



## Natural Gas Market Fundamentals

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# Summary of Natural Gas Market Fundamentals

Due to technical and economic challenges in global trade and transportation, natural gas markets tend to be more localized than the crude oil market, even with the recent growth in LNG. As such, the United States dynamics tend to dictate the Canadian natural gas market.

## US Natural Gas Supply

- Based on the latest monthly Short-Term Energy Outlook from the EIA (January 2024), US dry natural gas production is expected to average 105.04 Bcf/d in 2024, up 1.4% or 1.49 Bcf/d from 2023 levels. Supply growth has been driven mainly by gas-focused plays in the Appalachia and Haynesville regions following the shale revolution and a significant associated gas growth from the Permian, an oil-focused play.

## US Natural Gas Demand and Net Exports

- On the demand front, the EIA forecasts average demand of 89.89 Bcf/d in 2024, up ~1 Bcf/d relative to 2023 (+1.1% Y/Y). Net exports are expected to increase by 1.1 Bcf/d Y/Y. This would result in a total supply surplus of approximately 1.1 Bcf/d in 2024.

## US Natural Gas Storage

- In North America, as of the beginning of January 2023, winter has had warmer-than-average temperatures, weakening heating demand and causing high natural gas storage levels, which sit above 5-year averages. According to the National Oceanic and Atmospheric Administration (NOAA), El Niño conditions are expected to continue through the Northern Hemisphere during winter 2023-2024, which could lead to warmer-than-average temperatures through parts of the continent and keep natural gas storage levels elevated.

## Natural Gas Benchmark Pricing

- The primary benchmark pricing hub for natural gas sold in the United States is Henry Hub, located in Louisiana, while in Canada, the primary benchmark pricing hub is AECO, located in Alberta. Numerous factors can influence pricing at a particular hub, such as regional supply/demand, transportation costs, pipeline constraints, storage capacity, and/or weather.
- Looking ahead, the futures curve for Henry Hub over the next 12 months indicates an average price of roughly US\$2.92/MMBtu in 2024, compared to the average price of ~US\$2.67/MMBtu in 2023. Meanwhile, in Canada, the futures curve for AECO over the next 12 months indicates an average price of roughly C\$2.30/GJ in 2024, implying a differential to Henry Hub of ~US\$1.10/MMBtu, slightly wider than average 2023 levels.

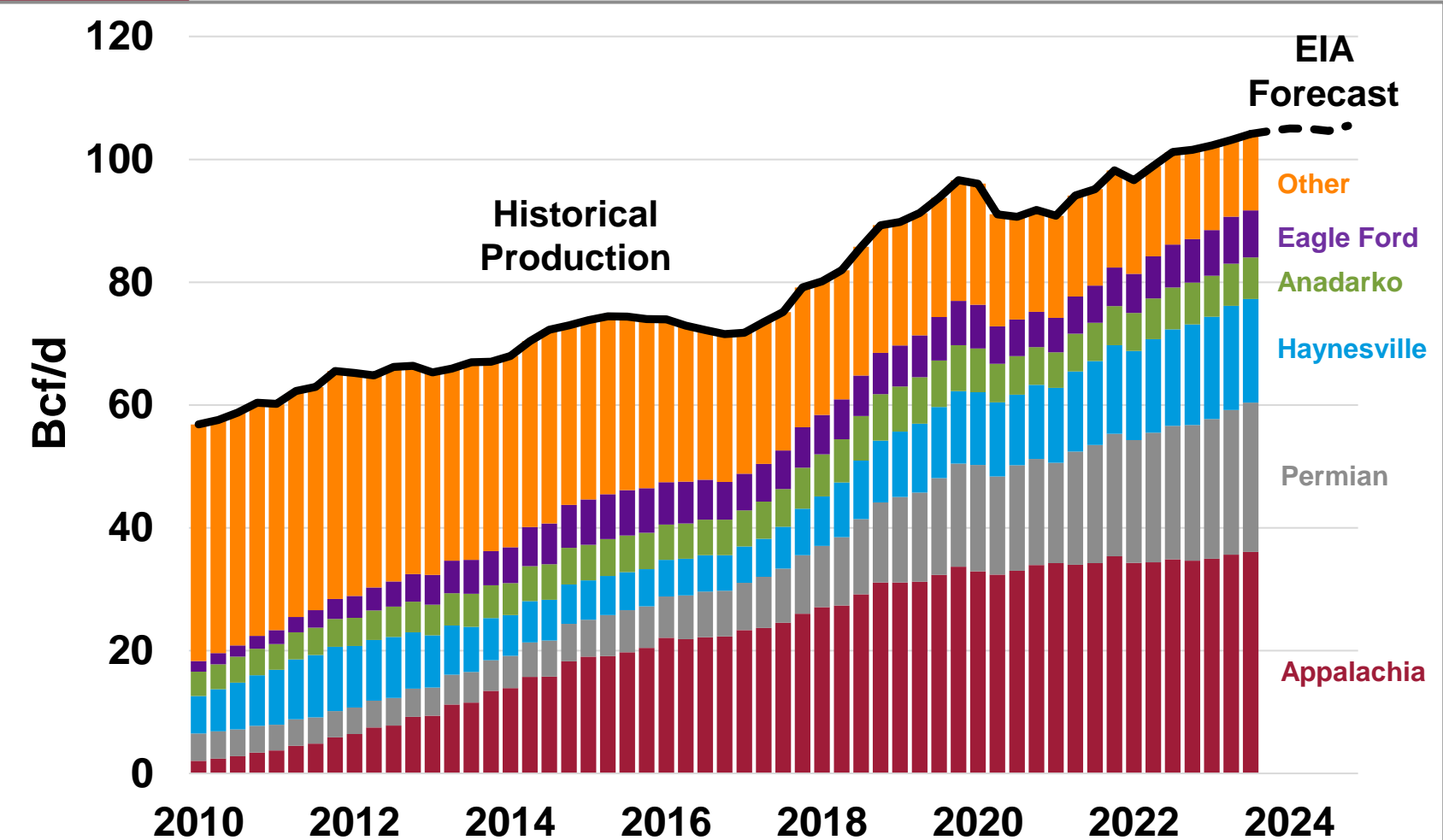
Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024) , National Oceanic and Atmospheric Administration, Bloomberg. Futures pricing as of Jan 8<sup>th</sup>, 2024.



## US Natural Gas Markets



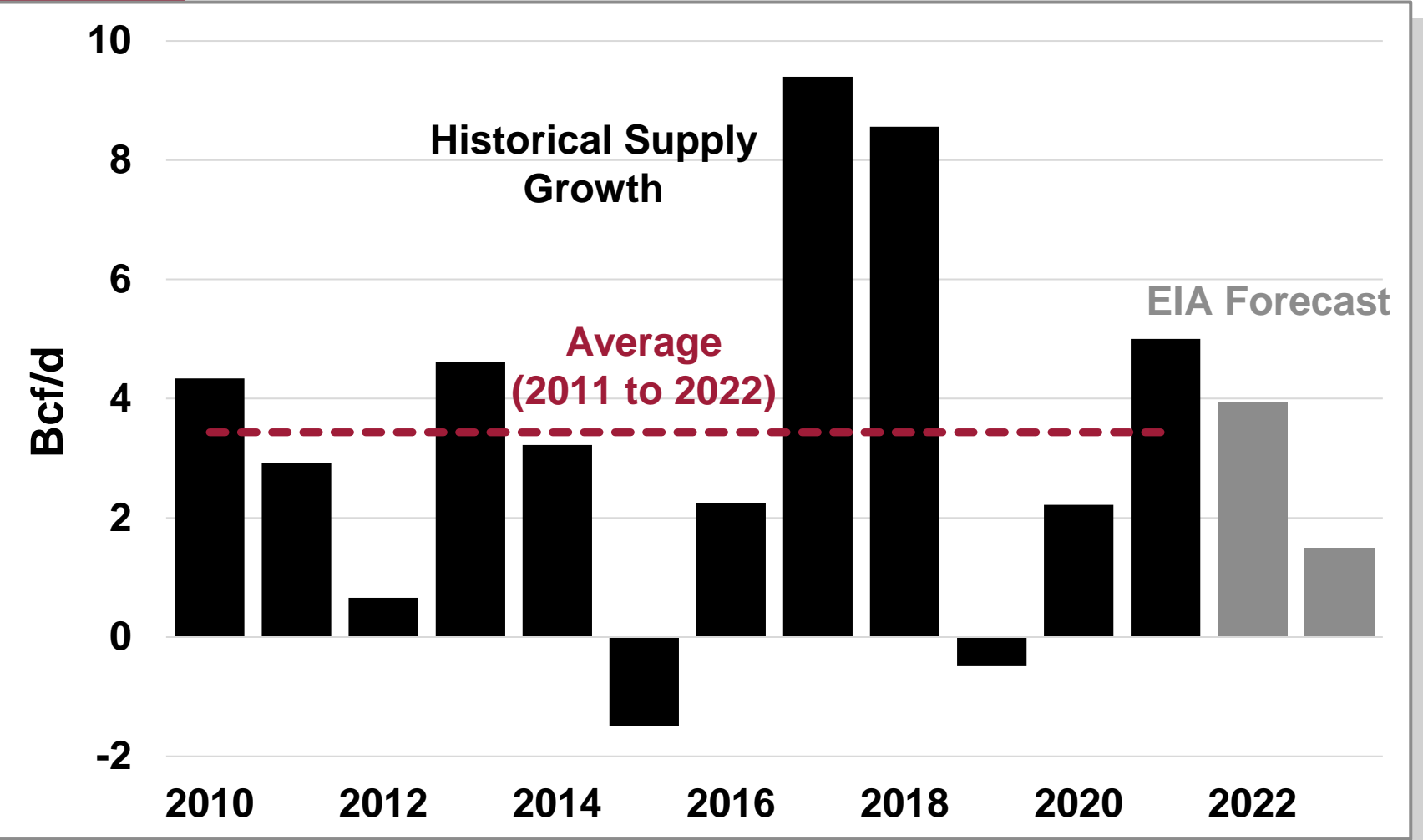
# Short-Term US Dry Natural Gas Production Outlook | Quarterly | 2010 to 2024e



- Since 2010, US natural gas production has increased by 80% from roughly 57 Bcf/d to roughly 104 Bcf/d, largely driven by gas-focused plays in the Appalachia and Haynesville regions following the shale revolution.
- The Permian, an oil-focused play, has also driven meaningful growth and is now the second-largest natural gas-producing region in the United States, accounting for close to 25% of total production.
- The Permian gas is a byproduct of oil production (also called associated gas), and therefore, its production growth is more tied to oil prices.

Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024), Drilling Productivity Report (Dec 2023)

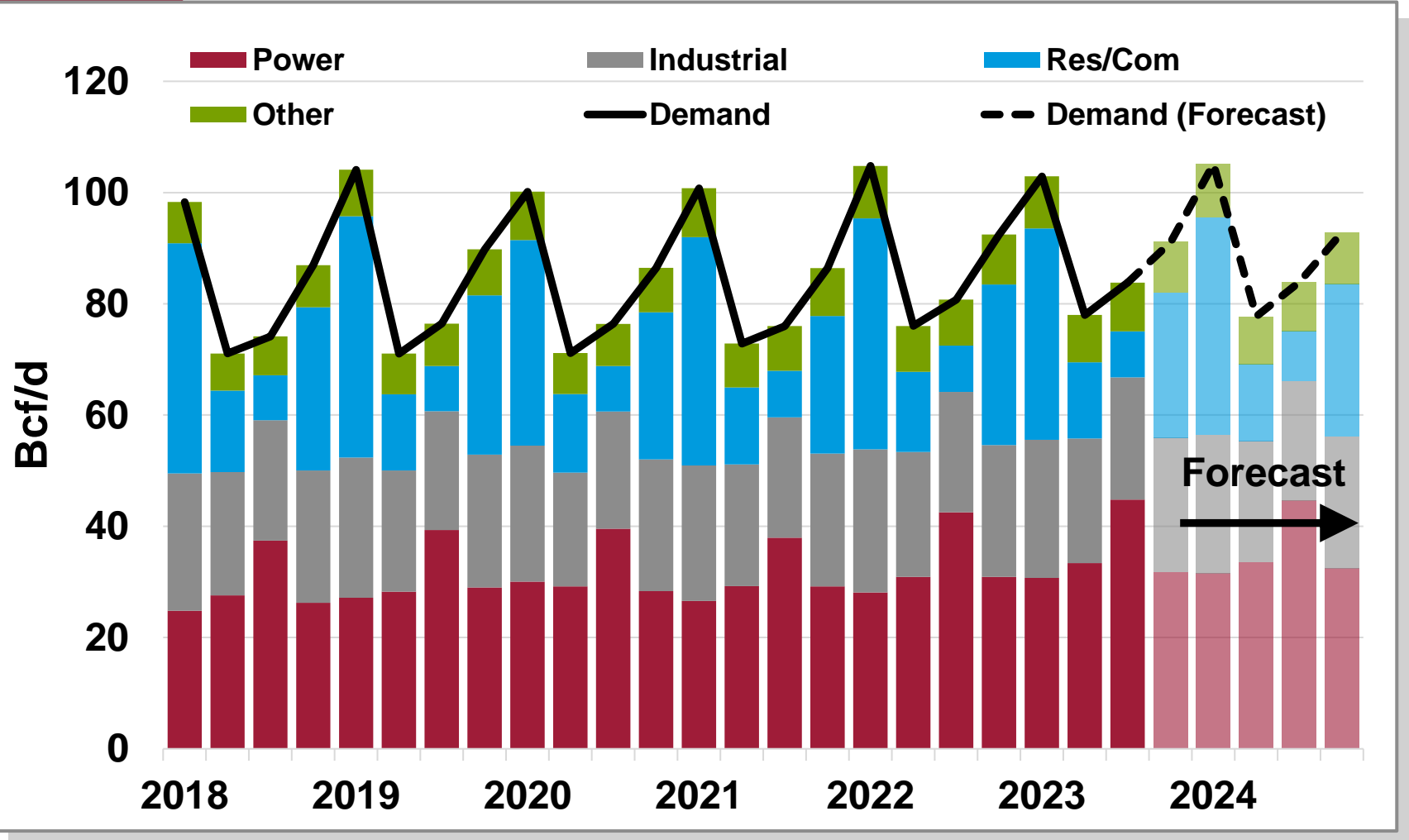
# Annual US Dry Natural Gas Production Growth | 2011 to 2024e



- Based on the latest monthly Short-Term Energy Outlook from the EIA (Jan 2024), US natural gas production is expected to average 105.04 Bcf/d in 2024, up 1.4% or 1.49 Bcf/d from 2023 levels.
- From 2011 to 2022, US natural gas production has increased by an average of 3.4 Bcf/d per year.
- Forecasted annual production growth of 1.5 Bcf/d in 2024 is lower than the historical average from 2011 to 2021 of 3.4 Bcf/d and well below the growth in 2023 of 4 Bcf/d. Production growth in 2023 exceeded initial expectations and reached a record high, largely driven by associated gas growth in the Permian.

Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024)

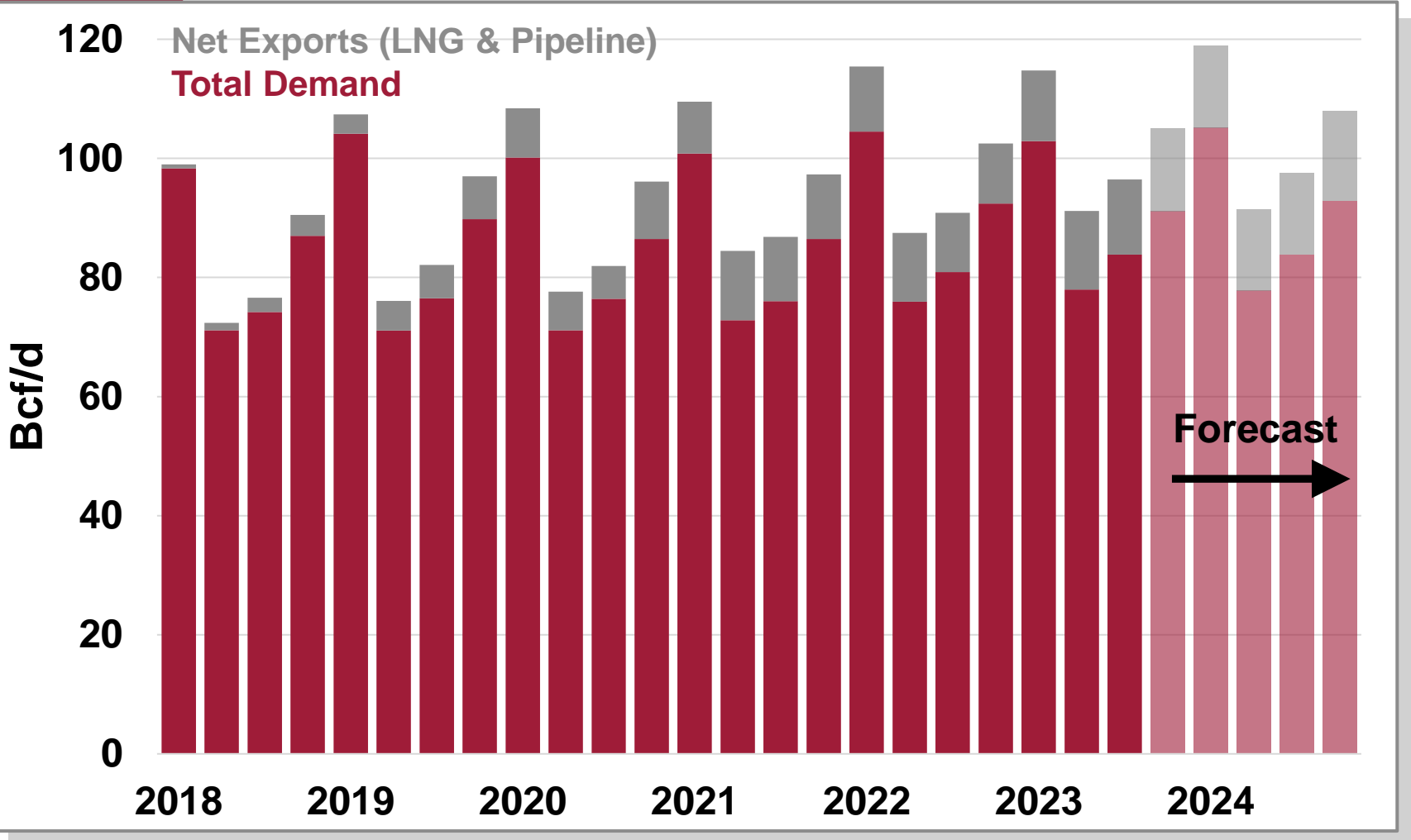
# Short-Term US Natural Gas Demand Outlook | Quarterly | 2018 to 2024e



- Based on the latest monthly Short-Term Energy Outlook from the EIA (Jan 2024), US natural gas demand is expected to average 89.9 Bcf/d in 2024, up ~1 Bcf/d relative to 2023 (+1.1% Y/Y). Since 2010, demand growth in the United States has been predominantly driven by coal-to-gas switching in the power sector.
- A large portion of natural gas demand is influenced by weather, leading to seasonal fluctuations. Peak winter demand can reach upwards of 100 Bcf/d during winter, while trough demand can hit as low as ~70-85 Bcf/d during spring. As a result, natural gas prices tend to be correlated with the weather.

Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024)

# Short-Term US Natural Gas Demand and Net Exports | Quarterly | 2018 to 2024e

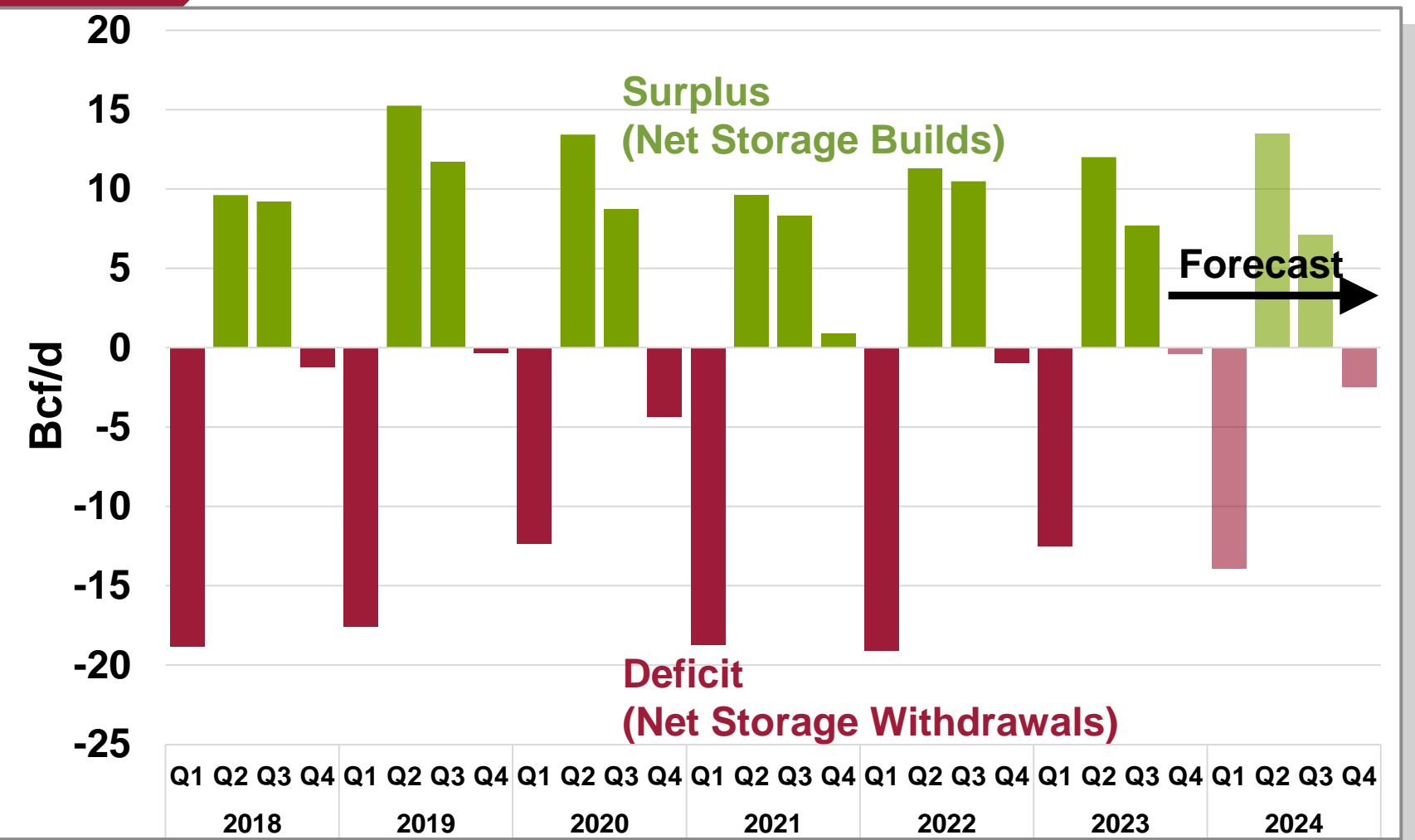


- The United States is a net exporter of LNG and natural gas via pipeline to Mexico, which have a meaningful impact on the overall supply/demand balance.
- According to the latest monthly Short-Term Energy Outlook from the EIA (Jan 2024), combined net LNG and pipeline exports are expected to average 14.1 Bcf/d in 2024, compared to ~13 Bcf/d in 2023 (+9% Y/Y).
- Net LNG exports will increase with the start-up of the Golden Pass LNG terminal in Sabine Pass, Texas, and the Plaquemines LNG terminal in Plaquemines Parish, Louisiana in late 2024/early 2025.

Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024)



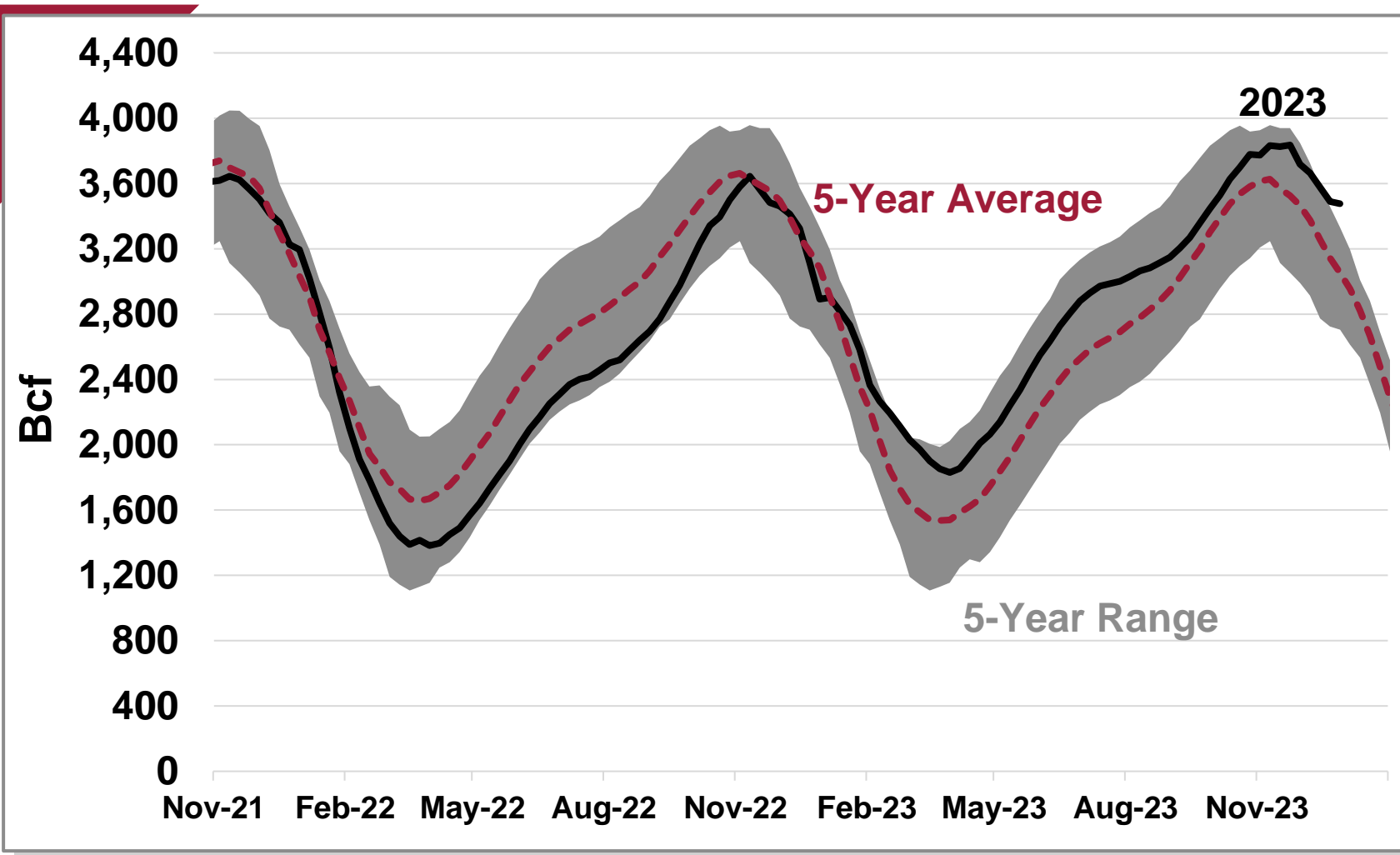
# US Natural Gas Supply<sup>1</sup>/Demand Balance | Quarterly | 2018 to 2024e



- Based on the latest monthly Short-Term Energy Outlook from the EIA (Jan 2024), there is expected to be a total supply<sup>1</sup> surplus of approximately 1.1 Bcf/d in 2024, compared to an estimated total supply<sup>1</sup> surplus of ~1.8 Bcf/d in 2023. Surpluses cause weaker prices.
- During periods of lower demand (Q2 to Q3), surplus natural gas is injected into storage to ensure adequate supplies during the higher demand months.
- Conversely, natural gas is withdrawn from storage from Q4 to Q1 to supplement domestic supply, due to a deficit, when heating demand is the highest.

Source: US Energy Information Administration – Short-Term Energy Outlook (Jan 2024)  
<sup>1</sup> Supply is net of pipeline and LNG exports

# US Working Gas in Underground Storage | Weekly | 2021 to 2024

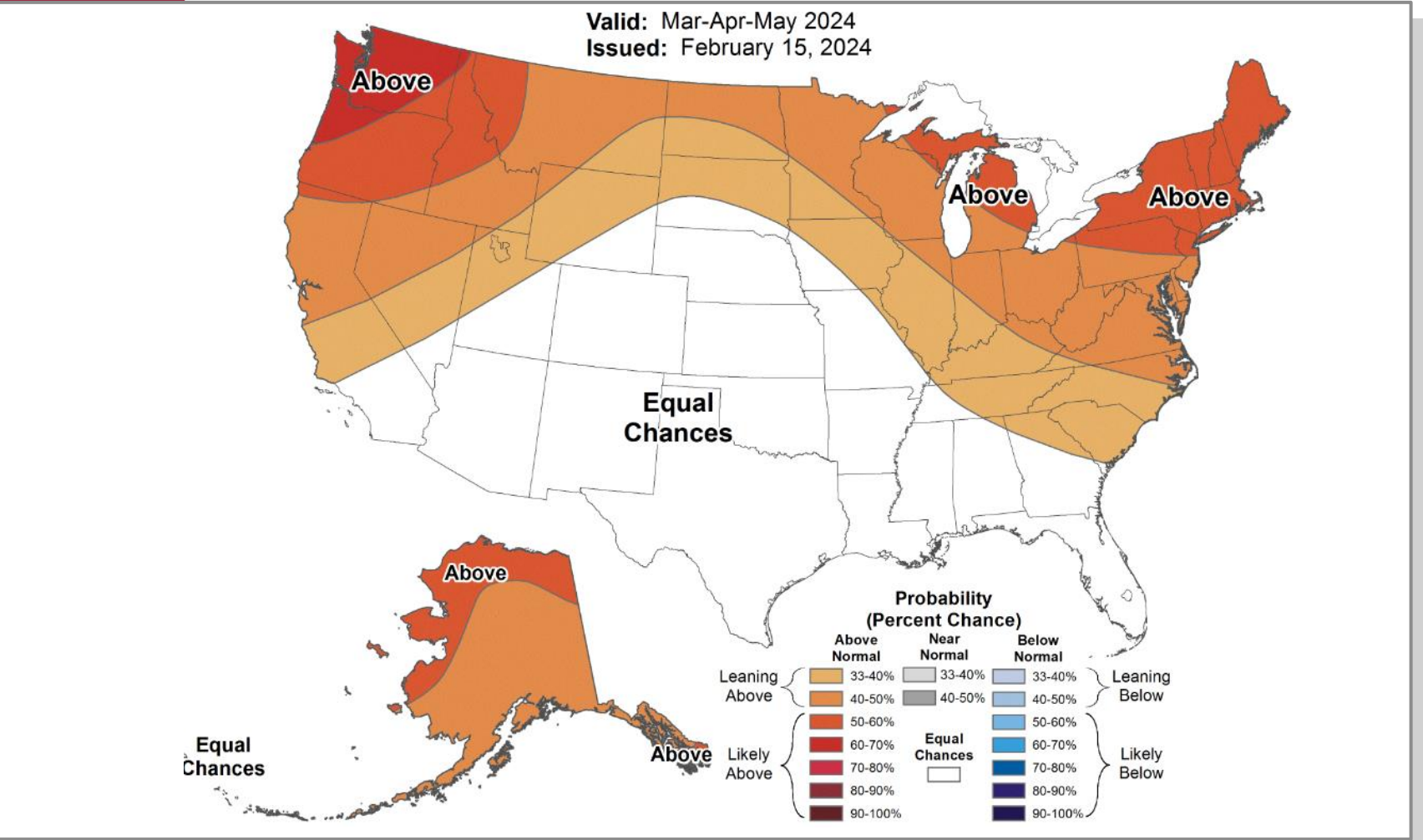


- High storage levels indicate ample supplies and/or weak demand, while low storage levels indicate the opposite.
- At the start of 2022, US natural storage levels were well below the 5-year average, driven by surging LNG exports and strong domestic demand switching (coal to gas).
- In June 2022, a major LNG facility went offline due to a fire, thereby reducing exports. Simultaneously, winter 2022/23 was warm, which flipped supply/demand into a surplus, creating a growing glut of gas in storage by the end of 2022 that has continued to plague the market through 2023.

Source: US Energy Information Administration

\*5-yr range represents the highest and lowest weekly inventory level over the equivalent week during the prior 5 years

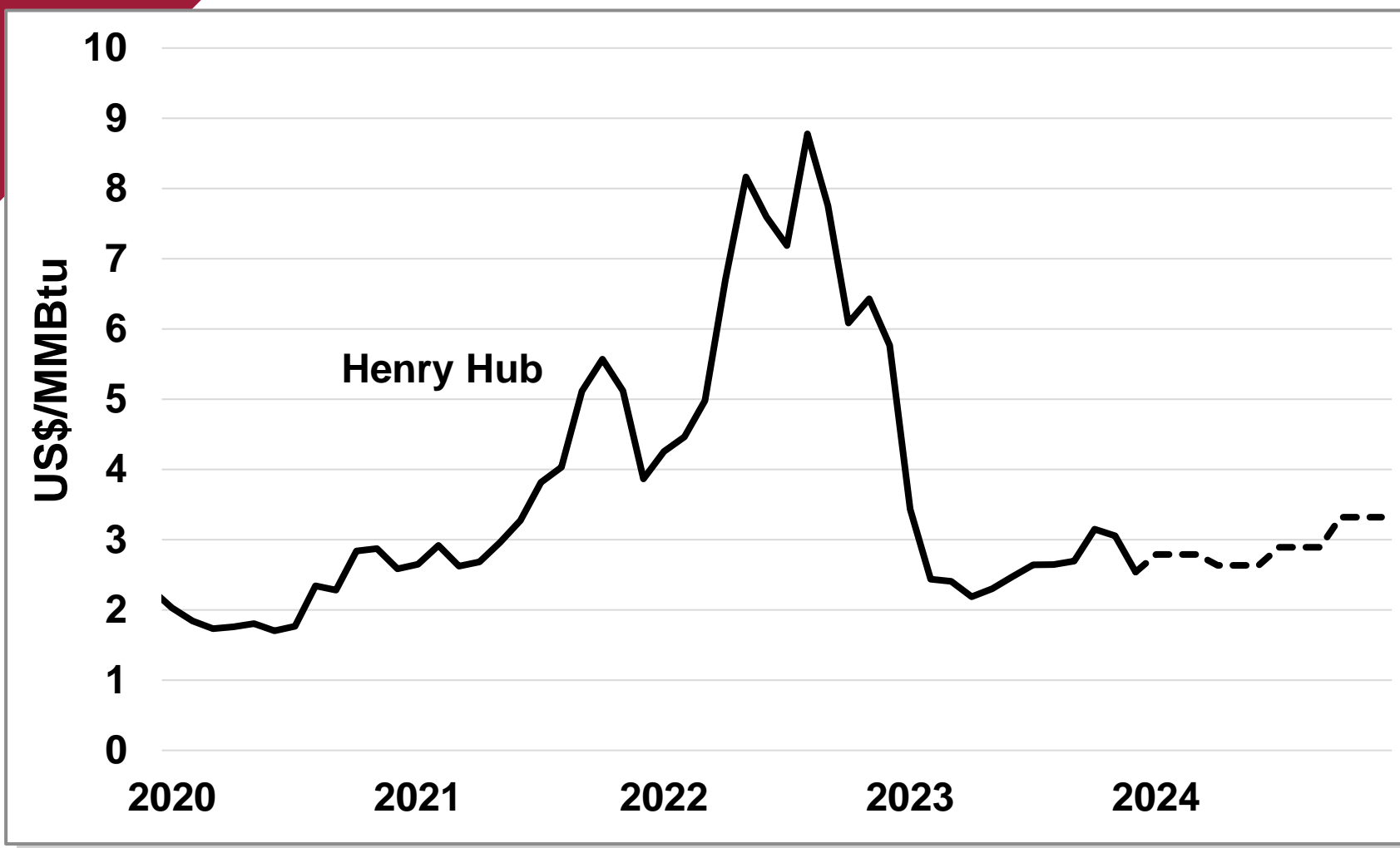
# Seasonal Temperature Outlook | Mar-Apr-May 2024



- Weather significantly influences natural gas demand; cold temperatures in winter months increase heating demand, while hot temperatures in summer can boost prices from increased air conditioning demand.
- In North America, the 2023-2024 withdrawal season has gotten off to a slow start due to warmer-than-average weather.
- According to the National Oceanic and Atmospheric Administration (NOAA), El Niño conditions are expected to continue through the Northern Hemisphere during winter 2023-2024, which could lead to warmer-than-average temperatures through parts of the continent.

Source: National Oceanic and Atmospheric Administration – the current Three Month Outlook was published on February 15<sup>th</sup>, 2024

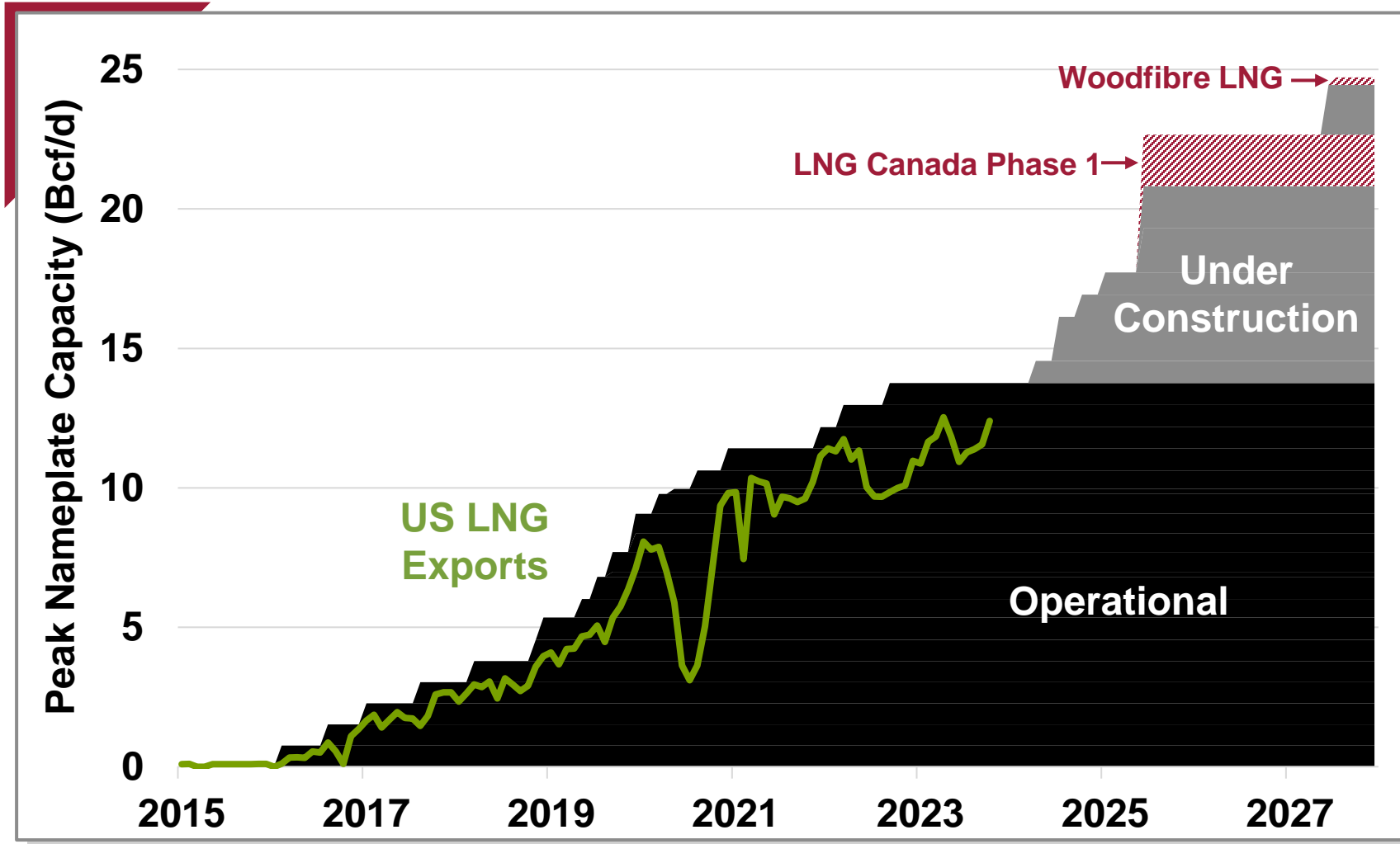
# Henry Hub Pricing | Monthly | 2020 to 2024e



- Since peaking at over US\$9/MMBtu in August 2022 with low inventories and the Ukraine/Russia war, Henry Hub has faced numerous headwinds, including warm winters, surging domestic supplies, and an LNG export facility outage.
- These headwinds caused prices to drop, with Henry Hub ultimately averaging US\$2.67/MMBtu in 2023, down from US\$6.54/MMBtu in 2022 (-59% Y/Y).
- Looking ahead, the futures curve for Henry Hub over the next 12 months indicates an average price of US\$2.92/MMBtu in 2024.

Source: Bloomberg, National Bank Financial. Futures pricing as of Jan 8<sup>th</sup>

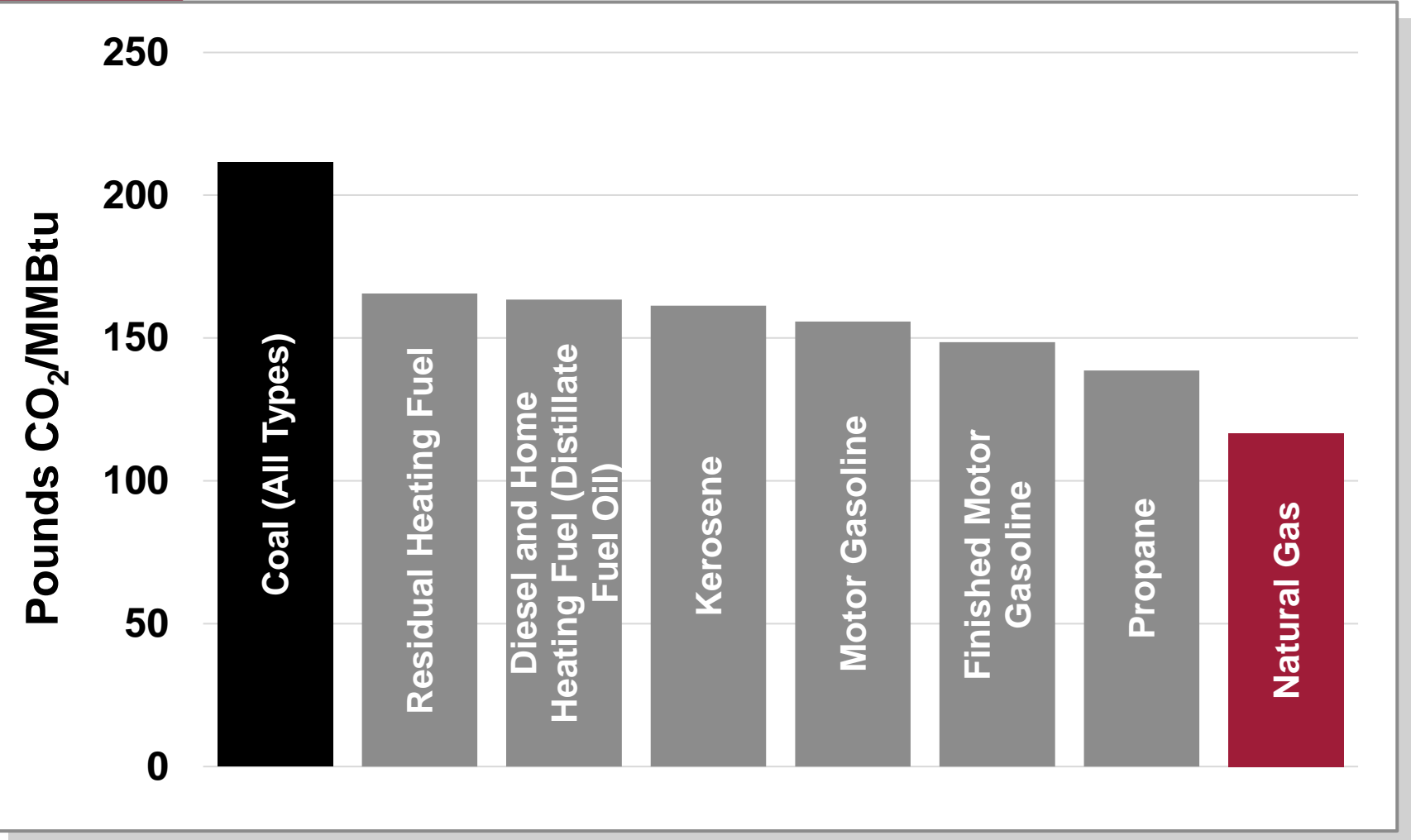
# North American LNG Export Capacity | Operational and Under Construction



Source: Energy Information Administration, Canada Energy Regulator, Company Reports

- As of October 2023, US LNG exports were 12.4 Bcf/d, and North American LNG exports are poised to reach ~25 Bcf/d by 2027, which should tighten North American gas markets.
- US LNG is growing to help fill the void made by European countries reducing their reliance on Russian gas.
- This is a success story for the United States; in contrast, Canada has been very slow to develop its LNG export business. First exports from Canada are not expected until 2025 via LNG Canada Phase 1, with roughly 1.8 Bcf/d of nameplate capacity. In addition, Woodfibre LNG will add another ~0.3 Bcf/d of nameplate capacity in 2027.

# CO<sub>2</sub> Emissions Coefficients by Fuel Types For Homes and Businesses

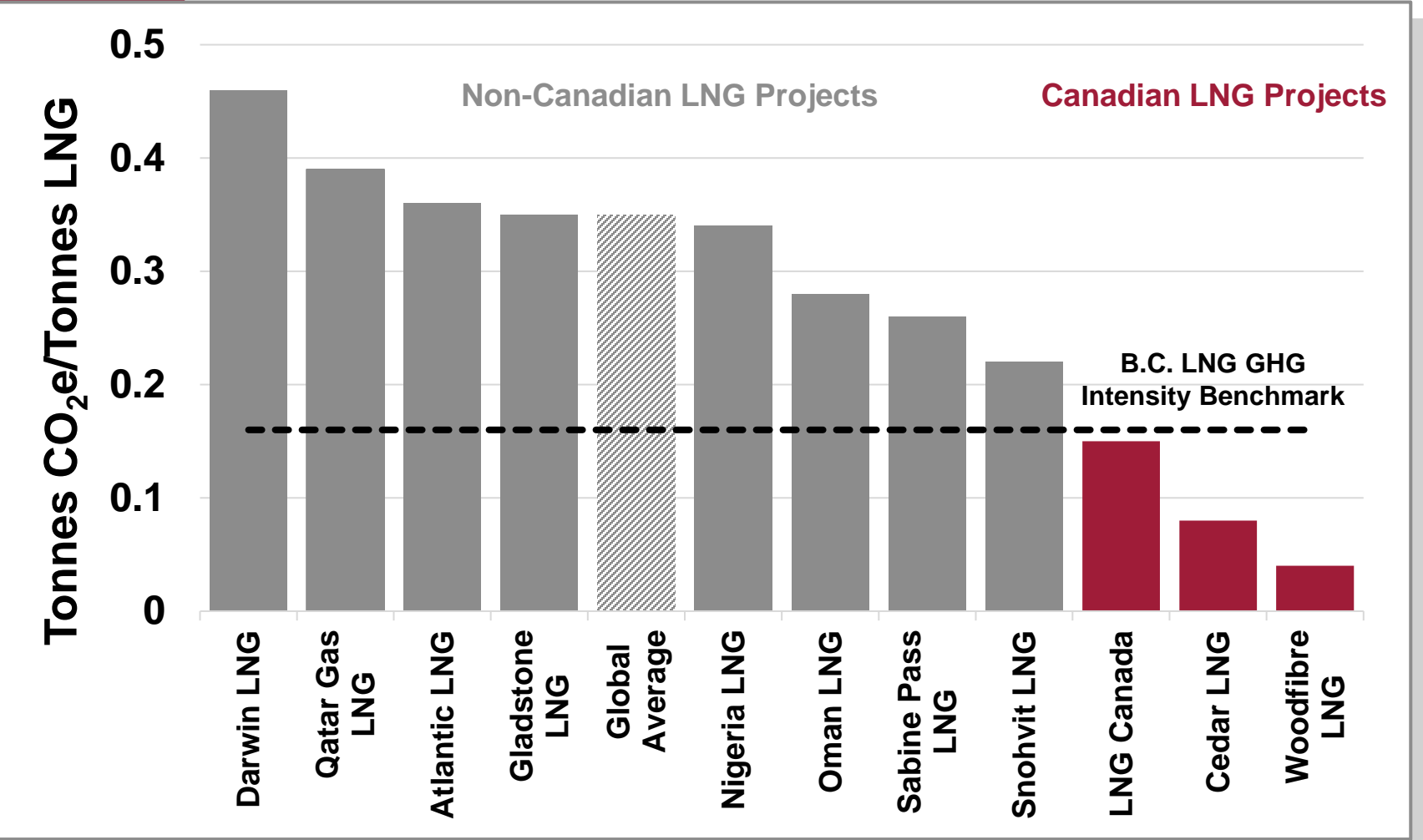


- A CO<sub>2</sub> emissions coefficient can be used to measure the amount of CO<sub>2</sub> emitted per unit of energy consumption. Coal is roughly double that of natural gas at 211 Pounds CO<sub>2</sub>/MMBtu and 117 Pounds CO<sub>2</sub>/MMBtu, respectively.
- Many developing economies remain reliant on coal for electricity generation. Meanwhile, countries like the United Kingdom and the United States have successfully reduced emissions by converting coal-fired power plants to natural gas-fired.
- LNG is expected to play a major role in facilitating coal-to-gas switching and lower GHG emissions.

Source: US Energy Information Administration



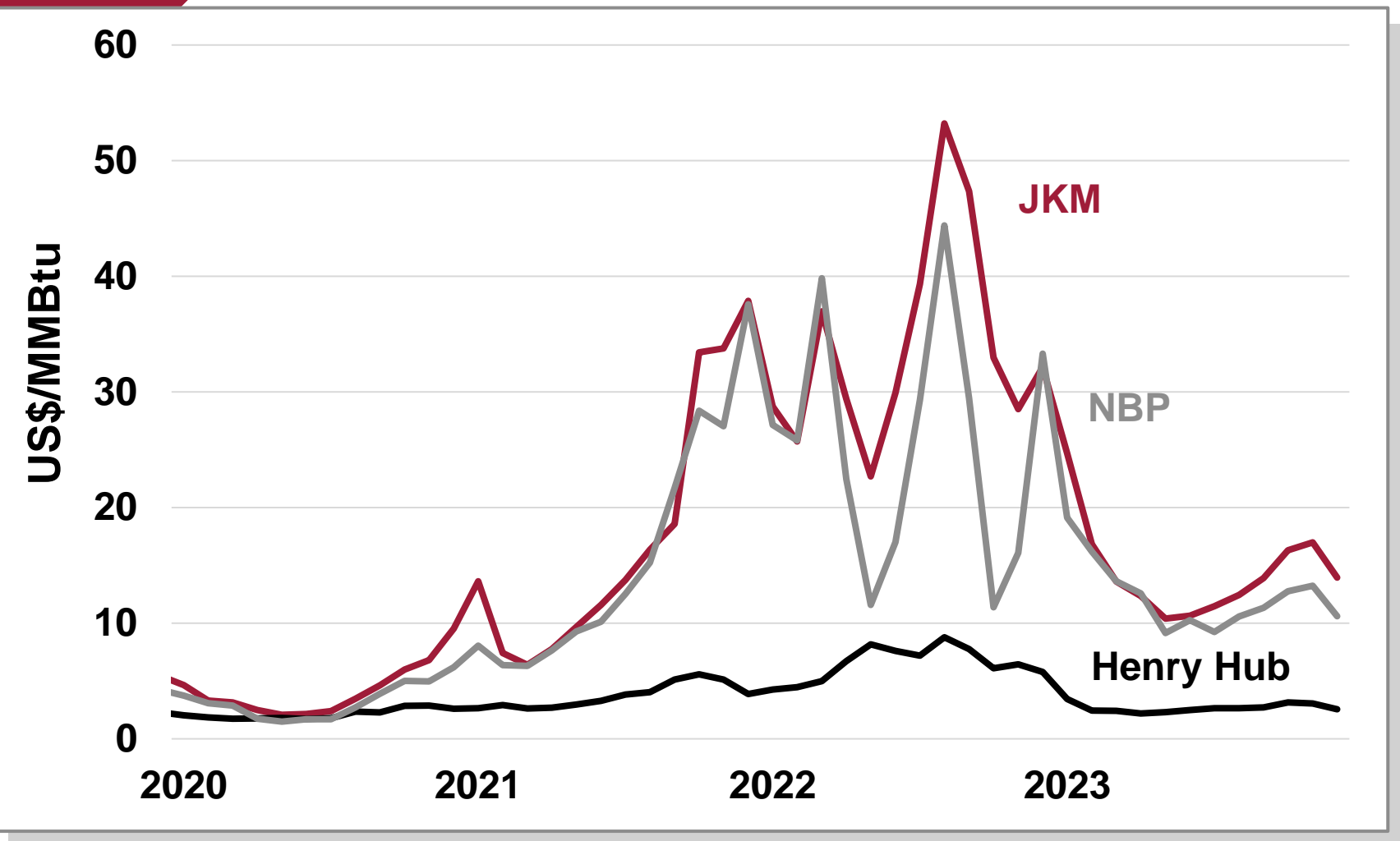
# Global LNG Project Comparison by CO<sub>2</sub> Emissions



- Canadian LNG facilities are poised to be some of the lowest emitting in the world.
- The B.C. government has committed to having the cleanest LNG facilities in the world by setting a GHG intensity benchmark of 0.16 tonnes CO<sub>2</sub>e/tonnes LNG.
- On an emissions intensity basis, LNG Canada, Cedar LNG and Woodfibre LNG will be roughly 57%, 77%, and 89% below the global LNG average of 0.35 tonnes CO<sub>2</sub>e/tonnes LNG, respectively, based on current estimates.

Source: Oxford Institute for Energy Studies, Delphi Group, LNG Canada, Woodfibre LNG, Cedar LNG, Government of British Columbia, CAPP

# Global LNG Benchmarks | Monthly | 2020 to 2023



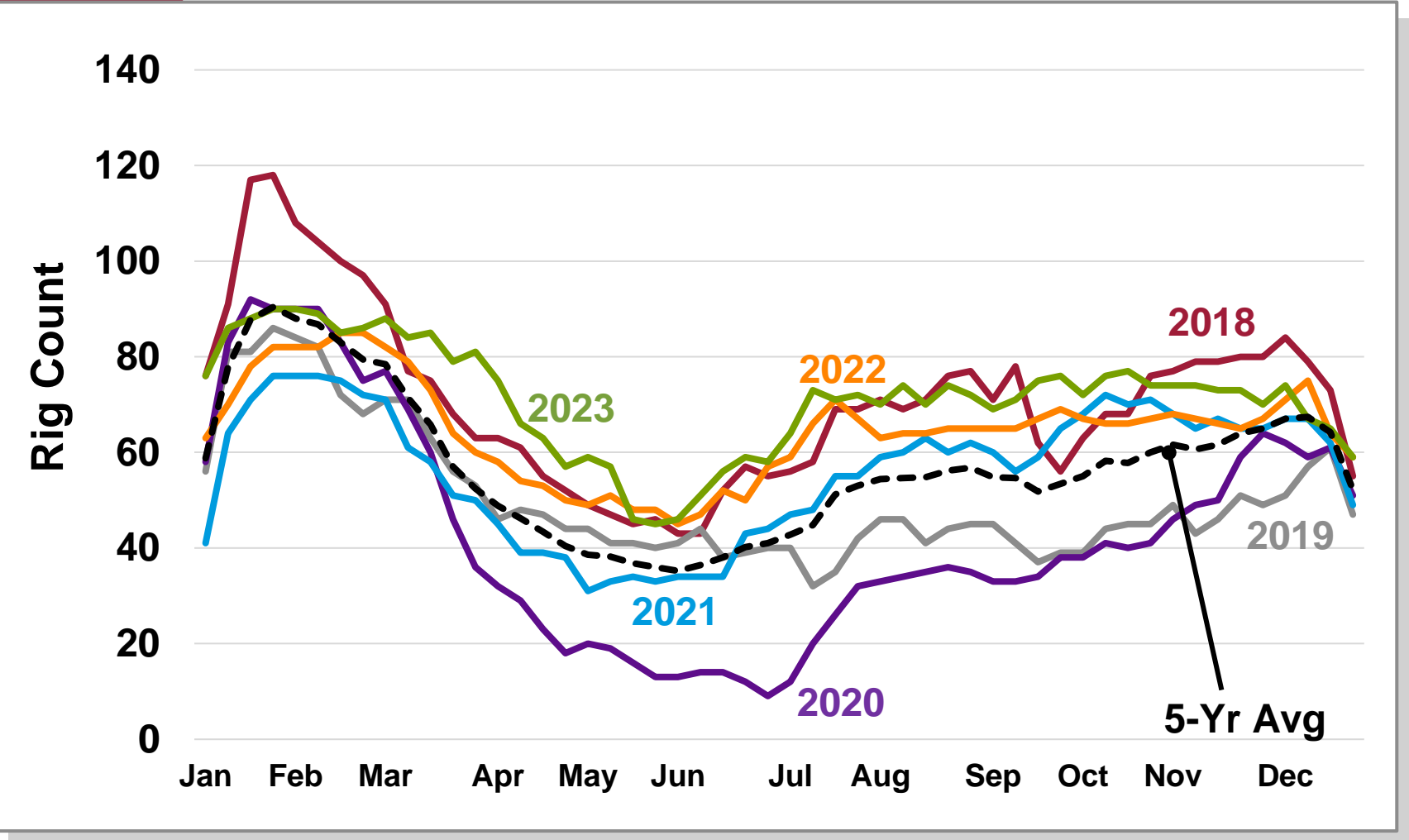
- Japan Korea Marker (JKM) and National Balancing Point (NBP) are two major global LNG benchmarks in Asia and Europe, respectively.
- Global LNG prices surged in 2021 following the Russia/Ukraine conflict, reaching close to US\$70/MMBtu in early 2022 at the NBP trading hub. Prices have since softened but remain at a significant premium to Henry Hub.
- For context, in 2023, JKM and NBP averaged a premium of roughly US\$12/MMBtu and US\$10/MMBtu to Henry Hub, respectively.

Source: Bloomberg



## WCSB Natural Gas Fundamentals

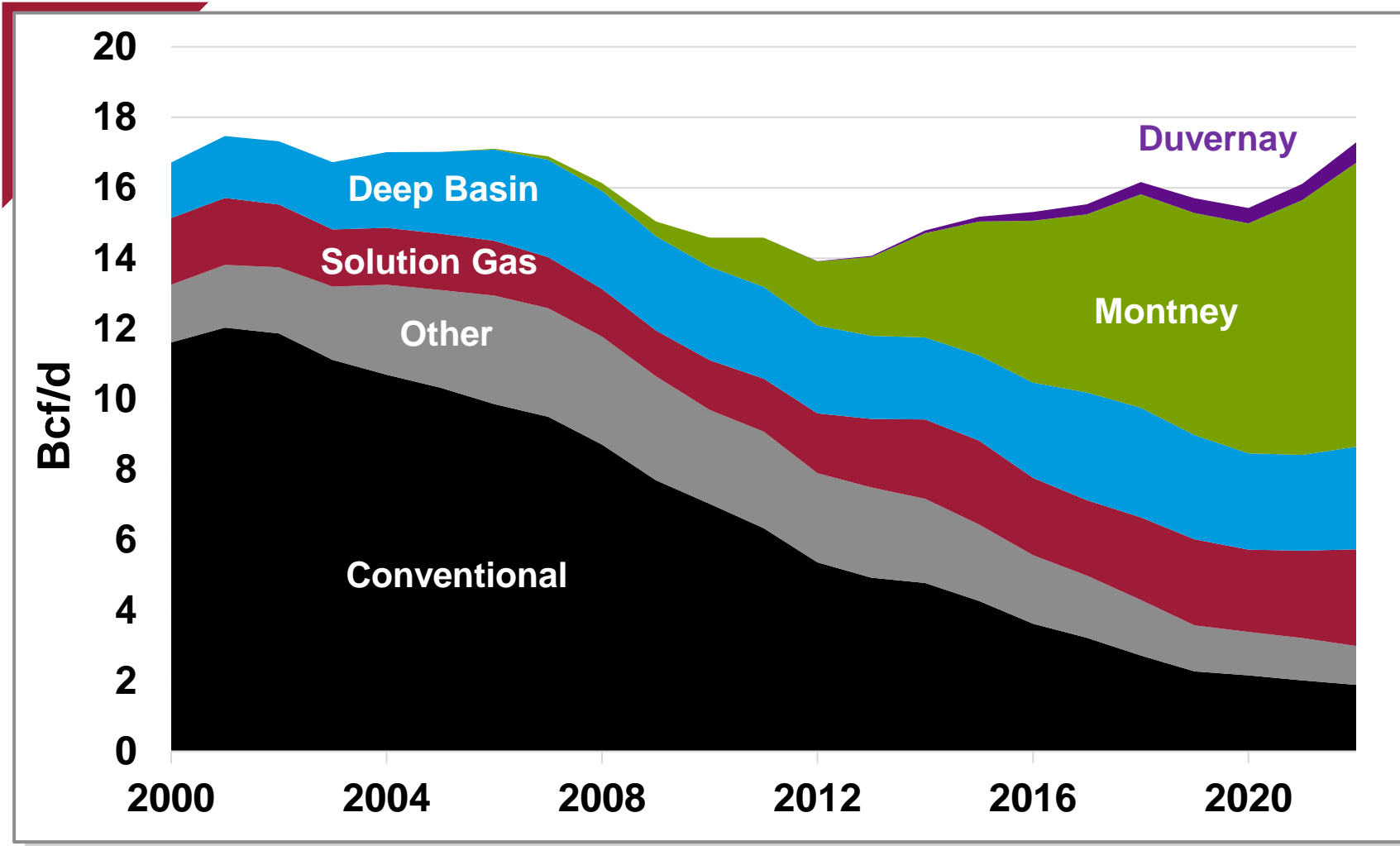
# Canadian Natural Gas Rig Count | Weekly | 2018 to 2023



- The rig count can be used as a leading indicator for potential natural gas supply growth.
- Compared to historical averages, the natural gas rig count in Canada has remained relatively high in 2022 and 2023.
- For context, from Jan 2022 to Dec 2023, Canadian natural gas production grew by roughly 1.5 Bcf/d (+9%) to 18 Bcf/d.
- It should be noted that over the last decade, drilling technological advancements have improved well efficiencies and reduced the correlation between rig count and production growth.

Source: Baker Hughes, Canada Energy Regulator

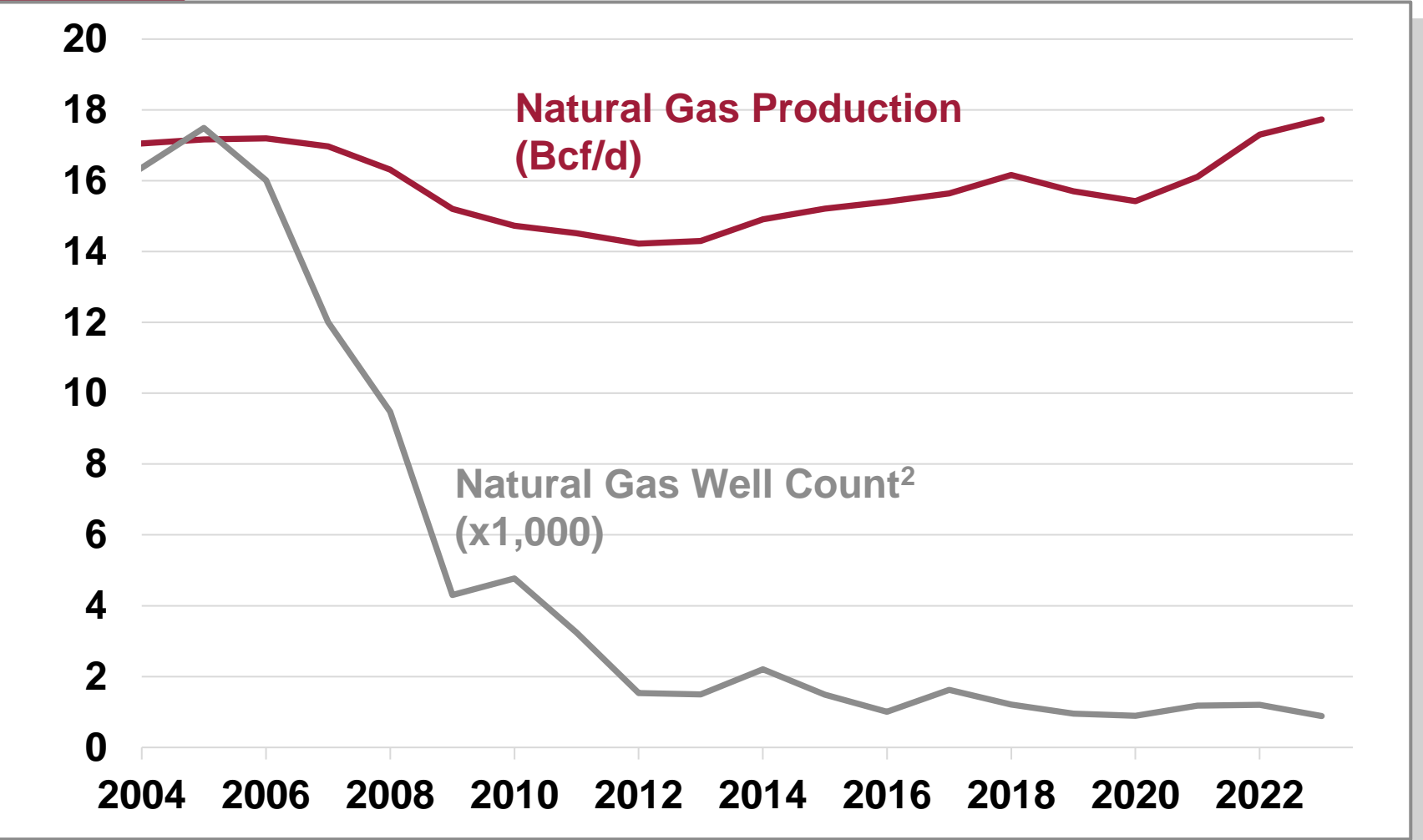
# Canadian Natural Gas Production | Annual | 2000 to 2022



- The complexion of natural gas production in Canada significantly changed following the development of shale gas in the Montney formation in 2008.
- Before this, a large portion of natural gas production in Canada came from conventional natural gas plays. Growth from the Montney and Duvernay since 2008 has helped offset natural declines from other areas. In 2022, Montney natural gas production averaged roughly 8 Bcf/d, or ~47% of Canada's total production.
- For context, as of September 2023, Canadian natural gas production was ~17.6 Bcf/d, compared to US natural gas production of ~104.5 Bcf/d over the same period.

Source: Canada Energy Regulator, Canada's Energy Future 2023, US Energy Information Administration

# Canadian Natural Gas Well Productivity | Annual | 2004 to 2023<sup>1</sup>



- Since 2004, natural gas production in Canada has remained relatively steady, growing by a modest 0.5-1.0 Bcf/d by 2023<sup>1</sup>. However, over the same period, the number of natural gas wells drilled has decreased significantly from roughly 17,500 per year in 2004 to 880 per year in 2023<sup>1</sup>.
- This trend has been driven by the proliferation of horizontal drilling and technological advancements in completions which unlocked access to unconventional reservoirs. Before 2009, most wells were vertically drilled, in stark contrast to the mid-2010s, when horizontal drilling became the norm.
- Horizontal wells, with horizontal legs often longer than 1.5 km, offer increased contact with the reservoir and are far more productive than vertical wells. This reduces the number of wells required to maintain current production levels.

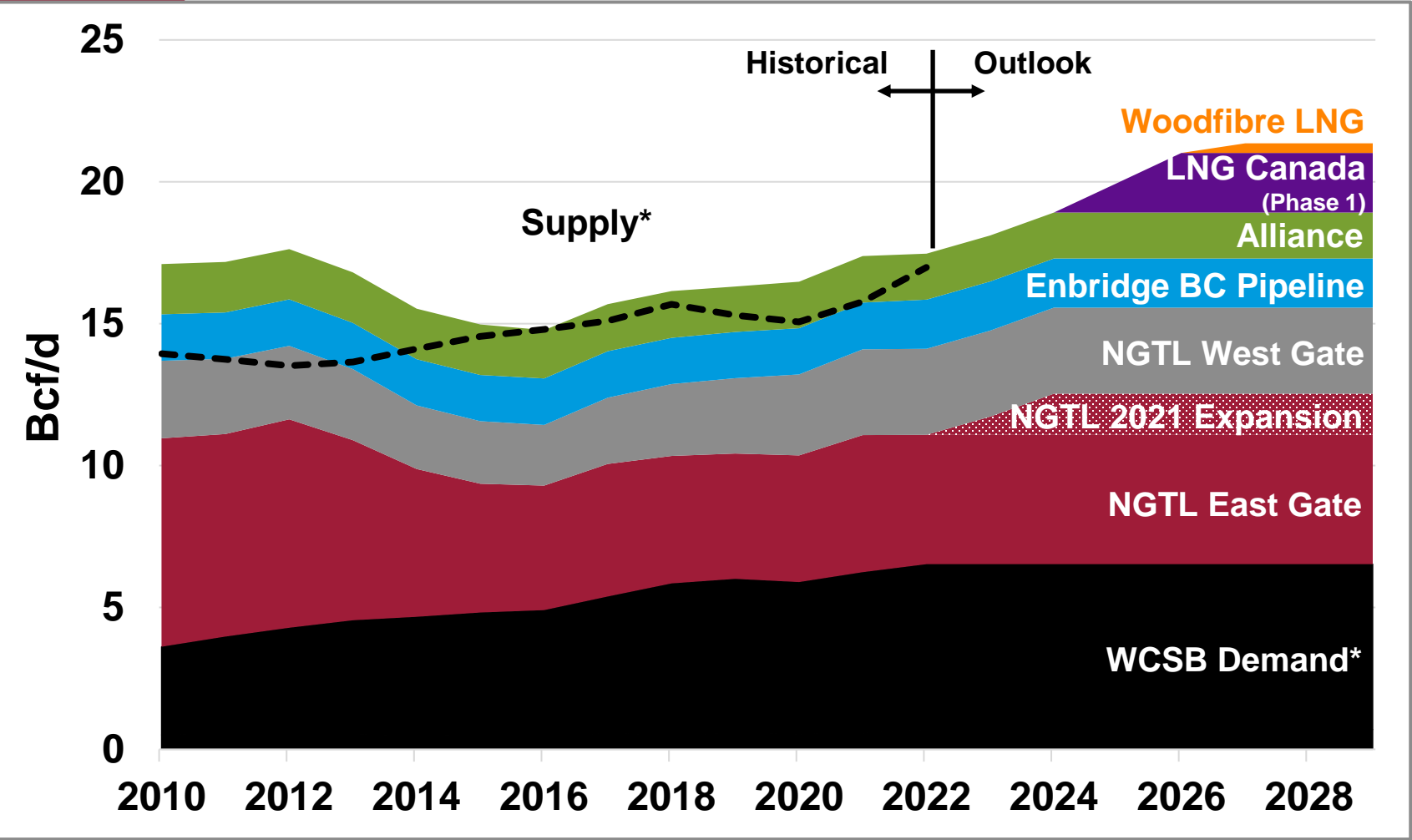
Source: Canada Energy Regulator, Daily Oil Bulletin

<sup>1</sup> 2023 data is up to September

<sup>2</sup> Well count is on a rig release basis. Includes development and exploratory wells.



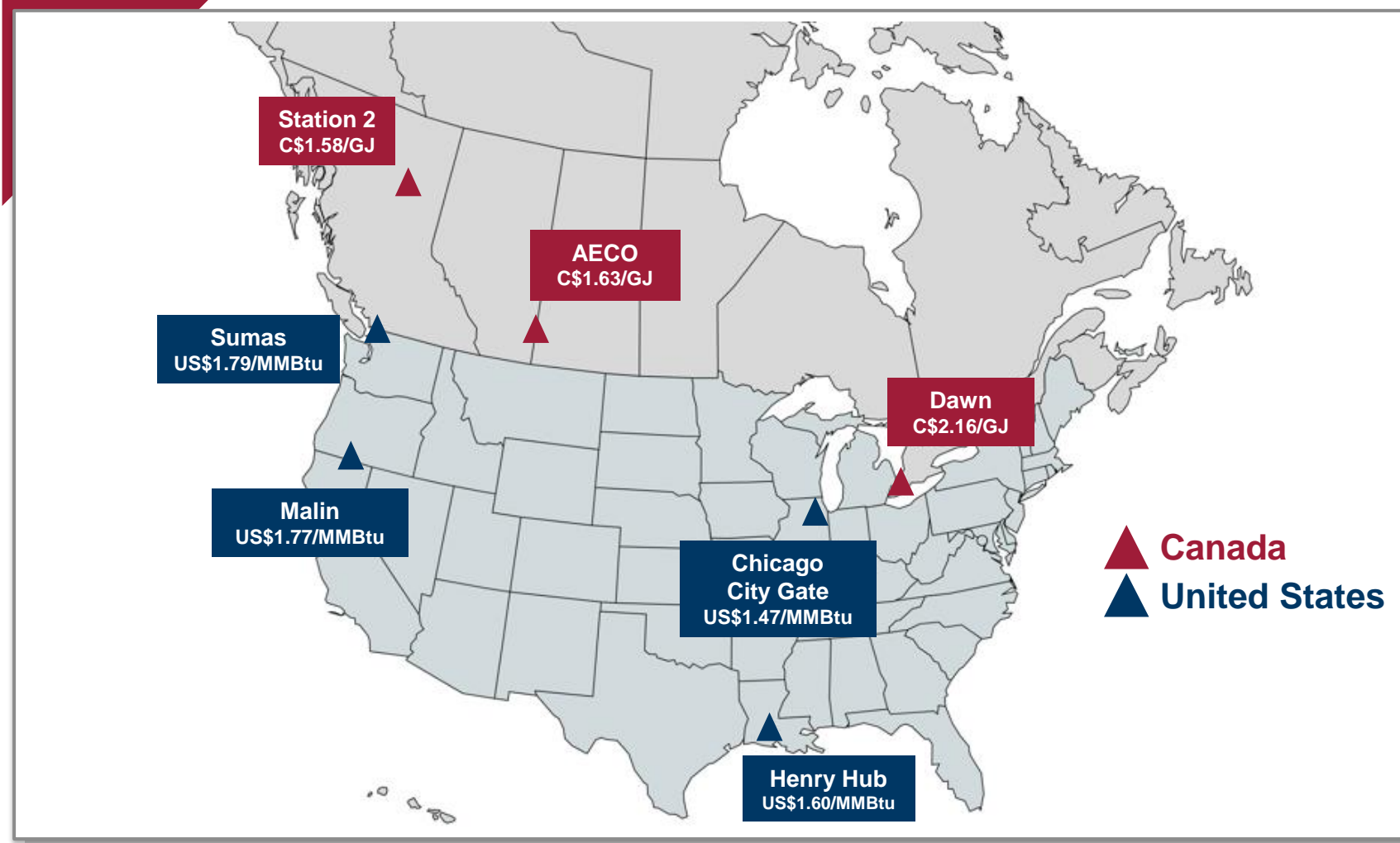
# WCSB Natural Gas Demand and Egress Capacity vs. Supply | Incl. Expected Export Capacity | Annual



- The amount of egress capacity out of the Western Canadian Sedimentary Basin (WCSB) is a critical influence on Canadian natural gas prices. Since the mid-2010s, supply has often approached export capacity, leading to volatile and discounted prices.
- However, the outlook is poised to improve as LNG Canada comes online, followed by Woodfibre LNG. Future LNG projects have yet to reach a final investment decision.
- These projects will allow Canadian gas to reach global markets and should help stabilize and narrow price differentials.

Source: Canada Energy Regulator, AER, BC Ministry of Farming, Natural Resources and Industry, LNG Canada, Woodfibre LNG  
\*WCSB supply and demand are shown for only Alberta and British Columbia, as major export capacity constraints occur west of Saskatchewan  
Outlook only shows NGTL 2021 Expansion (1.45 Bcf/d) and Post-FID LNG projects. Demand and other pipes assumed to equal 2022

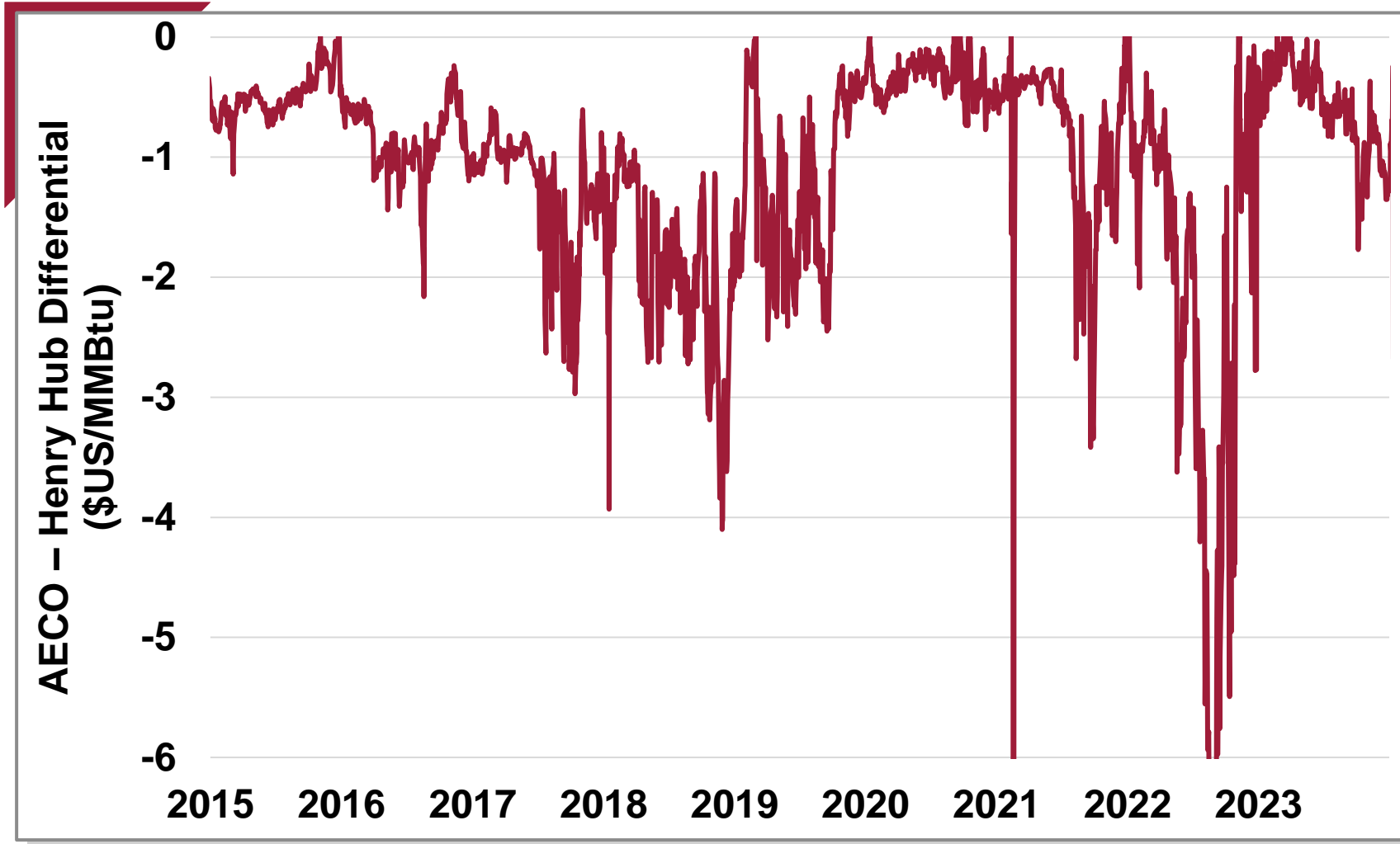
# Major North American Natural Gas Price Hubs and Daily Spot Pricing (Feb 22<sup>nd</sup>, 2024)



- There are many natural gas price hubs located throughout North America. Several factors can influence pricing at a particular hub, such as regional supply/demand, transportation costs, pipeline constraints, storage capacity, and/or weather.
- Canada's dominant pricing hub is AECO, located in Alberta. The dominant pricing hub in the US is Henry Hub.
- Other major pricing hubs in Canada include Station 2 and Dawn, while in the United States, other significant pricing hubs include Chicago City Gate, Malin, and Sumas.
- Through transportation agreements and/or hedging, natural gas producers can diversify their pricing exposure by selling at multiple pricing hubs.

Source: Canada Energy Regulator, Bloomberg, Daily Oil Bulletin

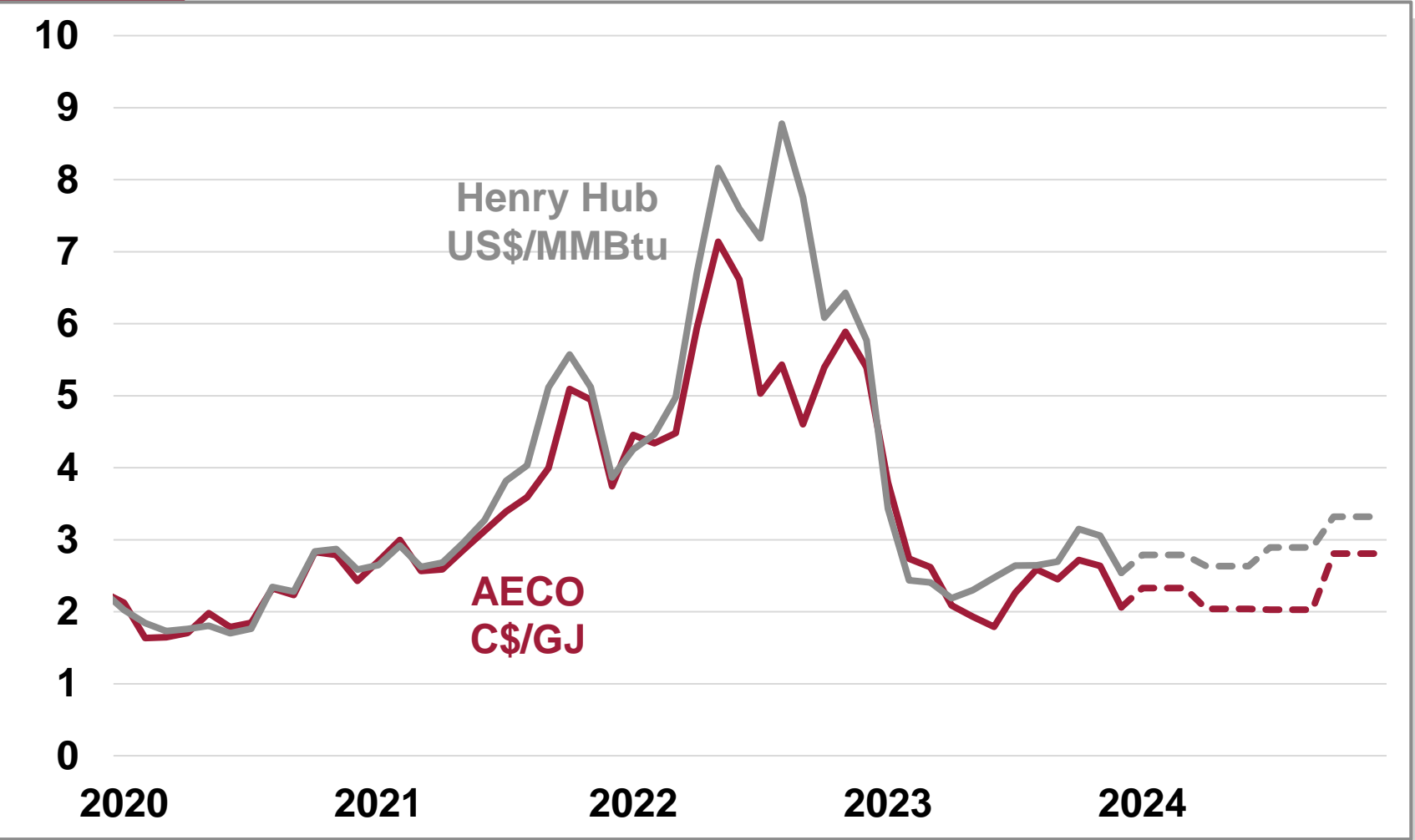
## AECO Differential | Daily Spot Price | 2015 to Dec 2023



Source: Bloomberg

- During periods of pipeline capacity constraint, price discounts at the AECO hub (Alberta's main pricing point) relative to Henry Hub grow dramatically. This is measured by the AECO differential, where a negative value indicates AECO prices are lower than Henry Hub.
- Pipeline constraints were partially driven by a shift in where natural gas is produced, as production in NW Alberta and NE BC has nearly doubled over the past 15+ years. Capacity has grown substantially, but at times, has lagged the significant supply growth.
- Since the NGTL expansion in late 2022, differentials have narrowed, while initiatives undertaken on the NGTL System to improve access to storage during curtailments also seem to be helping.

# AECO and Henry Hub Pricing | Monthly | 2020 to 2024e



- After nearly approaching C\$10/GJ in mid-2022 (in the daily spot market), AECO, in tandem with Henry Hub, has softened following a warmer-than-average winter 2022-2023 and increasing domestic supplies.
- The futures curve for AECO over the next 12 months indicates an average price of roughly C\$2.30/GJ in 2024, implying a differential to Henry Hub of ~US\$1.10/MMBtu.
- Beyond 2024, with the startup of LNG Canada, the expectation is for AECO differentials to become more stable and narrower.

Source: Bloomberg, National Bank Financial. Futures pricing as of Jan 8th, 2024.