

Natural Gas Balance in Europe: Germany as a Case Study

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Abstract

Russia's invasion of Ukraine on February 24, 2022 compromised security of supply for natural gas in Europe. The balance of 2022 was aimed at bracing for a potentially difficult winter marked by high prices and considerable uncertainty. While the winter has not been as bad as it could have been, the situation is far from settled. Future natural gas supply faces tremendous precarity due to the substantial reduction in Russian gas imports. Germany, the EU's largest economy, is a microcosm of the European natural gas market and of the current and future issues facing Europe. Natural gas is important for manufacturing, so compromised imports will continue to have an outsized effect on both gas availability and economic performance for the EU as a whole. In order to assess the potential outcomes for natural gas market balances this winter and next in Germany, we constructed three demand-oriented scenarios: (1) cold winter 2022-23, (2) mild winter 2022-23, and (3) an extreme case. Herein, we describe the key takeaways from these scenarios and highlight some critical points.

Framing the Issue

Europe spent the balance of 2022 bracing for a potentially difficult winter. Natural gas supply, in particular, faced, and continues to face, tremendous precarity due to the substantial reduction in Russian gas imports. A combination of new liquefied natural gas (LNG) imports and additional pipeline supplies from other producing regions together are not sufficient to make up for the nearly 40% market share that Russian gas volumes recently occupied (see Figure 1). As such, Europe will need to employ a combination of fuel-switching and demand-rationing to weather the storms of this winter and the balance of 2023 into next winter.

The difficulties do not end with winter 2022-23. The risk of natural gas shortages and high price burdens on European consumers will likely persist, as all signs point to even greater difficulties the following winter. The lingering impacts of reduced Russian gas supplies to Europe will have spillover effects for the world. Already, European demand for LNG imports has forced LNG prices to unprecedented highs, driving a redirection of marketed volumes away from Asia to Europe. This stands in stark contrast to the status quo that

generally persisted previously, where Europe was viewed as a "market of last resort" for global LNG volumes.¹ Indeed, European LNG terminals operated at maximum capacity in an effort to fill storage for this winter.²

Germany in Focus

Germany is a microcosm of the European natural gas market and of the current and future issues facing the EU. Figure 2 shows Russian gas supply to Germany. As the EU's largest economy, much of which relies on natural gas for manufacturing, Germany has an outsized effect on both gas availability and economic performance for the EU as a whole. Over the past decade, Germany has accounted for as much as one-quarter of all natural gas imports to the EU in any given year, and for one-third of all imports to the EU from Russia. As such, anything that affects the natural gas market in Germany is likely to have ramifications for the EU as a whole.

Regarding the German gas market, imports of Russian natural gas have accounted for at least 40% of supply since the 1990s. This reliance has been fortified in recent years by two pipeline projects for direct delivery of Russian gas into Germany:

- Nord Stream 1, a pipeline that began operations in 2011 with 55 billion cubic meters per year (bcm/y) capacity, and

This brief initially came with an interactive dashboard that provides tools to assess the potential outcomes for natural gas market balances in Germany. <https://www.bakerinstitute.org/german-natural-gas-market-balance-dashboard>
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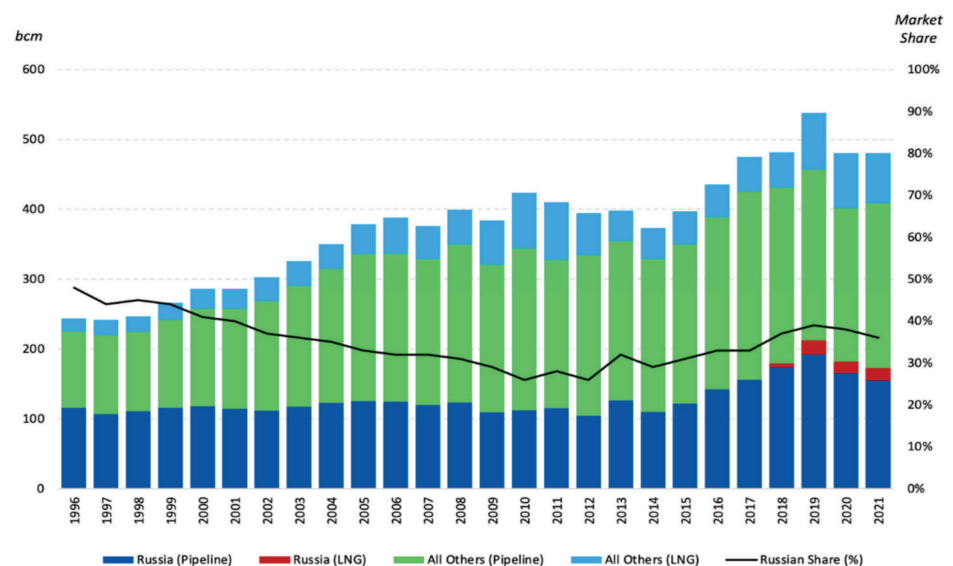


Figure 1. Natural Gas Imports to the European Union and Russian Market Share of Total Supply
Source: Data are taken from CEDIGAZ.
Note: bcm = billion cubic meters.

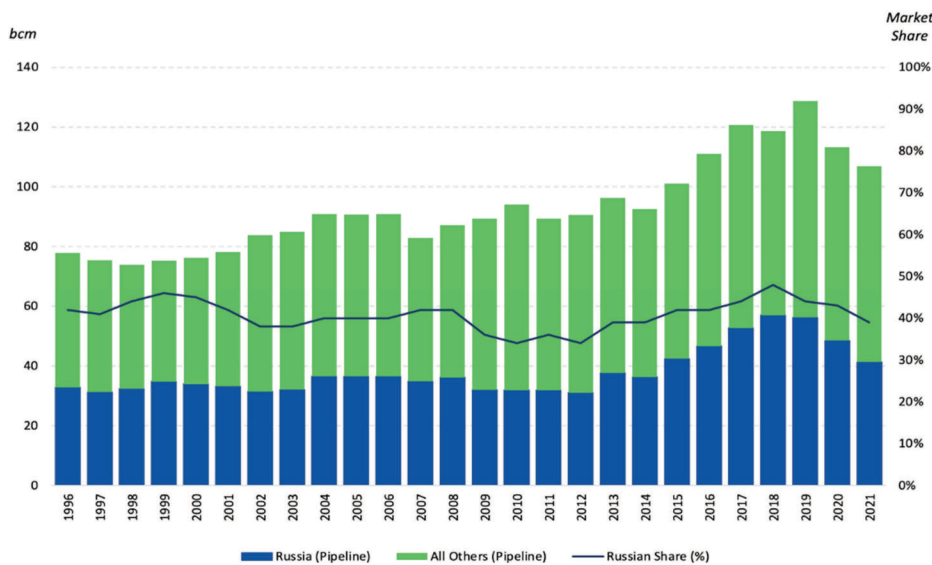


Figure 2. Natural Gas Imports to Germany and Russian Market Share of Total Supply

Source: Data are taken from CEDIGAZ.

Note: Germany re-exports some of its imports to neighboring countries, so not all of the imported volumes are consumed domestically.

- Nord Stream 2, a pipeline completed in 2022 but never commissioned, which would have added another 55 bcm/y of capacity for Russian-sourced imports.

While Nord Stream 2 was not commissioned, its mere existence promised additional volumes, abating investments in other sources of supply into Germany. If Nord Stream 2 had been commissioned and become fully operational, the pipeline together with Nord Stream 1 could have satisfied Germany's entire annual gas demand and provided some gas for re-exports. Both pipelines were portrayed by Germany as a part of the EU's gas market diversification efforts away from transit country risk, i.e., the diversification of gas transit away from Ukraine that both Russia and Germany had considered to be unreliable. At the same time, the need for diversification of suppliers — in particular via LNG imports — was dismissed on the basis of high costs compared to Russian supply.

The notion that Europe would move away from fossil fuels, including natural gas, had also dampened interest from policymakers and corporations in developing long-lived import infrastructures underpinned by long-term supply contracts. Indeed, this perspective was actively reinforced by energy transition policies advanced by most countries in Western Europe. In Germany, the policy of *Energiewende* (energy transformation) was aimed at facilitating the goal of economy-wide decarbonization. Low-cost natural gas from Russia was considered a bridge fuel that would help reach its goal, particularly since the German plans for the energy transition also required phasing out the country's nuclear fleet by the end of 2022. Importantly, while Germany has been the most aggressive of European countries in its effort to eliminate nuclear power, the attitudes of other European countries have been largely ambivalent. Even France, which is very dependent on nuclear

power for its energy needs, had not been proactive in maintaining or rebuilding its aging nuclear power fleet until the current energy crisis.

The “wind drought” in the fall of 2021 stoked fears about a lack of sufficient redundancy in the European energy mix.³ Then, with Russia's invasion of Ukraine, Russian President Vladimir Putin threw a boulder into the proverbial pond of European energy policy. Energy security moved to top-of-mind for most European policymakers and the general public. In March 2022, merely two weeks after the invasion, natural gas and nuclear energy were both somewhat back in favor, and declared “in-line with EU climate and environmental objectives” by the European Commission Directorate General for Financial Stability, Financial

Services and Capital Markets Union.⁴ In turn, an accelerated emphasis on bringing more LNG import capacity online emerged.⁵

While floating storage and regasification units (FSRU) have been mobilized as near-term opportunities to bring more LNG into Germany, there is limited capacity along LNG supply chains to do more in the near term. A lack of *spare* LNG liquefaction and tanker capacity drove the LNG market into a very tight situation, so much so that large Asian buyers redirected cargoes to Europe and rationed their own demands. Germany (and Europe more generally) has been faced with the unavoidable outcome of having to use other fuels to sate its energy needs and/or ration its own gas demand, particularly industrial demand.⁶ According to Bundesnetzagentur, industrial demand in October 2022 was 27.4% lower than the average from 2018 to 2021, a time period that included the COVID-19 pandemic.⁷ High energy prices have many companies, like Germany-based BASF, considering relocation to countries like the U.S. and China. This does not bode well for the future of the German economy, nor, by extension, for Europe as a whole.

Scenario Analysis: Revelations about this Winter and Next

In order to assess the potential outcomes for natural gas market balance in Germany, we constructed three demand-oriented scenarios: (1) cold winter 2022-23, (2) mild winter 2022-23, and (3) an extreme case in which this winter and the next are colder than normal, with a warmer than normal summer. We then evaluated the implications of LNG imports and storage policies in each scenario. The tool for analysis and a technical note to explain the modeling effort [can be accessed here](#).⁸

Herein, we describe the key takeaways from these scenarios and highlight some critical points. Across the three scenarios, imbalance is inevitable — even in a mild winter — and the imbalance can only be rectified through fuel-switching and demand-rationing. In this regard, LNG imports are critical for market balance in every case considered, as two German FSRU terminals in Wilhelmshaven and Brunsbüttel will bring an additional import capacity of 16 bcm/y.

Storage targets that bring inventories to near-full capacity are helpful. They provide a form of insurance that can alleviate shortages during winter periods, but they are not enough by themselves.⁹ In fact, the analysis indicates that the combination of new LNG imports and full storage will still require other active margins of response — fuel-switching and/or demand-rationing — even with a mild winter.¹⁰ If the winter is colder than average, the situation tightens significantly.¹¹ To date, the mild winter scenario has been playing out.

One margin that Germany can consider is its exports to neighboring countries. Specifically, Germany can flex these down to minimum historical levels, which is the assumption in the scenarios we constructed. However, depending on realized demand across all of Europe, this could put pressure on gas market balances in Germany's neighboring regions as well. The political and social fallout that could result might weaken European resolve to completely wean itself from Russian natural gas.¹²

In all of the scenarios we considered, the demand outlook is critical for assessing costs. The 2023 demand forecast is 73.5 bcm for the mild winter 2022-23 scenario, 90.0 bcm for the cold winter 2022-23 scenario, and 95.7 bcm for the extreme scenario. For comparison, demand in Germany was 93.6 bcm in 2021, 89.3 bcm in 2020, 91.8 bcm in 2019 and 85.5 bcm in 2018. Notably, while the mild scenario represents an extremely low-demand case relative to recent history, our analysis indicates that the market will only balance with proactive demand-rationing and/or fuel-switching.

Importantly, our analysis indicates that the gas market balance issues in Germany and throughout Europe will persist. It is likely that the balance of 2023 will be focused on refilling storage for winter 2023-24. In fact, refilling storage will become more difficult if this winter is colder than normal, as inventories will be drawn down more than is typical, and Russian gas will not be available to prepare for next winter. Replenishing depleted inventories in a supply-constrained environment will carry implications for demand-rationing and fuel-switching through the balance of 2023.

Concluding Remarks

The 2022-23 winter heating season is not over. The natural gas market balance remains precarious, particularly if the winter turns colder. Management will require fuel-switching, demand-rationing, and concerted effort to bring new gas supplies to Europe, all while policymakers must thread the needle of keeping energy supplies affordable. This will generally mean

that large industrial consumers will be the first to face interruption.

As we move beyond this winter, we already see issues arising for the balance of 2023 and into the next winter heating season. The historical reliance on Russian natural gas for energy balances has set the stage for difficulties to persist, and possibly worsen. This outcome follows from several factors. To begin, global LNG supply cannot be increased quickly enough to offset lost imports of Russian pipeline volumes. It takes years to permit, build and commission new LNG export infrastructure and the associated supply chains to deliver LNG to regasification locations. While FSRUs can serve as a near-term bridge for LNG imports, a casual reliance on FSRUs does not address the lack of sufficient global liquefaction capacity, the time to build new capacity, or constraints on the current availability of FSRU capacity. We already know that only about 6.6 million metric tons per year (mtpa), or 9.1 bcm/y, of baseload LNG capacity will enter global markets in 2023 (with 5.2 mtpa coming from Golden Pass in the U.S. and 1.4 mtpa coming from Congo-Brazzaville).¹³ This, however, is nowhere close to the amount of Russian pipeline gas that has been removed from the European market since the invasion of Ukraine. So, the global market will remain stressed, carrying implications for Europe and beyond.

In general, infrastructure and logistical constraints prevent the global market from adjusting rapidly to lost Russian gas volume into Europe. In particular, Russian gas cannot simply be redirected to other markets (e.g., China) due to the lack of alternative infrastructure. As such, there is no displacement opportunity whereby greater Russian pipeline volumes move into Asia and allow more LNG to be redirected from Asia to Europe. Hence, logistics and a lack of excess pipeline capacity prevent rapid, full adjustment.

In addition, by law the EU's natural gas storage must be filled to at least 90% by Nov. 1, 2023. Some countries have set even more aggressive requirements. In Germany, for instance, storage must be filled to 95% by Nov. 1. Such a legal imperative will result in the removal of supplies available to consumers during the non-heating season, since they are instead being injected into storage. This is likely to tighten markets throughout the year.

Finally, significant volumes were still flowing to Europe from Russia for most of 2022, which helped countries to fill storage in anticipation of the coming winter heating season. In 2023, these volumes are very likely to remain unavailable. As such, while the near-term emphasis should be on meeting heating demands for the remainder of winter 2022-23, winter 2023-24 may pose an even more difficult challenge.

Footnotes

¹ See, for example, Howard Rogers, *Does the Portfolio Business Model Spell the End of Long-Term Oil-Indexed LNG Contracts?* (Oxford: Oxford Institute for Energy Studies, 2017).

² Miles, Steven R., Gabriel Collins, and Anna Mikulska. 2022. *US Needs LNG to Fight a Two-Front Gas War*. Policy report no. 08.18.22. Rice Uni-

versity's Baker Institute for Public Policy, Houston, Texas. <https://doi.org/10.25613/GDVP-QN45>.

³ Nora Buli and Stine Jacobsen, "[Analysis: Weak winds worsened Europe's power crunch; utilities need better storage.](#)" *Reuters*, December 22, 2021.

⁴ Directorate-General for Financial Stability, Financial Services and Capital Markets Union, "[EU taxonomy: Complementary Climate Delegated Act to accelerate decarbonization.](#)" *European Commission*, February 2, 2022.

⁵ See Gabriel Collins, Kenneth B. Medlock III, Anna Mikulska, and Steven R. Miles, "[Strategic Response Options if Russia Cuts Gas Supplies to Europe](#)," Research paper 02.11.2022, Rice University's Baker Institute for Public Policy, Houston, Texas.

⁶ Tom Käckenhoff, Vera Eckert, and Christoph Steitz, "[As German gas rationing looms, industry begs exemptions.](#)" *Reuters*, August 9, 2022.

⁷ Bundesnetzagentur, "[Current Gas Supply Situation.](#)" accessed December 1, 2022.

⁸ In the appendix of the issue brief in the link, we provide the description of our modeling approach to analyze the German natural gas market. It includes demand, supply, storage, policy, and scenario. Using historical data, we estimate a natural gas demand function by linear regression, and forecast demand for different scenarios. Across the scenarios we make common assumptions regarding natural gas imports via pipelines, and each scenario has different assumptions

regarding weather. For policy analysis, we provide two storage paths to meet mandates and include LNG imports via new FSRUs.

⁹ German gas storage is 90.4% full as of January 15, 2023, which on its own can provide about one-quarter of annual consumption. [Aggregated Gas Storage Inventory](#).

¹⁰ Demand-rationing for natural gas is already taking place among commercial and industrial users. We, however, define realized rationing as the difference between industrial consumption and its historical minimum. Then, we assume that such demand-rationing will continue throughout the prediction period by applying the share of the rationed volumes to total consumption in Oct. 2022 (18.8%) to quantify demand-rationing that would occur regardless of market balance if such demand-rationing behavior were to persist going forward. Note that this is a somewhat conservative assumption providing a minimum bound in that we ignore the commercial side.

¹¹ We note that net withdrawals relative to gas in storage in every scenario not only fall within the historical range of net withdrawals, but are also less than the withdrawal capacity limit.

¹² See Perdana et al., "[European Economic impacts of cutting energy imports from Russia: A computable general equilibrium analysis.](#)" *Energy Strategy Reviews* vol. 44, 2022.

¹³ Miles, Steven R., Gabriel Collins, and Anna Mikulska, *US Needs LNG to Fight a Two-Front Gas War*.