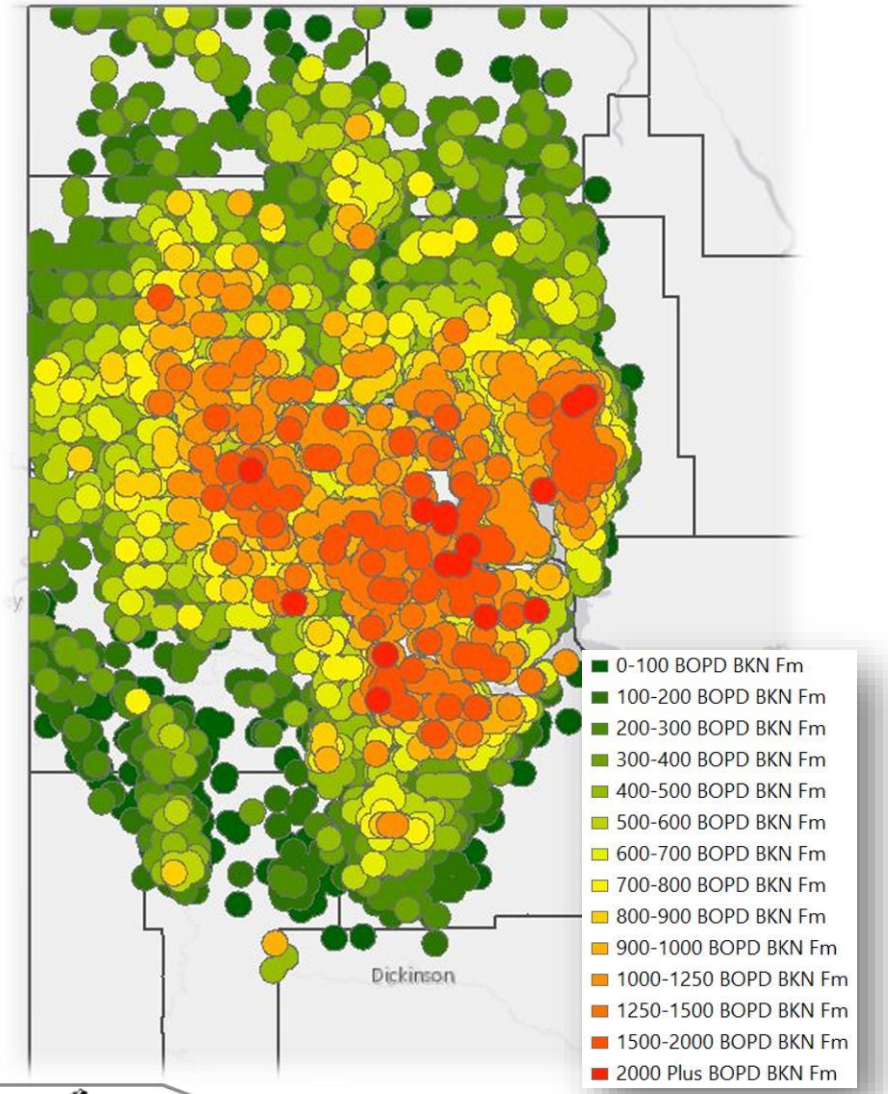
North Dakota Oil & Gas Research Program

Justin J Kringstad
Geological Engineer
Director
North Dakota Pipeline Authority

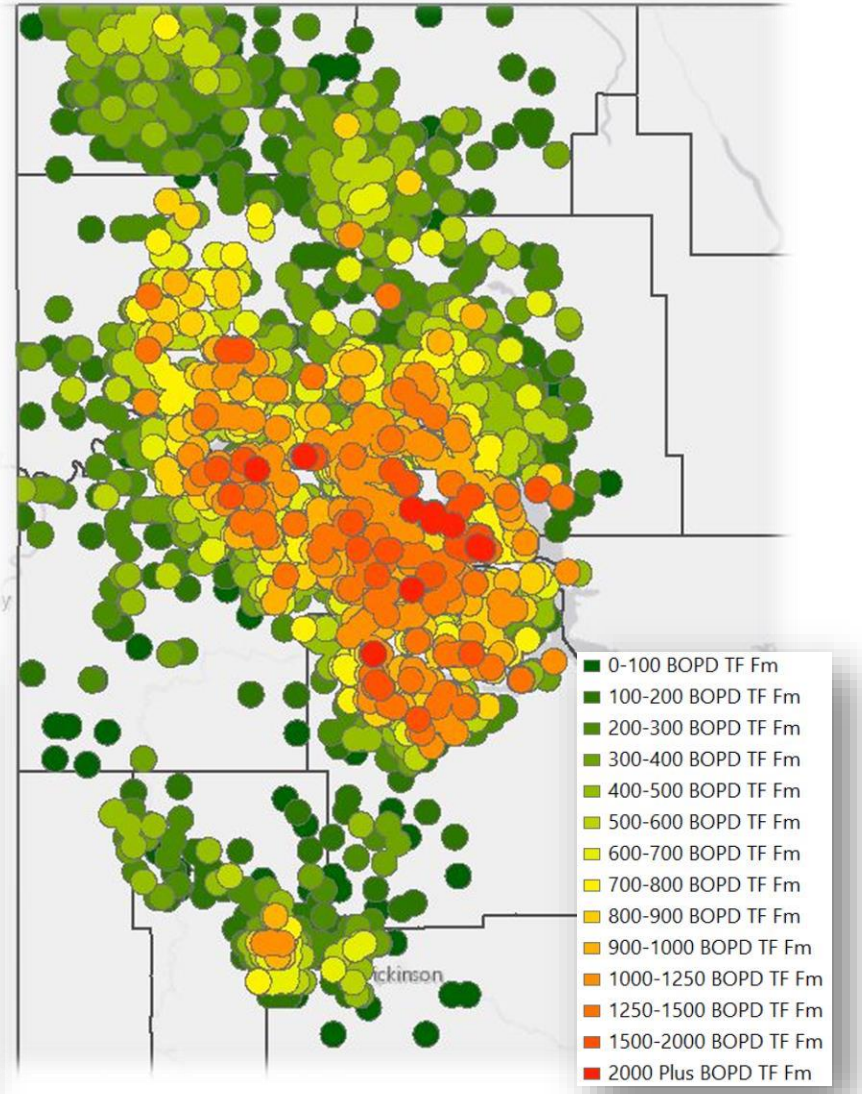
July 21, 2021

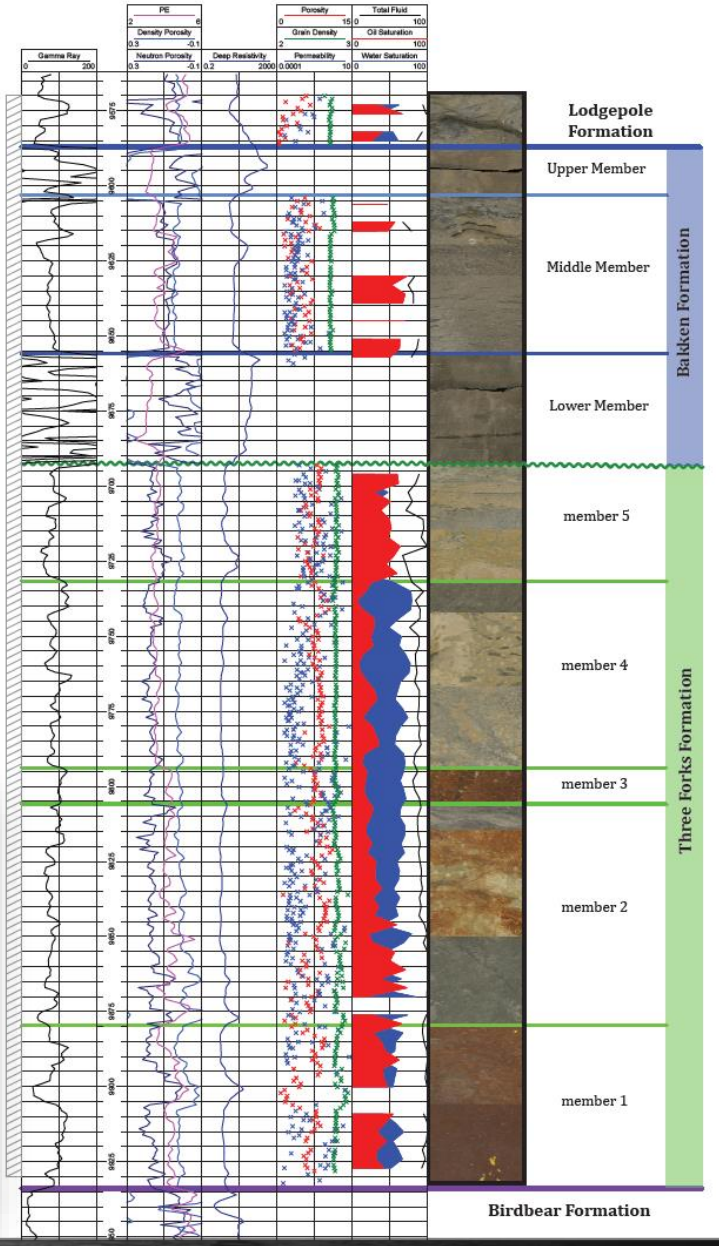
Bakken & Three Forks Formations

Bakken Formation

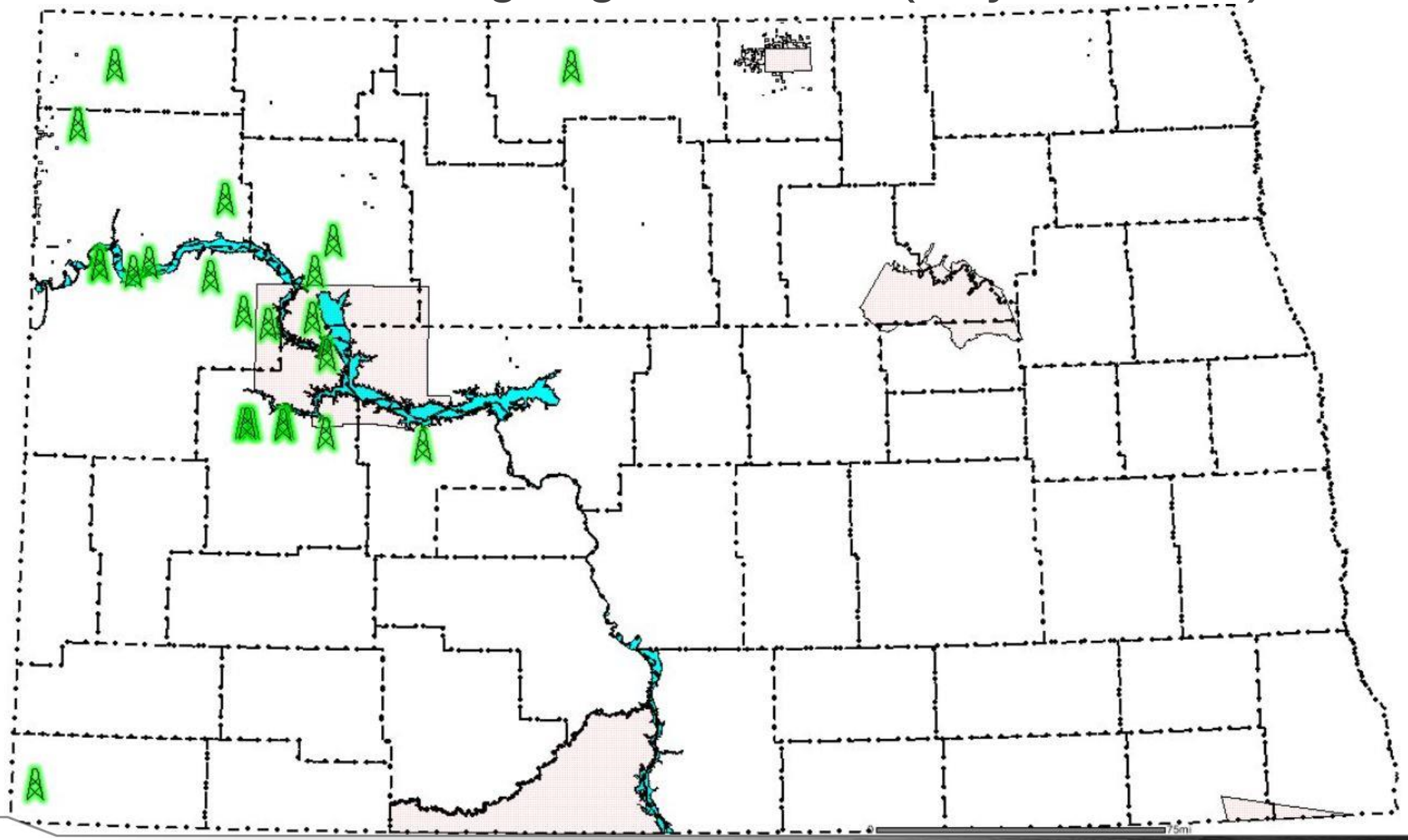


Three Forks Formation

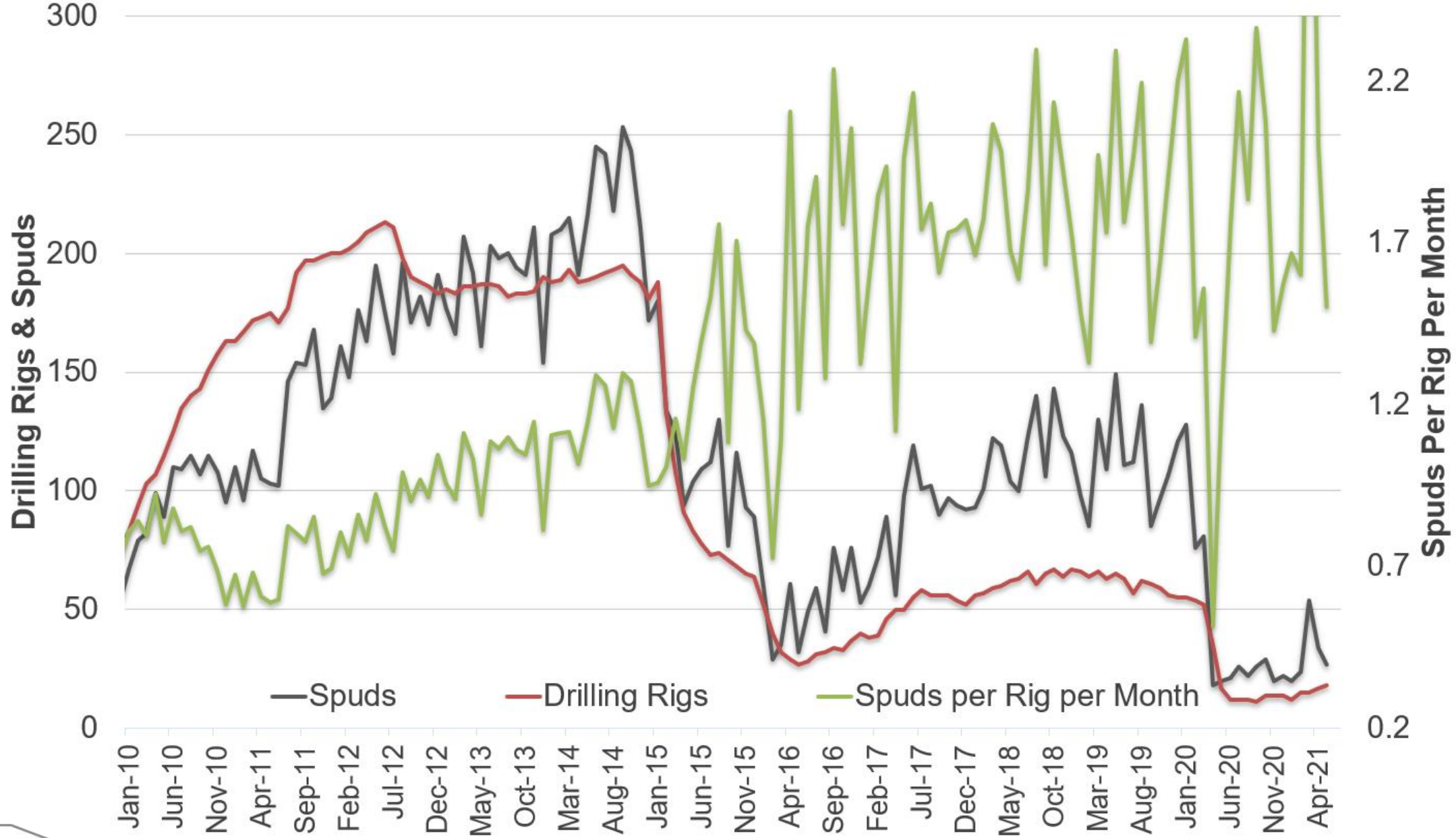




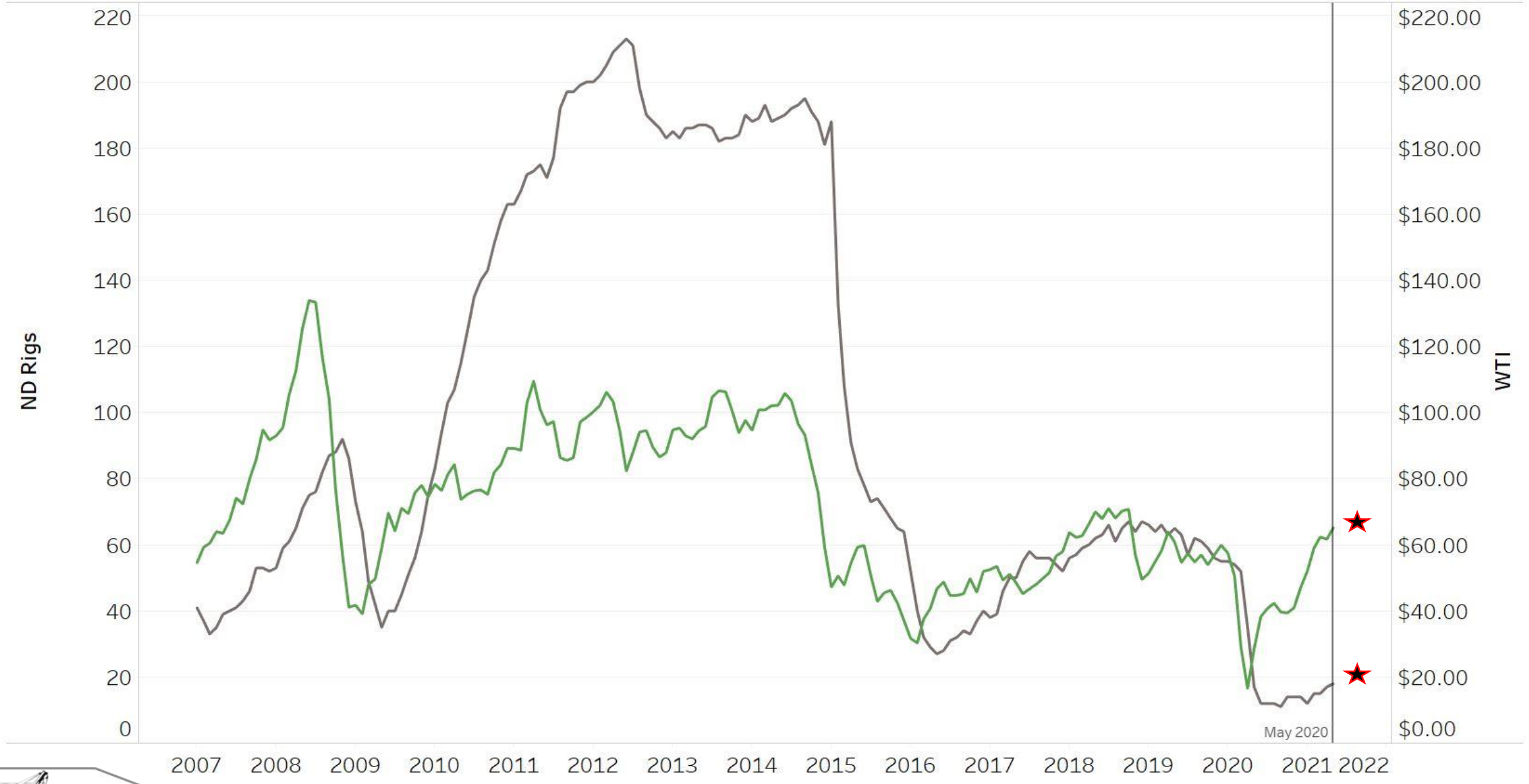
Current Drilling Rig Fleet – 23 (July 20, 2021)



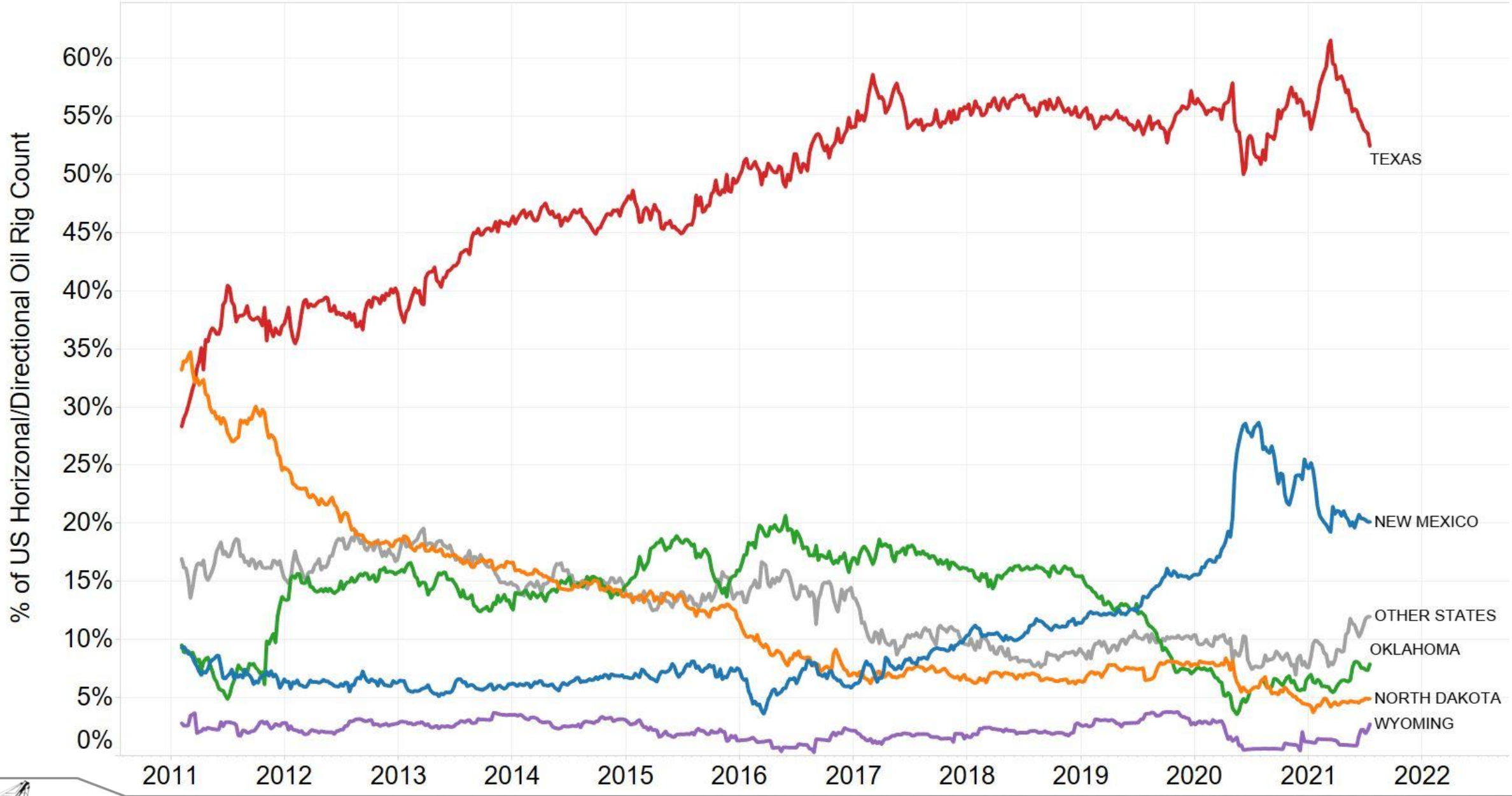
North Dakota Drilling Rig Efficiency



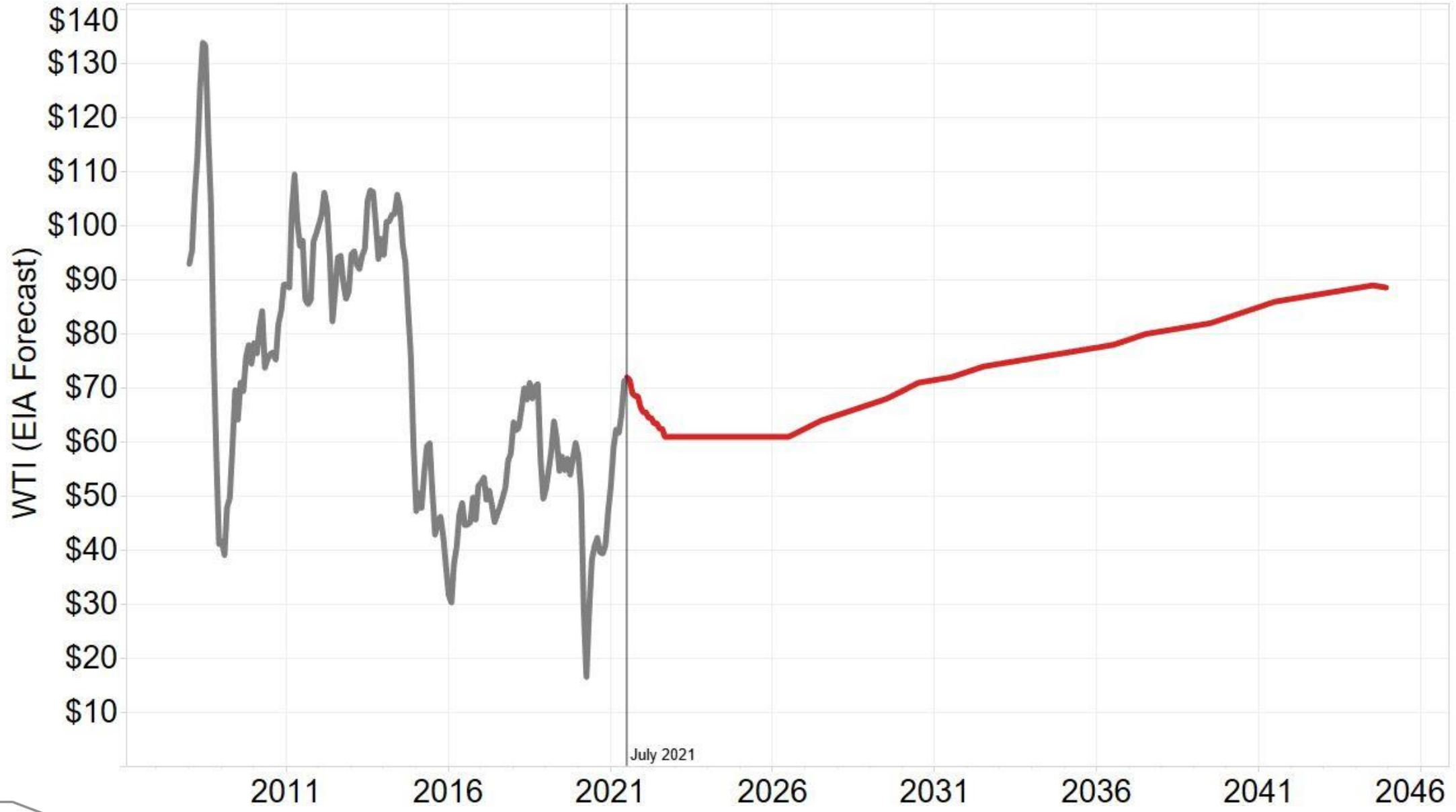
North Dakota Drilling Activity History



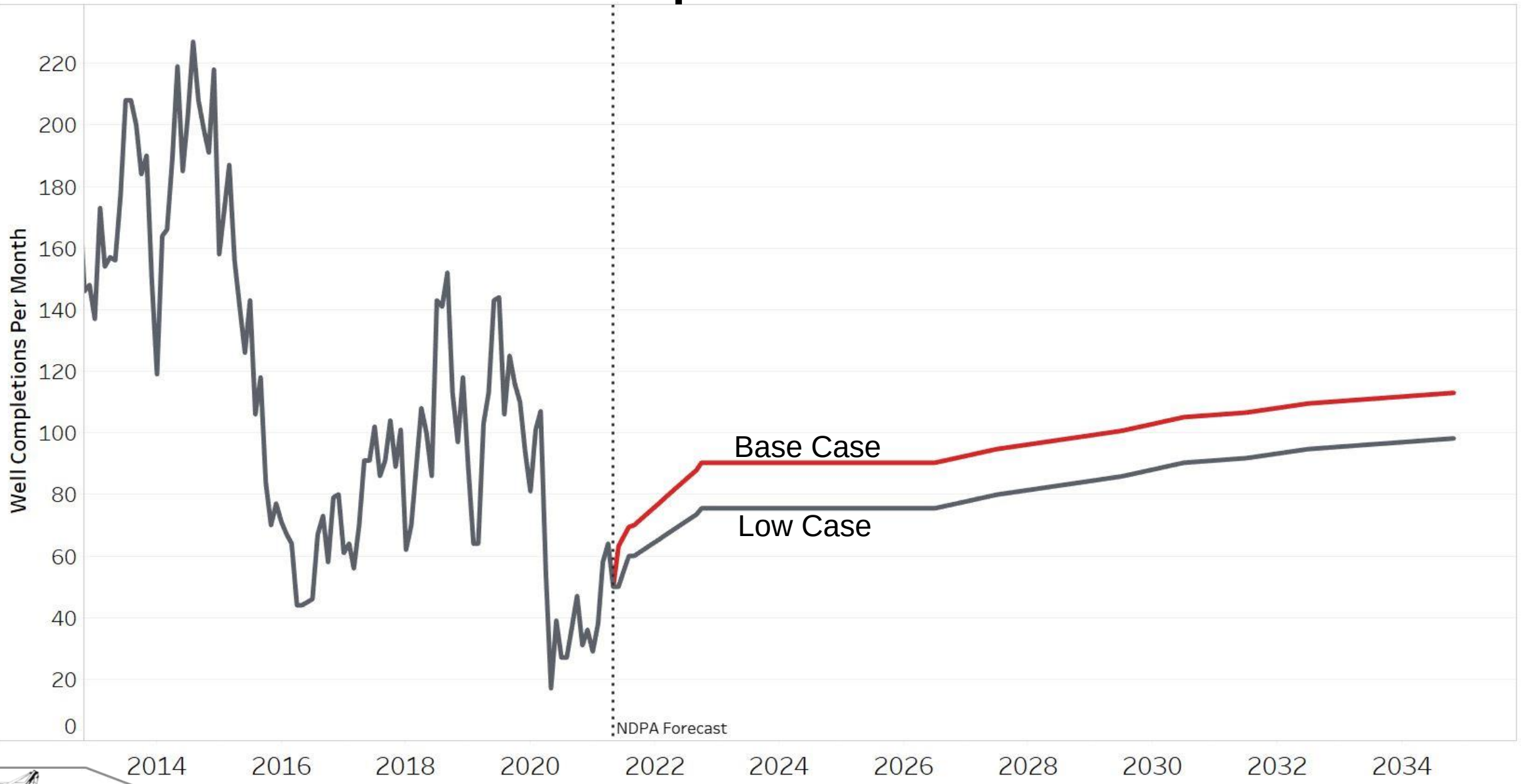
Domestic Horizontal/Directional Oil Drilling (Baker Hughes)



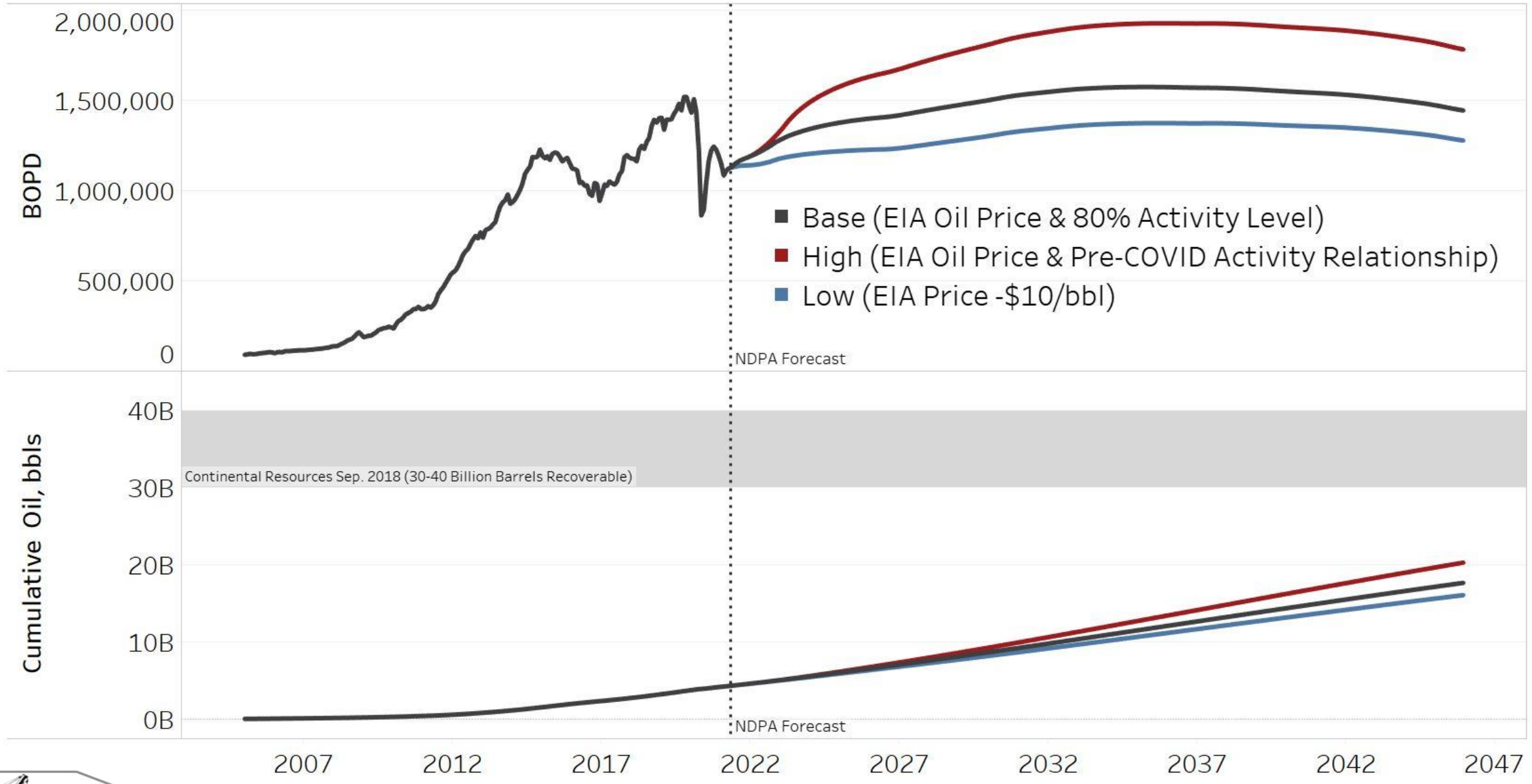
EIA Oil Price Outlook



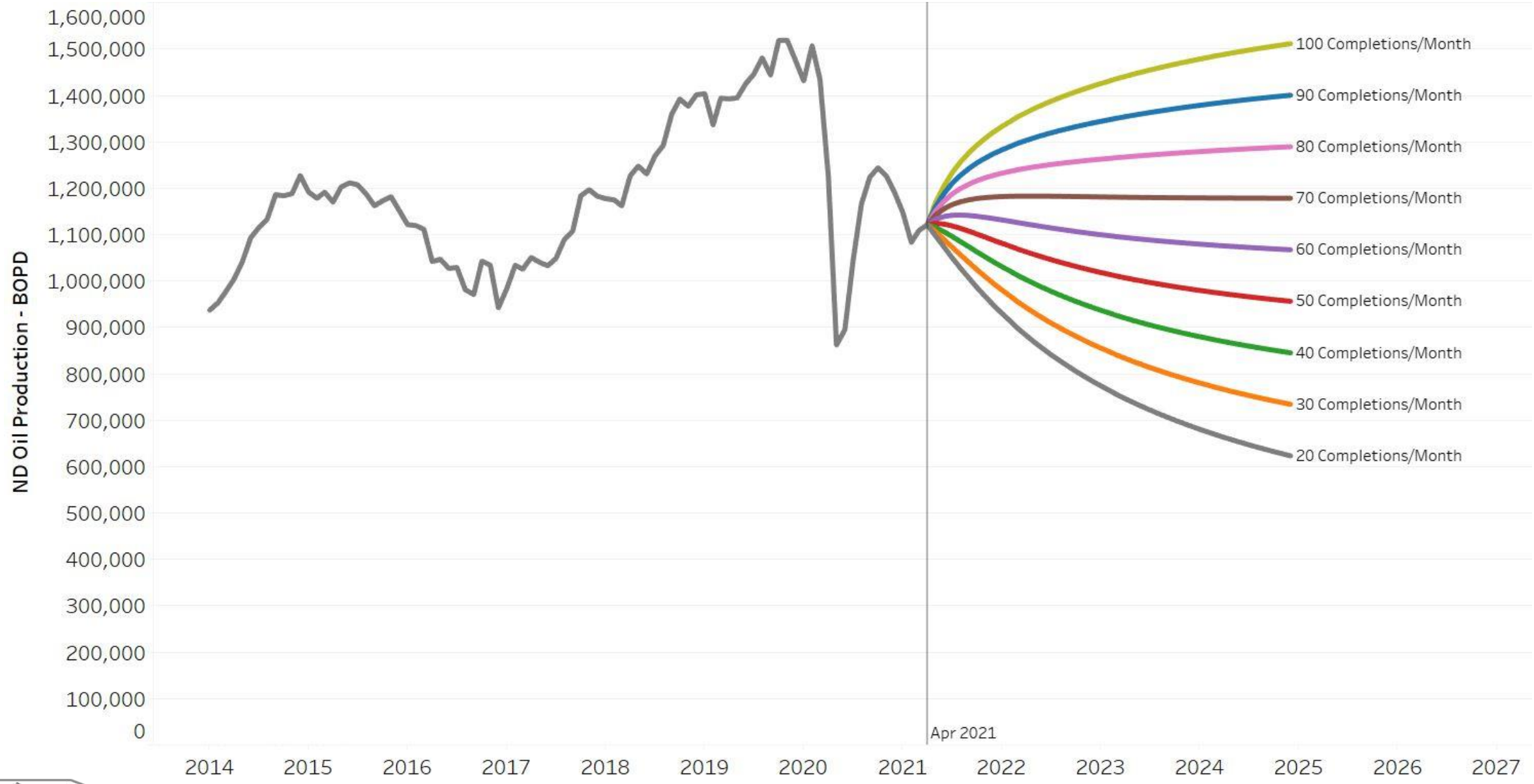
Well Completion Outlook



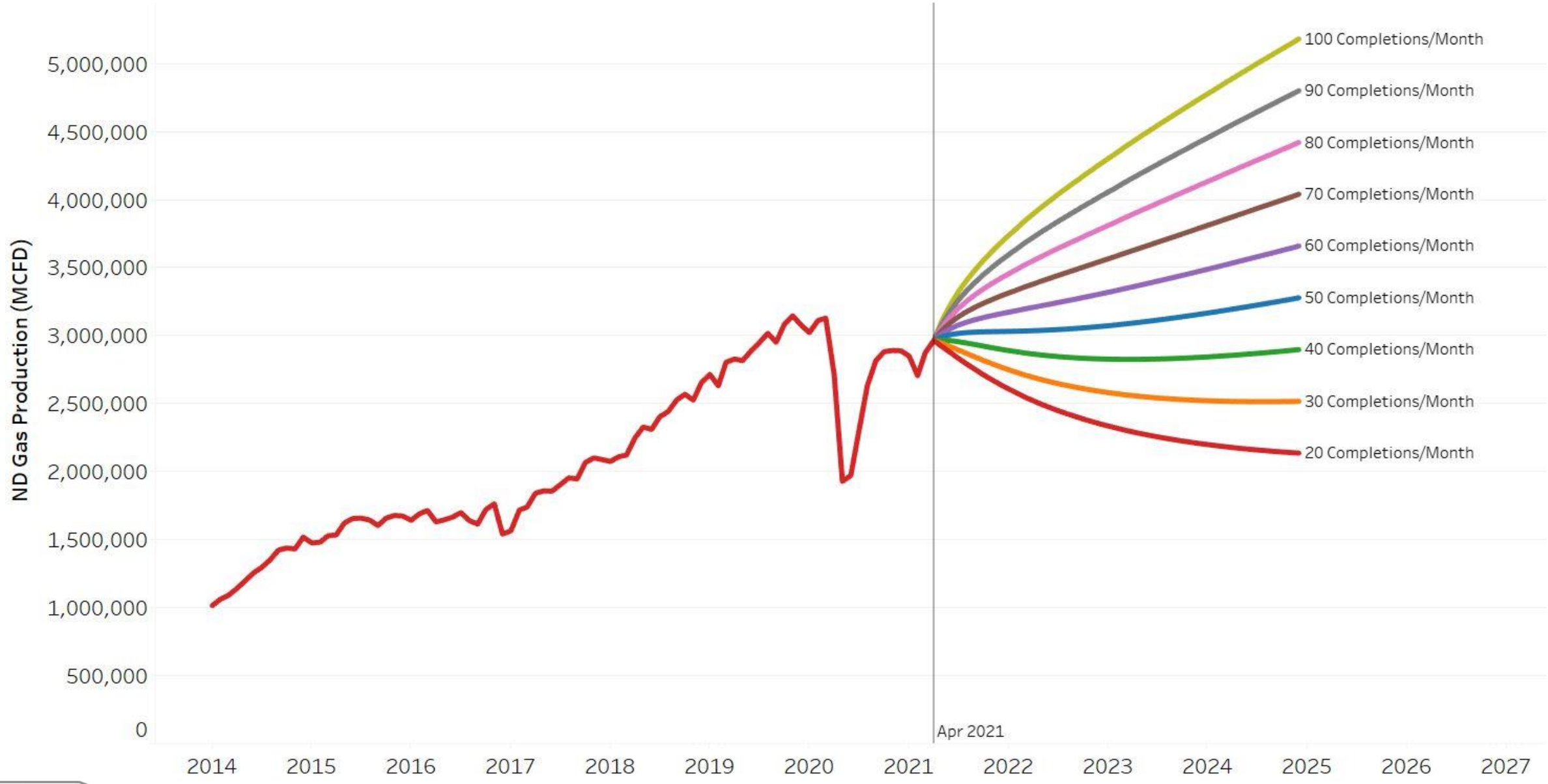
ND Oil Production: EIA Price Deck



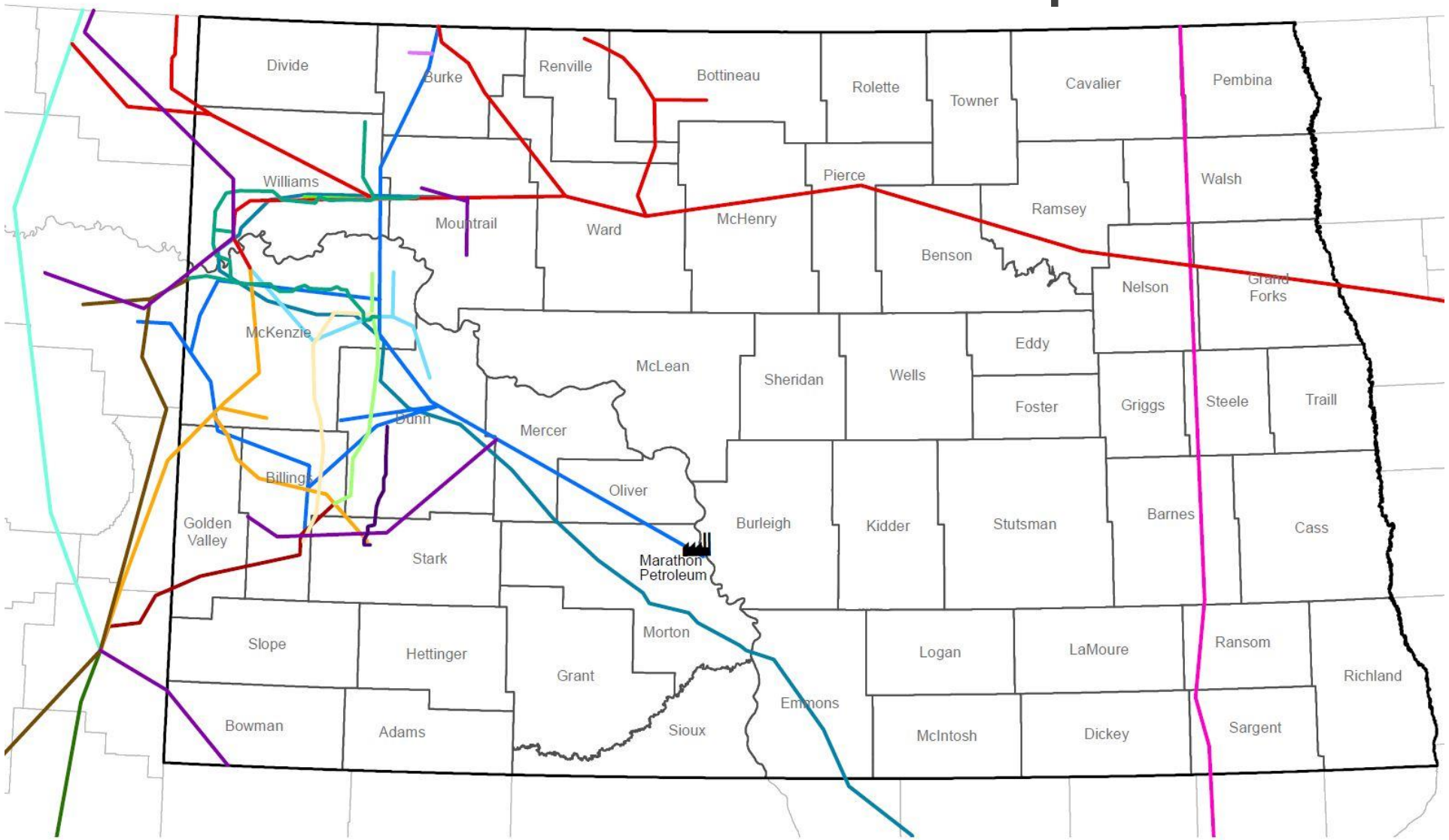
Monthly Completion Scenarios - Oil



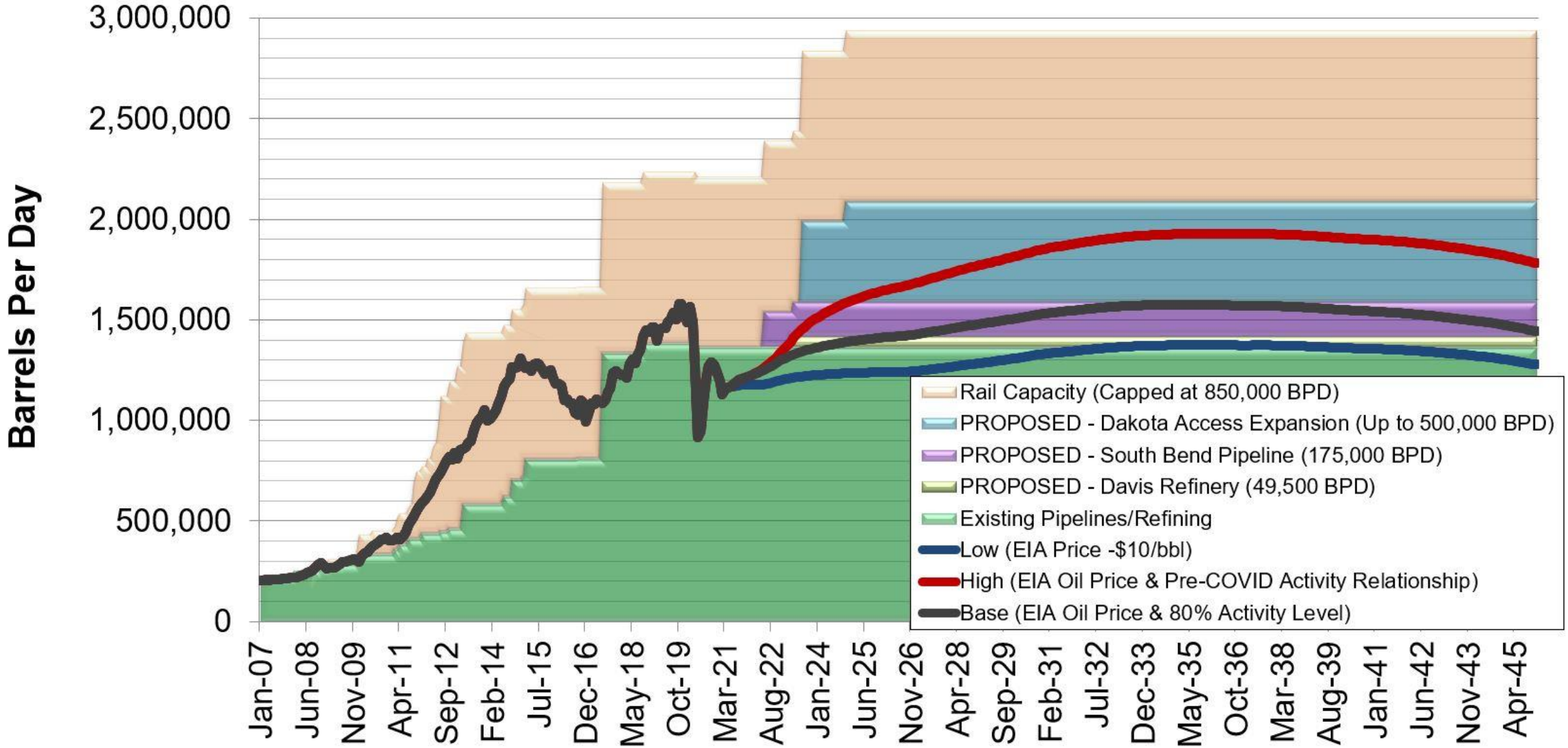
Monthly Completion Scenarios - Gas



North Dakota Oil Transmission Pipelines



Williston Basin Oil Production & Export Capacity, BOPD



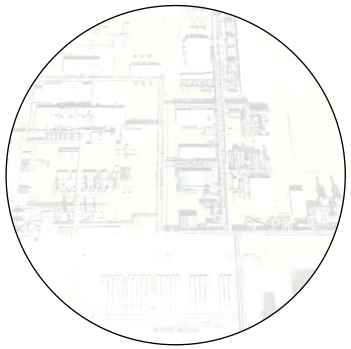
Natural Gas Update

Production

- Technology
- Markets

Gathering

- Capacity
- Connections



Processing

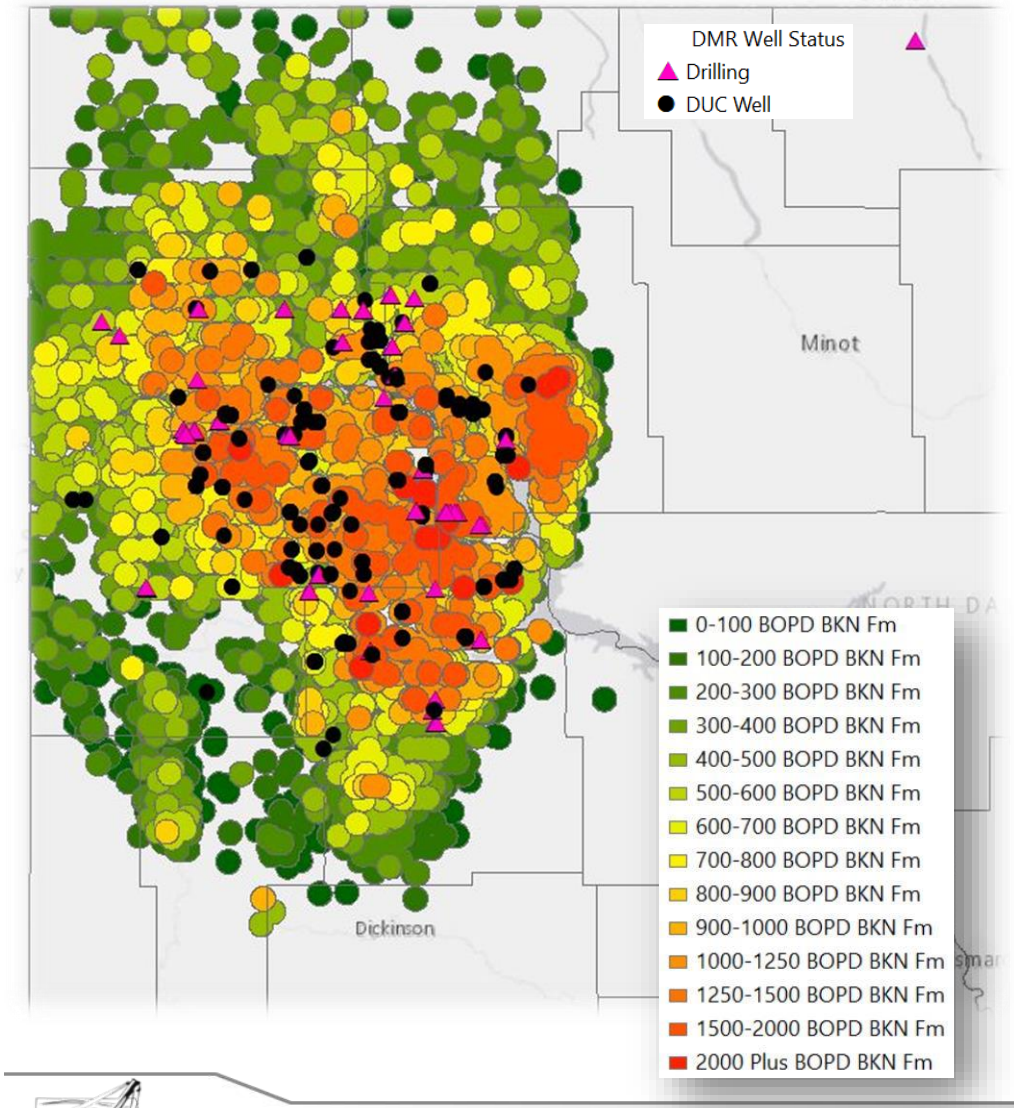
- Capacity
- Location

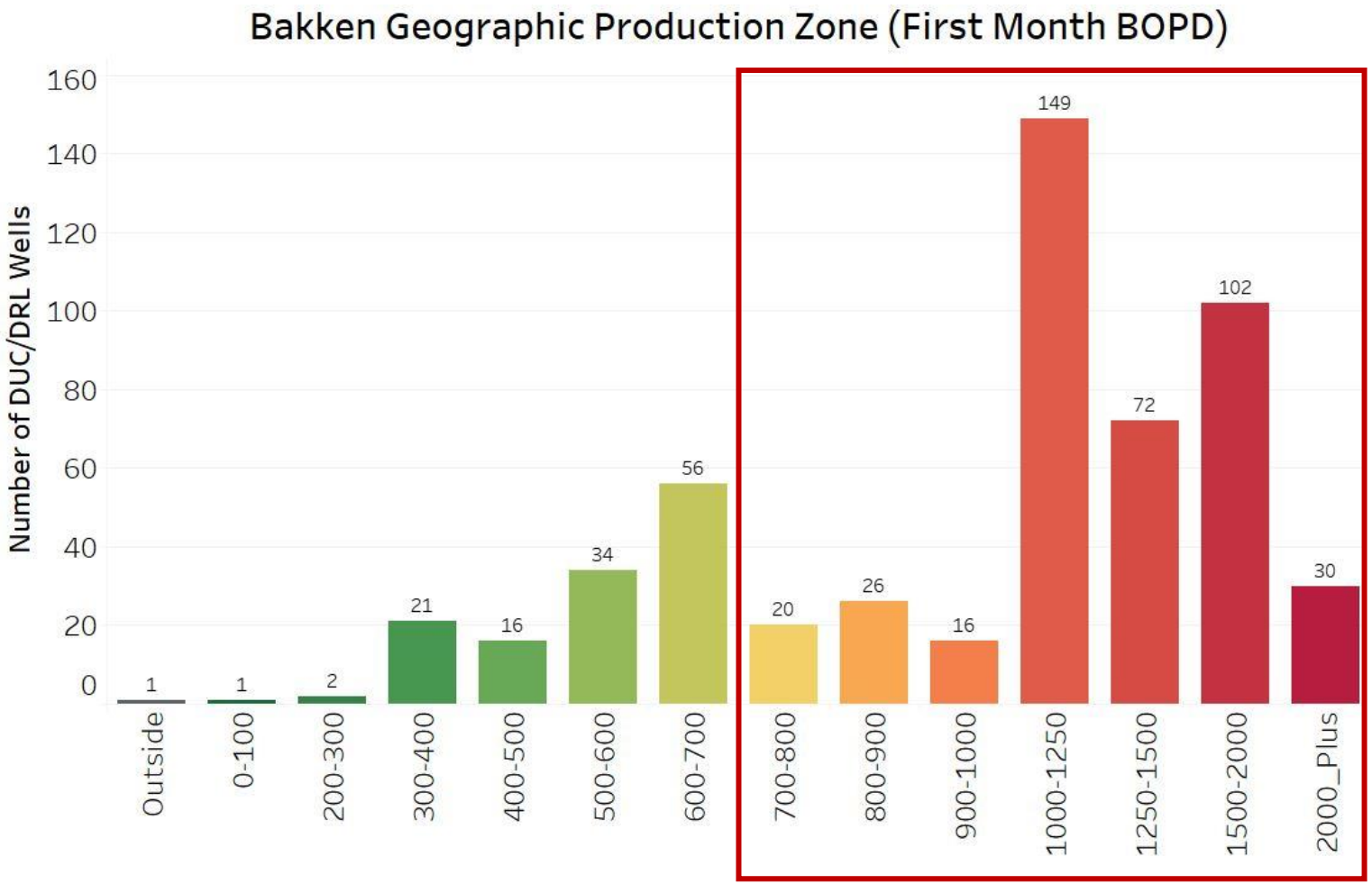
Transmission

- Dry Gas
- Natural Gas Liquids

North Dakota Wells Waiting on Completion – April 2021

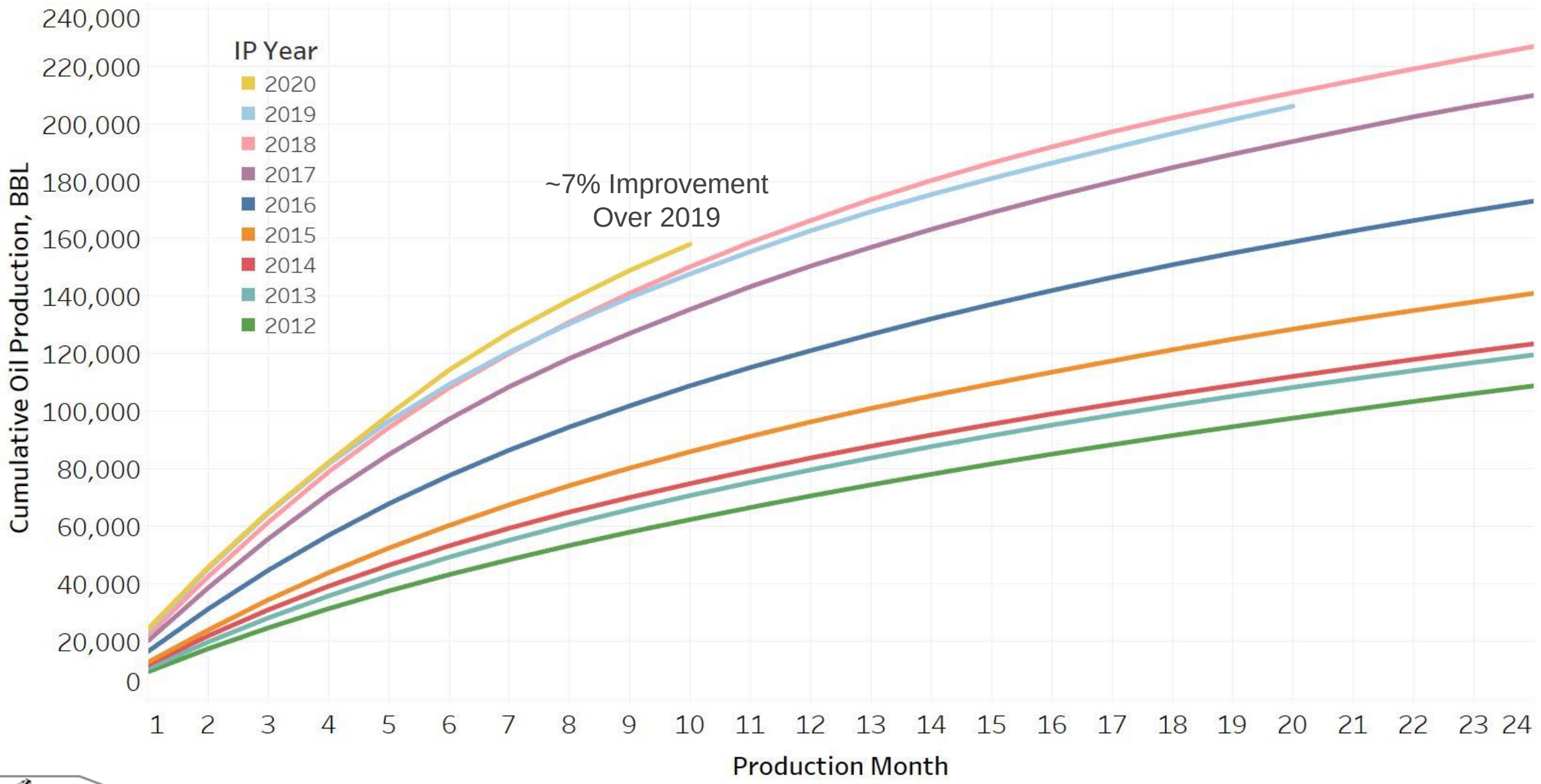
Bakken Formation



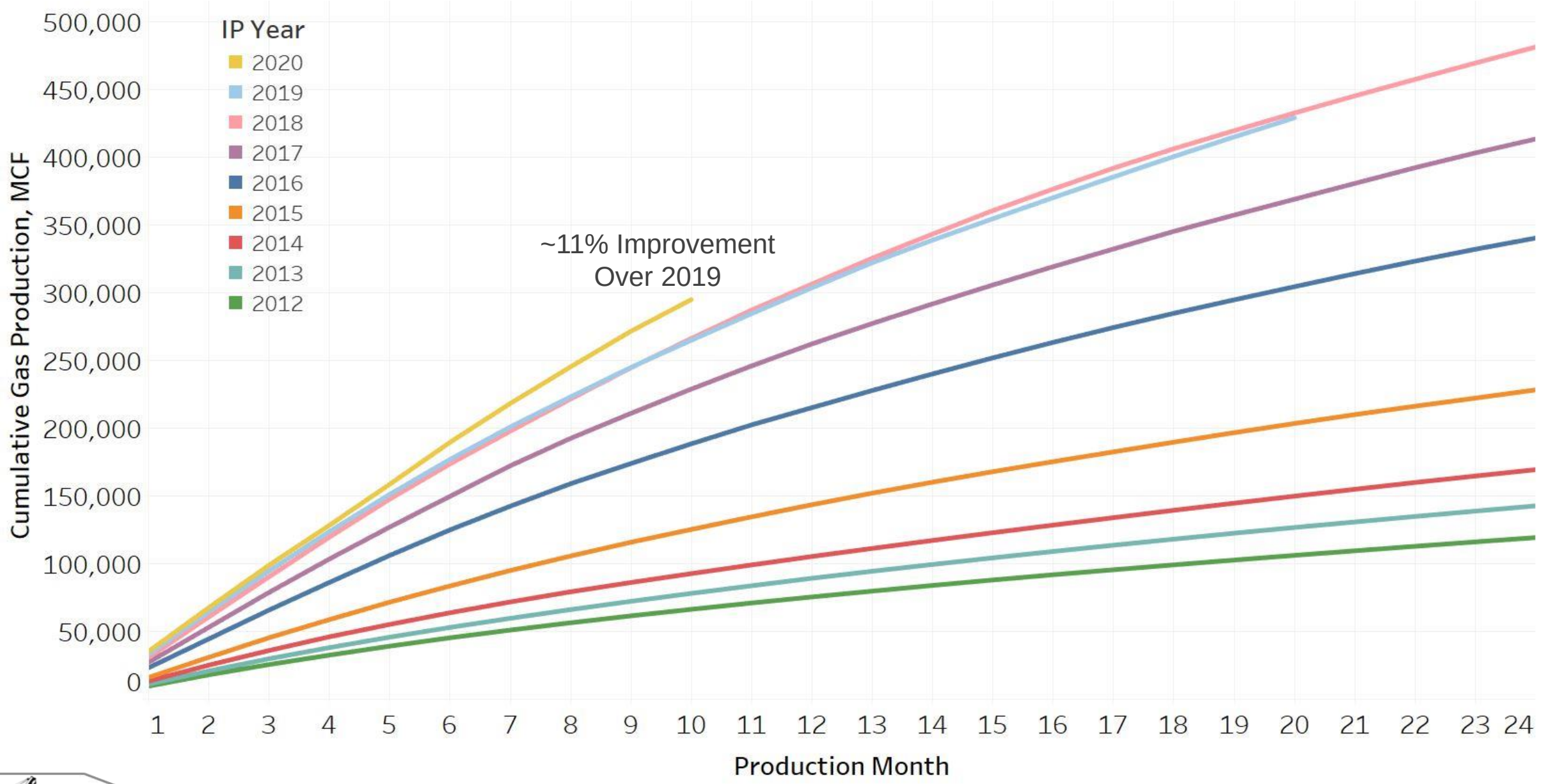


Most Attractive Acreage
in $60+ WTI Environment

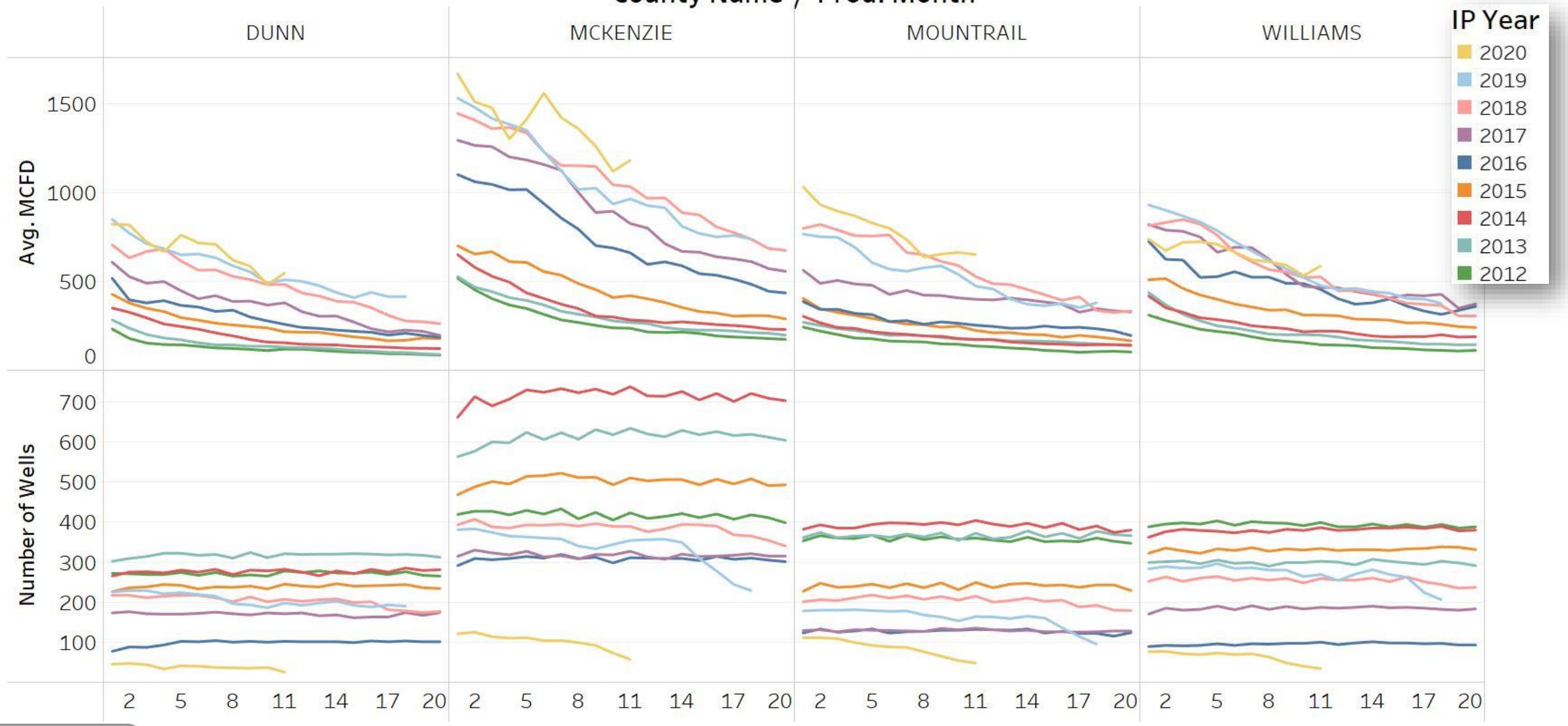
Statewide Bakken Oil Performance



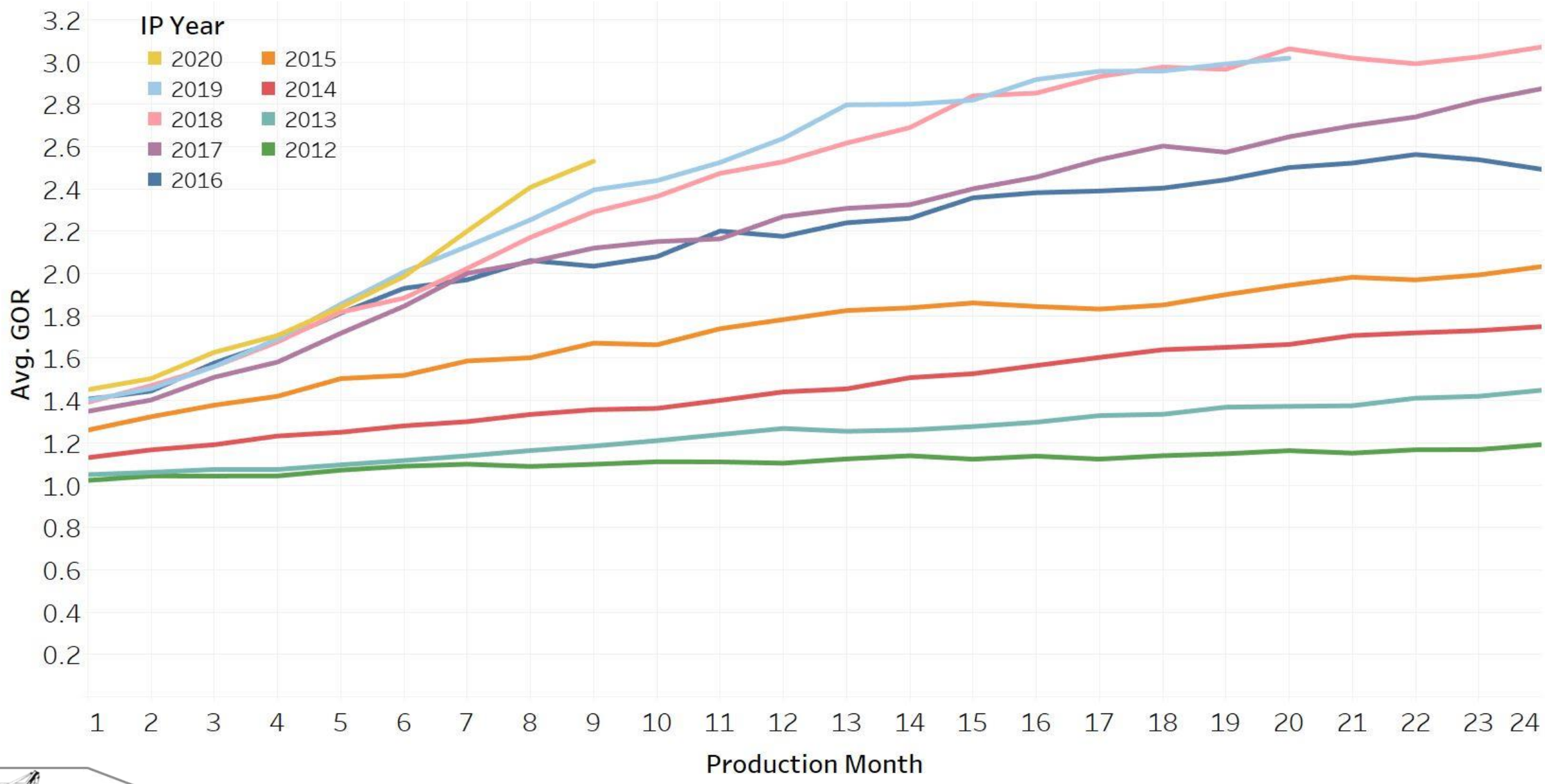
Statewide Bakken Gas Performance



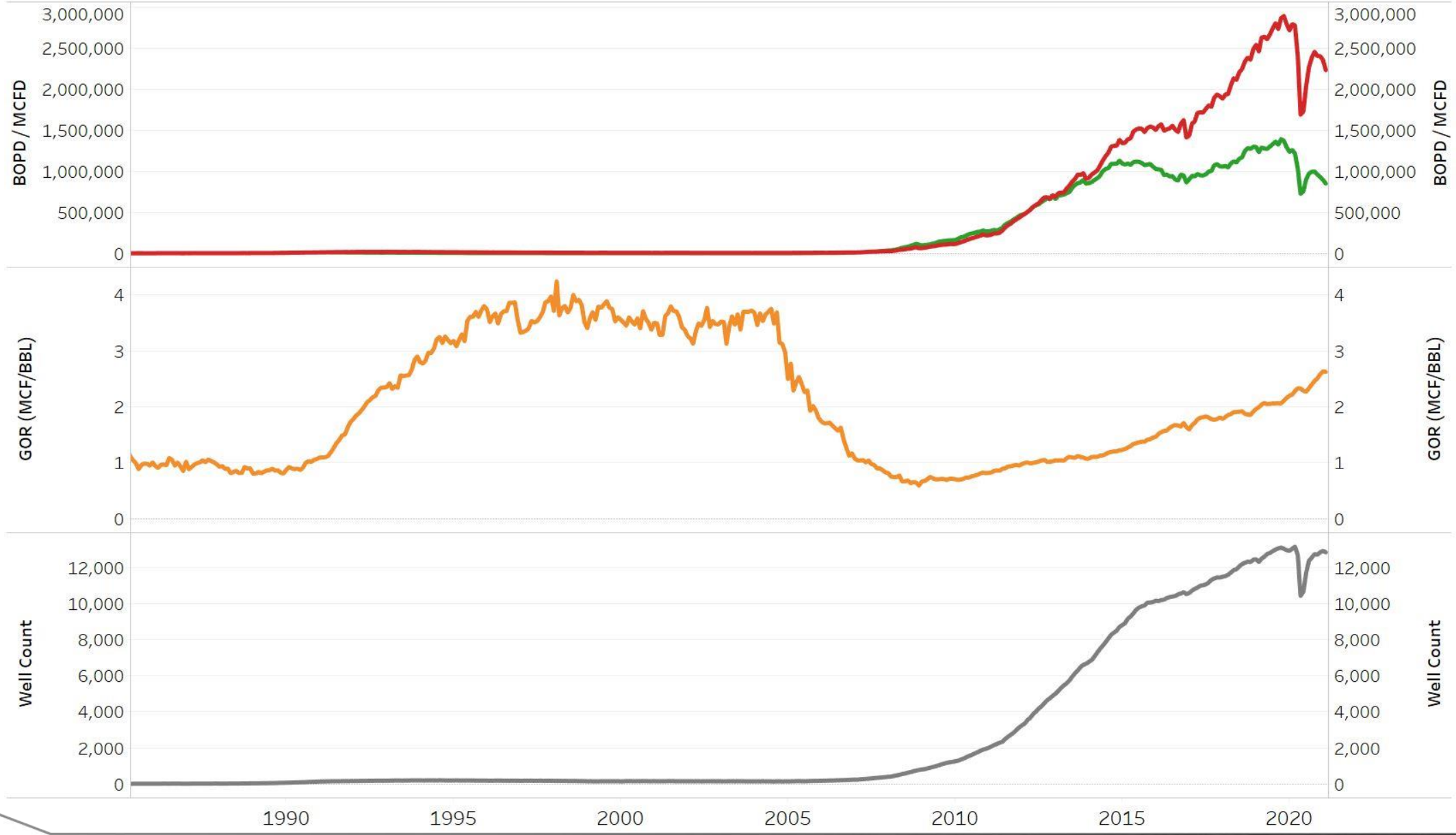
Core County Bakken Gas Performance



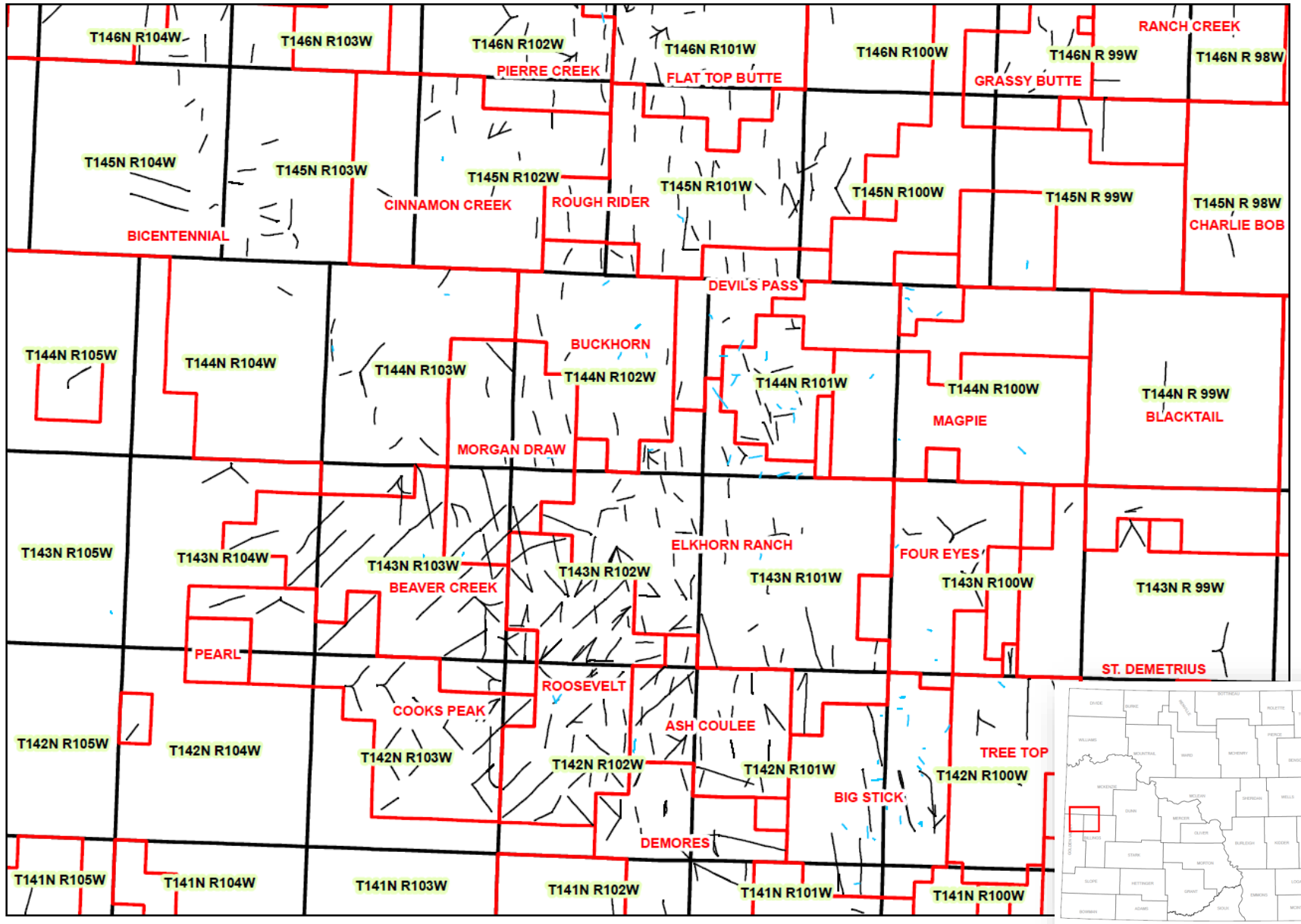
Statewide Bakken Gas/Oil Ratios



Statewide Bakken Production



Back to the 90's...



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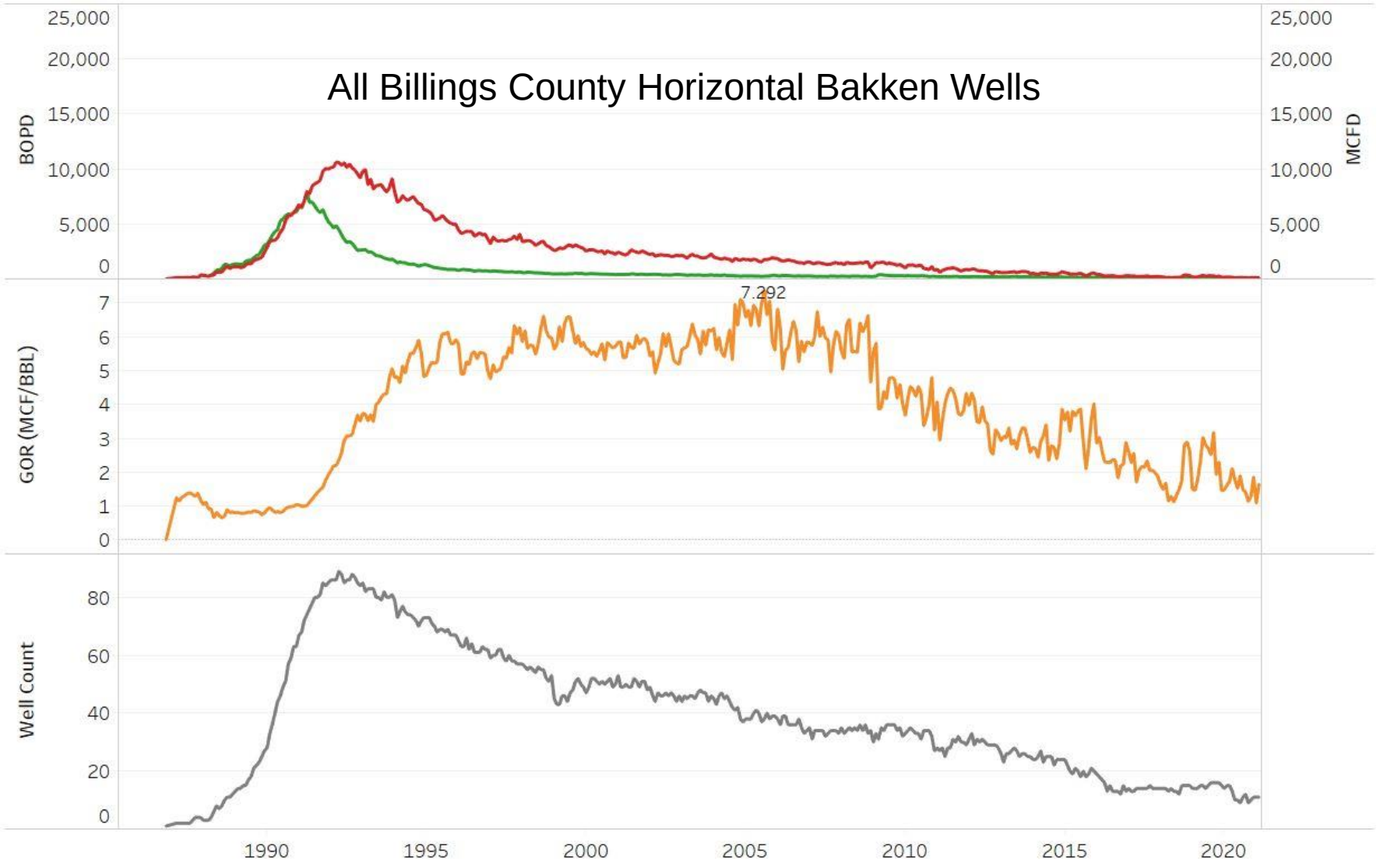
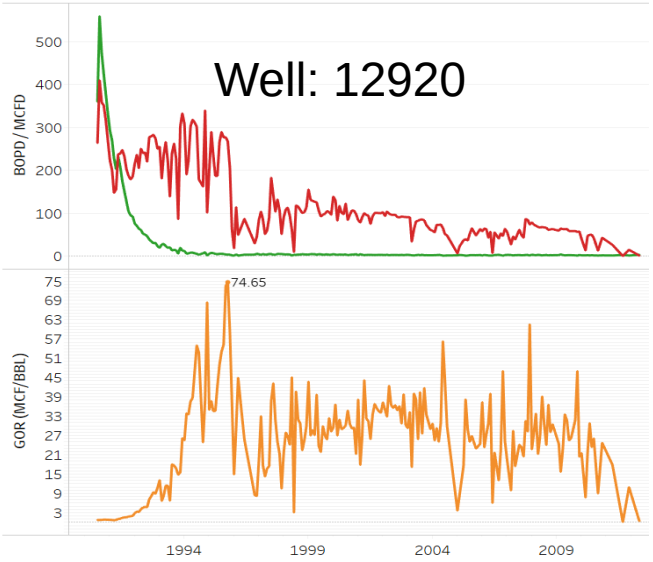
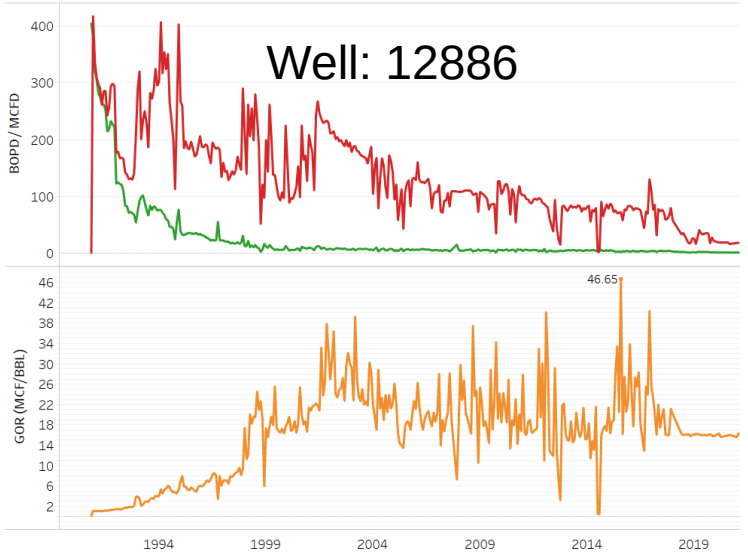
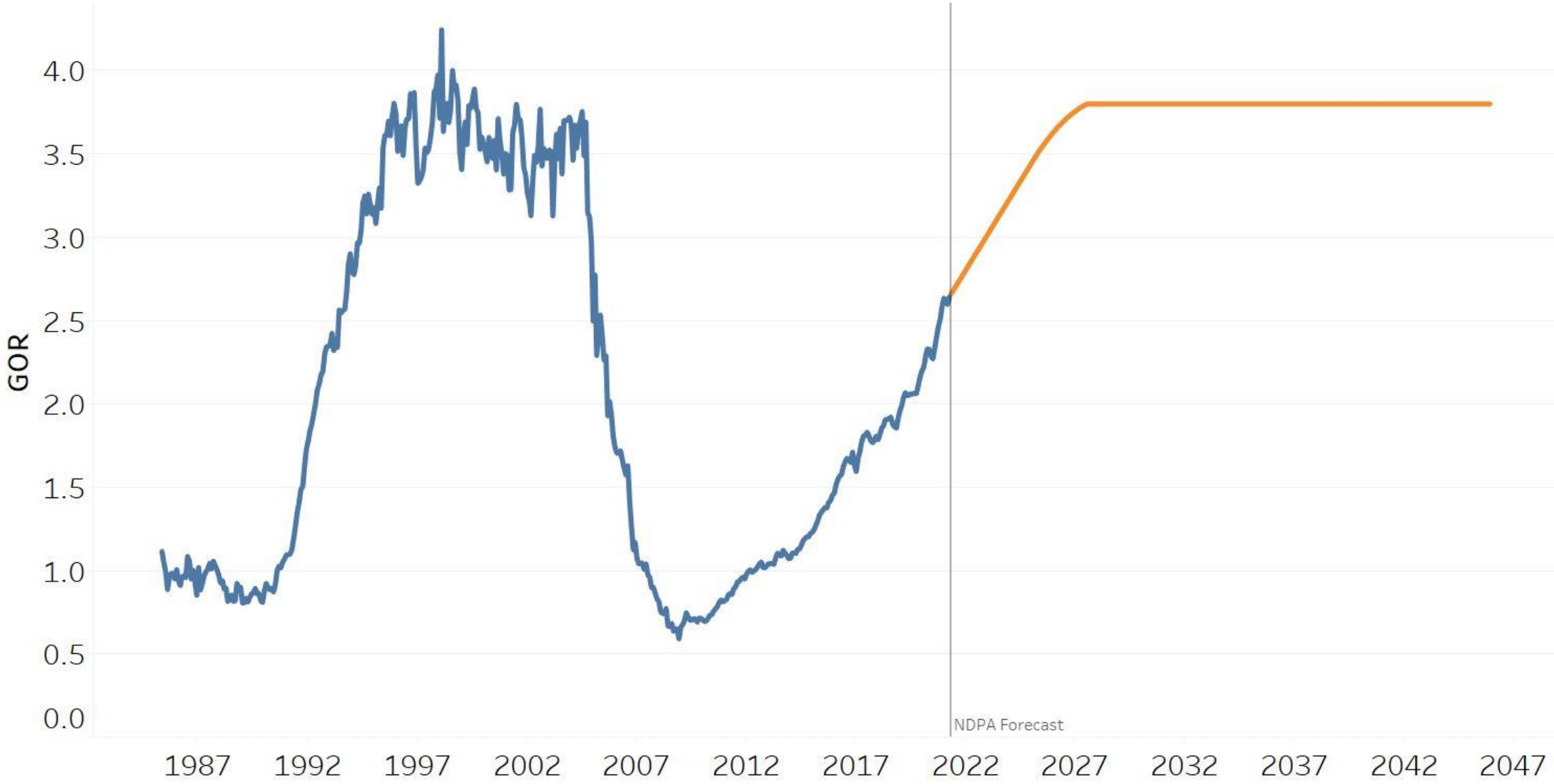


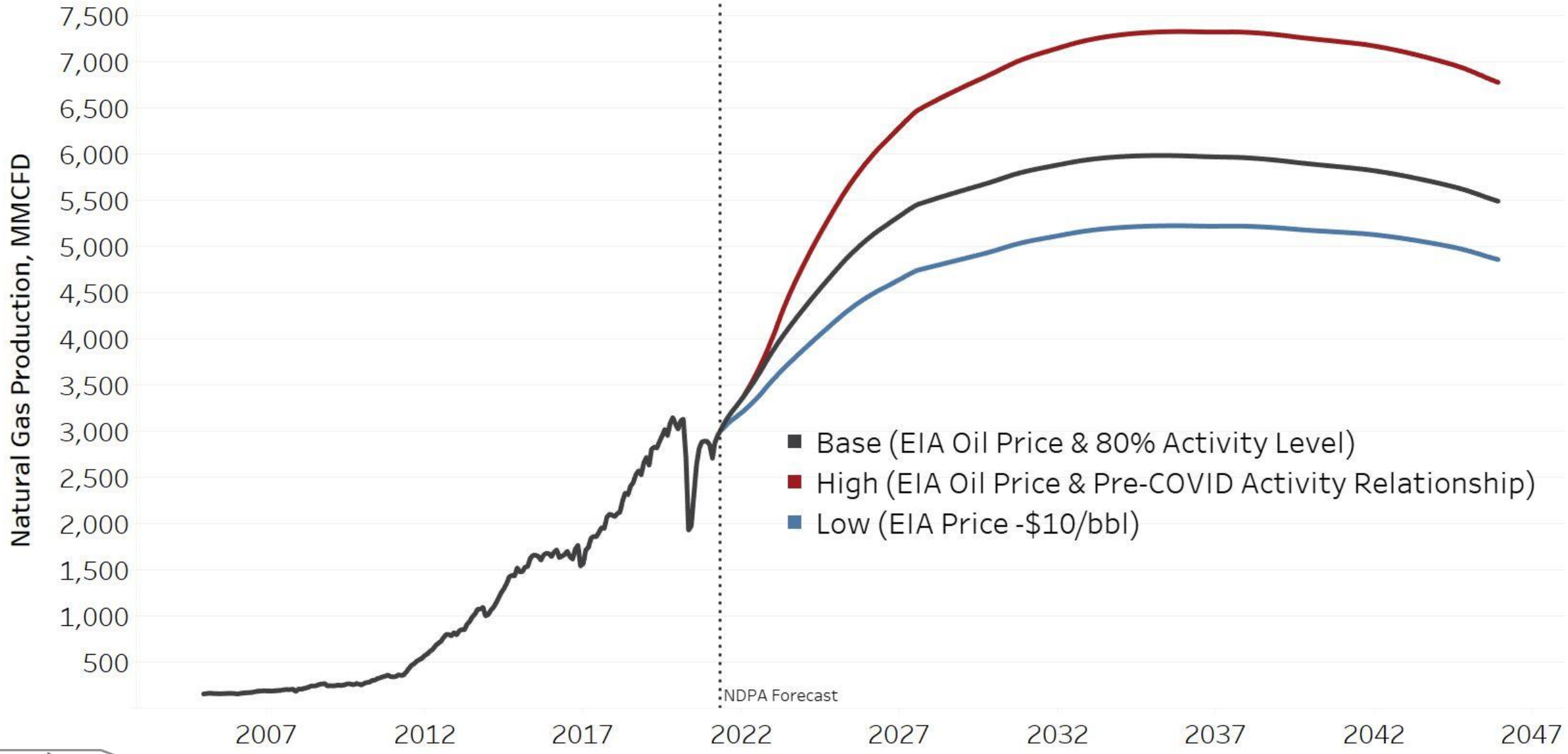




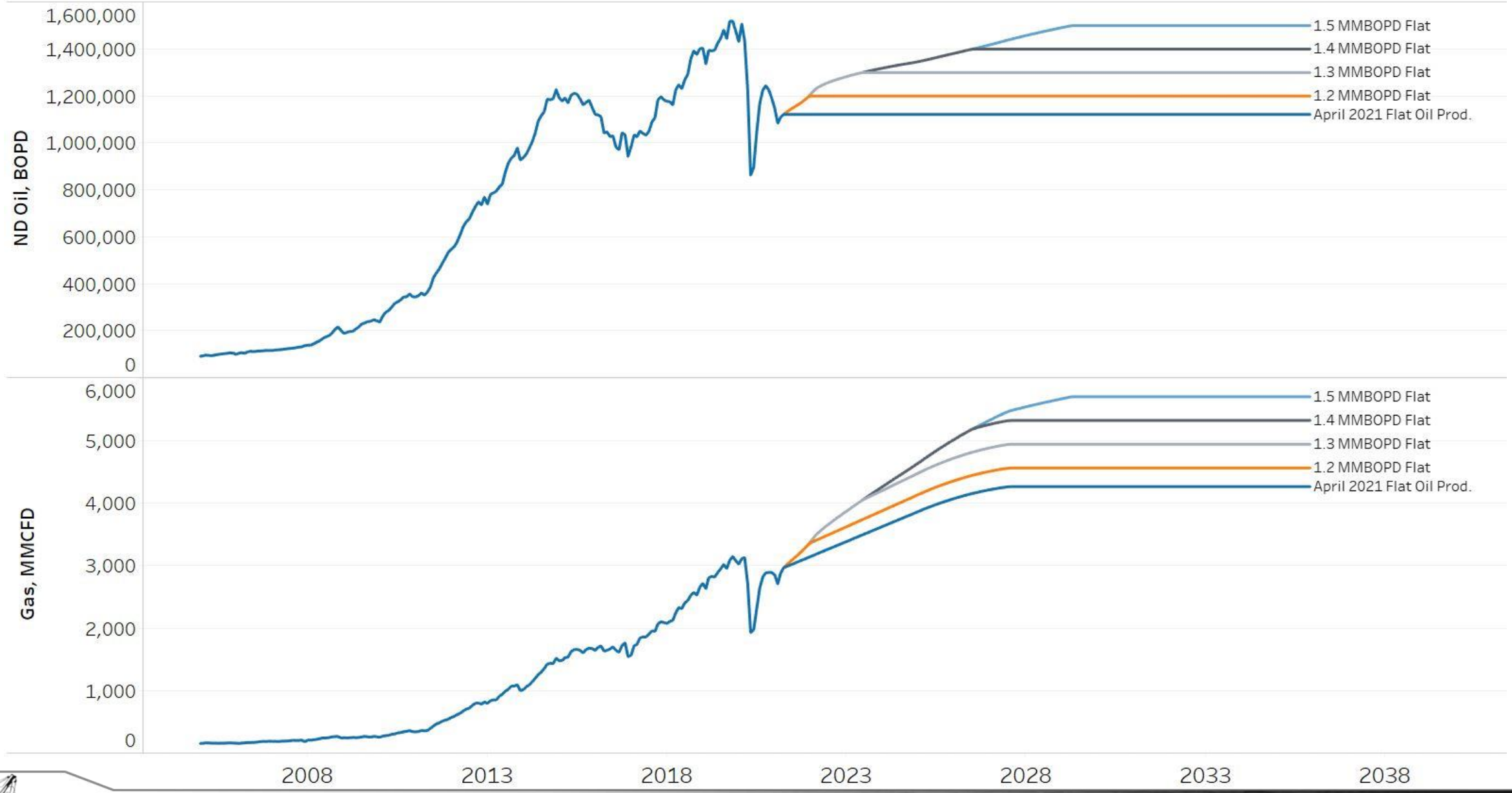
ND Gas Production: GOR Assumption



ND Gas Production: EIA Price Deck



What if Oil Production Growth is Slower?



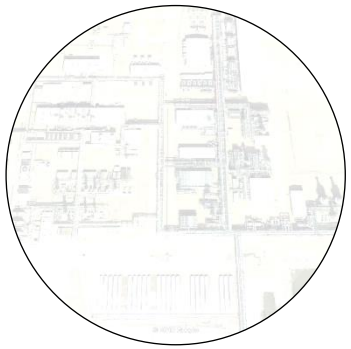
Natural Gas Update

Production

- Technology
- Markets

Gathering

- Capacity
- Connections



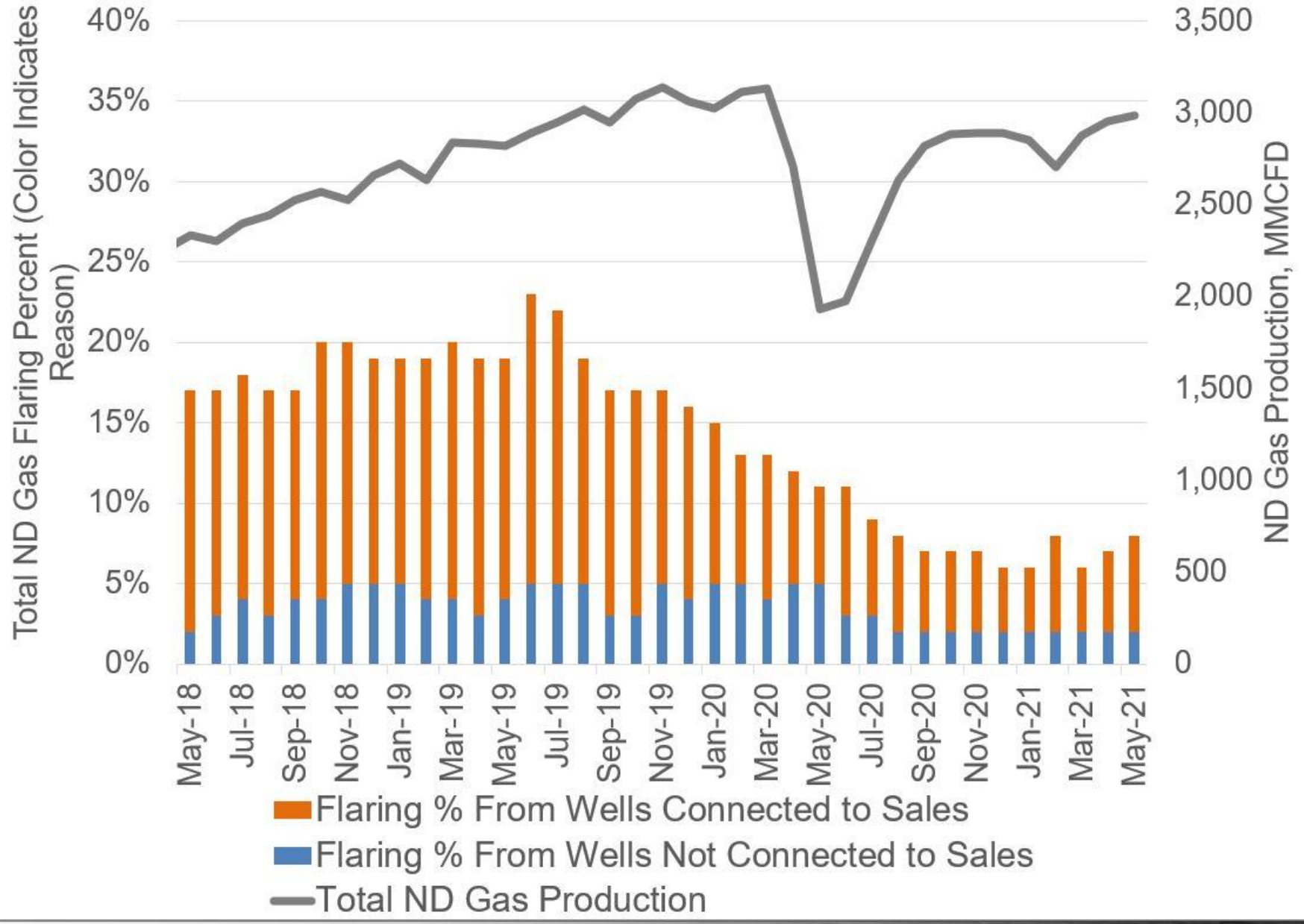
Processing

- Capacity
- Location

Transmission

- Dry Gas
- Natural Gas Liquids

Solving the Flaring Challenge



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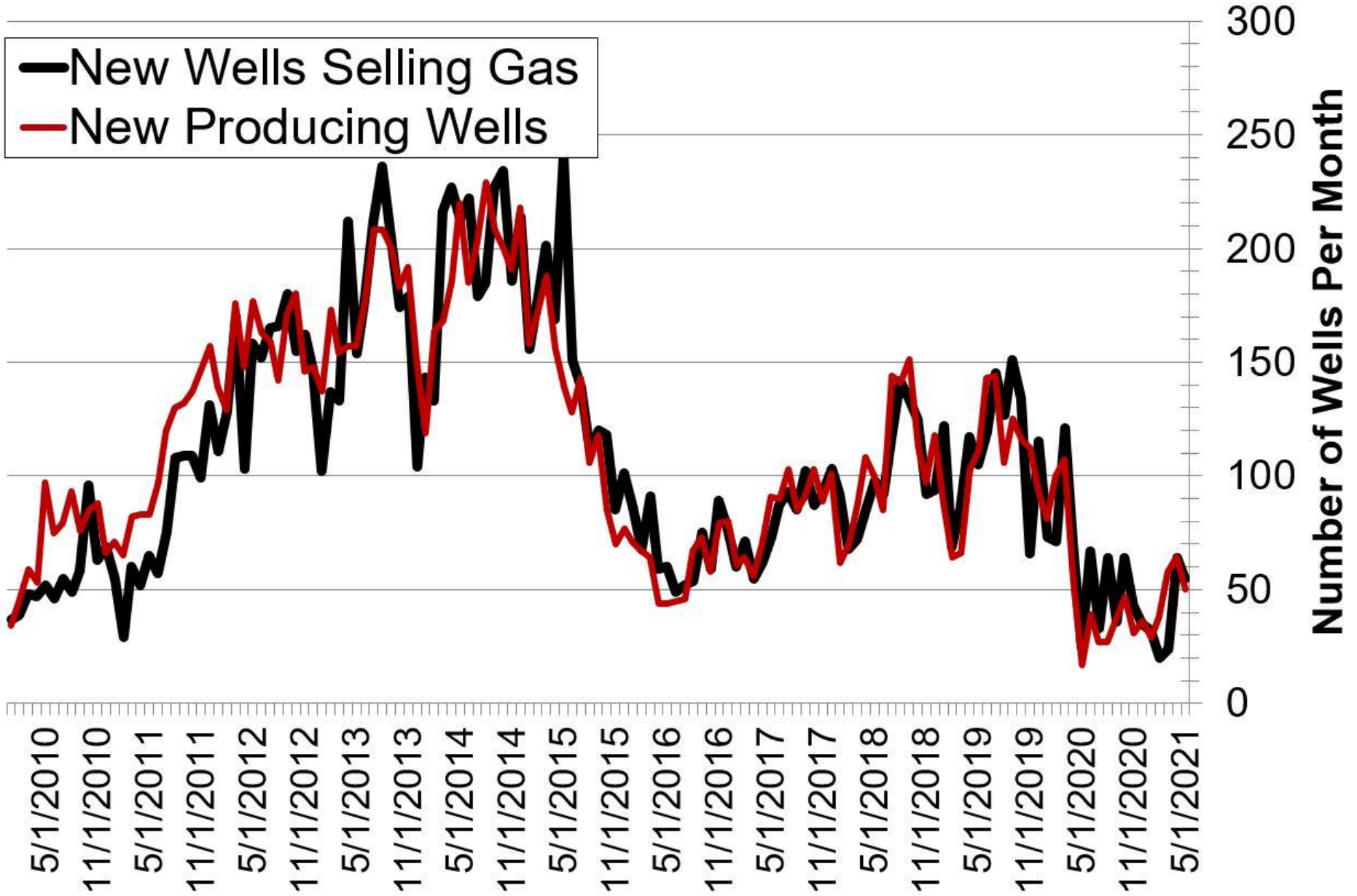

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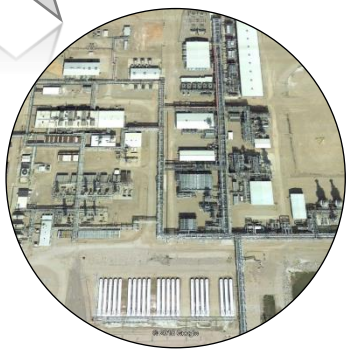

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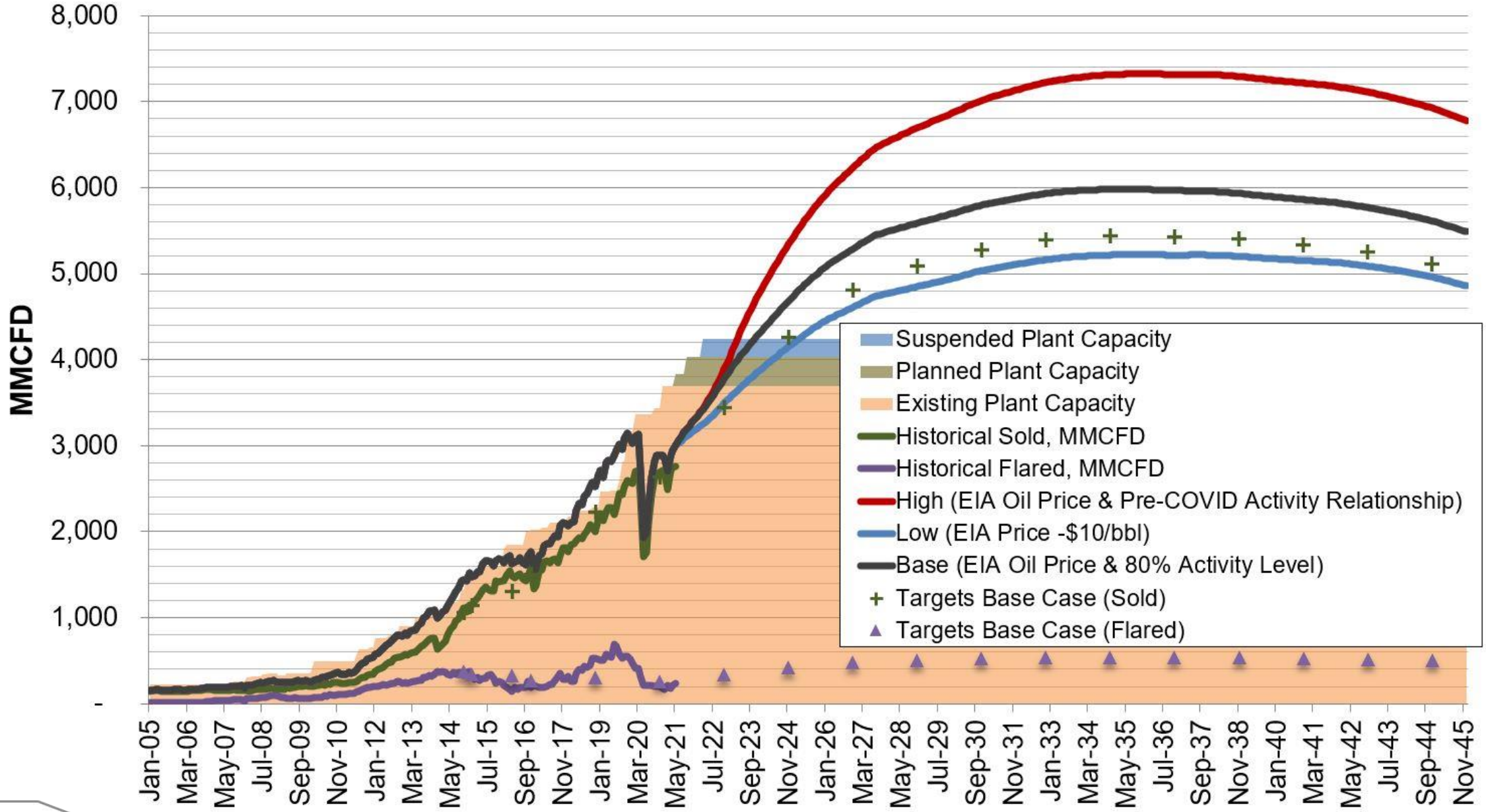
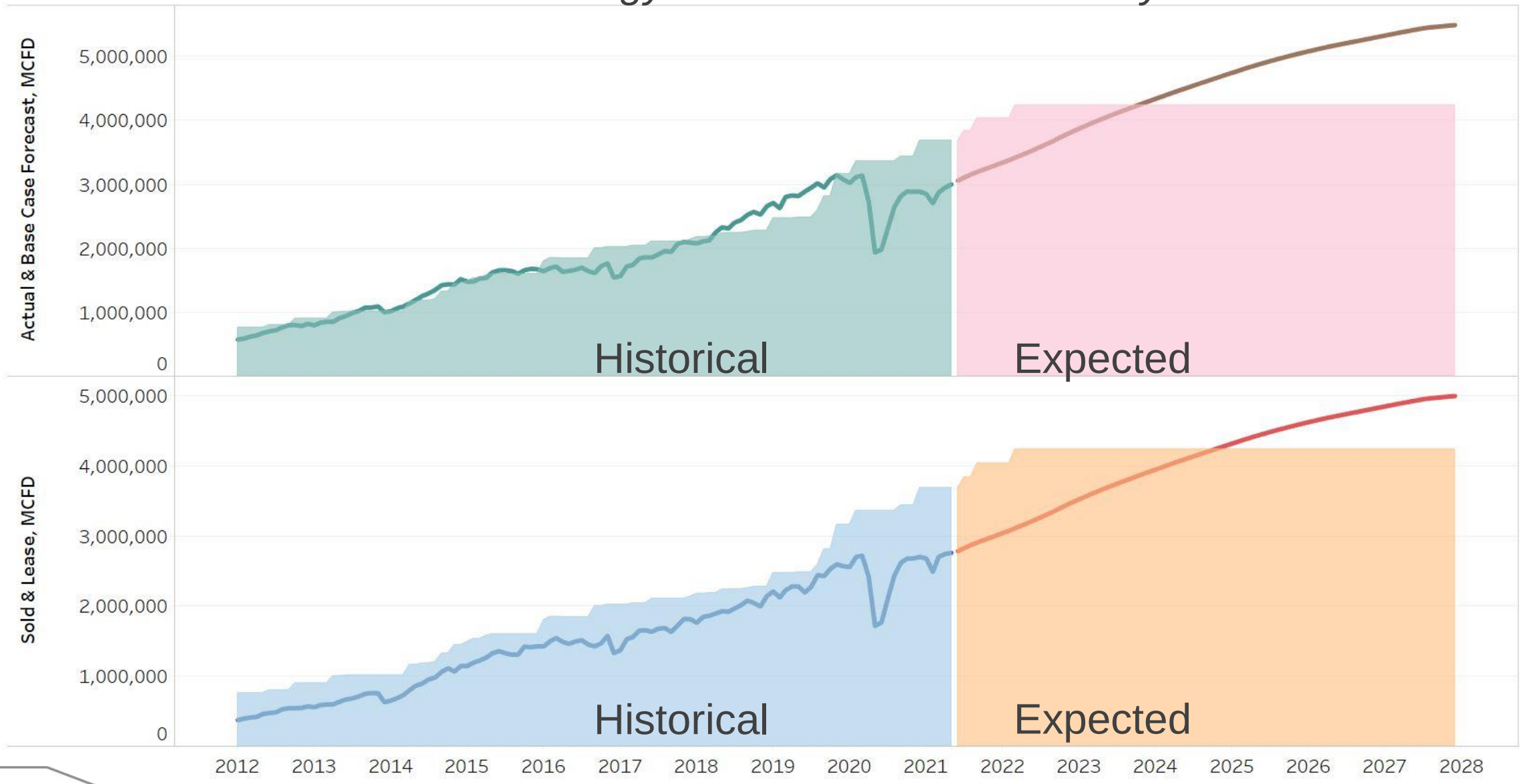
Solving the Flaring Challenge

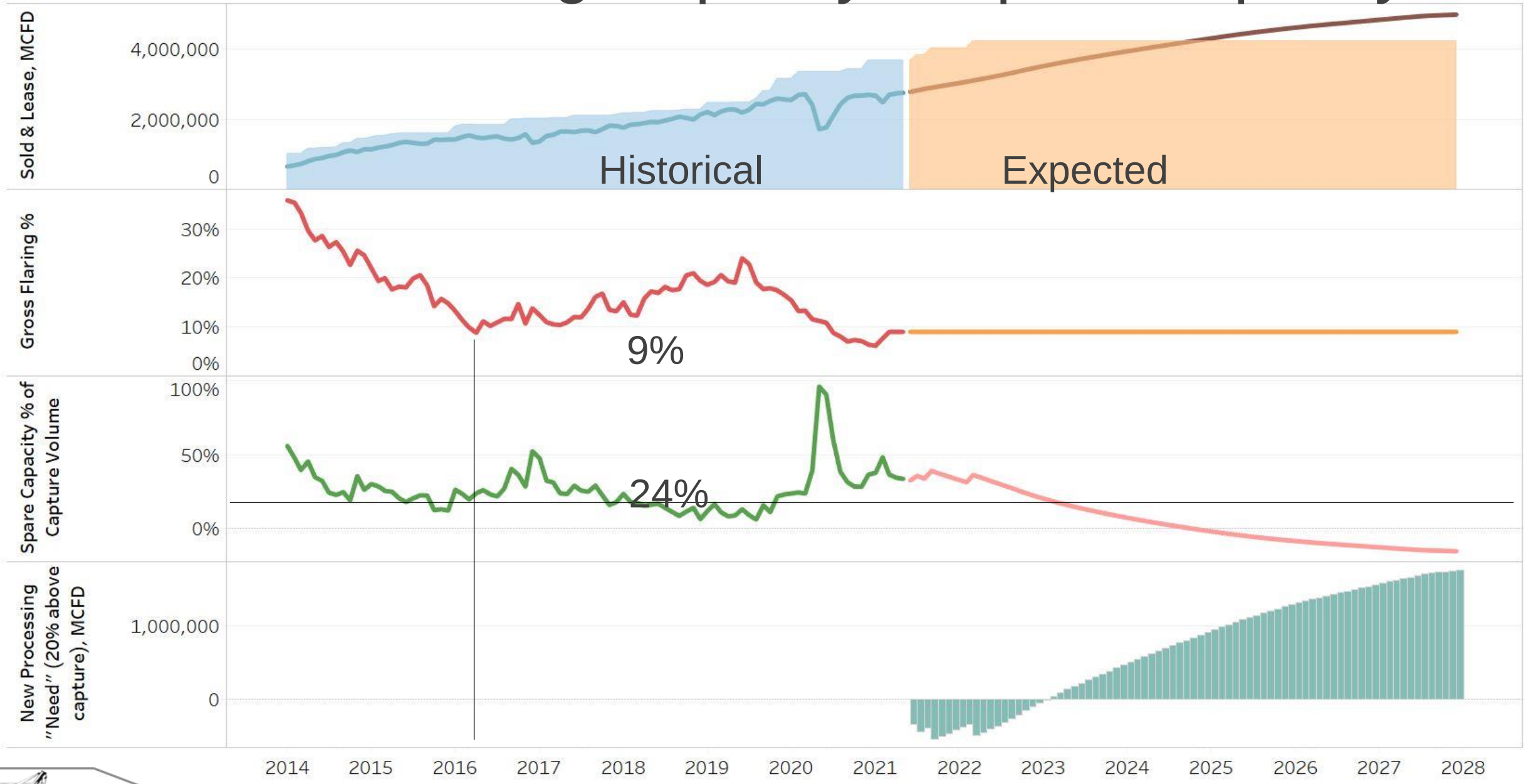


Gas Processing Capacity & Future Outlook

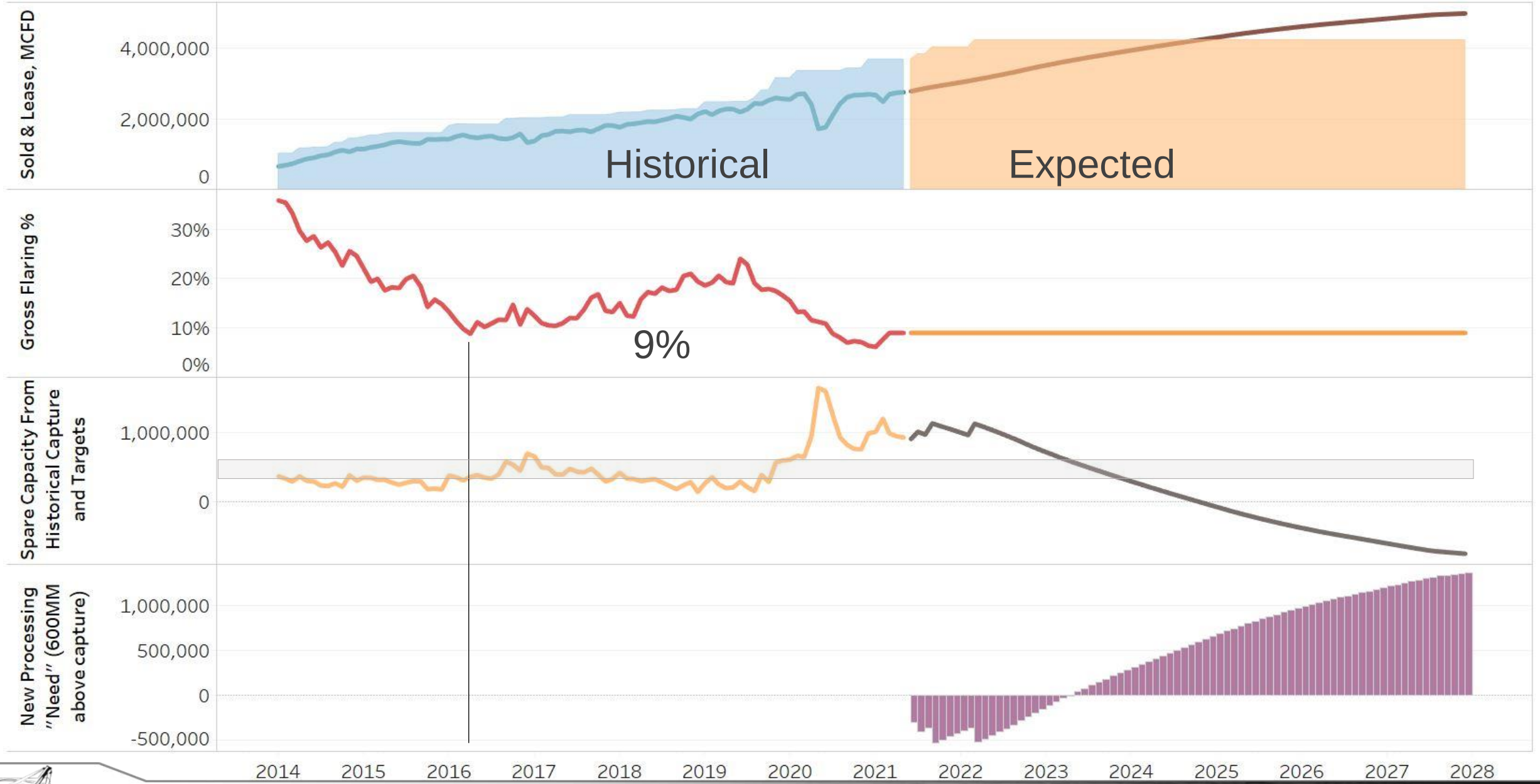
Assumes Current Technology – Enhanced Oil Recovery Not Included



Gas Processing Capacity & Spare Capacity



Gas Processing Capacity & Spare Capacity



Natural Gas Update

Production

- Technology
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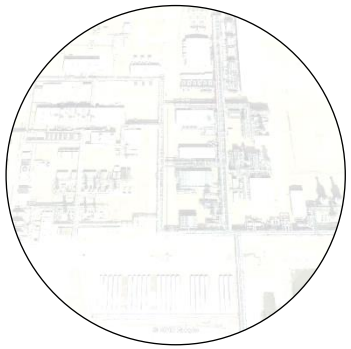


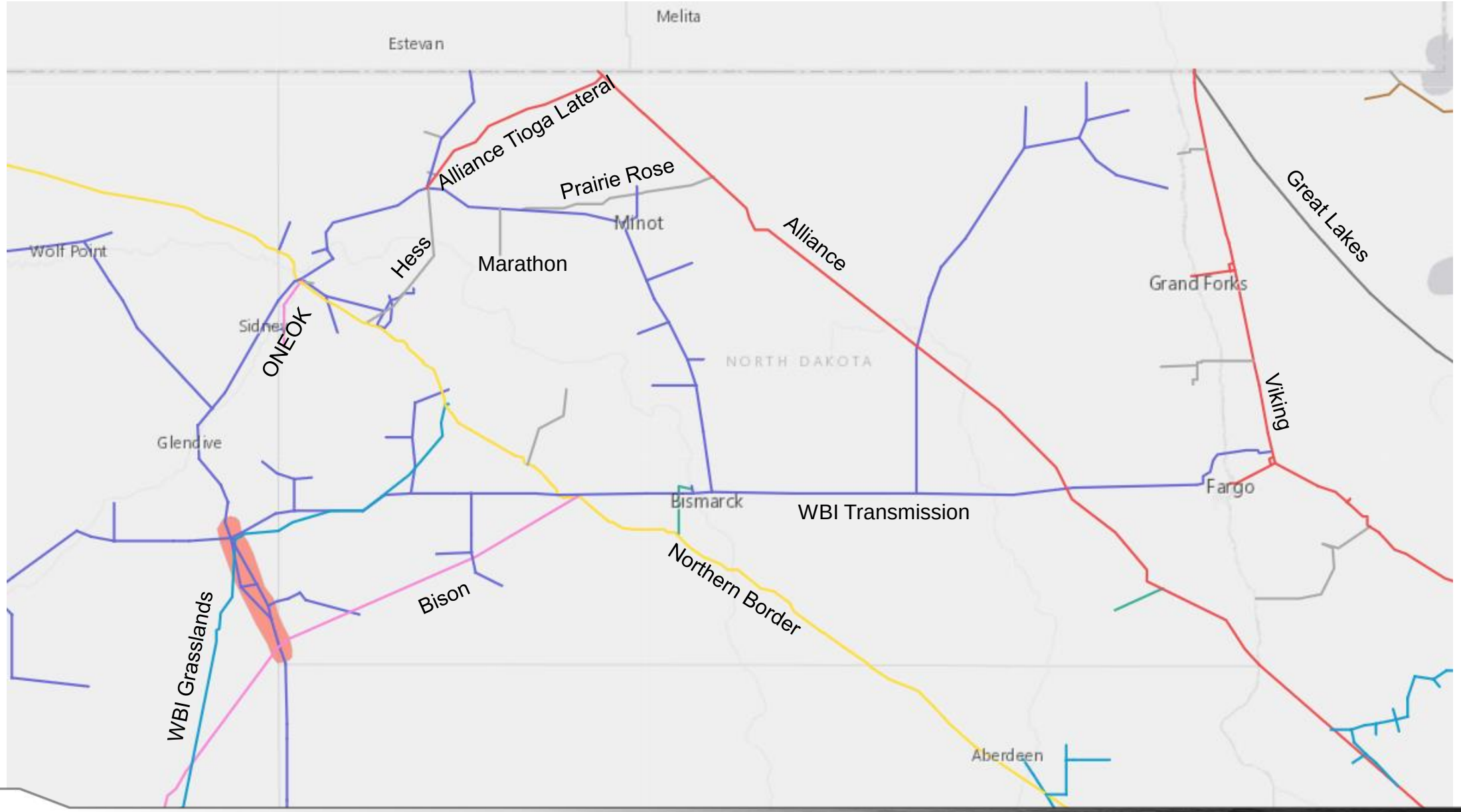
Processing

- Capacity
- Location

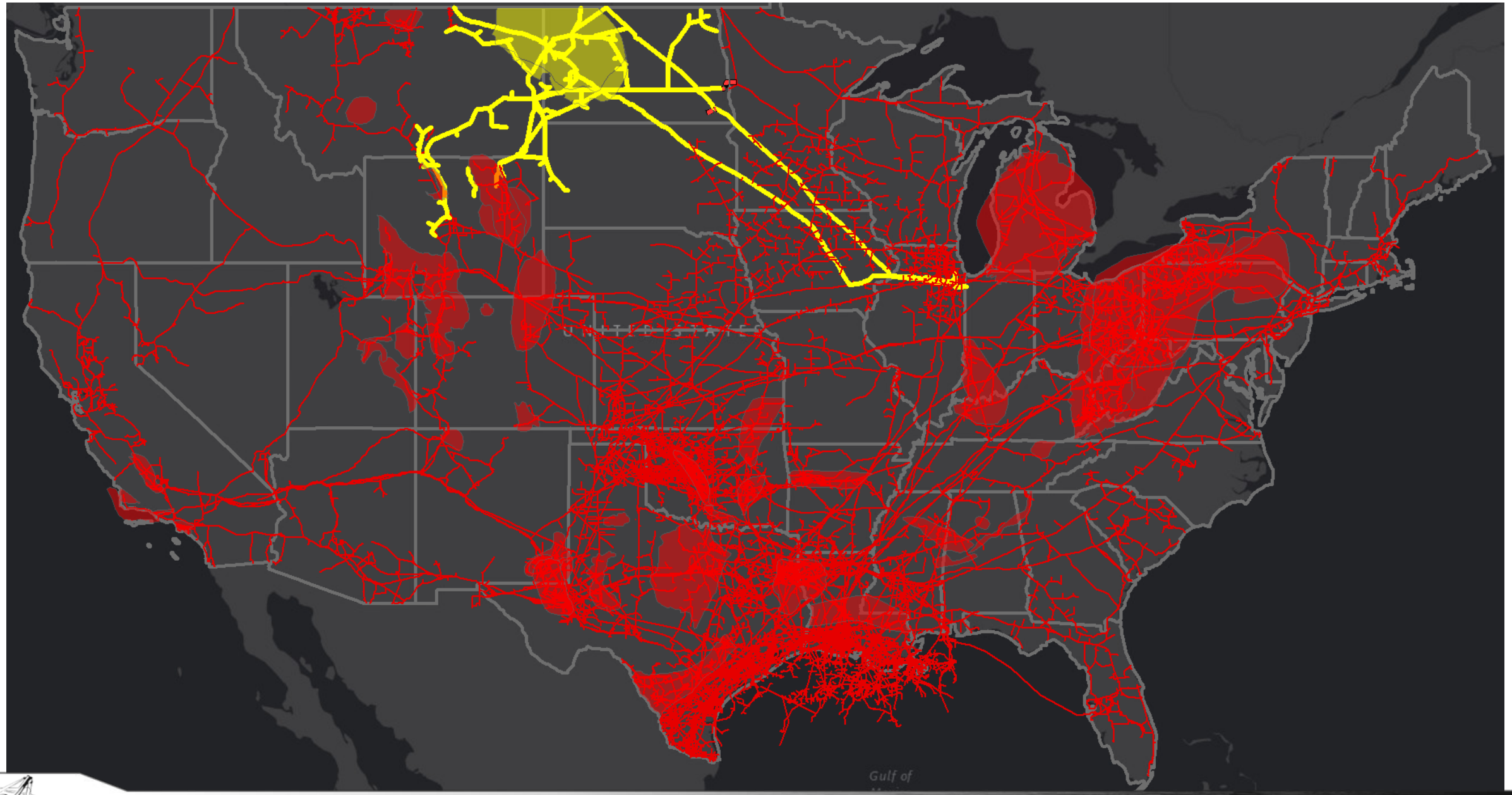
Transmission

- Dry Gas
- Natural Gas Liquids

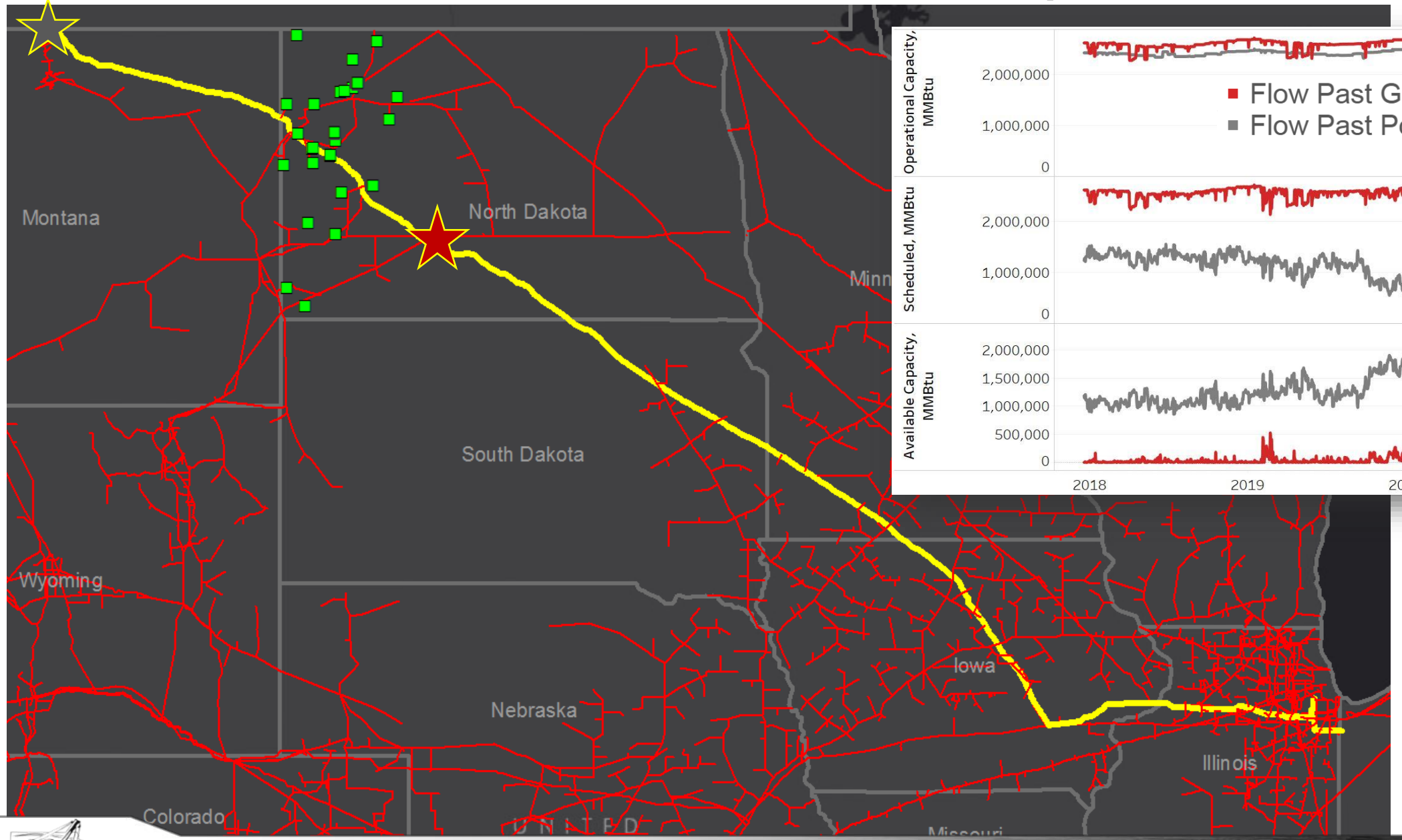
Major Gas Pipeline Infrastructure

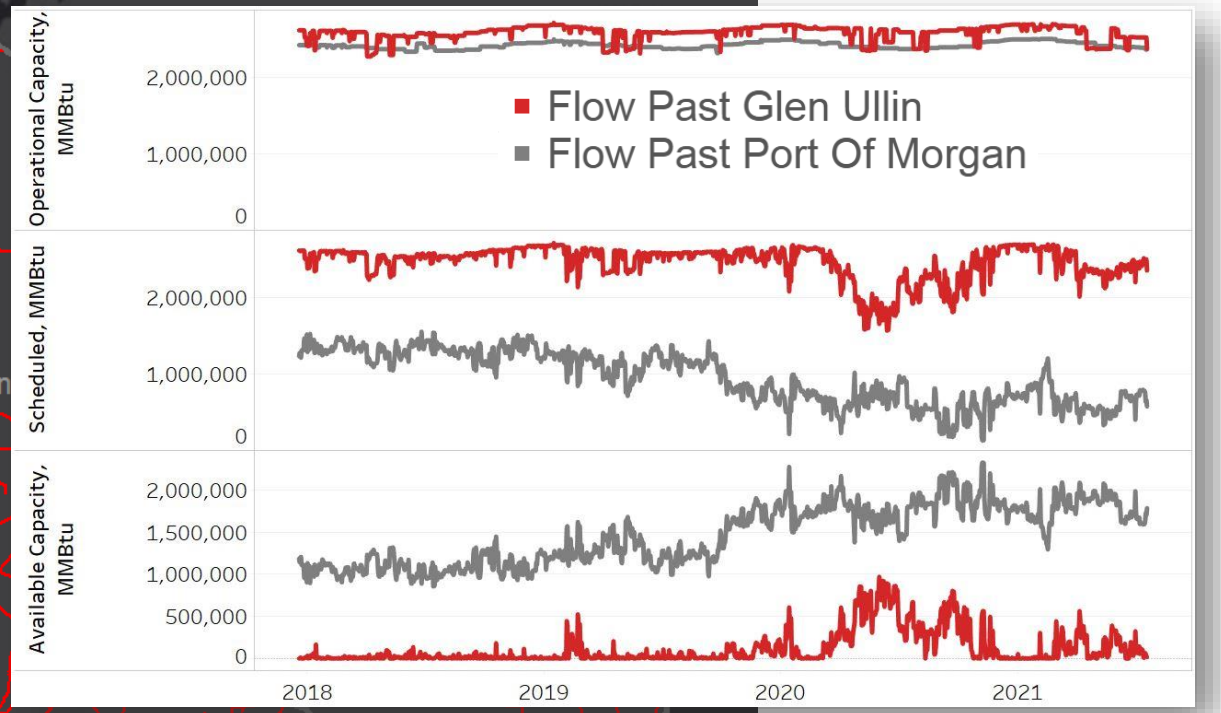


Bakken Natural Gas Infrastructure



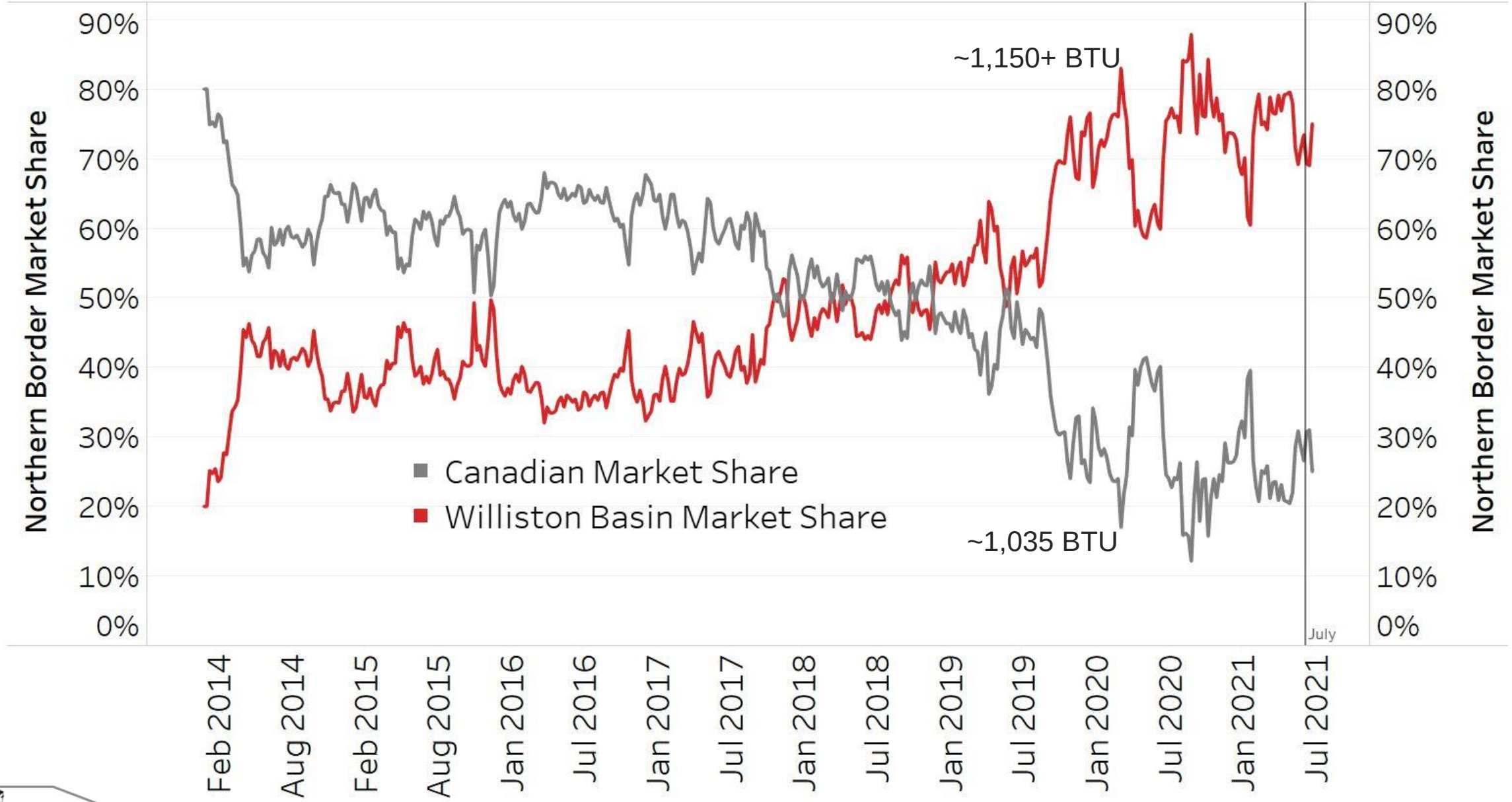
Northern Border Pipeline



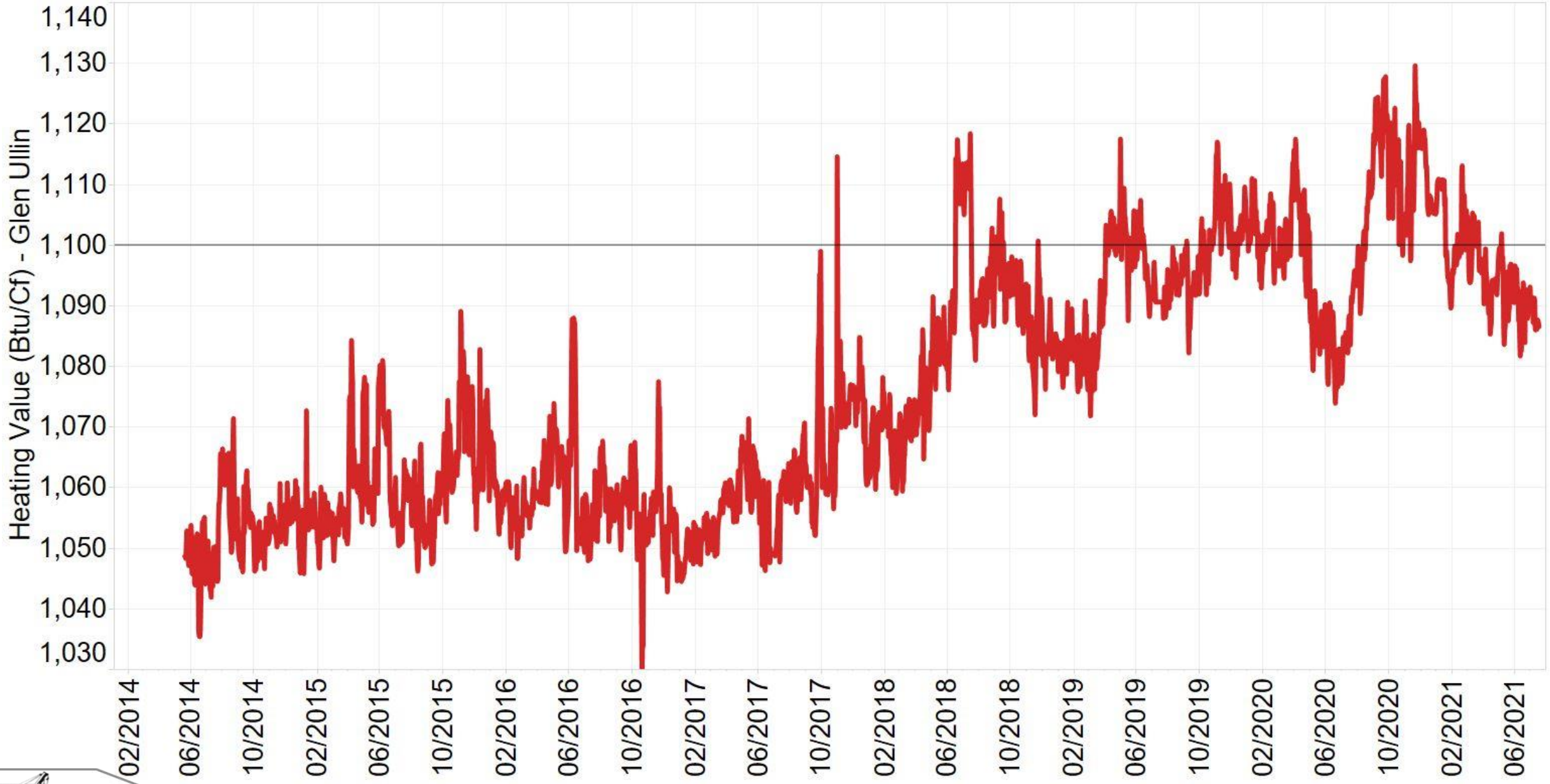


*Data Source: Northern Border

Northern Border Pipeline Market Share

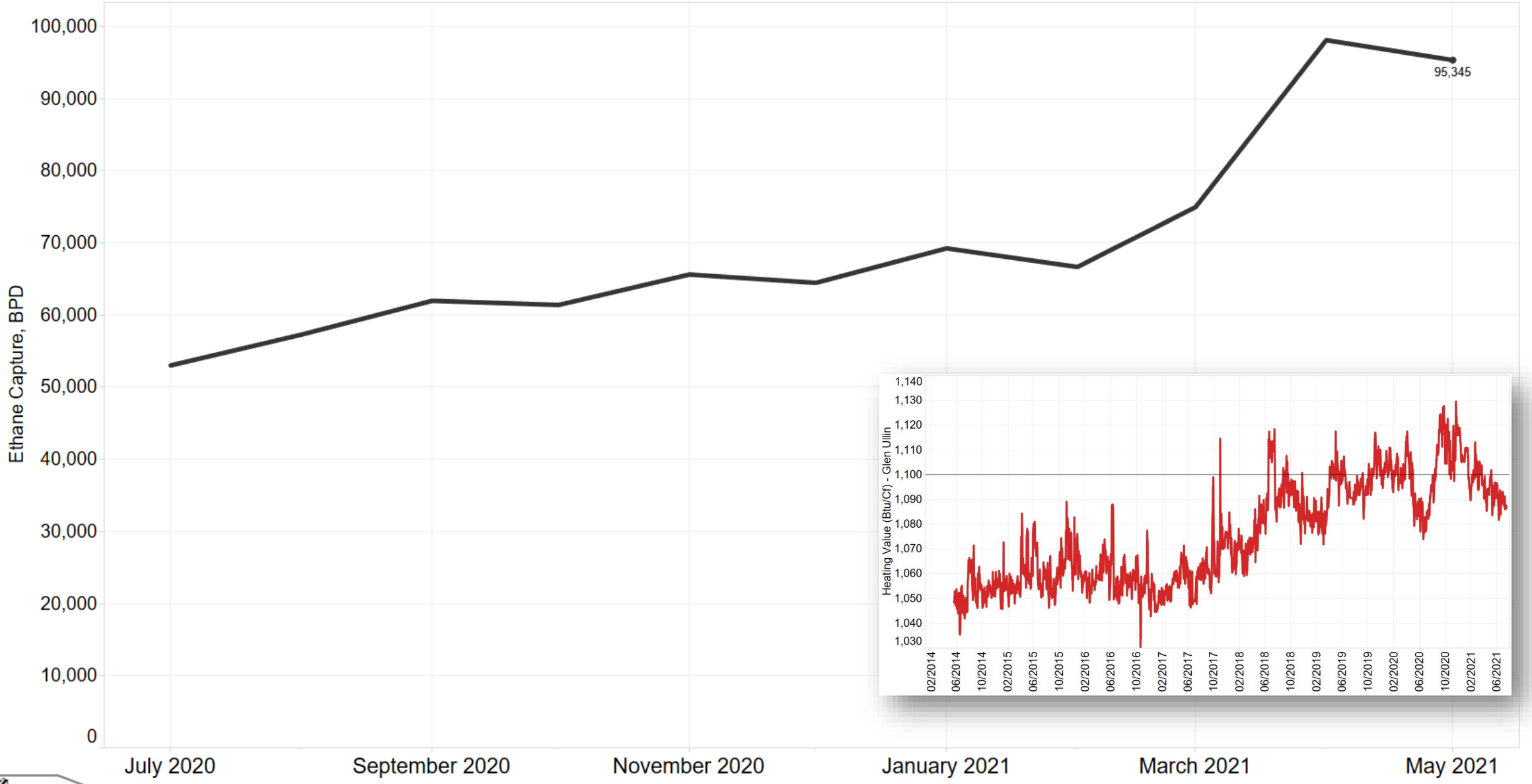


Northern Border BTU at Glen Ullin, ND

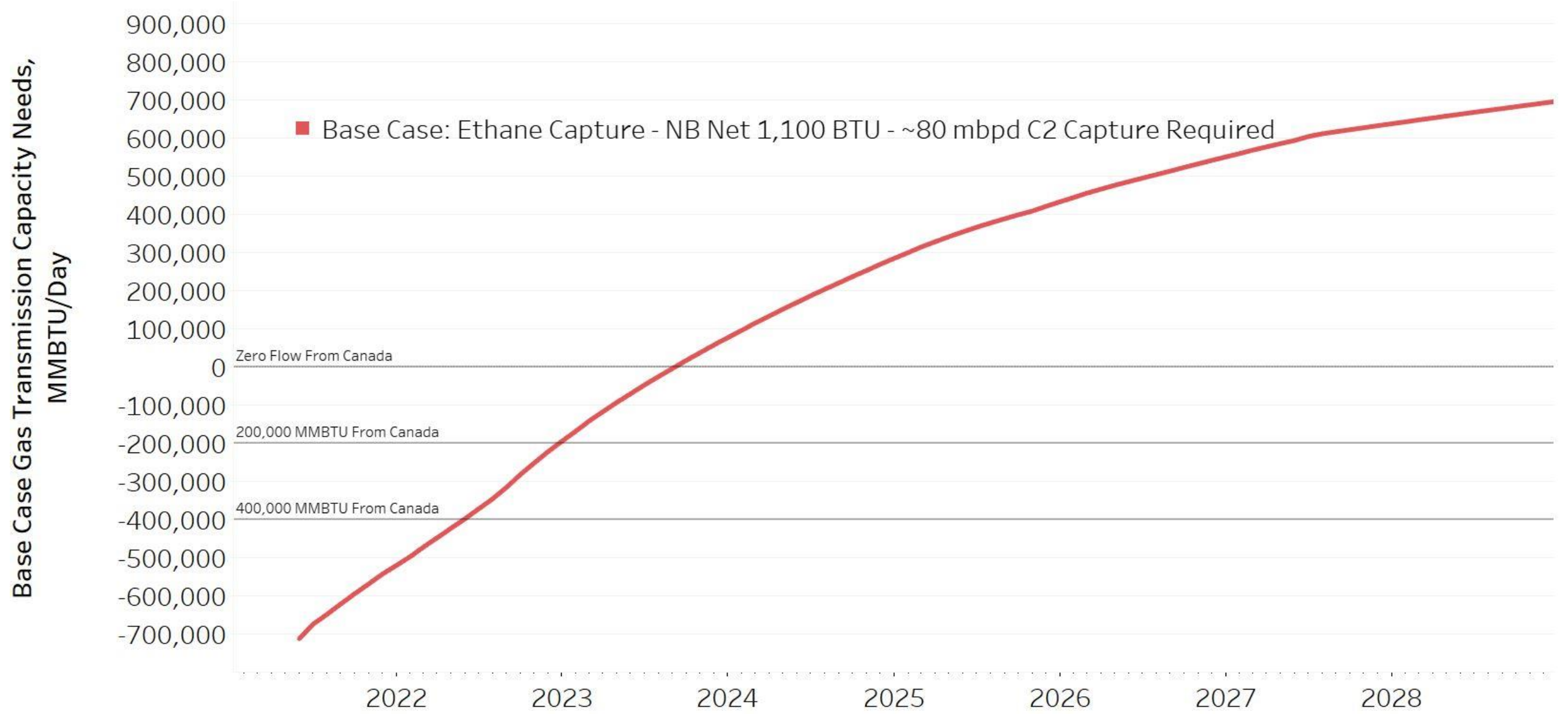


*Data Source: Northern Border

ND Ethane Capture Driving Northern Border BTU Lower

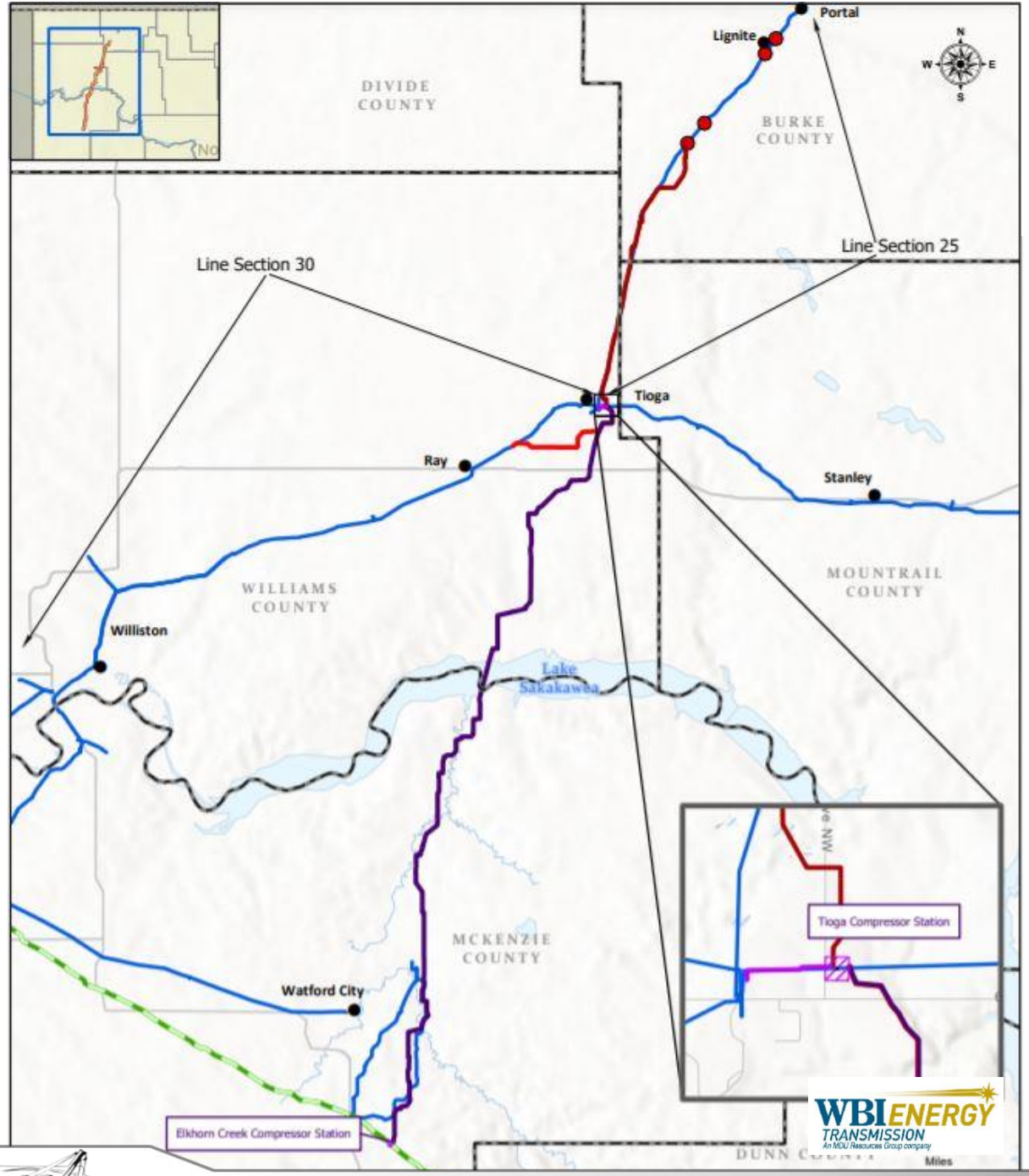


Northern Border – BTU Calculations*



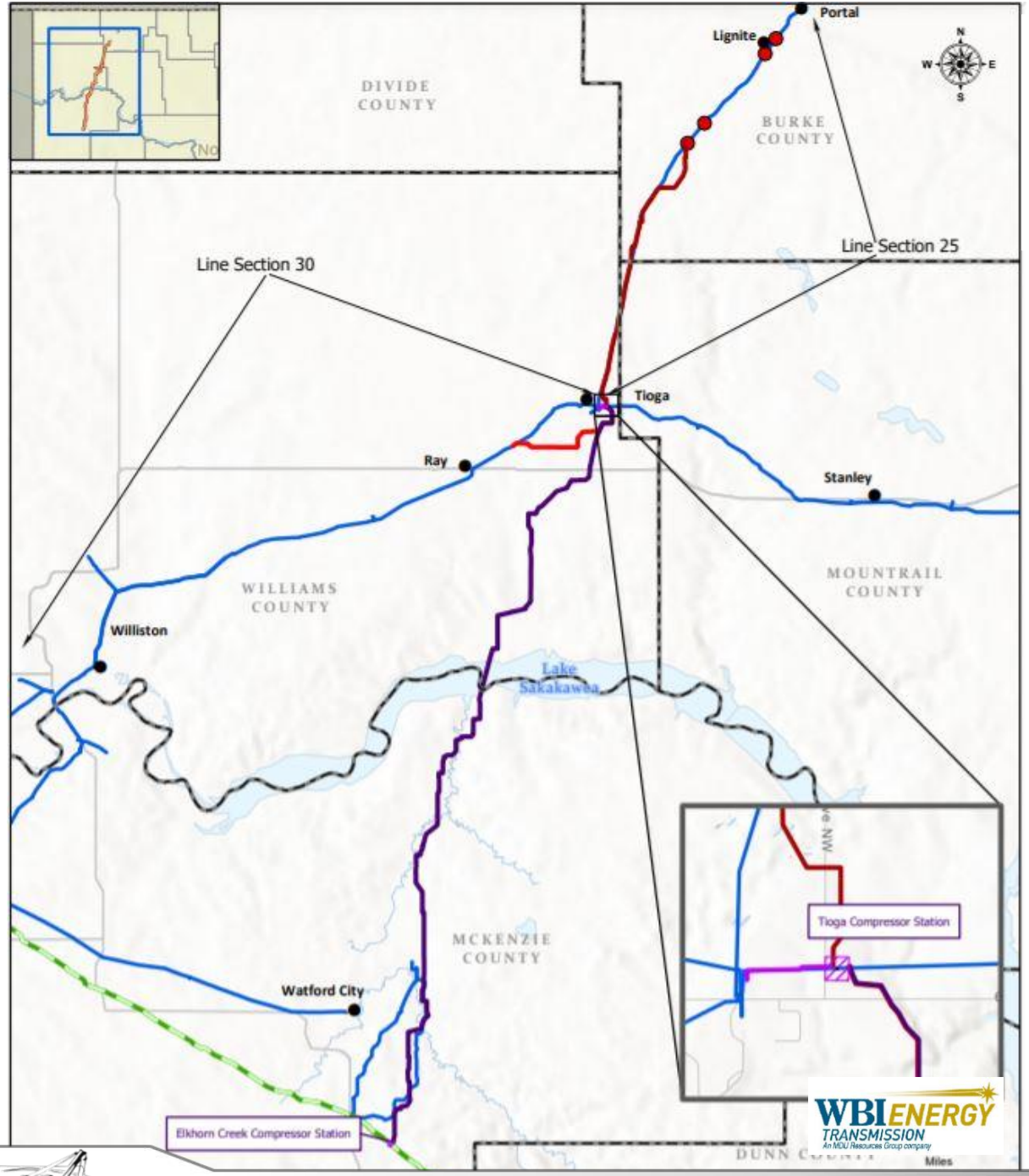
*Includes Proposed 2020 Tariff Timeline to 1,100

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



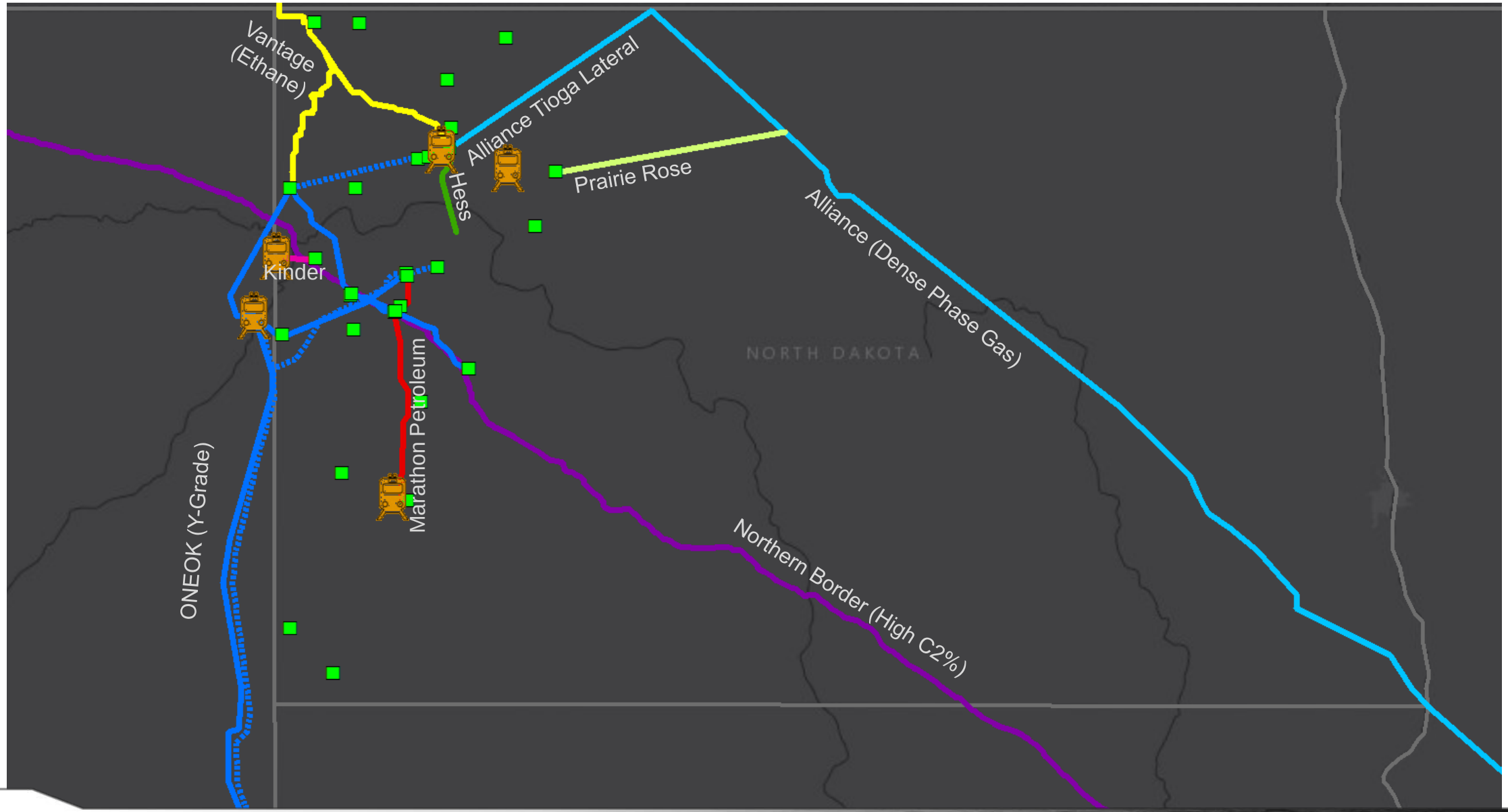
Potential North Dakota Oil Tax Impact

250,000 MCFD Calculation

- = 137,360 BOPD at 2 GOR, 0.7 tailgate/inlet factor, and meeting gas capture targets
- Assume $54 wellhead oil price and 9.6% avg. tax rate
- = $1,017,000+ per day

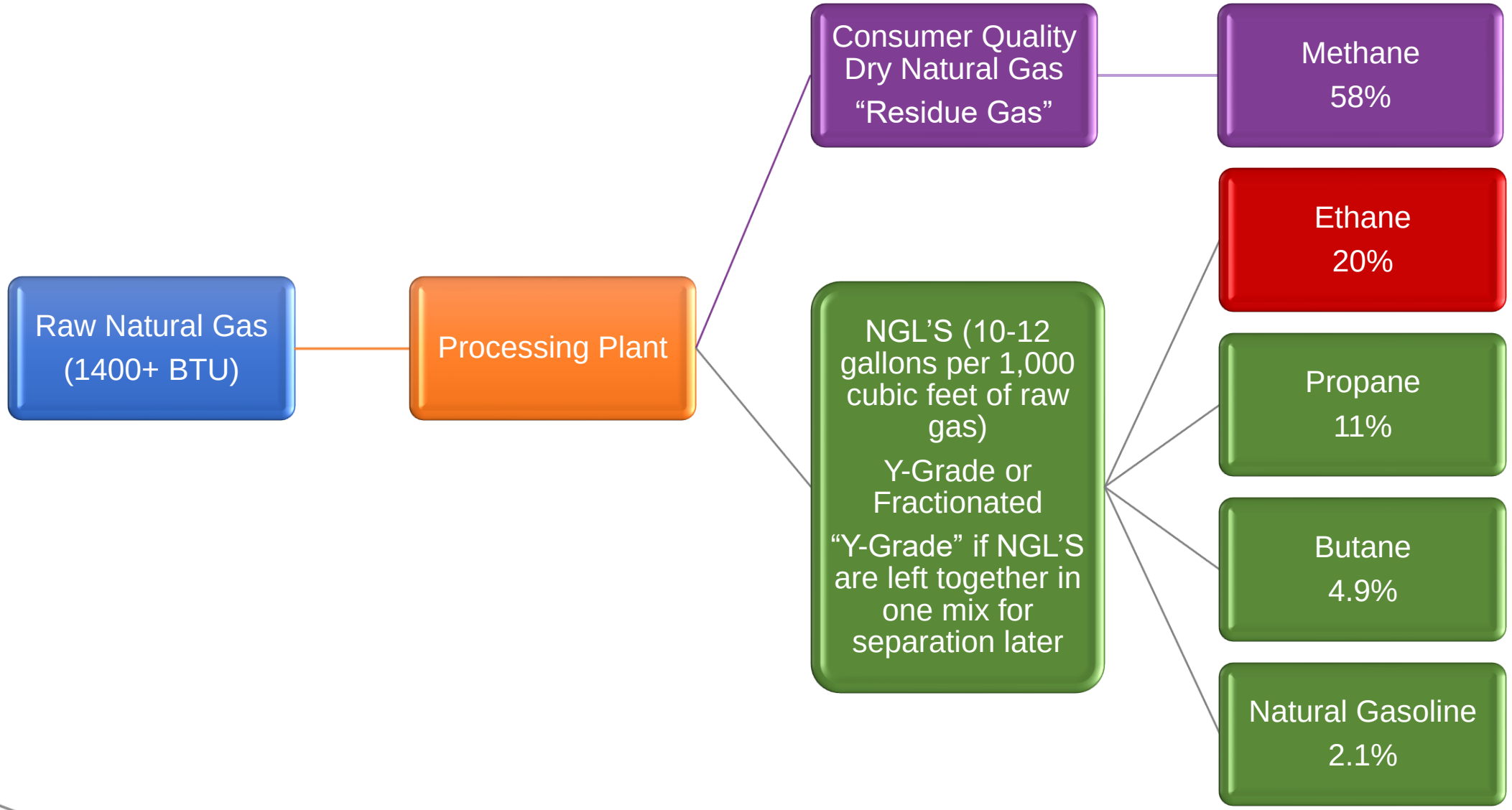
~$30.9 million per month

Regional NGL Infrastructure

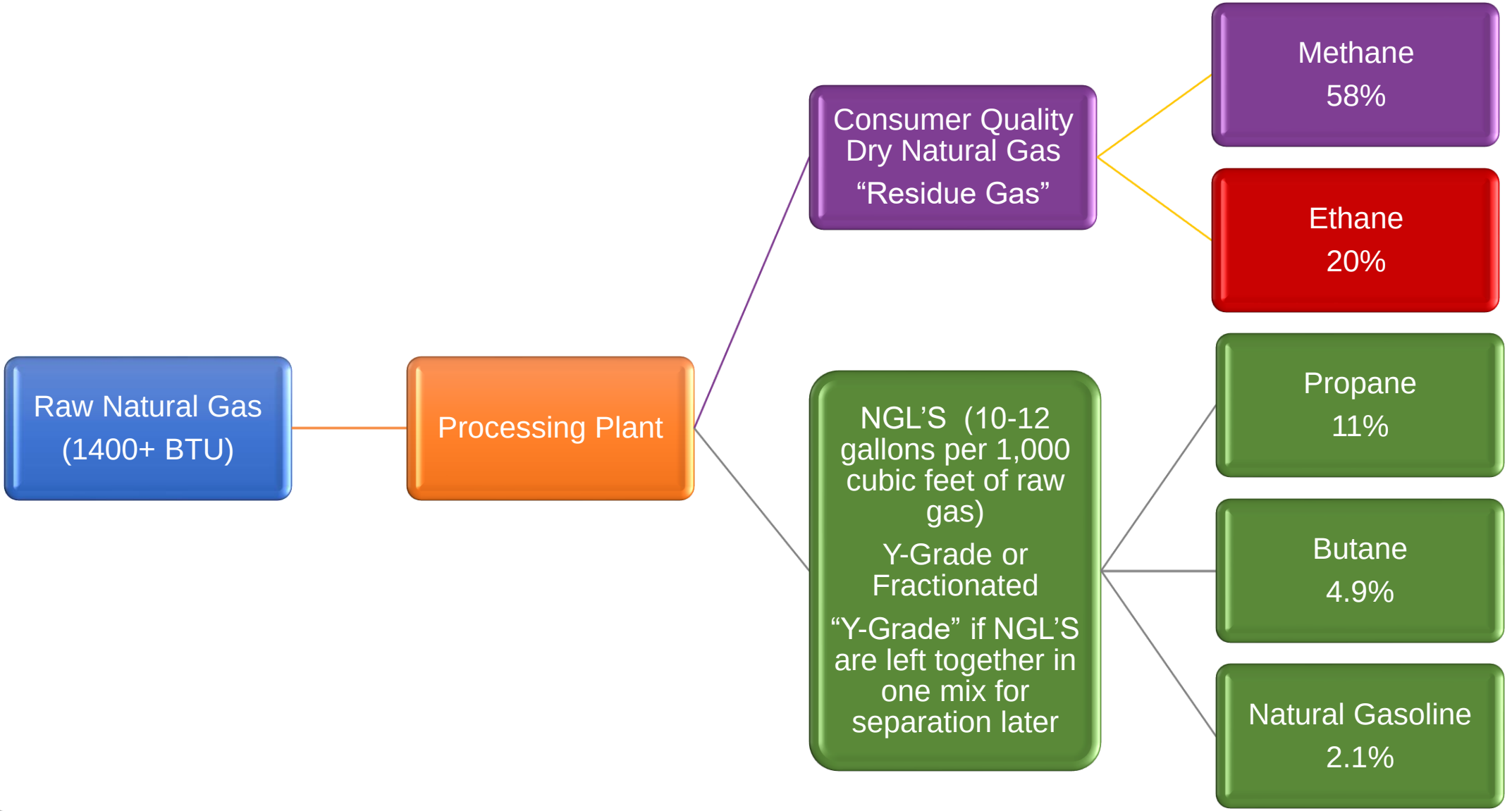


Bakken & Three Forks Natural Gas Liquids Chemistry

Natural Gas Processing – “Ethane Capture”



Natural Gas Processing – “Ethane Rejection”



NGL Chemistry Study - 2020

EERC

ASSESSMENT OF BAKKEN PETROLEUM SYSTEM PRODUCED GAS COMPOSITIONS

Final Report

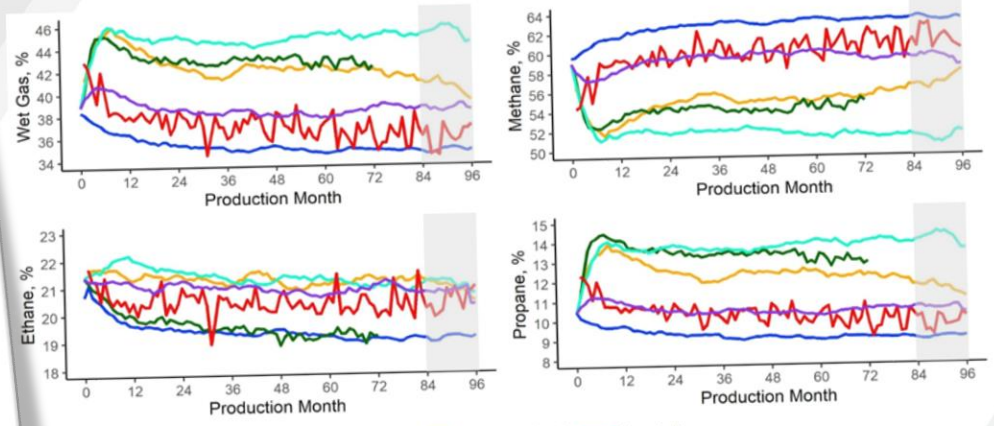
(Project Period: October 15, 2019 – June 19, 2020)

Prepared for:

Justin Kringstad

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

Temporal Patterns in Measured Gas Composition



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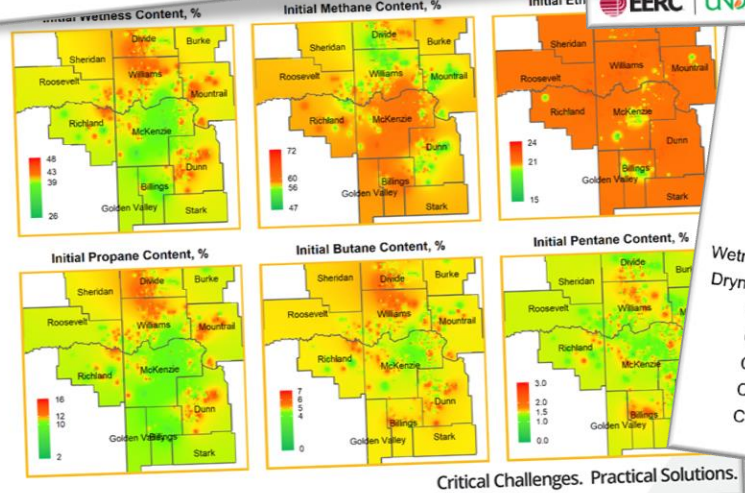
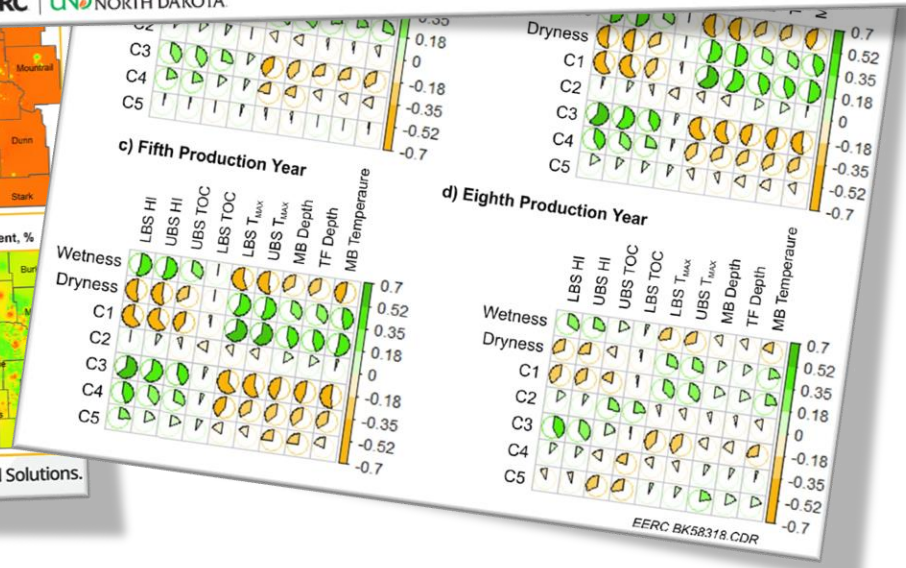
Critical Challenges. Practical Solutions.

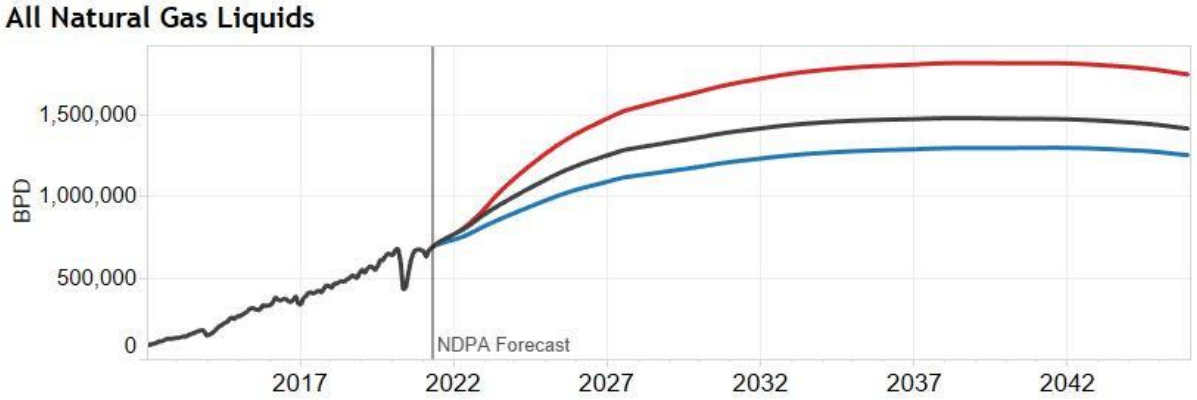
Spatial Patterns

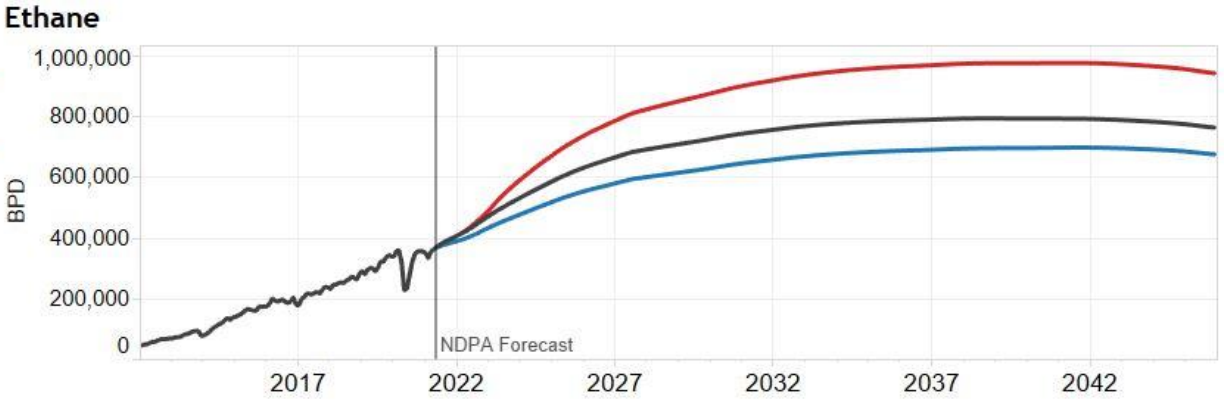
- The highest methane concentrations occur in the core Bakken area, and the lowest levels occur in northern Williams and southern Divide counties.
- There is considerably less variation in ethane content across the BPS than with other NGLs.

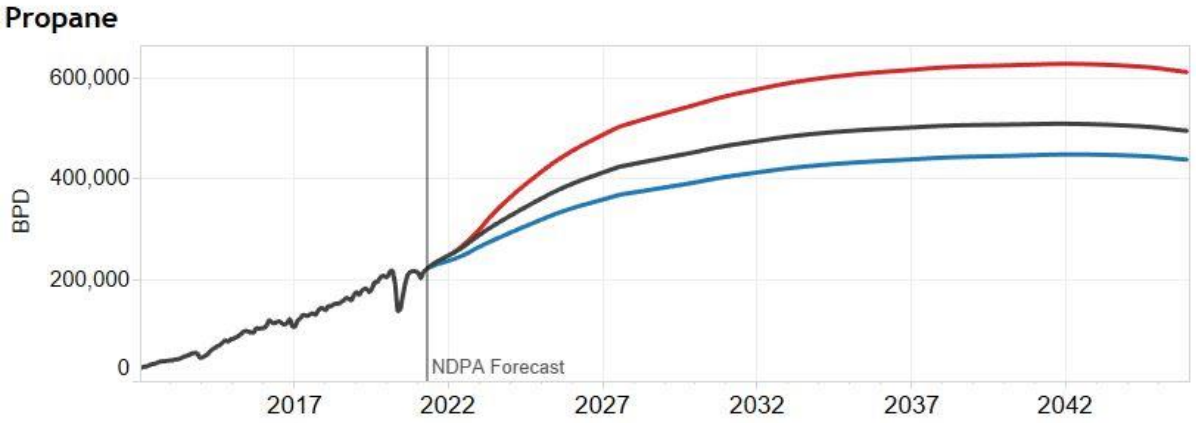


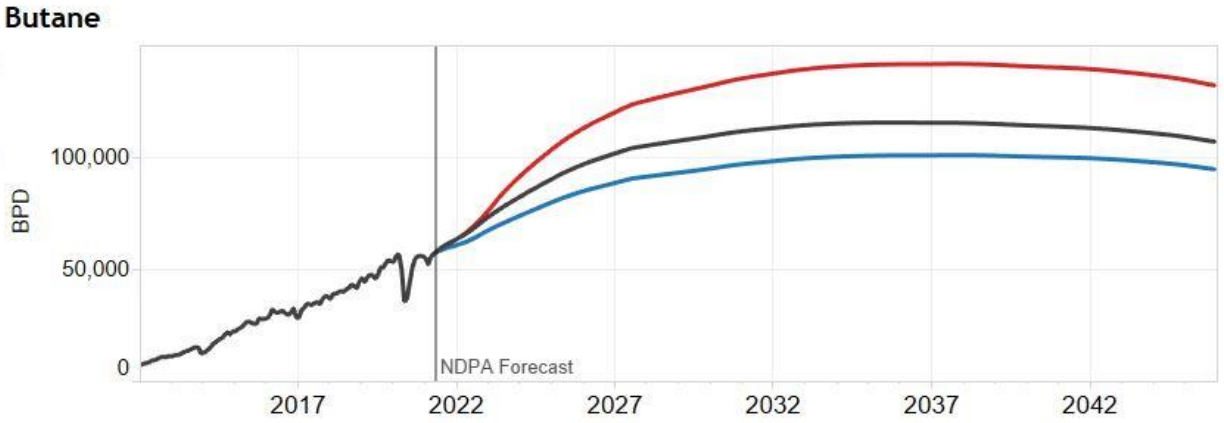


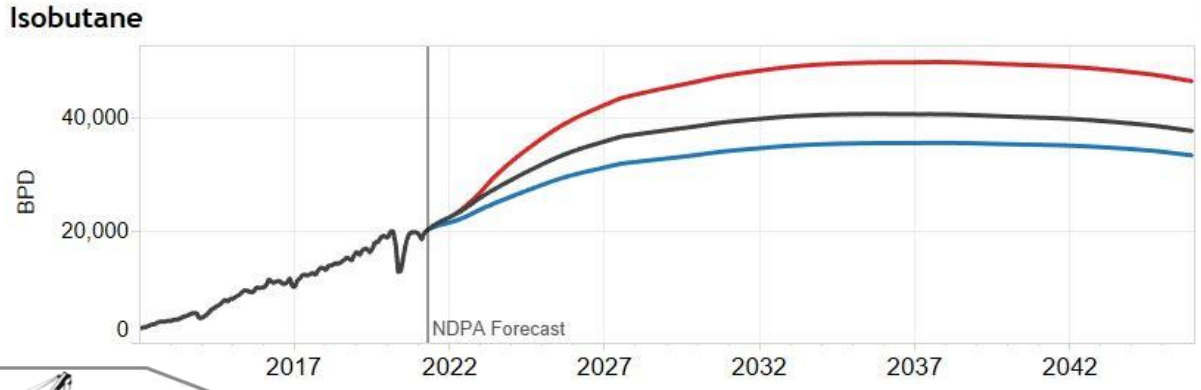
North Dakota Captured* NGL's

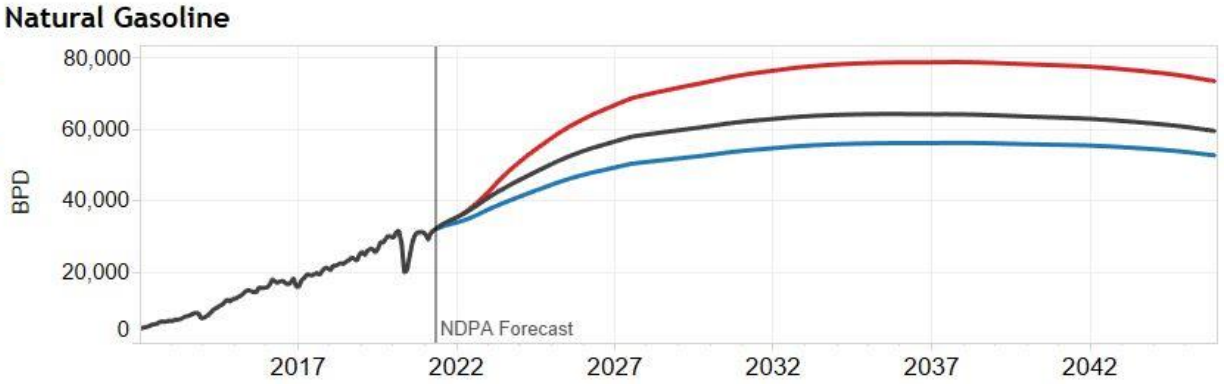




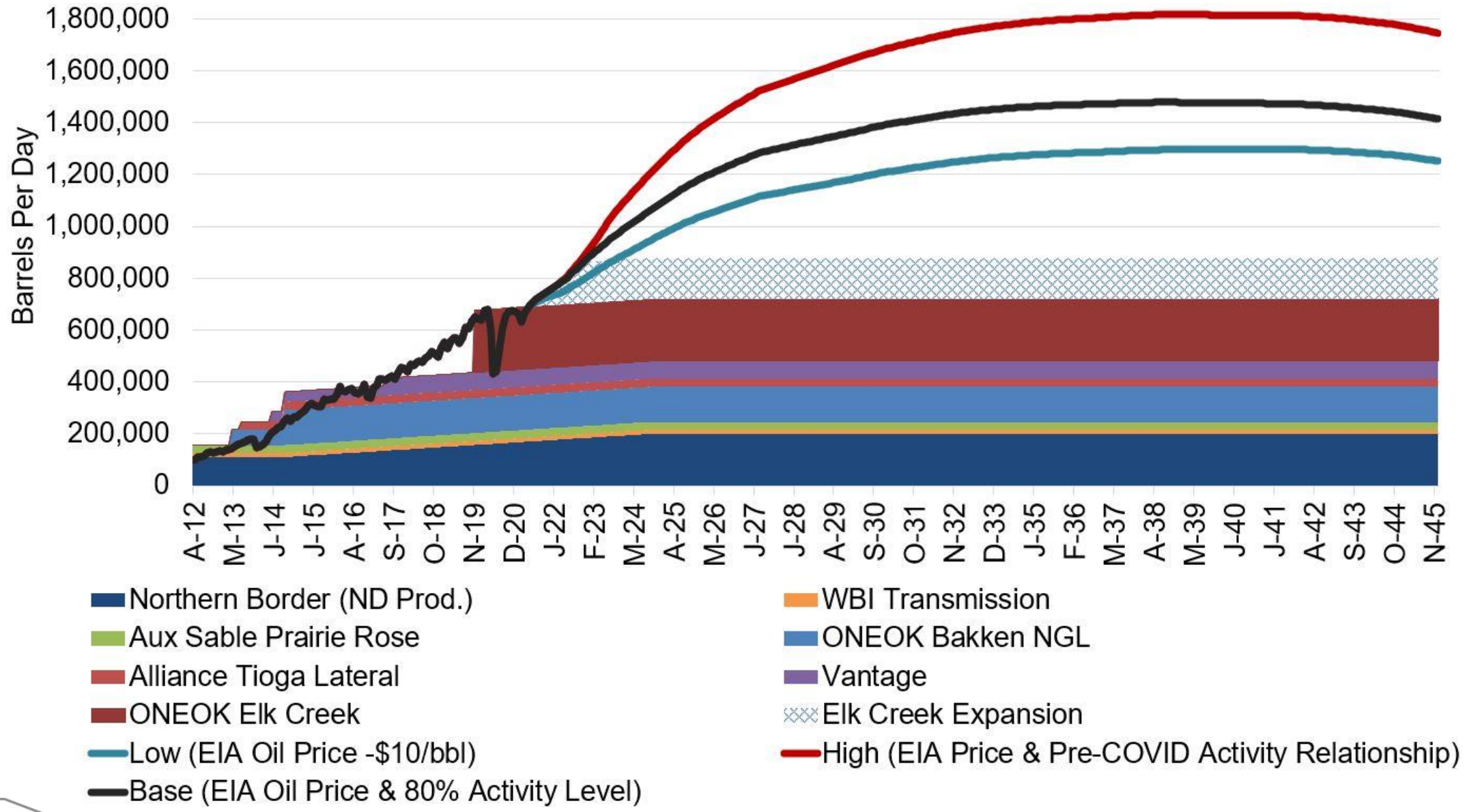




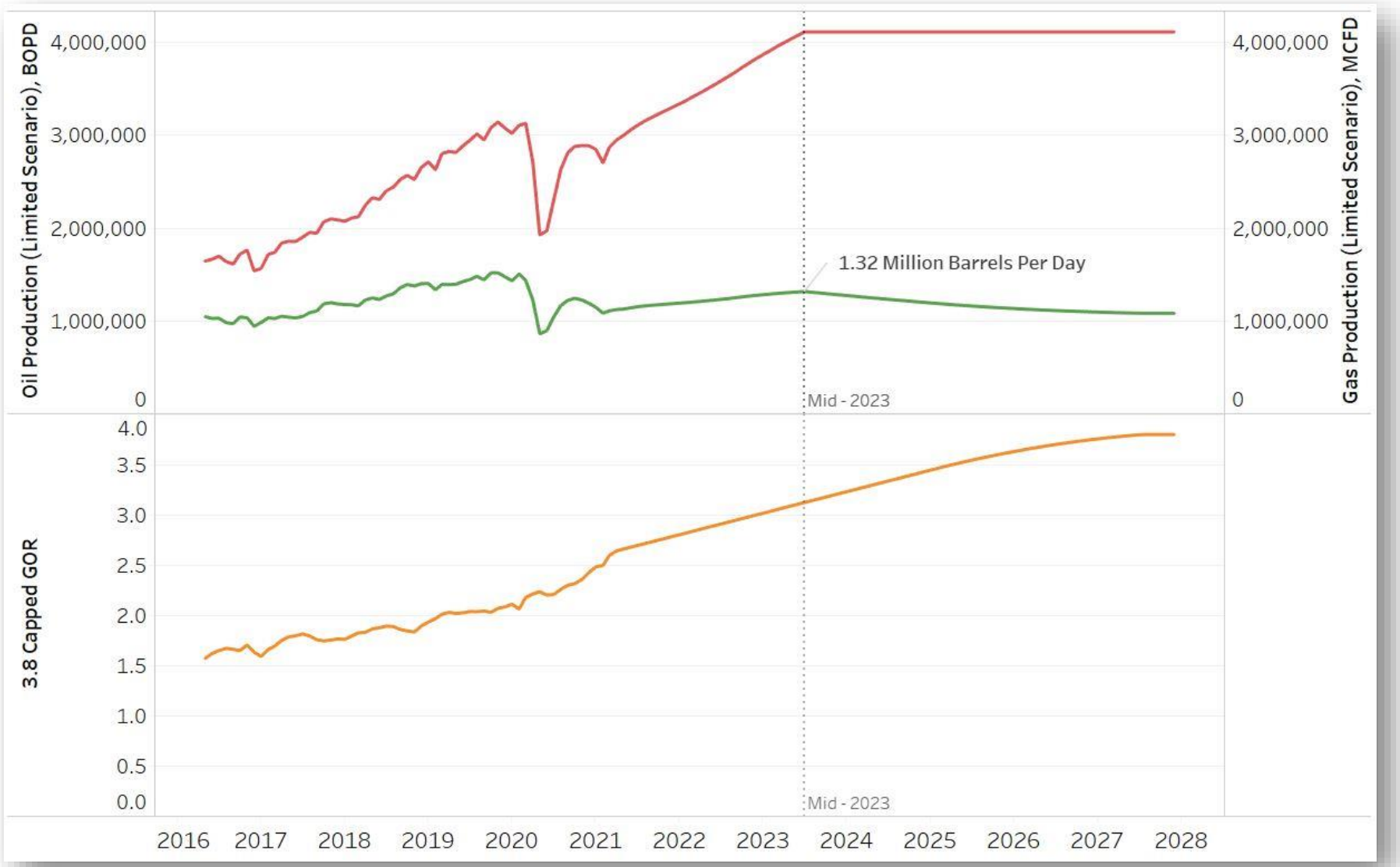


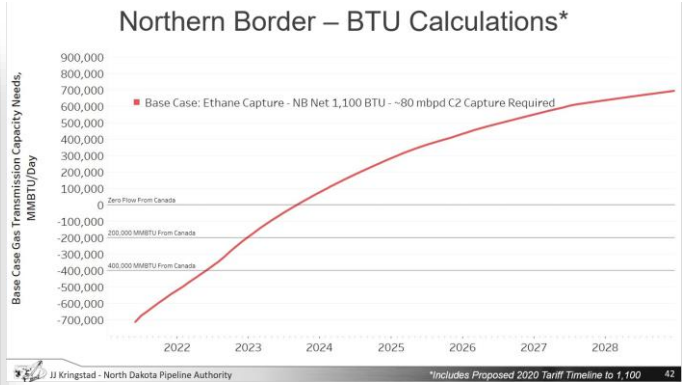


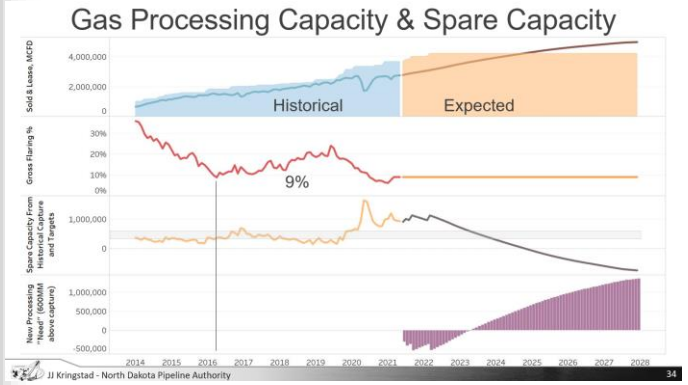
NGL Pipeline Takeaway Options

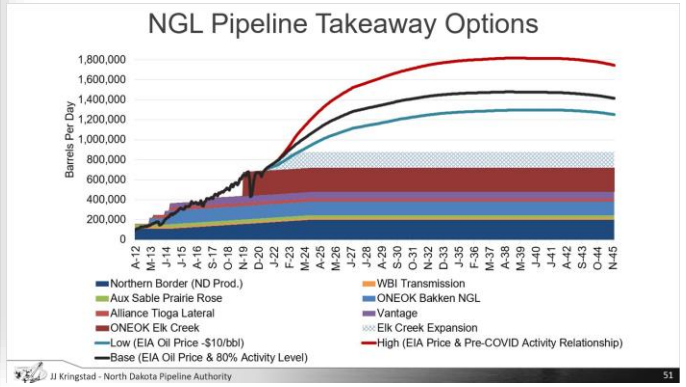


Additional Gas Capture Investments Are Necessary

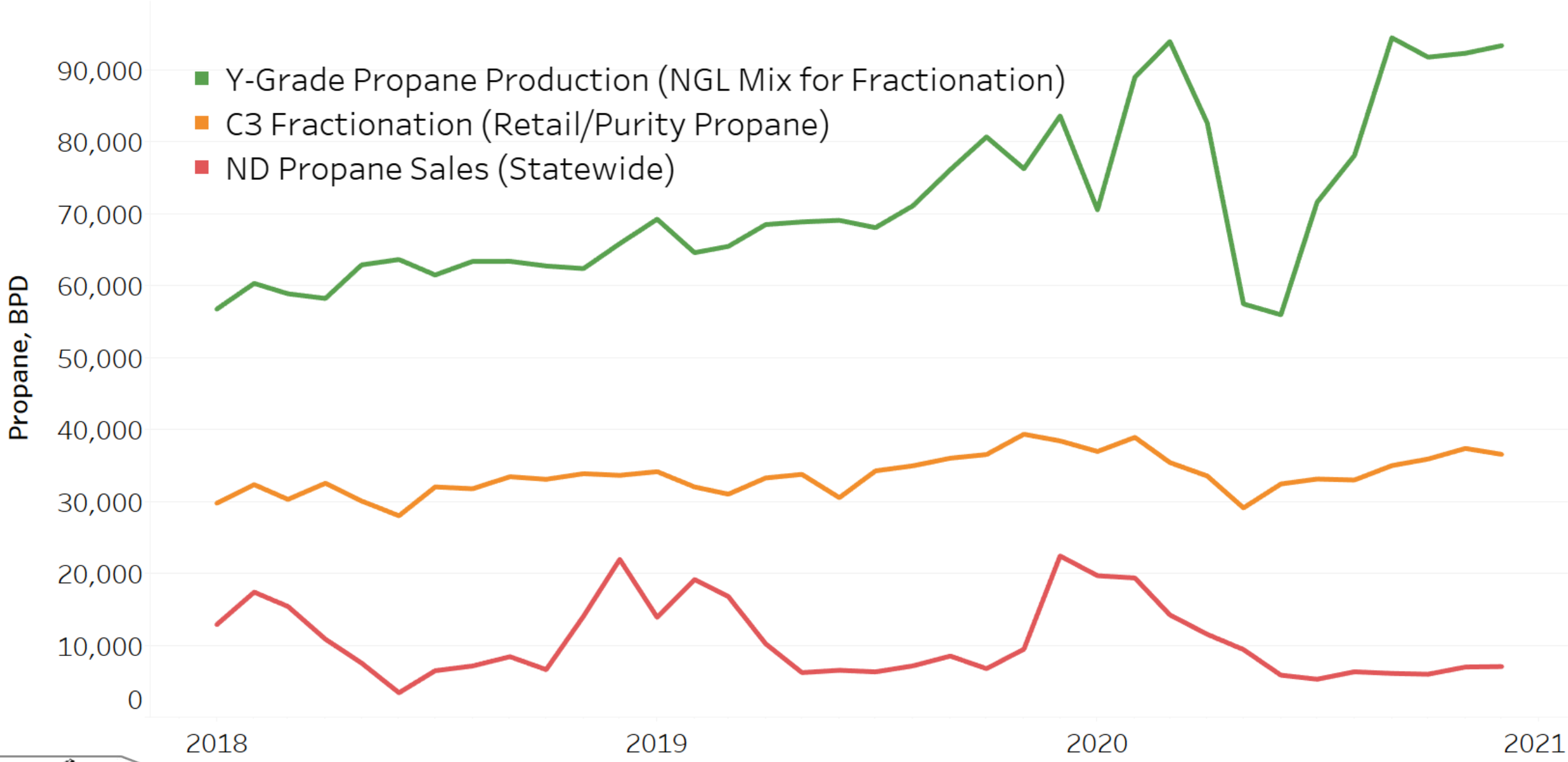




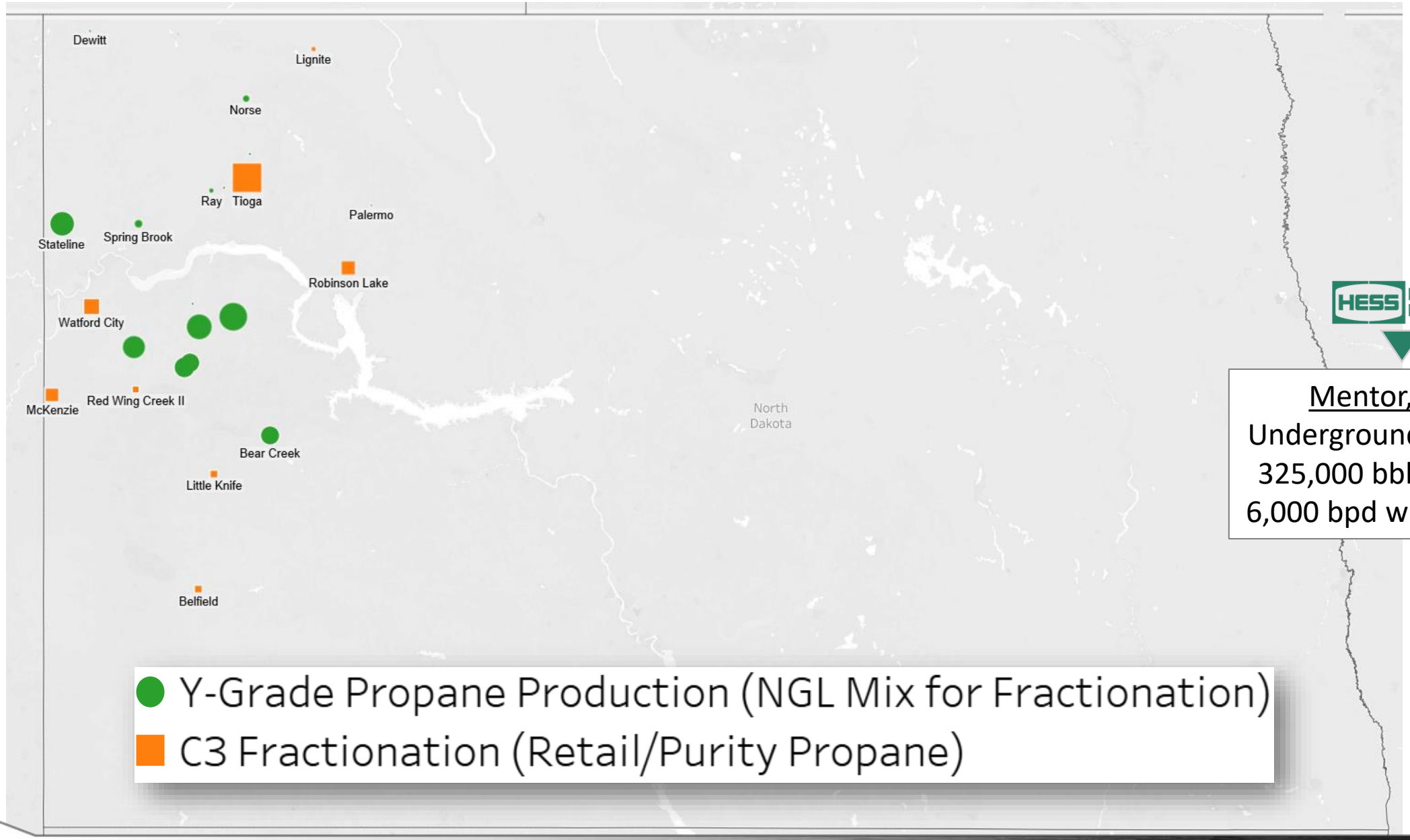




North Dakota Propane Production & Sales



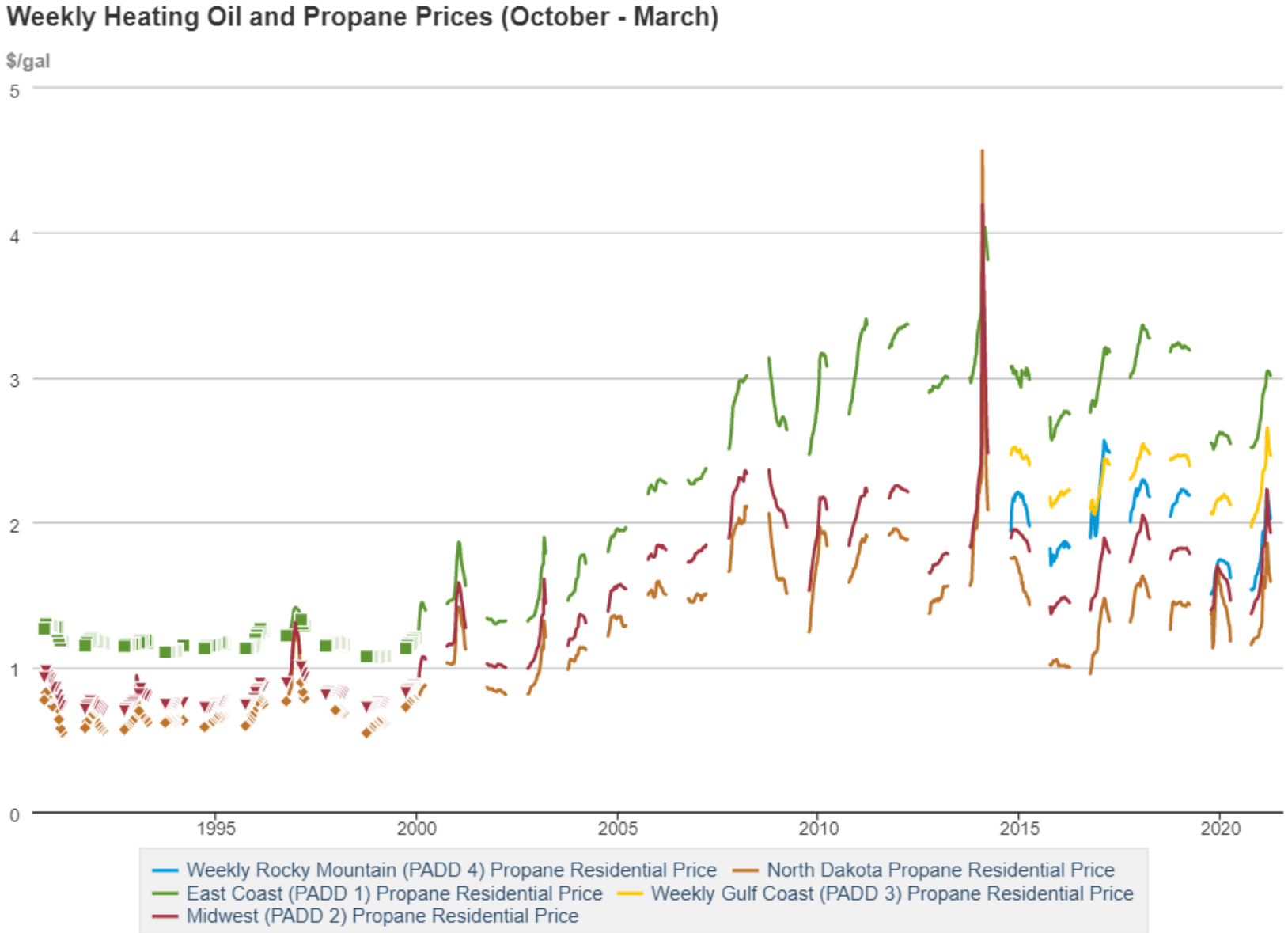
North Dakota Gas Plants Propane Output



Hess Midstream

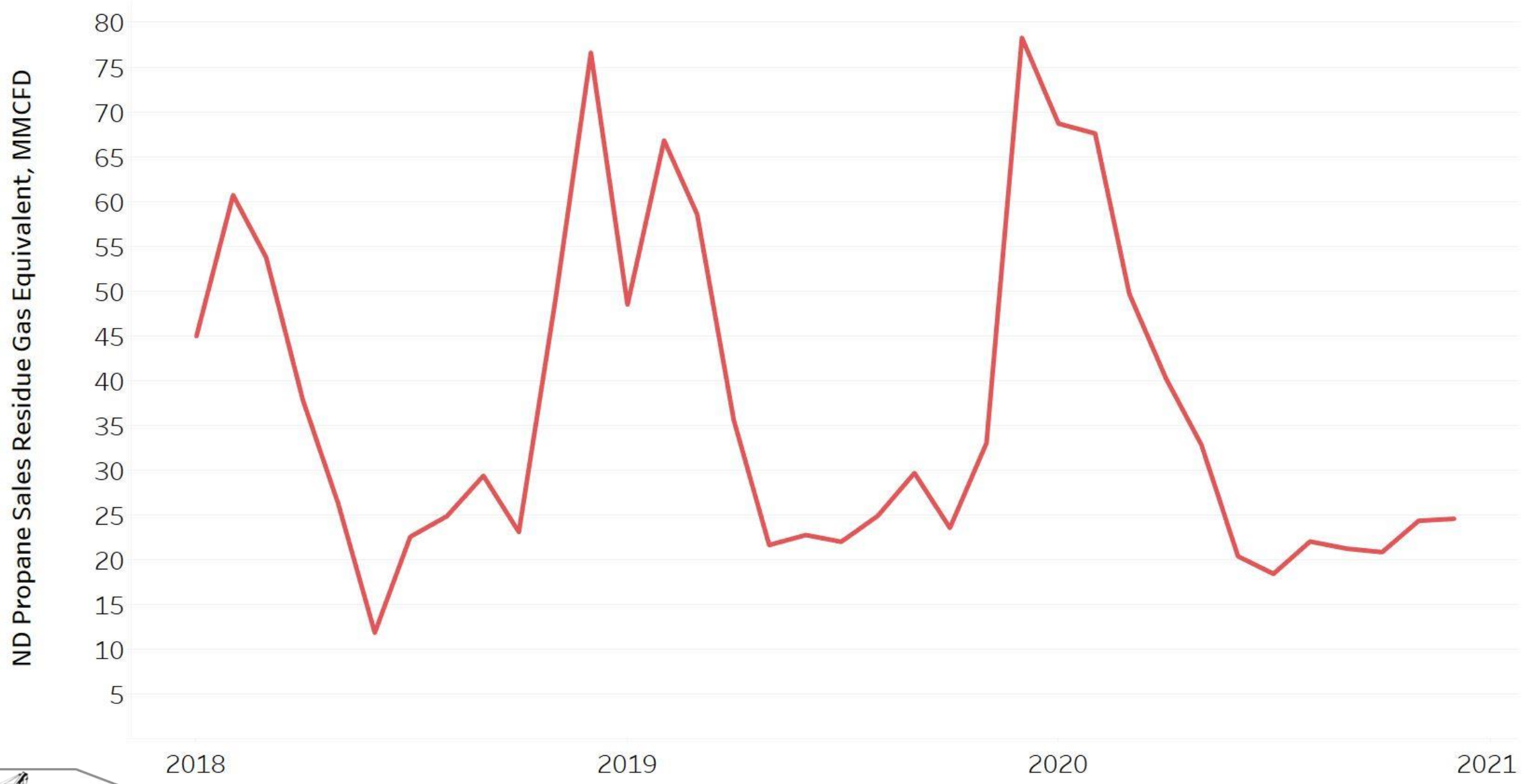
Mentor, MN
Underground Storage
325,000 bbl Storage
6,000 bpd withdrawal

North Dakota Residential Propane Pricing



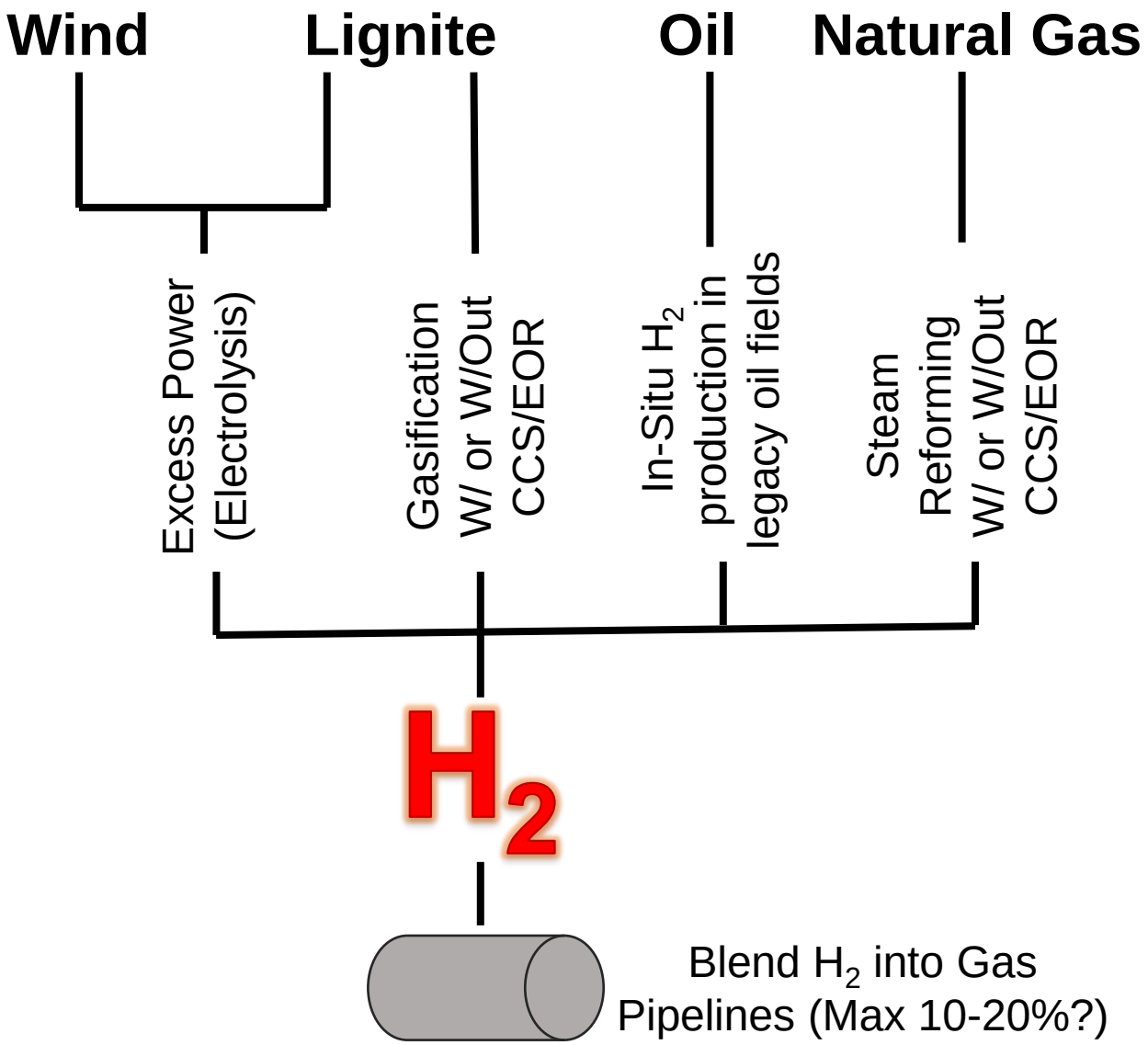
Source: U.S. Energy Information Administration

North Dakota Propane Sales Residue Gas Equivalent*



*Assumes 1,100 BTU/SCF

Exploring Hydrogen Solutions



Electric Generation

- Large and Immediate Market for Excess Power in Regional Pipelines
- Excess Electrons Sold for H_2 BTU Value in Gas Markets
- Gas Pipelines Could Support Intermittent Deliveries
- Gasification Options for Lignite

Gas Pipelines & Petroleum

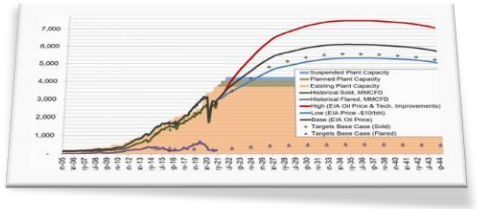
- Lowers Pipeline BTU
- Possible Support for Expansion Efforts
- Gas Marketing Advantages with Renewable or Carbon-Free Sources of H_2
- In-situ H_2 production in legacy fields
- Natural Gas Steam Reforming W/CCS or EOR Options

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?

Hydrogen/Residue Gas Blending

Rethinking Bakken Gas Processing



Concept Only

ND Gas Processing Plant 2.0
(Steam Reforming "Raw" Gas)

Raw Gas

H_2
- Pipeline Blending
- Ammonia/Fertilizer
- Power Generation

CO_2
- 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 CO_2 Distribution Pipeline Network to Regional Oilfields

Proposed CATCH Act (45Q Revisions)
Sequester @ ~$4.59/MCF gas eq. & $85/ton 45Q
EOR @ ~$3.24/MCF gas eq. & $60/ton 45Q

*Assumes 54kg of CO2 / MCF Gas

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