

MNI Gas Weekly: Market Tamed by Healthy Supply

By Lawrence Toye, Daniel Dawson, & Zach Simon (12/11/2025)

Executive Summary:

- **European Gas Benchmarks** see some upside on colder weather forecasts.
- Asia's **LNG market** is struggling for upside support as the region remains well supplied.
- In the **Middle East & Africa**, Egypt is looking to buy additional LNG cargoes.
- **Henry Hub** had a turbulent week amid moves in underlying fundamentals.
- In the **Americas**, Pemex is planning to assign hydrocarbon projects to private sector partners.

European Natural Gas

TTF front month rallied in the middle of the week, boosted by the forecast for colder weather next week, though remains within the recent range overall amid healthy supplies.

- Front month TTF prices traded between €30.765/MWh and €32.25/MWh this week, compared to €30.975/MWh and €32.575/MWh over the previous week.
- Temperatures in NW Europe are forecast above normal in the coming days before dropping below normal next week. CWE Wind is trending downward over 13-16 Nov although has been revised higher over Nov. 16-17 Nov and revised lower over Nov. 18-19.
- NW European LNG sendout is estimated up at the highest since March at 276.7mcm/d on Nov. 11 compared to an average of 269.4mcm/d so far this month and 190mcm/d in H1 Nov. 2024, Bloomberg shows.
- Norwegian pipeline supplies to Europe are 339.3mcm/d today. Gassco shows total planned unavailable capacity of 14mcm/d until Nov. 16 and with a brief spike over 40mcm/d on Nov. 19-20.
- European gas storage was down to 82.39% full on Nov. 10, according to GIE data, with net withdrawals roughly in line with seasonal normal levels in recent days. The previous five-year seasonal average is 91.4% full.
- Algeria gas flow to Italy at Mazara are 52.8mcm/d today compared to an average of 50.2mcm/d over the previous week, Bloomberg shows.
- Morgan Stanley has lowered its late-2026 TTF forecasts, as new projects starting successfully in 1H 2026 will be the catalyst for TTF to fall below €30/MWh by 2H 2026. The bank does not assume significant disruption to EU LNG supply based on the 19th sanctions package on Russia.

NWE Natgas Demand Rose 12% W/W: JPMorgan

Natural gas demand in NWE averaged 456 mcm/d for the week of Nov. 3-Nov. 9, 12% higher w/w but 19% lower y/y, according to JPMorgan.

- The bank attributes higher gas demand w/w to increased gas burn in the power sector as wind generation declined 50% w/w.
- On a country level, all countries in the area experienced higher demand w/w, led by Germany, where demand increased by 15% w/w.

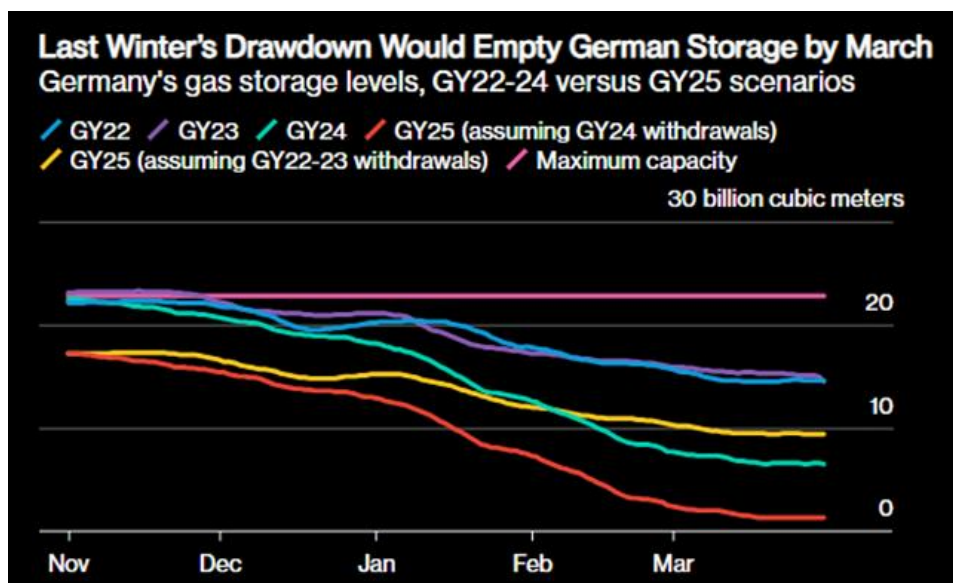
- Month-to-date November demand is averaging 435 mcm/d, significantly lower than demand observed during the same period last year (525 mcm/d).
- It is also well below the bank's forecast of 528 mcm/d for the month, primarily due to warmer-than-normal temperatures.
- Storage is broadly flat month-to-date, compared to the bank's forecast of 58 mcm/d of net withdrawals, largely driven by weak heating demand.
- Year-to-date, natural gas demand is averaging 382 mcm/d, compared to 378 mcm/d last year.

Germany Entering Heating Season with Significantly Lower Storage Y/Y

Germany is entering the winter season with significantly less natural gas storage than last year, adding to concerns about its ability to manage demand swings in the months ahead, according to BNEF.

- German storage sites struggled to attract commercial interest over the summer.
- As a result, Germany entered November with storage levels about 5 bcm lower than last year, with sites 75% full instead of the 98% seen in 2024.
- During the winters of 2022-23, withdrawals averaged about 8 bcm during a period of mild conditions.
- Last year was cooler and less windy, with lower gas imports, prompting withdrawals to double to 16 bcm.
- If this winter mirrors last year's, inventories could be almost depleted by the end of March.
- In contrast, a milder season would likely leave storage around 40% full.

German Gas Storage Scenarios - Source (Bloomberg Finance L.P.)

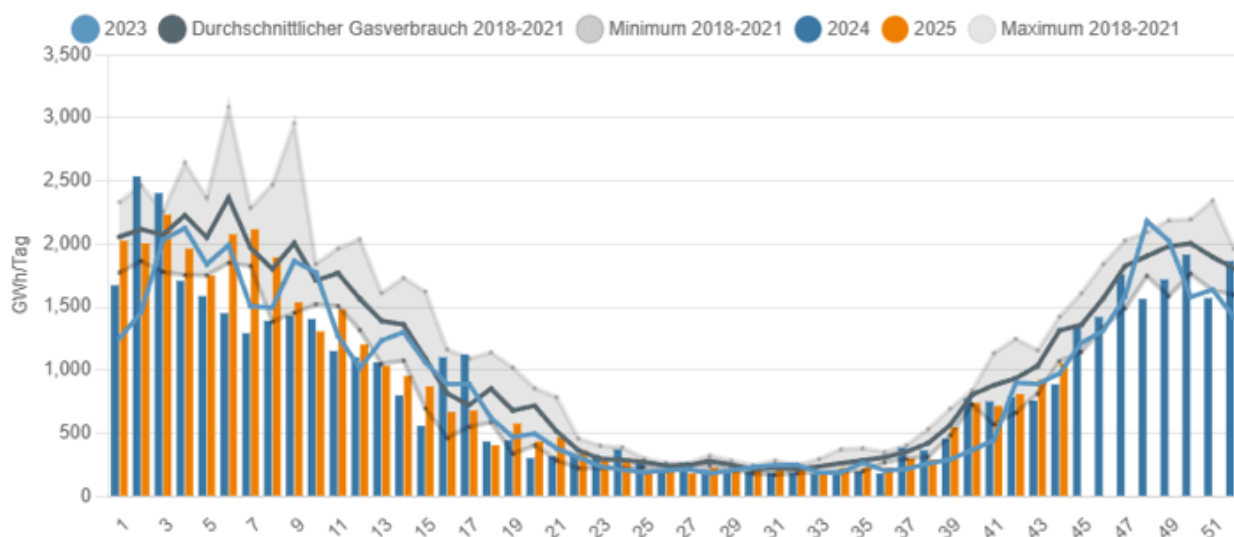


German Gas Demand Rises on Week but Falls to 18.5% Below Normal

German natural gas consumption in the week to Nov 2 rose by 6.2% on the week and was 18.5% below the 2018-21 average, Bnetza data showed. Industrial demand rose by 1.1% on the week while demand from households and small businesses rose 13.7%.

- Industrial gas consumption increased to 1,377GWh/d in the week, to 17.4% below the 2018-21 average and compared to 1,439GWh in 2024. Gas consumption from electricity generation is also included in the data.
- Demand from households and small businesses was up to 1,053GWh/d last week, 19.9% below the 2018-21 average and compared to 888GWh/d in 2024.
- German gas demand stood 12.9% below the 2018-21 average the week prior.
- Natural gas inventories in Germany were up on the week to 75.32% full on Nov 05 compared to 75.05% a week ago with average daily injections of 125GWh/d, GIE data shows.

German Household & Business Gas Consumption - Source (Bundesnetzagentur)



Croatia's LNG Hrvatska Starts Testing New FSRU

Croatia's LNG Hrvatska started testing of its new FSRU that will double maximum annual capacity at the Krk terminal, managing director Ivan Fugas said cited by Reuters.

- The maximum capacity at the terminal is set to increase from 3.1bcm to 6.1bcm, or about 4.4m tons, per year after completion of testing.
- "We have increased the security of supply for all countries in our surroundings," he said.
- The capacity expansion enhances gas supply security with connection to EU member states Slovenia, Hungary and Slovakia and non-EU members Serbia and Montenegro.
- Sendout from the terminal has been 75.8GWh/d, Bloomberg shows, since the FSRU returned late last month after adding a liquefaction module and undergoing other maintenance at a Turkish shipyard.
- Croatia's annual natural gas demand in 2025 is around 2.6bcm with 26% covered by domestic production.

Bulgaria Floats Idea of Aggregated US LNG Supply For Southeast Europe

Bulgaria is exploring the potential for Southeast European countries to aggregate purchases of US LNG, Platts said.

- Energy Minister Zhecho Stankov discussed the idea with US Secretary of the Interior Doug Burgum in Athens Nov. 7.
- The talks focused on increasing LNG supplies to the region, with Bulgaria proposing regional supply aggregation in line with US infrastructure development prospects.
- Bulgaria is a key participant in the Vertical Gas Corridor, aimed at expanding gas transport capacity in Southeast, Eastern, and Central Europe to accommodate non-Russian gas, including US LNG arriving via Greece and Turkey.
- The country has begun construction on critical corridor sections, targeting completion by October 2026.
- The initiative is seen as strengthening energy security, reducing dependence on Russian gas, and facilitating broader US LNG imports.
- Greece also aims to act as an LNG hub, signing a 20-year deal with Venture Global to supply US LNG, with plans to distribute it to Romania, Ukraine, and beyond.

Ukrainian Gas Production Posts Recovery from Mid-Oct. Attacks

Ukrainian gas production has rapidly recovered since attacks in mid-October, with just 6-9 mcm/d currently offline, according to Ukrainian sources cited by ICIS analyst Brendan A'Hearn.

- In comparison, ICIS and its sources estimated that around 25 mcm/d was offline just weeks ago following several rounds of attacks.
- The tight range of estimates given by the separate sources suggests a good degree of certainty on the offline production, A'Hearn said.
- Despite the recovery, Naftogaz is still expected to continue importing strongly in Nov.-Dec., incentivised by the contango shape of the price curve this winter.
- Private importers are also heard to be interested in Nov.-Dec. volumes, with UAVTP (Ukraine gas price assessment) as much as +€10/MWh above TTF.
- Ukraine has resumed gas imports via the southern Transbalkan route following Russian attacks on the country's gas infrastructure, Reuters reports.
- Ukrainian state-run energy company Naftogaz will increase US LNG gas imports for the winter period, the company's CEO said in a Facebook post.

TSOs Propose Two New Route Products to Support Ukraine

ICGB has joined regional partners in signing an agreement for the launch of two new route products to support Ukraine, according to a company statement.

- In the joint letter to regulators, the TSOs propose that Routes 2 and 3 are available from December 2025 until April 2026.
- If approved, the new products will enable discounted routes for natural gas deliveries from TAP and the LNG terminal in Alexandroupolis via the IGB pipeline in direct support for Ukraine.
- "The initiative marks a major milestone in the development of the Vertical Gas Corridor," ICGB said.
- The TSOs have agreed to establish Route 2 and Route 3 capacity products.
- Routes 2 and 3 are dedicated capacity products designed to transport natural gas from the Alexandroupolis LNG terminal and the Trans Adriatic Pipeline (TAP) through the Greece-Bulgaria interconnector and onwards via the Trans-Balkan pipeline, Romania and Moldova to Ukraine.

- “ICGB has introduced a substantial discount rate on its tariff - 46%, reaffirming company’s commitment to creating economically viable and competitive options for cross-border gas supply.”

APAC LNG

Asian spot LNG prices were steady this week, with plentiful supply and subdued demand preventing any upward movement, Reuters said.

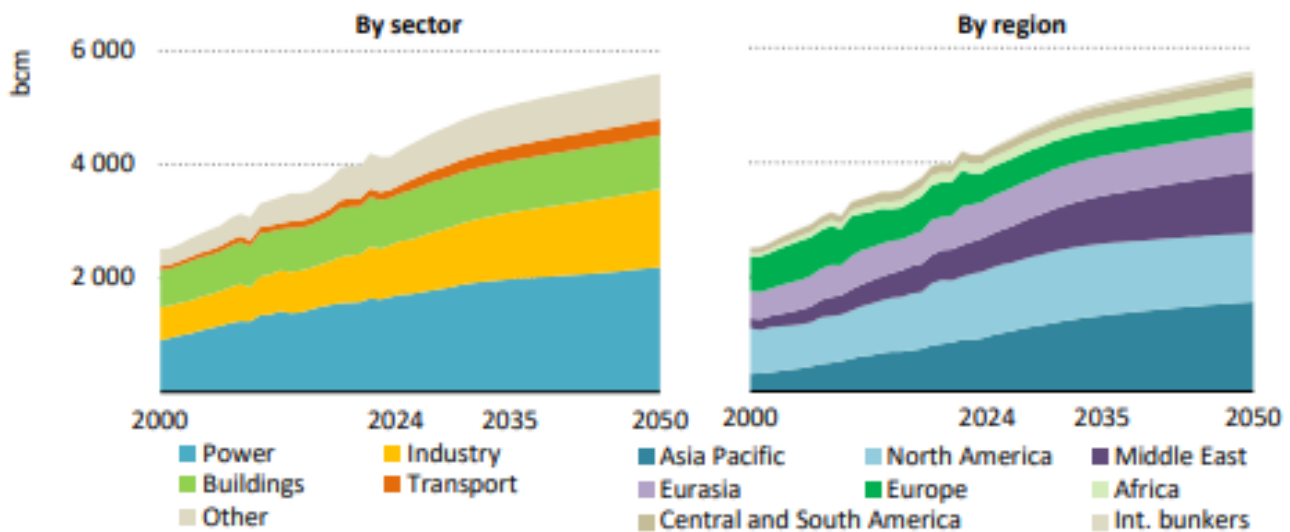
- December spot LNG prices DES North Asia held steady at \$11.10/MMBtu, sources told Reuters.
- Weak demand across the region reflects comfortable inventories and typical seasonal weather forecasts, Argus’ analysts told Reuters.
- Bloomberg deems it unlikely that the region’s top importers will procure additional supply from the spot market, unless temperatures turn much colder. Consequently, analysts expect JKM to soften in the coming months.
- However, rising LNG freight rates have widened the spread JKM-TTF spread, with Asia needing to maintain a price premium to attract cargoes.
- The tightness in LNG shipping is expected to be short term, as forward charter rates for January are less than half of current spot levels.
- Overall, the LNG market remains well supplied, with China’s winter heating demand yet to pick up and pipeline imports meeting marginal needs, according to Davenport Energy Partners.
- The total estimated quantity of LNG on tankers that have not unloaded for at least 20 days decreased 15% on the week to 2.56m mt as of Nov. 9, according to Bloomberg estimates.

IEA World Energy Outlook

The global market could absorb a record wave of new supply of LNG, but much depends on net zero policies and renewables growth, according to the IEA.

- The IEA revised up gas demand in its World Energy Outlook, but there are still questions as to where the additional LNG will go.
- Global LNG capacity is set to rise by about 50% by the end of the decade.
- The IEA detailed several scenarios in its outlook, assuming different paces for the energy transition.
- The most bullish for gas demand — the so-called “current policies scenario” — sees global LNG appetite rising in line with supply until the end of the decade and even slightly exceeding already planned export capacities by 2035.
- However, the “stated policies scenario” has stronger renewables growth, producing an oversupply of LNG in 2030-2035.

Global Natgas Demand by Sector & Region in Current Policies Scenario- Source (IEA)



China

China could keep its gas demand growing 5.1% per year through 2030, supported by power expansion and industrial efforts to phase down coal, according to CNPC cited by Bloomberg.

- Gazprom set a fresh record for daily gas flows to China via the Power of Siberia link on Nov. 5, the company said via Telegram.
- The delivered volume exceeded Gazprom's contractual obligations, Gazprom said. The post did not specify the new level. This is the ninth record since supplies via the Power of Siberia pipeline reached the maximum contractual level on Dec. 1, 2024.
- China is stepping up its efforts to import US-sanctioned Russian gas, building the beginnings of a domestic "shadow fleet", Bloomberg said. This would further diversify its gas import sources.
- While the effort is still in its infancy, tanker movements and ownership in China are starting to reflect patterns seen in Russian oil.
- Bloomberg noted that Hong-Kong owned LNG tanker CCH Gas is carrying a blacklisted cargo and is hiding its location near a Chinese port.

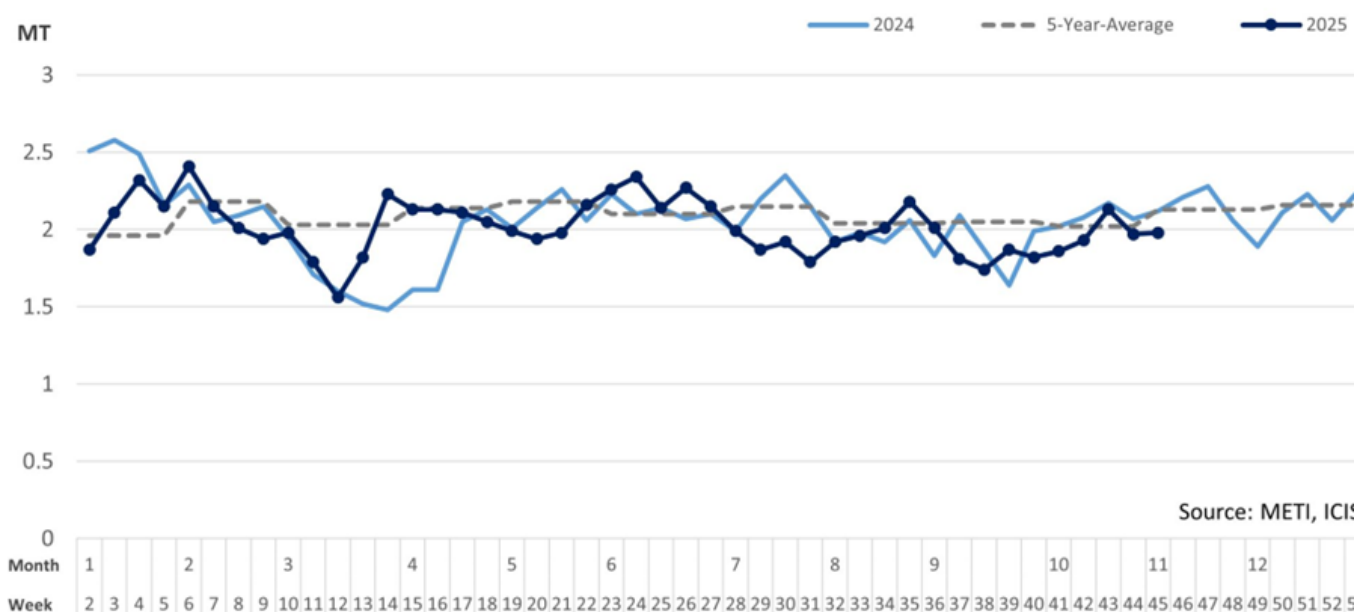
Japan

The market is monitoring for signs of whether a Japanese nuclear plant will be restarted, according to Bloomberg.

- Hideyo Hanazumi, the governor of Niigata prefecture, is scheduled to visit the Kashiwazaki Kariwa Nuclear Power Plant Nov. 14 and will decide this month whether to approve the restart. This is one of the last steps before it can resume.
- A Rystad Energy analyst said that resuming a reactor at the facility would potentially reduce LNG demand for electricity by roughly 130k mt/month.
- Japan is entering a mild La Niña pattern that suggest a relatively gentle winter start while LNG imports reached 5.8m mt in October - the highest October volume in the past five years.

- LNG inventories at Japan's major utilities are stable heading into winter after a shorter summer peak and stores are likely to edge slightly higher through November and December, according to ICIS.
- Japan's utilities have greater flexibility to meet demand without heavy reliance on gas-fired generation since the restart of the Shimane 2 nuclear power plant in January 2025.
- LNG stockpiles held by Japanese utilities fell by 1.01% on the week to Nov. 9 to 1.96m mt, according to trade ministry data.
- Stocks remain below the five-year average for the end of October of 2.03m tons and 2.05m mt at the end of November.

Japan LNG Stock of Major Power Utilities- Source (ICIS)



India

Petronet LNG expects Exxon Mobil to start supplying additional LNG from Australia's Gorgon project by March or April, the company's managing director said, cited by Bloomberg.

- The volume this year will be 500k mt and will be increased to 1.2m mtpa in three years. Petronet has an existing 20-year contract with Exxon for 1.4m mt, which will now increase to 2.6m mt.

Southeast Asia

Indonesia is facing a shortage of about 20 cargoes of LNG this year due to higher than expected domestic demand and is seeking to delay some exports until 2026, its energy minister said on Tuesday, cited by Reuters.

- Energy Minister Bahlil Lahadalia told lawmakers the shortage was due to a miscalculation of demand expectations.

- Indonesia's upstream oil & gas regulator SKK Migas estimated in July that Indonesia would export 150 cargoes this year, but flagged risks of cargoes being diverted to domestic buyers due to rising demand from the state utility company.
- Malaysia's Petronas has agreed to buy 1m mtpa of LNG for 20 years from Canada's Pembina from the Cedar LNG project, according to a statement

Middle East & Africa

Egypt's state-run energy company is looking to buy three LNG cargoes for delivery this month, Bloomberg reports.

- Egypt General Petroleum Corp. submitted a tender to its current suppliers requesting LNG for mid-to-late November, sources told Bloomberg.
- The North African country, a net LNG exporter until last year, is now a sizeable driver of the global gas market, with traders closely monitoring fluctuations in domestic demand.
- Egypt snapped up large LNG shipments earlier this year, only to then request some delays in October.
- Recently it has sought to use more oil products for power generation, freeing up more gas for export.

Egypt Exports Further Cargo

Egypt also exported a new shipment of LNG from Idku liquefaction and export complex to Greece, the Ministry of Petroleum and Mineral Resources announced on Saturday.

- The facility has seen limited activity in recent years, especially since Egypt reverted to being a net importer starting in 2024.
- Some market participants have previously said the loading may be more technical than commercial to keep the facility running.
- On Oct. 13, the ministry announced that Idku liquefaction and export plant shipped a 155,000-cubic-meter LNG cargo to Italy, on behalf of Shell International, via New Nature ship.

Egypt-Israel Gas Deal in Jeopardy

Concerning the 130 bcm Israel-Egypt gas deal, Leviathan partners NewMed and Ratio believe the agreement only needs small tweaking, while others are unconvinced that it can be resurrected, MEES reported.

- The partners have given themselves until Nov. 30 to meet certain conditions, otherwise the 130 bcm deal could be in jeopardy.
- While missing the deadline might not kill the deal, it faces political headwinds.
- MEES noted that the coming weeks should reveal the agreement's outlook as the US looks to pressure Israeli PM Benjamin Netanyahu and Energy Minister Eli Cohen into approving the gas permit application.

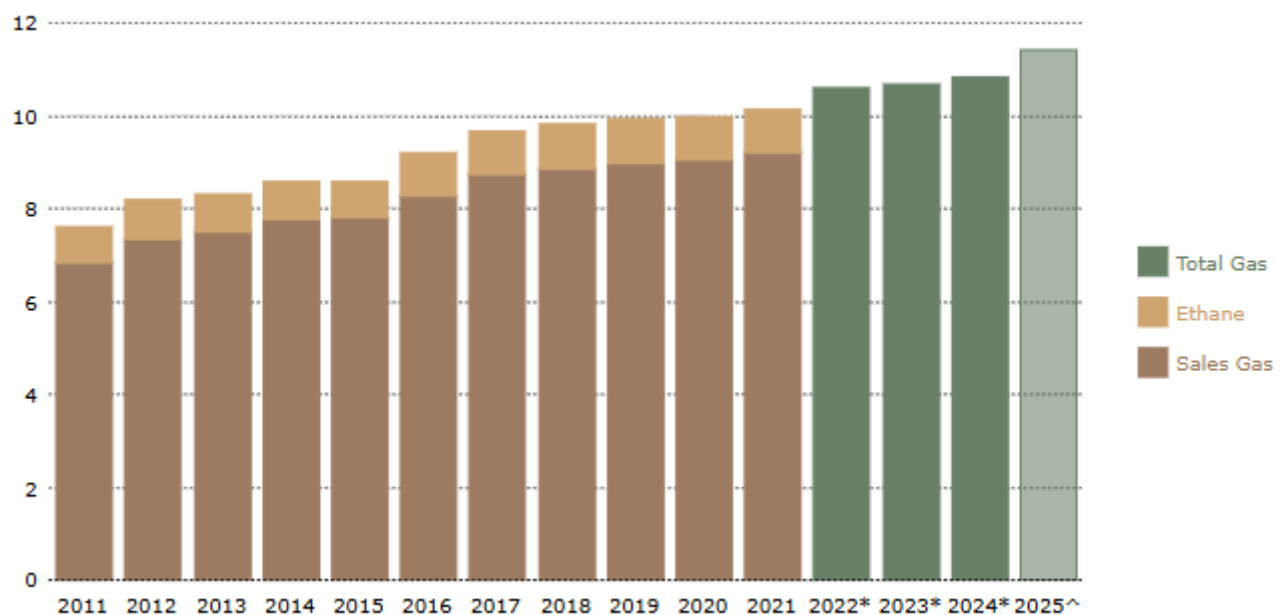
Aramco Raises Gas Growth Target

Aramco has revised up its sales gas growth target from 60% to 80% by 2030, MEES reported.

- Aramco has increased its sales gas target for 2030 target from 14.7 bcf/d to 16.8 bcf/d.
- Sales gas output averaged 9.2 bcf/d in 2021.

- The increase is also accompanied by huge amounts of NGLs, which could exceed 1m b/d and supply Saudi's petrochemicals sector.
- Gas growth has long been key to the government's plan of ending oil burn by 2030, while Riyadh's growing focus on AI investments has opened up a new value proposition, MEES said.
- The company is also confident that it can raise gas output with minimal investment.

Aramco Gas Output- Source (MEES)



Mozambique LNG

Mozambique aims to wrap up discussions within a week with TotalEnergies about the resumption of its \$20bn LNG export project according to Portuguese news outlet Lusa.

- TotalEnergies and its partners froze the Mozambique LNG project in 2021 after Islamic State-affiliated militants staged a major attack nearby.
- The FT reported late in October that the consortium behind (including TotalEnergies) the project had "taken the decision to lift the Force Majeure" and that it had informed the Mozambican government.
- Under the updated schedule, the first shipments of gas from the project would begin in H1 2029, five years after the initial schedule of July 2024.

Wider Regional Developments

Elsewhere in the Middle East, gas output in Bahrain during Jan-Aug. averaged 2.35 bcf/d, the lowest level since 2018 and down 10% year on year, according to MEES.

- This is likely to make Bahrain more dependent on imports as unconventional deployment fails to cover the shortfall.

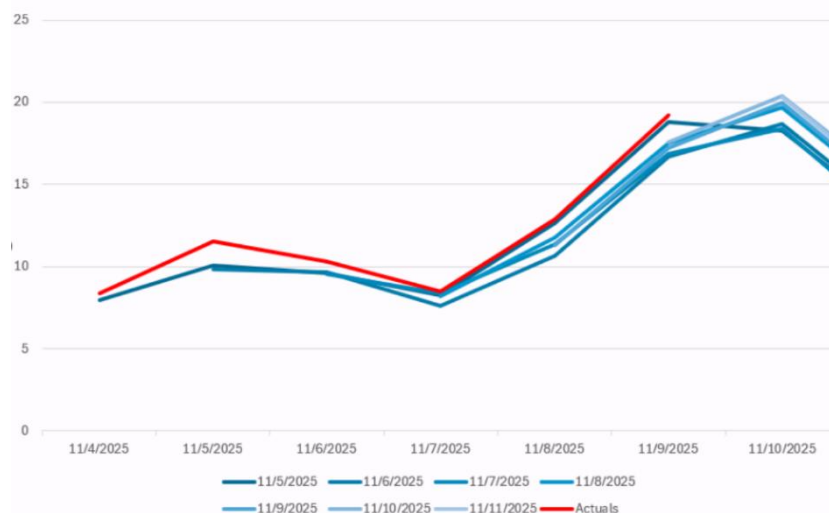
- In Africa, Angola LNG offered a sell tender for one cargo on a DES basis for December delivery to locations in Europe and South America, Bloomberg reported. The tender closes Nov. 12.

US Natural Gas

The prompt month had a turbulent week, swinging nearly 30 cents despite little change in underlying fundamentals. The contract reached a weekly high of \$4.581 on Nov. 11 and settled at \$4.565, its highest close since Dec. 29, 2022, when prices were stabilizing after the energy crisis triggered by Russia's invasion of Ukraine.

- On the same day, Lower 48 demand fell by 6.4 Bcf/d even as cold weather lingered along the East Coast. Day-ahead feedgas nominations edged up only 0.14 Bcf/d to 18.31 Bcf/d, while production receipts slipped 1 Bcf/d to 110.6 Bcf/d, roughly in line with the 30-day moving average. L48 HDDs appear to have changed little between predictions and actuals over the past week.

L48 HDD's



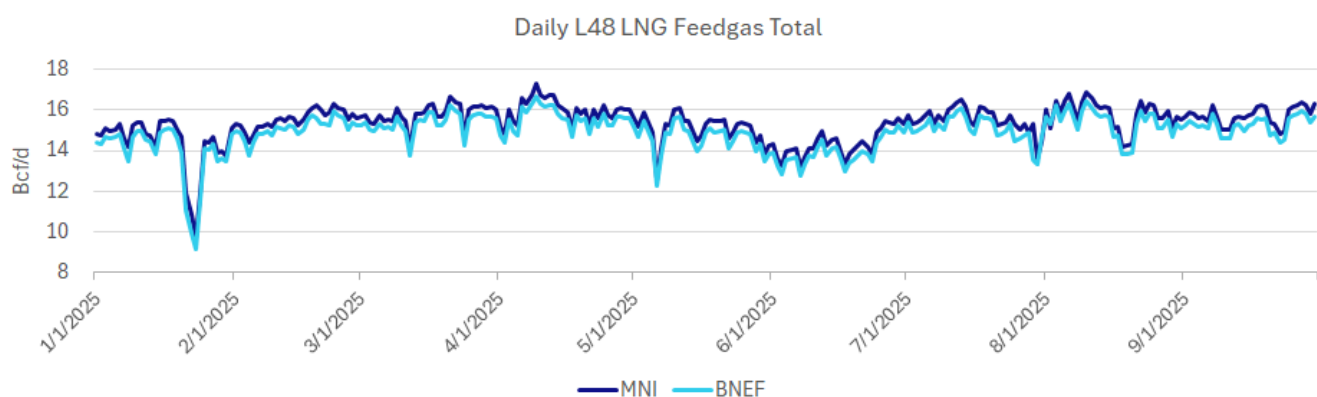
- The sharp price action instead appears driven by position liquidation over the past two sessions. Front-month open interest has dropped by about 25,000 lots since Friday, Nov. 7, while volume has surged. Front-month volume reached 244,000 lots on Nov. 11, the busiest day since Oct. 20, up roughly 55,000 lots from Nov. 10 and nearly 70,000 lots from Nov. 7.
- Henry Hub Front Month has traded between \$4.192/MMBTU and \$4.581/MMBTU this week, compared to \$3.786/MMBTU and \$4.396/MMBTU over the previous week.
- Natural gas deliveries to US LNG terminals averaged 17.46 bcf/d in the seven days to Nov-12, compared to the seven-day average of 16.97 bcf/d during the previous period.
- Lower 48 natural gas production averaged 111.13 bcf/d in the 10 days to Nov-11, compared to last week's 10-day average of 109.59 bcf/d.
- Baker Hughes US rig count: Gas: 128 (3) - up 26 rigs, or 25.5% on the year.

- US heating demand for the week ending November 8 is forecast to be 32 heating degree days (HDD) below the long-term normal, according to Bloomberg, citing the NOAA. During the week to November 1, the US was 1 HDD below normal.

US LNG

Natural gas deliveries to US LNG terminals averaged 17.46 bcf/d in the seven days to Nov-12, compared to the seven-day average of 16.97 bcf/d during the previous period.

Daily L48 LNG Feedgas Total- Source (Bloomberg Finance L.P./MNI)



Venture Global

Venture Global and Mitsui & Co. announced a 20-year 1 mtpa SPA to begin in 2029 amid tough legal challenges from other offtakers

- "Venture Global is honored to announce our new partnership with Mitsui, a distinguished leader in the LNG industry, to further increase the flow of U.S. LNG to Japan and the global market," said Venture Global's CEO Mike Sabel.
- Meanwhile, Sabel said in the company's 25Q3 earnings call that he expects arbitration cases against the company's spot selling practices to continue for years.
- On Nov 11, Shell appealed to an unsuccessful arbitration ruling against Venture. Other offtakers have outstanding cases. BP managed to win its case, but each case is unique.

Freeport Outage

Freeport LNG suffered an outage at Train 2 on Nov 10 due to a compressor issue

- Freeport LNG came fully back online on Nov 11 after Train 2 suffered a compressor issue on Nov 10 that lasted seven hours and fifteen minutes, resulting in unavoidable venting of gas, according to an emissions report and reported by Kpler

- Offtakers said that Freeport's outage likely did not disturb exports, but Freeport could not confirm. Kpler data show that LNG tanker Kool Frost left Freeport for Europe Nov 9. Gaslog Wellington arrived yesterday and will depart tomorrow Nov 12 for Western Europe.
- Feedgas demand at the terminal on Nov 10 was 1.7 bcf/d, according to MNI data, bumping back up to 1.95 bcf/d on Nov 11 above the 30-day average of 1.66 bcf/d.

Corpus Christi Stage 3

Train 4 of Cheniere's Corpus Christi Stage 3 export facility reached LNG production on Nov 5

- Train 4 was approved by FERC to introduce feedgas last week, after the company announced that Train 4 would come online by year's end.
- Train 4 nearing completion brings the facility slightly ahead of schedule compared with prior guidance to have trains 4-7 online in 2026.
- Cheniere's 3Q25 results indicated that Train 3 achieved "substantial completion" as of Sept 30 ahead of schedule, bringing Stage 3 to ~91% completion, according to company documents.
- Cheniere expects to send out 51 to 53 mtpa (~6.8-7.1 bcf/d) total of LNG from its export facilities Corpus Christi and Sabine Pass in 2026, with nearly 90% linked to long-term contracts with about ~1.5 mtpa available for spot sales and about 1.5-3.5 mtpa of unsold volumes.
- According to Kpler data, Corpus Christi exported 13.33 mt of LNG in the first 10 months of 2025, up from 12.09 mt in the same period last year.

LNG Canada

LNG Canada's second train started producing LNG last week, cushioning this winter's balance

- This raised BNEF's expectations for winter '25/'26 by 0.4 mt through March but remains flat for 2026.
- Train 2 beat BNEF's initial expectation for starting up that was originally for July next year.
- Spot LNG prices are expected to come down with the additional capacity, finds BNEF.

Energia Costa Azul

Sempra's CFO Karen Sedgwick said that Energia Costa Azul (ECA) is now 95% Complete, expecting first drop by Spring 202

- Pre-commissioning activities are ongoing at the facility with repair work ongoing on an auxiliary turbine designed to increase efficiency. Approximately one-third of existing turbines are now online and operational.
- Commercial operation date is set for the first half of 2026

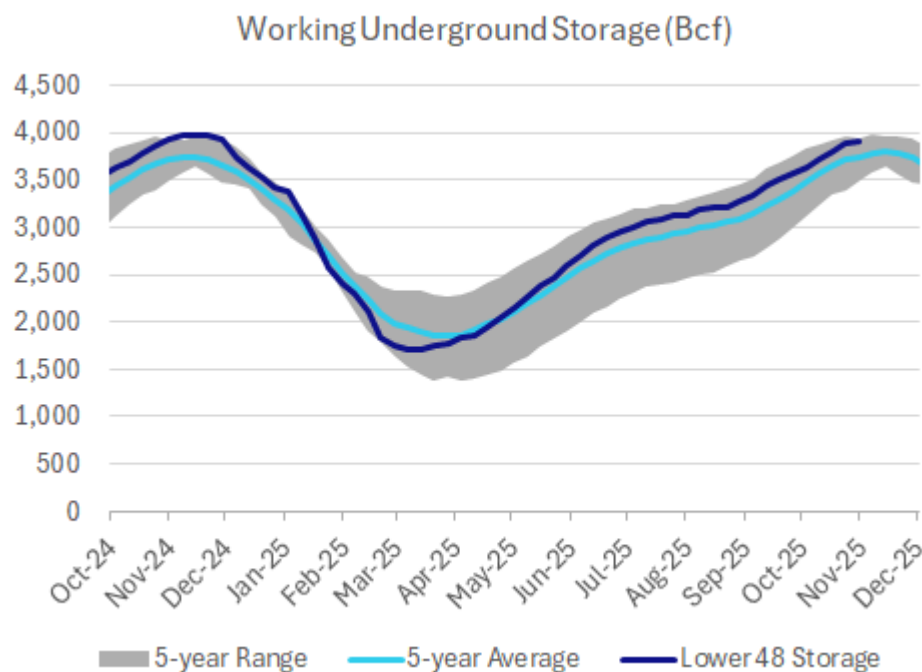
US Natgas Inventories

The EIA weekly gas inventories for the week ending Oct. 31 showed a build of 33 bcf. The seasonal five-year average shows a net build of 42 bcf.

- The storage report was overestimated by NGI by 2 (+35), underestimated by Reuters by 1 (+32), underestimated by WSJ by 2 (+31), underestimated by BBG by 2 (+31).

- The Oct 31 injection of 33 bcf was below the five-year average of 42 bcf and lifted storage to 3,916 bcf, 162 bcf above the five-year average of 3,753 bcf.
- Storage ended the injection season at 3.916 tcf, in line with MNI expectations.
- Storage in the East region declined uncharacteristically for Week 44 ahead of colder-than-average temps arriving next week.
- Injections should continue through the next two weeks according to five-year averages.

US Gas Inventories – Source (EIA)



Latam

Mexico's Pemex is currently in the process of assigning hydrocarbon development projects to private sector partners, Energy Minister Luz Elena Gonzalez told Congress Nov. 7.

- Pemex officials have said the company is aiming to sign the first mixed development contracts with partners this month.
- Earlier constitutional changes allowed for private sector involvement for oil and gas projects in Mexico, provided they partner with Pemex and the state-owned company is the majority partner.
- Mexico's energy minister had also denied that the country is violating its obligations under the USMCA by favouring state-owned companies Pemex and utility CFE, BNamericas reported.
- The ministry added that its energy sector reforms comply with the USMCA and promote private investment. It cited the introduction of mixed contracts between Pemex and private sector companies.

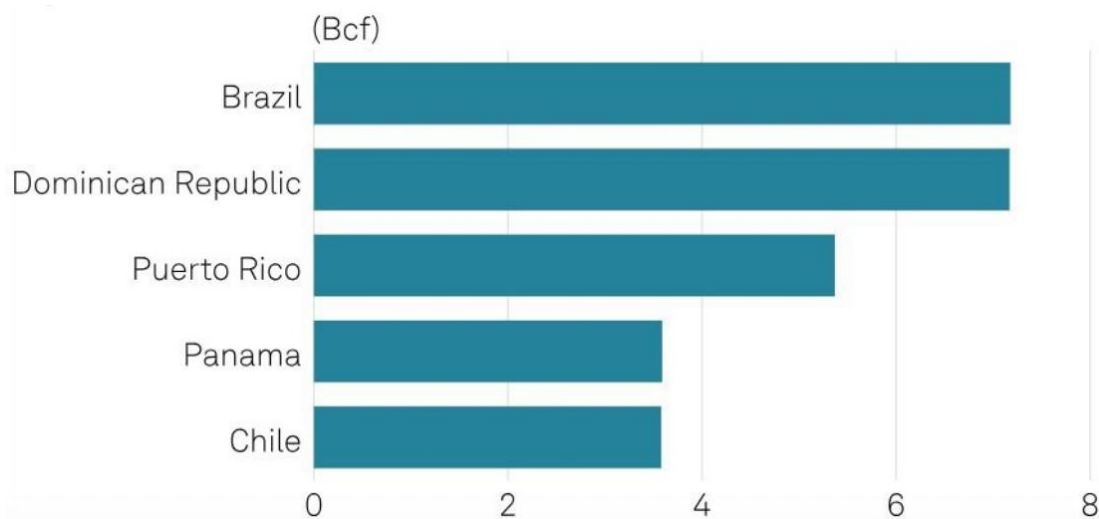
US LNG Exports to Latam Ease in Oct

US LNG exports to Latam and the Caribbean fell 12.5% on the month in October to 26.89 bcf, amid limited export destinations, Platts said.

Brazil remained the top destination for a fourth consecutive month, taking 7.18 bcf. However, this was down 31% on the month.

A total of 8 cargoes were exported from the US to the region, the lowest monthly count since January.

Latam Imports from the US in Oct – Source (Platts)



Petrobras Signs Small-Scale LNG Contract

Petrobras and Amazônica Energy have signed the first contract for the sale of natural gas from the Urucu Cluster for small-scale LNG commercialisation, marking a new phase in developing the Solimões Basin reserves, BNamericas said.

- Gas deliveries are set to begin in February 2028, with an initial supply of 0.1 mcm/d over ten years, potentially increasing as the project advances.
- The initiative aims to expand natural gas access across remote areas of the Brazilian Amazon, addressing logistical challenges while reducing emissions and improving energy efficiency.