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Effects of a possible end to energy supplies from Russia on energy security and economic output

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↘ BOX 3

Effects of a possible end to energy supplies from Russia on energy security and economic output

The Russian war of aggression against Ukraine since 24 February 2022 has intensified the discussion of Europe's reliance on energy imports from Russia. A **ban on Russian imports of oil, natural gas and coal** has already been imposed by the **United States**, while the United Kingdom plans to cease oil imports from Russia by the end of 2022. The Western community of states has been struggling in particular with the idea of a gas embargo against Russia. The Federal Government is currently opposed to an energy embargo against Russia (BMWK, 2022a). However, the Federal Ministry for Economic Affairs and Climate Action (BMWK) is working on a strategy to reduce gas consumption (BMWK, 2022b). At the same time, Russia may decide to stop its energy exports to countries that are imposing sanctions.

Reliance of Germany and the European Union on energy imports from Russia

Russia plays **an important role as an energy supplier** not only to Germany but to the European Union as a whole. According to Eurostat, 27 % of crude oil, 44 % of hard coal and 38 % of natural gas imported into the 27 EU Member States in 2019 came from Russia. EU Member States are required to hold reserves of oil for emergency situations and these must, at a minimum, correspond to 90 days of net imports or 61 days of consumption – depending on which quantity is larger (European Commission, 2022a). It is unclear just how large the European Union's reserves of hard coal are. Some 2.6 million tonnes (MT) – roughly equivalent to three weeks of imports from Russia – are currently stocked in ports but additional reserves should be available at power plants (McWilliams et al., 2022b). A sufficient quantity of lignite is mined within Europe itself (McWilliams et al., 2022b). The markets for crude oil and coal are globally integrated. This means that oil and coal imports from Russia could be replaced by global market procurement if supply is suspended. The associated challenges of procurement and logistics are not discussed below. In contrast, the natural gas market is regionally segmented, which goes a long way towards explaining the significant regional differences in natural gas prices (Barbe and Riker, 2015). ↘ CHART 13 TOP LEFT Due to insufficient global transport capacities, Russian natural gas imports cannot be fully replaced in the short term, i.e., over the course of a year (McWilliams et al., 2022c).

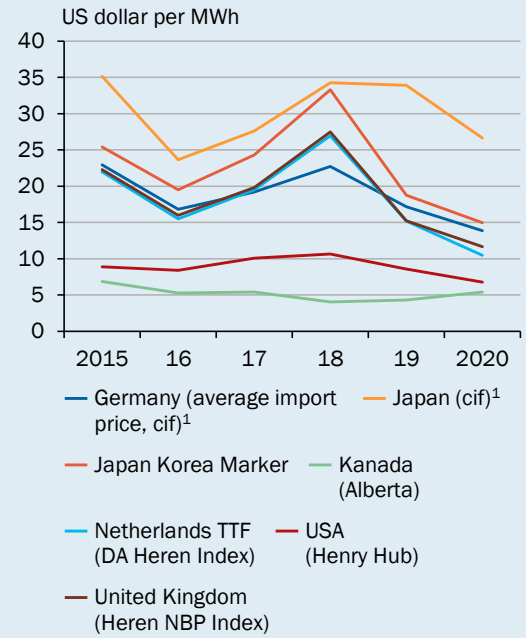
According to Eurostat, over 400 billion cubic metres of **natural gas** were consumed in the 27 EU Member States in 2019. A large portion of this – over 160 billion cubic metres (**40 %**), – was **imported from Russia**, ↘ CHART 13 TOP RIGHT with more than 46 billion cubic metres of this share being imported by Germany. According to Eurostat, this represented 48 % of natural gas consumption in Germany. However, Germany's reliance on natural gas from Russia is significantly lower according to the gas statistics published by the Federal Office of Economics and Export Control (BAFA) and the statistics on foreign trade published by the Federal Statistical Office. Between 2016 and 2020, gas imports from Russia accounted, on average, for 39 % of all gas imports into Germany according to BAFA (BAFA, 2022; BMWK, 2022c). One possible reason for the divergence in these figures is the different handling of re-exports and loop flows, i.e., volumes of gas that flow out of Germany and then re-enter the German grid elsewhere.

In recent years, the **supply of gas piped from Russia has declined** considerably. ↘ CHART 13 BOTTOM LEFT At the end of 2021 in particular, flows were falling compared to earlier years and had dropped to a very low level by the start of 2022. While Russia was continuing to meet its long-term contractual obligations, 2021 in particular saw a significant short-term drop in the volume of natural gas that was made available for purchase on the spot markets (Elliott, 2021). Natural gas imports from Russia have risen again since the start of the war in Ukraine. European **gas in storage** is currently at a low level of around 25 % as at 16 March 2022 (GIE, 2022), while

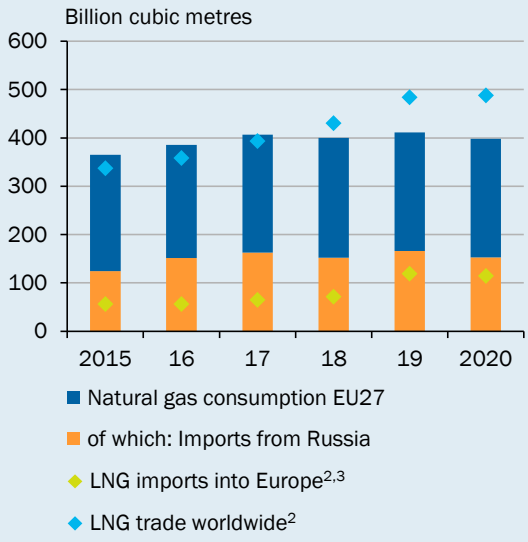
↘ CHART 13

Indicators of the natural gas market in Europe

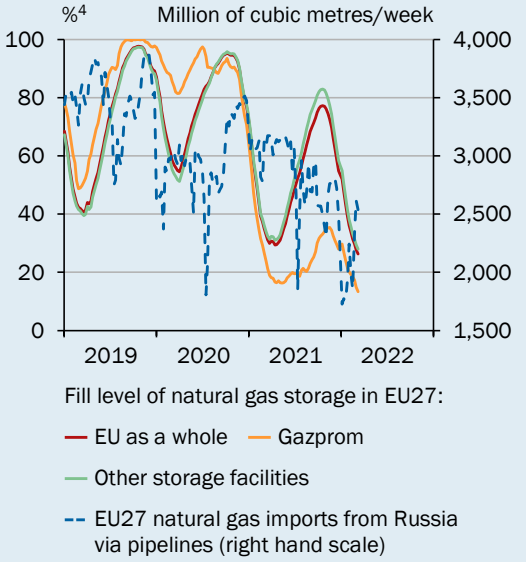
Natural gas prices vary between world regions



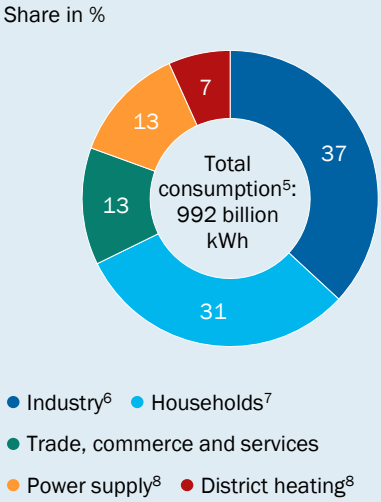
Consumption and import of natural gas in Europe



EU natural gas imports from Russia via pipelines and fill level of natural gas storage



Natural gas in Germany most consumed by households and industry in 2021



1 – Cost + insurance + freight (average prices). 2 – Liquefied Natural Gas. 3 – This includes all European countries, not just the EU27. 4 – In % of the relevant storage capacity. 5 – Provisional, differences in the totals due to rounding. Natural gas sales do not include the gas industry's own consumption. 6 – Including industrial power plants. 7 – Including housing companies. 8 – Including combined heat and power plants.

Sources: BAFA, BDEW, BP (2021), EDMC Energy, Energy Intelligence Group, entsog, Eurostat, Gas Infrastructure Europe (GIE), ICIS Heren Energy Ltd., OECD/IEA, S&P Global Platts, own calculations

the levels of gas stored in Russian-owned Gazprom facilities are significantly lower on average at 13 % as at 16 March 2022 (Zachmann et al., 2022). ↘ CHART 13 BOTTOM LEFT

Price effects

Since the start of 2022, the **price of natural gas on the European market** has climbed **by more than 35 %** (as at 17 March 2022), at one point sky-rocketing by over 200 % – a much greater rise than has been seen in the US market. ↘ CHART 7 LEFT On the supply side, the sharp price hike in Europe is primarily due to reduced natural gas exports from Russia. ↘ CHART 13 BOTTOM LEFT A further reduction or complete cessation of Russian supplies with a (partial) replacement with supplies from other sources (such as the import of liquefied natural gas, LNG) would drive the gas price higher again. Around 70 % of global trade in LNG is in connection with **long-term supply contracts** lasting 10 years or more (The Economist, 2022). The remainder is traded on spot markets and as part of short-term supply agreements. In total, 145 billion cubic metres of gas is traded for immediate delivery – a figure slightly less than the quantity supplied by Russia to the European Union in 2019. The prices of LNG could continue their upward trend due to scarcity accompanied by increased demand from Europe – although a portion of the price rise due to expectations of scarcity may already been included in current prices. Despite fragmentation of the markets, the increased demand in Europe is having an impact on prices in Asia. ↘ CHART 13 TOP LEFT This could reduce the demand for LNG from other regions of the world. In addition, the mandatory gas storage levels that are currently planned for Germany (Deutscher Bundestag, 2022) may temporarily drive prices up even further. Extracting larger quantities of gas in Europe should be possible only at those gas fields which have spare capacity (McWilliams et al., 2022c). Spare capacities can be found in Norway, the United Kingdom and the Netherlands (McWilliams et al., 2022c; Patterson and Zhang, 2022). Higher prices could induce higher extraction quantities.

The extent to which energy companies can pass on higher costs of procurement to their customers depends on the type of contracts in place and on the price elasticity of the demand. Burke and Yang (2016) estimate that increasing the consumer price of natural gas by 1 % would cause consumption to drop by 0.13 % for households and by 0.37 % for industry within one year. Given the **low price elasticity of the demand**, a sufficient short-term adjustment in the demand for natural gas in line with reduced supply is therefore unlikely. In addition, rises in wholesale prices are passed on to consumers after a delay rather than immediately.

In accordance with the principle of marginal pricing, the rising prices of natural gas contribute to an **increase in energy wholesale prices**. It is estimated that gas power plants determined the price in European energy markets during 30 % of hours in 2020 (Blume-Werry et al., 2021). However, energy prices vary significantly for the various economic players due to the diverse structure of supply contracts, as well as rates and levies. At the start of 2022, for example, the average energy price for German households rose by 12.5 % compared to the annual average for 2021, while the corresponding figure for small and medium-sized companies (SMEs) was 27 %, with this difference being explained by the lower charges and levies and thus the larger share of the wholesale price in the retail price (BDEW, 2022a). As the procurement costs for energy suppliers have continued to rise recently, further price increases are possible in the coming months (BDEW, 2022a).

The **price of mineral oil** has also **risen sharply** in the face of the crisis, i.e., by 36 % (as at 17 March 2022) compared to the start of the year. ↘ CHART 7 ↘ ITEM 10 As a result, the oil price is currently at a level similar to that in the period 2011 to 2014. Mineral oil is the most important primary energy source in Germany (German Environment Agency, 2022a). Most of the oil is used as a fuel in the transport sector, for heating or as a raw material in industry (German Environment Agency, 2022b). Therefore, the price rise may lead to increased costs in certain industries and for households. If imports of Russian oil grind to a halt, it may be possible to find an alternative source based on globally integrated oil markets. However, price pressure may

become even more intense. And even with mineral oil there are challenges to overcome in terms of transport within Europe and due to differences in oil quality depending on its origin. Moreover, an internationally coordinated approach is needed to reduce the demand for petroleum as soon as possible (McWilliams et al., 2022b). The potential to reduce demand is particularly high in the transport sector (IEA and OECD, 2018). If there is an import embargo on Russian oil, Russia could potentially divert its supply to China, although this would involve significantly longer freight routes. As recently as February 2022, Russia and China extended contracts for oil to be supplied via the Kazakhstan-China pipeline (Bloomberg, 2022). Several factors will determine whether China will purchase the Russian oil that is not imported by the West – including the price and how much oil from other suppliers can be displaced (Downs, 2022). In addition, some independent refineries in China are currently reluctant to purchase from Russia due to uncertainty over sanctions (Downs, 2022). The price differences of around 25 US dollars that are already evident would also imply a significant loss of income for Russia in this case. China, on the other hand, would be in a position to benefit from the low prices. Price rises on the global market and the scale of a possible subsequent increase in supply will depend on the extent of such a re-routing of oil supplies.

Alternative natural gas suppliers

With a potential cut-off of natural gas supplies from Russia, the question arises as to which alternative sources could be accessed by Europe. European gas extraction can only be expanded to a limited extent. For example, the Netherlands has cut back on gas extraction in recent years due to the risk of earthquakes. Imports from Norway and North Africa could be increased slightly (McWilliams et al., 2022c). Key considerations are the extent to which **LNG imports** (e.g., from the United States and Qatar) could at least partly replace Russian gas and how long it would take. Imports of LNG into Europe have already **increased** considerably in recent years. ↘ CHART 13 TOP RIGHT The European Union could intensify efforts to increase these imports, and these efforts could also be supported by procurement via other countries, such as Japan, South Korea and the United States. The degree to which LNG imports can be further increased depends both on the potential to expand **production capacities** (e.g., from the United States) in the short term, on the **transport capacities of the shipping fleets**, and on the European infrastructure, i.e., the **capacities of LNG terminals, liquefaction plants, and gas pipelines** for distributing the gas within Europe. Germany currently has no LNG terminals of its own. While two terminals are currently at the planning stage, it is likely to take several years for them to be commissioned. Another bottleneck is presented by the fact that Europe's system of pipelines is not currently designed to transport large quantities from the west to the east or from the south (e.g., Spain) to the north (McWilliams et al., 2022c). This means that the impact will be felt particularly strongly, not only in Germany but also in countries in eastern Europe that currently import a large share of their gas from Russia and only have limited capacity for LNG imports (McWilliams et al., 2022a).

Potential for saving and replacing natural gas

Due to the limited options for increasing supplies of natural gas from other countries, several economic experts (Hirth et al., 2022; Leopoldina, 2022; McWilliams et al., 2022a) have suggested that an end to imports of Russian gas will necessitate a **reduction in gas consumption in the European Union**. For one thing, price increases are likely to reduce demand to a certain extent. For another, additional measures to replace natural gas with other sources of energy will contribute to a reduction in demand. In the area of electricity supply, an **accelerated expansion of renewable energy** and storage options will only succeed in providing relief in the medium to long term – in other words, in a few years from now. In the short term, i.e., in the current year, partial replacement by **coal-based power generation** presents an option (Leopoldina, 2022). Delaying the closure of nuclear power plants has also been proposed as a means of replacing

Russian gas (IEA, 2022). In addition, measures to **increase efficiency** could be intensified, e.g., by means of heating settings in buildings, rapid replacement of old boilers and digital control of facilities, also in industry. Substantial savings could also be achieved through **information campaigns to reduce consumption** (Grimm and Kuhlmann, 2022; IEA, 2022; Leopoldina, 2022; McWilliams et al., 2022c).

The quantity of gas that can be saved by the various measures depends on what share of overall gas consumption is attributable to the various consumer groups. In Germany, industry consumes the **largest share** (36 %) **of natural gas, followed by private households** (31 %). ↘ CHART 13 BOTTOM RIGHT In industry, a large volume of natural gas is used as an energy source and a raw material in the chemical sector, for example. In addition, 14 % of gas consumption is used to generate electricity, which is particularly important during times of peak demand ("peaking power plants"). However, only a portion of this can be replaced due to the concurrent production of electricity and useful thermal energy in combined heat and power plants for example. Agora Energiewende (2022) predicts that, if Russian supplies of natural gas cease and if extensive energy-saving measures are implemented and additional supplies of gas are obtained from other countries, there will be a shortfall of 30 TWh for Germany in the short-term (meaning, in this case, up to winter 2023/24). A recent analysis conducted by the German Association of Energy and Water Industries (BDEW, 2022b) concludes that one-fifth of German gas consumption can be replaced in the short term. This corresponds to half the volume of gas imported from Russia, assuming that 40 % of gas consumed in Germany comes from Russian imports. An analysis by IEK-3 at the Jülich research centre (Forschungszentrum Jülich, 2022) concludes that approximately one-third of the Russian natural gas that is imported into Germany can be saved in the short term by private households, businesses, trade, services, industry and electricity generation.

In the **event of a physical shortage** of available gas, **emergency plans** (BMWi, 2019) are in place that prioritise gas supply for heat generation for private households as well as for the supply of critical infrastructure. In this scenario, there may be a decline in industrial production next winter (BDEW, 2022b; Leopoldina, 2022). Reducing gas consumption at an early stage, for example, by partially replacing gas-based power generation with coal-based power generation, may help alleviate bottlenecks next winter (Hirth et al., 2022; Leopoldina, 2022). Various analyses indicate that these precautionary measures need to be implemented with care to prevent Russia from viewing energy supply as a vulnerability in strategic negotiations (Hirth et al., 2022; Leopoldina, 2022).

According to recent **estimates by the International Energy Agency** (IEA, 2022), the European Union **can reduce its procurement of gas from Russia by up to one-third within a year** using measures that are compatible with the European Green Deal. These measures include, in particular, greater use of alternative natural gas suppliers, an accelerated switch to alternative energy sources and improved efficiency in energy usage by homes and businesses. According to the IEA, this approach could potentially reduce imports of natural gas from Russia by more than 50 billion cubic metres, despite the need to increase gas storage levels in 2022. A **reduction of 80 billion cubic metres in total (or around 50 %)** would be **possible** if additional measures were implemented that are not compatible with the European Green Deal, in particular increased coal-based power generation or use of crude oil.

If gas-based power generation is replaced by coal-based power generation, the EU Emissions Trading System (EU-ETS) in its current form could ensure that CO2 emissions do not rise as a result of this measure, because an upper limit for emissions in the power and industry sector is defined in this system. In this scenario, however, fewer emission allowances may be cancelled from the Market Stability Reserve. The additional demand for allowances would in principle increase their price, thereby burdening the companies in the ETS and their customers. This could create pressure to increase the number of allowances in the short term as a result of the crisis.

According to an **analysis by Bruegel** (McWilliams et al., 2022a), **gas consumption in the European Union will need to drop by 400 TWh (10–15 % of annual consumption)** if supplies from Russia are cut off. The analysts assume that LNG imports can be increased to the maximum capacity of the gas terminals – which is unlikely to be possible due to the inadequate piping capacities (e.g., from Spain to northern Europe). They also assume that the currently high level of imports from North Africa, Norway and Azerbaijan can be maintained. The analysts also indicate that incentives must be put in place to fill gas stores over the summer, which is likely to require regulatory intervention. The Leopoldina (German National Academy of Sciences) highlights the point that commercial gas store operators could be exposed to a significant economic risk if they fill their stores at high prices and Russian suppliers subsequently flood the market with cheap gas in the heating period (Leopoldina, 2022).

For the medium term, the EU Commission's "**REPowerEU**: Joint European Action for more affordable, secure and sustainable energy" (European Commission, 2022b) sets out a plan for how the European Union's reliance on energy sources from Russia is to be significantly reduced before 2030. In particular, this plain aims to reduce the high degree of reliance on Russian natural gas **by two-thirds (100 billion cubic metres) within one year**. This objective is to be achieved by (i) increasing gas imports from other countries by 60 billion cubic metres (LNG imports by 50 billion cubic metres and pipeline imports by 10 billion cubic metres), (ii) increasing the sustainable production of biomethane (to replace 3.5 billion cubic metres of gas), (iii) increasing the use of solar roofs and heat pumps (to replace 4 billion cubic metres of gas) and (iv) speeding up the construction of wind and solar power plants (to replace 20 billion cubic metres of gas). In addition, energy efficiency measures, such as reduced heating in buildings, will be used to save 14 billion cubic metres of gas.

Assessing the effects of an escalation of conflict on economic output

Overall, the impact of Russian's war of aggression against Ukraine on the German and European economy – especially in case sanctions will be tightened – is highly uncertain. To assess the effects of an intensification of the conflict on economic output, different institutions prepared **risk scenarios for economic development in Germany and Europe** as part of their economic forecasts (Deutsche Bank Research, 2022; ECB, 2022b; Goldman Sachs, 2022; Köppl-Turyna et al., 2022; Liadze et al., 2022; Oxford Economics, 2022). ↘ TABLE 3 These scenarios examine, for example, the possible economic effects of increased uncertainty leading to a decline in consumer confidence and household spending, a deterioration of financing conditions, further restrictions on trade relations with Russia and rising costs of raw materials. ↘ BOX 1 Due to Russia's important role as an energy supplier for Europe and the limited possibilities to substitute Russian energy imports in the short to medium run, one of the major transmission channels in these scenario analyses works through a supply shortage of crude oil and natural gas, especially in Europe. ↘ BOX 1 Most of these scenarios assume a temporary stop of imports of crude oil and natural gas from Russia resulting in higher prices – at least temporarily – for crude oil and natural gas in Europe. The scenario analysis by Oxford Economics (2022), in particular, assumes that the price for natural gas remains significantly higher in the longer term. In this scenario, the price increases immediately to 190 Euro per MWh due to a stop of imports from Russia in 2022 and, subsequently, slowly decreases to roughly 70 Euro per MWh in 2025. This represents more than a quadrupling compared to the average price in 2019 and slightly less than a tripling compared to the average price in the period 2019 to 2021. ↘ ITEM 10 Depending on the scale and the duration of the assumed rise in energy prices and a potential amplification through the financial market, these studies predict **deduction of 1.2 % to 2.2 %** to the **euro area GDP in 2022** compared with the forecast based on the latest situation of the war and the sanctions when the studies were conducted. The **addition to the inflation rate in**

↘ TABLE 3

Selected scenario calculations relating to the effects of an intensified conflict on economic output

Institution	Scenario	Assumptions	GDP deduction[1]	Inflation increase[1]	Region
Effects relative to a baseline scenario, taking into account the current conflict and sanctions situation					
Deutsche Bank Research[2]	Negative scenario with temporary ban on imports of natural gas and oil from Russia	Highly elevated energy prices (oil US$140/barrel; natural gas €150/MWh)	1.5	1–1.5	Germany
ECB[2]	Adverse scenario	Sharp temporary increase in natural gas prices and increase in oil prices	1.2	0.8	Euro area
ECB[2]	Severe scenario	Sharper and longer increase in natural gas and oil prices; strong second-round effects	1.4	2.0	Euro area
Oxford Economics[2]	Ban on Russian natural gas imports for 6 months	Oil price between US$100 and US$115/barrel, natural gas price at €190/MWh	1.5	2.6	Euro area
Goldman Sachs[2]	Ban on Russian natural gas imports		2.2	–	Euro area
Effects relative to a baseline scenario without taking into account the current conflict and sanction situation					
EcoAustria[2] (Köppl-Turyna et al.)	Increase in natural gas prices and ban on exports to Russia	Natural gas price of €172/MWh and no exports to Russia and to Ukraine	1.3	–	Austria
NIESR[2] (Liadze et al.)		Oil price at US$140/barrel; higher public expenditure	0.8	2.5	Euro area
Estimates by Bachmann et al. (2022)					
Bachmann et al.[3]	Ban on Russian natural gas imports	Introduction of trade barriers with the model used by Baqaee and Farhi (2021), which cut off all Russian imports to the EU	0.2–0.3	–	Germany
Bachmann et al.[4]	Ban on Russian natural gas imports	Drop of 30 % in natural gas imports; elasticity of substitution of 0.1 between natural gas and other inputs	2.2	–	Germany
Bachmann et al.[5]	Ban on Russian natural gas imports	Energy imports down by 30 %; 5 percentage points change in the share of energy import costs in GNE to 7.5 %	1.4	–	Germany

1 – In percentage points relative to the baseline scenario. 2 – Deduction or increase for the year 2022. 3 – The estimate using Baqaee and Farhi's (2021) trade model compares two different long-term equilibrium with various trade barriers. Does not take into account any of the common macroeconomic multipliers. 4 – Based on a production function approach with conservatively estimated elasticities of substitution, but excluding common macroeconomic multipliers. 5 – Based on an approximation of the GNE loss on the basis of sufficient statistics. Lemma 1 in Bachmann et al. (2022) derives the approximation using the model of Baqaee and Farhi (2021). Does not take into account any of the common macroeconomic multipliers.

Sources: Bachmann et al. (2022), Deutsche Bank Research (2022), ECB (2022b), Goldman Sachs (2022), Köppl-Turyna et al. (2022), Liadze et al. (2022), Oxford Economics (2022)

2022 is in the **range of 0.8 percentage points and 2.6 percentage points** depending on the respective scenario.

In addition to these scenarios, which focus in particular on estimating the consequences of higher energy prices within the standard forecasting models, there exist additional approaches to estimate GDP deductions, for example as a result of a complete stop of Russian energy imports. **Bachmann et al. (2022)** use various approaches to estimate the potential effect of a complete stop of Russian energy imports. On the one hand they calculate two different equilibria within the neoclassical multi-sector trade model of Baqaee and Farhi (2021). One with imports to the EU from Russia and one without. With this approach one can estimate the long-run effects of a potential stop of imports. The stop of imports is simulated by an increase of trade barriers which induce a complete cessation of trade between Russia and the EU. Due to possible adjustments in trade flows that are likely to occur in the long run, the resulting deduction to GDP of 0.2 % to 0.3 % is very small. ↘ TABLE 3 On the other hand the authors use a production function approach with very conservative substitution elasticities. To this end, the authors derive a theoretical relationship that allows to estimate the change in gross national expenditure (GNE) and in GDP using changes in the quantity of energy imports and the elasticity of substitution between energy inputs and other inputs. Additionally, they derive an approximation of the decline in GDP using a sufficient statistic. This allows to estimate the change in GDP by using an assumption about the change of the average price of energy imports, rather than by using an assumption about the elasticity of substitution in order to arrive at an. They present a pessimistic scenario in which a stop of Russian gas imports leads to a **30 % decline in German natural gas imports** and the **elasticity of substitution between gas and other energy inputs is very low (0.1)**. In this scenario, which the authors interpret as a very pessimistic scenario for the short run, **German GDP would contract by 2.2 %.** ↘ TABLE 3 In another scenario, the authors assume a complete cessation of all Russian energy imports and that the expenditure share of energy imports in the GNE increases by 5 percentage points to 7.5 %. In this scenario, German GDP would contract by 1.4 %. ↘ TABLE 3 However, this approach omits common macroeconomic amplification mechanisms such as those triggered by investment adjustment costs, price rigidities or financial market frictions. Thus, the estimated effects could potentially come on top of the aforementioned scenarios that do not take account of a full cessation of Russian energy imports.

Using the sufficient statistic derived by Bachmann et al. (2022), the GCEE has compiled its **own estimates in additional scenarios relating to the decline in natural gas imports and the increase in natural gas prices**. These scenarios complement the present economic forecast, which is based on the sanctions adopted at the time of date cut-off (March 18, 2022) and the corresponding energy price trend. However, they should not be interpreted as full-fledged risk scenarios. ↘ ITEM 39 In particular, like Bachmann et al. (2022), these estimates **do not take into account common macroeconomic amplification mechanisms.** In the extreme case that only a quarter of the shortfall in Russian natural gas imports could be compensated for and thus **German gas imports would drop by 30 %** (this assumes that Russia accounts for 40 % of Germany's natural gas imports, in line with BAFA's figure for the average Russian share from 2016 to 2020) and that the **average import price** for the remaining **natural gas imports increases to 350 Euro per MWh** (a sevenfold increase compared with December 2021), **German GNE would decrease by 2.0 %.** ↘ TABLE 4 Using this method, **additional estimates** of the effect of a stoppage of Russian energy imports on the GNE in **other EU member states** can be made. Under the same assumptions as for Germany (cessation of Russian natural gas imports, only 25 % of the shortfall can be compensated; natural gas prices increase to 350 Euro per MWh) the decline would amount to 2.2 % in Italy and to 0.6 % in Poland. With a decline of 0.14 % and 0.03 % respectively, France and Spain would be far less severely affected due to their lower volume of natural gas imports overall and the low share of natural gas imports stemming from Russia, respectively. ↘ TABLE 4

↘ TABLE 4

GCEE estimates of the deductions to economic output and additions to inflation resulting from a restriction of imports of Russian energy carriers

Assumptions	GNE deduction[1]	Additional inflation[1]	Region
Own estimates based on the method of Bachmann et al. (2022)[2]			
Decline in natural gas imports amounting to 75 %	2.0	–	Germany
of the natural gas imports from Russia; Increase	2.2	–	Italy
in the average price of natural gas imports to	0.6	–	Poland
350 €/MWh	0.14	–	France
	0.03	–	Spain
Estimates of the deduction to economic output and additional inflation due to an adverse oil supply shock			
40 % increase in the oil price	0.4–0.8	1.6	Germany

1 – In percentage points relative to the baseline. 2 – Approximation of the GNE loss based on a sufficient statistic. Lemma 1 in Bachmann et al. (2022) derives the approximation in the general model of Baqaee and Farhi (2021). The approach does not incorporate common macroeconomic amplification mechanism.

Source: own calculations

In addition to the restrictions of the natural gas imports from Russia, a restriction of crude oil supplies from Russia, which would represent an **adverse oil supply shock**, could spark **further negative GDP effects**. In general, the price of crude oil follows the development of the global economy. However, exogenous events, such as the wars in Iraq or the sanctions against Iran, can lead to increases in the price for crude oil that are not caused by economic developments. By historical standards, the price of oil (unlike the price of gas in Europe, for example) is still below the interim highs reached between 2011 and 2014, based on a monthly average. ↘ CHART 14 Furthermore, for the most part, there are only minor differences between the prices of crude oil in Europe (Brent) and the United States (WTI). ↘ CHART 14 LEFT

Previous macroeconomic studies on **oil supply shocks** find **moderate and delayed effects on real economic activity and inflation** (Kilian, 2008, 2009; Carstensen et al., 2013; Baumeister and Hamilton, 2019). According to a 2013 study on Germany, adverse oil supply shocks that lead to a 10 % increase in crude oil prices lower industrial production by 0.5 % after 1 year and by 1 % after 2 years (Carstensen et al., 2013). German producer prices increase by 0.5 % one year after a corresponding shock. GCEE estimates based on the method of Känzig (2021) yield similar magnitudes for the effect on industrial production. Further, the consumer prices would rise by 0.4 % at the peak.

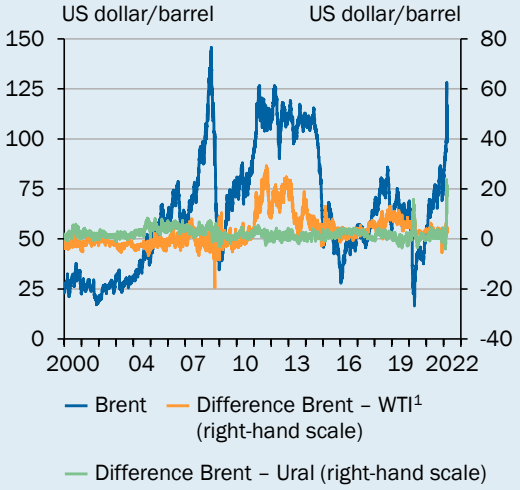
The reasons for the estimated moderate effects of an increase in the price of oil are manifold. It is argued that the share of crude oil in value added is lower today than in 1970s and 1980s (Blanchard and Galí, 2007; Herrera and Pesavento, 2009). Moreover, strong **fluctuations in crude oil prices** can largely be **explained by** aggregated, oil-specific, and expectation driven **demand factors**. Consequently, crude oil price increases in the past have often not been accompanied by negative economic growth (Kilian, 2008, 2009; Baumeister and Hamilton, 2019). During the oil crises of the 1970s and 1980s, it was precisely the expectation-driven and oil-specific demand component (demand grew as oil was stockpiled in anticipation of the impending drop in supply and price increase) and other non-supply-side oil shocks that were major factors in the sharp increases in the price of oil. The adverse oil supply shocks were only partly to blame (Kilian, 2009; Baumeister and Hamilton, 2019; Känzig, 2021). Finally, the global market for crude oil is highly integrated. Consequently, restrictions on the production of

crude oil in one country have been at least partially offset by an expansion of production in other country (Kilian, 2009). This was also observed during the Gulf War and as a result of US sanctions on Iran (Kilian and Murphy, 2014; Caldara et al., 2019). As a direct consequence, oil supply shocks have led only to transitory and moderate increases in the price for crude oil. This is also likely to apply to the current situation if Russia's 16 % share of global oil production would be sanctioned by Western industrialised countries. Rerouting Russian oil production at a significant price discount to China, for example, would presumably at least partially cushion the supply shock through the global market.

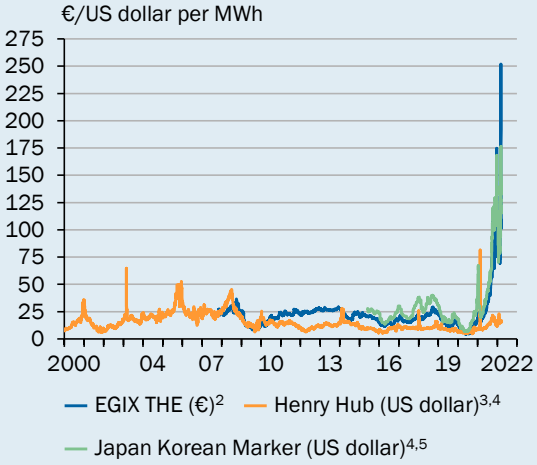
↘ CHART 14

Development of oil and natural gas prices in the longer term

Crude oil prices in 2022 at a similar level as in 2011 to 2014



Natural gas prices in Europe and Asia in 2022 at historic high



1 – West Texas Intermediate. 2 – The European Gas Index (EGIX) is based on exchange trades which are concluded in the respective current front month contracts (THE). 3 – Prices are based on delivery at the Henry Hub in Louisiana. Official daily closing prices at 2:30 p.m. from the trading floor of the New York Mercantile Exchange (NYMEX) for a specific delivery month. 4 – Prices in US dollar per MMBtu (1 million British thermal units) converted to US dollar per MWh. 5 – Japan Korean Marker (JKM) is the Liquefied Natural Gas (LNG) benchmark price assessment for spot physical cargoes. JKM reflects the spot market value of cargoes delivered ex-ship (DES) into China, Japan, Republic of Korea and Taiwan. Deliveries into these locations equate to the majority of global LNG demand.

Sources: EEX, EIA, NYMEX, Refinitiv Datastream, own calculations

Given the aforementioned evidence, the most recent observed **increase in oil prices of more than 40 %** implies a decline of 2 % to 4 % in industrial production in Germany over the course of 2 years. With German industry accounting for roughly 20 % of gross value added, the **resulting deduction to GDP** could be **less than 1 %.** ↘ TABLE 4 However, stronger price increases due to a stoppage of imports to Western economies and additional multiplier effects could result in larger effects. In particular, the effect on GDP depends on the reaction of the central bank to the oil price-induced increase in inflation and inflation expectations. Empirical evidence on the oil price shocks of the 1970s and 1980s suggests a strong effect on GDP (Bernanke et al., 1997). Thus, oil supply shocks result in a difficult trade-off for the central bank.

Overall, the different estimates show that a disruption of Russian energy imports is likely to have a considerably negative effect on GDP growth. The estimates can be interpreted as **possible deductions** to the baseline scenario of **the GCEE's economic forecast**. The different deductions could come on top of each other because the scenarios calculations within the established forecasting models have a hard time to estimate the consequences of a complete stoppage of

Russian energy imports and any resulting short-term physical shortages, for example. However, the estimates for such a complete stop do not take into account potential spillover effects via financial markets.

In the short run in particular, **possibilities to substitute Russian energy supplies** in the case of a complete disruption of Russian energy imports could be **more constrained** than presumed in these estimates, and thus trigger a stronger decline in GDP growth. Consequently, a number of parties argue that short-run shortages in both natural gas and coal supplies could cause far-reaching **disruptions to production at energy-intensive companies** (Bardt et al., 2022; Fuest, 2022), and that these disruptions would in turn give rise to unemployment or short-time work and thus restrict demand (Dullien and Krebs, 2022; Schaefer and Küper, 2022). These interruptions of production could further exacerbate supply shortages in various sectors. Additionally, inflation, further fuelled by rising energy prices, is likely to dampen demand and thus place additional pressure on the economic outlook. Aside from the effects outlined by the authors, a sharp increase in energy prices and a decline in GDP could lead to **credit losses** and thus to disruptions on financial markets. Energy suppliers, for example, could struggle to cope with sharply rising energy prices if they are unable to pass these increases on to their customers because of longer-term contracts.

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