

US Lower-48 Natural Gas Short-Term Outlook

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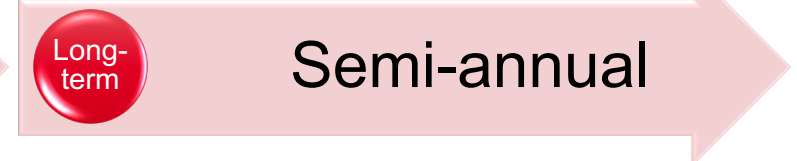
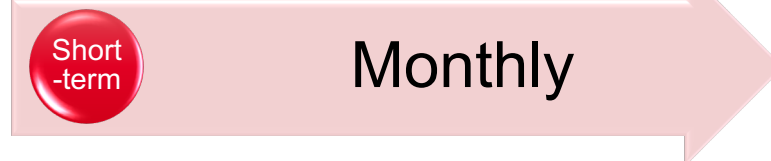


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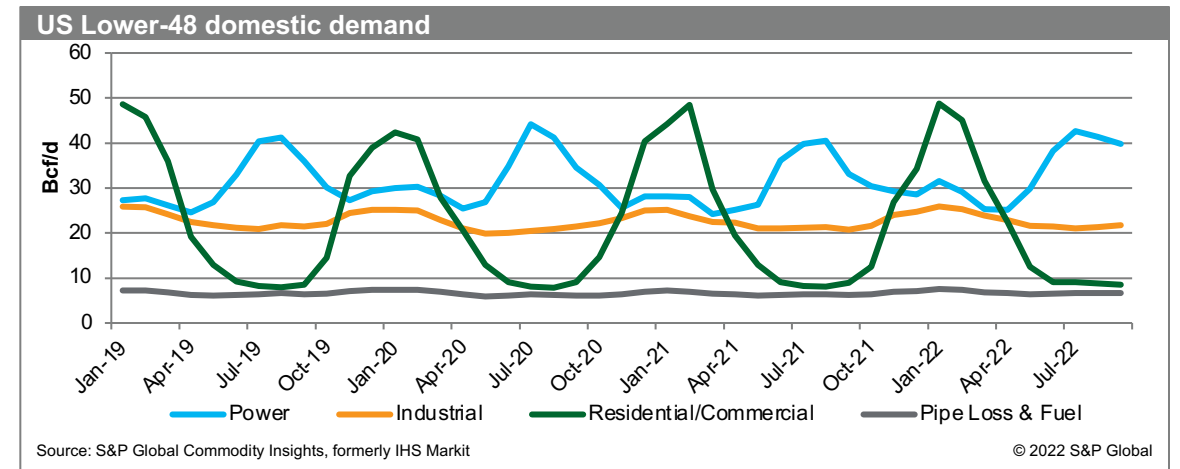
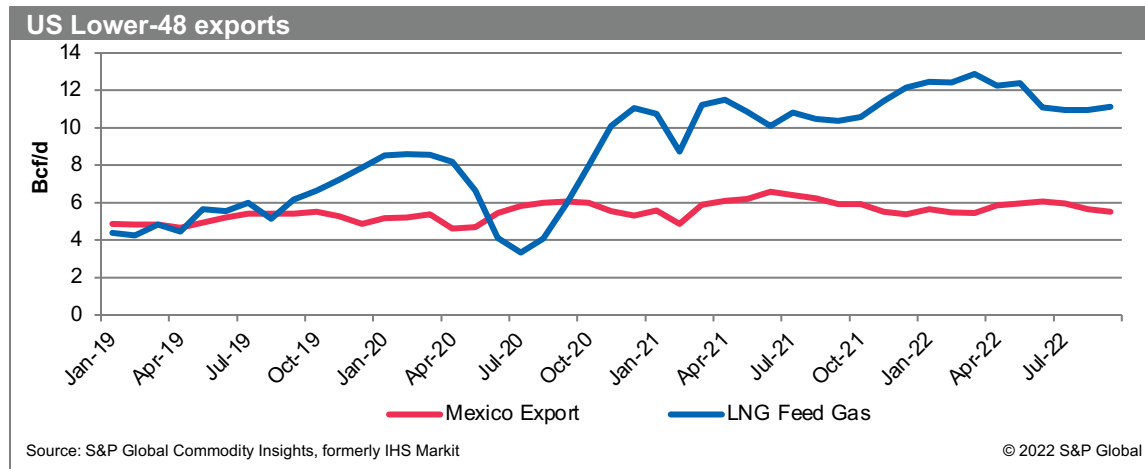
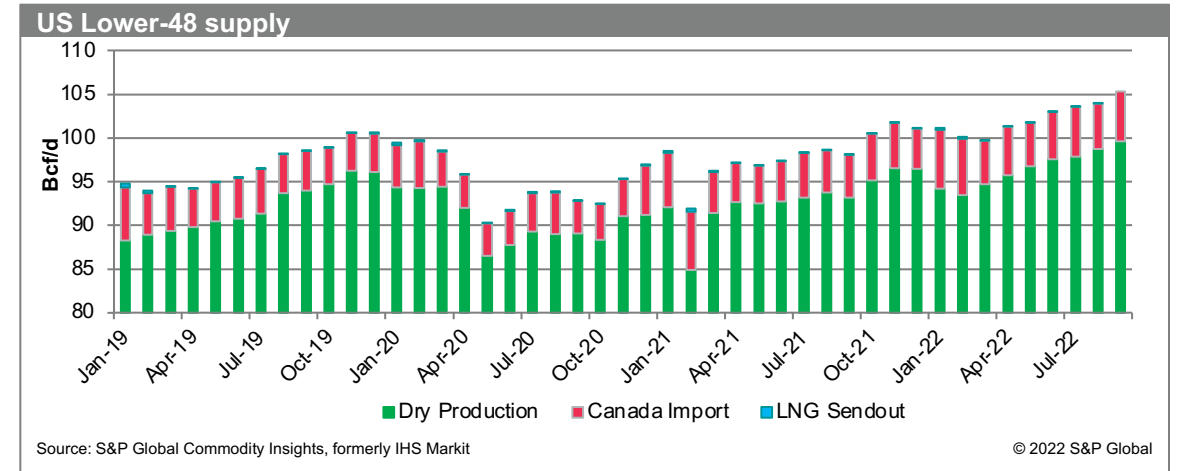
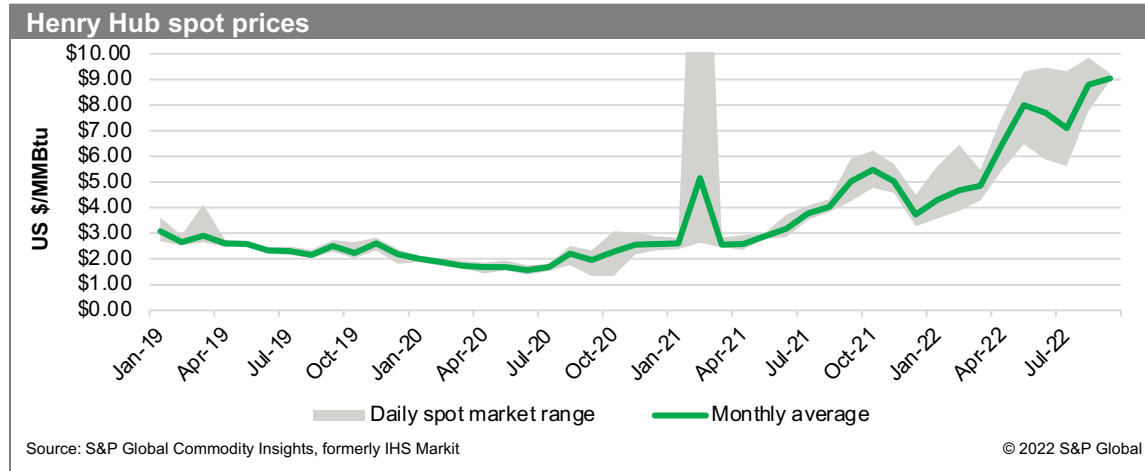


Discussion topics

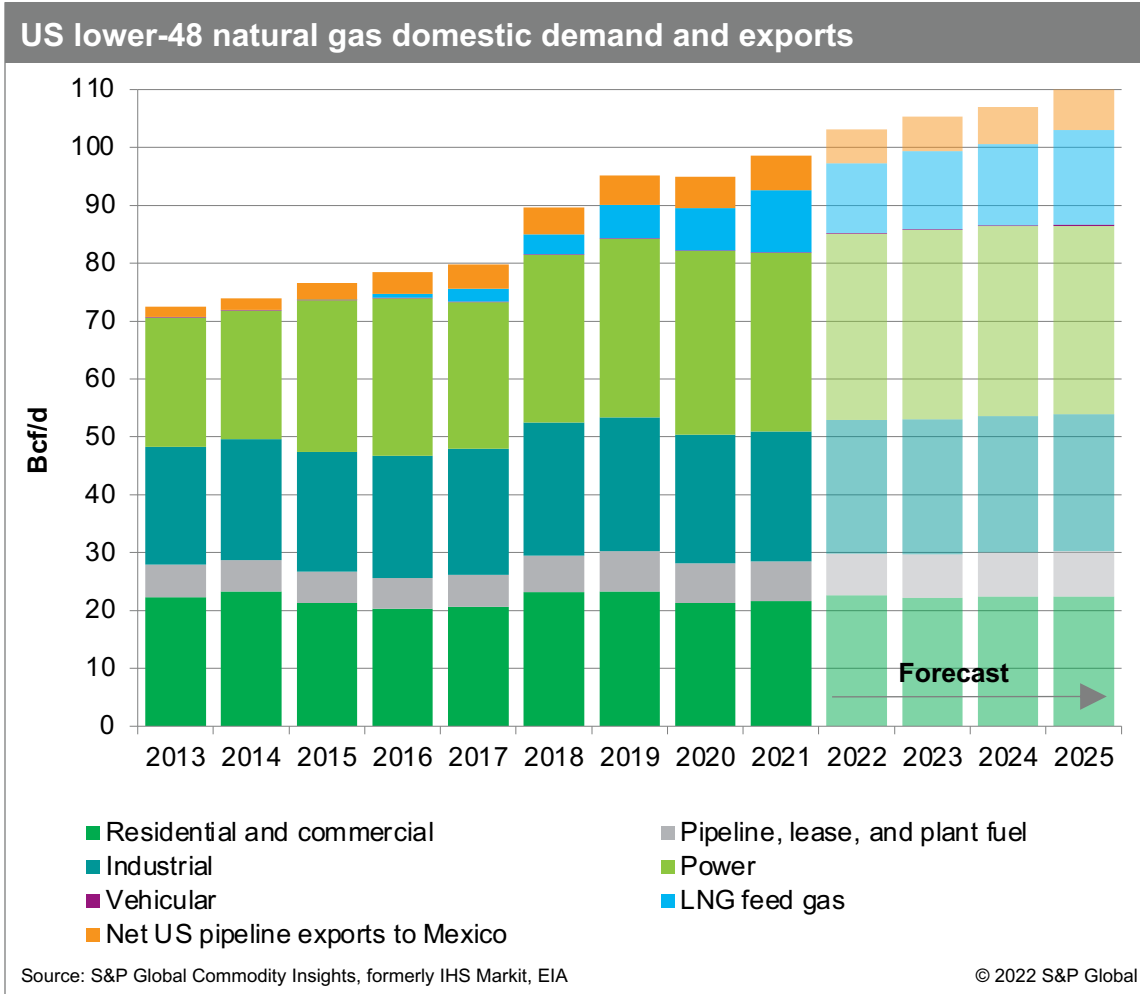
- Current state of the US natural gas market
- Focus on short-term demand drivers
 - Power market fundamentals and how they affect natural gas
 - The state of coal markets
 - Evolution of US power generation by fuel type
 - Changes within MISO-North
 - What's going with LNG exports and how much more is coming?
- Storage and Henry Hub prices

US Lower-48 gas markets have been on a 2022 rollercoaster ride

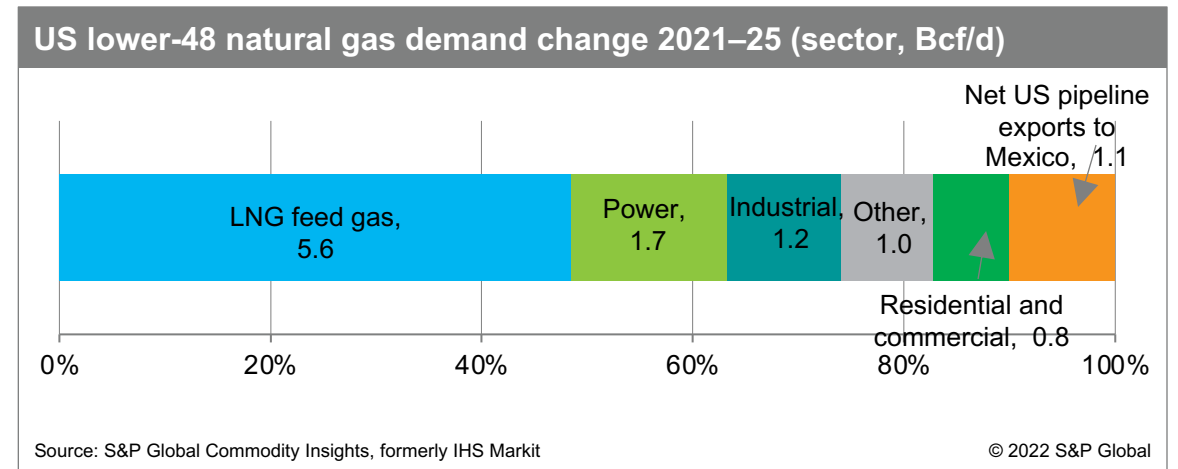
Lagging production growth, strong domestic demand post pandemic, surging LNG exports and price levels not seen in over a decade



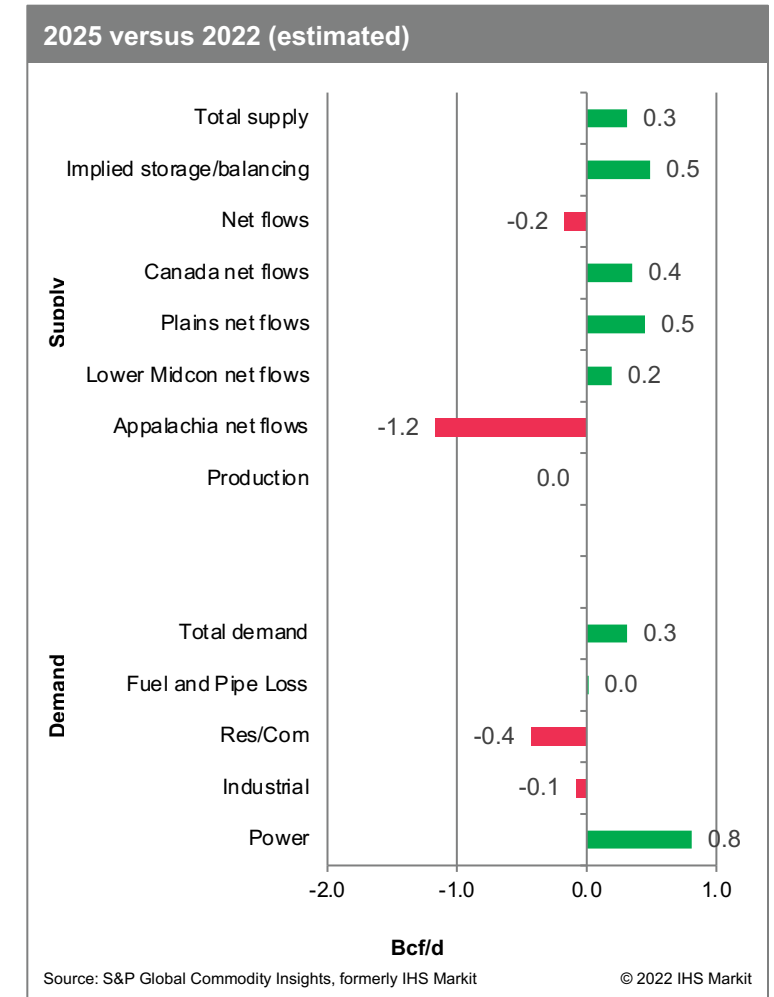
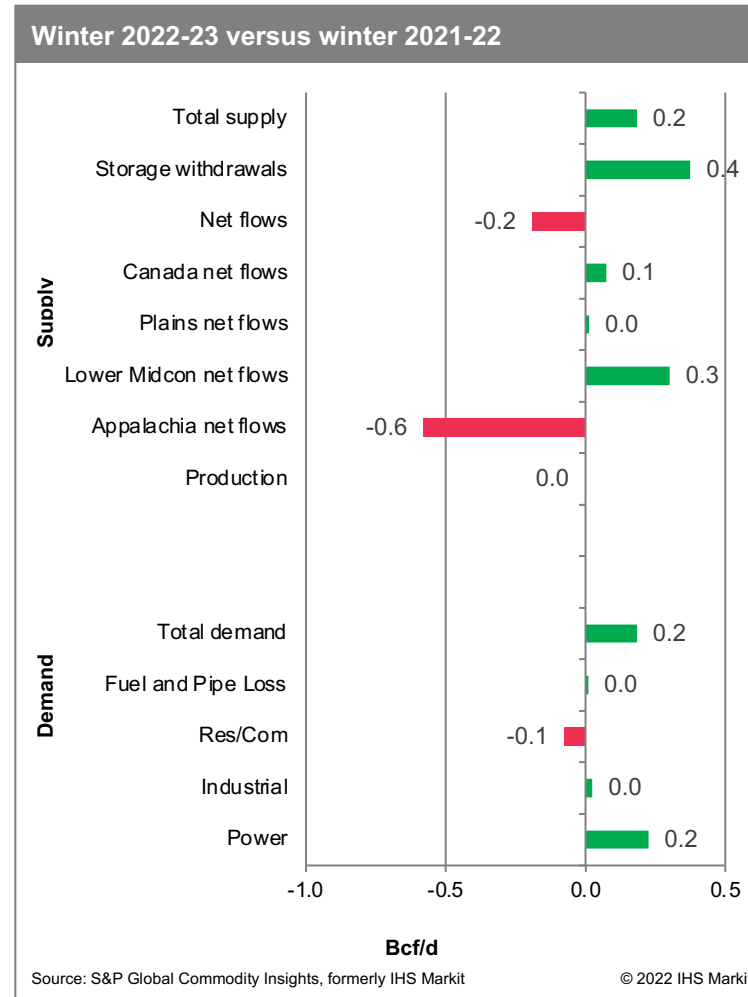
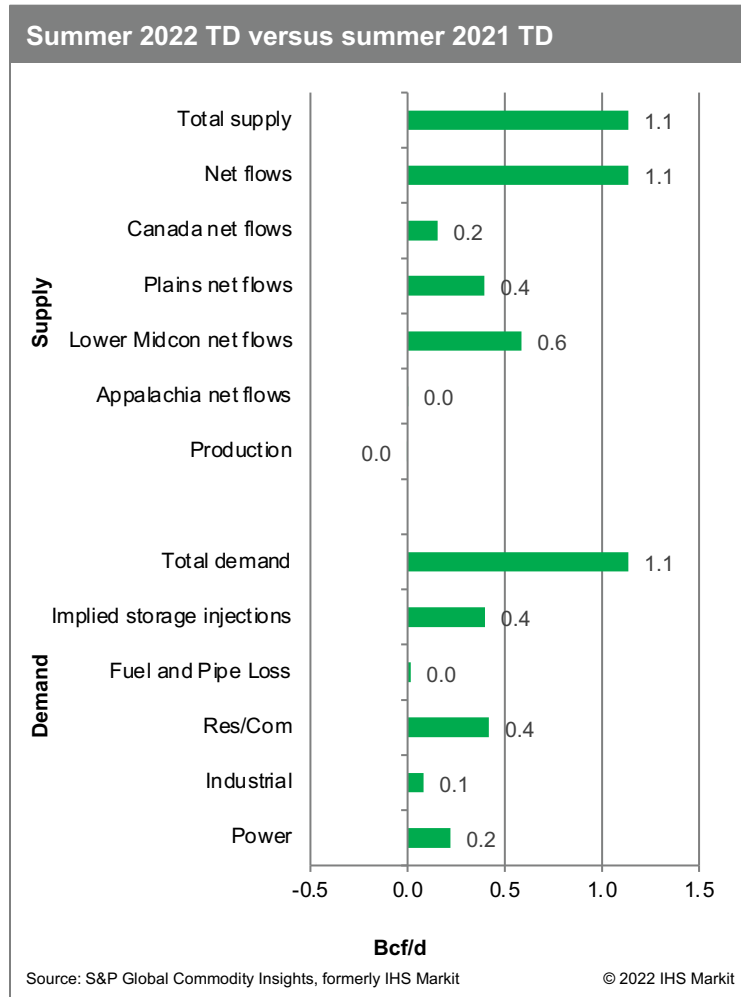
Gas demand from the power sector and LNG exports to grow through 2025



- **We expect US lower-48 demand in 2025 to be up 11.5 Bcf/d from 2021.** In 2021, total demand grew by 3.7 Bcf/d, driven primarily by LNG feed gas demand. For 2022, we expect total demand to grow by 4.6 Bcf/d, driven by LNG exports as well as from growth in the industrial, power, and residential/commercial sectors.
- **We expect nearly half of demand growth to come from exports through 2025. US LNG feed gas demand will reach a projected annual average of 16.3 Bcf/d in 2025, up 5.6 Bcf/d from the 2021 level. Exports to Mexico will be up an estimated 1.1 Bcf/d from 2021, reaching 7.0 Bcf/d, in 2025.**
- **Power sector gas demand in 2025 is expected to be up by 1.7 Bcf/d from the 2021 level.** Increasing electricity demand will increase the call on gas-fired generation, among other sources of electric generation.

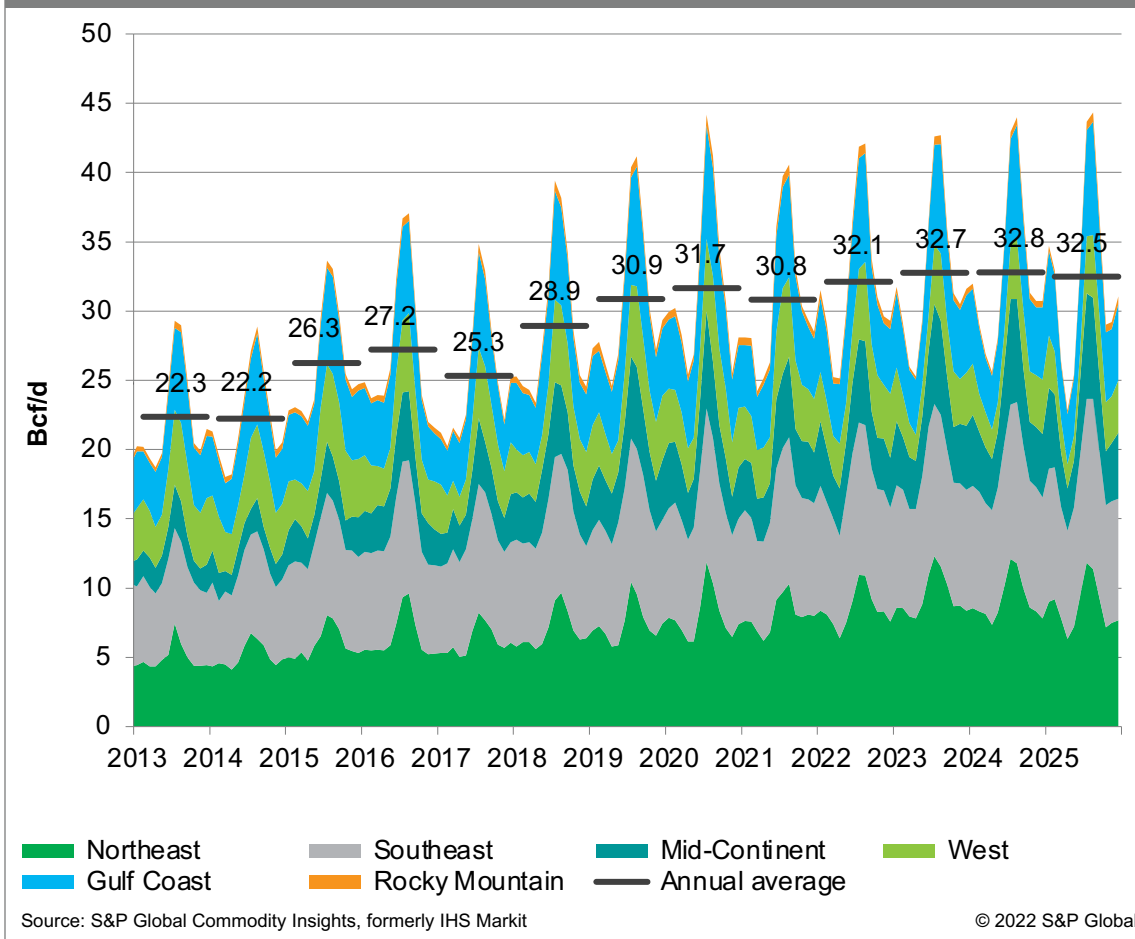


Midwest supply and demand balances evolve with growing power demand and shifts within inflowing supplies



Power sector in 2022 demand expected to top prior annual record high

US lower-48 power sector gas demand by region



US lower-48 power sector gas demand change (Bcf/d)

	2021	2025	Change*	Percent change
Northeast	8.0	8.7	0.6	8%
Southeast	8.5	9.6	1.1	13%
Mid-Continent	4.1	5.0	0.9	23%
West	4.3	3.2	-1.0	-25%
Gulf Coast	5.4	5.6	0.2	4%
Rocky Mountain	0.6	0.4	-0.1	-22%
Total	30.8	32.5	1.7	5%

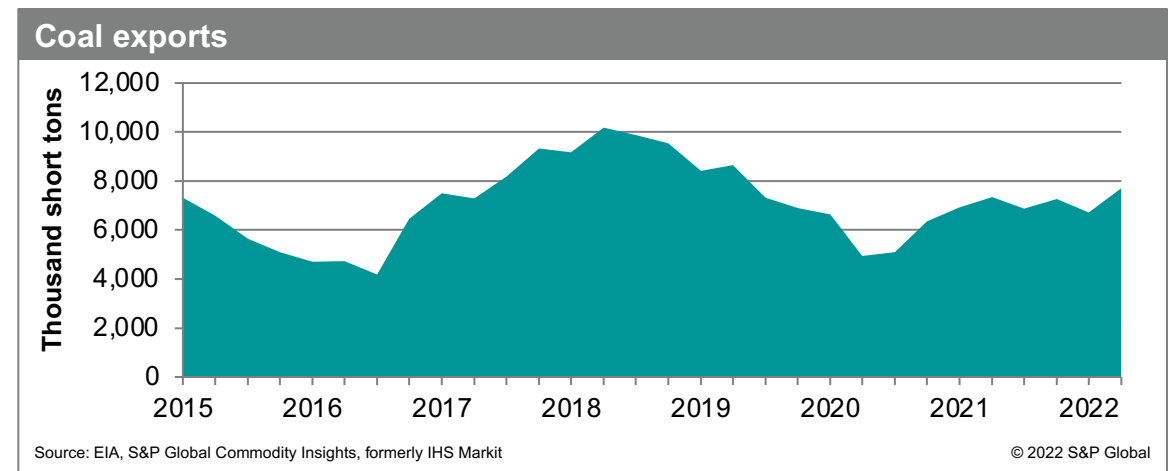
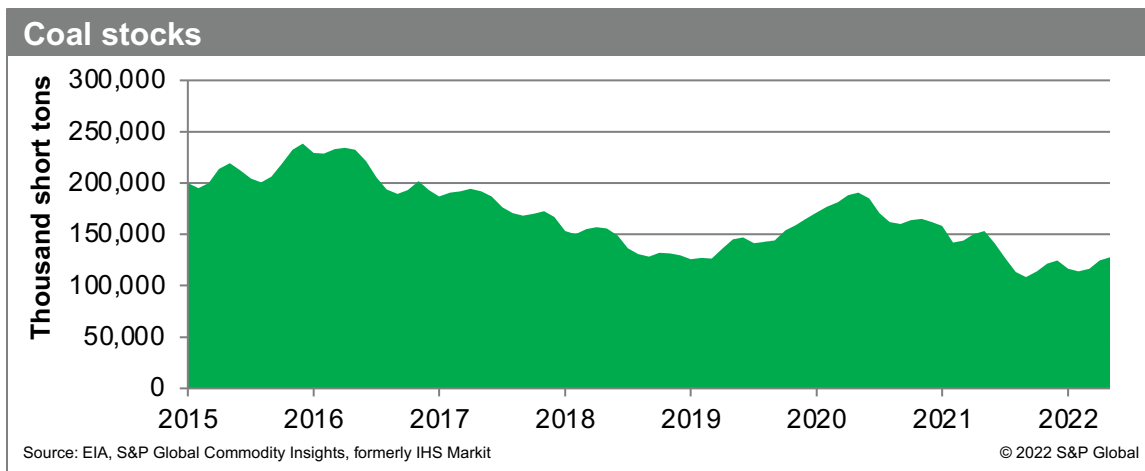
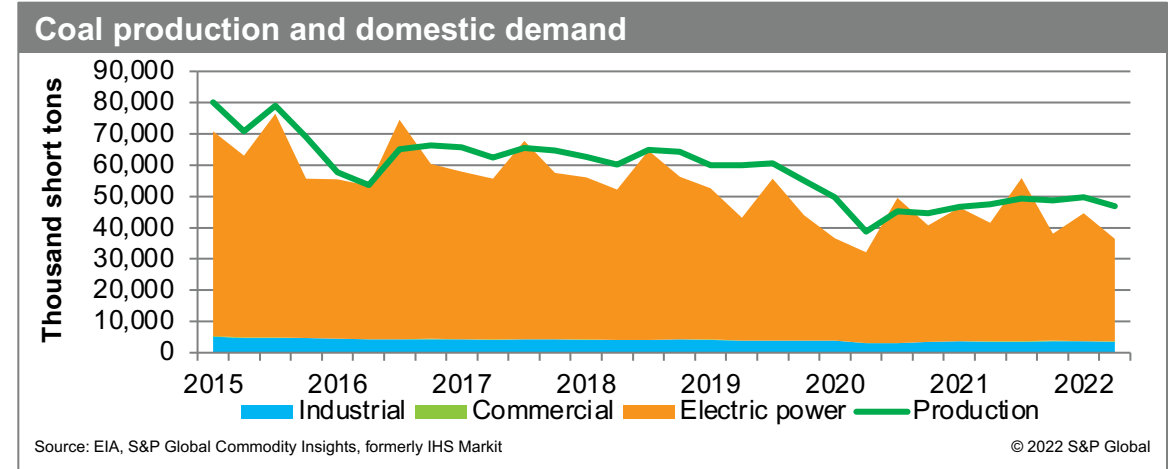
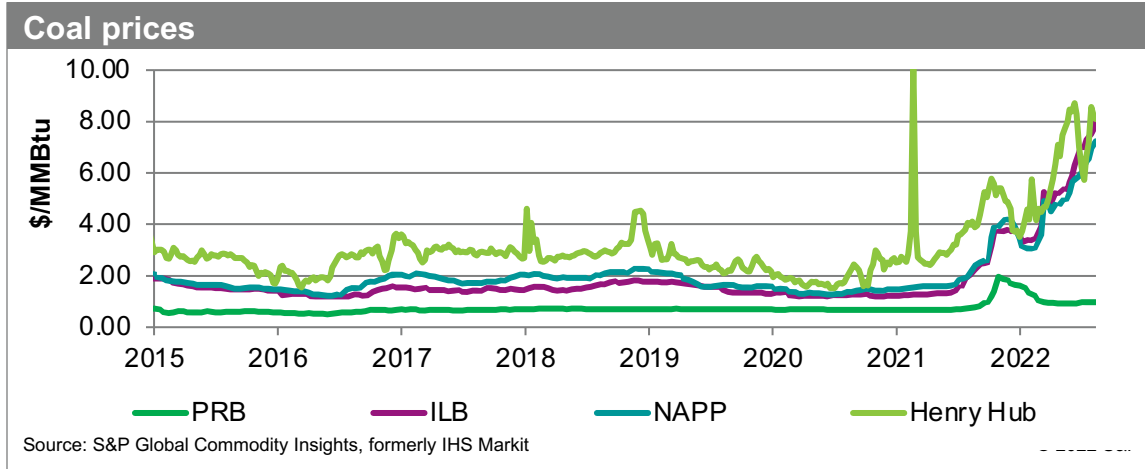
*Data shown may reflect rounding.

Source: S&P Global Commodity Insights, formerly IHS Markit

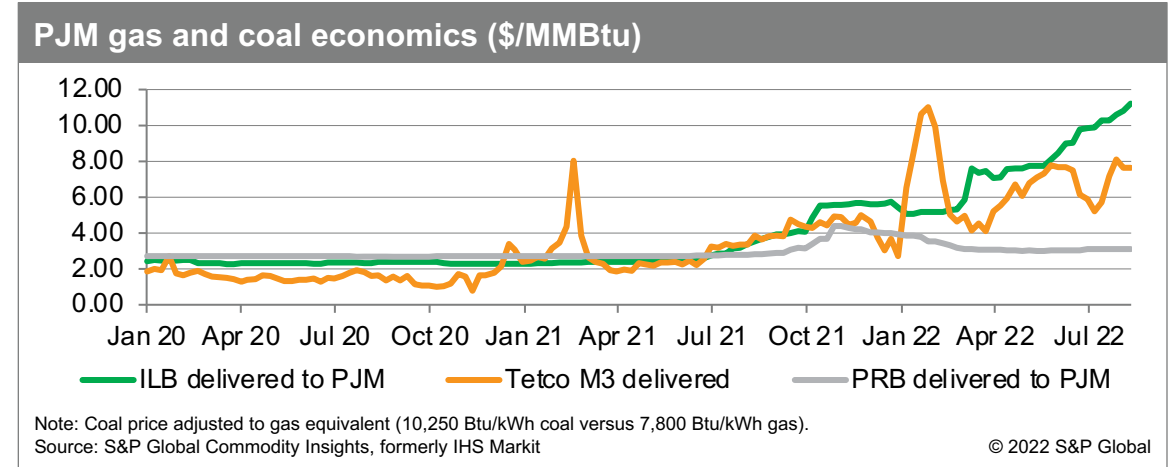
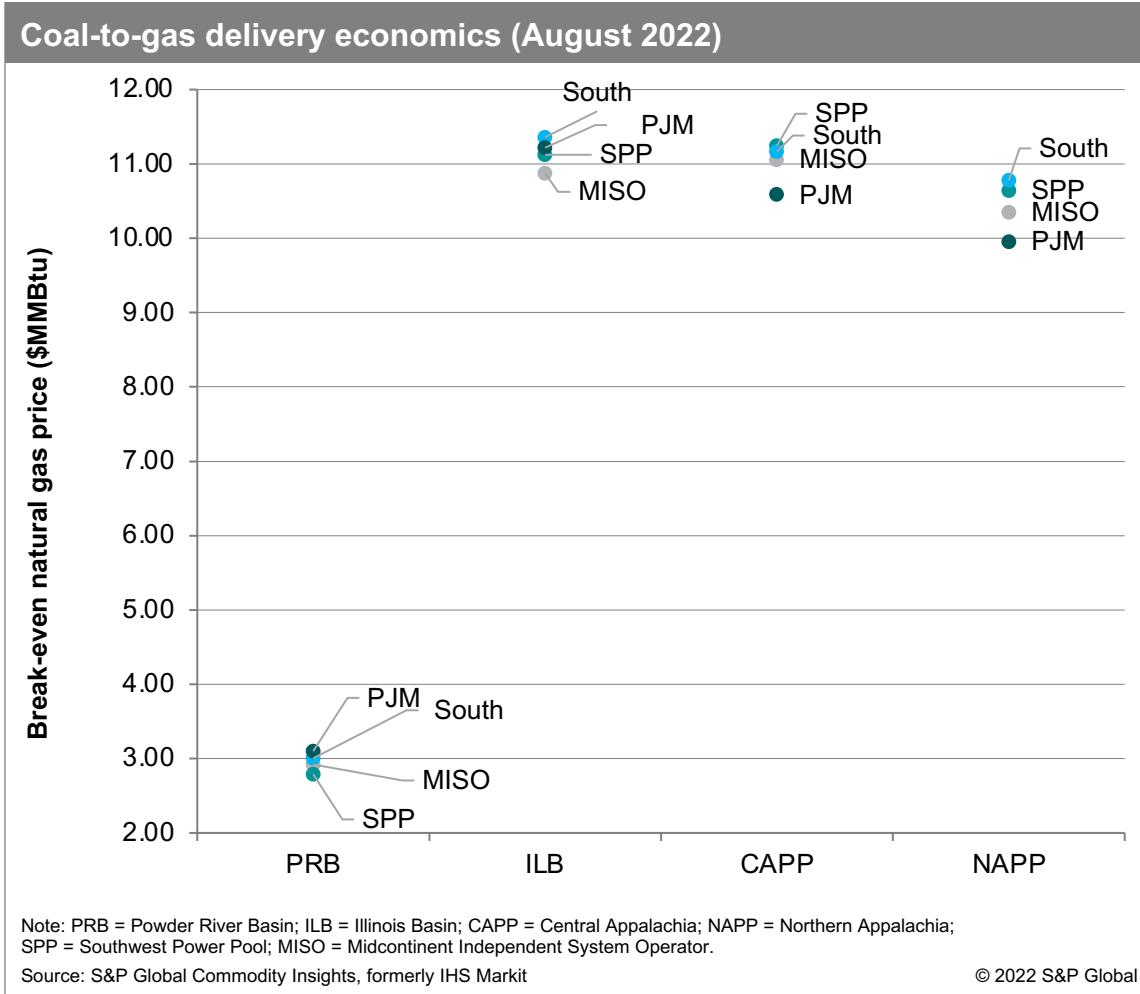
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- **The power sector has traditionally been the primary lever to bring the gas market back into balance.** However, with the coal fleet constrained by limited rail capacity, low coal stocks, and reduced mining capacity, there will continue to be little additional gas-to-coal switching available to balance the market despite rising gas prices.
- **For 2022, US power sector gas demand is expected to increase over 2021 levels.** Prices are expected to rise by \$3.15/MMBtu year on year, to an estimated average of \$6.98/MMBtu in 2022.
- **We expect annual average power sector gas burns through 2025 to grow modestly to reach an annual average of 32.5 Bcf/d** as electricity demand grows and increasingly calls upon gas, even as renewable generation continues to expand.

US coal prices rally on supply side constraints, robust exports and low storage inventories

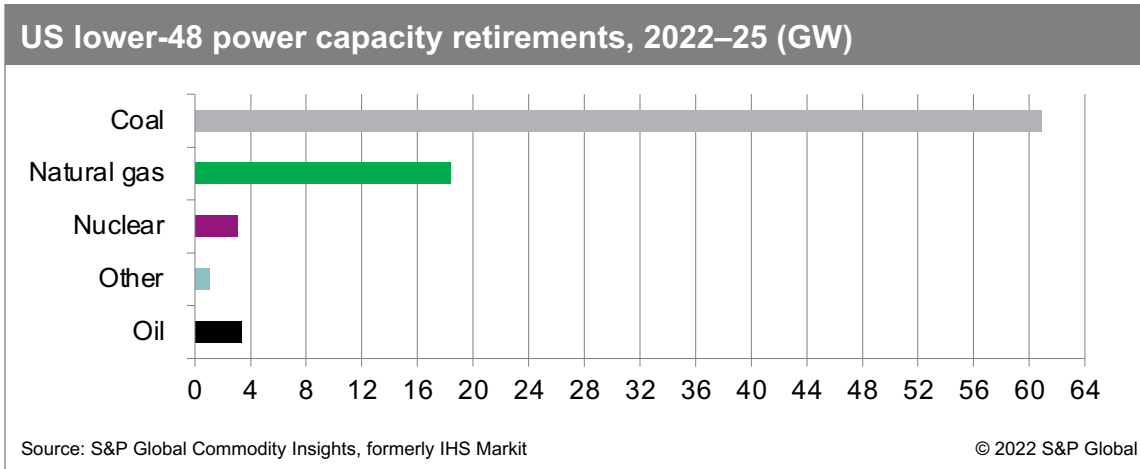


Power sector demand flexibility constrained on the upside evidenced by coal and gas prices chasing each other higher

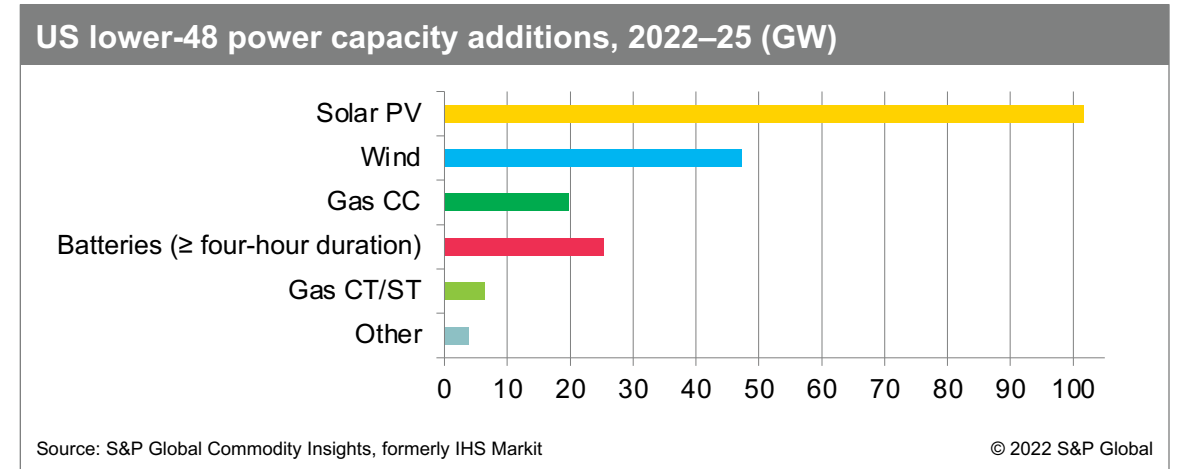


- There is limited flexibility between gas and coal in the power sector, and if the gas market needs to shed demand to help balance itself, the power sector is not an option. Rather than putting a ceiling on gas prices by offering a lower-cost fuel alternative in the power sector, coal and gas prices have risen in tandem in response to an unexpected demand surge.
- Given historically low coal stockpiles, the limited upside for incremental coal production, the accumulation of retired capacity from coal-fired power plants, and robust international coal prices keeping the pressure on exports, we believe there is limited upside potential for coal-fired power generation.

Solar and wind dominate capacity additions through 2025



- **For 2022–25, we expect nearly 95 GW of capacity to be retired across the US Lower-48 with the US coal fleet expected to dip below 156 GW from over 200 GW by 2030.** Over the past 10 years, more than 100 GW of coal retired across the US lower-48. Coal plants, which continue to struggle financially, are forecast to account for 70% of the retiring capacity during this period.
- **Retired natural gas capacity is now expected to total 18.4 GW for 2022–25, a nearly 3% increase from our prior outlook.**



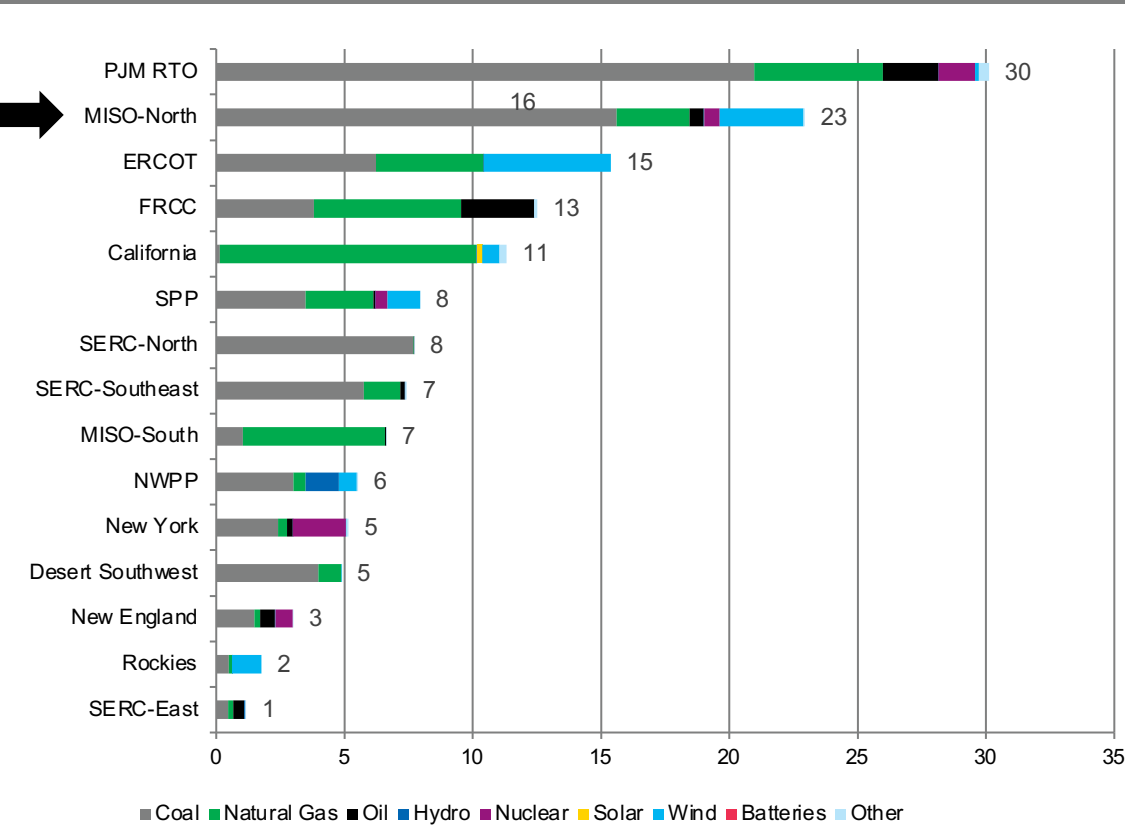
- **US power sector capacity additions are expected to average nearly 51 GW per year during 2022–25.**
- **Installed solar PV capacity should more than double from 2018 to 2022 as developers race to take advantage of the availability of the full investment tax credit through 2024.** Grid-facing solar PV additions are on pace to exceed 16 GW in 2022. Last year, the US power sector added about 13.5 GW of solar PV.
- **The gradual phaseout of the production tax credit slowed wind development beginning in 2021.** Despite a strong start to the year with over 4.5 GW of onshore wind capacity completed through April 2022, the industry is expected to add a total of about 10 GW in 2022 and just under 10 GW in 2023.

US retired 77 GW of coal during 2015-25, another 61 GW is expected by 2025

Past

Future

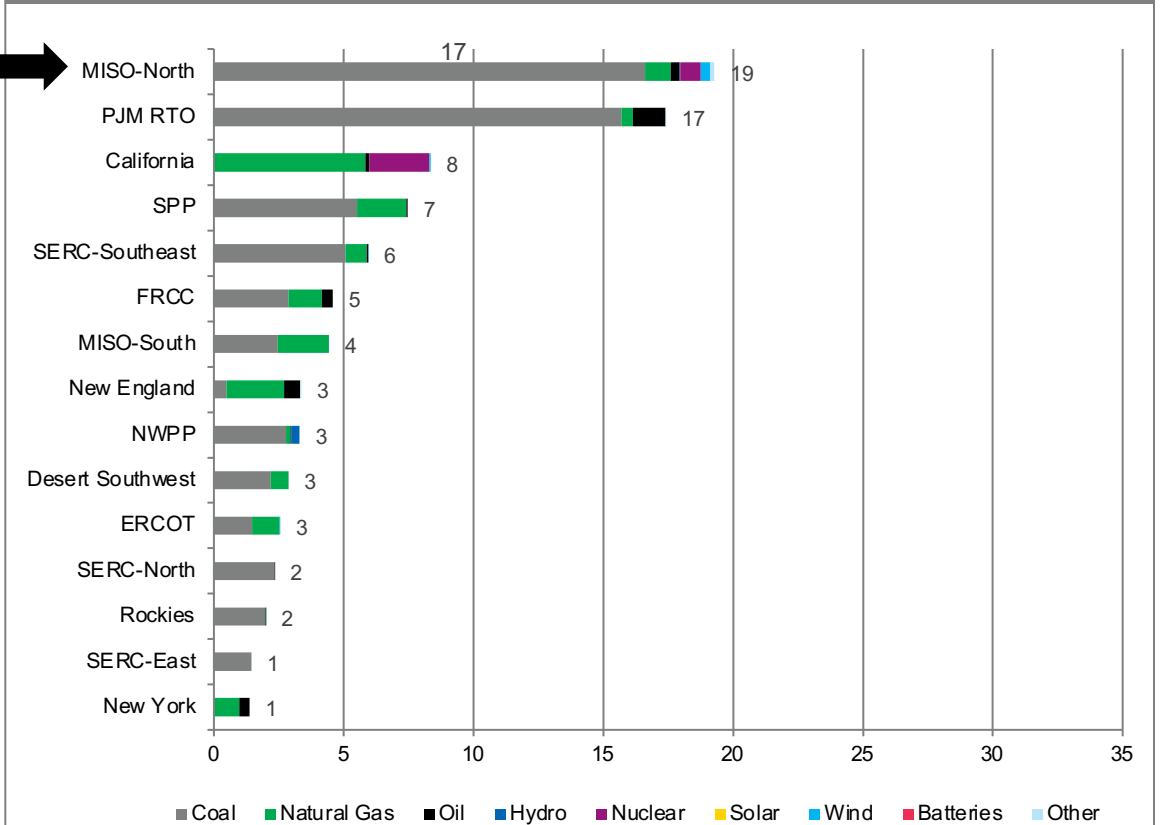
Capacity retirements by region 2015-21 (GW)



Source: S&P Global Commodity Insights, formerly IHS Markit

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Capacity retirements by region 2022-25 (GW)



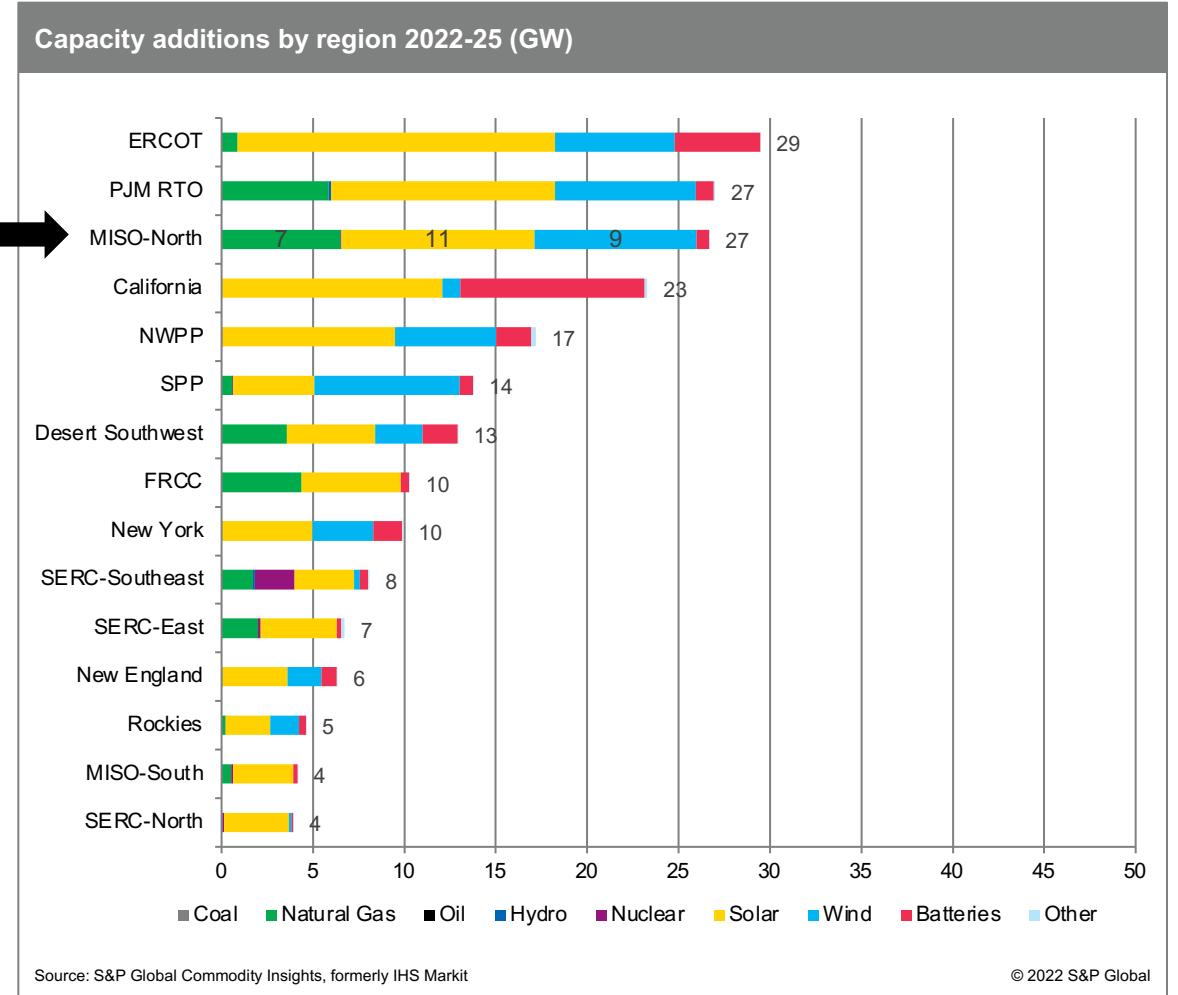
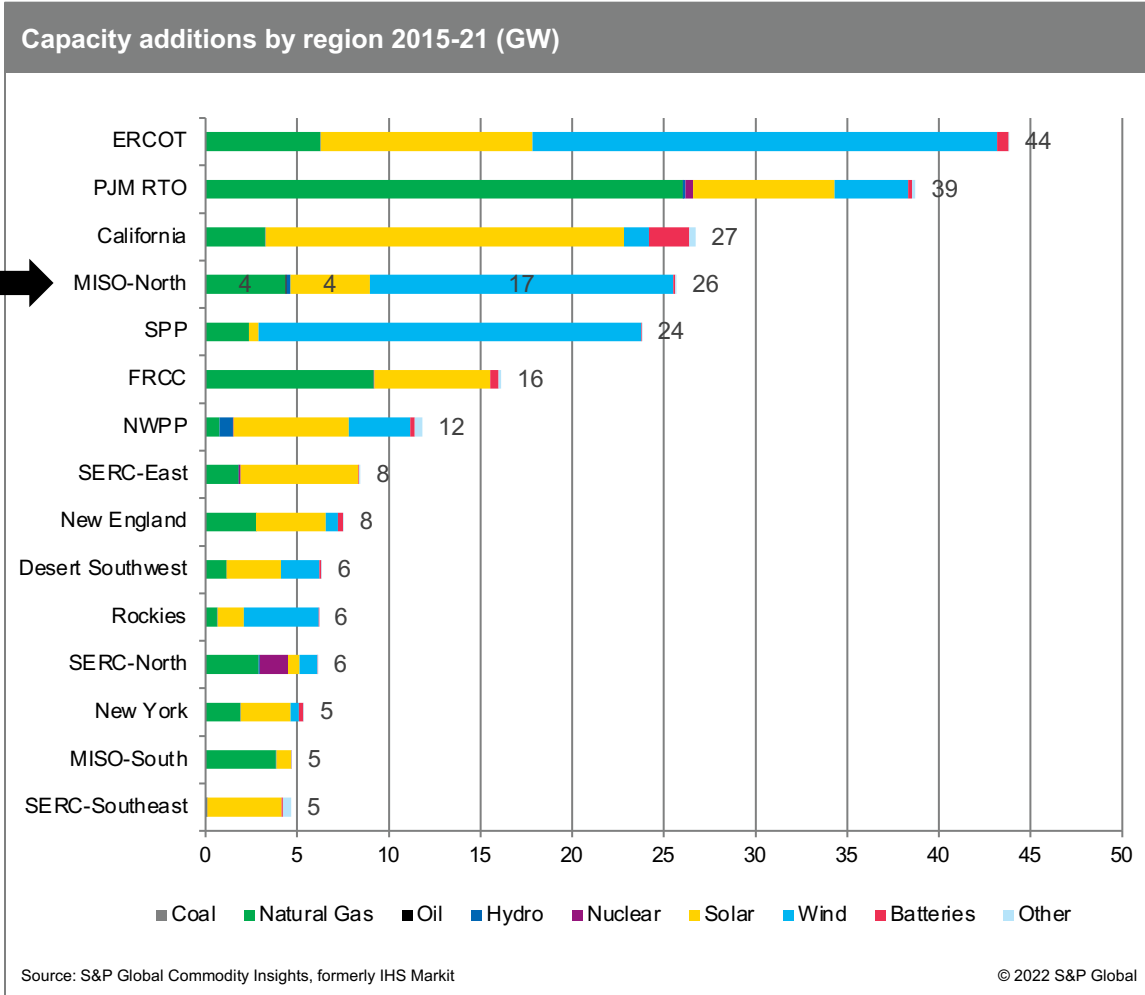
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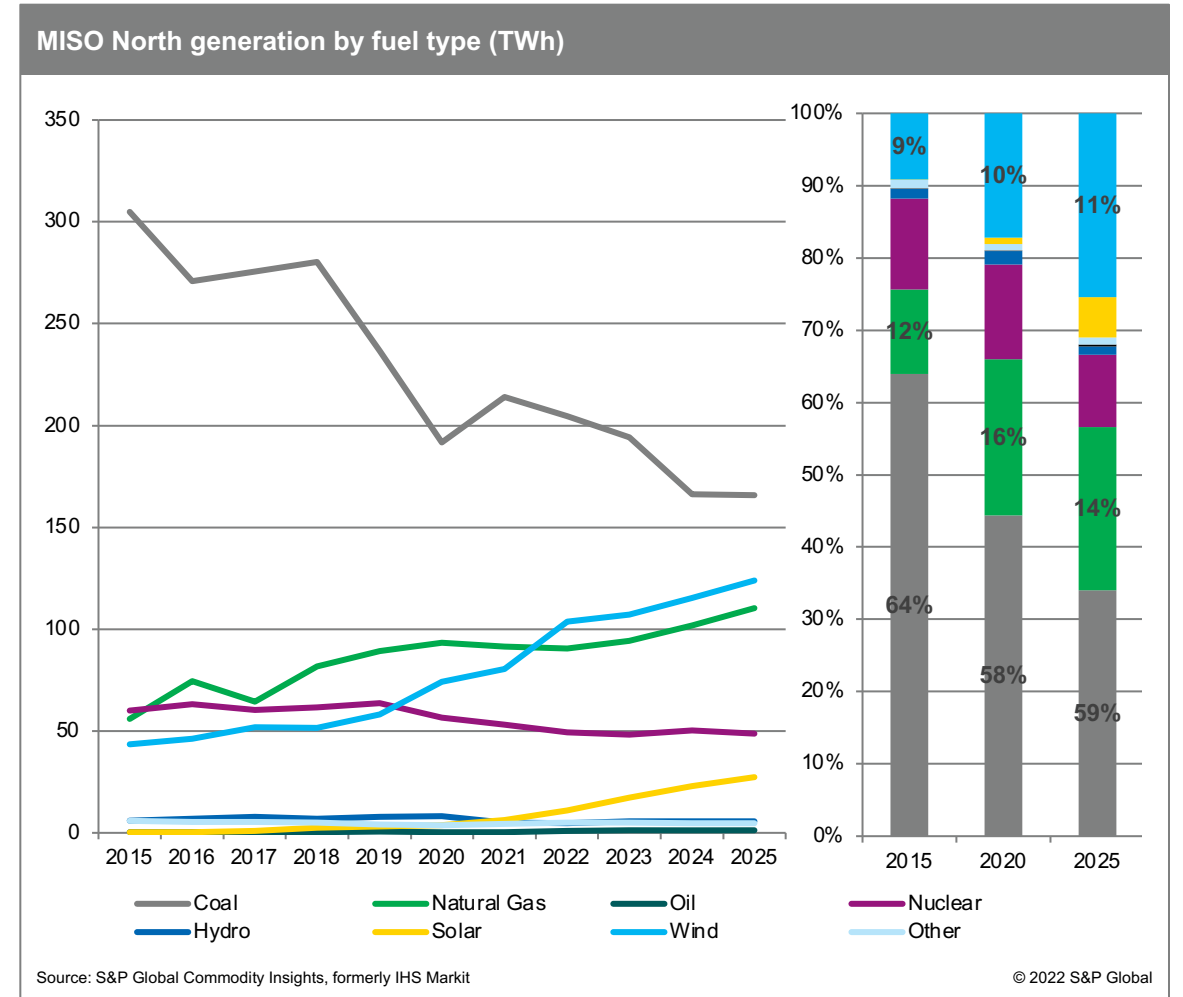
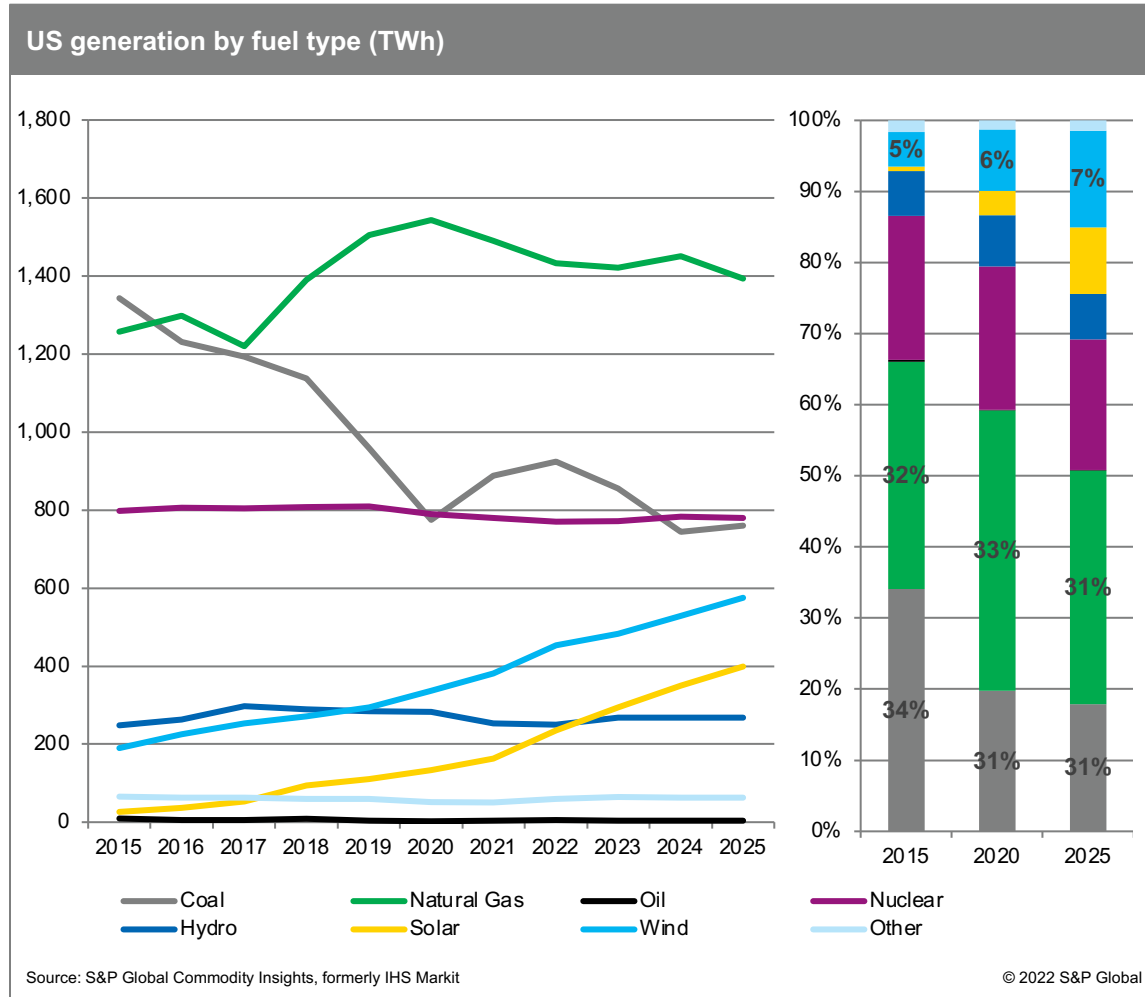
The buildout of renewables continues to accelerate and claim market share

Past

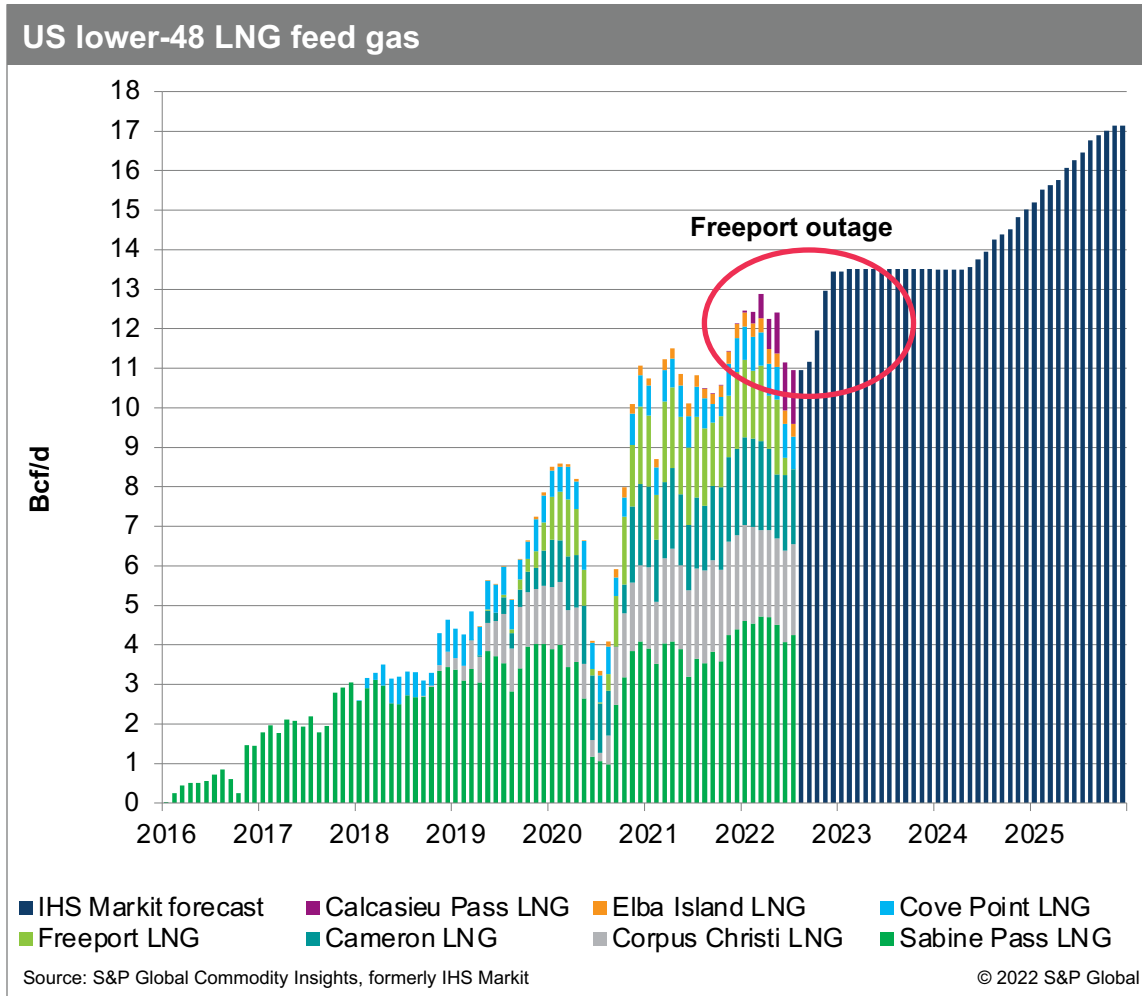
Future



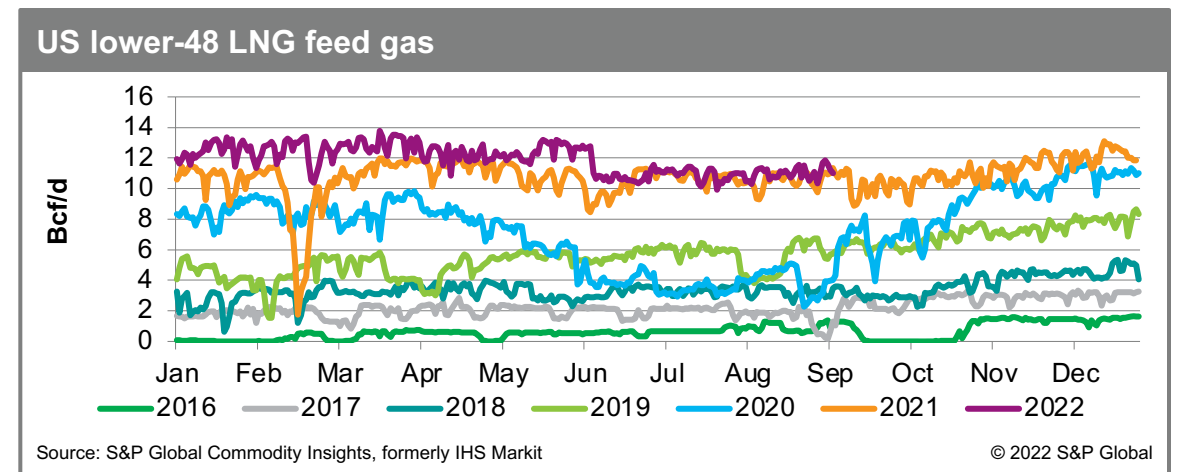
The evolution of MISO North's generation stack partly contrasts the US story, market pressures on the remaining natural gas fleet are likely to intensify



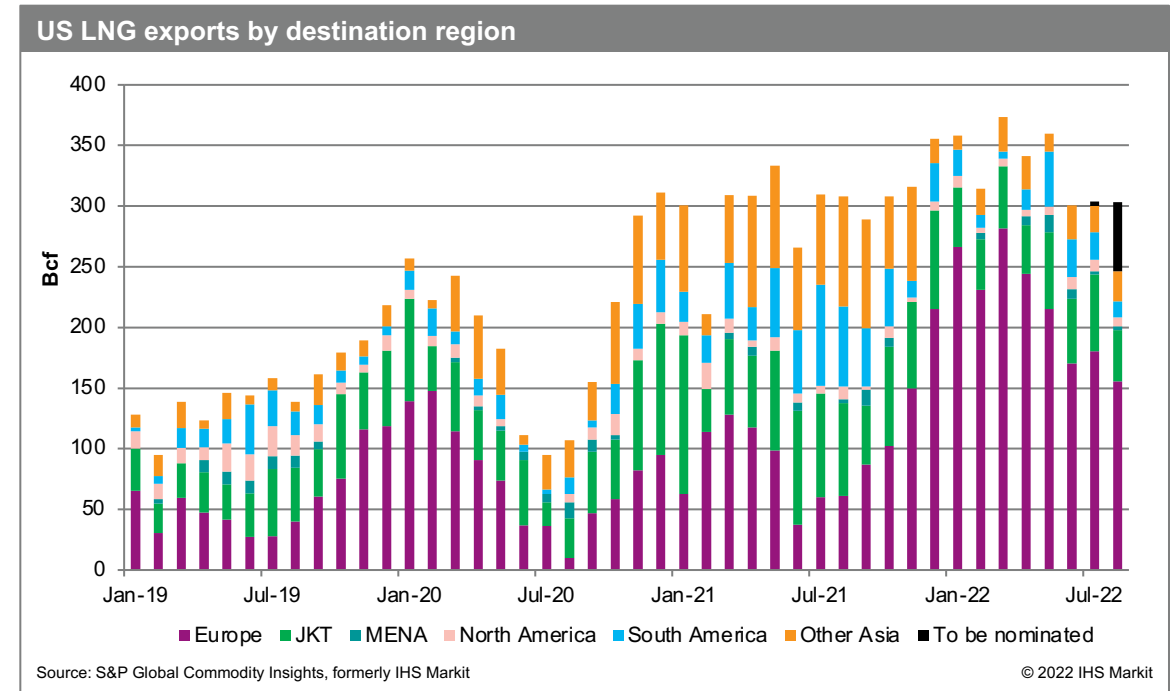
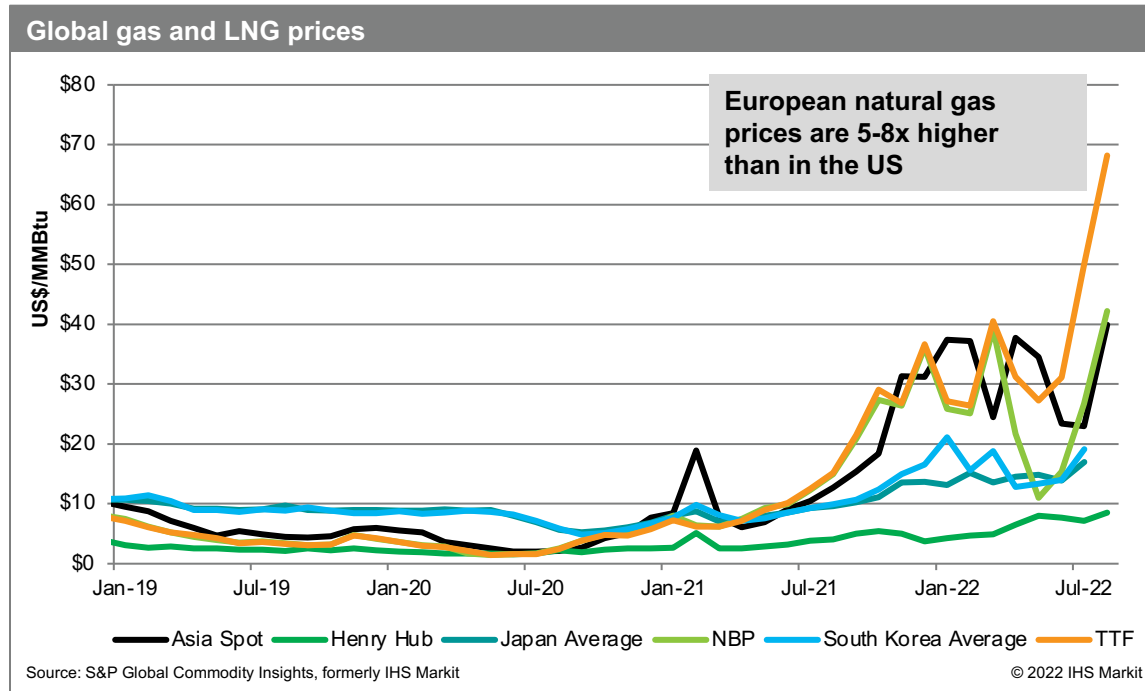
US LNG exports expected to increase significantly in 2024–25



- **We expect LNG feed gas demand this summer to be up 0.9 Bcf/d from last summer's average level.** An incident at Freeport LNG has resulted in a shutdown of the facility for at least 90 days, with approximately 2.0 Bcf/d of feed gas suspended. Partial operations could commence in October.
- Golden Pass LNG is expected to begin commercial operations in 2024 and ramp up through 2025, and Plaquemines LNG is expected to begin commercial operations in 2025.
- LNG feed gas demand is expected to average 12.1 Bcf/d in 2022, 13.5 Bcf/d in 2023, 14.0 Bcf/d in 2024, and 16.3 Bcf/d in 2025.
- **There is limited upside in the short term for additional LNG exports to Europe; however, the current crisis is expected to accelerate FIDs, leading to significant LNG export growth between 2025 and 2030.**



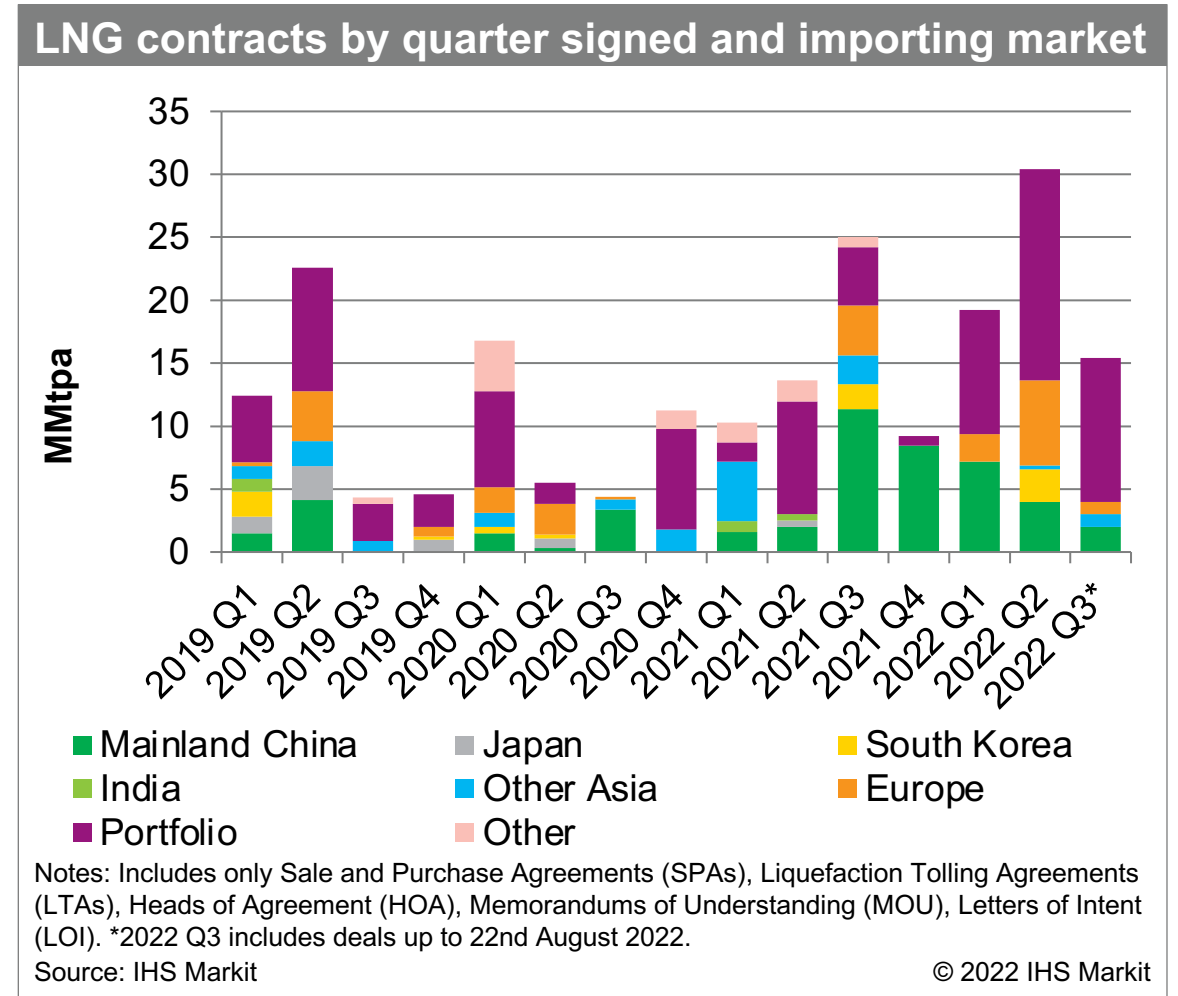
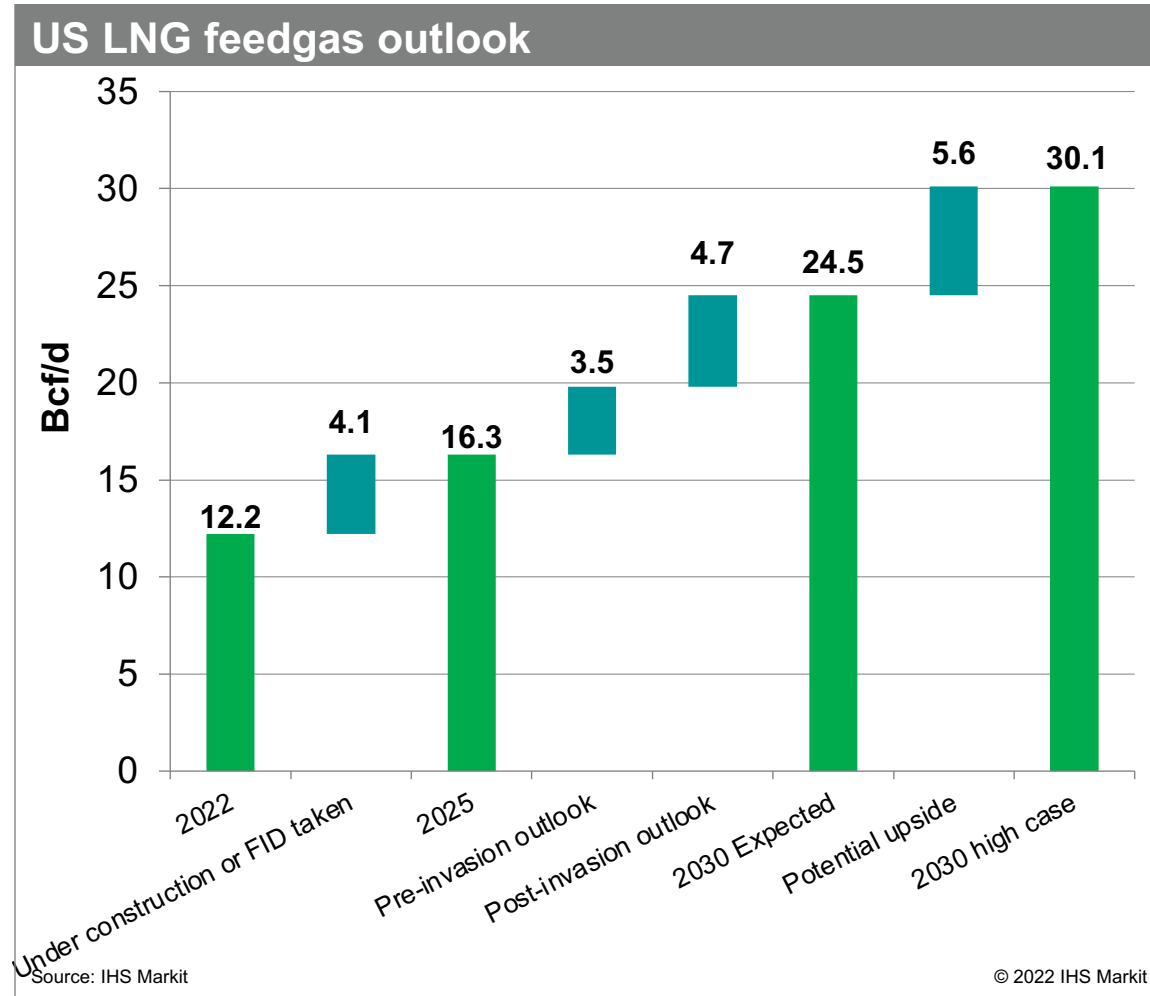
Rising US LNG exports have quickly cemented the importance of US shale supplies across the globe



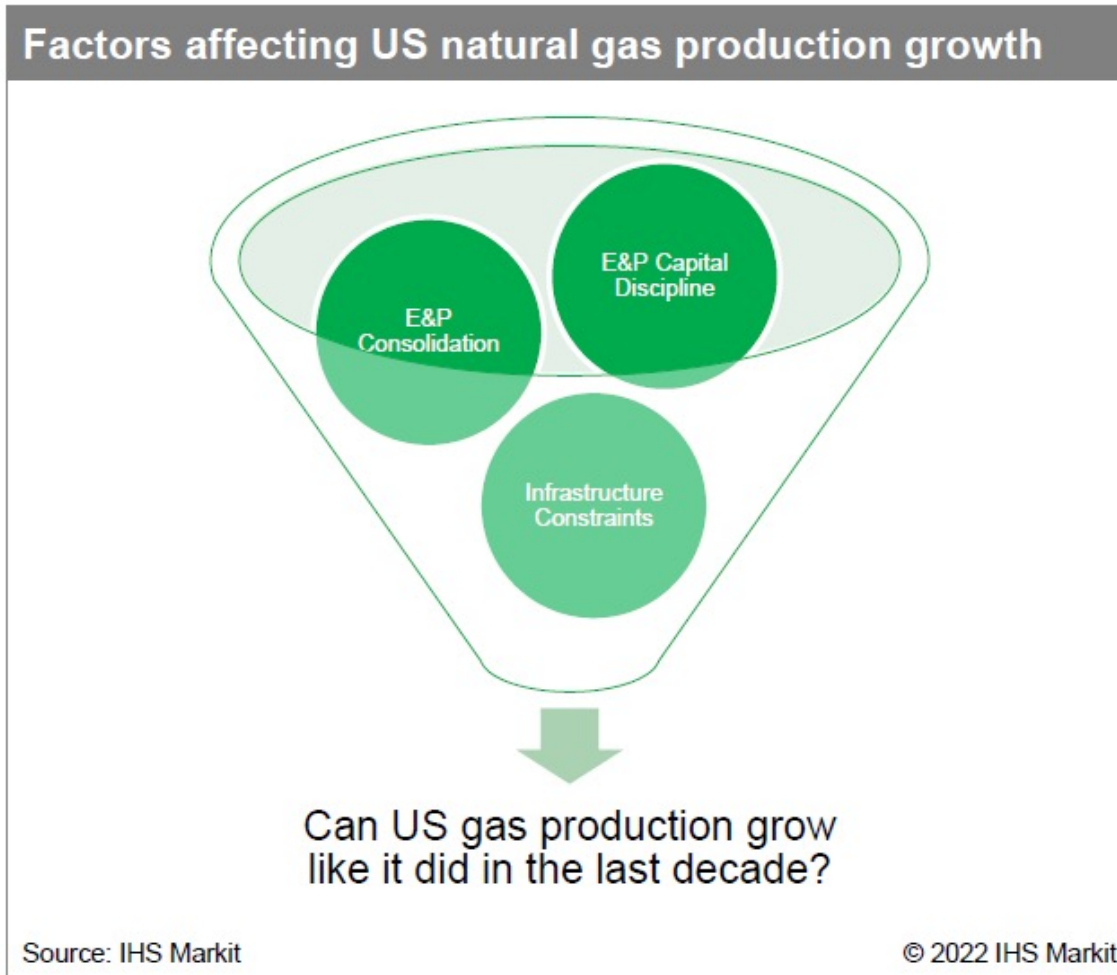
- Global gas markets have been running tight for over a year as evident in the run-up in natural gas and LNG prices. April-August 2022 prices effectively doubled year-over-year at Henry Hub, Japan and the UK's National Balancing Point. Prices have nearly tripled in Asia and quadrupled in Europe.
- For 2022 to date, the United States accounts for 20% of global LNG exports, doubling its 10% share in 2019 and approximately matching the market shares of Qatar and Australia. These three markets remain the top three LNG suppliers by volume.
- Cargoes going to Europe account for 60% of all US LNG exports (April-August 2022) compared to only 24% in the same period last year. Conversely, Asian bound cargoes have declined from 53% of all US LNG exports to 24%.

Post-invasion outlook for US LNG significantly higher

Increase in LNG supply contracting over past 12 months, driven by mostly by Asia Pacific with Europe starting to sign in 2022 too

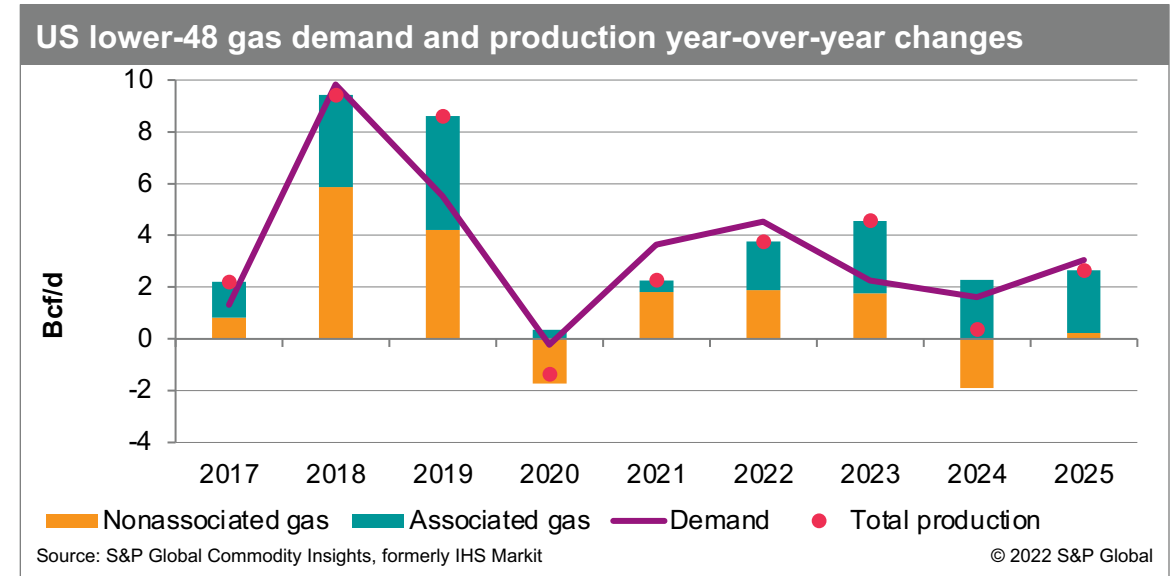
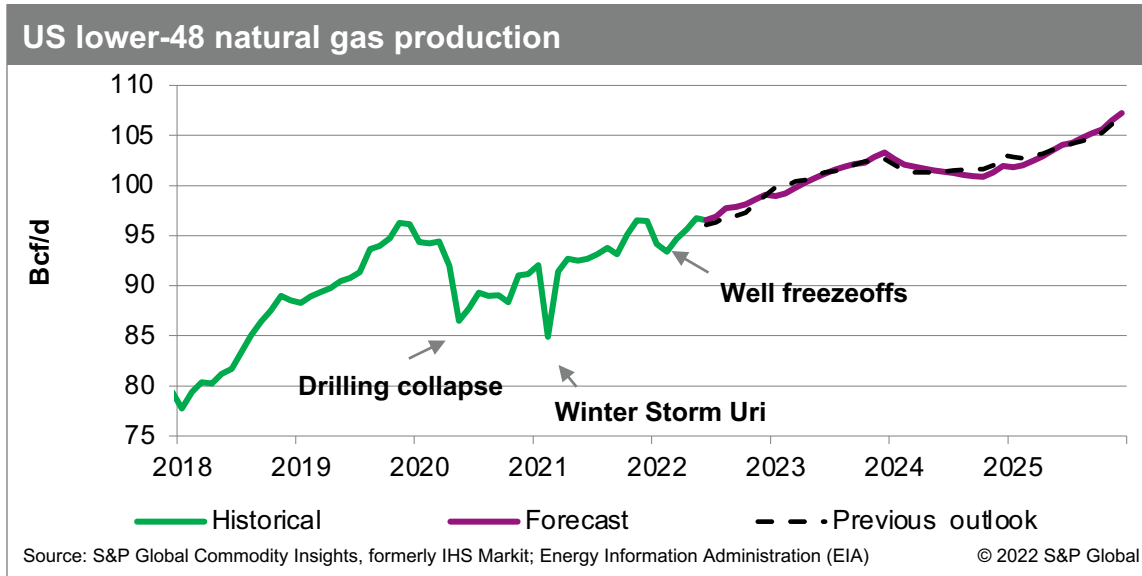


Another significant wave of US LNG exports in the offing post 2025, can the market support it?



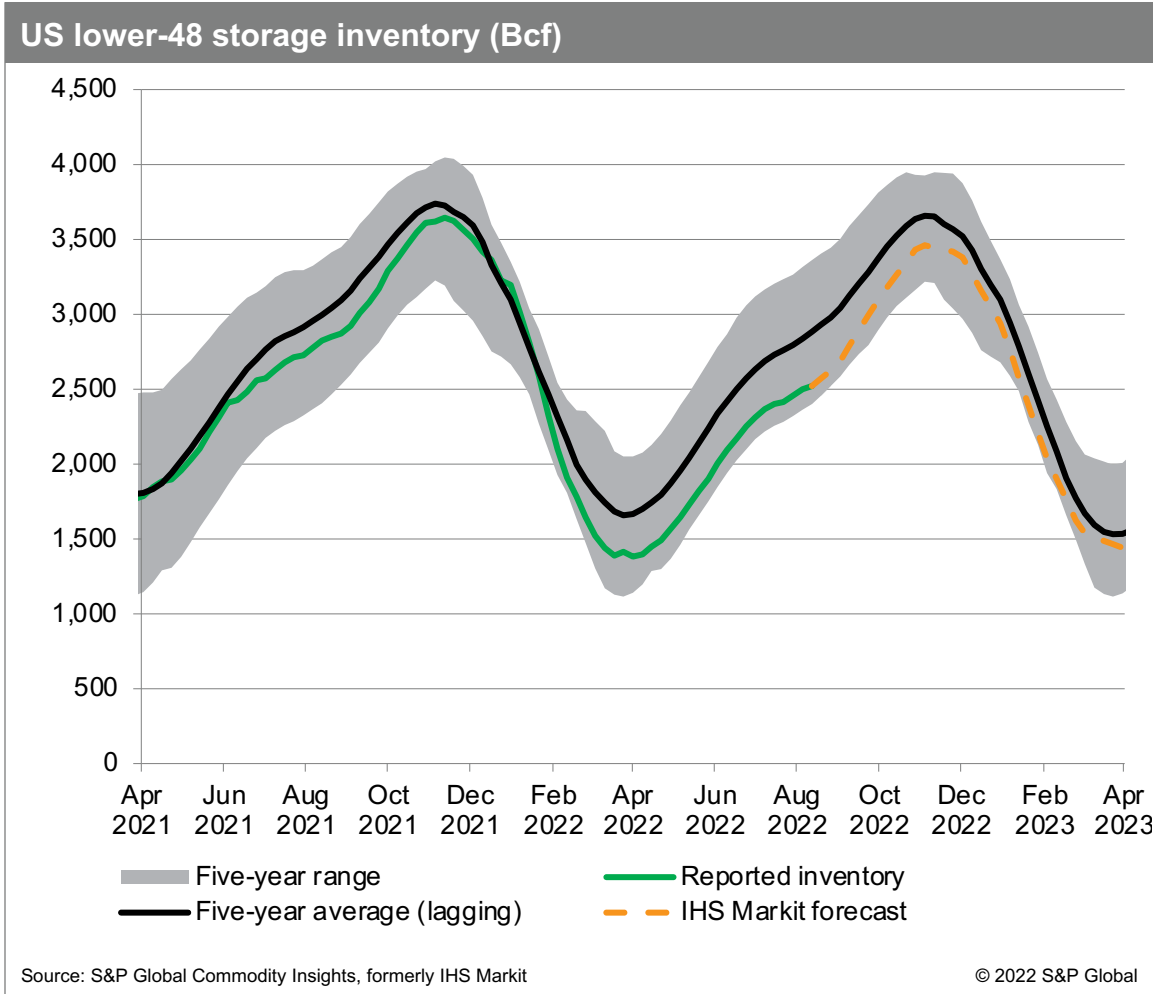
- The US natural gas market has abundant resource, yet pipeline infrastructure constraints are now limiting access to some of the most low-cost basins (namely the Marcellus and Utica)
- Capital discipline is the mantra of the day and public independents are prioritizing returns to shareholders, fixing balance sheets by paying down debt, and sticking to their guidance even as commodity prices have skyrocketed. Shareholders are rewarding this behavior along with increased focus on ESG.
- The US gas market is more dependent upon supply growth along the Gulf Coast. The Haynesville and Permian plays have been the focus of E&P's activity with rig counts in both plays increasingly significantly since mid-2020.
 - Pipeline infrastructure will be required for significant growth from these plays too (albeit within state borders making it less difficult to construct)

US lower-48 production breaks a new record after several months of lackluster growth

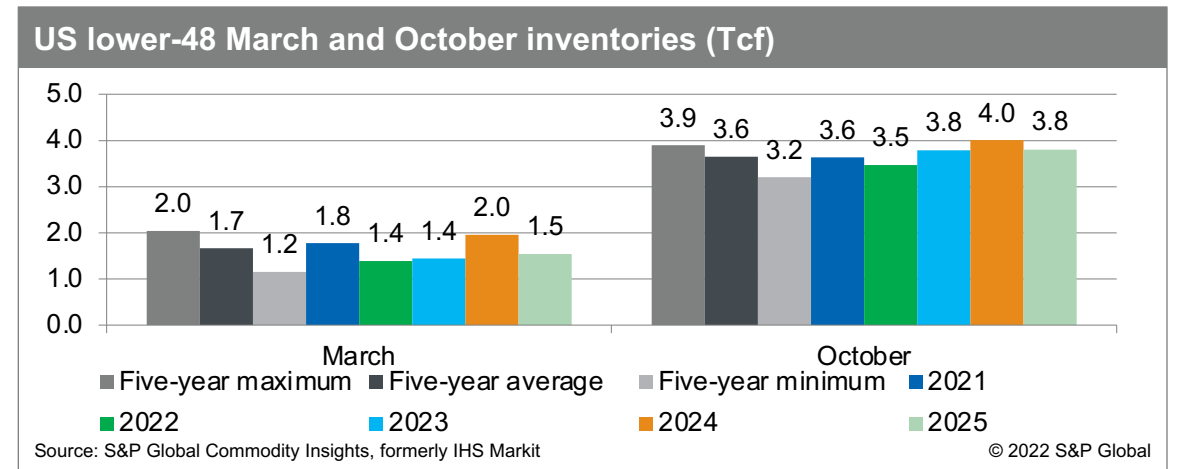


- **Supply chain/service sector and labor (frac crews) logistical issues, E&Ps' capital discipline regimen, inflation, and hedging continue to take a toll on production growth this year compared with pre-pandemic years.** Drilling activity over the past eight months is starting to manifest in some production growth.
- In 2022, we expect production growth of 2.6 Bcf/d on an entry-to-exit basis (3.8 Bcf/d on an annual average).
- In 2023, production growth accelerates as service sector constraints are expected to improve, especially in the second half of the year. Production growth outpaces demand growth, forcing a slowdown in drilling activity. As a result, production declines through summer 2024 after which it ramps up again in late 2024 to meet growth in LNG exports and domestic demand.

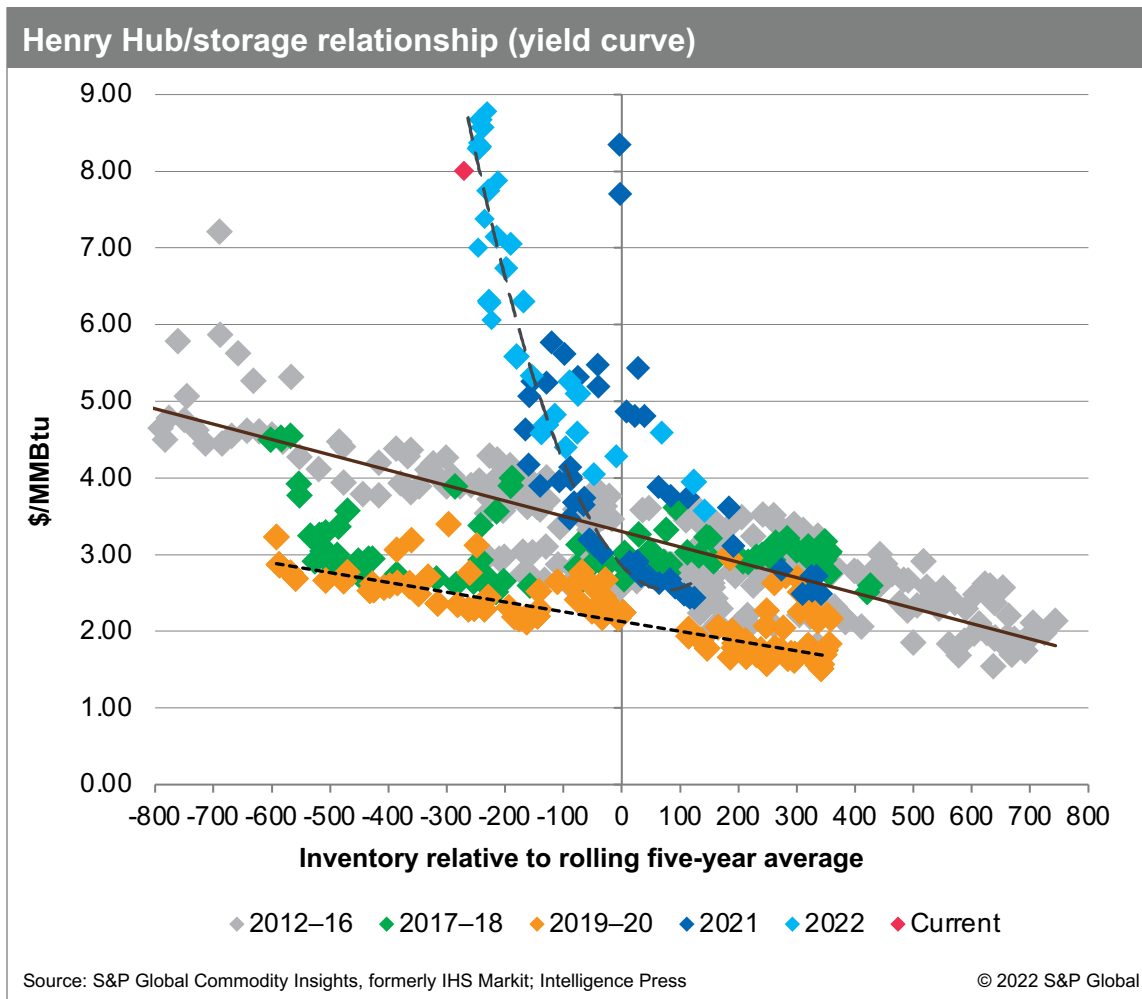
US lower-48 storage inventory deficit will struggle to return to the five-year average by October



- **Inventories are now expected to reach 3.5 Tcf at the end of October, or 0.1 Tcf below the five-year average.** An outage at Freeport LNG is expected to continue pushing 2.0 Bcf/d into storage through early-to-mid November. Yet, above average temperatures have supported power sector demand this summer countervailing the additional supply for injection.
- **Despite strong demand growth this summer, we expect production growth to support building inventory into the five-year range.** However, any delays to production growth or above-normal temperatures could slow injections and put downward pressure on this expectation.

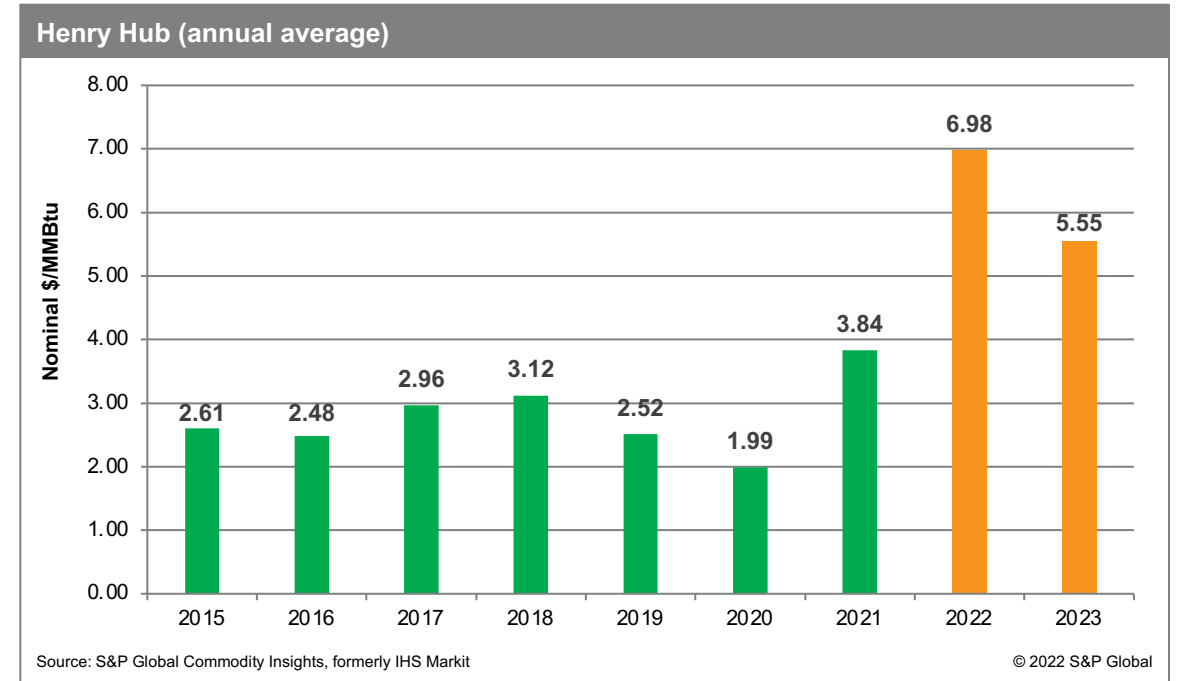
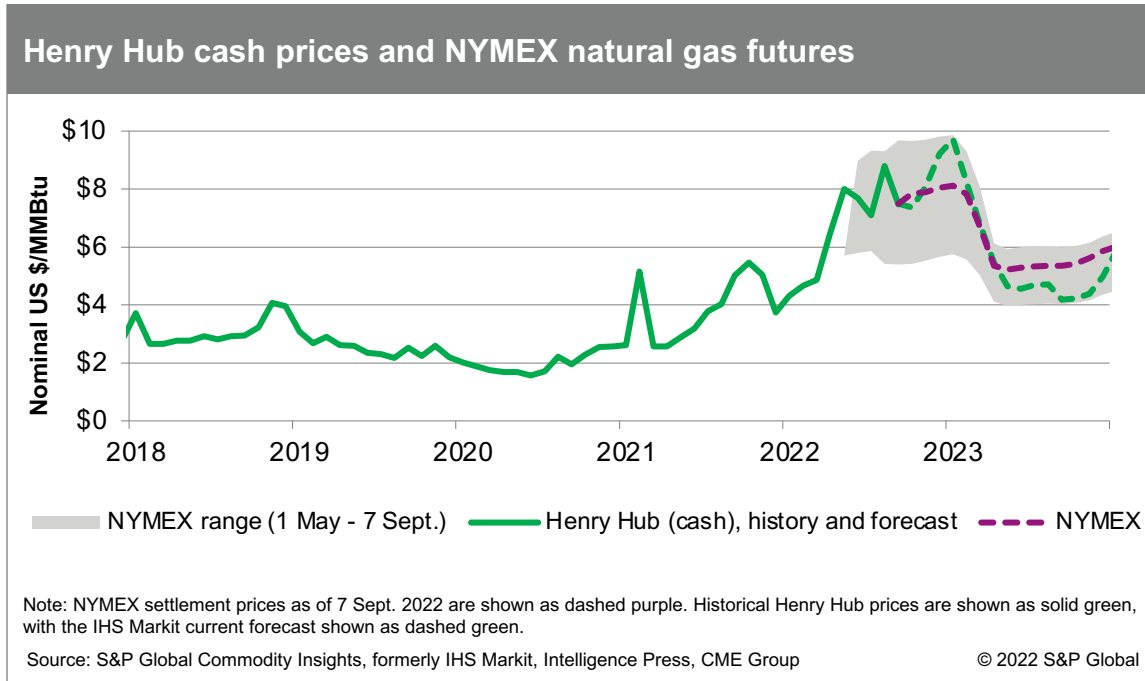


Prices increased sharply along a steeper yield curve beginning in 2021 as inventories went below the five-year average



- Storage inventories on 12 August were at a 271 Bcf deficit to the rolling five-year average as Henry Hub prices for the corresponding week averaged \$8.00/MMBtu (see the red diamond in the chart).
- A steeper yield curve has emerged owing to a tight coal market and capital discipline among oil and gas drillers.
 - With coal production unlikely to grow, coal inventories depleted, and coal exports well above 2020 levels, higher gas prices are unlikely to induce significant additional switching from gas to coal in the electric power sector. Rather than putting a ceiling on gas prices by offering a lower-cost fuel alternative in the power sector, coal and gas prices have risen in tandem in response to robust demand.
 - Furthermore, oil and gas producers have been under pressure from investors to exercise capital discipline and deliver better returns, raising the marginal cost of new supply and shifting the entire curve upward.

Henry Hub expected to average \$6.98/MMBtu in 2022 and remain elevated relative to recent history



- Robust power sector demand and resilient exports coupled with lackluster production growth are expected to keep upward pressure on the benchmark price over the next six months.
- The market returns to balance as demand and export growth slow in 2023 while production, namely associated gas production, maintain pace, bringing storage inventories above the five-year average. Thereafter, demand and export growth resume once again, placing upward pressure on Henry Hub.

Short-term outlook key messages

- **Henry Hub prices are expected to average \$6.98/MMBtu in 2022, retreat toward \$5.55/MMBtu in 2023 and then remain below \$5.00/MMBtu in 2024 and 2025.** A slowdown in domestic demand *growth* in 2023 and 2024 will ease pressure off gas prices. The ramp up in new LNG export capacity in late 2024 through 2025 will lift gas prices in 2025. If a more bearish production outlook were to manifest, or weather-driven demand is higher than forecast, prices could rise further in 2022 (all else equal).
- **Natural gas demand is forecast to increase 11.5 Bcf/d between 2022 and 2025 from 2021 levels, with nearly 50% of that growth from exports of LNG.**
 - **LNG feed gas demand** should increase by 50% as new liquefaction capacity enters service (Golden Pass LNG and Plaquemines LNG in 2024/25), reaching an annual average of 16.3 Bcf/d in 2025.
- **Industrial and power sector gas demand growth is modest through the short term.** Natural gas for power generation is expected to increase 1.7 Bcf/d (5%) through 2025 despite the addition of 150 GW of wind and solar capacity as roughly 60 GW of coal generation capacity is retired. Industrial gas demand increases by 1.2 Bcf/d (6%) through 2025 as the economy grows and olefin and methanol production capacity increases.

We expect US lower-48 annual average gas production to be 96.7 Bcf/d in 2022, 101.2 Bcf/d in 2023, and 104.2 Bcf/d in 2025.

- Drilling activity accelerated since fall 2021 on the back of soaring oil and gas prices. DUC inventory has been growing in the Haynesville since February, which indicates that some production could be delayed till later- all else equal. As of June, rig count stabilized in some plays, namely Appalachia and Haynesville. Several operators, especially in Appalachia, are abiding by capital discipline and maintaining production despite high prices.
- The new shale paradigm of capital discipline, in addition to, inflation, labor shortages, and service sector/supply chain bottlenecks, has raised the cost of new marginal supply. Market participants should pay close attention to oil prices and the level of rig activity in key oil plays such as the Permian, Bakken, and Eagle Ford. The level of associated gas production relative to demand is expected to dictate the amount of required “dry gas” production and, therefore, the marginal price required to meet demand. Oil prices averaging above \$100/bbl in 2022 and \$85/bbl in 2023–25 should help producers return money to investors, pay down leftover debt, buy back shares, and support growth in associated gas production.
- We expect production to grow by 11.3 Bcf/d between 2022 and 2025 from 2021 levels, where associated gas, Haynesville, Marcellus/Utica production grow by 9.3 Bcf/d, 5.3 Bcf/d, and 0.3 Bcf/d, respectively, partially offset by declines in other dry gas (3.6 Bcf/d). The Haynesville successfully competes with the Marcellus/Utica plays, shifting some of the operators’ focus away from Appalachia to the Haynesville.

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