KfW Research
Focus on Economics

Natural gas as a bridge to climate neutrality in Germany – a reassessment

No. 442, 24 November 2023

Author: Anke Brüggemann, phone +49 69 7431-1736, anke.brueggemann@kfw.de

The complete halt of piped Russian natural gas supplies to Germany marks a turning point for Germany's energy supply and requires a reassessment of the role which natural gas plays as a bridge on the path to climate neutrality. In the meantime, natural gas has become scarce and more expensive. The bridge function refers to the idea that natural gas should replace more carbon-intensive fossil fuels such as coal for a transitional period until sufficient quantities of renewable energy and green hydrogen are available.

A Prognos AG study commissioned by KfW Research revealed that the planned expansion of LNG infrastructure can secure Germany's natural gas supply for the long term. However, with a view to the coming winter, vigilance is still called for. Acts of sabotage or damage to European natural gas infrastructure, unforeseen cold spells or a stop of all natural gas supplies from Russia to Europe could make the situation more difficult again. Apart from building domestic infrastructure, what is relevant to Germany's LNG supply is the availability of the required LNG in the global market. With a view to the global supply situation, all scenarios raised in the study show that heavy competition for available LNG quantities might continue at least in the years 2023 and 2024. Taking into account all worst-case scenarios, tightness in natural gas availability should ease from 2026 at the latest. The same applies to gas price trends. Natural gas prices are expected to remain above the level preceding the energy price crisis for the foreseeable future – despite the significant decline in the current year – because Russian pipeline gas is being replaced primarily with imported liquefied natural gas. The necessary liquefaction process, shipping and regasification make this gas more expensive.

Risks from one-sided high dependencies on fossil fuel imports as well as the changed price path of natural gas have made the green transformation in Germany more urgent. Massive expansion of renewables and systematic advancement of energy efficiency are regarded as key strategies that ensure Germany's energy security and energy affordability while paving the way towards climate neutrality. The climate policy measures introduced by the government after the beginning of the energy crisis are likely to accelerate the decline in natural gas demand in Germany. Natural gas will therefore become a much narrower bridge but will not be eliminated. Its bridge function will remain important for both the energy sector and the basic industries in particular. For one thing, electricity from natural gas-fired power plants is to replace electricity from more climate-damaging coal in the short term until sufficient electricity from renewables is available. For another, natural gas-fired power plants are to temporarily back up the electricity system with their flexible output during periods of low renewable generation and high electricity consumption. Looking into the future, these back-up power plants will have to run on green hydrogen. In the steel industry, for example, natural gas enables a rapid uptake of climate-friendly production processes until green hydrogen is available in sufficient quantities (replacing the coal-based blast furnace route with direct reduction).

Germany's procurement of LNG to replace pipeline gas hardly changes the country's GHG emission balance because a large portion of the upstream emissions is assigned to exporting countries in accordance with the principle of origin. With a view to the impact on global GHG emissions it must be noted that although upstream emissions from the procurement of LNG are significantly higher than, for example, from pipeline gas from Norway, Russian pipeline gas supplies have similar GHG emissions as LNG owing to previously underestimated methane slip.

The faster the green transformation advances, the less natural gas Germany's economy will need. That is why measures that speed up the green transformation in Germany are the ones that make the bridge of natural gas narrower. Key prerequisites for the success of the transformation are (a) an appropriate risk-return profile for the necessary investments, (b) a suitable mix of instruments to finance investments, (c) faster planning and approval procedures, (d) securing long-term access to resources and production capacities required to make strategically relevant transformation technologies available, and (e) an upskilling campaign for the necessary skilled labour.

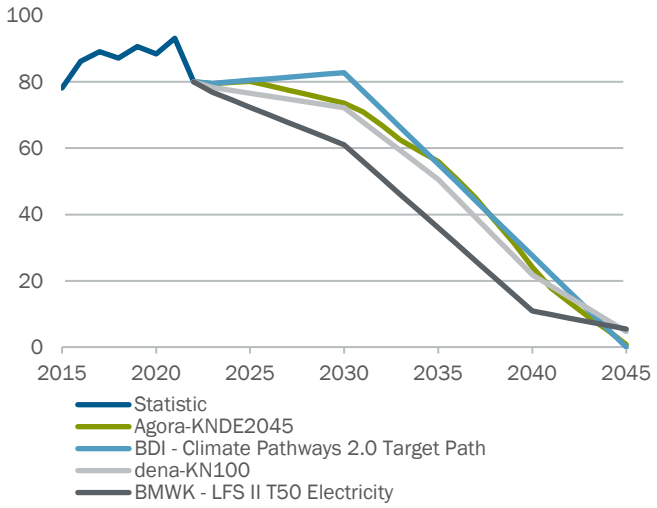
Russia's war of aggression against Ukraine calls for a reassessment of the bridge function of natural gas

The broad studies presented in 2021 – before the outbreak of Russia's war of aggression on Ukraine – which showed the transformation pathways for a climate-neutral Germany saw natural gas as an energy source that played an important role as a bridge in the transition from fossil fuel-based to green energy supply. Acting as a bridge means that natural gas should replace more carbon-intensive fossil fuels such as coal for a transitional period until sufficient quantities of renewable electricity and green hydrogen are available. Figure 1 outlines the predicted demand for natural gas in Germany over time for four selected climate neutrality scenarios. It shows that the scenarios are based on relatively high natural gas consumption up to the year 2030. Only thereafter will a sharp decline

appear in natural gas consumption, which is imperative for Germany to reach the target of climate neutrality by 2045.

Figure 1: Comparison of gas demand in Germany under selected climate neutrality scenarios before the energy crisis

In bcm (billion cubic metres)



Sources: Prognos (2023) on the basis of Agora Energiewende (2021), BDI (2021), dena (2021), BMWK (2021)[1]

Natural gas acts as a bridge primarily in the conversion sector. Most climate neutrality scenarios show electricity generation from natural gas increasing up to 2030. For one thing, the idea is for electricity from natural gas-fired power plants to replace electricity from more climate-damaging coal until sufficient electricity from renewables is available. For another, natural gas-fired power plants are to back up the electricity system with their flexible output during periods of low renewable generation and high electricity consumption. Looking into the future, these back-up power plants are expected to run on green hydrogen. For the manufacturing, building and transport sectors, on the other hand, the scenarios assume that most of the reduction pathways for natural gas will be ambitious already leading up to 2030. However, these reduction pathways are dependent on heavy electrification (for example with heat pumps for space heating and the generation of process heat with electricity instead of natural gas), so that as electricity consumption rises, the importance of natural gas as a bridge in the conversion sector continues to grow.

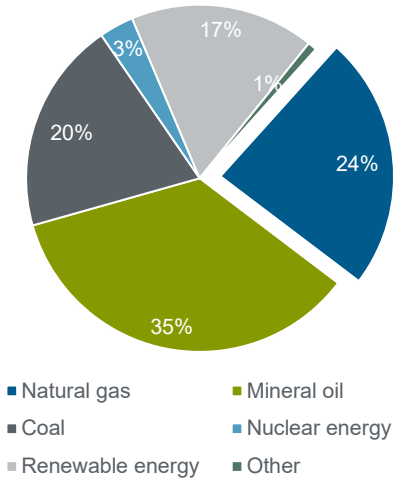
Russia's war of aggression on Ukraine marks a turning point for Germany's energy supply. As a result of the complete stop of Russian pipeline gas supplies, Germany is facing looming gas supply shortages and higher gas prices. This also calls for a reassessment of the bridge function of natural gas envisaged in the climate neutrality scenarios. Against this backdrop, KfW Research has commissioned a study which should deliver answers to the following questions: Will natural gas remain expensive and scarce in the long term? Given the new geopolitical situation, can natural gas continue to act as a bridge on the path towards climate neutrality in Germany? What strategic alternatives to natural gas as a 'bridge' are possible to achieve Germany's 2030 greenhouse gas reduction target while maintaining high energy supply security? What impacts does the natural gas crisis have on greenhouse gas emissions in Germany? In the following we summarise the key findings of this study[2] and complement them with our own analyses.

Natural gas savings and diversification of procurement sources prevented a gas shortage last winter

Natural gas currently still plays an important role for Germany's energy supply. It accounted for around one fourth of the country's total primary energy consumption in 2022 (Figure 2). Manufacturing is the largest single consumption sector with a share of around 36% in total gas consumption, followed by households (32%) and commerce, trade and services (13%), with natural gas used primarily for space and water heating in buildings. Twelve per cent of gas consumption went to electricity generation and 6% was used for district heating. Natural gas hardly plays a role at all in the transport sector. Germany's consumption fell by 15.7% in 2022 on the previous year, thus dropping to a consumption level last seen in the years 2014/2015. Strong increases in natural gas prices and the intense public debate about the need to reduce consumption in order to avert a supply crisis were the main reasons for this sharp decline.[3]

Figure 2: Primary energy consumption in Germany in 2022

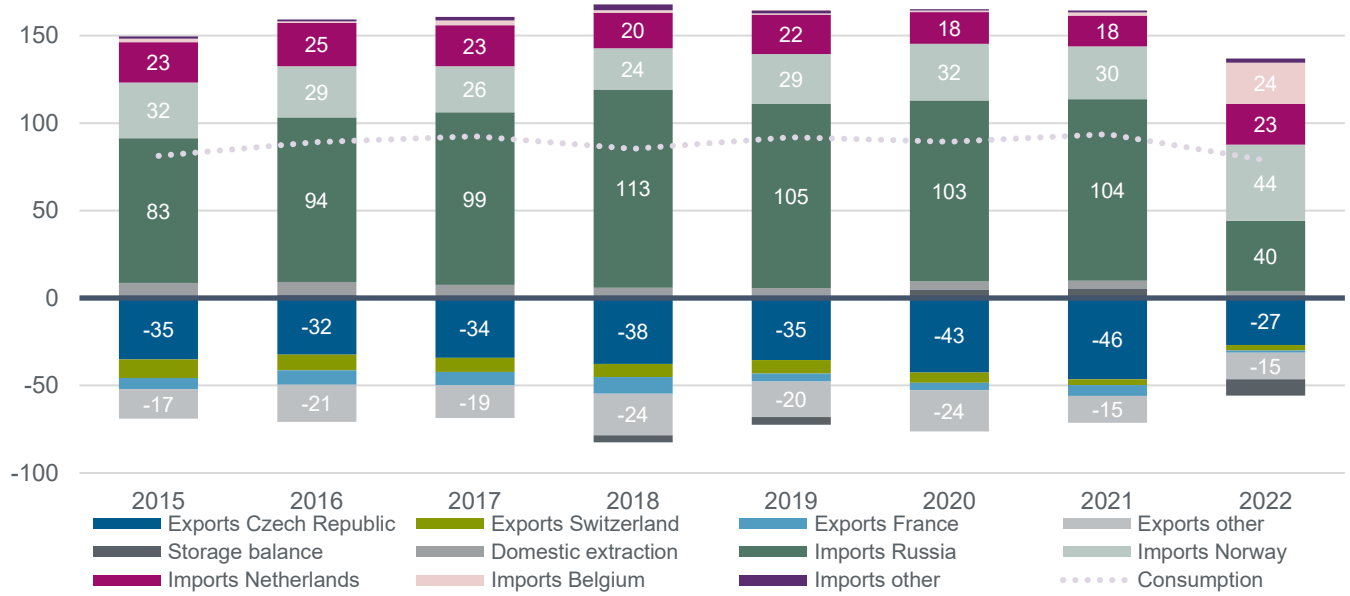
Total: 11,769 petajoules



Source: AG Energiebilanzen e.V (2023).

Figure 3: Germany's natural gas profile, 2015 to 2022

In bcm (billion cubic metres)



Sources: Prognos (2023) on the basis of Eurostat (2023), BNetzA (2023), ENTSOG (2023).

Germany is highly dependent on natural gas imports to satisfy its demand. Domestic natural gas production met only around 5.5% of demand in 2022.[4] Before the Ukraine war, Russia was the most important supplier country for Germany's natural gas imports. In 2021, the country provided around two thirds of all natural gas imports (see Figure 3). After gas supplies through the Nord Stream 1 pipeline and other border crossings (Mallnow, Waidhaus) were stopped, Russia ceased to supply Germany with natural gas in September 2022. This created considerable turbulence in the European natural gas market. Last winter Germany was able to avoid a gas shortage by diversifying procurement sources and sharply reducing consumption in businesses and households, as well as thanks to mild weather conditions. The shortfall in gas supplies from Russia was partly offset by increasing imports of pipeline gas from Norway and increasing LNG (liquefied natural gas) supplies from the world market through the LNG import terminals in the Netherlands, Belgium and France, which were then fed into the German gas pipeline network. In 2022, the US was the largest single LNG supplier for the EU-27, providing 25% of total LNG imports.

Germany is also an important transit country for pan-European gas trade. As a result of the gas scarcity caused by Russia's cuts to natural gas supplies, transit quantities last year fell by around one third on the previous year. In 2022 most exports from Germany went to the Czech Republic (56%), Austria (17%) and Switzerland (6%).[5]

Buildup of LNG infrastructure secures German natural gas supplies, but vigilance is still called for with a view to the next winter

Given that Russia has ceased to be a reliable natural gas supplier for the foreseeable future, and options for increasing pipeline gas imports from other countries such as Norway are limited, the political decision was made to build a domestic LNG import infrastructure in Germany. The aim is to overcome dependencies on individual natural gas suppliers and increase Germany's energy security. As at June 2023, eight floating storage and regasification units (FSRU) and three fixed onshore terminals were being planned, with three FSRUs already in operation (in Wilhelmshaven, Brunsbüttel and Lubmin) with a combined capacity of 13.5 bcm (see Table 1). Since the first FRSU went into operation in Wilhelmshaven in December 2022, Germany now has the capacity to import LNG directly. The idea is for the three FSRUs Brunsbüttel I, Stade I and Wilhelmshaven II to remain in operation until the fixed LNG terminals being built there go online. Provided the (onshore/ FSRU) LNG terminals being planned in Germany are realised as described, Germany will achieve a maximum annual LNG regasification capacity of 54 bcm in 2027. It will consist of the combined FSRU capacity of 20 bcm and onshore capacity of 34 bcm.[6] A total installed LNG import capacity of 37 bcm is currently expected to be in place for the winter of 2023/2024. For comparison: before the crisis broke out, each year approx. 40–50 bcm of natural gas was imported from Russia that remained in Germany. The planned LNG infrastructure thus enables full substitution of Russian pipeline gas supplies in the coming years.

Table 1: Planned LNG regasification capacity in Germany (as at June 2023)

Terminal type	Location	Start date	Capacity in billion m³	Operation time in years*	Operator	Government investment
FSRU	Wilhelmshaven I	Dec 22	5	10	Deutsche EnergyTerminal GmbH	x
	Wilhelmshaven II[1]	Jan 24	4.5	2	Deutsche Energy Terminal GmbH	x
	Brunsbüttel I[1,3]	Feb 23	7.5	4	Deutsche Energy Terminal GmbH	x
	Stade I	Jan 24	5	3	Deutsche Energy Terminal GmbH	x
	Lubmin I	Jan 24	5	10	Deutsche Energy Terminal GmbH	x
	Lubmin II[4]	Jan 23	10	8	Deutsche ReGas	Private
Onshore	Wilhelmshaven III[2]	2026	11	20	E.ON, TES, Engie	Private
	Brunsbüttel II	2027	10	20	Gasunie, RWE, KfW	x
	Stade II	2027	13	20	Hanseatic Energy Hub	Private

1) FSRU Brunsbüttel I, Stade I and Wilhelmshaven II will continue operating until the fixed onshore LNG terminal goes online
2) An additional green gas terminal is planned but not included in this table
3) Initial capacity of 3.5 bcm. Completion of the new connector at the end of 2023 will enable full utilisation of the 7.5 bcm capacity.
4) Initial capacity of 5 bcm in 2023, to be expanded to 10 cbm from 2024
* Operation times assumed by Prognos.

Source: Prognos (2023) on the basis of FNB-Gas (2022), BMWK report on plans and capacities of floating and fixed LNG terminals (2023).

Scenarios drawn up in the study for the development of natural gas demand and supply show that the planned expansion of LNG infrastructure can secure Germany's natural gas supply for the long term. The current gas supply situation in Germany has also eased significantly since autumn of 2022, as reflected in the high and still rising filling levels of gas storage facilities (100% as at 17 November 2023). Nonetheless, preparing for winter of 2023/2024 remains a key challenge.[7] Acts of sabotage or damage to European natural gas infrastructure, unforeseen cold spells or a stop of all natural gas supplies from Russia to Europe could make the situation more difficult again. For example, according to the Prognos analysis, supply security in Germany in 2023 could be jeopardised over the short term if Germany's gas demand were to rise again to pre-crisis levels and if, at the same time, a stop of the remaining Russian pipeline gas supplies to Europe (via the Ukraine transit corridor or the TurkStream-Pipeline) were to create the need to send gas to Eastern European countries through additional LNG transit supplies via Germany. In an extreme scenario in which not only Russian pipeline gas deliveries to Europe were to stop entirely but the largest pipeline between Norway and Germany were to be shut down, Germany could even experience a supply shortage up to 2025. In that case, gas consumption would have to be reduced much further. The commissioning of further planned LNG import terminals could then close the gap, but not until the year 2026. Under the impression of past events with the explosion of the Nord Stream I and II pipelines, a certain degree of probability may be attached to the occurrence of this extreme scenario with the loss of a pipeline, although a subsequent fast repair of the pipeline would be in the interest of all stakeholders as well.

Planned subsequent use of fixed LNG terminals for receiving green hydrogen and its derivatives aims to avoid stranded investments

The sizing of the LNG infrastructure expansion currently being planned by the Federal Government is not solely guided by Germany's forecast average natural gas demand but also serves to protect against unforeseeable events by creating a risk buffer. The aim is to strengthen the resilience of German and European energy supplies. Even so, even in the extreme scenario described above, it is possible that the onshore LNG terminals will have excess capacity from 2033 at the latest since natural gas demand can be expected to decline because of efforts to tackle climate change.

Revised in July 2023, the LNG Acceleration Act therefore requires land-based LNG terminals to provide proof of green readiness already during the approval procedure in order to avoid stranded investments.[8] This is to enable the subsequent use of the terminals to receive green hydrogen or its derivatives and to support the establishment of a forward-looking hydrogen infrastructure. To this end, components of facilities need to be designed from the outset to make sure that they are suitable to be retrofitted later for hydrogen and its derivatives. A study by the Fraunhofer Institute for Systems and Innovation Research examined the possible uses of LNG terminals for the import of green ammonia. The study estimated that 70% of the original investments in LNG terminals can be subsequently used for importing ammonia. It must be ensured that no nickel, copper or zinc compounds are used in tanks or equipment that will come into contact with ammonia in the future. As ammonia is heavier than LNG, the foundations must also be designed to carry future heavy loads. The additional cost of making an LNG terminal ammonia-ready is estimated at 7-12% of the capital expenditure.[9]

Prognos estimated the risks of lock-in effects in the form of higher carbon emissions from the development of an LNG infrastructure in Germany as rather low provided a coherent climate action policy is adhered to.[10] In accordance with Germany's target of reaching climate neutrality by 2045, lawmakers included a precautionary provision in the LNG Acceleration Act stipulating that the fixed LNG terminals may be licensed to operate with LNG only up to the end of 2043 and that their subsequent further operation is licensed only for climate-neutral hydrogen and its derivatives. The development of additional gas fields abroad for supplying Europe, however, poses more significant lock-in risks. Once fields are developed, there is a strong incentive for their operators to exploit their capacity for as long as possible regardless of global climate action efforts. European climate policy has very little to no power to influence such choices.[11]

Competition for available LNG quantities on the global market still expected to be strong in 2023 and 2024

Apart from building domestic LNG infrastructure, what is relevant to Germany's supply in the coming years is the availability of the required LNG on the global market. Against this backdrop, the Prognos study outlined scenarios for the development of global LNG supply and demand. With a view to the global supply situation, all the scenarios presented in the study show that heavy competition for available LNG quantities might continue in the years 2023 in 2024. Assuming demand remains on a level at which no further policy measures are adopted globally to reduce greenhouse gas emissions – and thus natural gas consumption – beyond those already in place (IEA STEPS scenario), global LNG demand from 2025 can be fully met by newer regasification capacity currently under construction or for which a final investment decision has already been made. If demand changes as a result of additional greenhouse gas reduction measures adopted by individual countries to achieve their climate neutrality targets (IEA APS scenario), demand can be fully met already from 2024 – if only just barely. An extreme scenario for the global LNG supply situation would occur if Europe were neither supplied with pipeline gas from Russia nor the expansion of the Power of Siberia 1 and the construction of the Power of Siberia 2 pipelines were realised for additional pipeline gas exports to Asia, and if demand developed in accordance with the STEPS scenario at the same time. In this scenario, the situation on the global market for LNG might not ease until the year 2026.

The analysis also revealed that EU-27 and Asia-Pacific countries in particular are competing directly today and will compete directly for available LNG quantities in the future, as was already evident in the LNG market in 2022. In all other regions of the world, regional natural gas production exceeds import requirements in the long term.

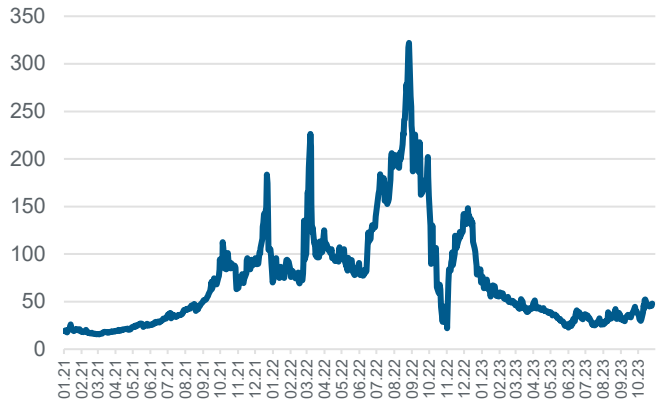
Gas prices have dropped noticeably since the energy crisis began but will remain above the pre-crisis level for the foreseeable future

There are currently many unknowns when it comes to forecasting gas prices. After European wholesale prices for natural gas had peaked at over EUR 300/MWh in early September 2022 as a result of Russia halting supplies via the Nord Stream 1 Pipeline, the gas price has in the meantime swung back to EUR 30–50/MWh in the course of the year 2023 (Figure 4). With that, however, the price still remains higher than in the years 2010 to 2019 (EUR 15–25 /MWh). For the future, the gas price level will depend mainly on the development of demand and the liquidity of the LNG market. If global demand continues to decline very steeply and at a constant rate, as is currently the case, the price scenarios assumed by Prognos predict that the gas price will remain on the current level. Should global demand for natural gas return to high levels again from the winter of 2023 onward, the gas price can then be expected to rise again (peaking at EUR 70/MWh) before easing again with a significant expansion of LNG supply in 2026.

LNG supplies will most likely set the floor for the gas price in the future, as already seen in 2022. Unlike pipeline gas, LNG incurs costs of liquefaction, shipping and regasification in addition to the pure procurement costs, so businesses and households will have to factor in a higher price level than before the energy price crisis for the foreseeable future. In the period from 2021 to 2022, the supply costs of LNG fluctuated between EUR 25 and EUR 36 EUR/MWh. The EU-wide gas price cap of EUR180/MWh can be assumed as a gas price ceiling. It is expected that this price level will be achieved again temporarily only if an unusual event occurs, such as the shutdown of an important natural gas pipeline.[12]

Figure 4: Development of the natural gas price (day-ahead prices)

In EUR/MWh (Trading Hub Europe, THE)



Source: Macrobond (2023).

Net zero scenarios prepared after the outbreak of the energy crisis point to a faster decrease in gas consumption

After the outbreak of Russia's war of aggression against Ukraine, Germany developed alternative climate neutrality scenarios. Whereas most scenarios modelled before the crisis provided for substantial use of natural gas as a source of energy until 2030, the scenarios prepared after the outbreak of the war are based on a faster and more even decrease in gas consumption (Figure 5). Supply risks associated with one-sided strong dependencies on fossil natural gas imports and the changed price path of natural gas have raised the urgency of the transition and are reflected accordingly in the new scenarios.

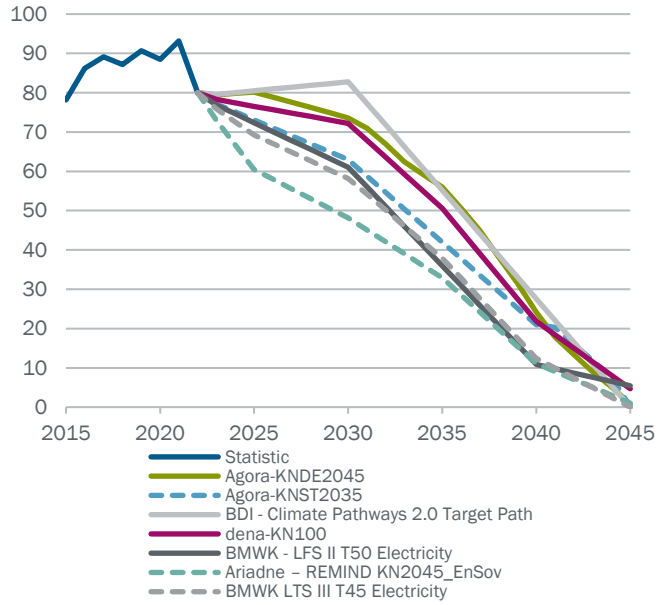
Approaches to reducing natural gas consumption in the sectors have been identified

In the building sector, key natural gas consumption reduction strategies identified by the climate neutrality scenarios are energy-efficient building refurbishments, electrification of heating systems with heat pumps and the supply of district heat through the connection of buildings to local and district heating networks that are increasingly converted for the use of renewable energy and waste heat. In most scenarios, natural gas heating systems disappear almost entirely by 2045. An exception to this is the dena scenario KN100. Among other things, it provides for injecting hydrogen into natural gas heating systems that must be hydrogen compatible.[13]

Figure 5: Gas demand in Germany under selected climate neutrality scenarios before and after the beginning of the energy crisis

In bcm (billion cubic metres)

Note: Scenarios represented by dashed lines were published after the outbreak of the war.



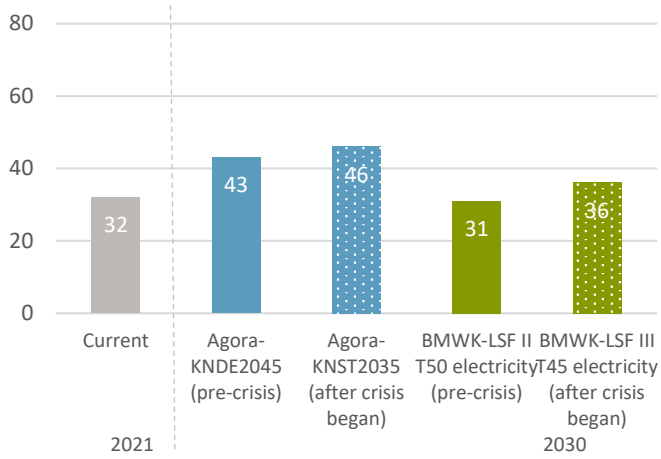
Source: Prognos (2023) on the basis of Agora Energiewende (2021, 2022), BDI (2021), dena (2021), BMWK (2021, 2022), Ariadne (2022).[14]

In the industrial sector, the most important area where natural gas is used today is in the supply of process heat, for example for steam generation or the operation of furnaces and drying facilities. Gas consumption can be reduced here by improving energy efficiency or through power-to-heat applications (for example electrode boilers or high-temperature heat pumps). Based on present-day knowledge, some areas of high temperature generation cannot be directly electrified, so that green hydrogen will need to be used here for combustion in the future in order to reach the net zero target. The use of climate-neutral hydrogen is also indispensable for significantly reducing process-related greenhouse gas emissions, especially in the steel and chemical industries. Primary steel production, for example, could become largely carbon-free if the currently prevailing coal-based blast furnace process were replaced by the technology of hydrogen-fuelled direct reduction.[15] Here as well, natural gas can act as a bridge fuel until green hydrogen is available in sufficient quantities by enabling a faster uptake of new, gas-based production processes. For example, green steel projects promoted by the Federal Government in Germany enable the use of natural gas for a transitional period and require the use of green hydrogen in the production process to increase over time. Even the injection of natural gas in direct reduction can lower direct carbon emissions by around two thirds compared with the blast furnace converter route.[16]

Electricity generation from natural gas will increase up to 2030, driven primarily by rising electricity demand arising from heavy electrification (for example, through the use of heat pumps and electricity for process heat). In order to avoid a strong increase in natural gas demand in the conversion sector, the scenarios prepared after the beginning of the crisis provide for a speedier expansion of renewables in order to satisfy growing electricity demand. Besides, some scenarios already envision the use of hydrogen for electricity generation on a small scale by 2030. With regard to gas-fired power plants, however, the scenarios before and after the beginning of the energy crisis both foresee undiminished capacity expansion. Figure 6 illustrates this by comparing the climate neutrality scenarios published by Agora Energiewende and the Federal Ministry for Economic Affairs and Climate Action before and after the beginning of the crisis as an example. Accordingly, the new scenarios assume an increase in gas power plant capacity from 32 GW today to 36–46 GW by 2030. New natural gas power plants must be hydrogen-ready because natural gas will increasingly have to be replaced by green hydrogen after 2030 in order to achieve the climate neutrality target.

Figure 6: Need for gas-fired power plants in the scenarios before and after the energy crisis

In GW



Sources: Prognos (2023) on the basis of Agora Energiewende (2021, 2022) and BMWK (2022).

In the future, gas-fired power plants will act as backup power plants. In a system with high levels of wind and photovoltaic solar energy, they will balance out the fluctuating output of these energy sources. Furthermore, they will have to make up for the lost capacity of coal-fired power plants in the short term. Although gas power plant capacities are being expanded for this reason, they only come online when generation from renewables is insufficient. Overall, these power plants operate at full capacity for increasingly fewer hours and, accordingly, burn less natural gas / hydrogen over time.[17] The climate neutrality scenarios published after the beginning of the energy crisis therefore do not eliminate natural gas as a bridge in the conversion sector; that bridge just becomes narrower as a result of lower gas consumption.

Germany has already embarked on a new path: measures have been adopted to speed up its energy transition

In the past one and a half years, the Federal Government has passed new laws and measures designed to speed up the energy transition in order to achieve the greenhouse gas reduction target for 2030 (-65% compared with 1990, situation in 2022: -40%) and, in this way, to also increase energy security by reducing dependence on fossil fuels. This means the energy transition in Germany is already on a different path than before the crisis. The role of natural gas will also change as a result of the climate policy measures introduced because

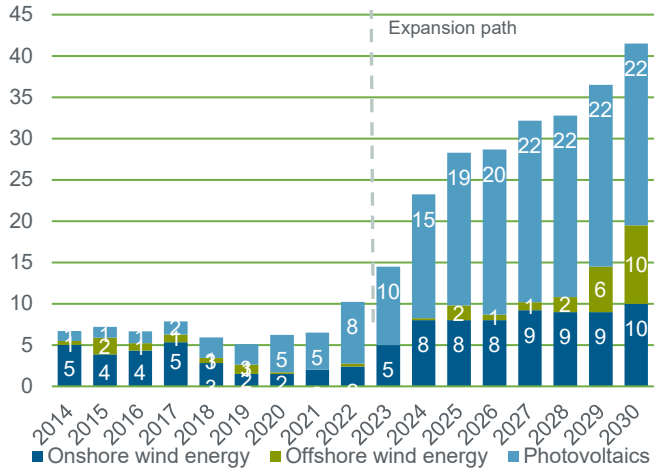
its consumption can now be expected to be lower in both the short and the long term.[18]

The measures already implemented include, among others, the revised Renewable Energy Sources Act (EEG) of 2023, the Onshore Wind Energy Act and the Offshore Wind Energy Act, all of which aim to significantly speed up the rate of expansion of renewable energy (RE). Sufficient availability of electricity from renewables is not just the foundation for decarbonising manufacturing, buildings and transport, but a cornerstone of Germany's energy sovereignty. With a view to the goal of increasing the share of renewables in gross energy supply from 46% today to 80% by 2030, the revised EEG 2023 corrected the expansion targets and tender quantities for the respective renewable energy sources significantly upwards. To this end, the domestic capacities of onshore wind generation are to double, photovoltaic (PV) solar generation to triple and offshore wind energy to nearly quadruple between now and 2030. This will require annual rates of expansion on an unprecedented scale in Germany (see Figure 7). The federal states and local governments are now also called upon to quickly realise space allocations required for wind energy by the Federal Government and to pursue legal options for accelerating approval procedures.

Further measures and laws designed to reduce the consumption of fossil fuels are to be implemented in the course of 2023. Among them are the Building Energy Act, the Municipal Heating Planning and Heating Network Decarbonisation Act and further measures for the climate-friendly transformation of industry.

Figure 7: Annual increase in photovoltaic, onshore and offshore wind energy capacity in Germany

In GW (gross increase)



Note: Historic data from 2014 to 2022, expansion path from 2023 in accordance with EEG 2023

Source: Prognos (2023) on the basis of EEG 2023 and AGEE (2022)

Echoing the existing climate neutrality scenarios, the Federal Ministry for Economic Affairs and Climate Action (BMWK) also sees the need for adding and upgrading controllable gas power plant capacity in order to ensure a high degree of energy supply security in the future. Specifically, it plans to put out to tender up to 15 GW of hydrogen-ready power plant capacity that can initially run on natural gas for a limited period of time and must be converted to hydrogen by 2035 at the latest. Of this capacity, 10 GW is to be put out to tender already in the years 2024 to 2026, 6 GW of which can be reserved for new power plants. The rest is available for retrofitting existing power plants for hydrogen. In addition, in the next few years the BMWK plans to put out to tender 8.8 GW for new power plant capacity and for the conversion of existing power plants that must run on hydrogen from the outset.[19] As the funding of the investment required for the new hydrogen-ready power plants is not secured in the current design of the electricity market owing to the expected low number of hours of full utilisation, the power plants will require additional pricing mechanisms. The BMWK is currently consulting with the EU Commission in order to explore a support scheme that complies with subsidy law.

Procuring LNG instead of pipeline gas will hardly alter Germany's total GHG emissions

What impact did the gas crisis have on Germany's greenhouse gas emissions in the past year? Despite higher greenhouse gas (GHG) emissions from the increased use of hard coal and brown coal in electricity generation, overall GHG emissions in 2022 fell by a moderate 1.9% on the previous year. The main factors that reduced GHG emissions were higher electricity generation from renewables (+9%) and the significant drop in energy consumption in the building and manufacturing sectors.[20] Electricity generation from renewables benefited from the fact that the rate of expansion picked up again in 2022. With around 8 GW additional capacity, the expansion of photovoltaic solar installations recorded particularly strong growth (see Figure 7). The steep increase in energy prices also lead to increased demand for heat pumps last year. Sales jumped from 154,000 heat pumps in 2021 to 236,000 in 2022.[21]

The industrial sector recorded the steepest drop in GHG emissions last year, at -10.4%. This was primarily due to production declines in energy-intensive sectors as a result of strong gas price increases.[22] It is possible that the use of natural gas in the industrial sector will grow again in the future on the back of improved availability and falling prices. However, should the energy price level remain high by international comparison, there is also a risk of energy-intensive production being moved abroad. In the future, besides energy efficiency, sufficient availability of electricity from renewables and green hydrogen at affordable prices will be a key factor for the competitiveness of German industry on the way to climate neutrality.

Germany's procurement of LNG instead of pipeline gas hardly changes the country's total GHG emissions because, in accordance with the principle of origin, a large portion of the upstream emissions (from extraction, liquefaction and, in part, shipping) is assigned to exporting countries. With a view to the impact on global GHG emissions (see Figure 8) it must be noted that although upstream emissions from the procurement of LNG are significantly higher than, for example, from pipeline gas from Norway, Russian pipeline gas supplies have similar GHG emissions as LNG owing to previously underestimated methane slip. Substituting Russian pipeline gas by LNG, for example from the US, is therefore not necessarily associated with higher GHG emissions.

Conclusion: The natural gas bridge will become narrower but not shorter

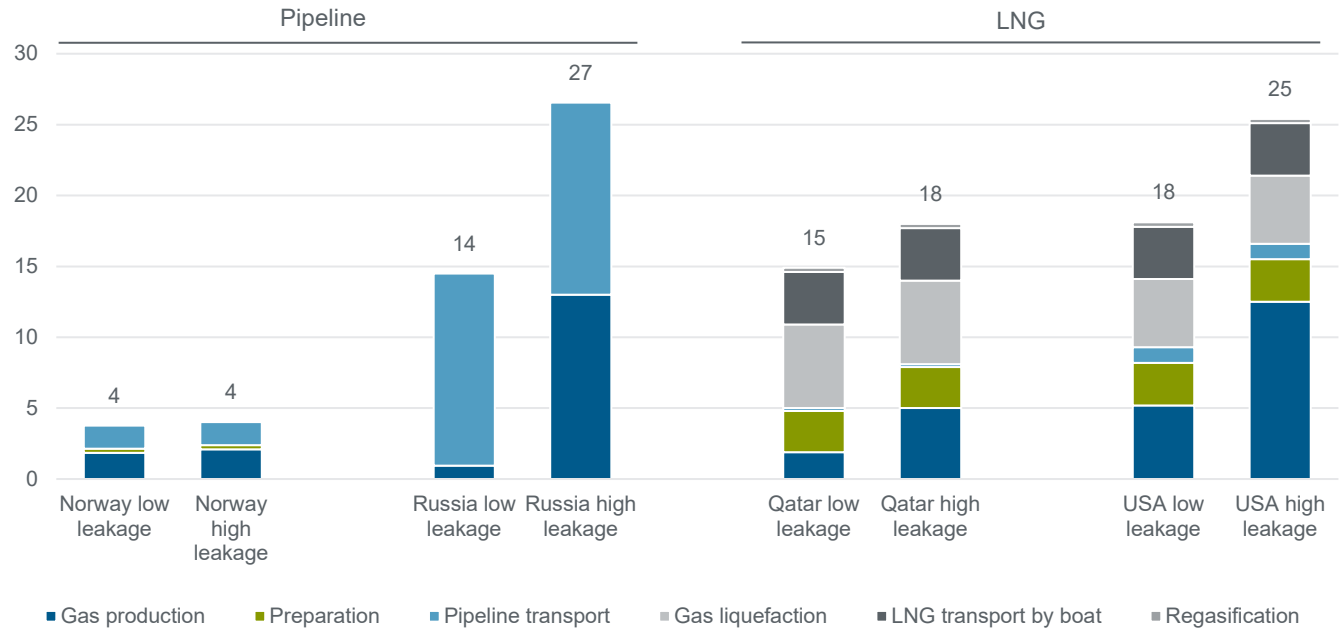
Risks to gas supplies as a result of Russia's war of aggression against Ukraine and the changed price path of natural gas have raised the urgency of the green transformation in Germany. Massive expansion of renewables and systematic advancement of energy efficiency are important key strategies that ensure Germany's energy security and energy affordability and pave the way towards climate neutrality.

The climate policy measures introduced by the government after the beginning of the energy crisis are likely to accelerate the decrease in natural gas consumption in Germany. Natural gas will thus become a much narrower bridge, but it will not be eliminated. Natural gas will remain important particularly for the electricity sector and basic industries such as steel until sufficient quantities of electricity from renewables and green hydrogen are available.

But the acceleration of the green transformation also creates enormous challenges that need to be overcome in order to effectively narrow the natural gas bridge. Key prerequisites for success are (a) an appropriate risk-return profile for the necessary investments, (b) a suitable mix of instruments to finance investments, (c) faster planning and approval procedures, (d) securing long-term access to resources and production capacities required to make strategically relevant transformation technologies available, and (e) an upskilling campaign for the necessary skilled labour.

Figure 8: Greenhouse gas emissions of upstream chains of natural gas by supply country

In g CO_{2e} per megajoule



Source: Prognos (2023) on the basis of German Federal Environment Agency (2019) and IEA (2022).

[1] Scenarios of the following studies were taken into consideration: Agora Energiewende et al. (2021): Klimaneutrales Deutschland 2045; (*Climate-neutral Germany 2045*); BDI (2021): Klimapfade 2.0 – Ein Wirtschaftsprogramm für Klima und Zukunft (*Climate pathways 2.0 – an economic programme for climate and future* – our title translation, in German); dena (2021): Aufbruch Klimaneutralität (*Awakening to climate neutrality* – our title translation, in German) BMWK (2021): Langfristszenarien für die Transformation des Energiesystems in Deutschland 2 (*Long-term scenarios for the transformation of the energy system in Germany 2* – our title translation, in German).

[2] For the full study see: Prognos - Srikandam, R.; Lübbers, S.; Bornemann, M.; Hobohm, J.; Mellahn, S and Wünsch, A. (2023a): Erdgas als Brücke auf dem Weg zur Klimaneutralität in Deutschland. Eine Neubewertung angesichts der aktuellen geopolitischen Lage (*Natural gas as a bridge to climate neutrality in Germany – a reassessment in the face of the current geopolitical situation* – our title translation, in German). Study commissioned by KfW.

[3] Cf. AG Energiebilanzen e.V. (2023): Energieverbrauch in Deutschland im Jahr 2022 (*Energy consumption in Germany in the year 2022* – our title translation, in German).

[4] Cf. ibid.

[5] Cf. Prognos (2023a): loc. cit.

[6] After the Prognos study went to print, it was announced that two more FSRUs were to go online in Mukran on the island of Rügen with a total capacity of 10–15 bcm by 2024/2025. Part of the capacity is to be met by moving the FSRU already in operation in Lubmin. It is possible that the total FSRU capacity may not change. But since the information about the project is unclear, this cannot be verified conclusively.

[7] Cf. Federal Network Agency: Aktuelle Lage der Gasversorgung in Deutschland (*Current gas supply situation in Germany* – our title translation, in German), accessed via https://www.bundesnetzagentur.de/DE/Gasversorgung/aktuelle_gasversorgung/start.html (as at 26 July 2023).

[8] FSRUs can be used more flexibly. Once the FSRUs initiated by the Federal Government are no longer needed at the current deployment locations in Germany within the term of their charter, a sub-charter can be entered into (for example outside Germany or for use as an LNG tanker to transport LNG).

[9] Cf. Prognos (2023a): oc. cit., on the basis of Fraunhofer ISI (2022): Conversion of LNG Terminals for Liquid Hydrogen or Ammonia.

[10] Cf. Prognos (2023b): Spezifikation der Lock-In-Thematik für die Frage von LNG-Importen nach Deutschland, Studie im Auftrag der Wissenschaftsplattform Klimaschutz (*Specification of the lock-in issue for the question of LNG imports to Germany, study on behalf of the Climate Action Science Platform* – our title translation, in German).

[11] Cf. Prognos (2023b): loc. cit.

[12] Cf. Prognos (2023a): loc. cit.

[13] Cf. Prognos (2023a): loc. cit.

[14] Scenarios of the following studies were taken into consideration: Agora Energiewende et al. (2021): Klimaneutrales Deutschland 2045; Agora Energiewende et al. (2022): Klimaneutrales Stromsystem 2035) (*Climate-neutral electricity system* – our title translation, in German); BDI (2021): Klimapfade 2.0 – Ein Wirtschaftsprogramm für Klima und Zukunft (*Climate pathways 2.0 – an economic programme for climate and future* – our title translation, in German); BMWK (2021): Langfristszenarien für die Transformation des Energiesystems in Deutschland (*Long-term scenarios for the transformation of the energy system in Germany* – our title translation, in German). BMWK (2022): Langfristszenarien III; Ariadne (2022): Deutschland auf dem Weg zur Klimaneutralität (Germany on the road to climate neutrality).

[15] Cf. Brüggemann, A. (2021): Transitioning to climate neutrality by 2050: a major challenge for German industry, Focus on Economics No. 322, KfW Research.

[16] Cf. German Steel Association (2021): Bedeutung von Erdgas für die Stahlindustrie und ihre Transformation (*Significance of natural gas for the steel industry and its transformation* – our title translation, in German). Position paper.

[17] Cf. Prognos (2023a): loc. cit.

[18] Cf. Prognos (2023a): loc. cit.

[19] Cf. BMWK (2023): Rahmen für die Kraftwerksstrategie steht – wichtige Fortschritte in Gesprächen mit EU-Kommission zu Wasserstoffkraftwerken erzielt (*Framework for power plant strategy is in place – important progress made in talks with EU Commission on hydrogen power plants* – our title translation, in German). Press release of 1 August 2023.

[20] Cf. German Federal Environment Agency (UBA) (2023): UBA-Prognose: Treibhausgasemissionen sanken 2022 um 1,9 % (*UBA forecast: Greenhouse gas emissions down 1.9% in 2022* – our title translation, in German). Press release of 15 March 2023.

[21] Cf. Bundesverband Wärmepumpe (BWP) e. V. (2023): Branchenstudie 2023: Marktentwicklung – Prognose – Handlungsempfehlungen (*Sector study 2023: Market development – forecast – recommendations for action* – our title translation, in German).

[22] Cf. German Federal Environment Agency (2023): loc. cit.