



EUROPEAN GAS DEPENDENCY MEANS GREATER PRICE VOLATILITY

FEBRUARY 2022

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Executive Summary

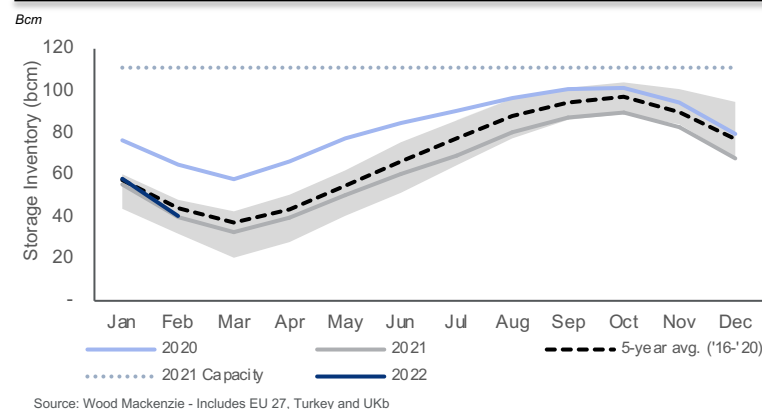


In October 2021, we identified key drivers of stress in Western European gas and power markets that were likely to create significant price volatility

European Natural Gas Inventories at Historically Low Level

- NW European gas inventories have been below the 5-year average since the beginning of summer after experiencing two consecutive cold weather events in April and May 2021
- Lower than expected renewable generation, particularly from wind in the North Sea, created a shortfall that was met by further draws on existing natural gas storage
- Continued pressure from Russian supply (namely the Yamal-Europe Pipeline, where natural gas was not shipped for a large part of Dec '21 – Jan '22) has resulted in gas storage levels dropping below 50% of total capacity, the earliest the half-empty mark has been reached in recent history

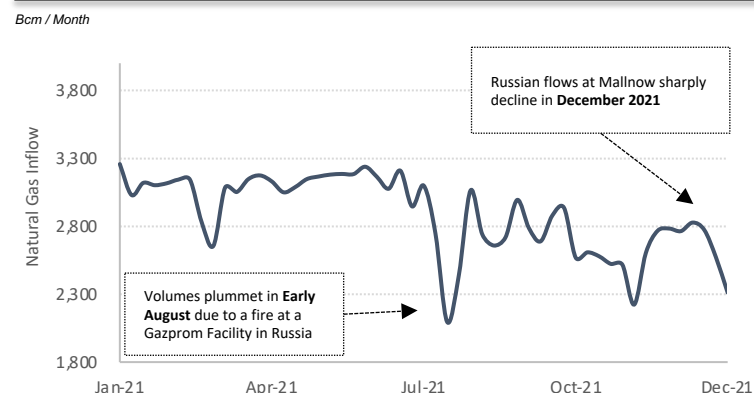
Natural Gas Inventory Level by Month



Natural Gas Flows from Russia Have Been Volatile Over Past 12 months

- Recently, supply concerns worsened by the possibility that Russian send-outs to NW Europe through existing pipes might disappoint
- Normalization of flows through Yamal pipeline post August fire at a Russian processing plant have been slow and inconsistent for September
- Yamal capacity booked for month of October was only 31 mcm/d vs the 74 mcm/d Gazprom typically supplies this time of year
- While Russia has recently announced additional export support for Europe, ongoing geopolitical tensions may continue to impact supply

Russia Flows Into Europe



Natural gas storage and imports from Russia were identified as two factors that would heavily influence commodity prices in the near- to medium-term. The recent escalation in Russia-Ukraine tensions is underscoring the importance of these factors to price stability (or lack thereof).

Source: S&P Global, Bloomberg, Goldman Sachs Global Investment Research, Wood Mackenzie, EntsoG

1. Margins calculated based on peak power prices, regional natural gas prices and plant efficiency of ~50% (i.e., ~7,000 Btu/kWh heat rate)

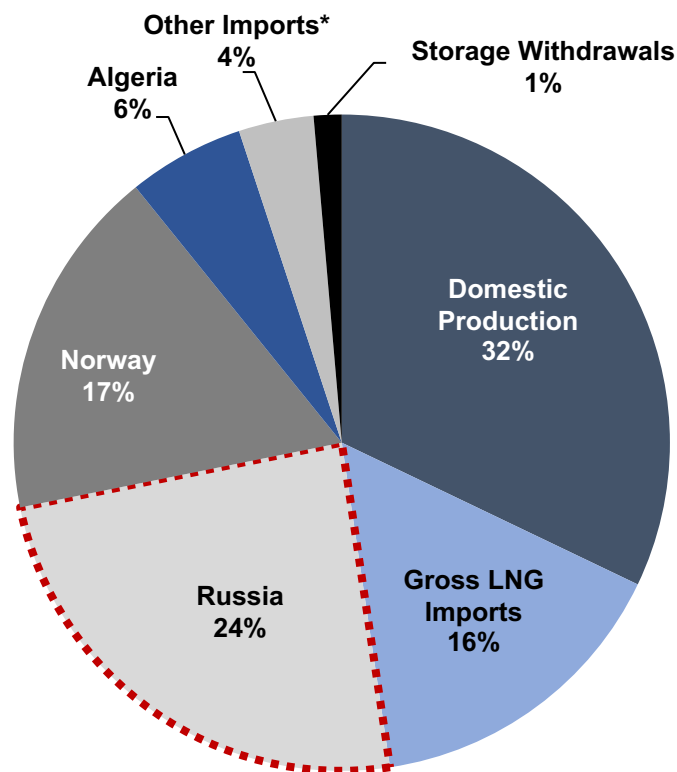
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How Important are Russia Imports to Europe?

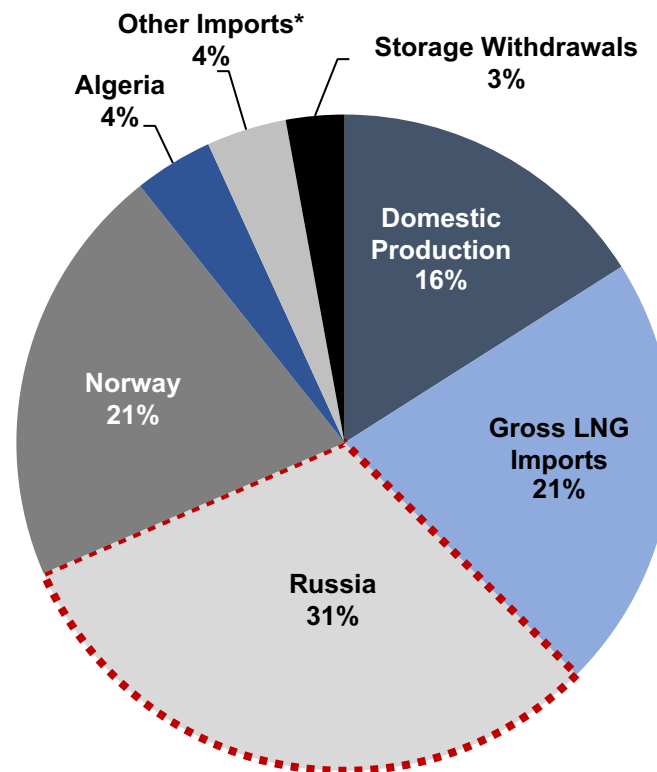
Despite increasing supplies from Russia, U.S. and Middle East, nearly 50% of natural gas consumed in Europe is from domestic resources

Historical European Natural Gas Supply by Source (2010)



Total European Gas Supply: 561 Bcm

Historical European Natural Gas Supply by Source (2020)



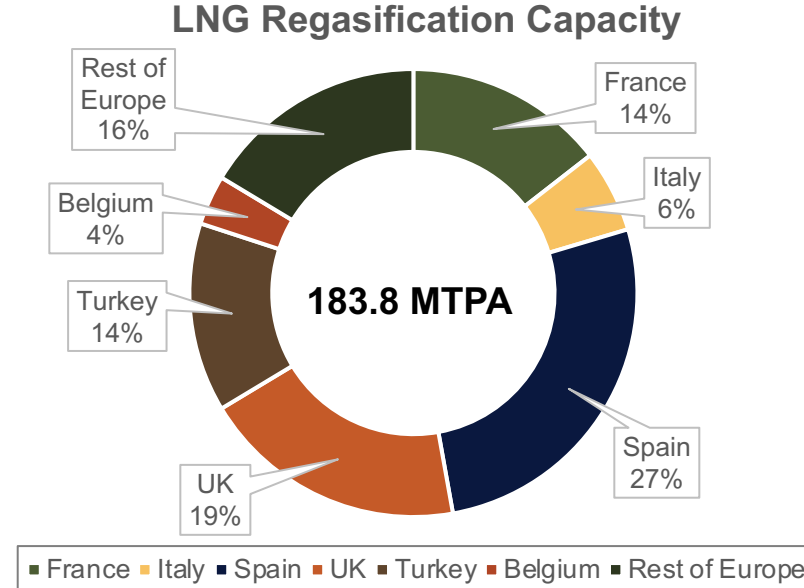
Total European Gas Supply: 532 Bcm

While Russia's share of European natural gas supply has increased in the past decade, there are alternate sources of natural gas to which Europe has access

Source: Wood Mackenzie, IEA, ENTSG, official statistics, TSOs, utilities

* Other represents Libya, Azerbaijan, and Iran

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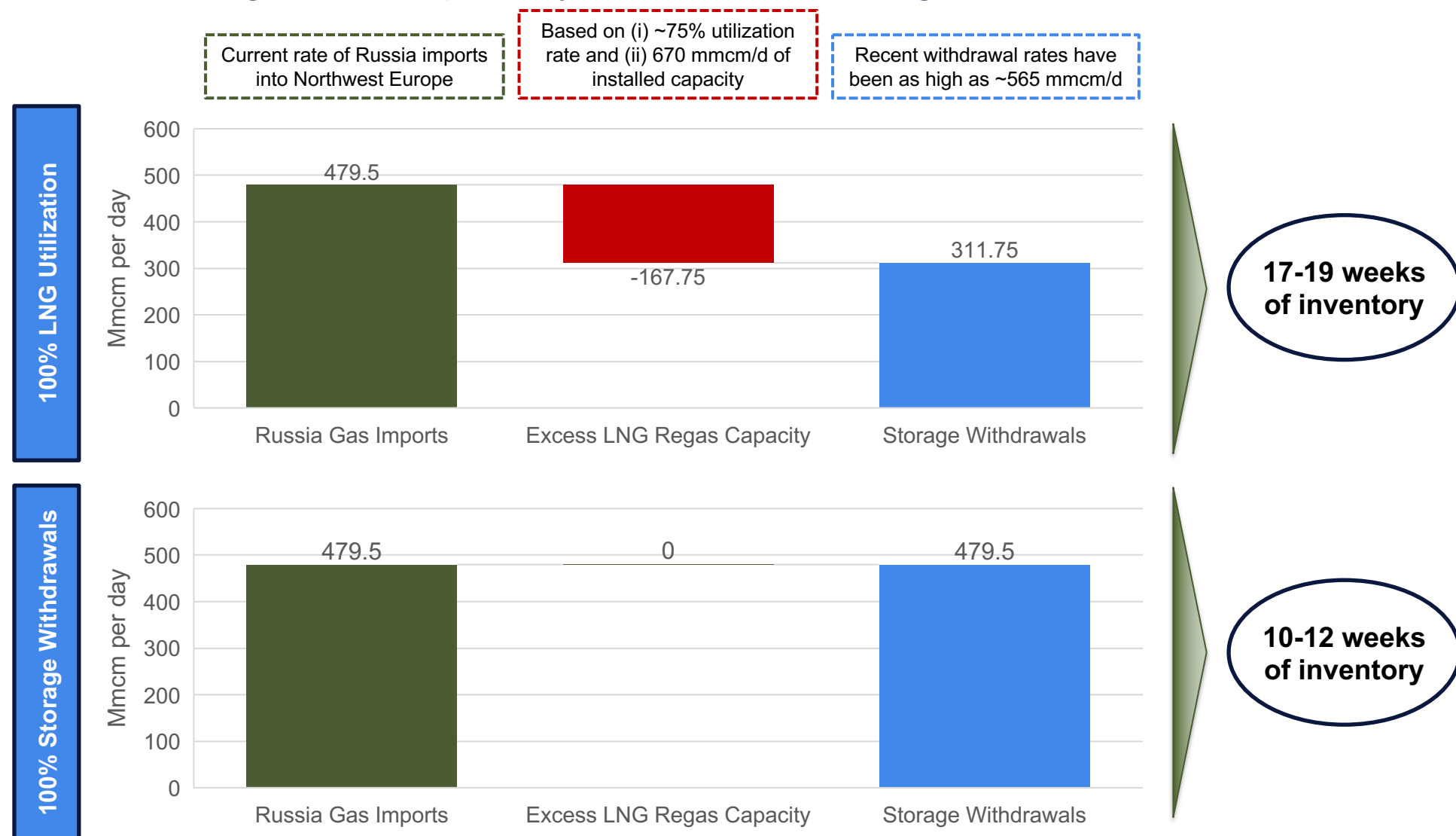
LNG utilization rates have increased over the past 12 months as a result of (i) increasing demand for natural gas from power producers and (ii) continued production declines from domestic resources

Sources: International Group of Liquefied Natural Gas Importers, 2021. S&P Global Platts, January 26, 2022. Reuters, January 31, 2022. Wood Mackenzie, February 10, 2022.

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For How Long Can Europe Rely on LNG and Storage?



With ~40 Bcm of storage inventory as of late January 2022, Europe could face a natural gas shortage within 10-12 weeks without incremental LNG cargoes if Russia halts all natural gas exports; the immediate impact of a complete Russian stoppage would be even greater commodity price volatility across the region

Sources: International Group of Liquefied Natural Gas Importers, 2021. S&P Global Platts, January 26, 2022. Reuters, January 31, 2022.

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What Could Happen if Russia-Ukraine Tensions Escalate?

Increased commodity prices and greater volatility in such prices are likely

1

Storage Withdrawals Likely to Persist

- January 2022 storage levels at historically seasonal low level <50% (4-6 weeks earlier than average year)
- “First line of defense” on sudden disruptions to LNG and/or pipeline imports

2

Increased Volatility in Natural Gas Prices

- Uncertainty around source of supply and amount of supply available should create more volatility in prices
- Offset to a spike in TTF prices would be a moderate to cool winter for rest of the season

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Alternatives to Gas Power Plants May Be Required

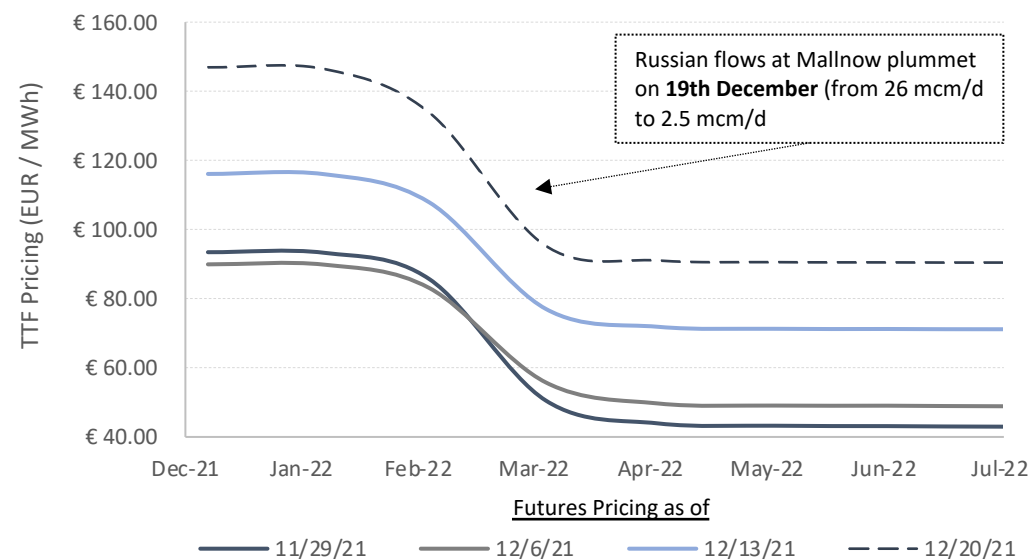
- Countries – UK and France – dispatching coal plants in excess of emissions limits to provide reliable power
- Negative implications from ESG perspective

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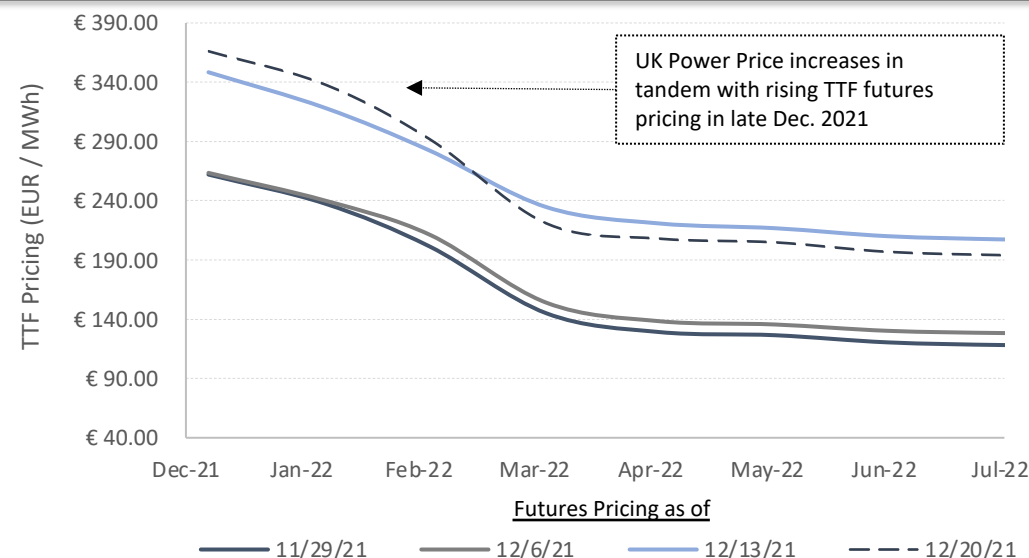
Upward Pressure on Power Prices Across Region

- With higher natural gas prices, power prices are expected to increase, on average
- Shifting to other technologies (coal, diesel) could create further dislocation in pricing market

Recent Evidence of Russian-Linked Volatility in TTF Futures



Late-December TTF Spike's Knock-on Effect Seen in UK Power Pricing

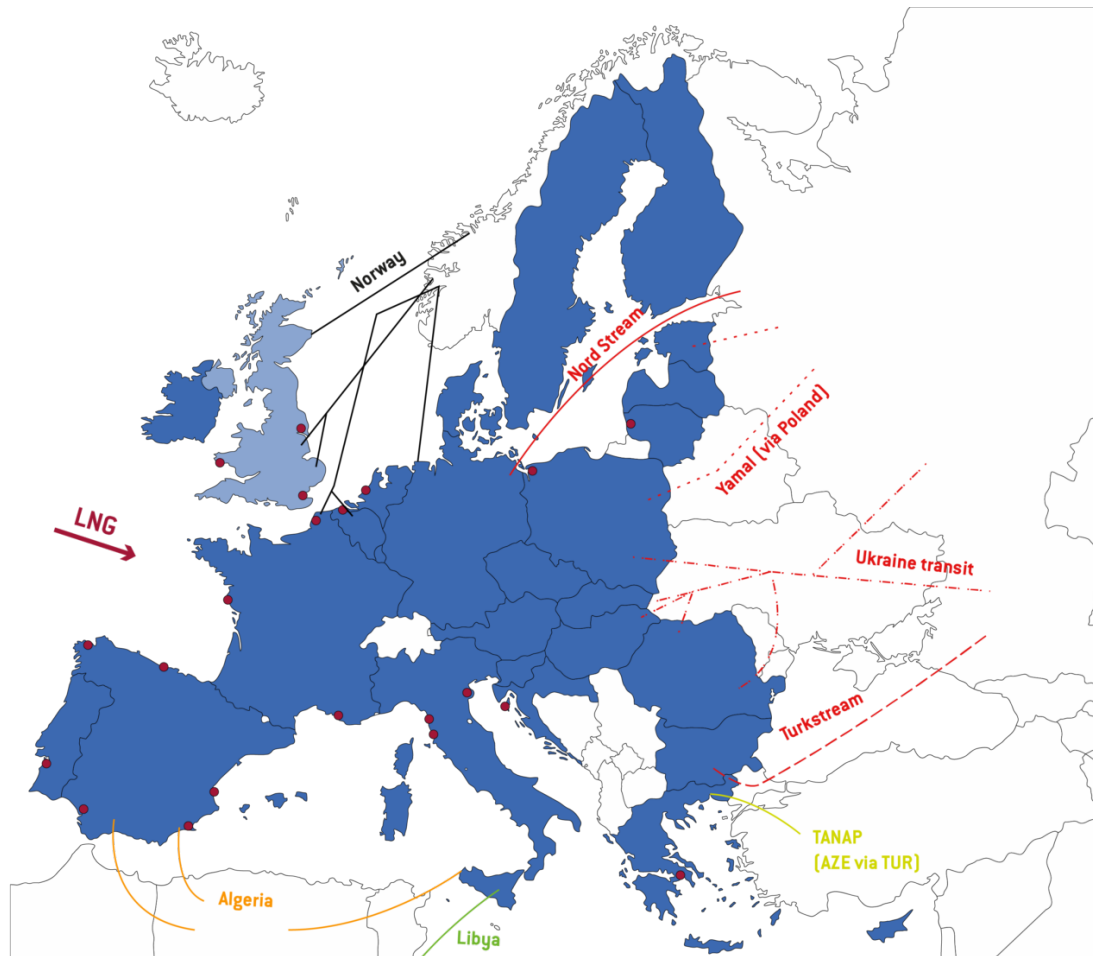


Sources: Washington Post, January 14, 2022.

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Western Europe Natural Gas Market Landscape

Given the decline in domestic production, Western Europe has developed significant interconnections with gas producers to the North, East and South



- Availability of natural gas comes from six key sources:
 - **Russia:** Four pipelines delivering gas via
 - North Sea (Nord Stream): 151 mmcm/d
 - Poland (Yamal): 90 mmcm/d
 - Ukraine (Transgas): 114 mmcm/d
 - Turkey (Turkstream): 86 mmcm/d
 - **Norway:** Seven pipelines delivering gas to Belgium, France, Germany and UK
 - **Algeria:** Seven pipelines delivering gas to Italy and Spain
 - **LNG:** 37 regasification terminals across the continent, with ~60% of capacity in France, Spain and UK
 - **Storage:** 113 LNG storage tanks totaling 11.2 mmcm of capacity
 - **Domestic:** Production in the North Sea, which has been in steady decline over the past decade and acts as “swing” supply in the winter months (high demand)

Europe has an extensive network of import pipelines – however, the cheapest gas is sourced from Russia, Norway and Algeria and the marginal unit is sourced from U.S. LNG exporters

Source: Bruegel, February 1, 2022. Gazprom company website, February 2, 2022. International Group of Liquefied Natural Gas Importers, 2021.

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