Is Russian gas phaseout still possible with the increased exposure of Europe to US LNG?

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Abbreviations

bcm	billion cubic meter
ENTSOG	European Network of Transmission System Operators for Gas
GWh	Gigawatt hours
JKM	Japan Korea Marker
LNG	Liquefied Natural Gas
LTC	Long-term contract
TYNDP	Ten Year Network Development Plan

1 EXECUTIVE SUMMARY

KEY MESSAGES

- Phasing out Russian gas is technically and physically feasible even during major global supply shocks, as missing volumes can be successfully replaced through a combination of storage withdrawals and alternative LNG imports.
- Maintaining Russian gas supplies has nearly no measurable effect on costs (1-3%) in most crisis scenarios. So there is no economic or technical necessity to postpone the phaseout.
- Europe’s primary energy vulnerability has shifted from a dependence on Russian pipeline gas to a heavy reliance on US LNG, which in some scenarios results in a market share similar to Russia's levels prior to the 2022 invasion of Ukraine.
- A 3-months drop of US LNG alone results in a 50% gas bill increase for European buyers. This risk points to the high dependence on US LNG and the potential weaponization of US supplies.
- The closure of the Strait of Hormuz could increase the EU’s gas bill by 48%, while a simultaneous 3-months loss of US LNG supply could drive that increase as high as 106%.
- The most effective response to neutralize severe price hikes is to reduce gas demand by 25% within the next 2 years.

STUDY CONTEXT

In 2021, Russia started to constrain its natural gas sales to Europe. Following the February 2022 full-scale invasion of Russia in Ukraine, pipeline gas deliveries were either unilaterally stopped by Russia, or terminated by European buyers. As of 2025, Russian pipeline gas and LNG which provided 43% of imports in 2021 to the EU27 dropped to 12%. This tremendous shift in the supply structure of Europe was made possible by a set of phenomena and measures, such as the price hikes of 2022-2023 which triggered a 20% demand response in Europe, as well as increased LNG supplies from the US (from 6% in 2021 to 26% in 2025). By 2025, a new gas market equilibrium was set in Europe, with lower gas consumption, somewhat higher gas prices and some Russian gas still imported to European consumers. This new equilibrium allowed the EU to take the political decision to phase out remaining Russian molecules without major technical difficulties or costs.

In March 2026, Israel and the United Stated launched an attack on Iran, which lead to the closure of the Strait of Hormuz and missile strikes in the Ras Laffan liquefaction facility of Qatar. Consequently 20% of global LNG supply disappeared from the market, as vessels from the Persian Gulf were unable to reach global LNG markets. As majority of Qatari cargoes targeted Asia, the supply shock directly affected Asian markets, nearly doubling the price of LNG. Although below 10% of European LNG imports originated from Qatar, TTF prices also reacted by a nearly 50% increase.

Considering the current crisis in the Middle East, it is worthwhile to assess whether the Russian gas phaseout for Europe is still possible? To answer this question, three aspects must be considered:

- Is there sufficient infrastructure and alternative supplies in the global market, accounting for the current and possible realistic future supply shocks?
- If there are no technical issues, how much will the Russian gas phaseout cost for European consumers?
- Is Europe shifting from one dependency to another?
- Are the new supply sources posing another supply security risk?

METHODOLOGY

The study investigated the exposure of European gas markets to LNG market shocks by using scenario analysis based on gas market modelling (EGMM).

Key scenarios analysed are: Strait of Hormuz closed, US LNG supply disrupted (1 and 3-months), and a combined crisis of these two. We tested the implementation of the REPowerEU Roadmap implementation or postponement on these scenarios and tested how the impacts can be mitigated by demand reduction.

RESULTS

Modelling results show that the 20% drop in global LNG supply due to the Middle East crisis resulted in a 48% gas bill increase in Europe, despite the limited (10%) share of Qatari LNG in the EU supply mix. The price increase in the EU is evenly spread between the Member States, as the internal pipeline system is sufficient to adapt to the changing gas flows. No major pipeline bottlenecks were identified.

The US LNG is the main beneficiary of the crisis, as due to the contractual structure (spot and DES cargoes available and can be diverted to Europe) it is the most flexible available source on the market and the EU substitutes missing volumes with US LNG. The two major competitors to US LNG, Russian pipeline gas and Qatari LNG are unavailable under the current modelled circumstances.

With the Russian gas phaseout the US LNG has gained substantial share in the EU27 gas supply mix, therefore we investigated what a drop in US LNG supply would cause in the EU gas prices. We found that a 1-month dropout could be weathered with the help of European storages, and the US volumes purchased would only shift in time within the year adding 3% increase to the EU gas bill.

A 3-months drop of US LNG alone results in a 50% gas bill increase for European buyers. If the US LNG deliveries would stop to Europe for 3-months combined with a Strait of Hormuz crisis, then the gas bill of the EU27 would increase by 106% in 2026 and 83% in 2028. In this most severe scenario, the internal gas market would fragment into different price zones: the Iberian Peninsula (Spain and Portugal) and Central and Southern Europe especially the Balkans would face the highest price increase. This is due to the limited connections to the Northwestern markets and the limited storage capacity.

Russian gas phaseout plans do not have any major impact on the modelling results. If the EU postponed the Russian gas ban and still purchased the pipeline gas and LNG under the ongoing long-term contracts, the gas bill would be decreased by 1-3% in most scenarios. The reason for this is the fact that by 2025, share of Russian pipeline gas and LNG dropped to 12% and would not serve as a major alternative for missing volumes. Therefore, it is more a political choice of the EU weather to pay the high price for the US LNG or for the Russian import. Russian gas could substantially affect the European gas markets in the US 3-months supply outage scenarios combined with the Hormuz crisis. The Russian long-term contracts to Hungary and Slovakia as well as LNG flows to Western European LNG terminals can result in a 61% increase in gas bill compared to a 83% increase without Russian gas.

The high prices will certainly trigger demand response. This modelling exercise did not investigate how gas demand would be reduced, but based on the experiences of the previous crisis energy efficiency measures and switching to renewables (solar mainly) may be the most widespread options. The REPowerEU strategy plans with a sharp demand reduction, – that might seem to be too ambitious – but in case it is implemented the negative price impacts of the modelled supply shocks could be far outweighed. Our modelling suggests that this is possible even with a less ambitious goal: reducing the EU gas demand from 3608 TWh/yr in 2026 to 2672 TWh/yr by 2028 would offset the negative market effects caused by the Strait of Hormuz

crisis. We assume that this ~25% demand reduction in 2 years is comparable to the demand reduction that was achieved during the previous energy crisis on a market basis.

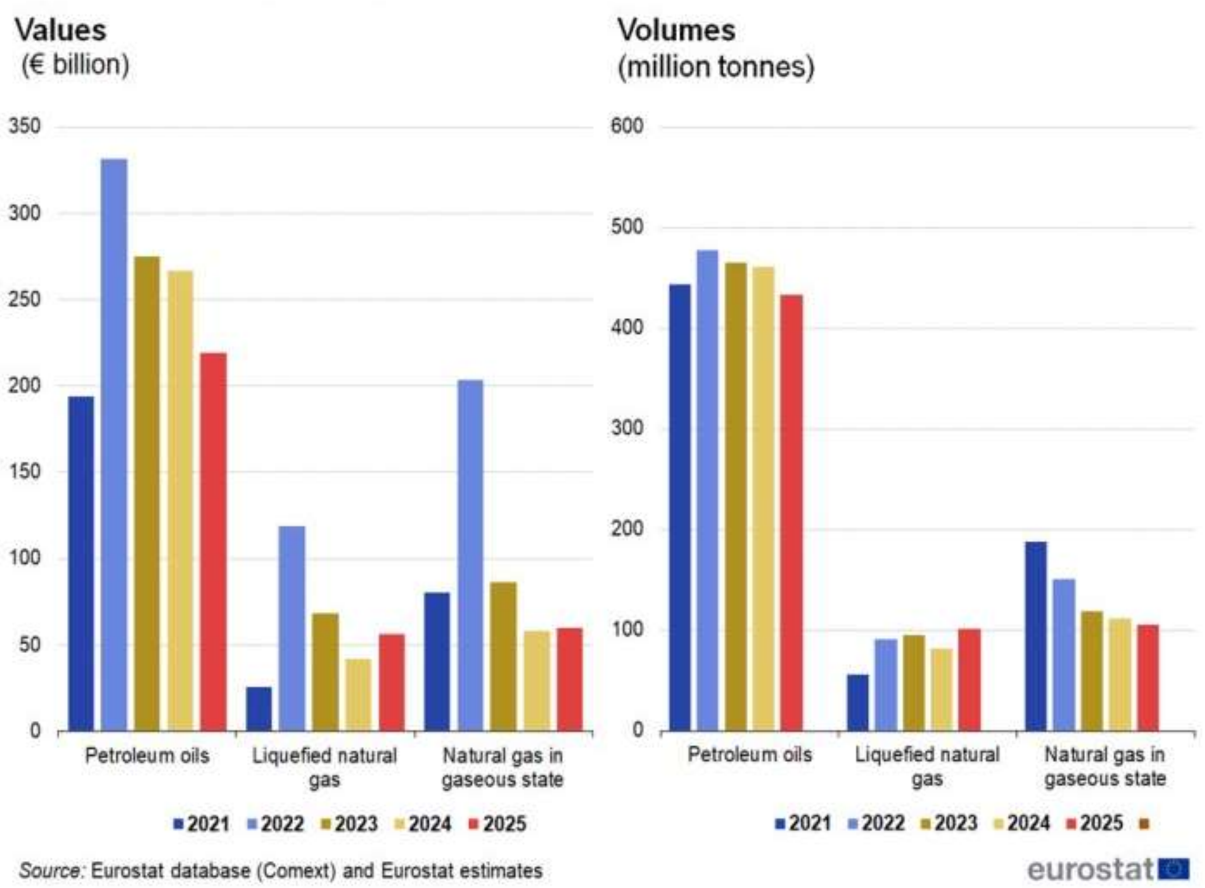
Furthermore, the supply gap can also be reduced by increased domestic gas extraction. From 2024 to 2025, EU gas production increased by 10% year-on-year, however it must be stressed that it is still delivered ~370 TWh/year.

2 INTRODUCTION

After the breakout of the 2022 Russian war on Ukraine the EU27 suffered its largest ever energy crisis.

Russia withholding of the natural gas supply to Europe and later numerous EU countries' decision not to buy Russian gas resulted in supply shortage, enormous gas price increase and tripling of the gas bill that the EU27 paid. The EU27 has paid 100 billion € for gas imports (LNG & pipeline together) in 2021 and 322 billion in 2022. (Figure 1.)

FIGURE 1. IMPORTS OF NATURAL GAS AND PETROLEUM OILS LEFT: VALUES, € BILLION, RIGHT VOLUMES (MILLION TONNES)

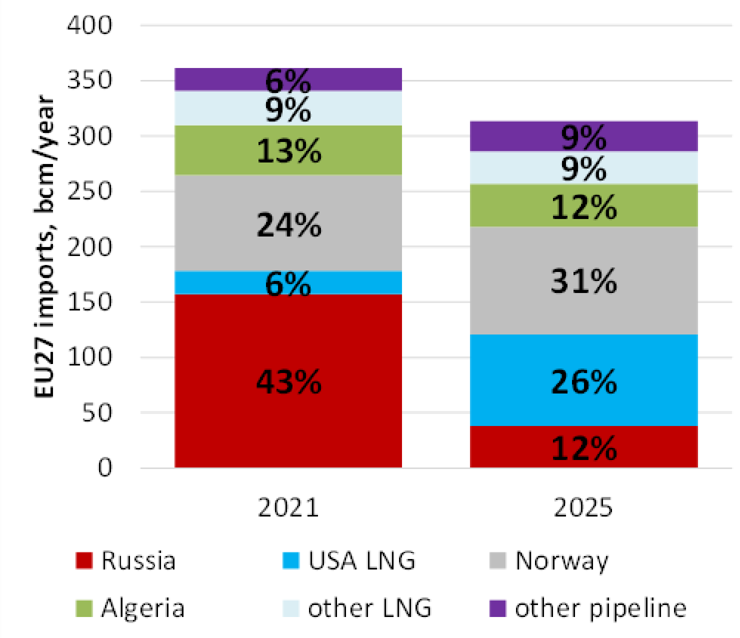


Source: [Eurostat]

The extremely high gas price that the EU paid also impacted Asian LNG prices as consumers competed for the spot LNG cargoes. Europe was willing to pay more: deeper European pockets resulted in higher prices in Europe than in Asia, which prevented any unserved demand in the European household sector. Still, high prices triggered a high demand response: a 20% demand drop in Europe. The main supplier that filled in the gap when Russian pipeline gas disappeared was US LNG.

As of 2025, the share of Russian gas reduced from 43% in 2021 to 12% in the European gas import structure. At the same time, the share of US LNG increased from 6 to 26 %. (Figure 2.)

FIGURE 2. EU27 NATURAL GAS IMPORT STRUCTURE, 2021, 2025, %



Source: REKK based on Bruegel

The restructuring of imports and the stabilization of the supply resulted in reduction of gas prices and a new equilibrium: this was set at somewhat higher gas prices in the EU than before 2021, with lower gas demand. As a result, the EU 27 gas bill was 116 billion € in 2025. (Figure 1) As the energy crisis seemed to be over, the EU adopted the RepowerEU Roadmap in December 2025 which has set up interim deadlines to phase out fully the remaining Russian gas from the EU27 gas mix by September 2027. The aim of the ban was to reduce the amount of money Russia can earn on fossil gas sales and reduce the money Russian can spend on buying arms against Ukraine. By the end of 2025, it was expected that LNG markets would be oversupplied by 2028 and additional Romanian offshore gas the EU can serve as an alternative to Russian gas in the most affected Central-Eastern European markets.

However, the US attacked Iran in February 2026, without consulting its ally and the NATO. By March 2026, when the first milestone of the REPowerEU was reached (all spot purchases of Russian gas has to be stopped) the EU witnessed that prices start increasing again, and a crisis outside Europe might have consequences for the European markets as well.

Though the Middle East crisis was planned to be a short intervention, it is certain that even if sudden agreement would be reached there will be long lasting impacts. The energy infrastructure damage in Qatar is expected to have long term impacts, and the expected LNG glut by 2028 is no longer there.

Could this geopolitical turmoil spread over to the natural gas and LNG markets? Would it be possible that besides the drop in supply due to the Middle East crisis even US LNG supply could be scarce? Be that a hurricane or a technical failure, US supply has a decisive role in the EU gas markets.

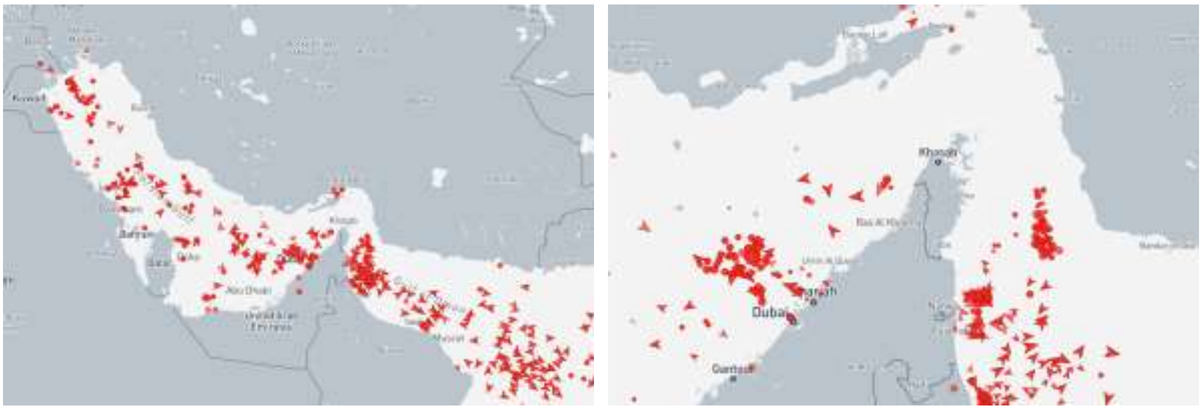
This study investigates the vulnerability of the EU gas markets to LNG supply shocks.

3 BACKGROUND

3.1 THE STRAIT OF HORMUZ CRISIS OF MARCH 2026

In March 2026, the United States and Israel started bombing Iran. Iran in return launched missiles at the US allies in the Gulf area and the Middle East, and blocked the strait of Hormuz. The blockade makes it risky or even impossible for LNG and oil tankers to reach the global markets, thus shutting out the LNG liquefaction capacities of Qatar and the United Arab Emirates.

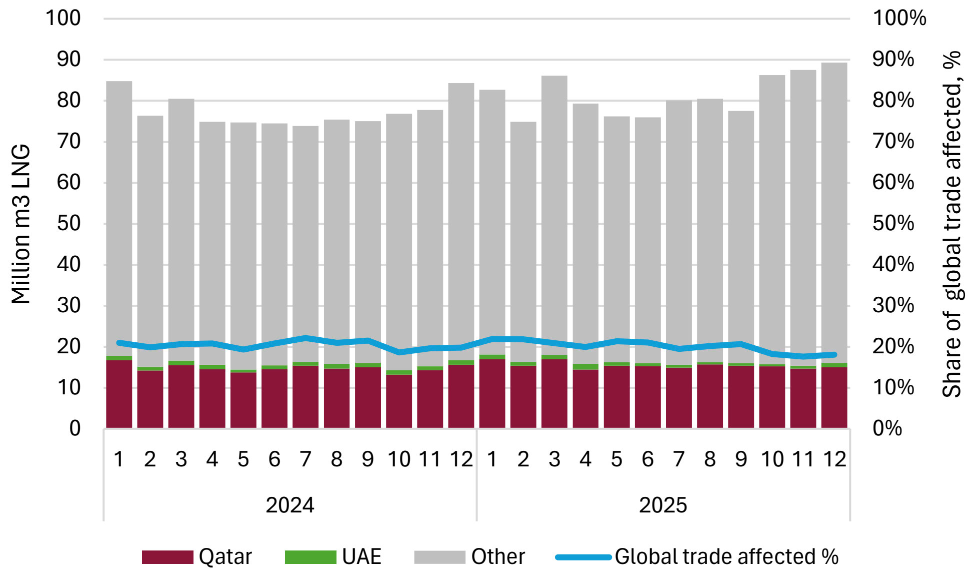
FIGURE 3. TANKERS MASSING AROUND THE STRAIT OF HORMUZ (04.03.2026)



Source: marine traffic

To understand the effects, we must first consider the role off Qatar and the United Arab Emirates in the global LNG trade. In 2024-2025, around 20% of the global LNG trade transited via the Strait of Hormuz. Volumes which cannot reach the global markets are related to mostly Qatari LNG from the Ras Laffan facility (~95% of the affected volumes), while the UAE cargoes from Das Island are only 5% of the volumes. Main target markets for Qatar were located in Asia: around 81% of volumes and cargoes were delivered to Asian countries, 13% to European markets and 6% to Middle Eastern and other countries in 2024-2025. Nearly all cargoes (99%) of the UAE were shipped to Asian markets, with a few cargoes to Middle Eastern countries (Kuwait and Bahrein).

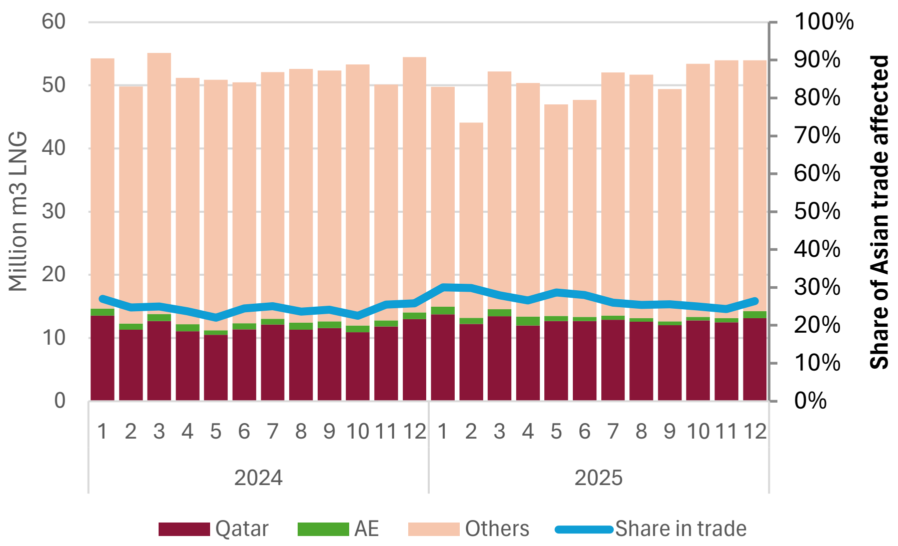
FIGURE 4. SHARE OF QATAR AND UAE IN THE GLOBAL LNG TRADE CONSTRAINED BY THE BLOCKADE, MILLION M³ LNG



Source: [*Signal LNG flows dataset*]

Within Asia, top 5 importers of Qatari LNG in 2024-2025 were China (~29%), India (~17%), Korea (~12%), Pakistan (~11%) and Taiwan (~11%). These five countries imported 80% of Qatari LNG bound to Asia. The remaining 20% was delivered to Bangladesh (7%), Japan (5%), Singapore (4%), Thailand (4%) and Hong Kong (1%). The share of Qatar and Emirates trade in Asian total LNG imports was on average 24-27% in 2024 and 2025.

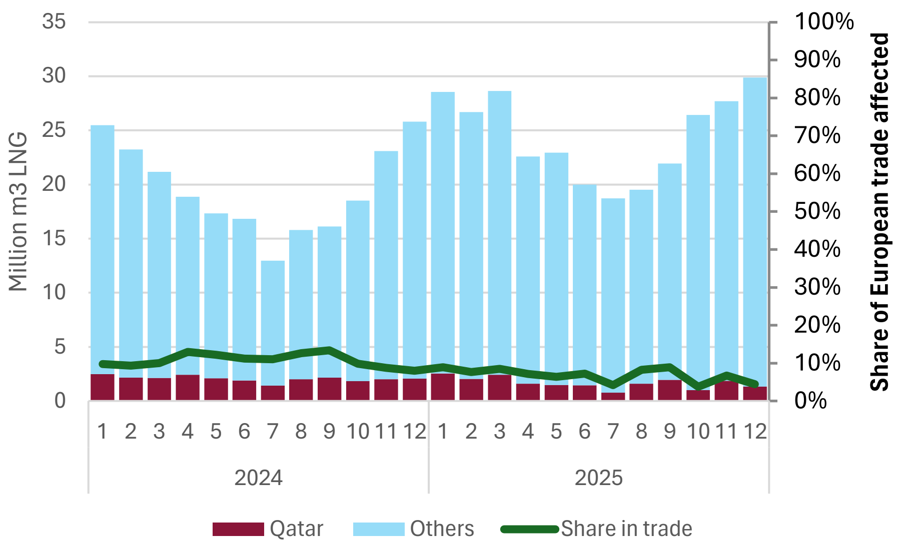
FIGURE 5. SHARE AND VOLUME OF LNG FROM QATAR AND UNITED ARAB EMIRATES TO ASIA, MILLION M3 OF LNG



Source: [*Signal LNG flows dataset*]

Within Europe, share of LNG from Qatar was below 10% in 2025, and no cargoes were delivered from the United Arab Amirates to Europe. (Figure 6) Qatari trade to Europe was mainly focusing on three markets: Italy, Belgium and Poland. In Italy, Qatar Energy was a minority owner of the Rovigo terminal until 2024. In 2025, Qatar Energy still supplied Rovigo with cargoes, delivering 10-11 million m^3 of LNG per year. In Belgium, the Zeebrugge terminal was booked until 2044 by Qatar Energy. In 2024 and 2025, 2.1 -3.1 million m^3 of LNG were shipped to Zeebrugge from Ras Laffan (3.4-5 bcm natural gas). Poland has a long-term supply contract with Qatar Energy from 2017 to 2034, supplying 3.6-4.1 million m^3 of LNG per year (~2.2-2.5 bcm natural gas). Compared to total LNG imports of Europe, Qatari LNG had a share of 11% in 2024 and 7% in 2025.

FIGURE 6. SHARE AND VOLUME OF LNG FROM QATAR TO EUROPE, MILLION M^3 OF LNG

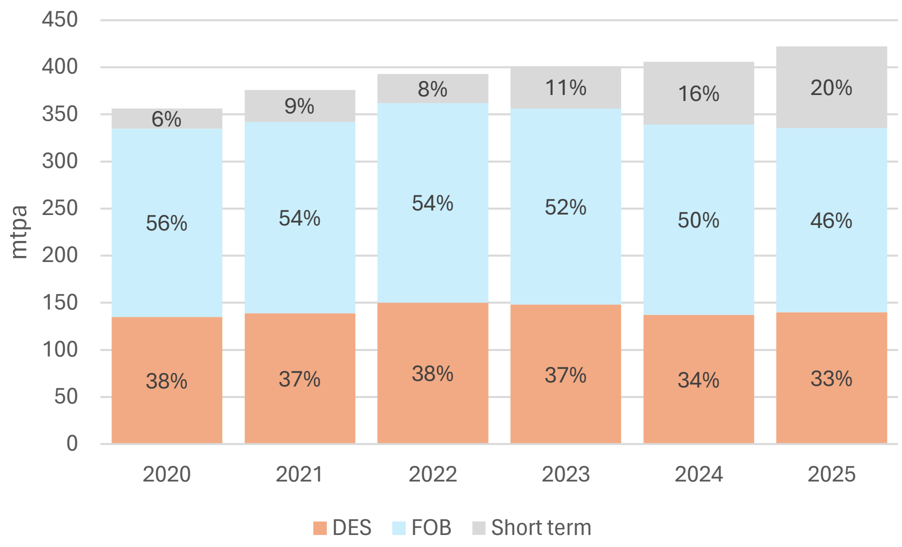


Source: Signal LNG flows dataset

3.2 MISSING VOLUMES AND THE GLOBAL SUPPLY CURVE

LNG liquefaction terminals have historically operated on a high utilisation, which is ensured by the fact that capacities of the terminals are booked on long-term contract basis. Contracts may be of FOB (free-on-board) or DES (delivered-ex-ship) delivery. The main difference between the contract types is when does the cargo switch ownership – DES contracts are delivered to the destination markets and are less flexible in this sense. FOB contracts are free-floating cargoes once they leave the liquefaction terminal. Price-responsive, flexible supply in this sense is related to FOB cargoes. The role of flexible contracts and short-term agreements has been growing in the past years, and by 2024-2025 over two-thirds of global LNG trade can be regarded flexible – either short-term or FOB contracts. (Figure 7)

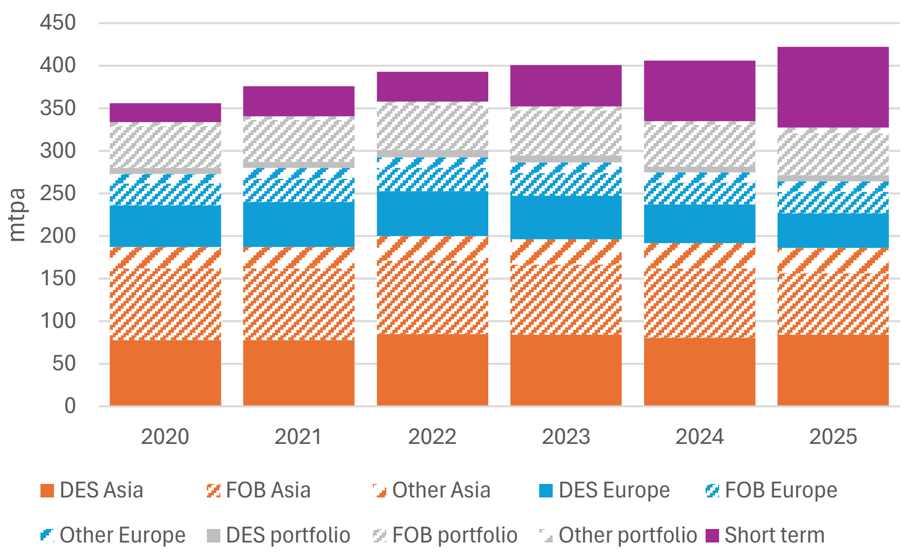
FIGURE 7. GLOBAL LNG CONTRACTS BY DELIVERY (FOB/DES)



Source: REKK based on GIIGNL annual report. Short term contracts equals total LNG trade minus contracts in force

Considering the target markets of LNG, volumes are globally distributed between Asian and European markets as well as portfolio traders. Portfolio traders are major energy trading companies, who can arbitrage between the global markets. (Figure 8)

FIGURE 8. GLOBAL LNG CONTRACTS BY TARGET MARKET



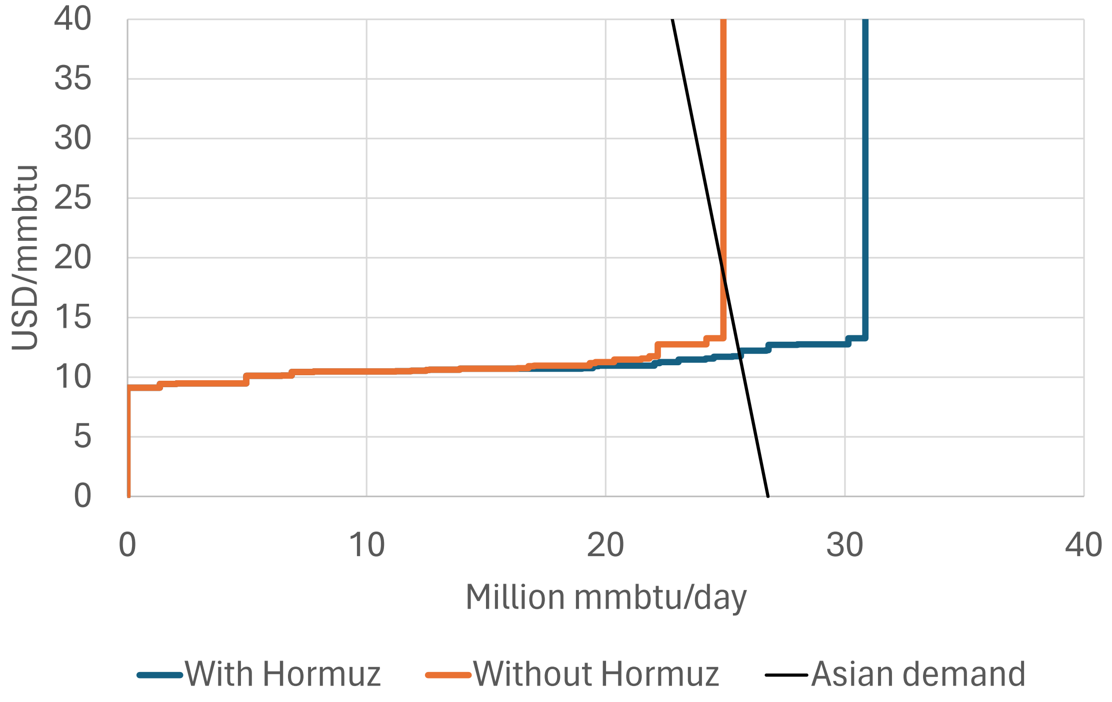
Source: REKK based on GIIGNL annual reports
Short term equals total LNG trade minus contracts in force

Effects of the blockade on the Strait of Hormuz can be estimated by plotting the LNG supply curve and the LNG demand, then simply constraining the supply from Qatar and the United Arab Emirates. The first issue is to determine the relevant supply and relevant demand.

In case of Asia, the relevant markets for the LNG supplies delivered to China, Japan, Korea and Taiwan, which add up to around 75% of Asian LNG demand. The price indicator Japan-Korea Marker denotes the price level for these four Asian countries.[1]

To plot a supply curve, volume and cost of supply sources is needed. Volumes were obtained from the Signal LNG database, while price of LNG imported was collected from UN Comtrade database. As trade statistics were only published by Japan, the cost of supply sources for the neighbouring markets were calculated relative to the Japanese imports based on relative distances. First, historical volumes of LNG supplies were matched to the respective cost of import, then volumes were cumulated and trade flows were put in an ascending order to represent the regional supply.

FIGURE 9. STRAIT OF HORMUZ EFFECT ON ILLUSTRATIVE LNG SUPPLY CURVE FOR ASIAN MARKETS (CHINA, KOREA, JAPAN, TAIWAN)



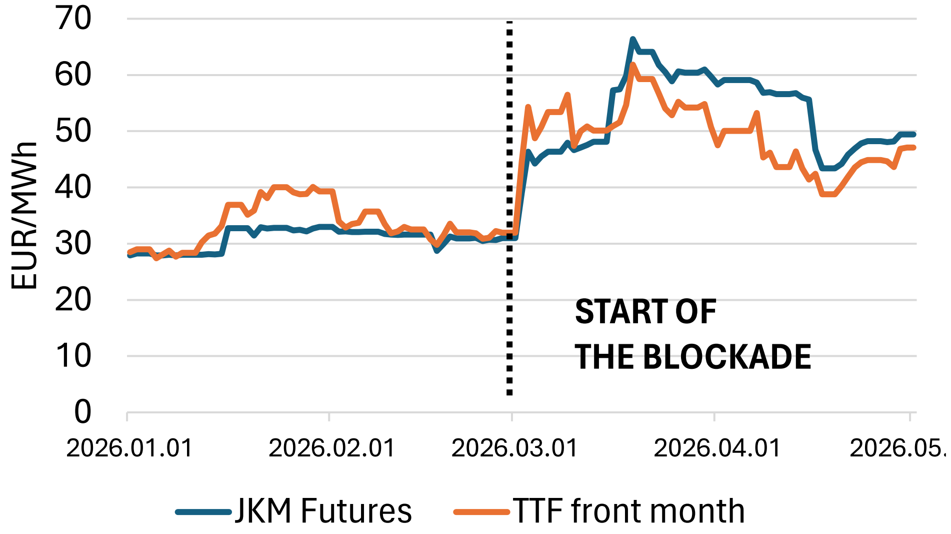
Source: REKK

Total LNG imports of the four major Asian markets were around 27-29 million mmbtu/day. The JKM marker in December 2025 ranged between 9.5-11 USD/mmbtu, with a median of 10.2 USD/mmbtu. Slope of the demand curve was assumed -0.00001. (Figure 9)

By simply taking out the volumes of Qatar and the United Arab Emirates from the supply curve to Japan, China, Korea and Taiwan, the effect of the supply shock can be estimated on the JKM price. The estimated effect is of 7 USD/mmbtu, which is in line with the average price increase observed in March-April 2026 compared to the first two months of the year (Figure 10).

[1] Although Qatari LNG plays an important role in India and Pakistan as well, these two account for 15% of total Asian LNG demand and the JKM marker may not be indicative of their market equilibrium.

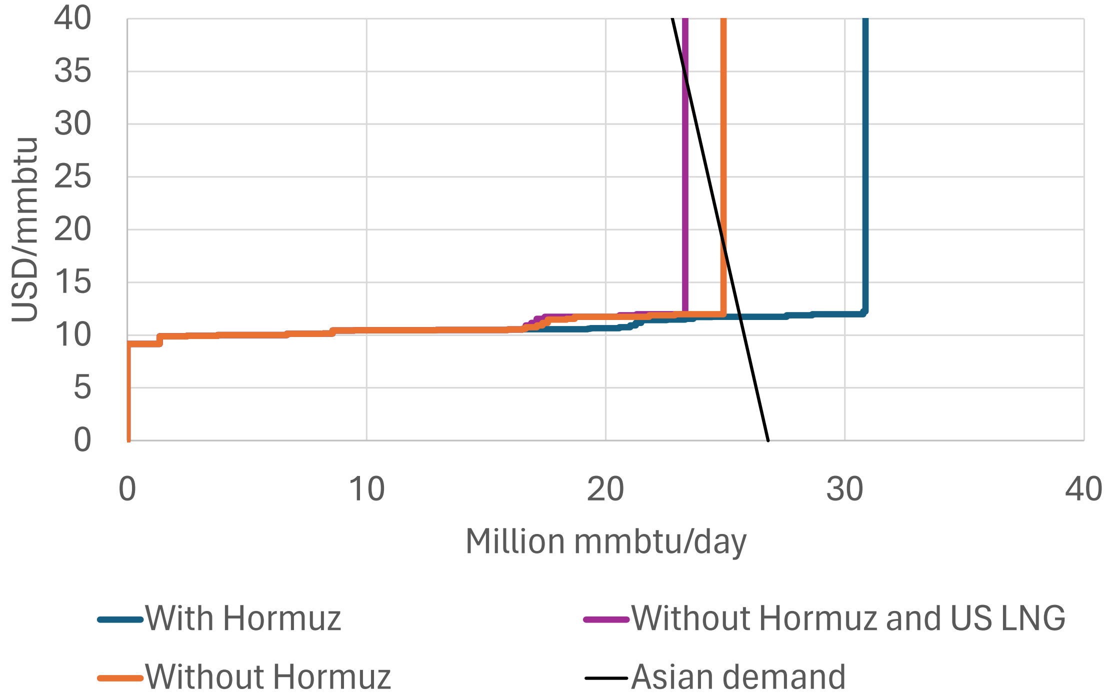
FIGURE 10. JKM AND TTF FORWARDS IN JANUARY-APRIL 2026, EUR/MWH



Source: REKK based on investing.com

This simple approach allows us to estimate the effects of further demand shocks, for instance the default of US LNG liquefaction capacities. Following the same logic, deliveries of US LNG are removed from the supply curve to China, Korea, Japan and Taiwan. Due to the supply shock, the JKM may increase to 35 USD/mmbtu (~100 EUR/MWh). (Figure 11)

FIGURE 11. STRAIT OF HORMUZ AND US LNG SUPPLY SHOCK EFFECT ON ILLUSTRATIVE LNG SUPPLY CURVE FOR ASIAN MARKETS (CHINA, KOREA, JAPAN, TAIWAN)

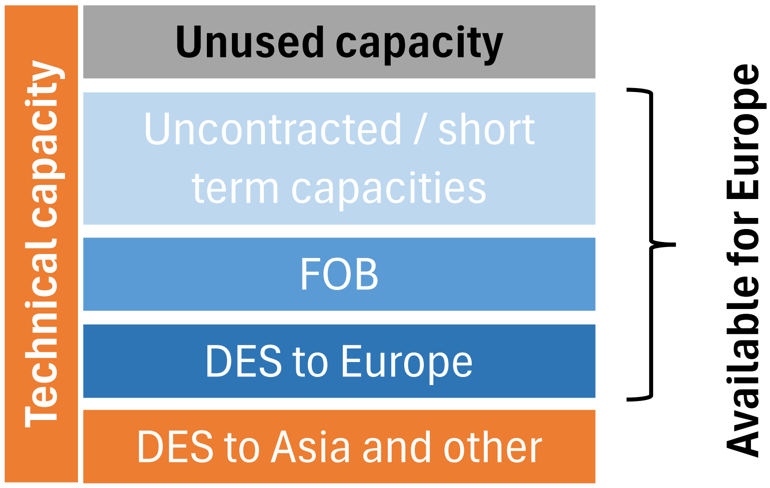


Source: REKK

3.3 HOW MUCH FLEXIBLE LNG IS AVAILABLE FOR EUROPE?

Global LNG trade was based on 70% long-term contracts and 30% short-term trade in 2024.[2] However, even the long-term contracts can be flexible in nature. This flexible supply is a technical maximum, which may be shipped to European markets, taking contractual and technical constraints into account. This potential does not take affordability or cost of the LNG into account, which will be integral part of the analysis. Our goal is to come up with a realistic potential volume of LNG supply. This potential LNG supply to Europe may be assessed by a simple logic as displayed in Figure 12.

FIGURE 12. SCHEMATIC REPRESENATION OF LNG CAPACITY AVAILABLE FOR EUROPE



Source: REKK

To assess the relevant supply for Europe, we have collected all LNG contracts in force published in GIIGNL annual reports 2023-2025. LNG capacity available for European buyers is covered by the following volumes:

- FOB contracts – these contracts may be diverted to either European, or any other markets, and such are possible supplies to Europe. These make up 43% of global liquefaction capacity
- DES contracts to Europe – originally targeted to European markets, these are cargoes from Algeria, Nigeria, Oman, Qatar and Russia. These make up 16% of global liquefaction capacity.
- Uncontracted/short term volumes – overall 16% of global liquefaction capacity is not contracted, allowing for shorter-term contracts.

Volumes which are inaccessible for Europe are:

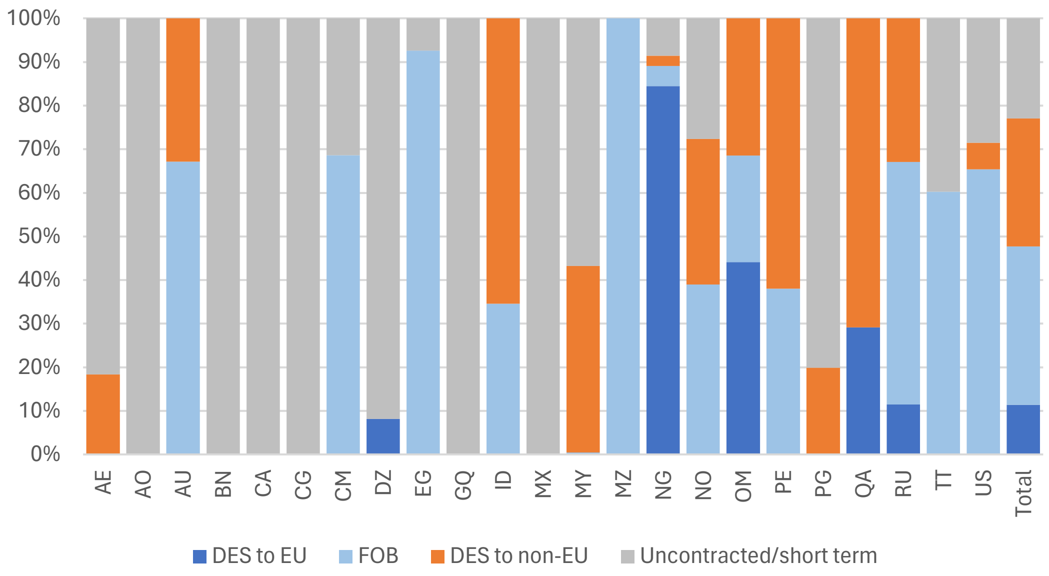
- DES contracts to Asia

[2] GIIGNL Annual Report 2025

- Unused technical capacity of terminals – due to technical, maintenance, economic or regulatory issues, liquefaction terminal capacity may not be used to full extent. To estimate these effects, the historical utilisation of liquefaction terminals was factored into the technical capacities.

Figure 13 indicates the share of various contracts by exporter country. It is apparent that major exporters of LNG follow different marketing strategies: Indonesia, Nigeria and Qatar prefer to engage in DES contract structures. FOB contracting is more widespread for US, Australia and other minor LNG exporting countries.

FIGURE 13. DISTRIBUTION OF LNG CONTRACTS IN FORCE BY PRODUCING COUNTRIES AND CONTRACT TYPE, 2025 (%)*



Source: REKK based on GIIGNL annual reports 2023-2025

** Uncontracted capacity was estimated as the residual value by subtracting DES to EU, DES to non-EU and FOB volumes from the technical liquefaction capacity in 2024*

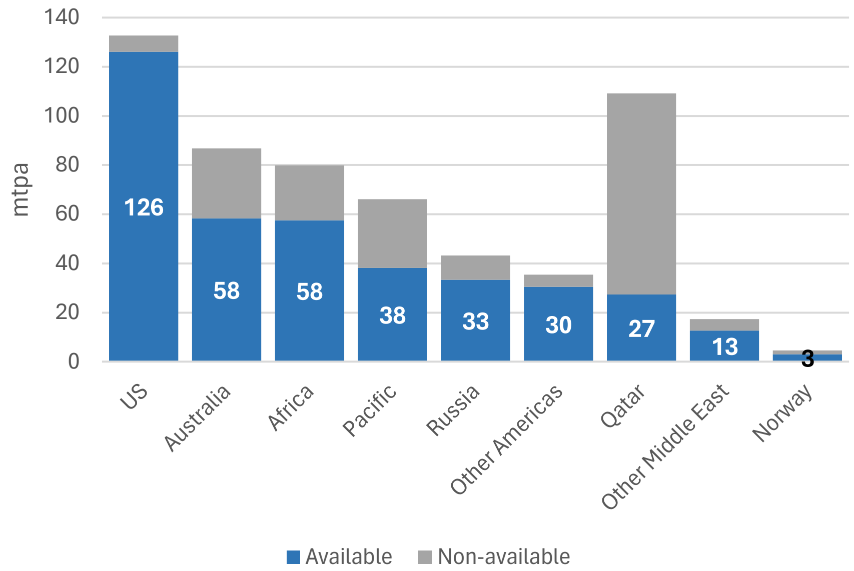
Figure 14 lists the main exporters in descending order by volumes available to Europe[3]. Overall, the global liquefaction capacity totalled ~575 mtpa/year (8313 TWh/year).[4] This still includes the liquefaction trains of Qatar before the Strain of Hormuz conflict. 67% of these total global capacities, 387 mtpa (5593 TWh/year) was available for European markets. The largest potential source of supply may be realised from the United States, African countries (Algeria, Angola, Cameroon, Congo, Egypt, Equatorial Guinea, Mozambique, Nigeria) and Russia. These technical capacities may further be constrained by geopolitics such as the Strait of Hormuz crisis of 2026 shutting out the total production of Qatar and United Arab Emirates, and the REPowerEU policy

[3] As explained above, volumes available for Europe is the sum of (i) FOB, (ii) DES to Europe and (iii) uncontracted volumes, (iv) constrained by historical utilisation which account for maintenance and other constraints

[4] Assuming a conversion factor of 1 mtpa=14.44 TWh/year

of banning Russian LNG imports to Europe by late 2027. Taking these limitations into account, total LNG liquefaction capacity available for Europe drops to 320 mtpa (4645 TWh/year).

FIGURE 14. LNG VOLUMES AVAILABLE FOR EUROPE (FOB, DES TO EUROPE AND UNCONTRACTED), 2025 MTPA



Source: REKK based on GIIGNL

The global capacity of 320 mtpa (4645 TWh/year) – without LNG from Qatar, Russia and the United Arab Emirates – will serve as a baseline for the modelling scenarios.

4 METHODOLOGY

To identify the effects of the Strait of Hormuz crisis and other supply scenarios, the European Gas Market Model (EGMM) was applied. EGMM is a partial equilibrium model of the European natural gas markets, including key infrastructure, demand, regulatory and contractual parameters related to the natural gas markets as inputs. The model calculates the equilibrium at which the welfare of European actors is maximal. The welfare is primarily affected by the cost of gas procurement for European consumers and takes the profits of European energy traders and gas producers into account as well. Infrastructure operators's operational profit is calculated but does not primarily affect the equilibrium outcome. Main output of the modelling is the wholesale natural gas prices by market, flow on all major infrastructure elements (pipelines, LNG terminals and storage infrastructure), and total expenditures of countries for natural gas procurement.

The model was calibrated to represent historical data from Q2 2025 to Q1 2026.

The model was updated with latest available input data from publicly available sources. Table 1 summarizes the datasets that we used for this modelling exercise:

TABLE 1. INPUT DATA AND SOURCES FOR MODELLING

Input data	Unit	Source of data
Demand	TWh/year	Eurostat, National trends (ENTSOG TYNPD 2024)
Production	TWh/year, max GWh/day	
Pipeline capacity	GWh/day	ENTSOG capacity map, TYNDP 2024
Storage capacity	GWh/day , TWh/year	ENTSOG capacity map, TYNDP 2024
LNG capacity (regasification)	GWh/day	ENTSOG capacity map, TYNDP 2024
LNG capacity (liquefaction)	GWh/day	Global Energy Monitor Global Gas Infrastructure Tracker 2024
LNG transport cost	EUR/MWh	Distance-based calculation (day rate, canal fee, fuel cost)
Tariffs (LNG regas, storage, pipeline entry and exit)	€/MWh	REKK calculation based on TSO published tariffs for 2026 (tariffs do not change between modelling years)
LTC (ACQ, price, route, expiry)	TWh/year, flexibility, €/MWh	Eurostat, Gazprom, company annual reports, OIES, country statistics, REKK data collection

Source: REKK

5 SCENARIO DESCRIPTION

The modelling is performed along a set of scenarios. Scenarios are then compared to each other and a common baseline. This approach allows to disaggregate specific effects of major geopolitical events, regulatory action or default of capacities.

Modelled corner years (2026 / 2028): Modelling was performed for 12 consecutive months, focusing on the immediate effects in 2026 and the lasting effects in 2028.

European ban on Russian pipeline gas and LNG (With RU gas / No RU gas): Europe plans to phase out Russian pipeline gas and LNG as outlined in the REPoweEU Roadmap.[5] In our scenarios, this means the following (also summarised in Table 2 below):

> *2026 with RU gas:* Spot Russian LNG and short-term Russian pipeline gas via TurkStream can reach Europe. Russian long-term contracted pipeline and LNG volumes are delivered. This covers pipeline gas to Greece, Hungary and Slovakia as well as Russian LNG to Western European LNG terminals.
>
> *2026 no RU gas*: Russian long-term contracted pipeline and LNG volumes are still allowed to reach Europe in 2026. This covers pipeline gas to Greece, Hungary and Slovakia as well as Russian LNG to Western European LNG terminals.
>
> *2028 with RU gas*: Russian spot LNG, long-term contracted pipeline gas to Hungary and LNG may reach European markets. This covers pipeline gas to Greece, Hungary and Slovakia as well as Russian LNG to Western European LNG terminals.
>
> *2028 no RU gas*: neither spot, nor long-term contracted Russian gas can be shipped to the EU27.

TABLE 2. SUMMARY OF RUSSIAN GAS BAN SCENARIOS

	2026	2028
With RU gas	Spot LNG & pipeline gas, LTCs to GR, HU, SK allowed	Spot LNG & pipeline gas, LTCs to GR, HU, SK allowed
No RU gas	No Spot LNG & pipeline gas; LTCs to GR, HU, SK allowed	No RU LNG or pipeline gas to EU27

Source: REKK

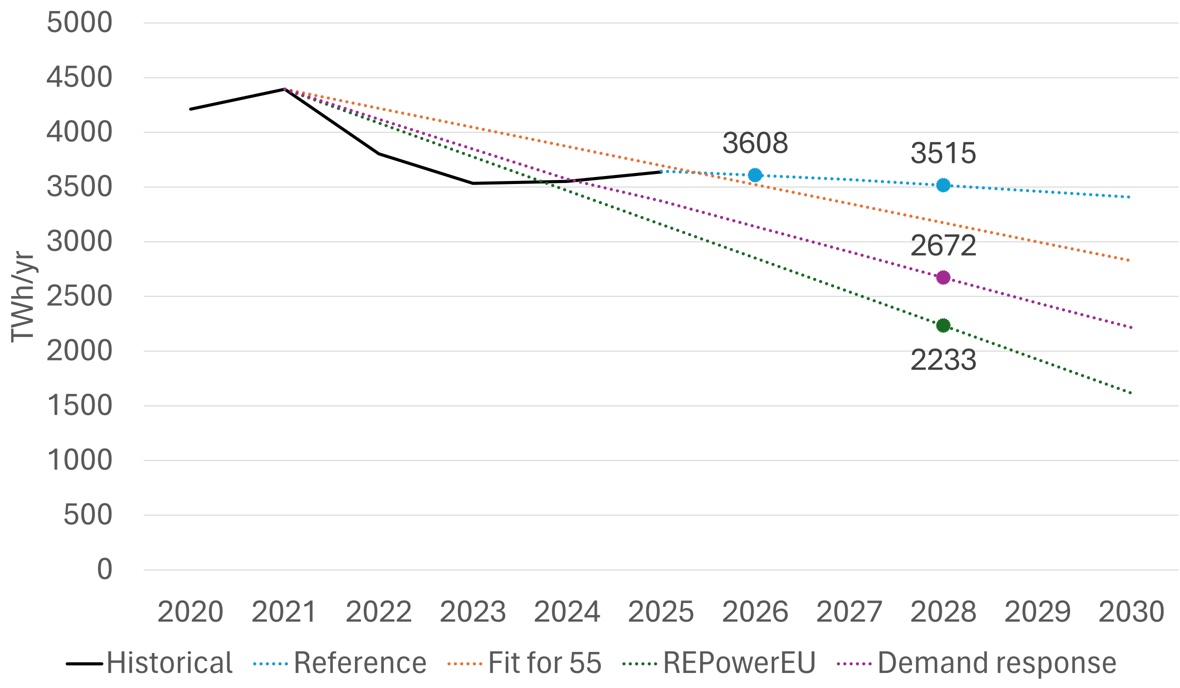
Strait of Hormuz (Open / Closed): As of 2026, the Strait of Hormuz crisis affects global LNG markets heavily and is considered in most scenarios to be closed. This means that total LNG liquefaction capacity of Qatar and the United Arab Emirates is shut down. Besides the obvious

[5] Regulation (EU) 2026/261 of the European Parliament and of the Council of 26 January 2026 on phasing out Russian natural gas imports and preparing the phase-out of Russian oil imports, improving monitoring of potential energy dependencies and amending Regulation (EU) 2017/1938.

loss of supplies, the Japan-Korea marker (JKM) is increased by 50%, which affects European short-term LNG supply costs directly.

European natural gas demand (Reference / REPowerEU / Demand Response): Natural gas consumption was assumed to stagnate in the reference scenario from 2026 to 2028. However, the REPowerEU Roadmap lined out an ambitious demand reduction, surpassing the Fit for 55 trajectories, resulting in a 35% demand reduction from 2023 to 2030. This means that natural gas demand in Europe would shrink to 2233 TWh/year to 2028 from 3608 TWh/year in 2026. Additionally, we have plotted a less extreme demand pathway, which was adjusted to offset the negative market effects caused by the Strait of Hormuz crisis – setting EU27 natural gas consumption at 2672 TWh/year (Figure 15).

FIGURE 15. EU27 NATURAL GAS DEMAND SCENARIOS, TWH/YEAR



Source: REKK modelling assumptions

US LNG supply disruption (None / 1 month / 3 months): from 2022 on, the missing Russian pipeline gas has been gradually replaced by US LNG. This single supplier dependency has brought a new security of supply risk. As 90% of US LNG liquefaction capacity is located in the Gulf of Mexico, extreme weather events may easily damage the LNG liquefaction infrastructure. We opted to use two scenarios, a one-month and a three-month disruption of US LNG liquefaction due to hurricane related damages.

These five dimensions altogether define 25 distinct scenarios (Table 3). For ease of understanding, these scenarios will be grouped into four main sets:

- Strait of Hormuz disruption scenarios
- Strait of Hormuz disruption + 1 month US LNG supply disruption scenarios
- Strait of Hormuz disruption + 3 months US LNG supply disruption scenarios

- 3 months US LNG supply disruption scenarios

Moreover, the effect of demand reduction as envisaged by the REPowerEU Roadmap and a less ambitious demand response scenario is presented.

TABLE 3. LIST OF SCENARIOS

Scenario set	Year	RU gas ban	Strait of Hormuz	EU27 gas demand	US LNG supply shock	Notes
Counterfactual	2026	With RU gas	Open	REF	None	JKM=40
Strait of Hormuz shock	2026	With RU gas	Closed	REF	None	JKM=60
	2026	No RU gas	Closed	REF	None	JKM=60
	2028	With RU gas	Closed	REF	None	JKM=60
	2028	No RU gas	Closed	REF	None	JKM=60
	2028	No RU gas	Closed	REPowerEU	None	JKM=60
	2028	No RU gas	Closed	Demand response	None	JKM=60
Strait of Hormuz + US LNG 1 month shock	2026	With RU gas	Closed	REF	1 month	JKM=60/100
	2026	No RU gas	Closed	REF	1 month	JKM=60/100
	2028	With RU gas	Closed	REF	1 month	JKM=60/100
	2028	No RU gas	Closed	REF	1 month	JKM=60/100
	2028	No RU gas	Closed	REPowerEU	1 month	JKM=60/100
	2028	No RU gas	Closed	Demand response	1 month	JKM=60/100
Strait of Hormuz + US LNG 3 months shock	2026	With RU gas	Closed	REF	3 months	JKM=60/100
	2026	No RU gas	Closed	REF	3 months	JKM=60/100
	2028	With RU gas	Closed	REF	3 months	JKM=60/100
	2028	No RU gas	Closed	REF	3 months	JKM=60/100
	2028	No RU gas	Closed	REPowerEU	3 months	JKM=60/100
	2028	No RU gas	Closed	Demand response	3 months	JKM=60/100
US LNG 3 months shock	2026	With RU gas	Open	REF	3 months	JKM=60
	2026	No RU gas	Open	REF	3 months	JKM=60
	2028	With RU gas	Open	REF	3 months	JKM=60
	2028	No RU gas	Open	REF	3 months	JKM=60
	2028	No RU gas	Open	REPowerEU	3 months	JKM=60
	2028	No RU gas	Open	Demand response	3 months	JKM=60

Source: REKK modelling assumptions

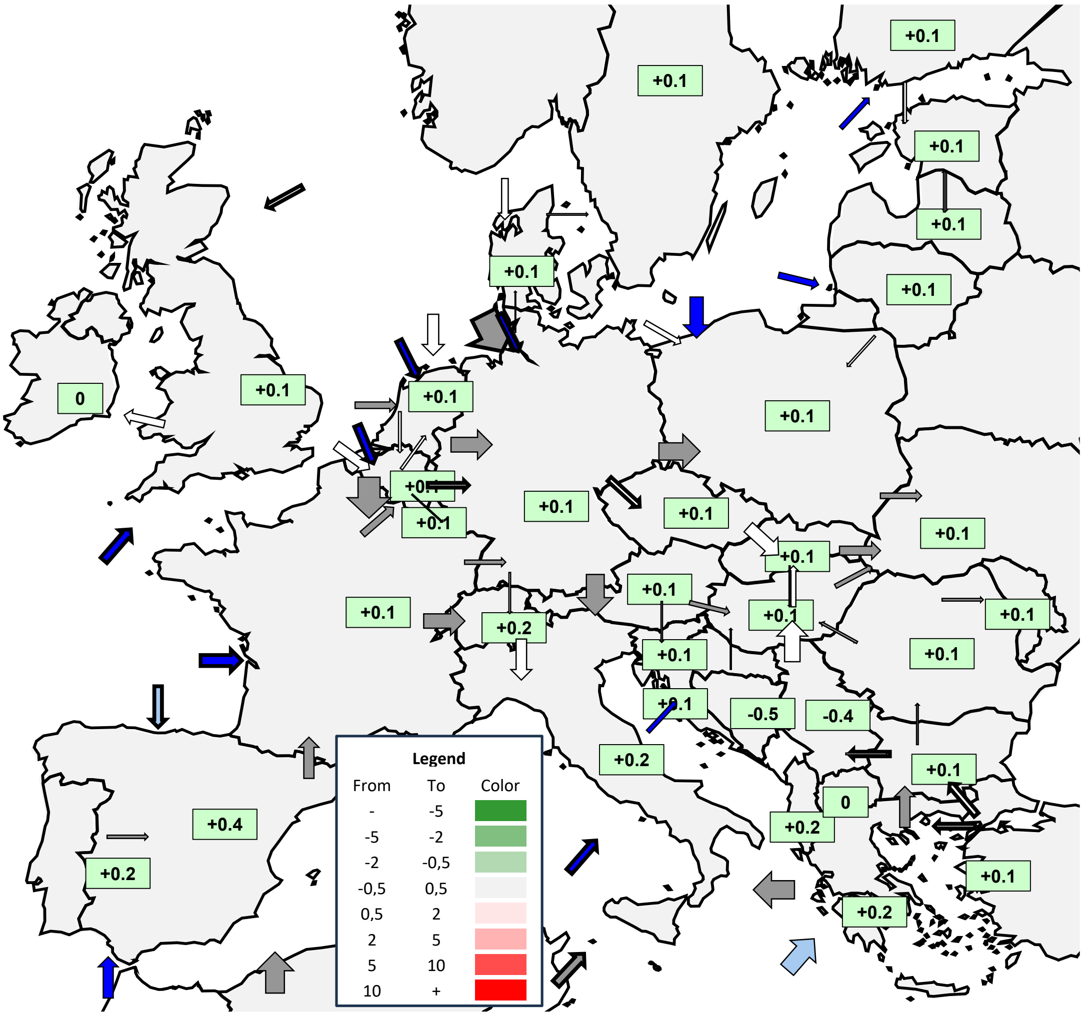
6 MODELLING RESULTS

Modelling results will be compared to the scenario before the energy crisis, representing the 2025-2026 Q1 period. The increase in total gas procurement cost is relative to this counterfactual.

6.1 STRAIT OF HORMUZ DISRUPTION SCENARIOS

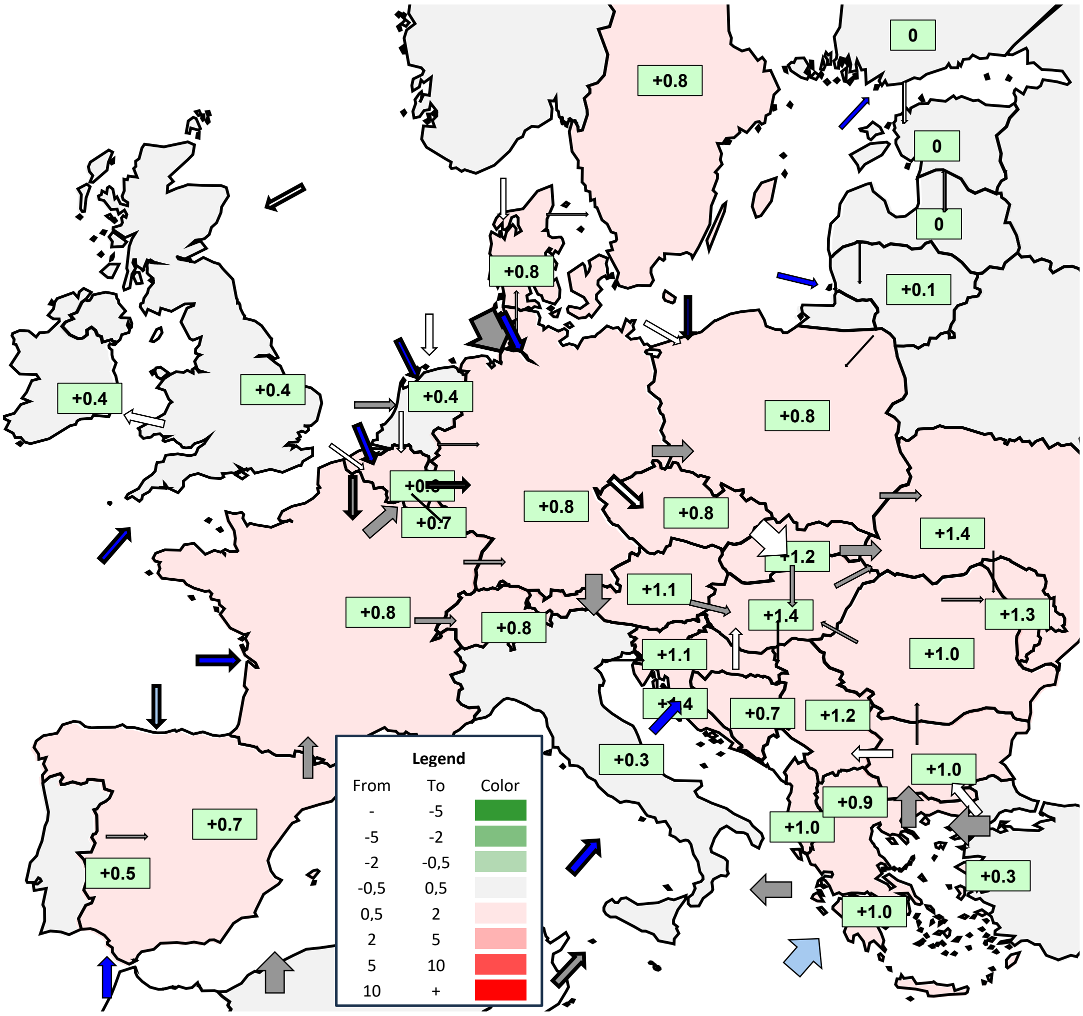
Closure of the Strait of Hormuz does increase the absolute price level of Europe by 20 EUR/MWh due to the scarcity of global LNG supply. Introducing a further Russian gas ban in 2026 as required by the REPowerEU Roadmap effectively constrains spot Russian LNG and spot Russian pipeline gas to Europe. The effect of such regulation is minimal (0.1 – 0.4 EUR/MWh across the EU27), as Russian LNG volumes are replaced by alternative US LNG supply (Figure 16, Figure 18). Price effects are more pronounced by 2028, as all Russian – including long-term contracted – LNG and pipeline gas is phased out from the EU27 mix. Still, the price increase is between 0 – 1.4 EUR/MWh across the EU27 (Figure 17).

FIGURE 16. YEARLY PRICE INCREASE DUE TO REPOWEREU 2026, STRAIT OF HORMUZ DISRUPTION, EUR/MWH



Numbers in the box depict the wholesale price change. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

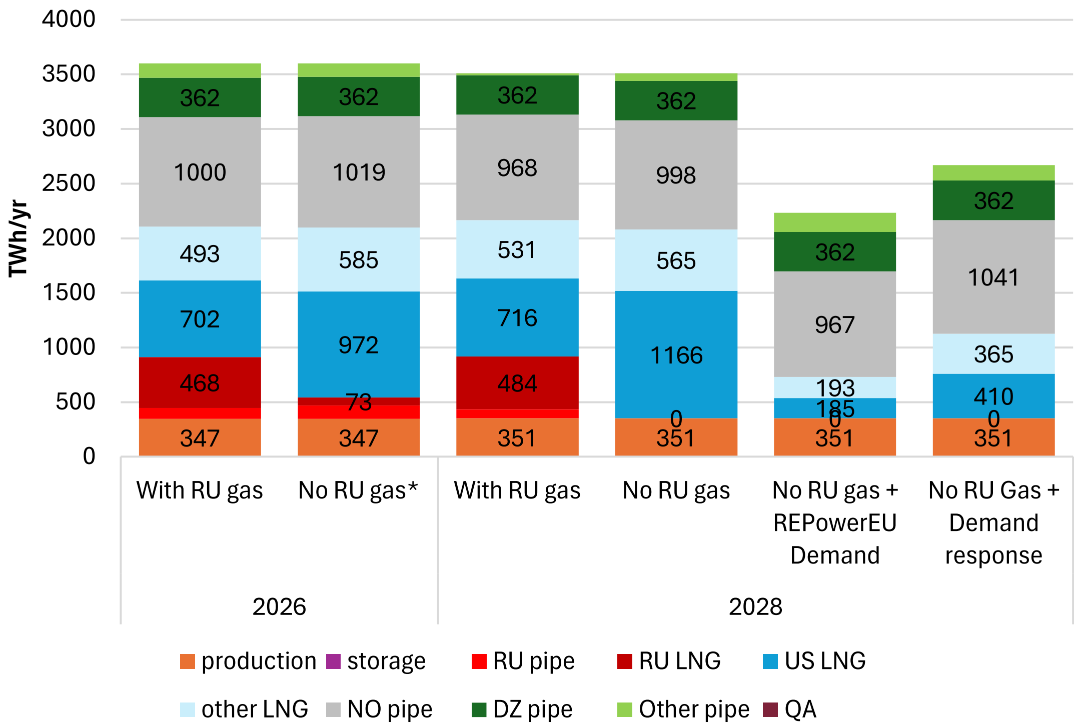
FIGURE 17. YEARLY PRICE INCREASE DUE TO REPOWEREU 2028, STRAIT OF HORMUZ DISRUPTION, EUR/MWH



Numbers in the box depict the wholesale price change. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

The supply structure of the EU27 in the various scenarios differs in the volume of US LNG and Russian gas in the mix. As Europe pushes on with the phasing out of Russian gas, US LNG serve as an alternative to Russian gas in all scenarios. The European market may be supplied in all scenarios without limiting consumption. This increased dependency on US LNG poses a single supplier risk, which may be partly mitigated with demand reduction by 2028. In the *No RU gas + REPowerEU* scenario, the import need for LNG may be reduced significantly as the EU27 may be supplied with pipeline gas from Norway and Africa. However, this assumes that EU27 gas consumption drops to 2 233 TWh/year, which would mean a 38% decrease from 2026 to 2028. The *No RU gas + Demand response* scenario assumes a 26% lower natural gas consumption for the EU27 from 2026 to 2028, which also limits the dependence on LNG. (Figure 18)

FIGURE 18. EU27 SUPPLY STRUCTURE, STRAIT OF HORMUZ DISRUPTION, TWH/YR

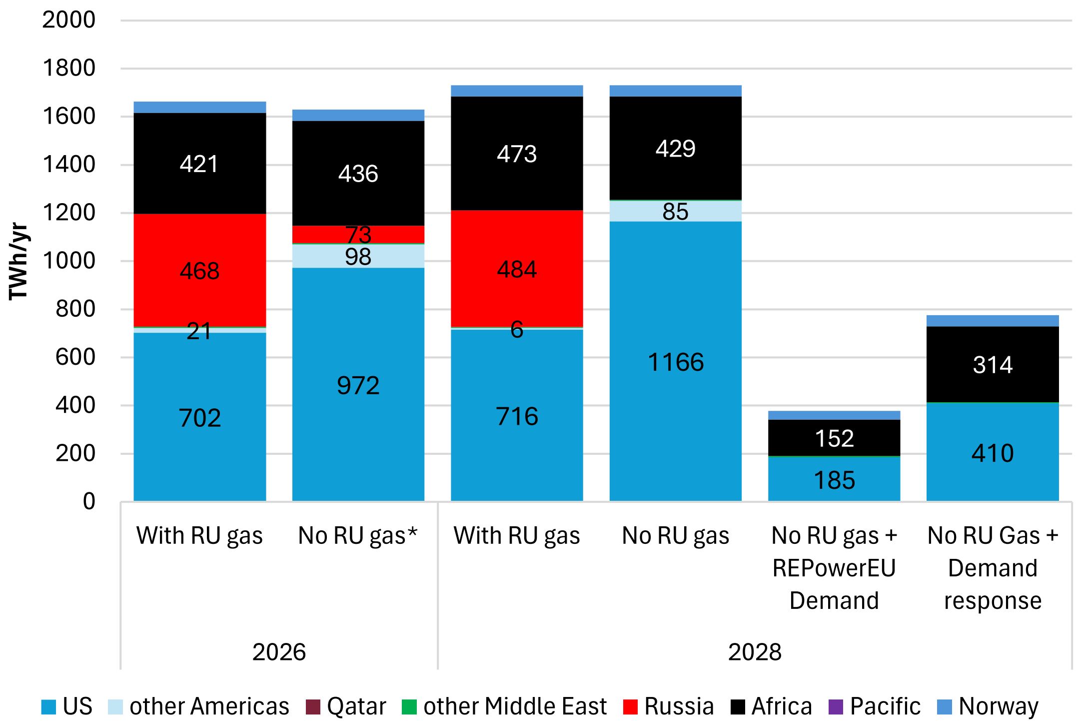


Source: REKK EGMM modelling

** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

Besides the United States, African LNG acts as the second largest supplier for Europe. Due to proximity of Europe to North African (Algeria, Egypt, Mauritania), West African (Nigeria) and Central African (Angola, Cameroon, Congo, Equatorial Guinea, Gabon) LNG exporters, cargoes rather target European than Asian markets. Russian LNG would also reach European markets if it is not banned by EU regulation. (Figure 19)

FIGURE 19. EU27 LNG IMPORT STRUCTURE, STRAIT OF HORMUZ DISRUPTION, TWH/YR



Source: REKK EGMM modelling

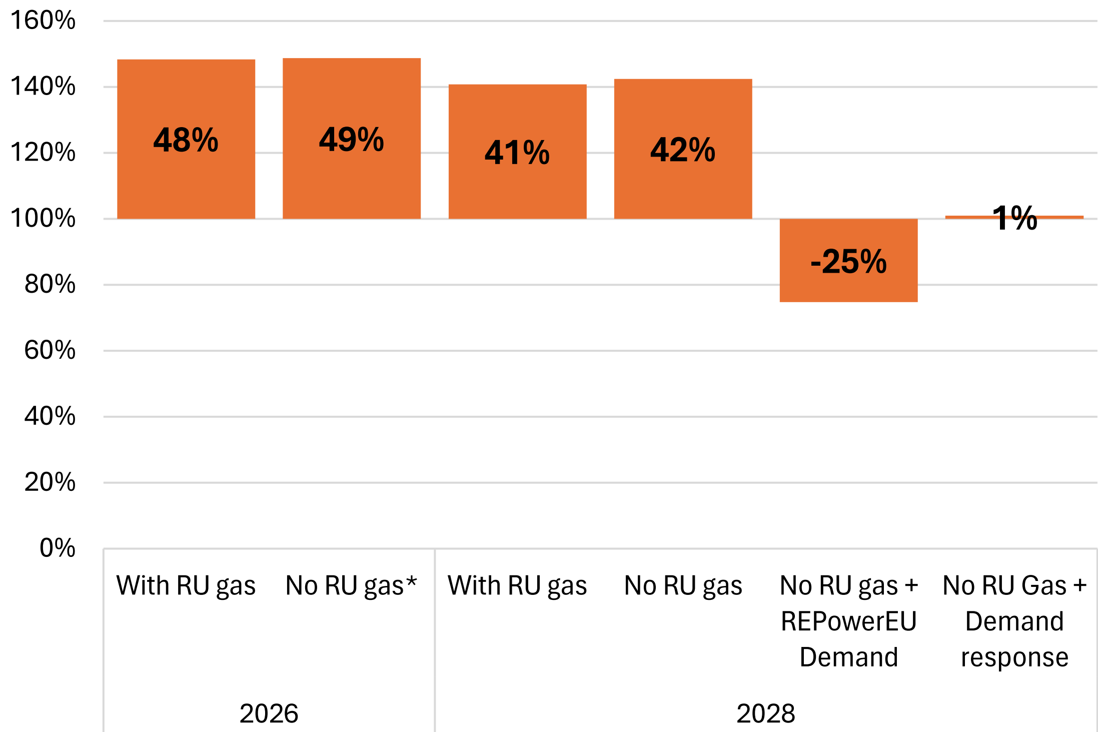
** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

The total cost of gas procurement is compared to the counterfactual case representing the year 2025: long-term contracted Russian gas and some spot Russian LNG is still allowed to the EU27, Strait of Hormuz is open, and global LNG prices are at 40 EUR/MWh. As opposed to this counterfactual, the Strait of Hormuz crisis induces a 48% increase in gas bill in 2026, and a 41% increase in 2028. The smaller increase in gas bill by 2028 is supported by two main factors: a slight (2%) reduction in EU27 natural gas demand as well as the increased global LNG supply.

Banning Russian pipeline gas and LNG on top of the Hormuz crisis further adds a 1% on the gas bill. The reason for this is the fact that (i) Russian pipeline volumes are mostly out of the supply mix of Europe already by 2026, and (ii) Russian LNG may be more flexibly replaced by alternative LNG sources.

The adverse effects caused by the Strait of Hormuz crisis may be mitigated by demand reduction in the EU27. The REPowerEU Roadmap sets forth an ambitious 38% demand reduction from 2026 to 2028 – this may even reduce the total gas bill of the EU27 by 25%. Nevertheless, this level of demand adjustment is unlikely in such a short period of time – the drop in natural demand due to the energy crisis in Europe was at the level of 20%, which was prompted by a much severe price signal in 2022. The energy saving investments and demand reduction already done may not be reproduced as easily. To offer an alternative pathway, we have set a the EU27 demand at a level which offsets the effects of the Strait of Hormuz crisis. To do so, EU27 demand needs to fall to 2672 TWh/year, which is a 26% reduction compared from 2026 to 2028. This is still higher than the demand response observed during the energy crisis of 2022.

FIGURE 20. EU27 GAS BILL INCREASE, STRAIT OF HORMUZ DISRUPTION, % (COMPARED TO 2026 BEFORE CRISIS)



Source: REKK EGMM modelling

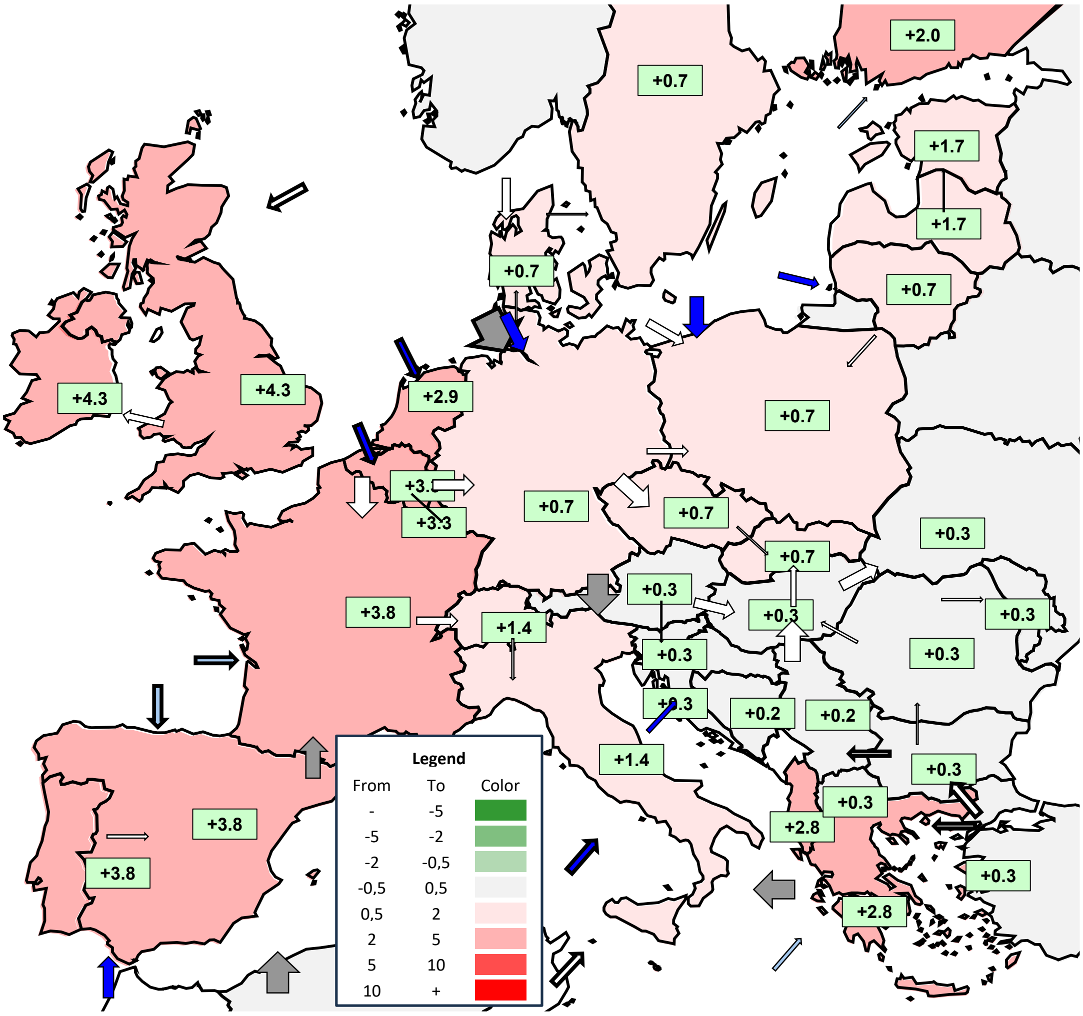
To sum up: the Strait of Hormuz crisis has a significant price-increasing effect in Europe. The missing volumes may be supplied with alternative US supplies. Gas bill due to the price effect may increase by 48% in 2026 and 41% in 2028. The Russian gas phaseout has a 1% price increasing effect on top of the Hormuz crisis effects. To offset the Hormuz price effects, a demand reduction by 26% from 2026 to 2028 is needed. (Figure 20)

6.2 STRAIT OF HORMUZ DISRUPTION + 1 MONTH US LNG SUPPLY DISRUPTION SCENARIOS

As US LNG was the most flexible and cost-effective alternative to replace Russian gas and missing Qatari volumes, it is worthwhile to analyse the risks associated with a disruption of US LNG production. This may be caused by a major hurricane which hits the LNG liquefaction trains concentrated in the Gulf of Mexico. If such an event causes a loss of US supply on top of the Strait of Hormuz crisis, global LNG prices may skyrocket (See Chapter 3.2 for details).

Price effects are shown for the one month of supply shock in Figure 21. Price increase ranges from 0.3 to 4.3 EUR/MWh. The highest price increase may be identified in countries consuming more US LNG. (Figure 21)

FIGURE 21. MONTHLY PRICE INCREASE DUE TO LOSS OF US LNG 2026 OCT EUR/MWH

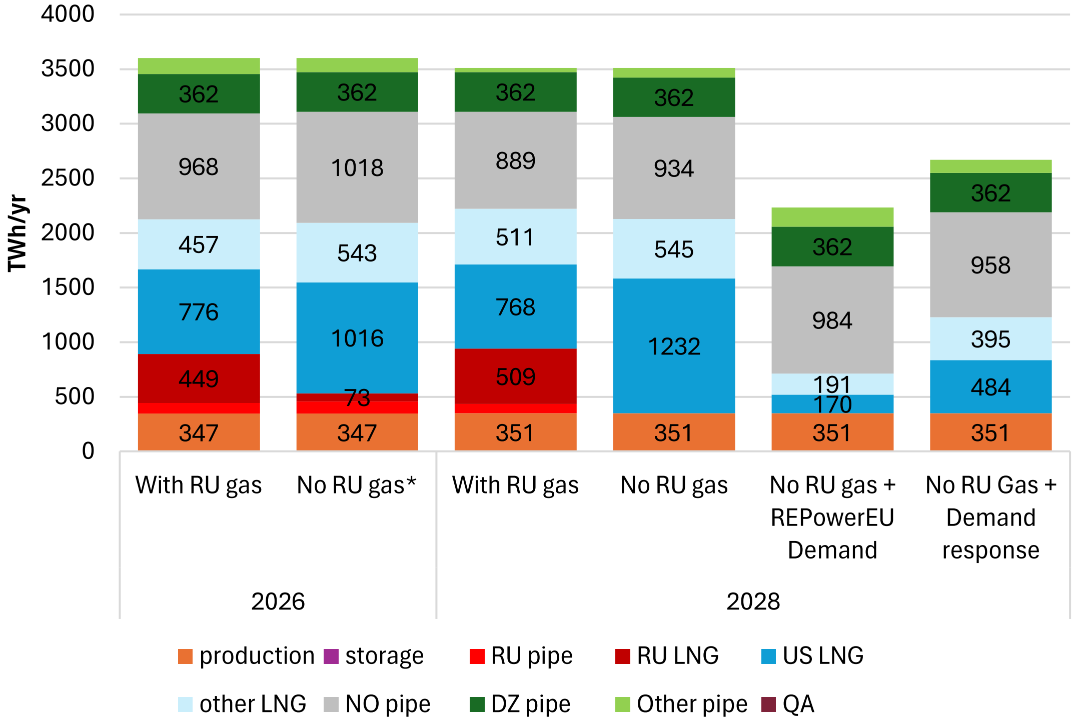


Numbers in the box depict the wholesale price change in October. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

The one-month loss of US LNG supplies does not alter the structure of the annual supply structure: US LNG imports are ramped up in the other 11 months, when supply is available.

Russian gas phaseout in the EU27 is not jeopardised – but this is due to the 1-month nature of the shock. Demand reduction scenarios further mitigate the risk, reducing the need for LNG imports. (Figure 22)

FIGURE 22. EU27 SUPPLY STRUCTURE, STRAIT OF HORMUZ DISRUPTION + 1 MONTH US LNG SUPPLY DISRUPTION,TWH/YR

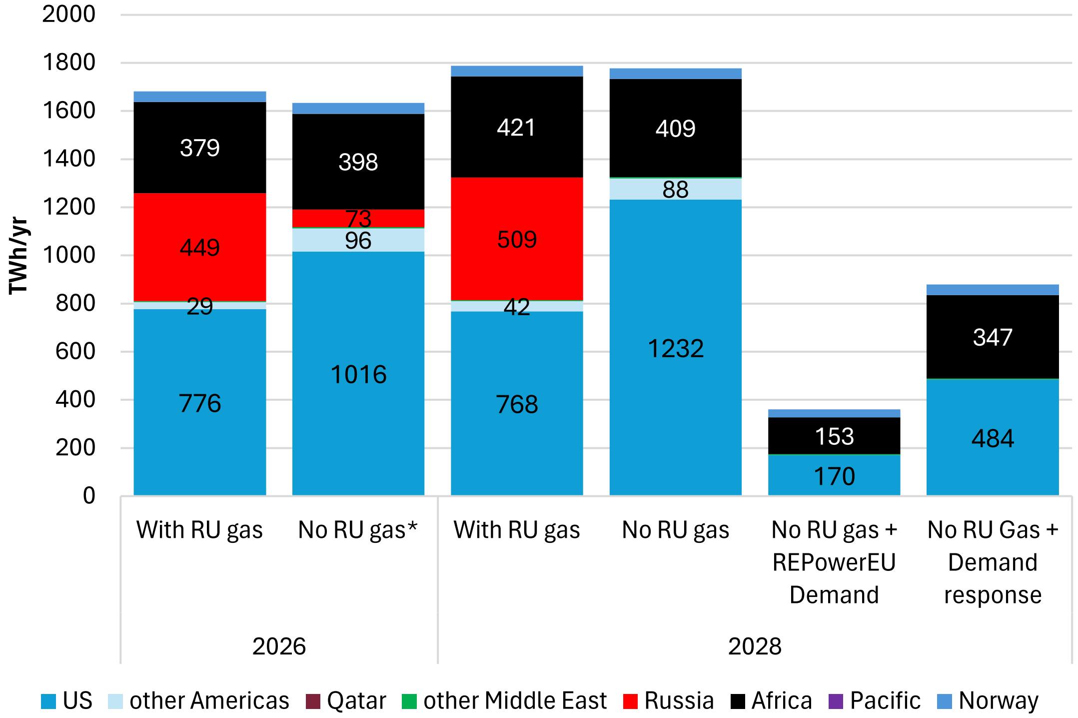


Source: REKK EGMM modelling

** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

Besides the United States, African LNG acts as the second largest supplier for Europe. Russian LNG would also target European markets if not banned by EU regulation. The one-month loss of US LNG can be handled by Europe with ramping up the imports in the other months and storing more gas. (Figure 23)

FIGURE 23. EU27 LNG IMPORT STRUCTURE, STRAIT OF HORMUZ DISRUPTION + 1 MONTH US LNG SUPPLY DISRUPTION, TWH/YR



Source: REKK EGMM modelling

** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

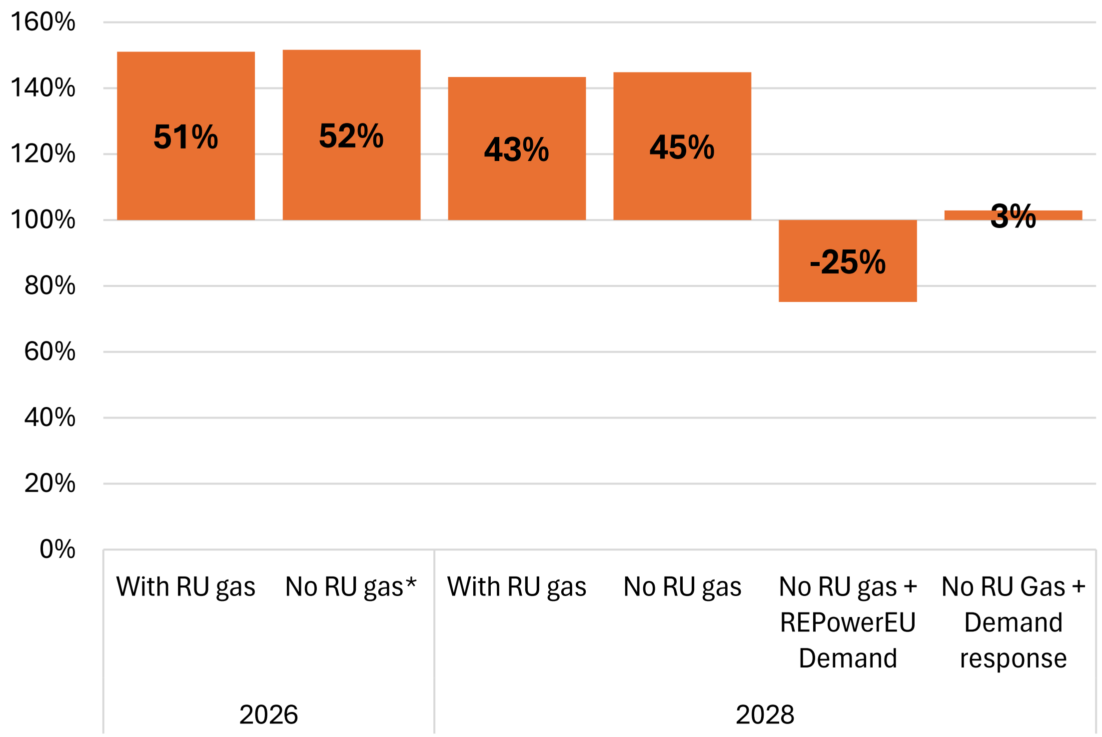
The total cost of gas procurement is compared to the counterfactual case representing the year 2025: long-term contracted Russian gas and some spot Russian LNG is still allowed to the EU27, Strait of Hormuz is open, and global LNG prices are at 40 EUR/MWh. As opposed to this counterfactual, the Strait of Hormuz crisis induces a 51% increase in gas bill in 2026, and a 43% increase in 2028. The lower effect in gas bill increase by 2028 is supported by two main factors: a slight (2%) reduction in EU27 natural gas demand as well as the increased global LNG supply (Figure 24).

Banning Russian pipeline gas and LNG on top of the Hormuz crisis and the 1-month US supply sock further adds 1-2% on the gas bill. The reason for this is the fact that (i) Russian pipeline volumes are mostly out of the supply mix of Europe already by 2026, and (ii) Russian LNG may be more flexibly replaced by alternative LNG sources.

The REPowerEU Roadmap sets forth an ambitious 38% demand reduction from 2026 to 2028 – this may even reduce the total gas bill of the EU27 by 25%. Nevertheless, this level of demand adjustment is unlikely in such a short period of time – the drop in natural demand due to the energy crisis in Europe was at the level of 20%, which was prompted by a much severe price signal in 2022. The energy savings investments and demand reduction already done may not be reproduced as easily. To offer an alternative pathway, we have set a the EU27 demand at a level which offsets the effects of the Strait of Hormuz crisis, causing a 3% increase in gas bills.

To do so, EU27 demand needs to fall to 2672 TWh/year, which is a 26% reduction compared from 2026 to 2028. This is still higher than the demand response observed during the energy crisis of 2022.

FIGURE 24. EU27 GAS BILL INCREASE, STRAIT OF HORMUZ DISRUPTION + 1 MONTH US LNG SUPPLY DISRUPTION, % (COMPARED TO 2026 BEFORE CRISIS)



Source: REKK EGMM modelling

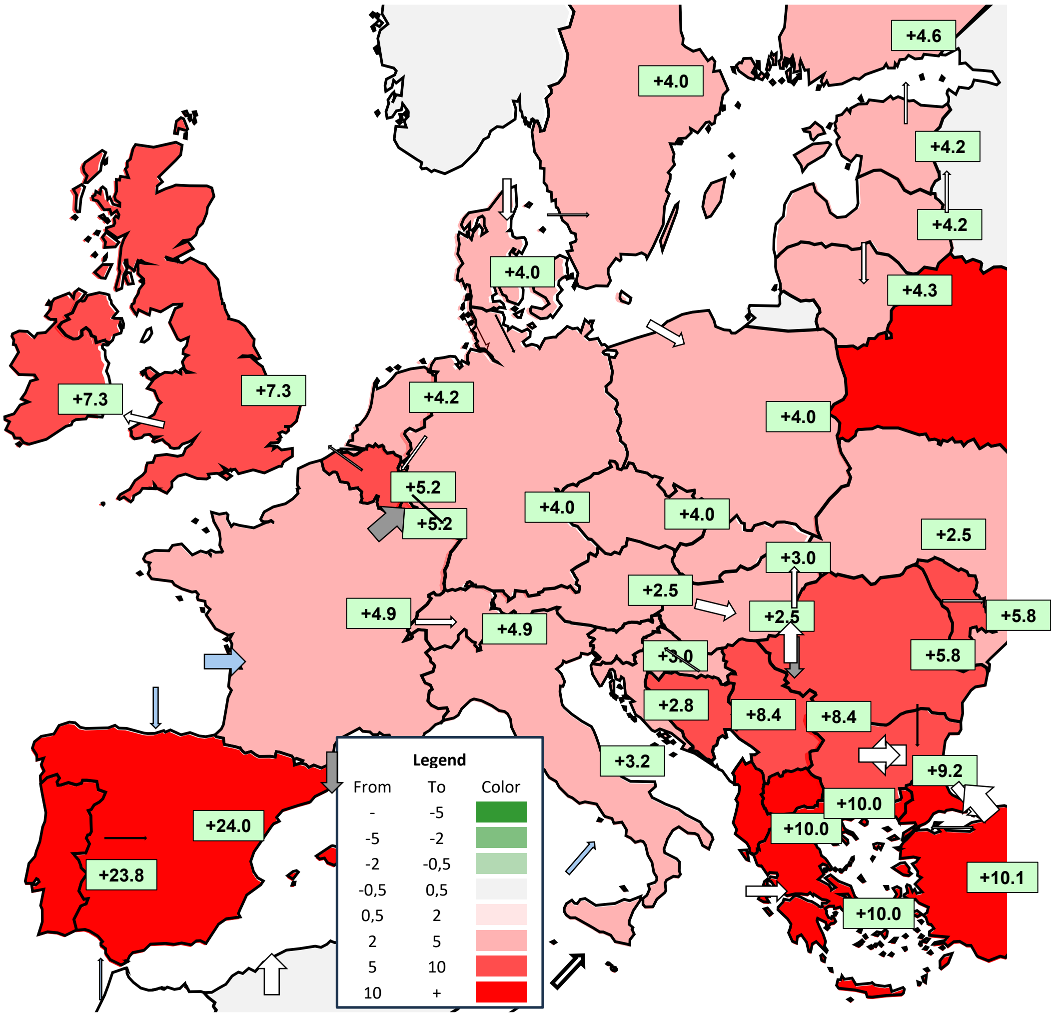
To sum up, a 1-month disruption of US LNG in addition to the Strait of Hormuz crisis further increases by the gas bill of the EU27. Due to the short disruption window, EU27 consumption can adjust and storages may mitigate the price effects to some extent. US imports are ramped up in the unaffected months. Compared to the Strait of Hormuz crisis results, the 1-month disruption of US LNG further adds 1-3% increase in the gas bill (comparing Figure 24 to Figure 20).

6.3 STRAIT OF HORMUZ DISRUPTION + 3 MONTHS US LNG SUPPLY DISRUPTION SCENARIOS

To assess a more severe shock, three-month disruption of US LNG capacities is assumed. When US LNG is unavailable in conjunction with the Strait of Hormuz crisis, global LNG prices are assumed to increase to above 100 EUR/MWh.

European wholesale prices in October are heavily affected, with a price increase of 2.5 – 25 EUR/MWh. Price effect is uneven between European markets, with the strongest increase in Spain and Portugal, followed by Greece and the Balkans countries. (Figure 25)

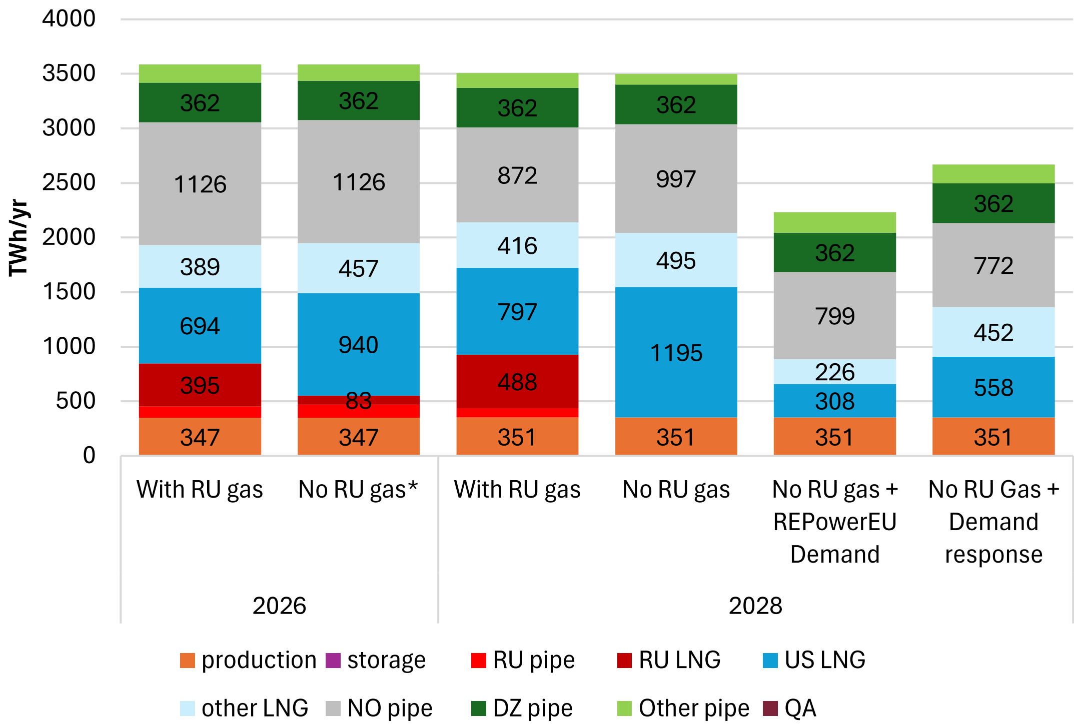
FIGURE 25. MONTHLY PRICE INCREASE DUE TO 3 MONTHS LOSS OF US LNG 2028 OCT EUR/MWH (JP=100€/MWH)



Numbers in the box depict the wholesale price change in October. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

Loss of US supply is replaced by additional Norwegian pipeline gas and alternative LNG supplies. Demand reduction may alleviate the adverse effects of the supply shocks. (Figure 26)

FIGURE 26. EU27 SUPPLY STRUCTURE, STRAIT OF HORMUZ DISRUPTION + 3 MONTHS US LNG SUPPLY DISRUPTION, TWH/YR

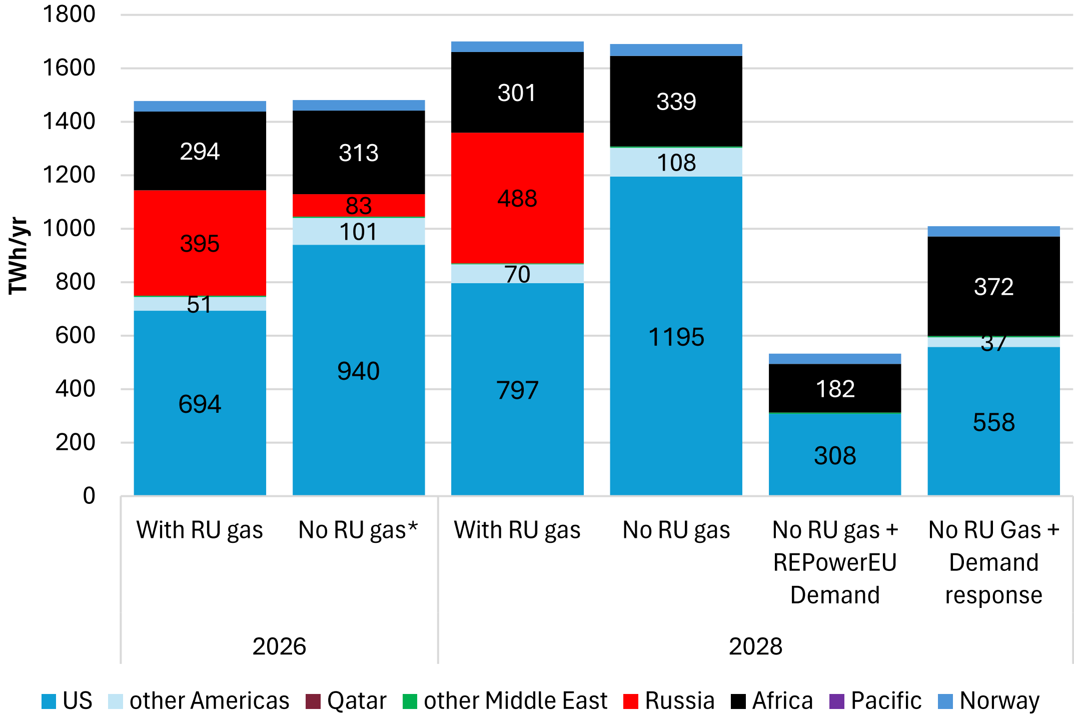


Source: REKK EGMM modelling

* *No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

Besides the United States, African LNG acts as the second largest supplier for Europe. Russian LNG would also target European markets if not banned by EU regulation. The three-month loss of US LNG can be handled by Europe with ramping up the imports in the other months and storing more gas (Figure 27).

FIGURE 27. EU27 LNG IMPORT STRUCTURE, STRAIT OF HORMUZ DISRUPTION + 3 MONTHS US LNG SUPPLY DISRUPTION, TWH/YR

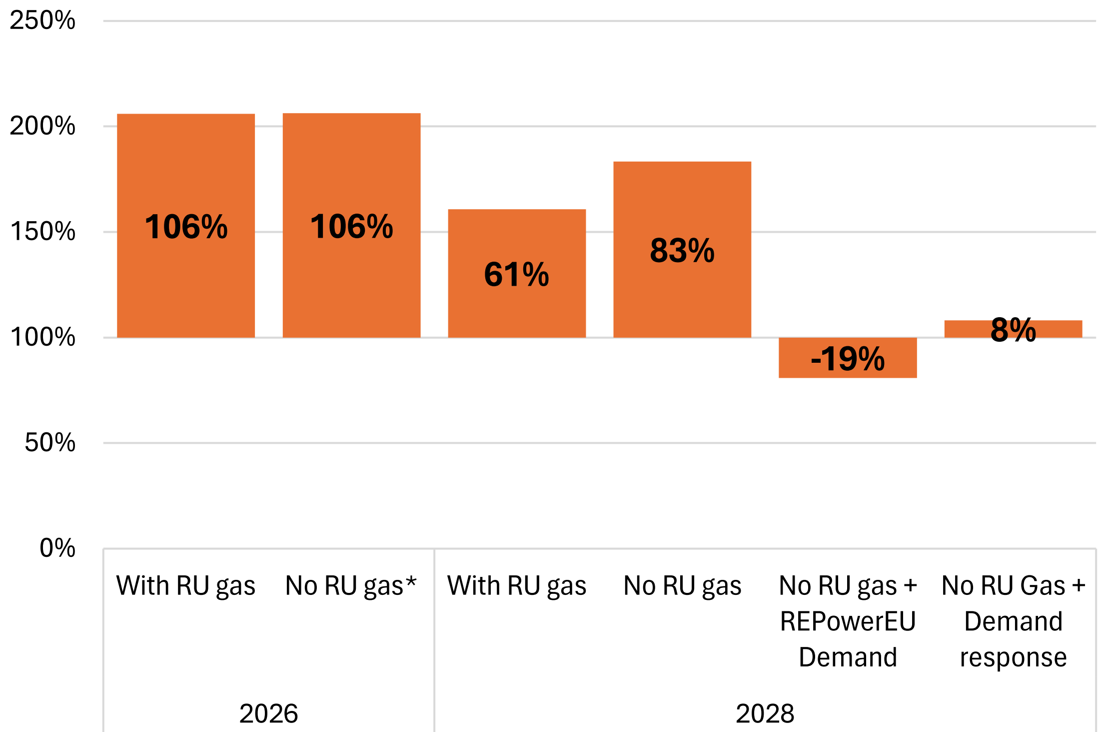


Source: REKK EGMM modelling

** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

Three-month loss of US LNG combined with the Strait of Hormuz crisis increases the gas procurement costs of the EU27 by 106% in 2026 and 61% in 2028. Banning Russian gas to the EU has little effect in 2026, but a huge difference is observed in 2028. This means that in a combined shock, Russian volumes would indeed help alleviate the adverse price effects of missing US LNG. Still, Europe can handle the price increase with demand reduction: in the demand response scenario, gas bill increases by 8% (Figure 28).

FIGURE 28. EU27 GAS BILL INCREASE, STRAIT OF HORMUZ DISRUPTION + 3 MONTHS US LNG SUPPLY DISRUPTION, % (COMPARED TO 2026 BEFORE CRISIS)



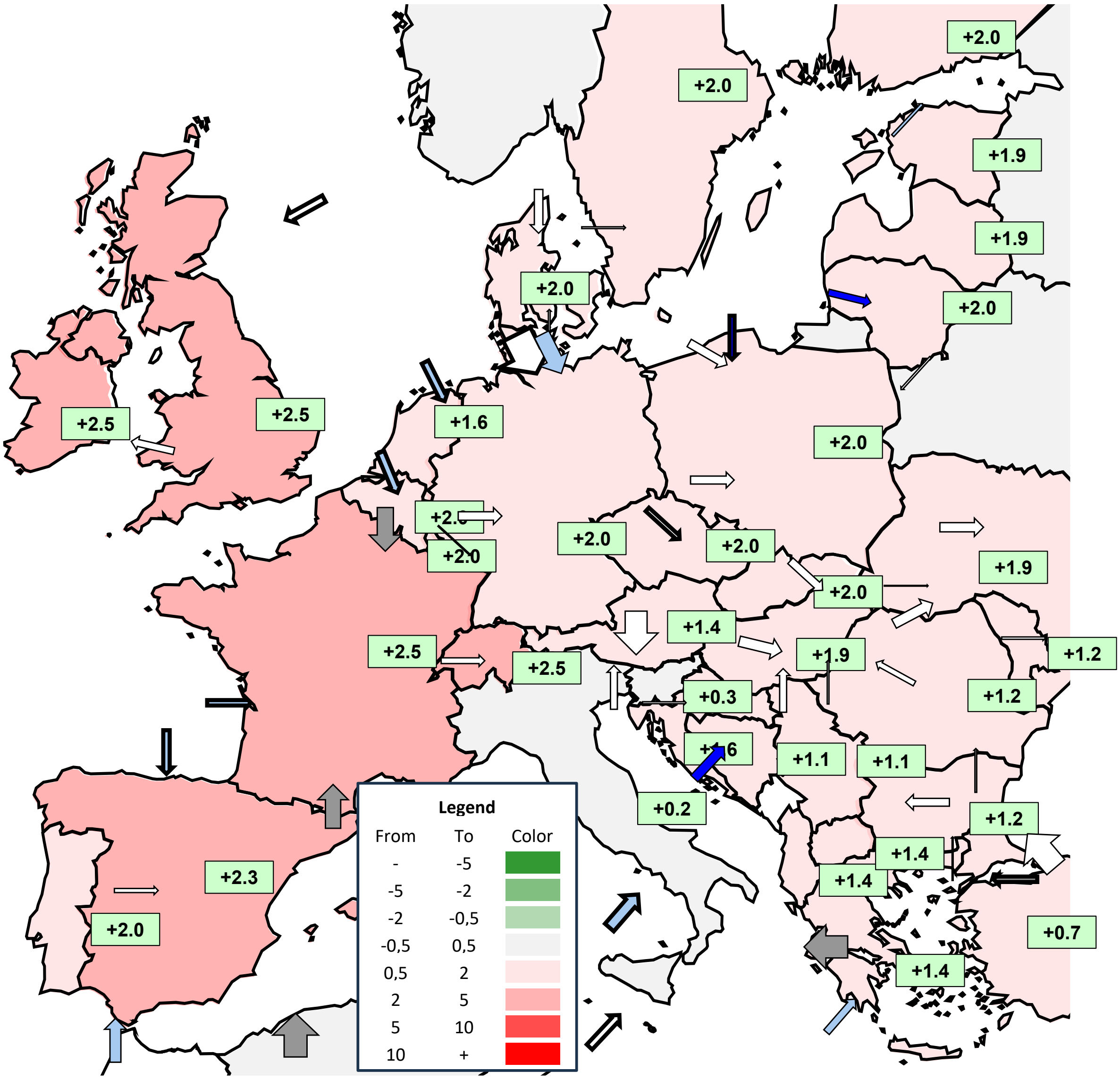
Source: REKK EGMM modelling

To sum up, a combined 3-months shock of US LNG liquefaction and closure of the Strait of Hormuz causes a considerable shortage of supplies to European markets. The combined effects of the two shocks increases the natural gas bill by over 100%. Most of the effects may be mitigated by demand reduction.

6.4 3 MONTHS US LNG SUPPLY DISRUPTION SCENARIOS

The volume of US LNG supply is on par with the volume of Qatari LNG liquefaction capacities – therefore a similar level of supply shock is expected when US LNG defaults as when Qatari volumes are missing due to the Strait of Hormuz crisis (Figure 29).

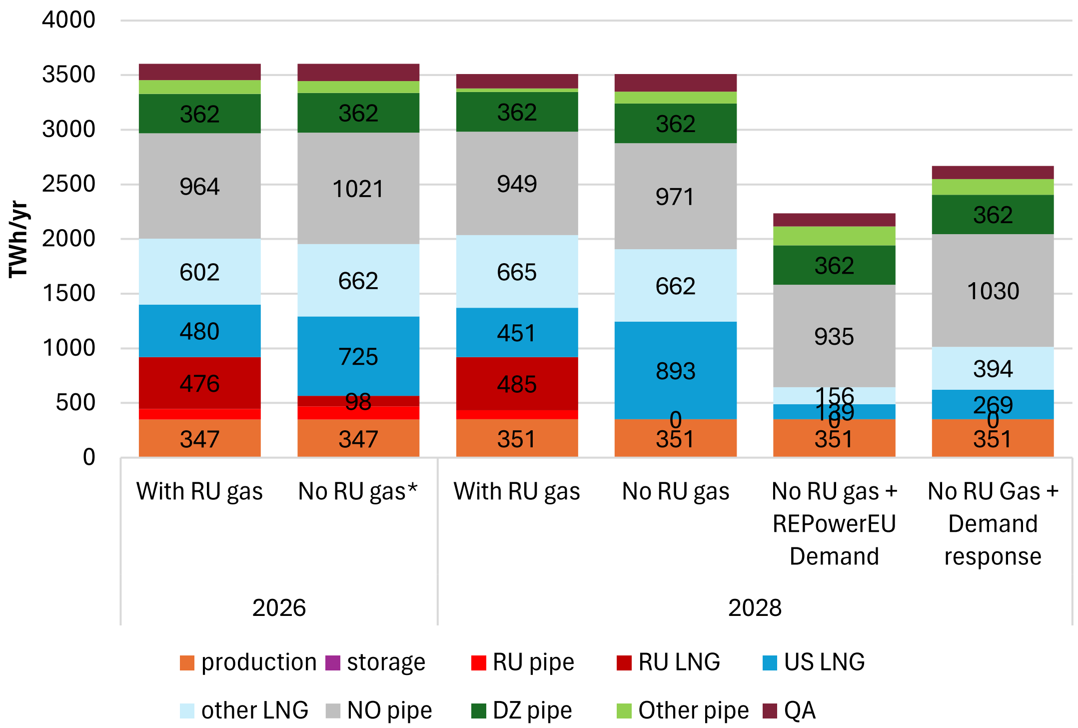
FIGURE 29. MONTHLY PRICE INCREASE DUE TO 3 MONTHS LOSS OF US LNG 2028 OCT EUR/MWH (JP=60 €/MWH)



Numbers in the box depict the wholesale price change in October. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

As the Strait of Hormuz is accessible in these scenarios, LNG from Qatar re-enters the mix. When not available, US LNG is replaced by other LNG sources (Figure 30, Figure 31).

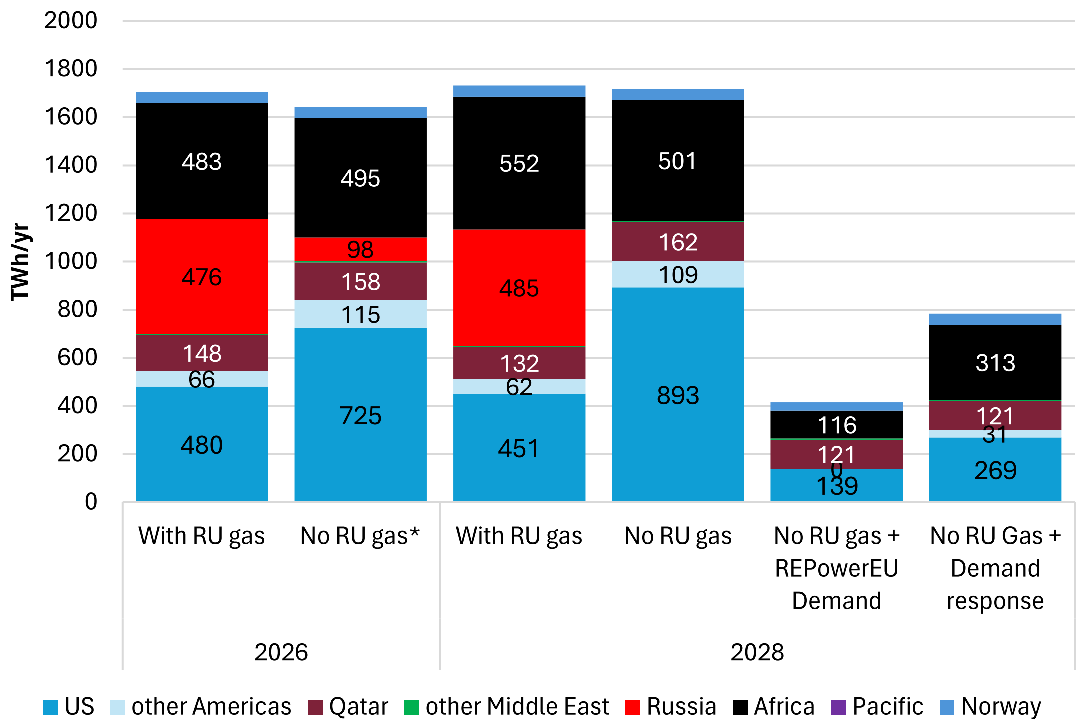
FIGURE 30. EU27 SUPPLY STRUCTURE, 3 MONTHS US LNG SUPPLY DISRUPTION, TWH/YR



Source: REKK EGMM modelling

** No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered*

FIGURE 31. EU27 LNG IMPORT STRUCTURE, 3 MONTHS US LNG SUPPLY DISRUPTION, TWH/YR

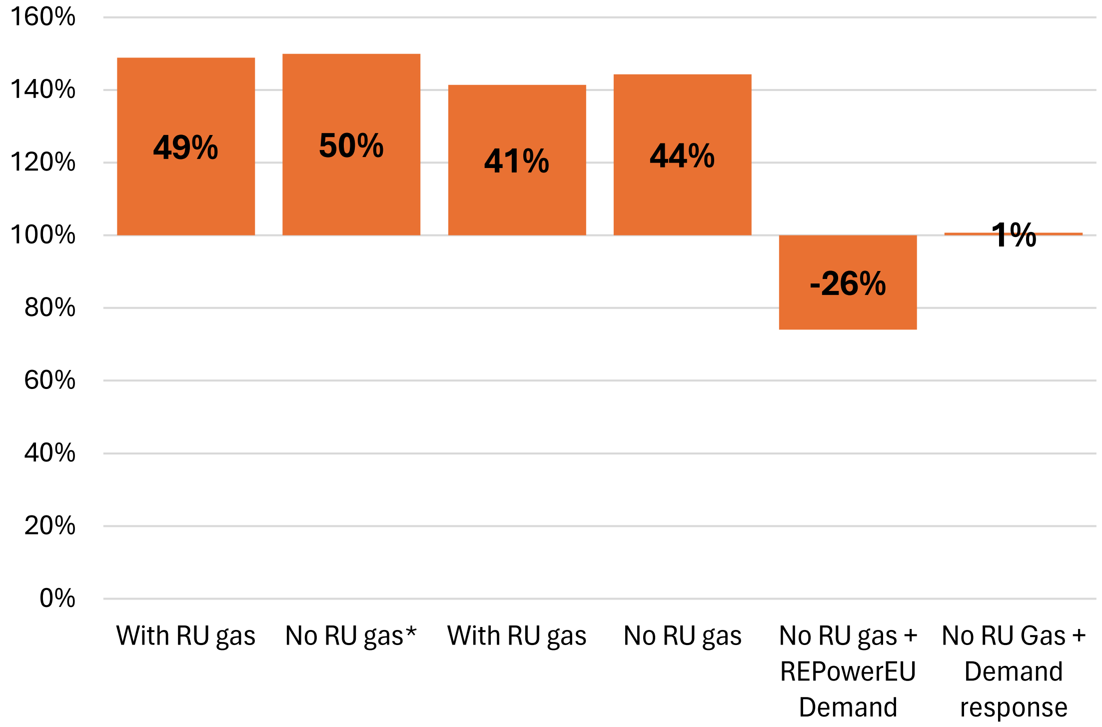


Source: REKK EGMM modelling

* No RU gas in 2026 refers to No RU short-term LNG and pipeline gas, long-term contracts are delivered

A three-month default of US LNG capacities results in a 49% higher gas bill in 2026 and 41% increase in 2028. Banning Russian gas on top of the 3-months supply disruption further increases the EU27 natural gas procurement costs by 1-3%. Assuming REPowerEU demand (38% demand reduction), total gas bill drops by 26%. By reaching a still ambitious 26% demand reduction, adverse effects of the scenario may be mitigated, by a 1% increase in gas bill. (Figure 32)

FIGURE 32. EU27 GAS BILL INCREASE, 3 MONTHS US LNG SUPPLY DISRUPTION, % (COMPARED TO 2026 BEFORE CRISIS)



Source: REKK EGMM modelling

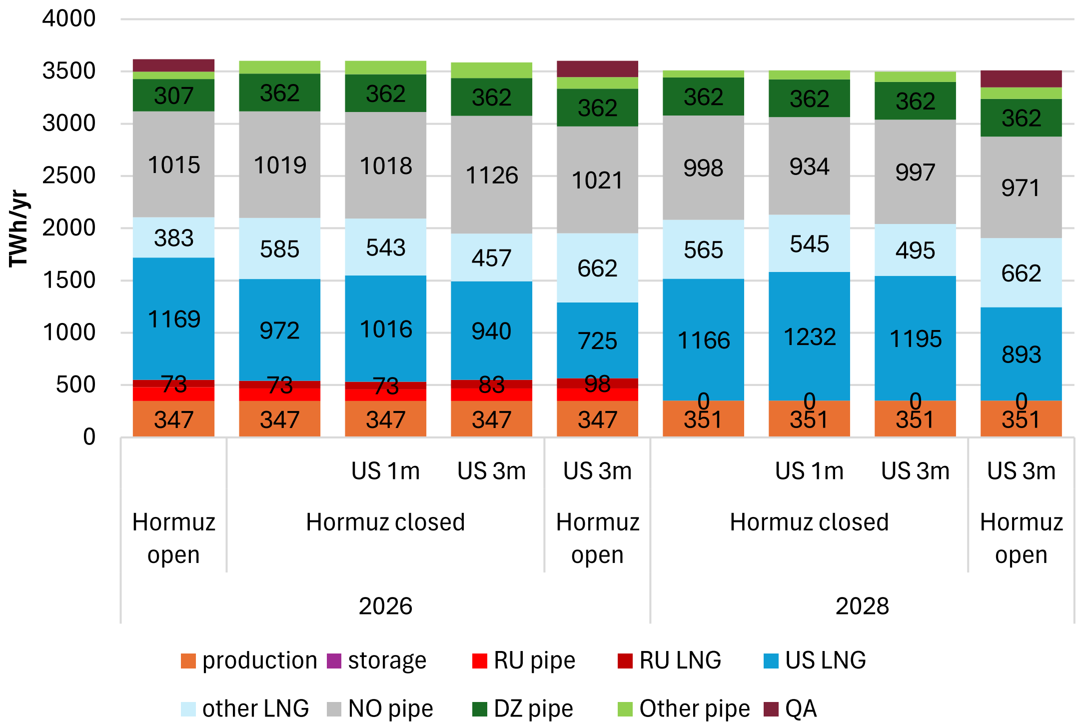
6.5 SCENARIO COMPARISON

This chapter summarizes the main findings of the modelling exercise and highlights the relative importance of the different supply shock scenarios for the European gas market.

The detailed scenario result descriptions in 6.1, 6.2, 6.3 and 6.4 showed how limited the impact of the Russian gas phaseout strategy is on gas prices and ultimately on the European gas bill. As the main focus of this analysis is on the 2026 geopolitical crisis's impact on Europe, we will zoom in the Middle East and US supply shortage crisis results - assuming that the EU sticks to the decided political aim to phase out Russian gas from the EU by September 2027.

Figure 33 demonstrates the supply structure of the European gas market in all modelled scenarios. Across all modelled scenarios, the EU27 is able to maintain security of supply through a combination of LNG imports, storage withdrawals and alternative pipeline deliveries. Even a prolonged closure of the Strait of Hormuz does not result in widespread physical shortages in Europe. However, the supply mix changes substantially across the scenarios. Under the REPowerEU pathway, Russian gas volumes are largely replaced by LNG imports, particularly from the United States and African suppliers. The results therefore indicate that Europe's key vulnerability is gradually shifting away from dependence on Russian pipeline gas towards increased exposure to global LNG markets and especially to US LNG. By 2028 with Russian gas being banned the US will be the largest supplier of gas in the EU, with a share similar to the Russian gas share before the full-scale invasion of Ukraine in 2022.

FIGURE 33. SUPPLY STRUCTURE OF THE EU27, ALL SCENARIOS

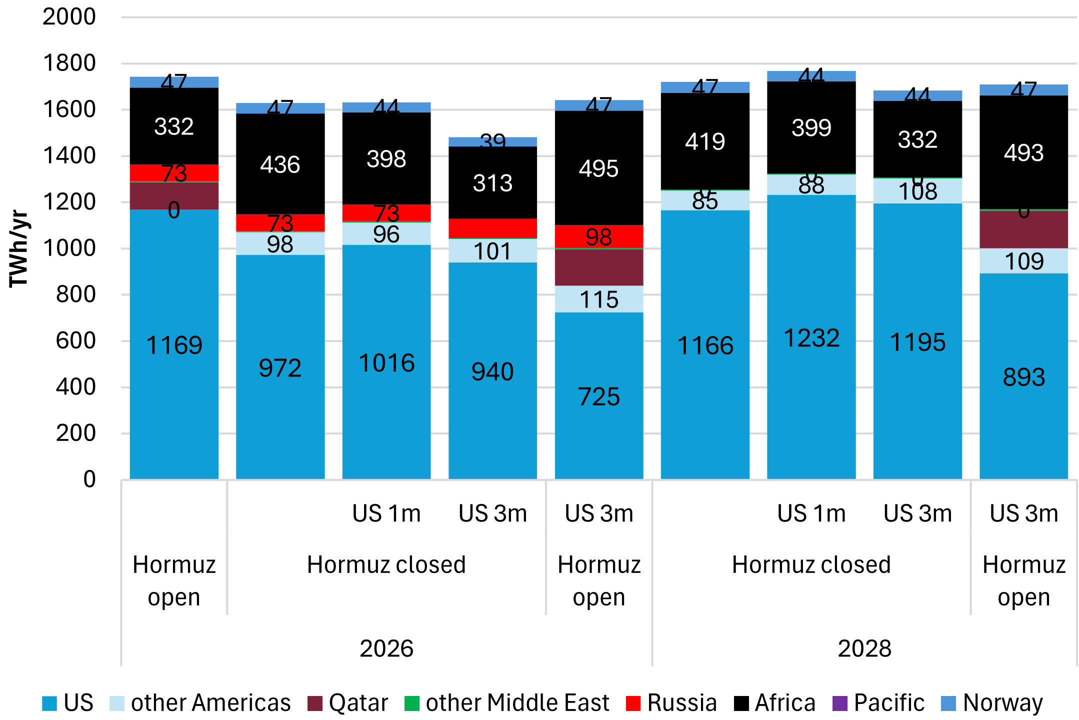


Source: REKK EGMM modelling

Figure 34 further details this restructuring of the LNG supply mix. As Russian LNG and pipeline gas are phased out, US LNG becomes the dominant flexible LNG source available to Europe, especially in the 2028 scenarios. African LNG suppliers also gain importance, partly compensating for the loss of Russian and Qatari volumes. At the same time, the scenarios underline Europe's increasing exposure to developments on the US supply side.

The modelling highlights that temporary disruptions of US LNG exports – for example due to hurricanes affecting liquefaction terminals on the Gulf Coast of the United States – significantly tighten the global LNG market. While a one-month disruption can largely be mitigated through storage withdrawals and alternative sourcing, a longer disruption combined with the closure of the Strait of Hormuz results in substantial increases in European gas prices and gas import expenditures. The results suggest that reductions in US LNG availability may have a larger impact on European gas markets than the phaseout of remaining Russian gas flows.

FIGURE 34. COMPOSITION OF LNG IMPORTS TO THE EU27, ALL SCENARIOS

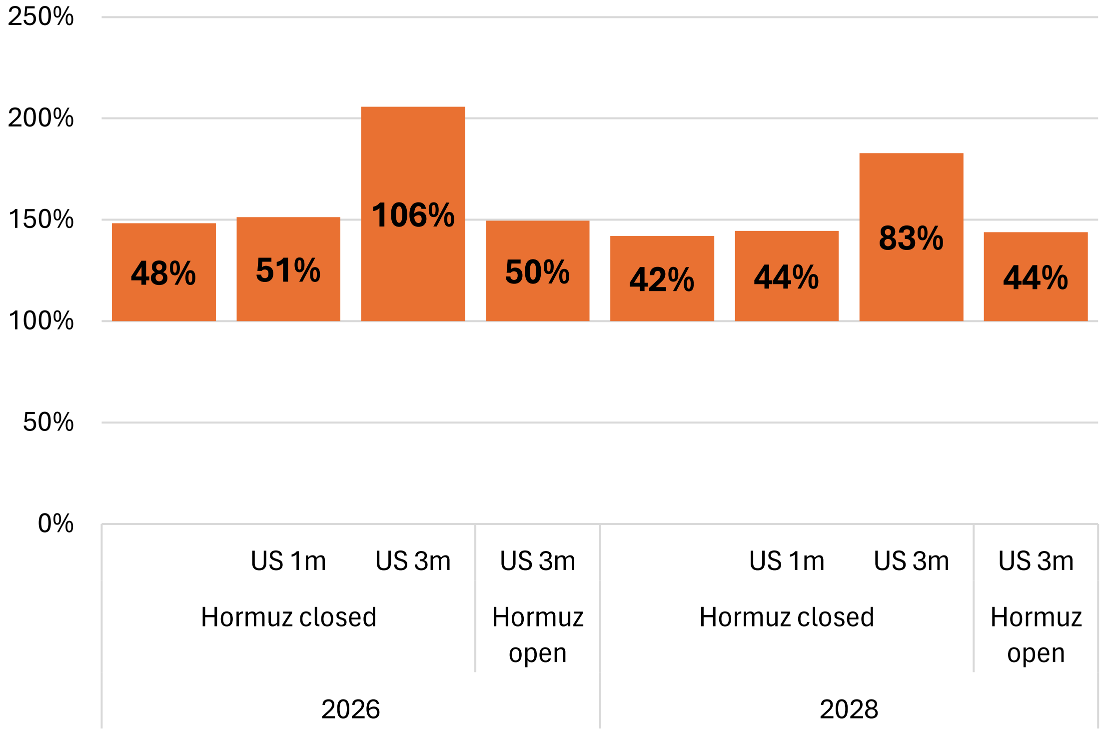


Source: REKK EGMM modelling

Figure 35 highlights that the largest impacts on the EU27 gas bill originate from global LNG market shocks rather than from the phaseout of Russian gas itself. The closure of the Strait of Hormuz alone increases the EU27 gas bill by approximately 41–48% relative to the baseline scenario. When combined with disruptions of US LNG supplies, the increase becomes substantially larger, reaching 83–106% in the most severe cases.

By contrast, continuing Russian gas flows has a comparatively limited effect on European security of supply and gas prices. In the 2026 scenarios, the REPowerEU phaseout of Russian gas increases the EU27 gas bill only marginally compared to the effects of the LNG market shocks. Even in the 2028 scenarios, the additional cost impact of Russian gas phaseout remains significantly smaller than the impacts caused by disruptions affecting global LNG markets and US LNG supplies. The modelling therefore suggests that restoring Russian gas imports would not materially reduce Europe’s exposure to future global LNG market shocks.

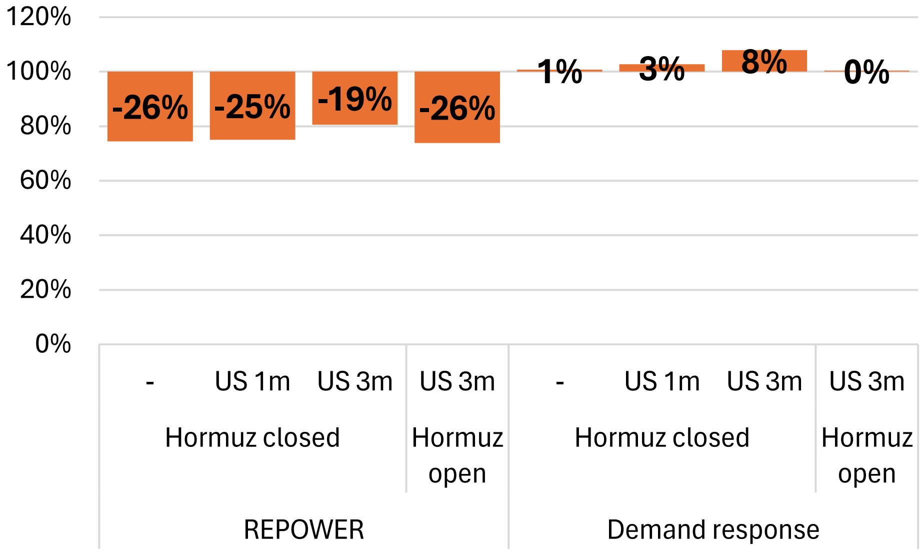
FIGURE 35. GAS BILL INCREASE IN THE EU27, ALL SCENARIOS %



Source: REKK EGMM modelling

Overall, the modelling results suggest that Europe's main challenge is the exposure to increasingly volatile and geopolitically sensitive global LNG markets. The closure of the Strait of Hormuz or the 3 months drop in US LNG shipments to Europe have similar price impacts hence same level increase on the EU gas bill. Both would add about ~50% to the gas bill, and a combined crisis could result in a 106% gas bill increase in Europe. Under these conditions, accelerating gas demand reduction measures appears to be the most robust long-term strategy for improving European energy security and reducing exposure to future price shocks. If the demand reduction set out in the REPowerEU Roadmap of nearly 38% is realised, natural gas bill of the EU27 would decrease by 19-26%. A still ambitious 26% demand adjustment would be needed to neutralise most of the adverse price effects of the shocks (Figure 36).

FIGURE 36. GAS BILL CHANGE IN DEMAND SCENARIOS, %



Source: REKK EGMM modelling

7 CONCLUSIONS

The study investigated the exposure of European gas markets to LNG market shocks.

Modelling results show that the 20% drop in global LNG supply due to the Middle East crisis resulted in a 48% gas bill increase in Europe, despite the limited (10%) share of Qatari LNG in the EU supply mix. The price increase in the EU is evenly spread between the Member States, as the internal pipeline system is sufficient to adapt to the changing gas flows. No major pipeline bottlenecks were identified.

The US LNG is the main beneficiary of the crisis, as due to the contractual structure (spot and DES cargoes available and can be diverted to Europe) it is the most flexible available source on the market and the EU substitutes missing volumes with US LNG. The two major competitors to US LNG, Russian pipeline gas and Qatari LNG are unavailable under the current circumstances. By 2028 African LNG could become an alternative, however the risks and uncertainty related to those sources may be higher than other suppliers.

If the US LNG deliveries would stop to Europe for 1 month – for example due to hurricane damages on infrastructure – then the gas bill of the EU27 would increase by 51%. Compared to the Hormuz crisis effects of 48% increase, this means that a 1-month dropout of US capacities adds 3 percentage points on the total gas bill of the EU27. A 1-month dropout could be weathered with the help of European storages, and the US volumes purchased would only shift in time within the year.

If the US LNG deliveries would stop to Europe for 3 months – for example due to major hurricane damages on infrastructure – then the gas bill of the EU27 would increase by 106% in 2026 and 83% in 2028. In this most severe scenario, the price increase is not spread evenly: the Iberian Peninsula (Spain and Portugal) and Central and Southern Europe especially the Balkans would face the highest price increase. This is due to the limited connections to the Northwestern markets and the limited storage capacity.

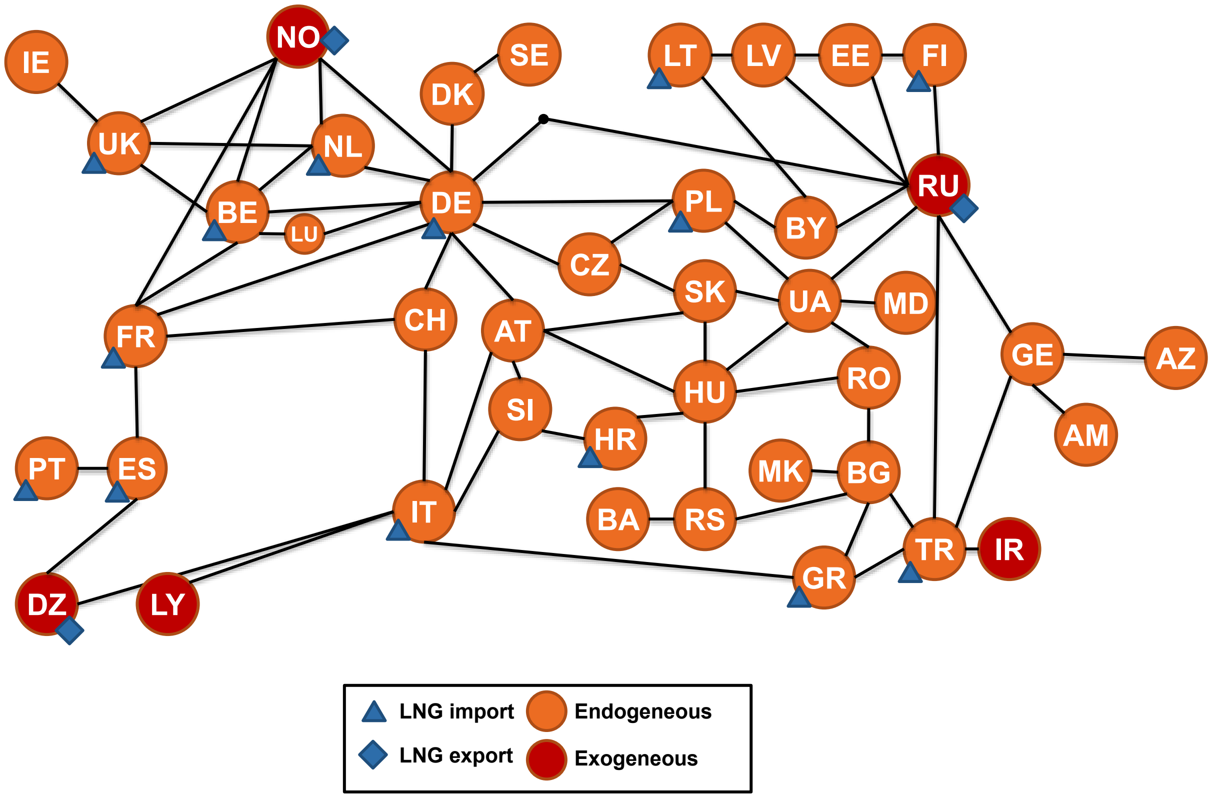
Russian gas phaseout plans do not have any major impact on the modelling results. If the EU postponed the Russian gas ban and still purchased the pipeline gas and LNG under the ongoing long-term contracts, the gas bill would be decreased by 1-3% in most scenarios. The reason for this is the fact that by 2025, share of Russian pipeline gas and LNG dropped to 12% and would not serve as a major alternative for missing volumes. Therefore, it is more a political choice of the EU weather to pay the high price for the US LNG or for the Russian import. Russian gas could substantially affect the European gas markets in the US 3-month supply outage scenarios combined with the Hormuz crisis. The Russian long-term contracts to Hungary and Slovakia as well as LNG flows to Western European LNG terminals can result in a 61% increase in gas bill compared to a 83% increase without Russian gas.

The high prices will certainly trigger demand response. This modelling exercise did not investigate how gas demand would be reduced, but based on the experiences of the previous crisis energy efficiency measures and switching to renewables (solar mainly) may be the most widespread options. The REPowerEU strategy plans with a sharp demand reduction, - that might seem to be too ambitious – but in case it is implemented the negative price impacts of the modelled supply shocks could be far outweighed. Our modelling suggests that this is possible even with a less ambitious goal: reducing the EU gas demand from 3608 TWh/yr in 2026 to 2672 TWh/yr by 2028 would offset the negative market effects caused by the Strait of Hormuz crisis. We assume that this ~25% demand reduction in 2 years is comparable to the demand reduction that was achieved during the previous energy crisis on a market basis. Furthermore, the supply gap can also be reduced by increased domestic gas extraction. From 2024 to 2025, EU gas production increased by 10% year-on-year, however it must be stressed that it is still delivered ~370 TWh/year.

8 ANNEX 1: EUROPEAN GAS MARKET MODEL

EGMM (European Gas Market Model) is a competitive, dynamic, multi-market partial equilibrium model that simulates the operation of the wholesale natural gas market across the whole of Europe. The detailed mathematical description of the model was published and is openly accessible in Energy Policy 2023 Volume 173[6]. It includes a supply-demand representation of EU27 countries, United Kingdom, Switzerland, the Contracting Parties of the Energy Community[7] and Turkey, including gas storage and transportation linkages. Large external markets, including Russia, Norway, Libya, Algeria, Azerbaijan, Iran and LNG (Liquified Natural Gas) exporters are represented exogenously with market prices, long-term supply contracts and physical connections to Europe.

FIGURE 37. GEOGRAPHICAL REPRESENTATION OF THE EGMM MODEL



Source: REKK. Country codes as ISO 3166-1 alpha-2 standards

The timeframe of the model covers 12 consecutive months and market participants have perfect information over this period. Dynamic connections between months are introduced by the

[6] Péter Kotek, Adrienn Selei, Borbála Takácsné Tóth, Balázs Felsmann (2023): What can the EU do to address the high natural gas prices? Energy Policy, Volume 173, 2023, 113312, ISSN 0301-4215, https://doi.org/10.1016/j.enpol.2022.113312. The model description is available in Annex 3.

[7] Contracting Parties of the Energy Community Treaty are: the European Union and Albania, Bosnia and Herzegovina, Georgia, Kosovo*, Montenegro, North Macedonia, Moldova, Serbia, Ukraine

operation of gas storages and take-or-pay constraints (minimum and maximum deliveries are calculated over the entire 12-month period, enabling contractual flexibility).

The European Gas Market Model consists of the following building blocks: (1) local demand; (2) local supply; (3) gas storages; (4) external markets and supply sources; (5) cross-border pipeline connections; (6) LNG (liquefied natural gas) infrastructure (7) long-term take-or-pay (TOP) contracts; and (8) spot trading.

1. **Local demand** is represented by demand functions. Demand functions are downward sloping, meaning that higher prices decrease the amount of gas that consumers want to use in a given period. For simplicity, we use a linear functional form, the consequence of which is that every time the market price increases by 0.1 EUR/MWh, local monthly consumption is reduced by equal quantities (as opposed to equal percentages, for example). The linearity and price responsiveness of local demand ensures that market clearing prices will always exist in the model. Regardless of how little supply there is in a local market, there will be a high enough price so that the quantity demanded will fall back to the level of quantity supplied, achieving market equilibrium.

2. **Local supply** shows the relationship between the local market price and the amount of gas that local producers are willing to pump into the system at that price. In the model, each supply unit (company, field, or even well) has either a constant, or a linearly increasing marginal cost of production (measured in EUR/MWh). Supply units operate between minimum and maximum production constraints in each month, and an overall yearly maximum capacity.

3. **Gas storages** are capable of storing natural gas from one period to another, arbitraging away large market price differences across periods. Their effect on the system's supply-demand balance can be positive or negative, depending on whether gas is withdrawn from, or injected into, the storage. Each local market can contain any number of storage units (companies or fields). Storage units have a constant marginal cost of injection and (separately) of withdrawal. In each month, there are upper limits on total injections and total withdrawals. There is no specific working gas fee, but the model contains a real interest rate for discounting the periods, which automatically ensures that foregone interest costs on working gas inventories are considered. There are three additional constraints on storage operation: (1) working gas capacity; (2) starting inventory level; and (3) year-end inventory level. Injections and withdrawals must be such during the year that working gas capacity is never exceeded, intra-year inventory levels never drop below zero, and year-end inventory levels are met.

4. **External markets and supply sources** are set exogenously (i.e. as input data) for each month, and they are assumed not to be influenced by any supply-demand development in the local markets. In case of LNG the price is derived from the Japanese spot gas price, taking into account the cost of transportation to any possible LNG import terminal. As a consequence, the price levels set for outside markets are important determinants of their trading volumes with Europe.

5. **Cross-border pipelines** allow the transportation of natural gas from one market to the other. Connections between geographically non-neighbouring countries are also possible, which allows the possibility of dedicated transit. Cross-border linkages are directional, but physical reverse flow can easily be allowed for by adding a parallel connection that "points" into the other direction. Each linkage has a minimum and a maximum monthly transmission capacity, as well as a proportional transmission fee. Virtual reverse flow ("backhaul") on unidirectional pipelines or LNG routes can also be allowed, or forbidden, separately for each connection and each month. The rationale for virtual reverse flow is the possibility to trade "against" the delivery of long-term take-or-pay contracts, by exploiting the fact that reducing a pre-arranged gas flow in the physical direction is the same commercial transaction as selling gas in the reverse direction. Additional upper constraints can be placed on the sum of physical flows (or spot trading activity) of selected connections. This option is used, for example, to limit imports through LNG terminals, without specifying the source of the LNG shipment.

6. **LNG infrastructure** in the model consist of LNG liquefaction plants of exporting countries, LNG regasification plants of importing countries and the transport routes connecting them. LNG terminals capacity is aggregated for each country, which differs from the pipeline setup, where capacity constraints are set for all individual pipeline. LNG capacity constraints are set as a limit for the set of "virtual pipelines" pointing from all exporting countries to a given importing country, and as a limit on the set of pipelines pointing from all importing countries to a given exporting country.

7. **Long-term take-or-pay (TOP) contracts** are agreements between an outside supply source and a local market concerning the delivery of natural gas into the latter. Each contract has monthly and yearly minimum and maximum quantities, a delivery price, and a monthly proportional TOP-violation penalty. Maximum quantities (monthly or yearly) cannot be breached, and neither can the yearly minimum quantity. Deliveries can be reduced below the monthly minimum, in which case the monthly proportional TOP-violation penalty must be paid for the gas that was not delivered. Any number of TOP-contracts can be in force between any two source and destination markets. Monthly TOP-limits, prices, and penalties can be changed from one month to the next. Contract prices can be given exogenously, indexed to internal market prices, or set to a combination of the two options. The delivery routes (the set of pipelines from source to destination) must be specified as input data for each contract. It is possible to divide the delivered quantities among several parallel routes in pre-determined proportions, and routes can also be changed from one month to the next.

8. **Spot trading** serves to arbitrage price differences across markets that are connected with a pipeline or an LNG route. Typically, if the price on the source-side of the connection exceeds the price on the destination-side by more than the proportional transmission fee, then spot trading will occur towards the high-priced market. Spot trading continues until either (1) the price difference drops to the level of the transmission fee, or (2) the physical capacity of the connection is reached. Physical flows on pipelines and LNG routes equal the sum of long-term deliveries and spot trading. When virtual reverse flow is allowed, spot trading can become "negative" (backhaul), meaning that transactions go against the predominant contractual flow. Of course, backhaul can never exceed the contractual flow of the connection.

Equilibrium

The European Gas Market Model algorithm reads the input data and searches for the simultaneous supply-demand equilibrium (including storage stock changes and net imports) of all local markets in all months, respecting all the constraints detailed above.

In short, the equilibrium state (the "result") of the model can be described by a simple no-arbitrage condition across space and time. However, it is instructive to spell out this condition in terms of the behaviour of market participants: consumers, producers and traders. Infrastructure operators (TSO, storage and LNG operator) observe gas flows and their welfare is not factored in the equilibrium.

Welfare

Welfare calculations are done ex post. The maximized value of the objective function is adjusted to properly account for actual welfare in the market. The operating profit of transmission and storage system operators is added using estimates for their marginal costs, and the expenditure on import contracts is increased by the take-or-pay fixed cost element.

Welfare components are assigned to regional and outside markets based on location. For consumer and local producer surplus, long-term contract profit,[19] storage operating income and congestion rent, the assignment is straightforward. Pipeline operating income is shared in the ratio of entry and exit fees and pipeline congestion rent is shared equally by the neighbouring markets. LNG-related welfare components are assigned to the market hosting the terminal." REKK EGMM model description based on Kiss, Selei and Tóth (2016)

Outputs

Outputs of modelling are the wholesale gas market prices per country and the natural gas flows. Based on those outputs the model also calculated welfare on country and stakeholder level (consumer, producer, traders, infrastructure operators).

The European Gas Market Model algorithm reads the input data and searches for the simultaneous supply-demand equilibrium (including storage stock changes and net imports) of all local markets in all months, respecting all the constraints detailed above.

In short, the equilibrium state (the "result") of the model can be described by a simple no-arbitrage condition across space and time. However, it is instructive to spell out this condition in terms of the behaviour of market participants: consumers, producers and traders. Infrastructure operators (transmission system operator (TSO), storage and LNG operator) observe gas flows and their welfare is not factored in the equilibrium.

9 ANNEX 2: MODEL CALIBRATION

In this chapter, we briefly discuss how the model outputs fit the main indicators such as:

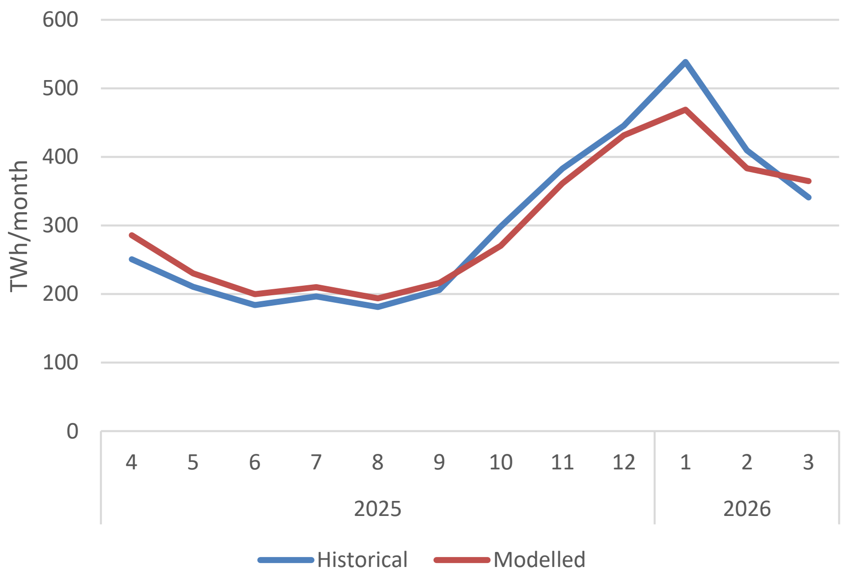
- Natural gas consumption of the EU27
- Natural gas production of the EU27
- Supply structure of the EU27
- LNG supply structure of the EU27
- Wholesale prices in the EU27
- Storage patterns in the EU27

Comparison of the counterfactual scenario was performed to the 2025 April-2026 March period.

9.1 NATURAL GAS CONSUMPTION

Country-level consumption data were based on the monthly published Eurostat table *Supply, transformation and consumption of gas - monthly data (nrg_cb_gasm).* As it is shown on Figure 38, modelled annual consumption of the EU27 is within 1% difference of the historical data, while modelled monthly consumption is within ±14% of historical data.

FIGURE 38. EU27 MONTHLY NATURAL GAS CONSUMPTION, HISTORICAL (BLUE) VS MODELLED (RED), TWH/MONTH

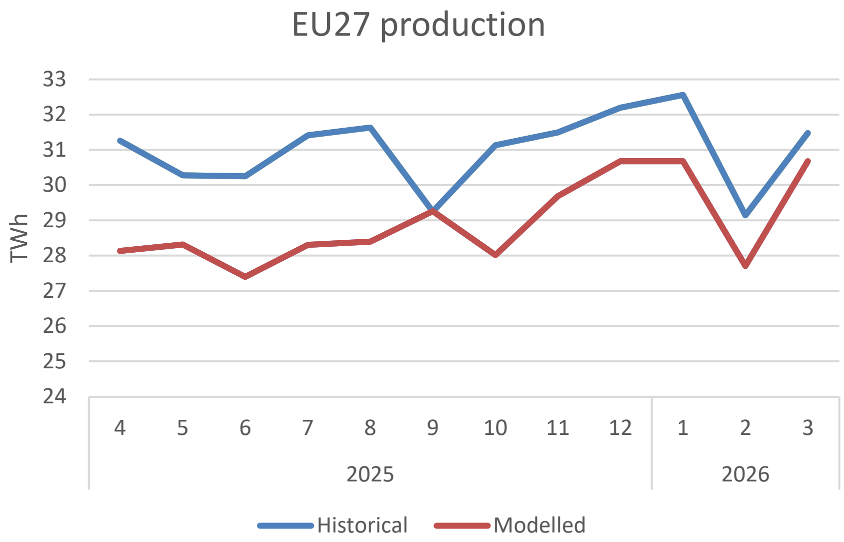


Source: REKK modelling and Eurostat

9.2 NATURAL GAS PRODUCTION

Country-level production data were based on the monthly published Eurostat table *Supply, transformation and consumption of gas - monthly data (nrg_cb_gasm).* Total modelled annual production is 7% lower than the historical data, whereas monthly modelled figures are within 10% of the historical data. (Figure 39)

FIGURE 39. EU27 MONTHLY NATURAL GAS PRODUCTION, HISTORICAL (BLUE) VS MODELLED (RED), TWH/MONTH



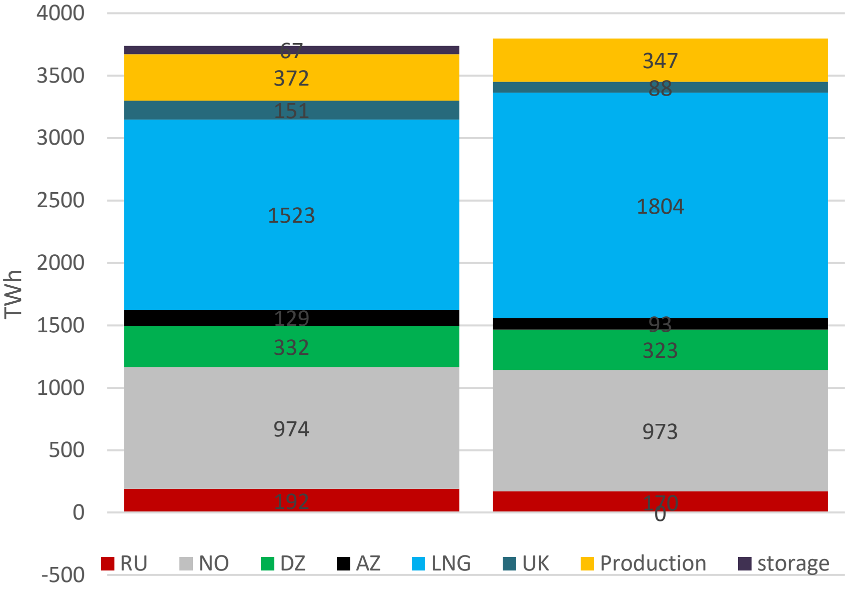
Source: REKK modelling and Eurostat

9.3 SUPPLY STRUCTURE OF THE EU27

Monthly supply structure of the EU27 was compiled based on the Bruegel dataset European natura gas imports.[8] The main sources of supply for the EU27 in 2025 were pipeline gas from Norway, Algeria, Russia and the UK, LNG from various sources, local production of natural gas and the utilisation of storages. Total annual supply volumes delivered to the EU27 market by main modelled sources of supply (RU, NO, LNG, production) are fitting the historical data. (Figure 40)

[8] Bruegel Dataset (2022) 'European natural gas imports', version of 12 May 2026, available at https://doi.org/10.64153/WVKK8731

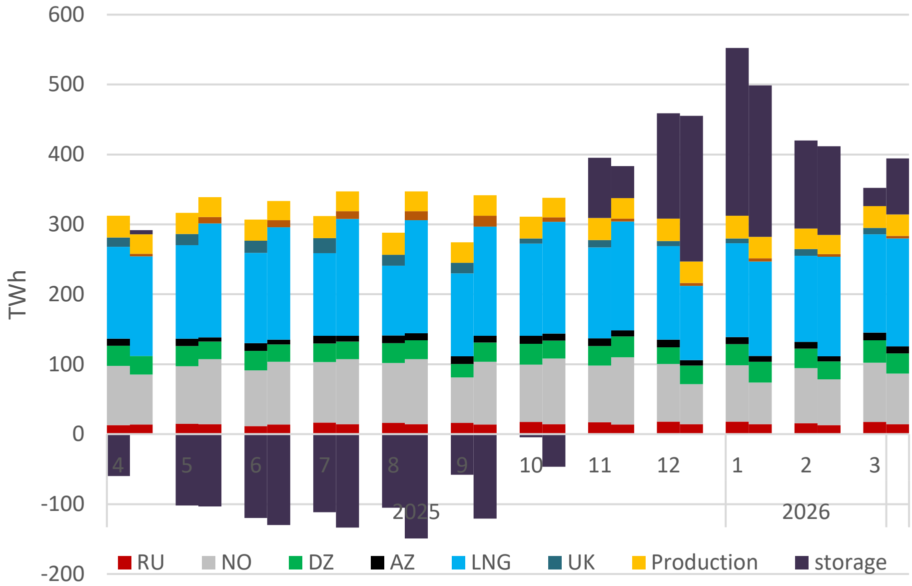
FIGURE 40. ANNUAL SUPPLY STRUCTURE OF THE EU27, Q2 2024-Q1 2025, LEFT: HISTORICAL FACT, RIGHT: MODELLED, TWH/YEAR



Source: REKK modelling and Bruegel

Monthly supply structure follows the seasonal consumption and flow patterns closely and recreates the historical observations well. (Figure 41)

FIGURE 41. EU27 MONTHLY SUPPLY STRUCTURE, HISTORICAL (LEFT STACKED COLUMES) VS MODELLED (RIGHT STACKED COLUMNS), TWH/MONTH

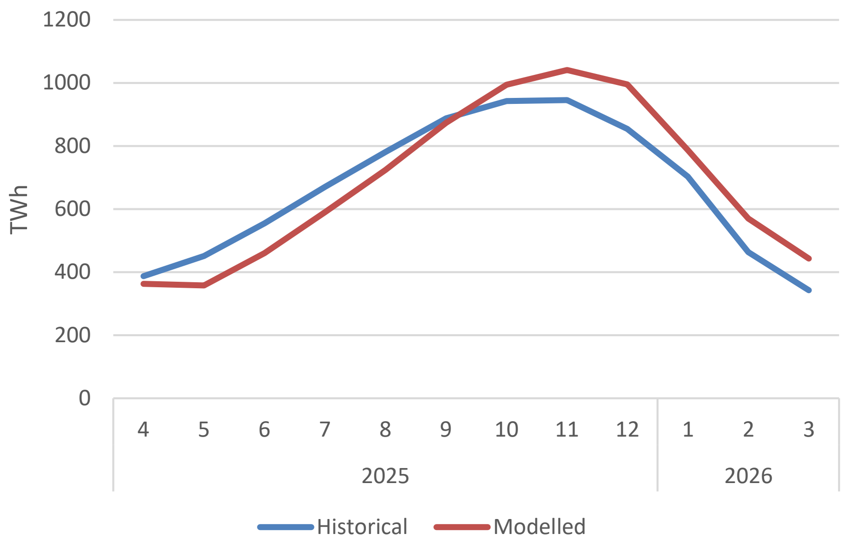


Source: REKK modelling, Eurostat and Bruegel

9.4 STORAGE PATTERNS IN THE EU27

Country-level storage volumes were collected from GIE AGSI (Aggregated Gas Storage Inventory) platform and compared to modelled outcomes. The mandatory 80% storage target by the start of injection season was added as an explicit constraint. Modelled working gas volumes are following the pattern of storage use well in 2025, modelled numbers are somewhat over the historical storage use. (Figure 42)

FIGURE 42. EU27 MONTHLY WORKING GAS VOLUMES IN STORAGES AT THE START OF THE MONTH, HISTORICAL (BLUE) VS MODELLED (RED), TWH

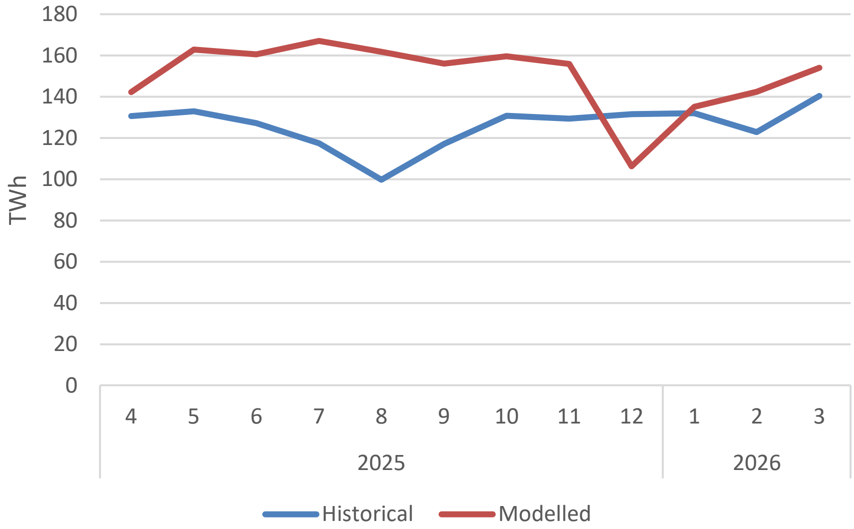


Source: REKK modelling and AGSI

9.5 LNG SUPPLY STRUCTURE OF THE EU27

Historical use of LNG terminals is obtained from ALSI (Aggregated LNG System Inventory) platform. Modelled LNG inflow to the EU27 is 20% higher than the historical observations. (Figure 43)

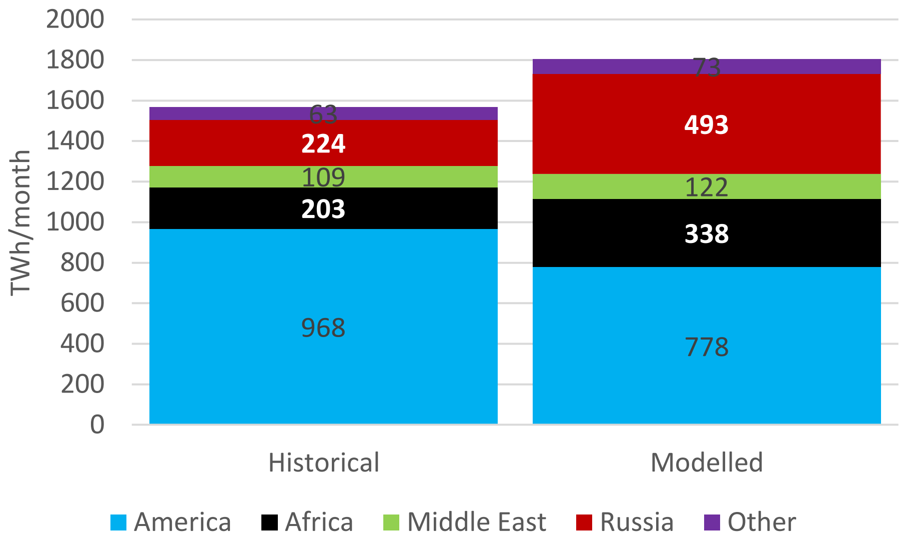
FIGURE 43. EU27 MONTHLY LNG IMPORTS, HISTORICAL (BLUE) VS MODELLED (RED), TWH/MONTH



Source: REKK modelling and ALSI

Source of the LNG was calculated based on the Bruegel dataset European natura gas imports.[9] Modelled results for the main supplier US was at somewhat lower level than the historical data suggests. Middle-Eastern, Russian and African sources are over-represented in the model compared to the data. (Figure 44)

FIGURE 44. EU27 ANNUAL LNG IMPORTS BY MAIN PARTNER, HISTORICAL (BLUE, LEFT) VS MODELLED (RED, RIGHT), TWH/YEAR



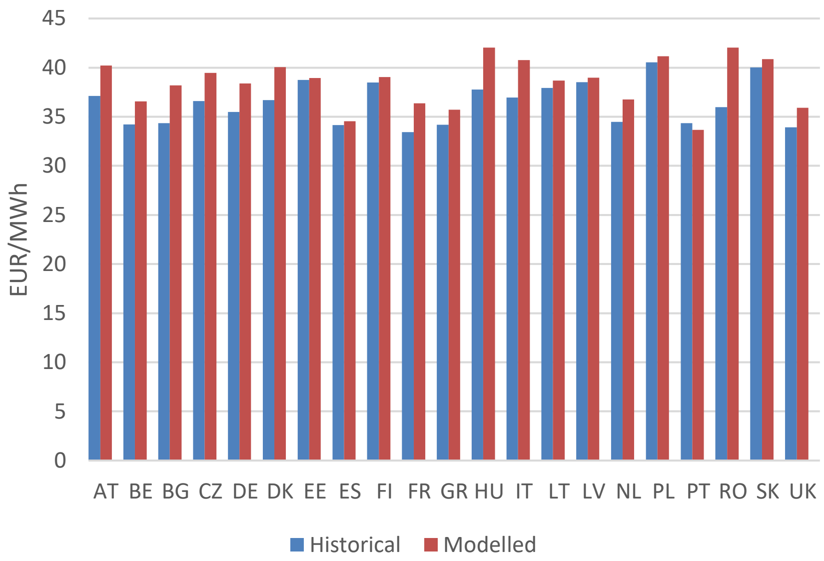
Source: REKK modelling and Bruegel data

[9] Bruegel Dataset (2022) 'European natural gas imports', version of 03 December 2025, available at https://doi.org/10.64153/WVKK8731

9.6 WHOLESALE PRICES IN THE EU27

The weighted average wholesale price (that is a key modelling output) was compared to the historical day-ahead prices of the natural gas exchanges.[10] Overall, the modelled prices of the 20 markets which have price signals, 9 modelled were within 5% of the historical annual average price. (Figure 45)

FIGURE 45. ANNUAL WHOLESALE NATURAL GAS PRICE, HISTORICAL (BLUE, LEFT) AND MODELLED (RED, RIGHT), €/MWH

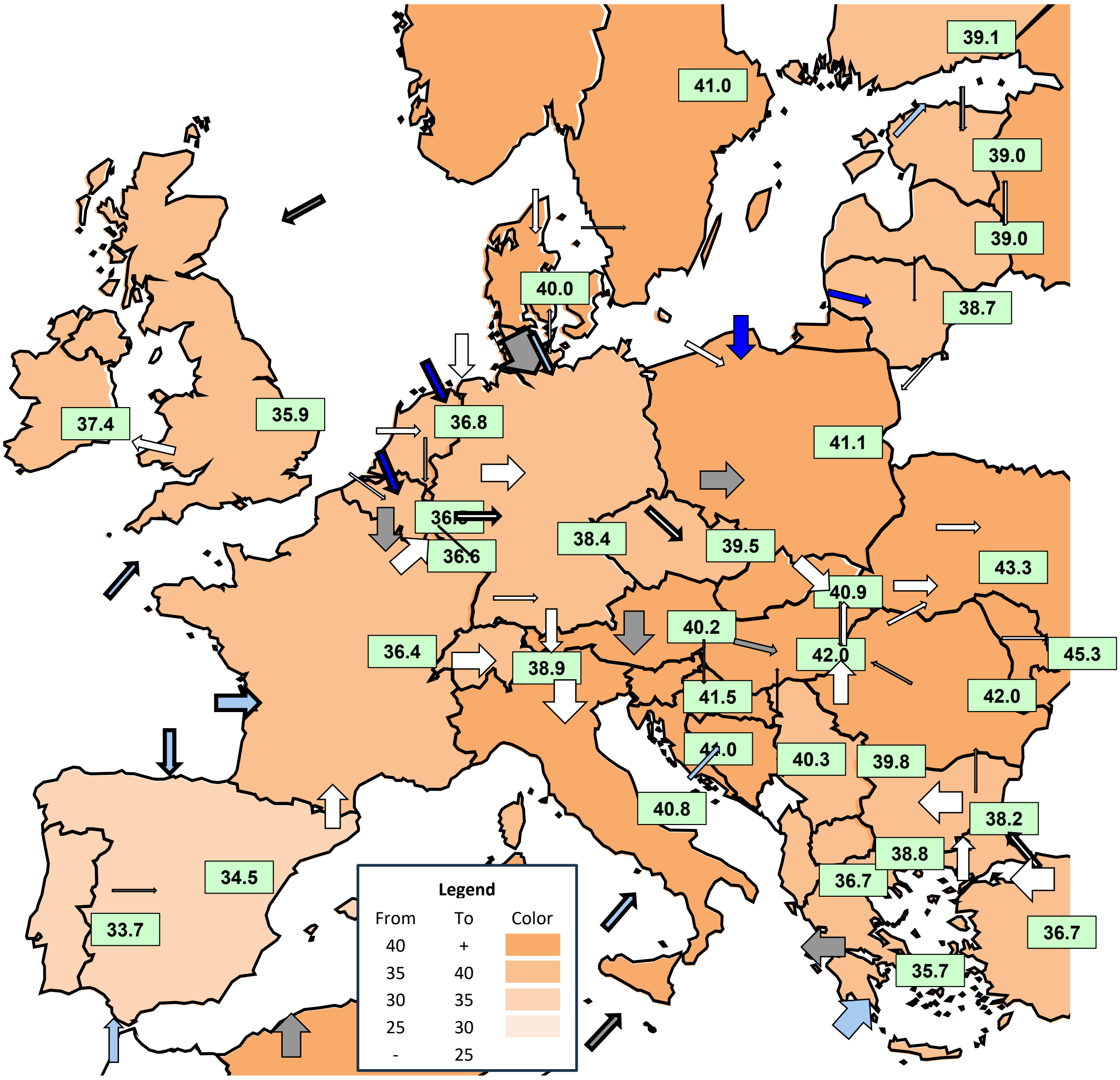


Source: REKK modelling and exchange market reports

Figure 46 shows the modelled annual average wholesale prices for the Q2 2025-Q1 2026 time period on a country basis.

[10] AT: CEGH, BE: ZTP, BG: Balkan Gas Hub, CZ: VTP, DE: THE, DK: ETF, EE: GetBaltic LV-EE zone, ES: PVB, FI: GetBaltic FI, FR: TRF, GR: HENEX, HU: CEEGEX, IT: PSV, LT: GetBaltic LT, NL: TTF, PL: TGE, PT: MibGas VTP, RO: BRM, SK: Eustream balancing, UK: NBP

FIGURE 46. MODELLED WHOLESALE ANNUAL AVERAGE NATURAL GAS PRICES IN EUROPE, 2025 Q2-2026 Q1, EUR/MWH



Numbers in the box depict the wholesale price. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they are 5 times higher) and the congestion of the technical infrastructure (the interconnectors are grey when they are congested in at least 3 months out of the 12 modelled months). Blue arrows represent the LNG regasification facilities. They are dark blue when they are physically congested at least in 3 months. Source: REKK modelling

10REGION DEFINITION