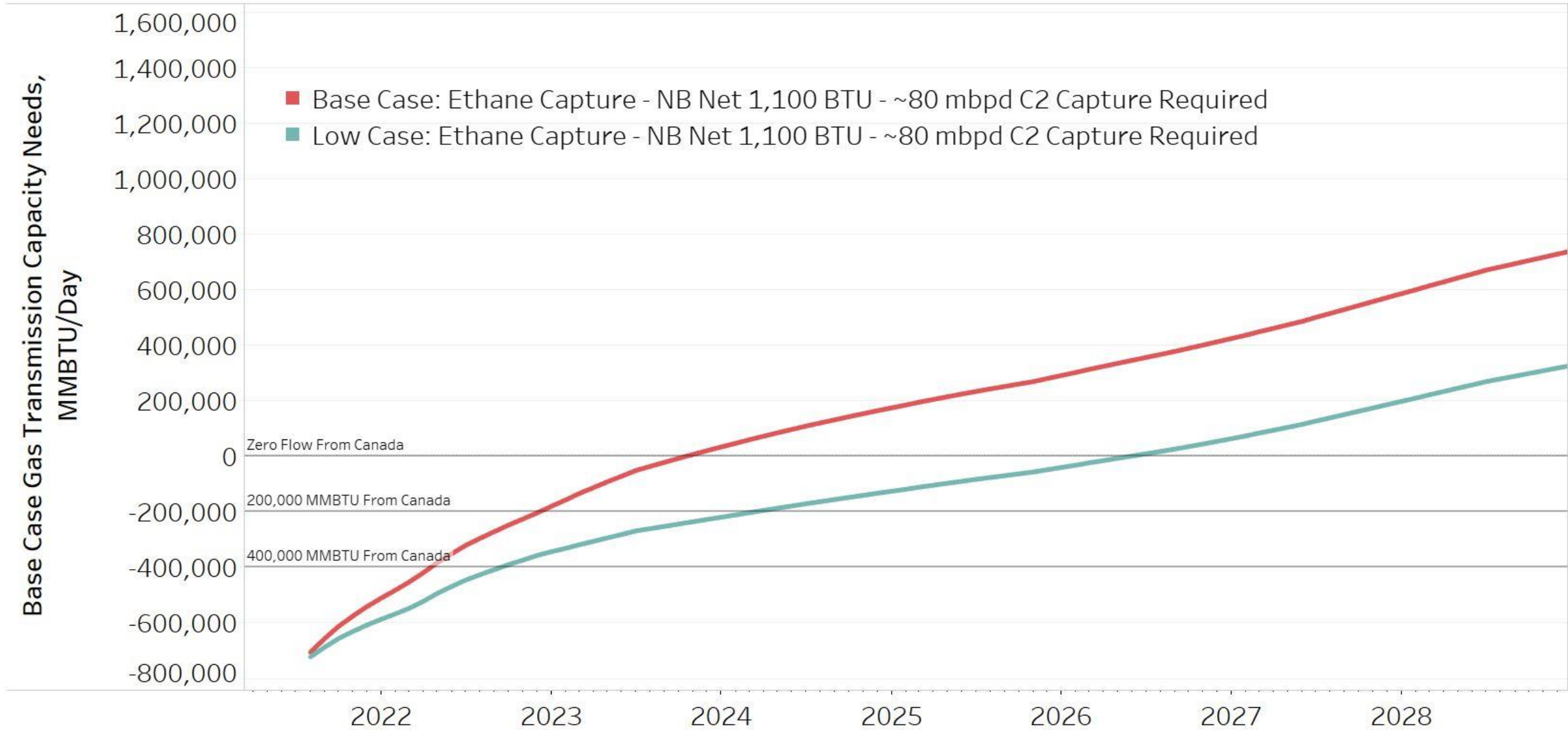
Northern Border BTU at Glen Ullin, ND



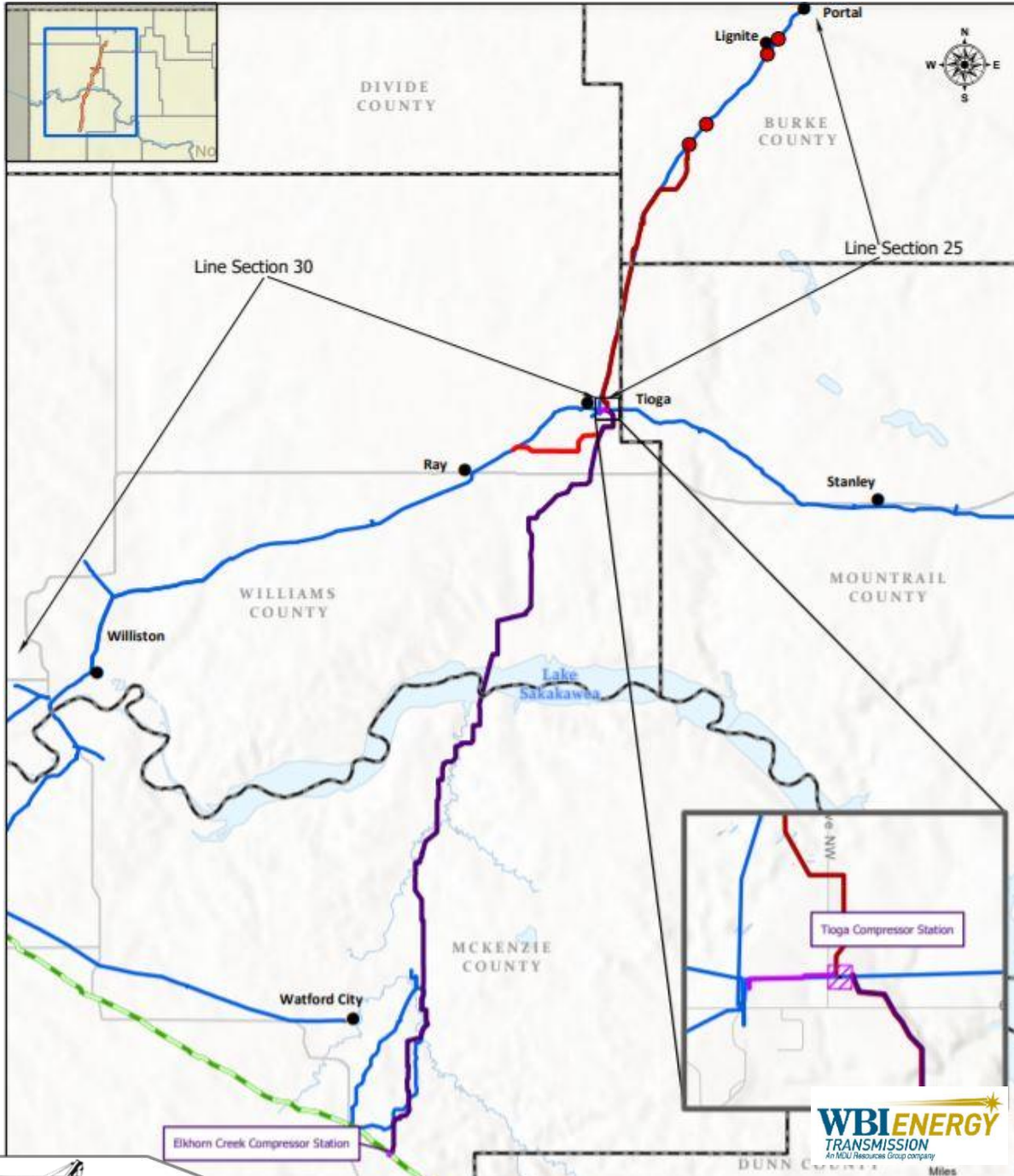
ND Ethane Capture Driving Northern Border BTU Lower



Northern Border – BTU Calculations*



WBI Energy – North Bakken Expansion Project

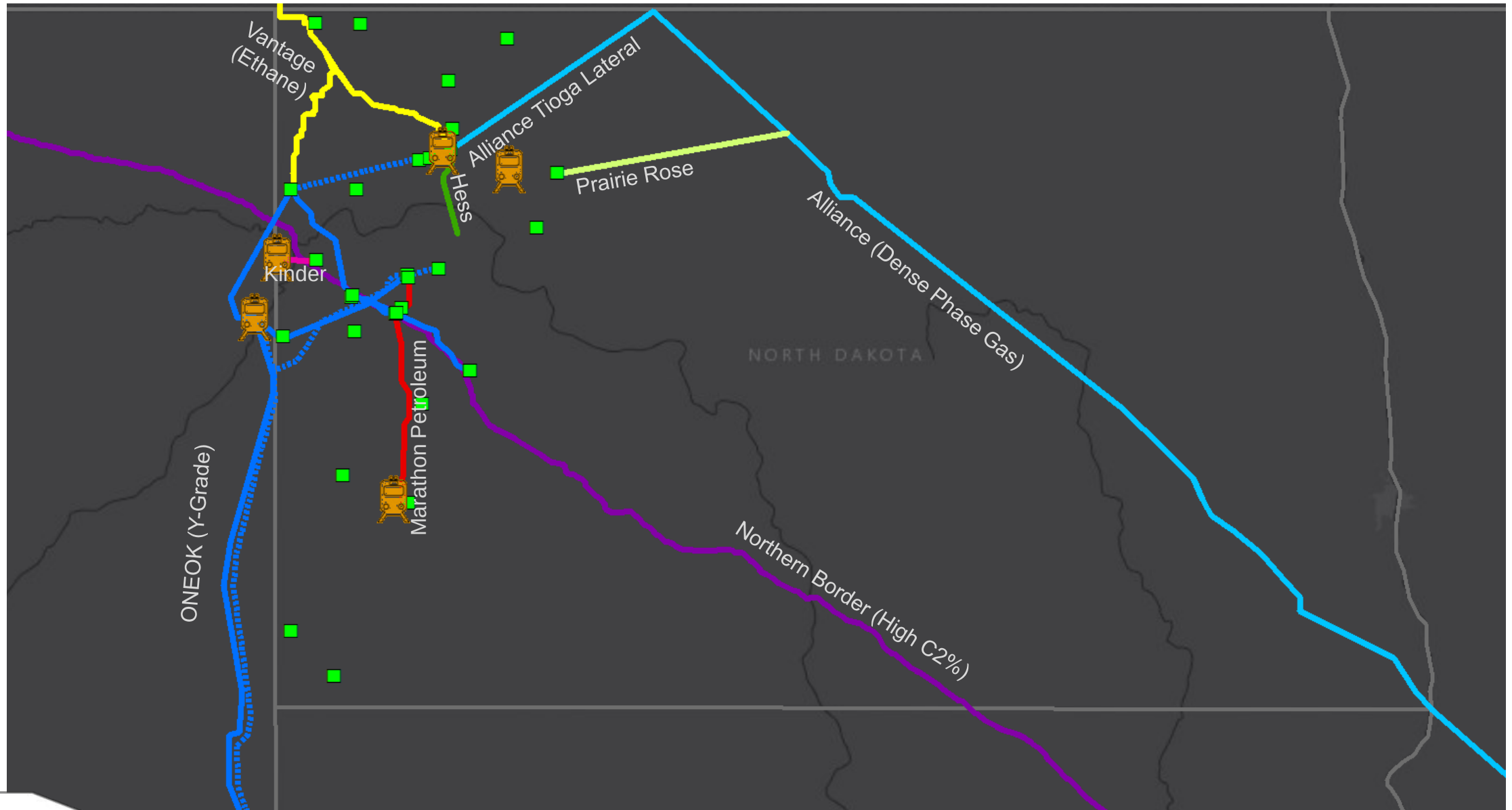


Project Highlights

- ~60 Miles - 24" Pipeline
- ~30 Miles - 12" Pipeline
- \$260+ Million
- Preliminary Capacity 250,000 MCFD
- Expandable to 600,000 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

NGL Chemistry Study - 2020



ASSESSMENT OF BAKKEN PETROLEUM SYSTEM PRODUCED GAS COMPOSITIONS

Final Report

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

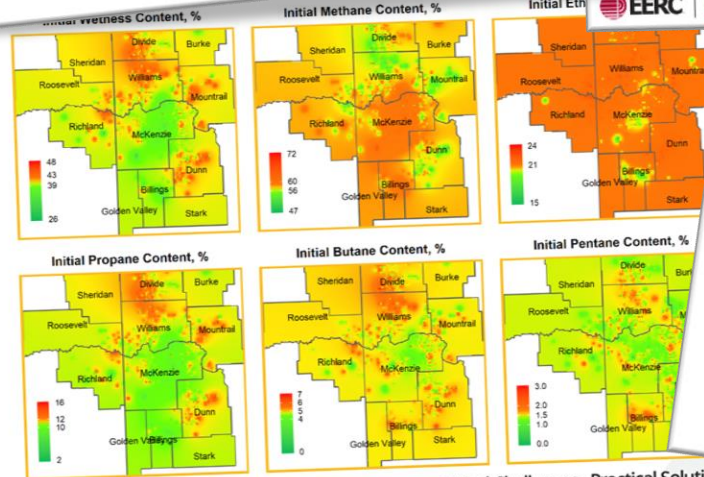
Prepared for:

Justin Kringstad

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

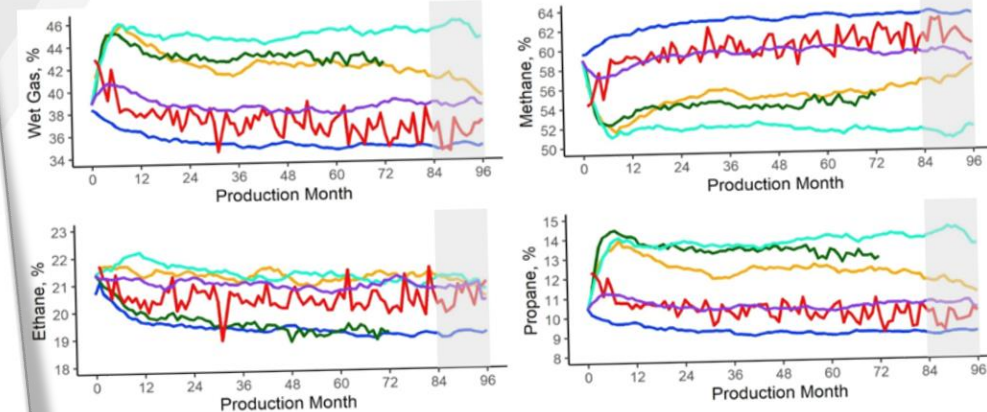
Spatial Patterns

- ❖ 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.



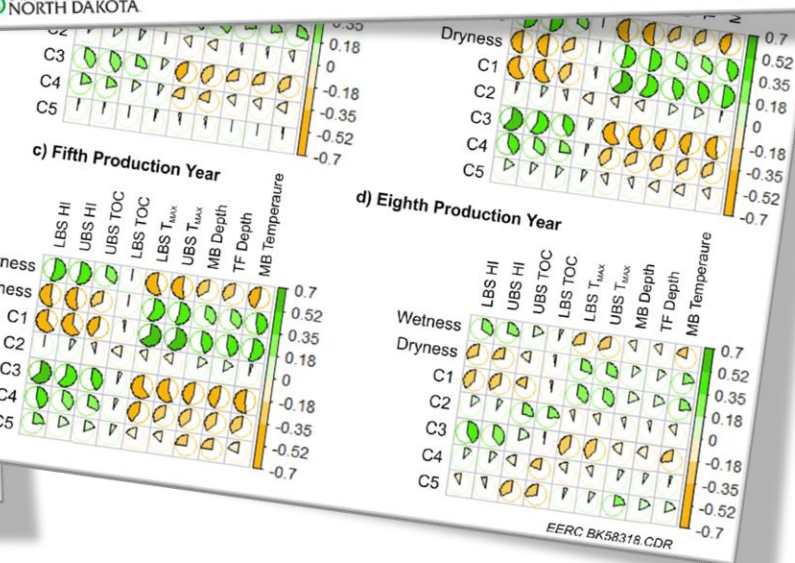
Critical Challenges. Practical Solutions.

Temporal Patterns in Measured Gas Composition



Divide Dunn-McKenzie Mountrail
Dunn McKenzie Williams

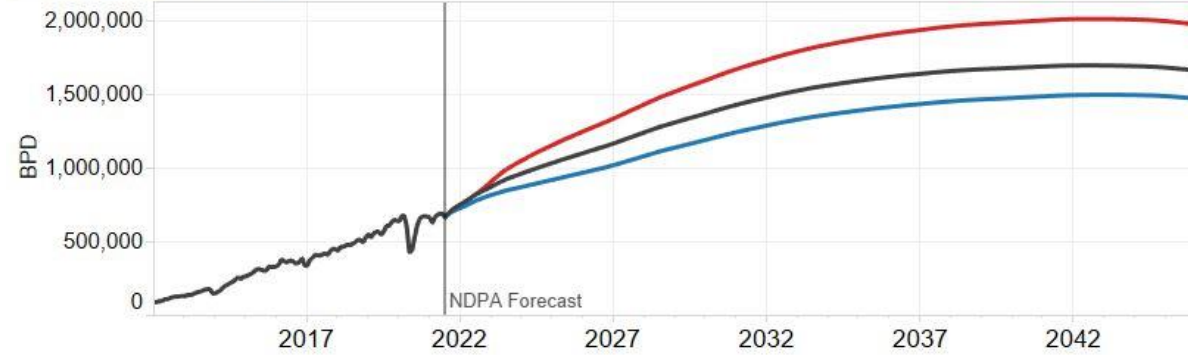
Critical Challenges. Practical Solutions.



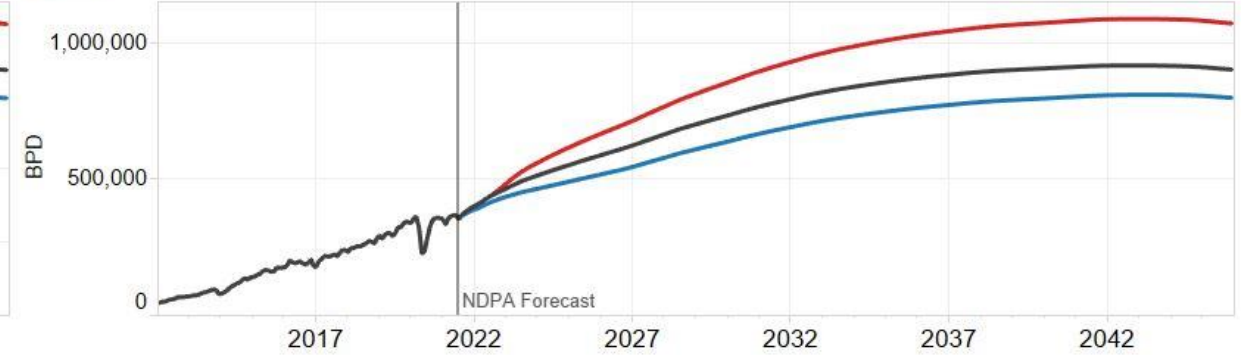
EERC BK58318.CDR

North Dakota Captured* NGL's

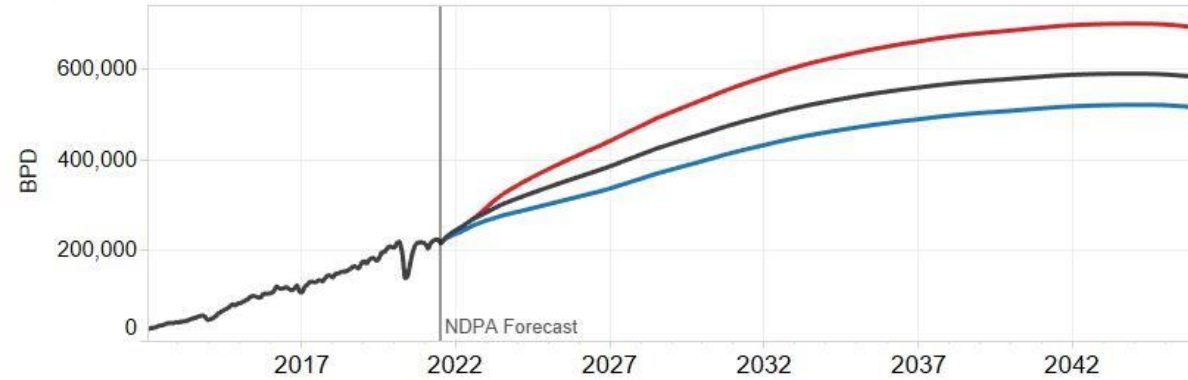
All Natural Gas Liquids



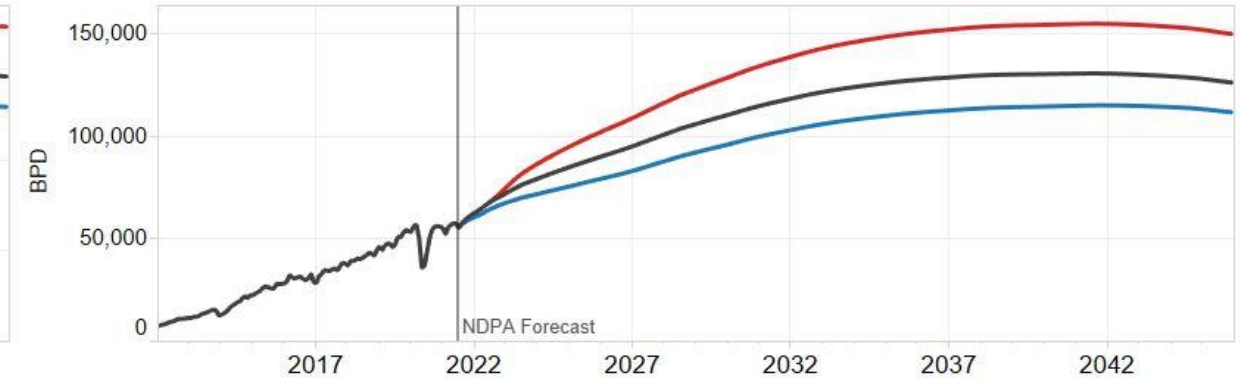
Ethane



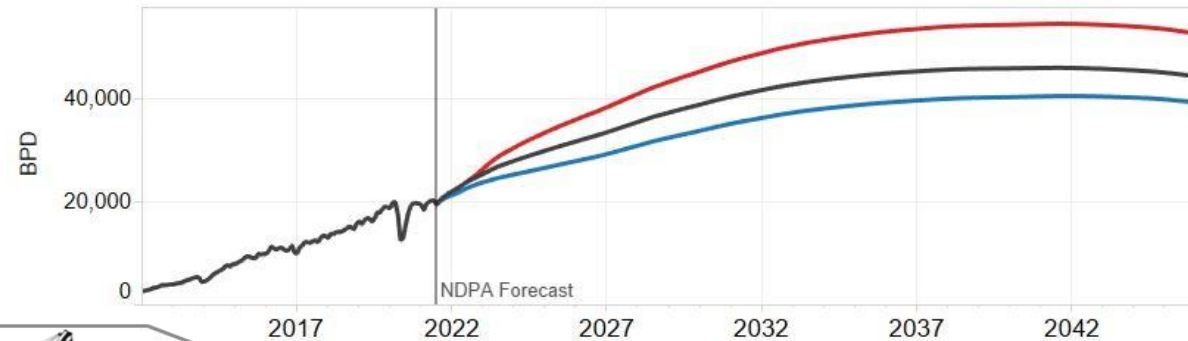
Propane



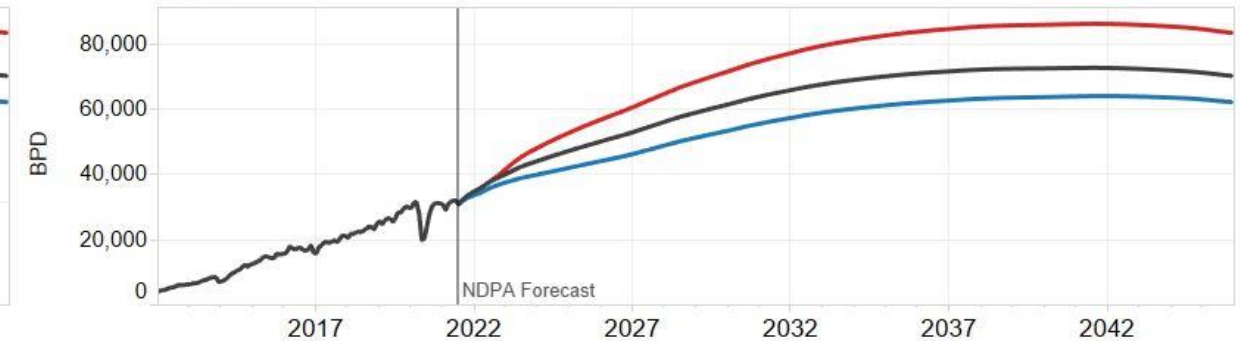
Butane



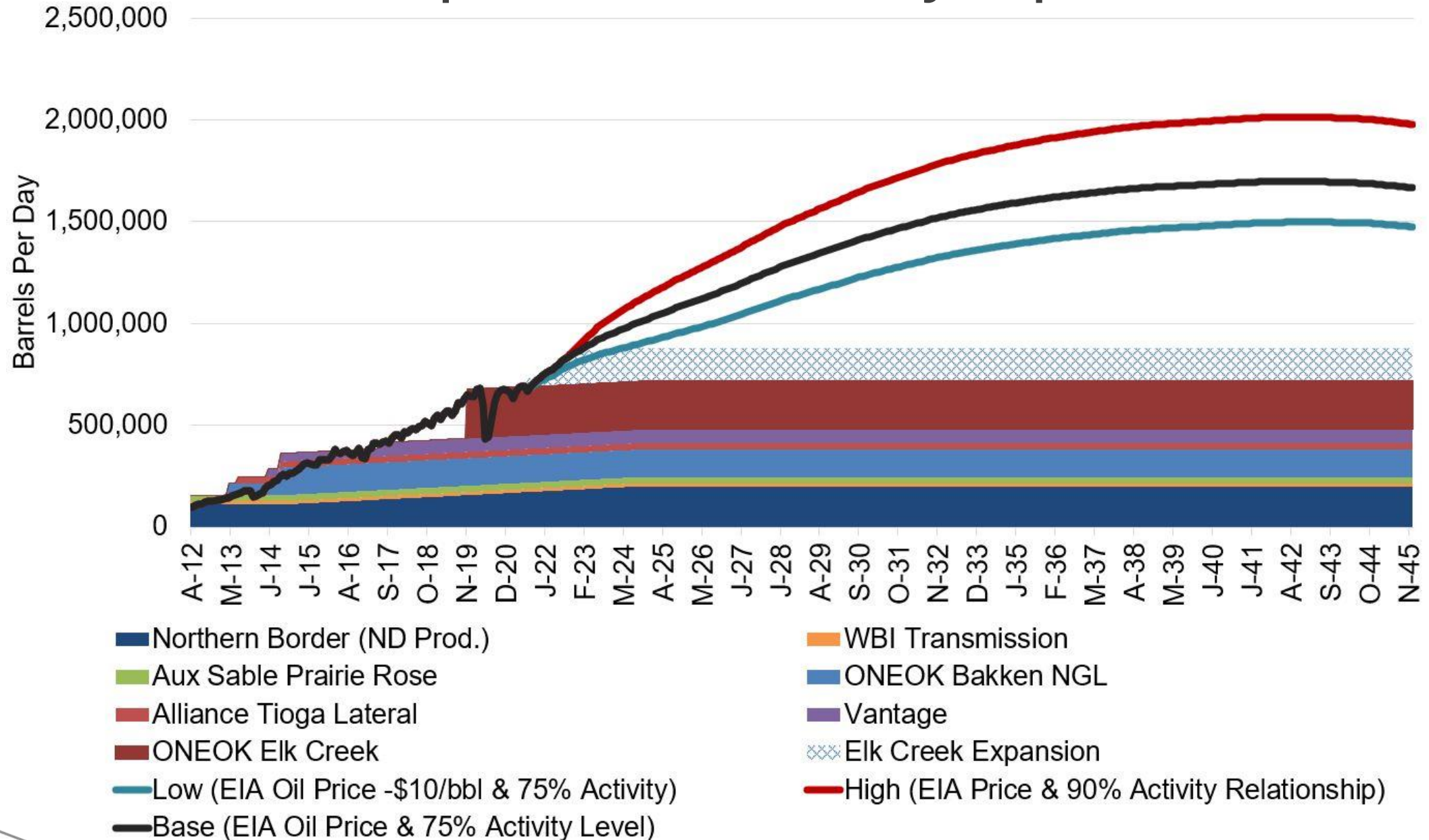
Isobutane



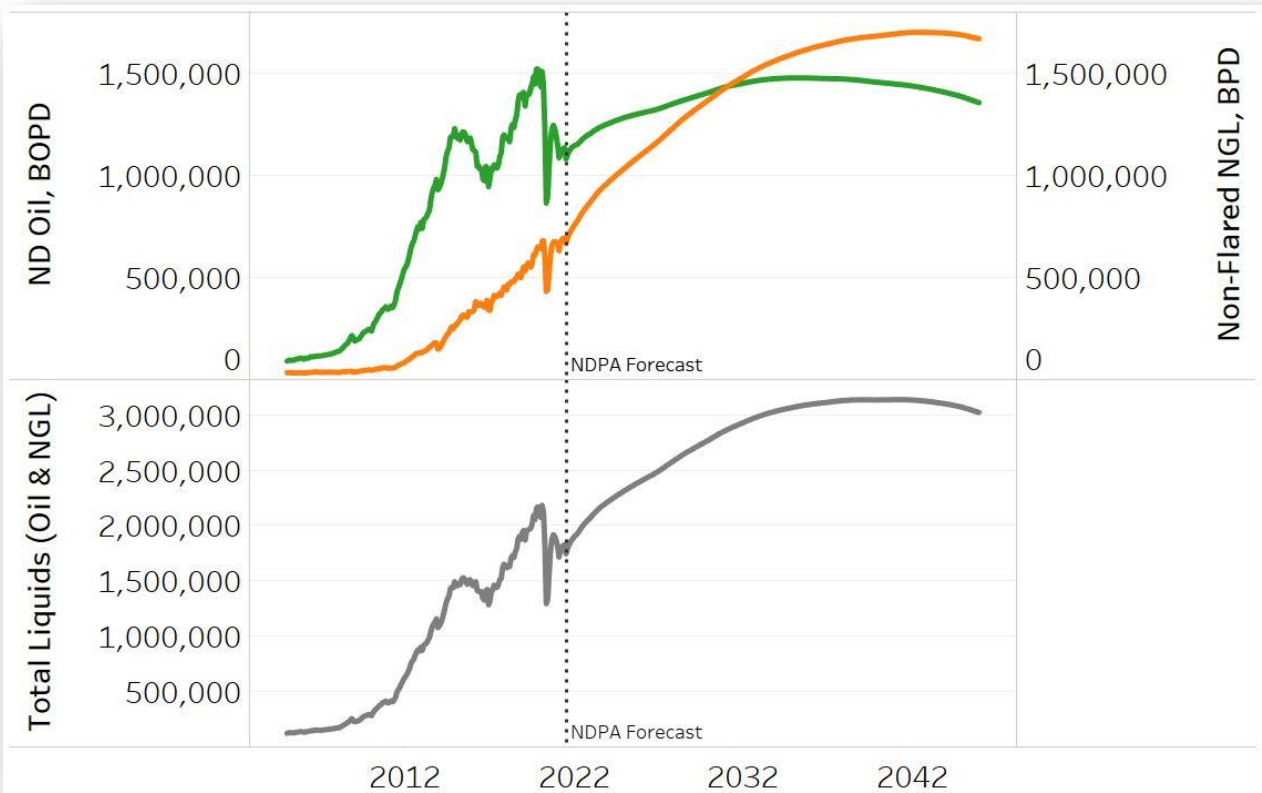
Natural Gasoline



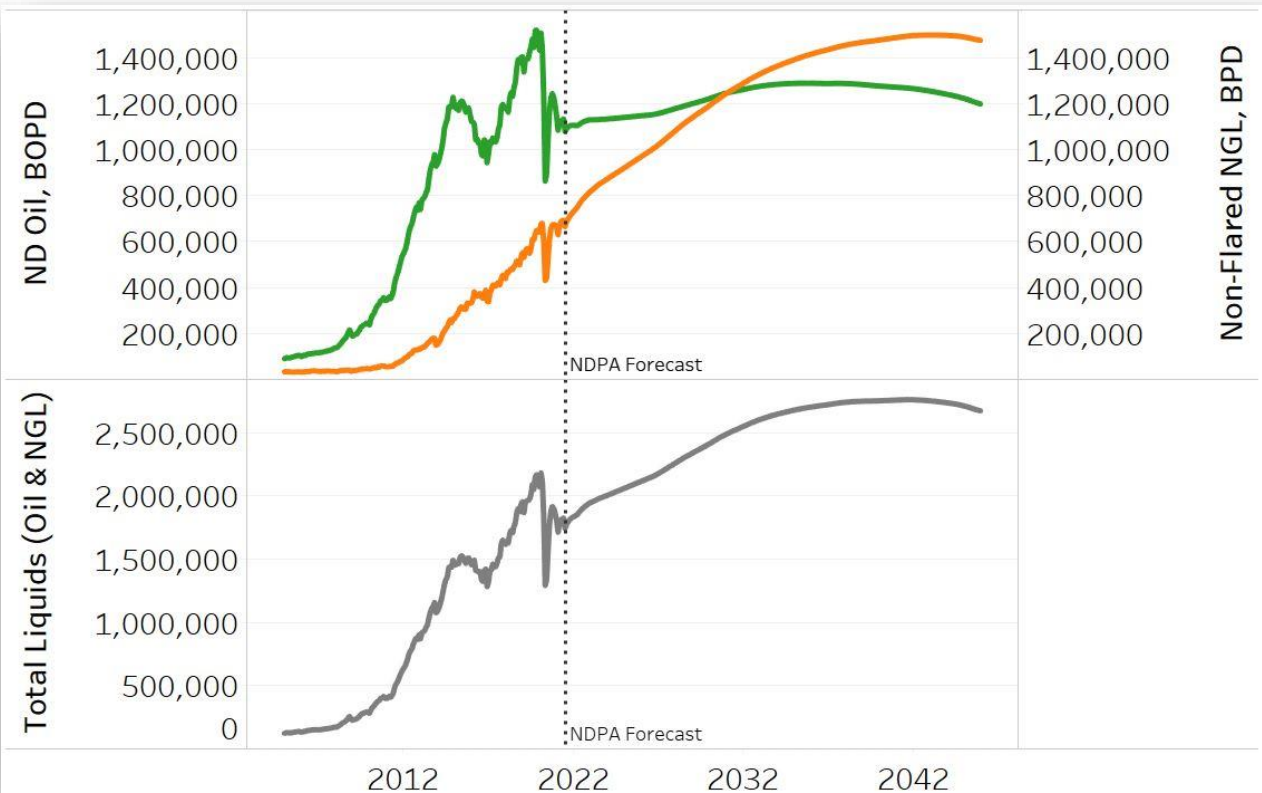
NGL Pipeline Takeaway Options



Total Liquids Production (Oil & Non-flared NGL)



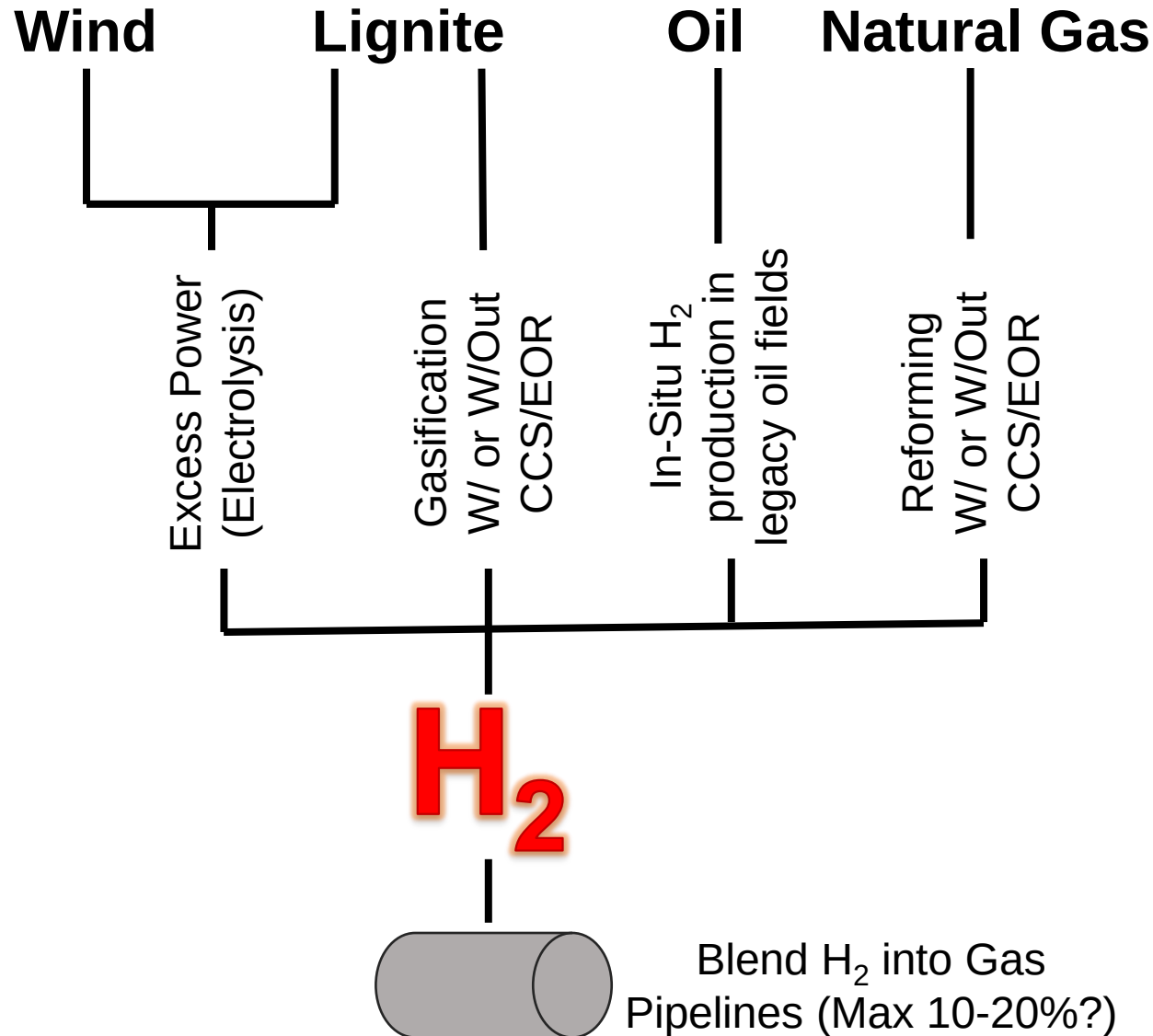
Base Case



Low Case



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 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



Hydrogen/Residue Gas Blending



Contact Information

Justin J. Kringstad, Director
North Dakota Pipeline Authority

600 E. Boulevard Ave. Dept. 405
Bismarck, ND 58505-0840

Phone: (701)220-6227
Fax: (701)328-2820
E-mail: jjkringstad@ndpipelines.com

Websites:

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



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