Modelling based assessment of the REPowerEU Roadmap on Danube Region countries

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Abbreviations

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

1 EXECUTIVE SUMMARY

The aim of this study was to assess the impact of prohibiting Russian gas supplies to the European Union on natural gas prices and the supply structure of the EU, the European countries and of the Danube Region, that comprises of both EU and non-EU countries.

To capture the differences, we applied scenario modelling using the European Gas Market Model where differences between the with and without Russian gas situation can be quantified. Two different timelines were proposed for the Russian gas phaseout. The Commission's proposal was modelled in a 2028 infrastructure and supply-demand situation, while the early implementation proposal of the Parliament was modelled as an overnight ban on Russian gas deliveries.

To avoid criticism about demand assumptions, in our core scenario we assumed more or less stagnating demand on EU27 level, and tested the results in sensitivities.

EU27 RESULTS ON THE REPOWEREU PROPOSAL OF THE COMMISSION

Modelling results show that the Commission's proposal would result in a very modest price increase across the EU in 2028 without threatening the markets to fall apart into regionally different priced sub-markets. **The regulatory measure alone would result in an average increase of 0.3 €/MWh in the EU27 wholesale gas price. This means that the gas bill that the EU pays would increase in total by 1% compared to the scenario where Russian gas would still be available.** At the same time the favourable change in market supply and demand conditions by 2028 highly outweigh the negative impact of the Russian gas phase out. Combining the market and regulatory effects, the overall price change would reduce the total gas bill by about 15% from 2024 to 2028 with no Russian gas.

EU27 RESULTS OF AN OVERNIGHT RUSSIAN GAS PHASE OUT

However, these positive results change when the Regulation is implemented too early: as the overnight modelling results shows, there is a pressing need for new alternative supplies especially in the Central Eastern European region and the Balkans. The new Romanian offshore gas resources and the additional supply of new LNG production facilities are key to balance the missing Russian volumes. Without these, the price impact is much higher and more importantly the spread between gas markets would emerge that would necessarily also spread over to the electricity markets, as natural gas-fired power plants are usually the price setting units. Overnight effects in **Western and Northwestern Europe are around +1 €/MWh** increase in the 40 €/MWh price environment. In the **Central and Eastern European** region the price impact is in the range of **+ 2-3 €/MWh** (Czechia, Austria, Slovakia, Hungary, Italy). The highest impact is measured **in the Balkans,** Romania, Bulgaria and Greece, an additional **+4-5 €/MWh** price increase. The total gas bill would increase by 4% for the EU27.

SENSITIVITY OF THE RESULTS

Balance on the global market and European demand matter, but results stay robust: Sensitivity scenarios allow us to decouple the effects of the market and regulations. The price level in European gas markets will mainly be driven by the availability and price of LNG, followed by the European gas demand. The effects of the regulation as proposed by the Commission are below 0.5 €/MWh for the Western European markets such as the Netherlands in all sensitivity scenarios. The effects of the regulation are somewhat higher for Central European markets like Hungary, but in 7 out of 9 scenarios the price effect of the regulation is still below 1 €/MWh.

A Russian gas weapon reaction would have a limited price effect on the Balkans: As a geopolitical risk, we tested the impact of Russia responding to the Regulation by cutting deliveries on Turk Stream 2 to Serbia, North Macedonia and Bosnia, which still have Russian long-term contracts but are not part of the REPowerEU strategy. Our findings suggest that if this were to occur in 2028, the impact would be negligible. However, in the event of an early implementation, a potential Russian response of cutting deliveries to non-EU markets in the Balkans would increase the cost of phasing out gas across Europe by an additional €2/MWh.

DANUBE REGION LEVEL RESULTS

The Danube Region Strategies (DRS) covers both EU and non-EU member countries: Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia and Ukraine. This region has been traditionally more exposed to Russian gas deliveries, therefore the Danube Region Strategies focuses its flagship project: *Diversification of gas supply in the EUSDR* on this matter. This study is part of this effort.

Depending on the timing, the impact of the Russian gas phaseout on the DRS can vary on a much larger scale than for the EU27. Considering all changes in the global LNG market and European demand, the difference in total wholesale gas procurement cost for the Danube region boils down to an overall ***10% increase (in the Parliament scenario) or a 12% decrease (in the Commission's proposal scenario)*** depending on the timing of the Russian gas phase-out.

Altogether the Danube Region purchases 198 TWh more LNG in 2028 than in 2024 in Commission's proposal scenario. LNG is the main source of the replacement of Russian gas. There is a minor increase in pipeline gas shipments from Algeria and North-West Europe.

CONCLUSION AND RECOMMENDATIONS FOR THE DECISION MAKERS

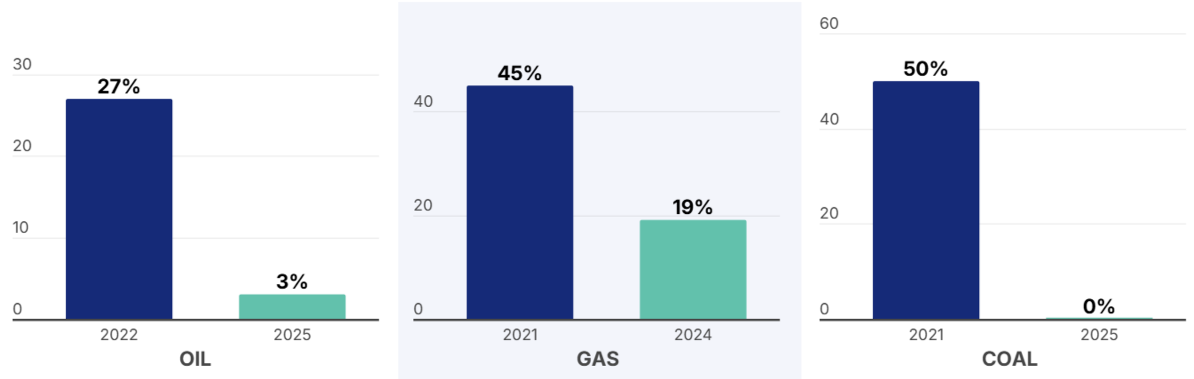
- *The Commission's original proposal is a well-designed plan to phase out Russian gas from the EU 27 without placing an excessive financial burden on the EU gas consumers. Even this minor burden would be shared equally across Europe, as the price increase would not differ between regions.*
- In all scenarios, the main source of replacing Russian gas is LNG, that is coming from the US.
- Though there are no threats of physical disruption, and the price impacts are also moderate especially compared to the price hikes witnessed in 2022, the change in supply flows would certainly affect counties and stakeholders across Europe differently.
- National TSOs are impacted very differently, and the tariff levels and structure should be monitored closely, as their change could have a backfire effect on the flows. The modelled TSO revenues increase compared to the baseline in 2024 (with Russian gas) to 2028 (with the REPowerEU in place) in Croatia (+1183%), Czechia (+415%) and in Romania (+197%). Some countries witness a huge decrease in TSO revenues: Austria (-92%), Bulgaria (-43%), Germany (-19%), Hungary (-49%), Serbia (-66%), Slovakia (-79%), Slovenia (-49%), Ukraine (-99%).

2 INTRODUCTION

The REPowerEU Plan[1] was launched in May 2022 in response to Russia's invasion of Ukraine on 22 February 2022 with the aim to phase out Russian fossil imports. Coal imports have fallen back to zero, and oil deliveries have been partly sanctioned.

By 2024 the change in fossil fuel imports from Russia decreased substantially (see Figure 1).

FIGURE 1. EU27 ENERGY IMPORT FROM RUSSIA



Source: European Commission: REPOWEREU

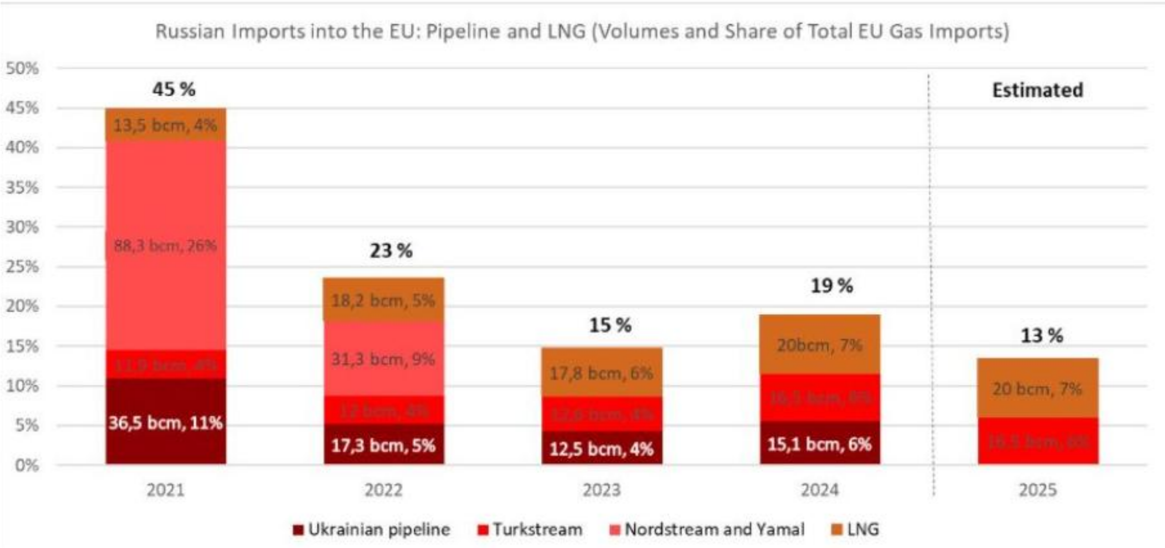
Natural gas imports started to rebound in 2024 driven by increased LNG imports and pipeline imports via the TurkStream pipeline. In response, the European Commission initiated the RE-PowerEU Roadmap in June 2025..

The Russian war on Ukraine changed rapidly the supply structure in Europe with Russian volumes falling from 45% of the EU27 import mix to 15% by 2023. This decrease however changed and volumes started to increase again in 2024. (Figure 2) The Commission's evaluation found that the original aim of the REPowerEU (to abandon Russian gas) will not be achieved voluntarily due to opposing business interests. Therefore, in summer 2025 they put a proposed Regulation on the table with the same goal. The Regulation can be approved by a qualified majority while any sanction would require the unanimity of all Member States and must be repeatedly renewed every 6 months.

The Russian gas to the EU27 accounted for 52 bcm in 2024, of which 32 bcm was pipeline gas and 20 bcm was LNG. Almost two-thirds of the Russian volumes arrived as part of long-term contract and one-third as short-term trade. (Figure 2)

[1] https://commission.europa.eu/publications/key-documents-repowereu_en

FIGURE 2. RUSSIAN IMPORTS INTO THE EU: PIPELINE AND LNG (VOLUMES AND SHARE OF TOTAL EU GAS IMPORTS)



Source: REPOWER EU Roadmap, 2025

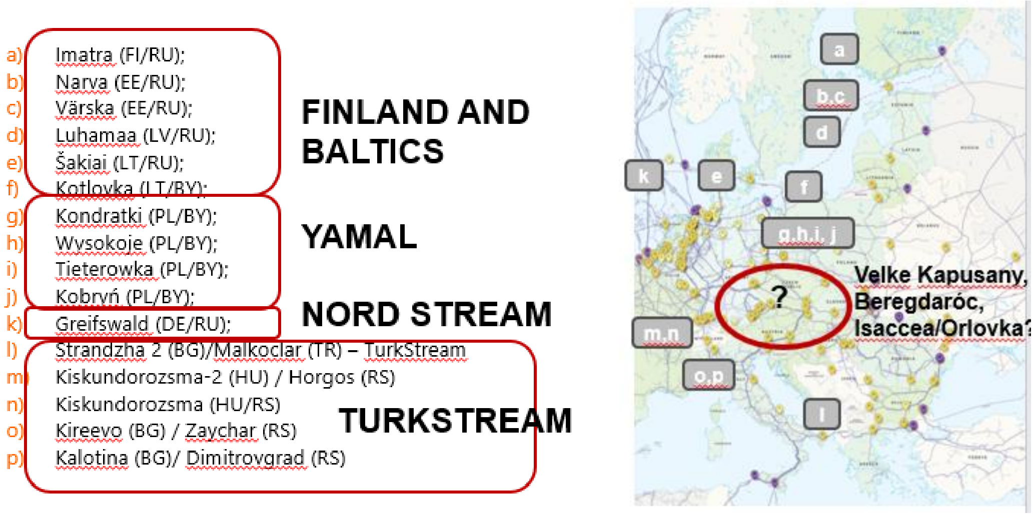
The Commission argues that the timing of such a move (full implementation from 2028) would not cause any disruption, as the Russian gas volumes could easily be replaced by increasing the supply on the global LNG market (about 200 bcm additional supply is assumed until 2030) and also in Romania (the Neptun gas field is expected to produce an additional 8-10 bcm/yr of gas from 2027). Pipeline infrastructure has already been improved and adjusted to the changed flows during and in the aftermath of the 2021-23 energy crisis. New LNG regasification capacities have continuously been added to the EU system (see Table 1), of which the 13 bcm/ yr total extension of the Greek, Polish and Croatian terminals is being the most important for the CEE region.

The Commission also argues that the sharp drop in gas consumption for the EU27 during the crisis (18% decrease in natural gas consumption between 2022 and 2025) will continue with a further expected drop of 70 bcm until 2027. Many stakeholders debate this expectation, and some Central Eastern European countries even experienced a demand increase in the recent years due to the coal phase out in the power sector but also due to some rebounding or new industrial demand.

The Commission's Roadmap published 6 May 2025, stipulates the full phase-out of Russian pipeline gas and LNG from 1 January 2026, with derogations for long-term contracts until 1 January 2028. The long-term contracts still delivered in October 2025 were the contract to Hungary (4.5 bcm/yr), Slovakia (2 bcm/yr) and Greece (2 bcm/yr). The Slovakian and Greek contracts expire by 2028 but the Hungarian contract expires by 2030 or 2035. Long-term LNG bookings at terminals in France and Spain are also affected.

To avoid relabelling of Russian gas deliveries, the proposal listed those entry points at which all gas must prove its origin before entering the EU. These entry points are depicted on the map below. (Figure 3)

FIGURE 3. NETWORK POINTS REGARDED DIRECTLY OR INDIRECTLY OF RUSSIAN ORIGIN GAS



Source: Commission REPowerEU Roadmap proposal, REKK visualisation

The Parliament discussed the proposal and during the discussion they proposed two serious changes:

- Change of timing: an even earlier phaseout without derogations.
- To include a smaller entry point form Turkey to the EU to the list of IP points where origin of gas needs to be proved.

Our study investigated the two proposal's different timeline on a stepwise prohibition of imports of natural gas from the Russian Federation. The Regulation also lays down rules to effectively implement and monitor the prohibition as well as the phase-out of oil imports from the Russian Federation. Our study however does not cover the oil sector.

After the modelling had been conducted and the results had been shared with the Danube Region Steering Group at its meeting on 20 November in Budapest and presented to various national and international audiences, on 3 December 2025 a provisional agreement[2] was reached on the REPowerEU Roadmap, that it shall be implemented from November 2027. Therefore, the scenario called REPOWER Roadmap presented in this study can be regarded as the one that has been provisionally agreed. This provisional agreement will now be endorsed by the Council and the Parliament before being formally adopted.

[2] Council and Parliament strike a deal on rules to phase out Russian gas imports for an energy secure and independent Europe, Press release on 3 Dec 2025 updated on 10 Dec 2025. https://www.consilium.europa.eu/en/press/press-releases/2025/12/03/council-and-parliament-strike-a-deal-on-rules-to-phase-out-russian-gas-imports-for-an-energy-secure-and-independent-europe/

3 SETTING THE SCENE – MODELL CALIBRATION

To identify the effects of a total Russian gas phaseout, the European Gas Market Model (EGMM) was applied. EGMM is a dynamic 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.

The model was calibrated to represent historical data from Q2 2024 toQ1 2025. In this chapter, we use the same data sources that we use as inputs in our modelling and 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

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:

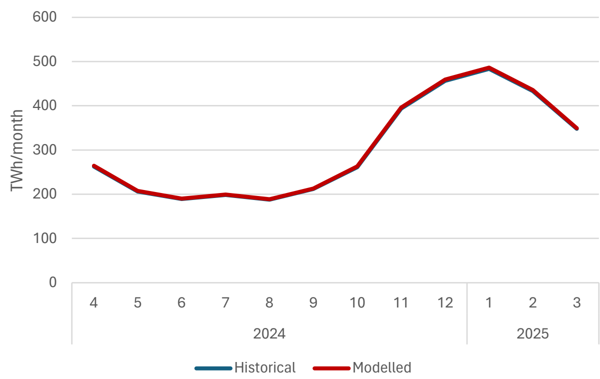
TABLE 1. INPUT DATA AND SOURCES FOR MODELLING

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 as of 2024
LTC (ACQ, price, route, expiry)	TWh/year, flexibility, €/MWh	Eurostat, Gazprom, company annual reports, OIES, country statistics, REKK data collection

3.1 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 4, modelled consumption of the EU27 is within 1% difference of the historical data.

FIGURE 4. EU27 MONTHLY NATURAL GAS CONSUMPTION, HISTORICAL (BLUE) VS MODELLED (RED), TWH/MONTH

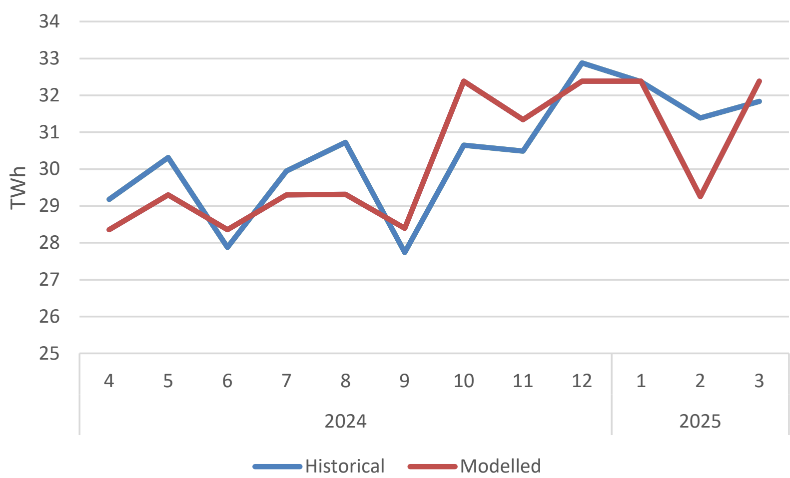


Source: REKK modelling and Eurostat

3.2 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 within 1% of the historical data, whereas monthly modelled figures are within ±7% of the historical data. (Figure 5)

FIGURE 5. EU27 MONTHLY NATURAL GAS PRODUCTION, HISTORICAL (BLUE) VS MODELLED (RED), TWH/MONTH

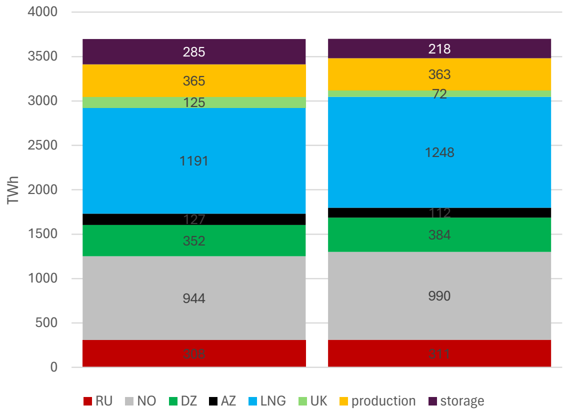


Source: REKK modelling and Eurostat

3.3 SUPPLY STRUCTURE OF THE EU27

Monthly supply structure of the EU27 was compiled based on the Bruegel dataset European natura gas imports.[3] The main sources of supply for the EU27 in 2024 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 within 5% of the historical data. (Figure 6)

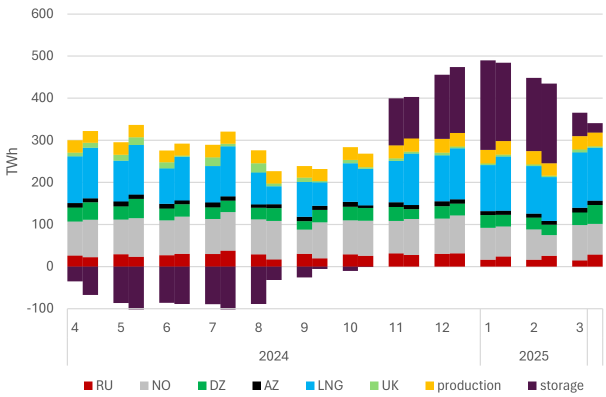
FIGURE 6. ANNUAL SUPPLY STRUCTURE OF THE EU27, Q2 2024-Q1 2025, LEFT: HISTORICAL FACT, RIGHT: MODELLED, TWH/YEAR



Source: REKK modelling and Bruegel

Monthly supply structure follows the seasonal consumption and flow patterns closely and recreates the historical observations well. (Figure 7)

FIGURE 7. EU27 MONTHLY SUPPLY STRUCTURE, HISTORICAL (LEFT STACKED COLUMES) VS MODELLED (RIGHT STACKED COLUMNS), TWH/MONTH



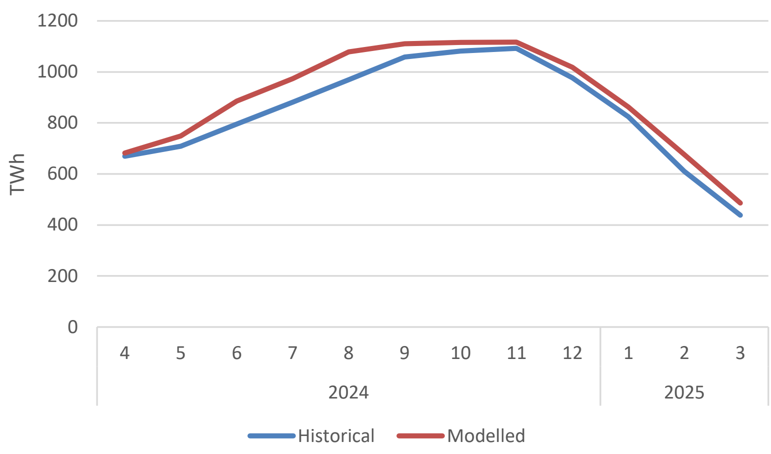
Source: REKK modelling, Eurostat and Bruegel

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

3.4 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 90% 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 2024, modelled numbers are somewhat over the historical storage use. (Figure 8)

FIGURE 8. EU27 MONTHLY WORKING GAS VOLUMES IN STORAGES AT THE START OF THE MONTH, HISTORICAL (BLUE) VS MODELLED (RED), TWH



Source: REKK modelling and AGSI

3.5 LNG SUPPLY STRUCTURE OF THE EU27

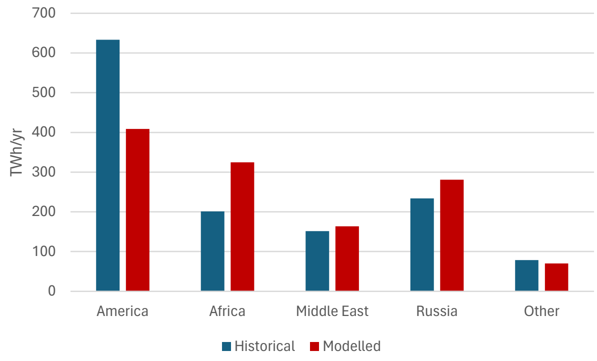
Historical use of LNG terminals is obtained from ALSI (Aggregated LNG System Inventory) platform. Modelled LNG inflow to the EU27 is 10% higher than the historical observations. (Figure 9)

FIGURE 9. 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.[4] Modelled results for the main supplier US was at somewhat lower level than the historical data suggests. African sources are over-represented in the model compared to the data. Middle-Eastern, Russian LNG and other sources are at the same level as the statistics suggest. (Figure 10)

FIGURE 10. EU27 ANNUAL LNG IMPORTS BY MAIN PARTNER, HISTORICAL (BLUE, LEFT) VS MODELLED (RED, RIGHT), TWH/YEAR



Source: REKK modelling and Bruegel data

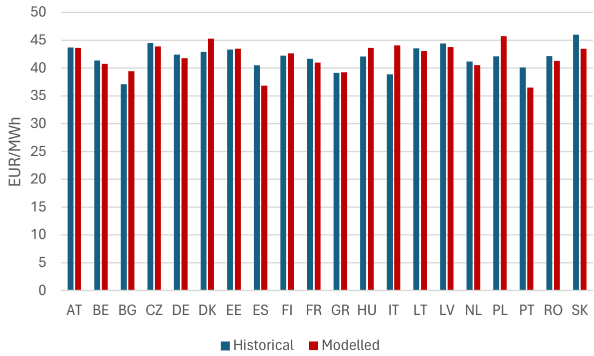
3.6 WHOLESALE PRICES IN THE EU27

The weighted average wholesale price (that is a key modelling output) was compared to the historical day-ahead prices of the natural gas exchanges.[5] Overall, the modelled prices of the 20 markets which have price signals, 14 modelled were within 5% of the historical annual average price. (Figure 11)

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

[5] 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

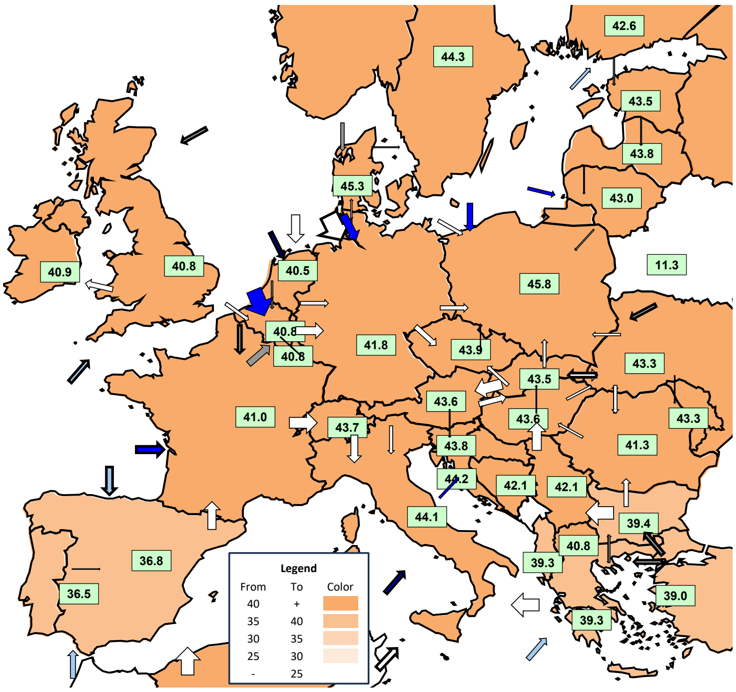
FIGURE 11. ANNUAL WHOLESALE NATURAL GAS PRICE, HISTORICAL (BLUE, LEFT) AND MODELLED (RED, RIGHT), €/MWH



Source: REKK modelling and exchange market reports

Figure 12 shows the modelled annual average wholesale prices for the Q2 2024-Q1 2025 time period on a country basis.

FIGURE 12. MODELLED WHOLESALE ANNUAL AVERAGE NATURAL GAS PRICES IN EUROPE, 2024 Q2-2025 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

4 MODELLING THE REPOWEREU ROADMAP

To answer the question, what cost the full Russian gas phase out would mean in terms of price increase at the wholesale level we applied two modelling setups to mirror the differences between the Commission's original proposal of the REPowerEU Roadmap and the Parliament's early implementation.

The summary of these scenarios is depicted on the table below.

TABLE 2. DESCRIPTION OF MODELLING SCENARIOS

Scenario	Overnight	Commission proposal
With Russian gas	2024/25 conditions*	2028 conditions
Repower EU Roadmap Russian gas phase out	2024/25 conditions*	2028 conditions

**historical demand between 2024 Q2 and 2025 Q1 and yearly average 40 €/MWh Asian gas wholesale price*

*** Central scenario: stagnating EU27 demand in 2028 with yearly average 40 €/MWh Asian gas wholesale price*

For the early implementation we modelled an "overnight" ban on Russian deliveries on a setup that reflected the European gas market reality from 2024 Q2 to 2025 Q1. This model setup could also be verified using historical data: the EGMM very closely reproduced the EU's supply mix, the consumption patterns, the storage use, the flows on the key routes and the modelled prices. The prices were then compared to the available price indices on hubs and exchanges in the EU27. In this scenario no additional LNG or Romanian offshore enters and the infrastructure in Europe is the same as the one we have now. In many ways, this scenario delivers the most severe impacts that the European gas market can face due to an overnight Russian gas phaseout.

In order to assess the Commission's proposal, we compared a 2028 counterfactual scenario, in which the Russian LTCs and spot deliveries are still in the mix and a scenario without Russian supplies to EU Member States. Compared to 2024, additional LNG capacities of 60 bcm/yr were added to the European network as well as the offshore production in Romania comes online. In CEE we added 13 bcm/yr extensions to the LNG regasification capacities in Greece, Poland, Croatia.

To avoid overestimating the savings and energy efficiency, we did not anticipate any sharp decrease in consumption, on EU27 level in our core modelling scenario demand is slightly going down from 3652 TWh/yr in 2024 to 3524 TWh/yr in 2028. On the contrary, for the Danube Region there is a 2% increase in demand, from 1593 TWh/yr in 2024 to 1623 TWh/yr by 2028.

This increase comes from consumption increase from 2024 to 2028 in Bulgaria (50%), Czechia (29%), Hungary (11%), Romania (25%) and Slovenia (21%). It must be noted, that due to uncertainties related to the war situation, the Ukrainian gas demand was kept stagnating. For other non-EU countries, such as Bosnia, Moldova and Serbia we also assumed a stagnating demand at the 2024 level. (Table 3.)

TABLE 3. GAS CONSUMPTION OF DANUBE REGION COUNTRIES IN 2021, 2024, 2028 (TWH/YR)

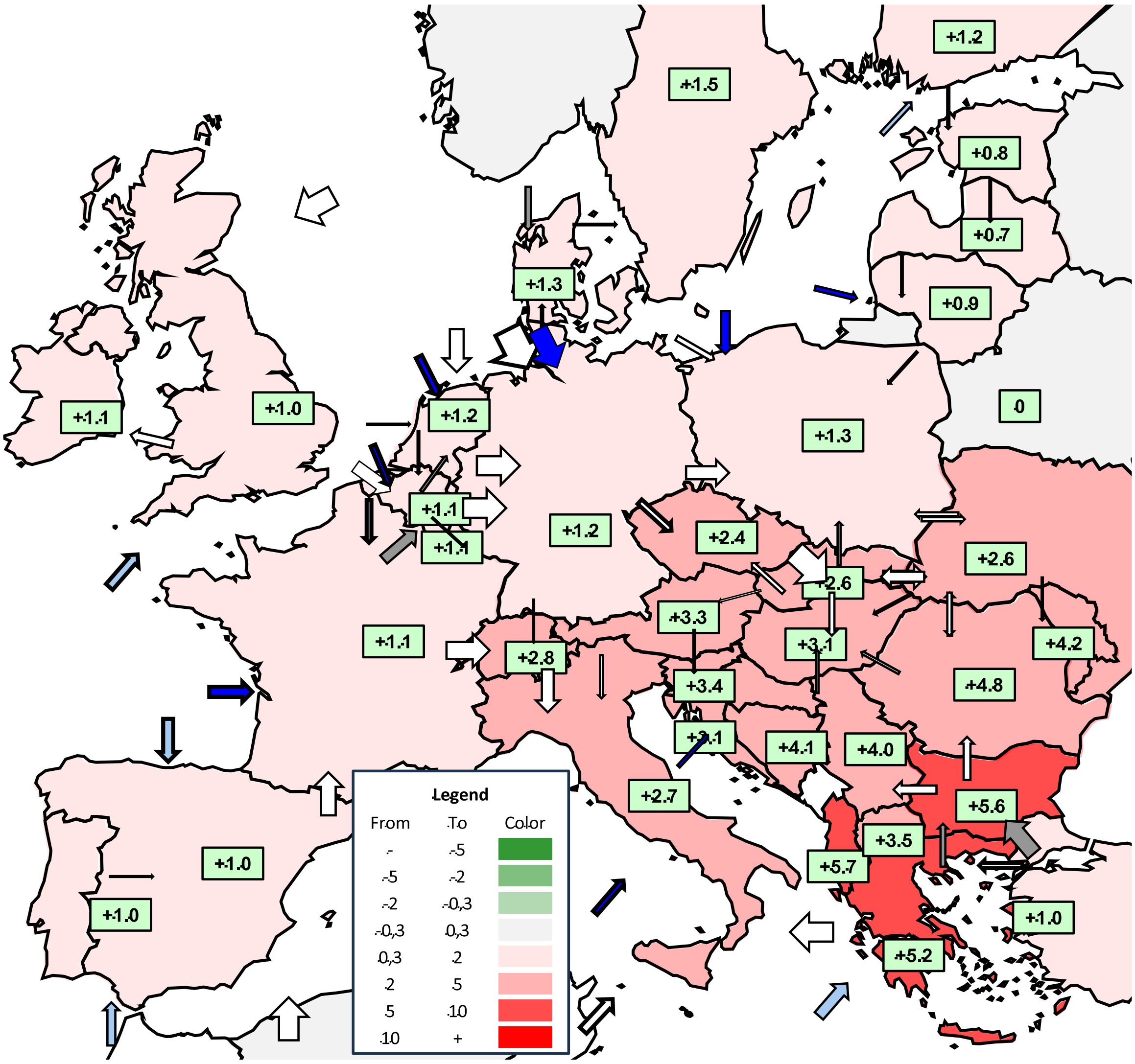
TWh/year	2021	2024	2028	Change from 2024 to 2028
AT	98	81	67	-17%
BA	2	2	2	0%
BG	36	31	46	50%
CZ	97	78	100	29%
DE	976	872	764	-12%
HR	33	28	24	-13%
HU	119	97	108	11%
MD	11	9	9	0%
RO	124	122	152	25%
RS	36	34	34	0%
SI	10	10	12	19%
SK	58	45	43	-3%
UA	279	186	186	0%
DR Total	1878	1593	1623	2%

Source: REKK assumptions based on Eurostat and ENTSOG

4.1 OVERNIGHT RESULTS

The overnight results show a differentiated price increase along the European countries. (Figure 13)

FIGURE 13. IMPACT OF THE OVERNIGHT RUSSIAN GAS PHASEOUT FROM EU27 ON YEARLY EUROPEAN WHOLESALE GAS PRICES (€/MWH, JP=40 €/MWH)



Numbers in the box depict the price impact of the Russian LNG and pipeline gas phaseout from the EU27 supply mix: the difference between the no Russian gas and the with Russian gas scenario. 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

Looking at the REPowerEU overnight results we see that EU countries are impacted differently mainly due to their different geographical location and their share of the Russian gas in their current mix. Overnight effects are negligible in Western and Northwestern Europe, where Russian gas is present only in LNG form. The main receiving countries of Russian LNG (Spain and France) can easily host different cargoes from other sources and substitute Russian gas. The price impact is around 1 €/MWh increase in the 40 €/MWh price environment. The arrows on the map depict pipeline flows between countries and they point from west to east. The colouring turns grey for pipelines, when they are at least in 3 months of the year physically congested. The pipeline capacities are highly utilized meaning that LNG can partially reach the Central and Eastern European region. The price impact is therefore higher, in the range of + 2-3 €/MWh in Czechia, Austria, Slovakia, Hungary and even in Italy. The highest impact, an additional 4-5 €/MWh price increase is measured in Romania, Bulgaria and in Greece as the pipeline deliveries from Russia are currently reaching Europe via the Turk Stream 2 pipeline from Turkey. Total gas procurement costs of the EU27 increase by 4% if the Roadmap is realised overnight. Being composed of more landlocked countries and having less LNG access, Danube Region total gas costs are affected slightly higher, with a 5% price increase.

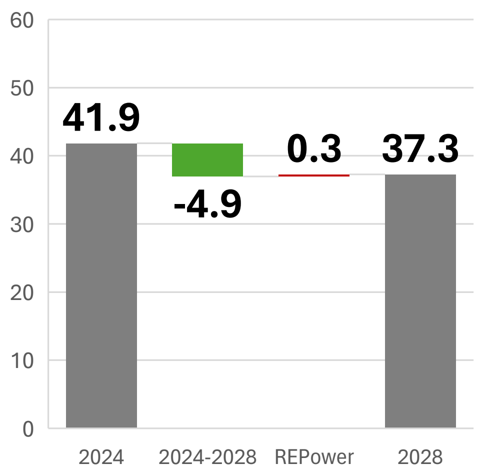
4.2 COMMISSION PROPOSAL RESULTS

Compared to these overnight impacts, the Commission proposal sets forth a stepwise implementation of phasing out Russian gas from the European mix, with all measures to be implemented by 2028. At that time more LNG is available at the global market, and additional Romanian offshore sources are also available. We assume that by 2028 there is a slightly decreasing overall EU27 demand. All these factors already dampen the EU level gas prices compared to the historical prices in 2024 in our core scenario. At this price environment the Russian gas phase out happens at a decreasing overall price environment. Figure 14 decomposes the two effects that happen to the EU27 gas prices in our REPowerEU roadmap implementation by 2028. The first change is due to the changes in the market circumstances (supply, demand, infrastructure), the second is attributable to the introduction of the regulatory change (full ban on Russian gas). EU average wholesale gas price is 4.9 €/MWh lower in 2028 than in 2024 due to changes in market conditions.

The regulatory measure would bring an average increase of 0.3 €/MWh in the EU27 wholesale gas price. This means that the gas bill that the EU pays would increase in total by 1% compared to the scenario where Russian gas would still be available.

The favourable change in market supply and demand conditions by 2028 highly outweigh the negative impact of the Russian gas phase out. The overall price change combining the market and regulatory effects would bring down the total gas bill from 2024 to 2028 with no Russian gas still by about 15%.

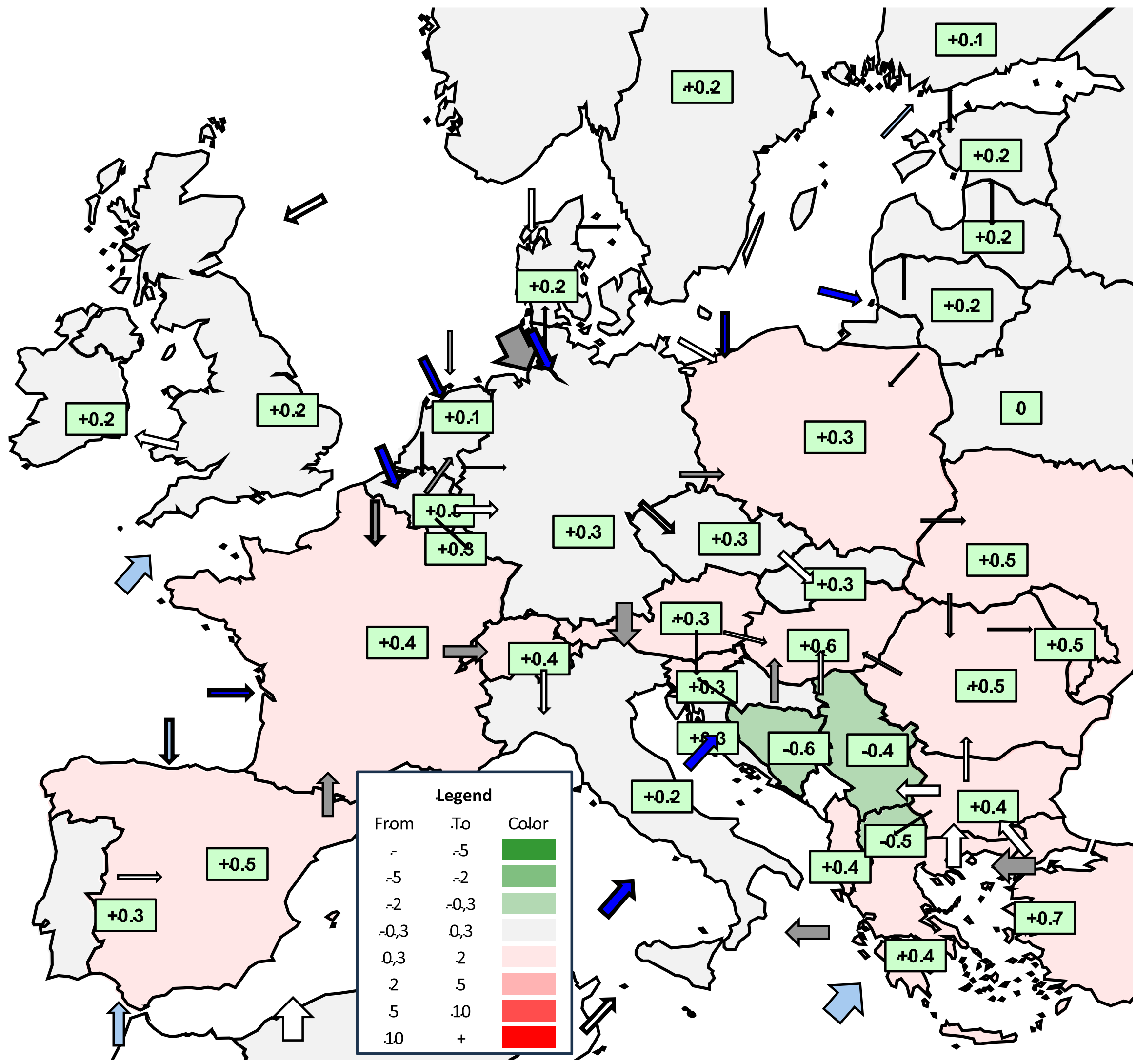
FIGURE 14. DECOMPOSING THE EU27 WEIGHTED AVERAGE NATURAL GAS WHOLESALE PRICE CHANGE FROM 2024 TO 2028 (€/MWH)



Source: REKK modelling

Looking at the country level price results on what the original Commission proposal would cause we see (Figure 15) that price impact of the Russian gas ban would be negligible not only in Western Europe but also in Central Eastern European and in the Balkans. The price change is in the range of 0.1-0.6 €/MWh in the EU Member States with the highest 0.6 €/MWh (+1.5%) increase in Hungary.

FIGURE 15. IMPACT OF THE RUSSIAN GAS PHASEOUT OF EU27 ON YEARLY EUROPEAN WHOLESALE GAS PRICES (€/MWH, JP=40 €/MWH IN 2028)

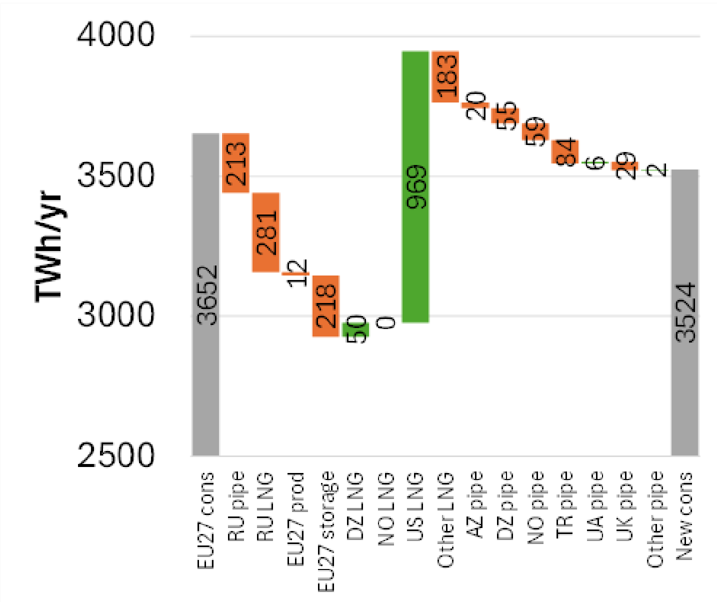


Numbers in the box depict the price impact of the Russian LNG and pipeline gas phaseout from the EU27 supply mix: the difference between the no Russian gas and the with Russian gas scenario. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they 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

It is also interesting to see which alternative sources could reach the EU market and replace the Russian volumes on a market basis. In our modelling by 2028 it would largely be US LNG entering the EU27 markets, and crowd out not only Russian but other LNG sources as well. (see Figure 16)

FIGURE 16. EU27 SUPPLY MIX CHANGE DUE TO THE REPOWEREU ROADMAP IMPLEMENTATION (TWH/YR, 2028)



Source: REKK modelling

4.3 SENSITIVITIES

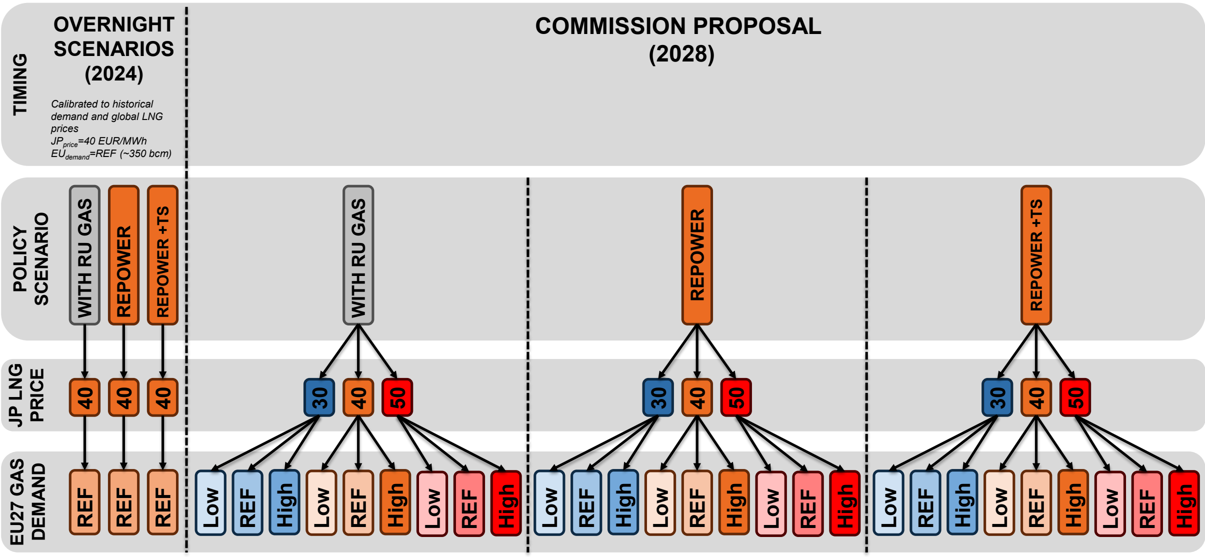
To test the robustness of the results, the key parameters driving them should be tested. Key parameters that are based on assumptions include the global price environment (at what price would LNG be available in 2028) and the level of European gas demand. These two factors together set the market conditions under which the Russian gas phase out could have different impacts.

An oversupplied LNG market was modelled for 2028 by setting the JKM price at 30 €/MWh, while a tight market was modelled at 50 €/MWh. EU27 natural gas demand was assumed to be 15% lower (representing pre-energy crisis gas consumption levels) and 15% higher than in the central scenario.

The other risk is that it might happen that when the EU starts implementing the Russian gas phaseout, Russia might decide to stop delivering gas via Turk Stream2. This would mean that non-EU countries in the Balkans (Serbia, Bosnia Herzegovina and Nort Macedonia) would also need to look for alternative supply options. These risks are discussed in this chapter.

A summary of all the scenarios modelled including the sensitivities is summarized in Figure 17 below:

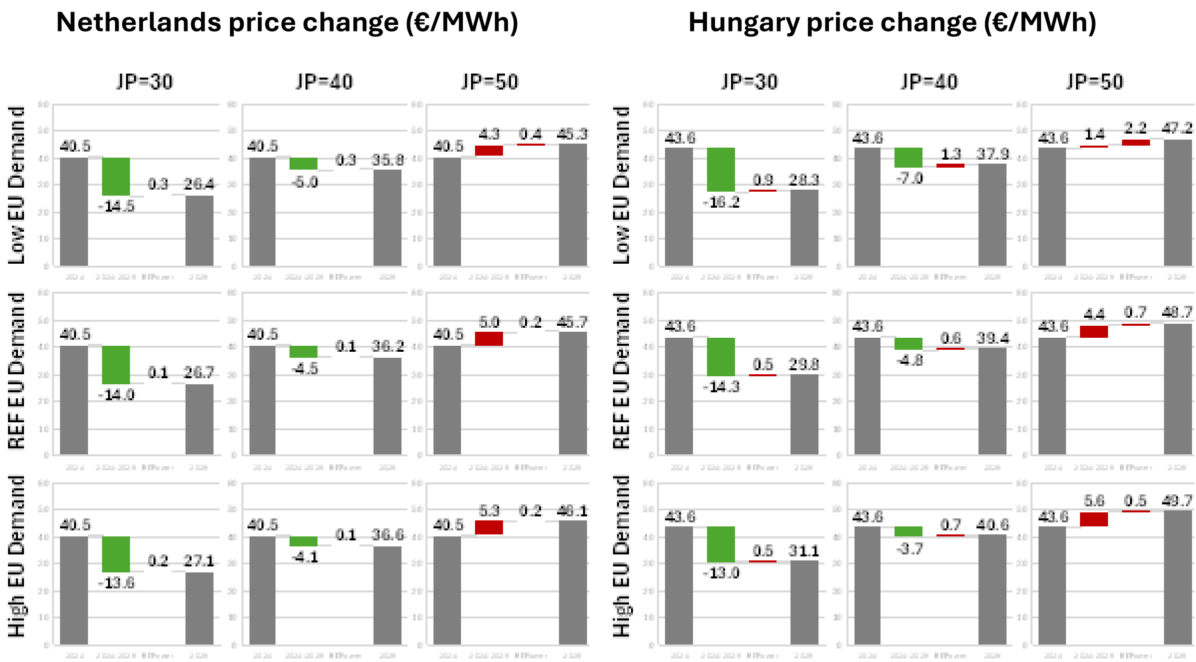
FIGURE 17. ILLUSTRATION OF THE MODELLING FRAMEWORK



4.3.1 DECOMPOSTION OF MARKET AND REGULATORY PRICE IMPACT IN DIFFERENT GLOBAL SUPPLY AND DEMAND CIRCUMSTANCES

Sensitivity scenarios allow us to decouple the effects of the market and regulations. It is apparent from Figure 18 and Figure 19 that the price level in European gas markets will be mainly driven by the availability and price of LNG, followed by the European gas demand. The effects of the regulation are below 0.5 €/MWh for the Western-European markets such as the Netherlands in all sensitivity scenarios. Effects of the regulation are somewhat higher for Central European markets like Hungary: still in 7 out of 9 scenarios the price effect of the regulation is below 1 €/MWh.

FIGURE 18. PRICE EFFECT OF MARKET AND REGULATORY CHANGES IN THE SENSITIVITY SCENARIOS (LEFT: NETHERLANDS, RIGHT: HUNGARY)



Source: REKK modelling

FIGURE 19. PRICE EFFECT OF MARKET AND REGULATORY CHANGES IN THE SENSITIVITY SCENARIOS, EU27 WEIGHTED AVERAGE ANNUAL WHOLESALE NATURAL GAS PRICE, EUR/MWH

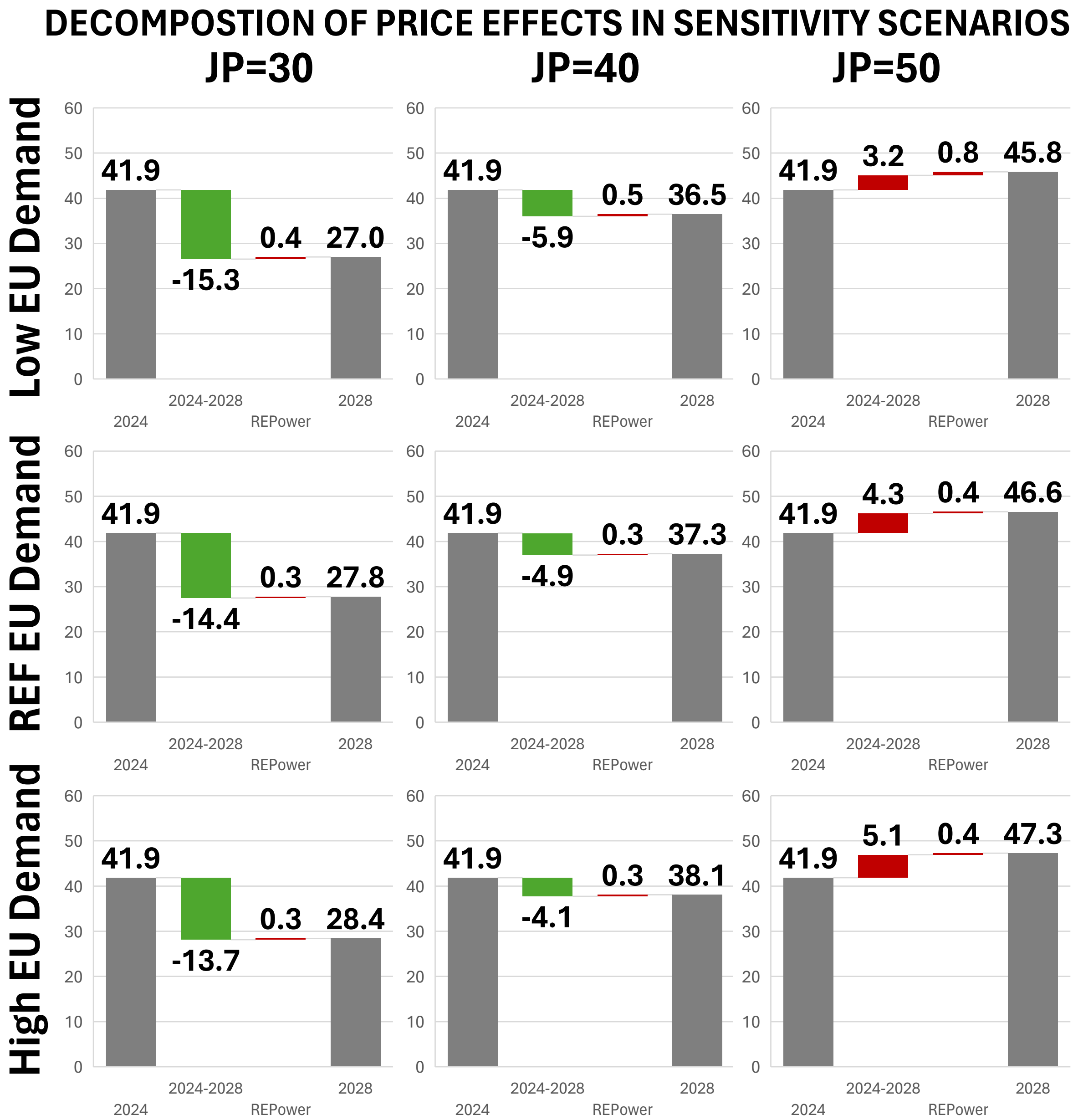
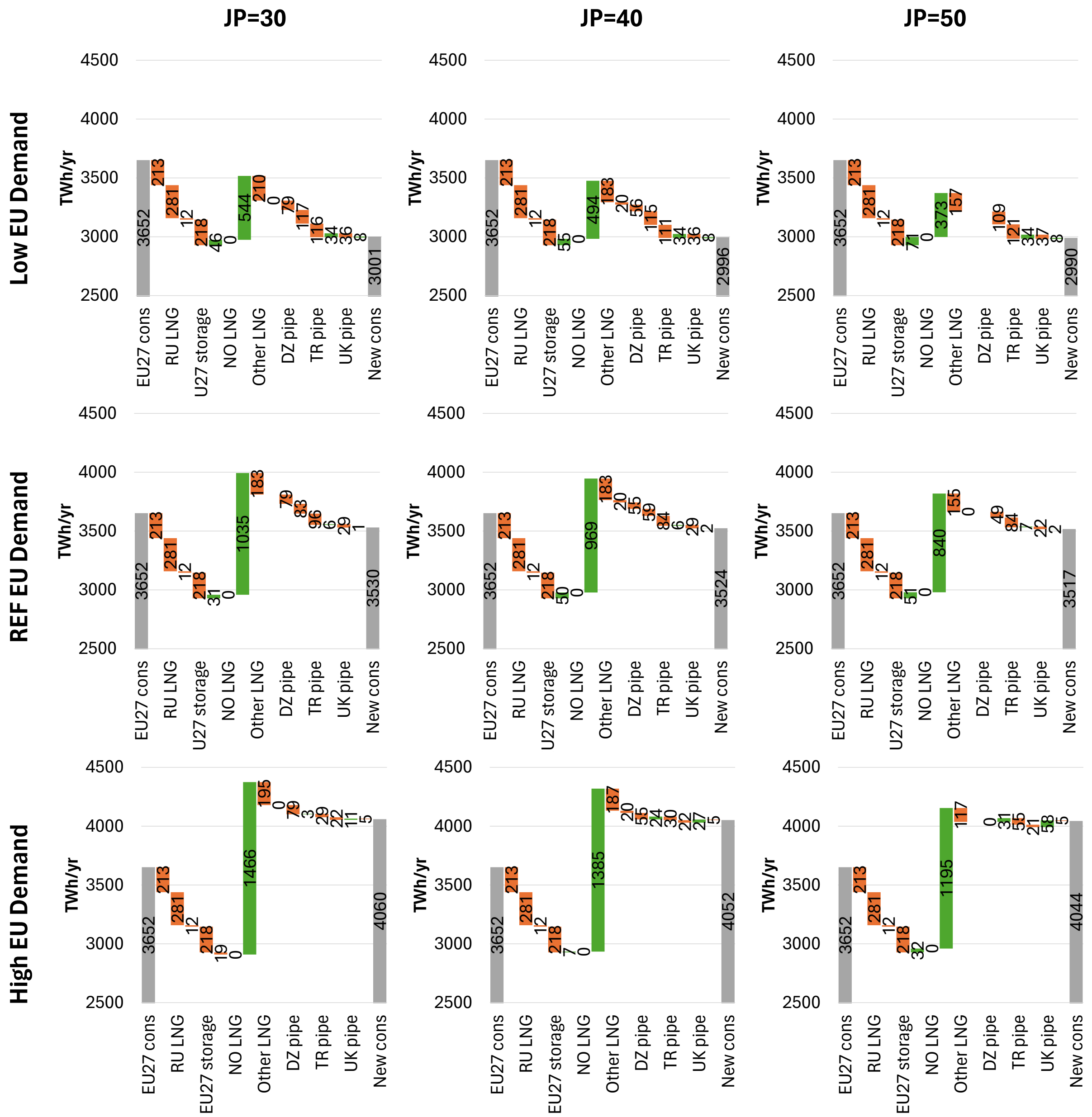


FIGURE 20. CHANGE IN SUPPLY STRUCTURE OF THE EU27 DUE TO THE REPOWEREU IMPLEMENTATION, 2024 TO 2028



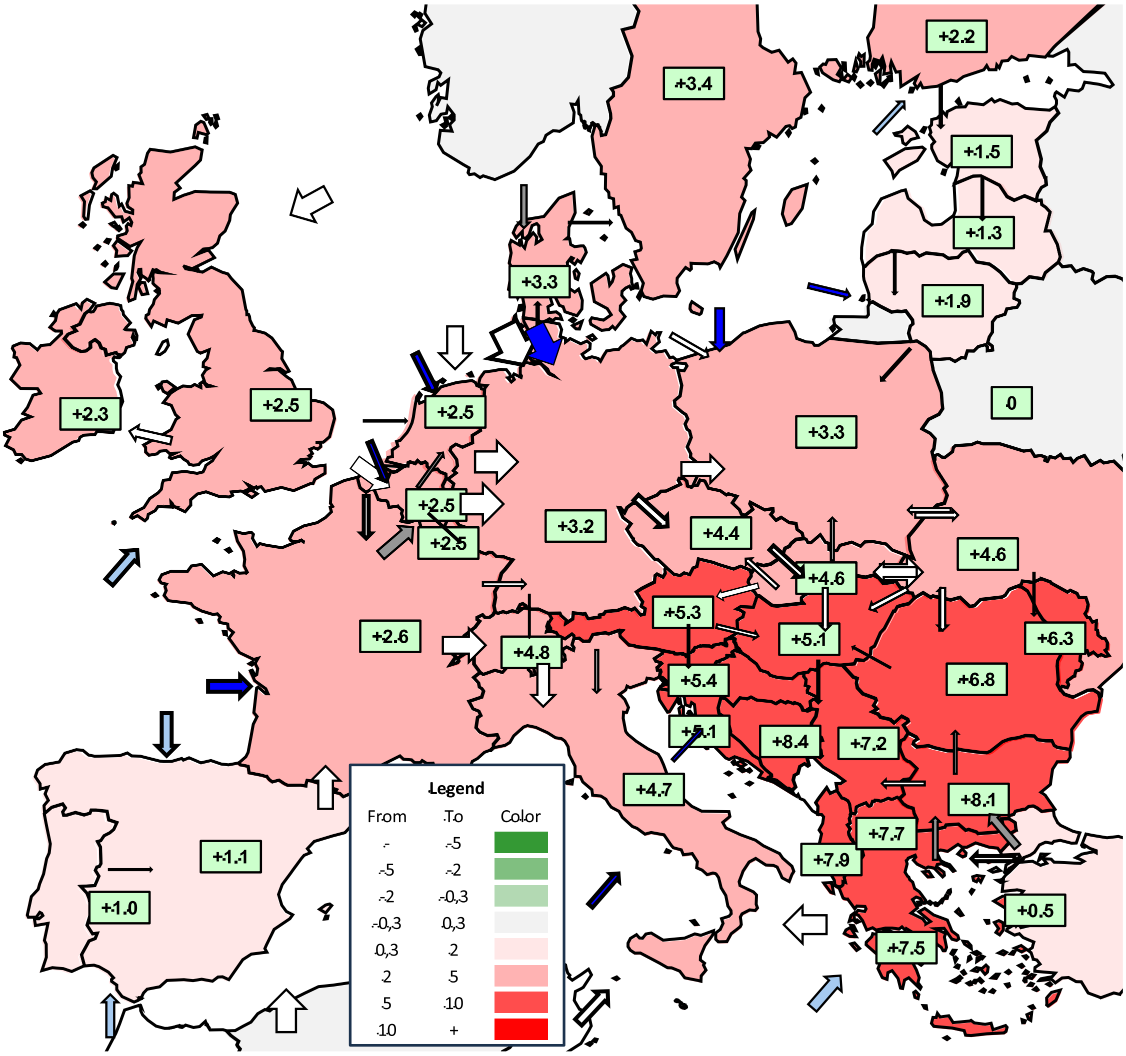
Russian gas is being replaced by LNG inflow, that can also provide the flexibility to balance the supply and demand. In our core scenario +969TWh LNG flow arrives to the EU, mainly form the US. The amount of additional LNG arriving to the EU varies between +373 and +1466 TWh/yr. (Figure 20)

4.3.2 MODELLING A RUSSIAN RESPONSE

As an even more severe supply shock than the REPowerEU Roadmap itself, we also tested a scenario in both setups (overnight and 2028), where the EU 27 gas phase out is complemented by a Russian gas phase out in the non-EU member states in the Balkans currently supplied via

Turk Stream 2. This could be a consequence of a Russian reaction to the EU ban, or a voluntary ban on Russian gas by these countries. This scenario would stop the Russian long-term contract deliveries to Serbia, Bosnia and Herzegovina and North Macedonia. Though not discussed within the REPowerEU Roadmap, the unilateral ban on Russian gas supplies leaves some of the non-EU member countries in the Balkans that are still supplied via their long-term contracts by Russian gas exposed to the decision of Gazprom on whether to continue Turk Stream 2 deliveries to these small contracts. The Turk Stream 2 pipeline has a yearly 15 bcm/ yr throughput capacity, that has been fully utilized in the last years. Would the REPowerEU Roadmap happen, it might be too costly to operate the system for the remaining 3-4 bcm/yr. This would not be an unprecedented move: at the beginning of 2025, the termination of the Ukrainian delivery route also resulted in the complete cessation of the Moldovan Russian supply contract, despite the physical possibility of supplying Moldova via the Trans Balkan pipeline in a backhaul mode, from Turkey, via Bulgaria and Romania. We have no information on the intentions of Russia towards Serbia, Bosnia and North Macedonia, however a complete shutdown could also result from political backlash against the REPowerEU. To see how exposed the EU and non-EU member European countries are to such a response, we tested the price impacts of a full Russian supply cut on Turk Stream 2, when the current long-term supply contracts to Serbia, Bosnia Herzegovina and to North Macedonia are not delivered. The results are depicted on Figure 21. Similar to the REPowerEU case spreads between regions emerge, however an additional + 2 €/MWh is visible. Countries with abundant LNG regasification capacities (Spain, UK) seem to withstand the price increase, however their interconnected-ness with the rest of the EU market is limited, therefore the other countries cannot utilize the access to the global LNG market fully. We see that even in France, in the Benelux countries, in the Nordic countries, in Germany and Poland the price impact is 2-3€/MWh in a 40 €/MWh price environment. The Central European counties (Czechia, Austria, Hungary, Slovakia, Slovenia, Croatia, Italy and Ukraine) see a +4-5 €/MWh price increase, while the Balkan is even +6-8 €/MWh more expensive than before the ban on Russian gas. (Figure 21).

FIGURE 21. OVERNIGHT IMPACT OF THE RUSSIAN GAS PHASEOUT OF EU27 + SERBIA, BOSNIA AND NORTH MACEDONIA (€/MWH, JP=40 €/MWH)

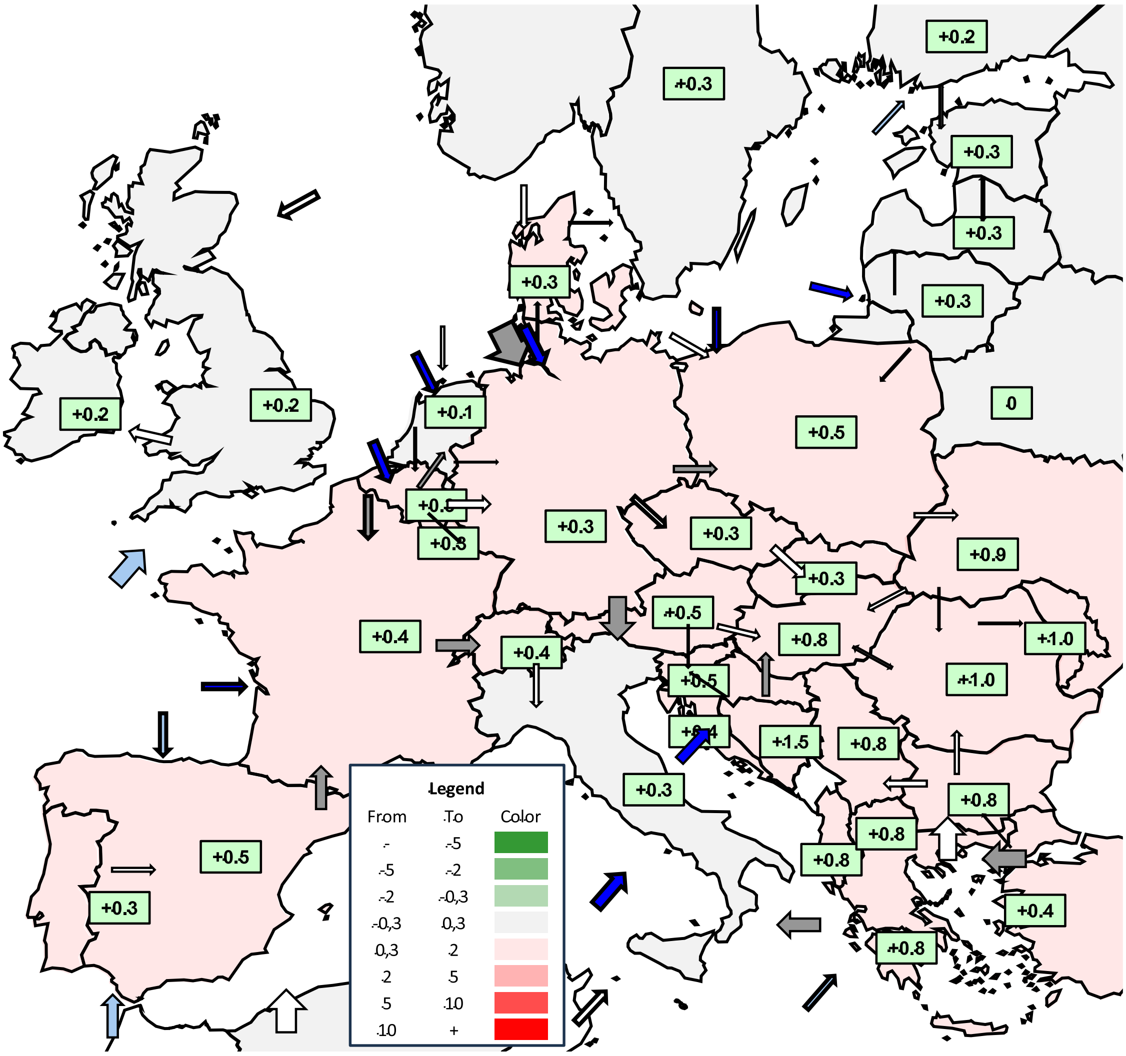


Numbers in the box depict the price impact of the Russian LNG and pipeline gas phaseout from the Eu27 supply mix: the difference between the no Russian gas and the with Russian gas scenario. Arrows on the map indicate the flows on the pipelines (white arrows) indicating also the volumes (when bold they 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

Would the full stop of Russian deliveries to the non-EU countries occur in 2028, the results are much more modest and stay below a 1€/MWh increase for all EU and for most of the non-EU countries, with the exception of Serbia (+1.5 €/MWh). These results show that there is no Russian leverage on the European gas market by 2028 and the Russian gas phase out can be implemented with negligible price impact. (Figure 22)

FIGURE 22. IMPACT OF THE RUSSIAN GAS PHASEOUT OF EU27 + SERBIA, BOSNIA AND NORTH MACEDONIA ON YEARLY EUROPEAN WHOLESALE GAS PRICES (€/MWH, JP=40 €/MWH IN 2028)



Numbers in the box depict the price impact of the Russian LNG and pipeline gas phaseout from the Eu27 supply mix: the difference between the no Russian gas and the with Russian gas scenario. 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

5 RESULTS FOR THE DANUBE REGION

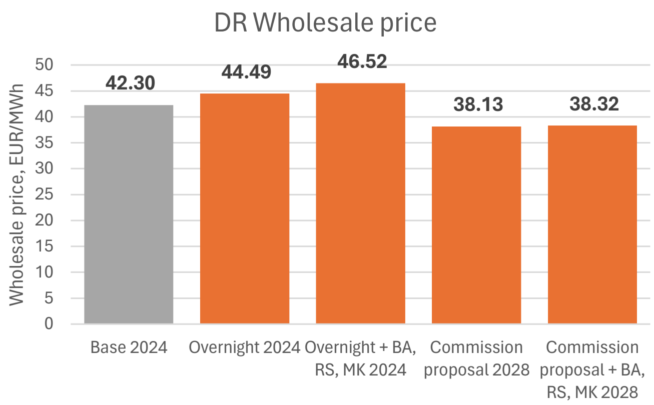
This chapter provides a short summary of the modelling results on a regional level. The region is defined as the total of the Danube Region countries:

Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czechia, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia and Ukraine.

There is no gas consumption and gas transmission infrastructure in Montenegro.

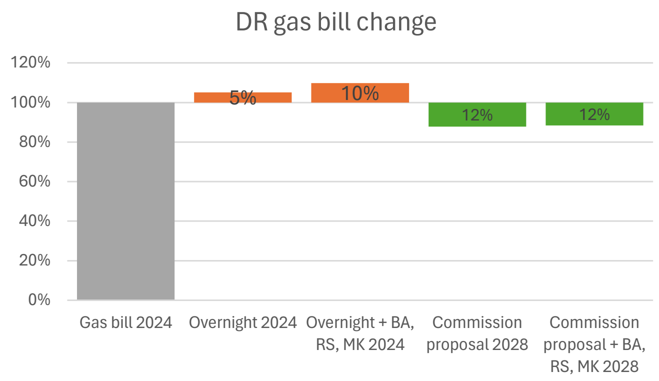
Modelled yearly average wholesale gas price of the scenarios (€/MWh), in the core modelling setup (JP=40€/MWh, with reference demand) were calculated at the regional level. From 2024 to 2028, Danube region gas demand increases by 2%, and the modelled wholesale price drops from 42.3 EUR/MWh to 38.13 EUR/MWh in the Commission's scenario but could also increase to 44.49 €/MWh in an early implementation as it was proposed by the Parliament. (Figure 23) Considering all changes in the global LNG market and European demand, this results in an overall ***10% increase (in the Parliament scenario) or a 12% decrease (in the Commission's proposal scenario)*** in the total wholesale gas procurement cost for the Danube region. (Figure 24).

FIGURE 23. WEIGHTED AVERAGE ANNUAL WHOLESALE PRICE IN THE DANUBE REGION, EUR/MWH



Source: REKK modelling

FIGURE 24. GAS BILL CHANGE IN THE DANUBE REGION, %



Source: REKK modelling

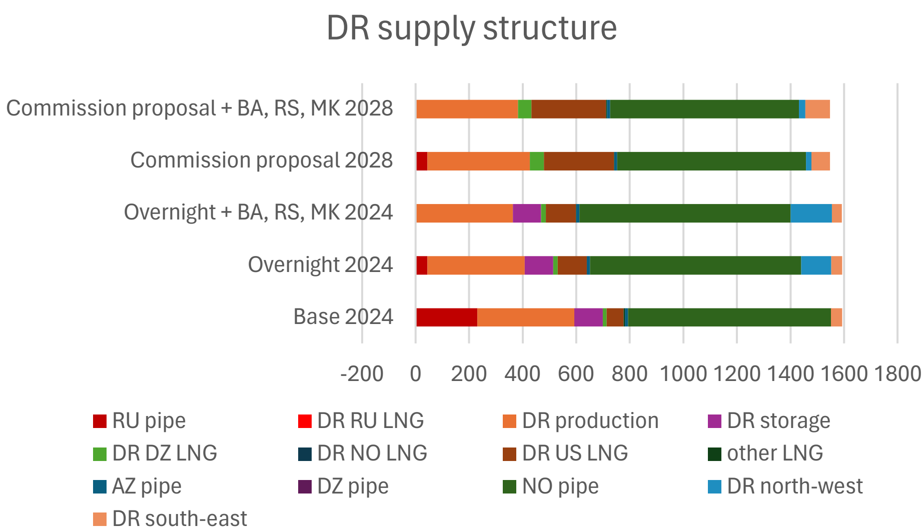
The supply structure of the Danube Region changes substantially as more LNG is imported and shipped to land-locked countries in Central Eastern Europe.

Many of the Danube Region countries already stopped buying Russian gas: Austria (2024), Bulgaria (2022), Croatia, Czechia (2022), Germany (2022), Moldova (2025), Romania (2021), Slovenia (2022) and Ukraine (2015) did so in different time between 2014-2025.

At a regional level, 186 TWh long term contracted Russian gas still needs to be replaced by alternative sources, even though Russian deliveries to Serbia and Bosnia Herzegovina are not impacted by the REPowerEU Roadmap prohibition to buy Russian gas. The contract to North Macedonia (which is not a Danube Region country) also belongs to this group.

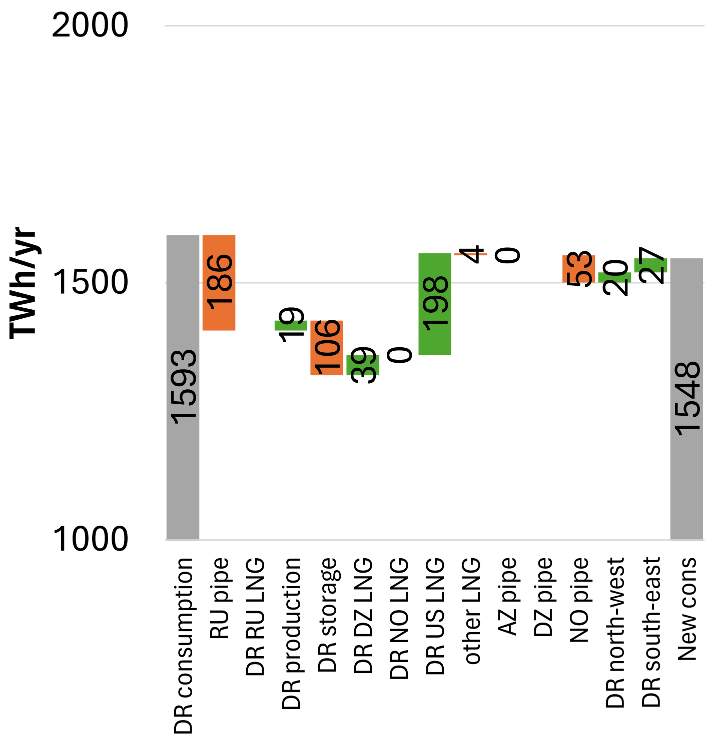
Figure 25 depicts the supply structure of the Danube region for the scenarios in the core modelling setup (JP=40€/MWh, with reference demand) and historical baseline of 2024 (TWh/yr). The overnight scenarios would require substantial import from North-West Europe on various routes to balance the missing Russian volumes. The provisional agreement reached on 3 December 2025 between Council, Parliament and Commission did not opt for this alternative, therefore we should take a closer look on the Commission's proposal scenario, that is closer to the agreed timeline of the provisional agreement. Figure 26 shows the supply structure change from 2024 to 2028 in the REPowerEU scenario as proposed by the Commission in the core modelling setup (JP=40€/MWh, with reference demand) (TWh/yr). We see that the Danube Region (including entire Germany) altogether purchases 198 TWh more LNG in 2028 than in 2024. ***LNG is the main source of the replacement of Russian gas***. There is minor increase in pipeline gas shipments from Algeria and North-West Europe.

FIGURE 25. DR SUPPLY STRUCTURE, TWH/YR



Source: REKK modelling

FIGURE 26. CHANGE OF SUPPLY STRUCTURE IN THE CENTRAL SCENARIO, 2024-2028 (JP=40, DEMAND=REF)

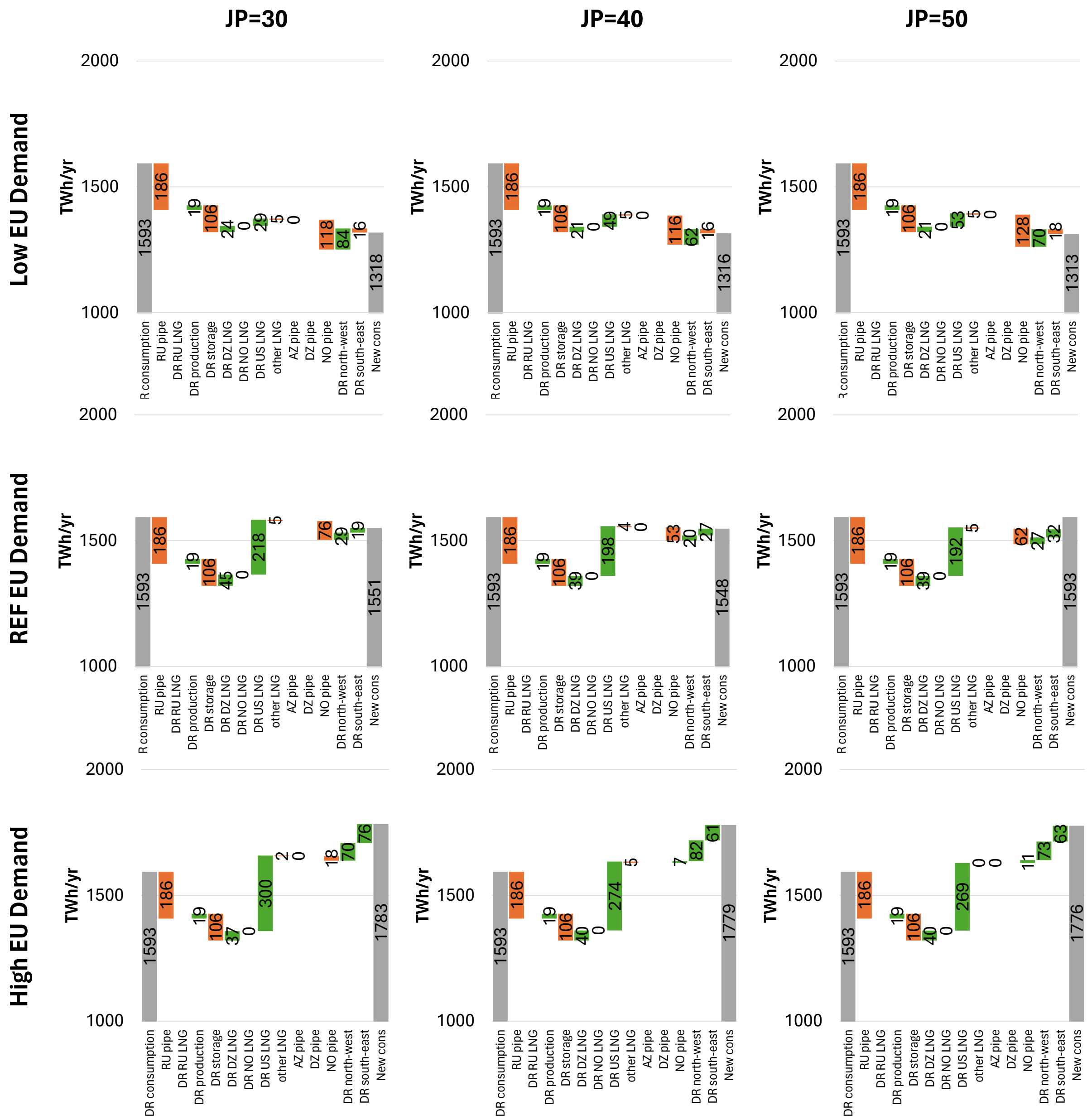


Source: REKK modelling

Figure 27 shows the sensitivity results for the supply structure change under the Commission's proposal. ***The volume of LNG arriving varies between 29 TWh and 300 TWh across the various scenarios, largely driven by the level of the EU gas demand.***

The impact of the Russian gas phaseout is changing the origin of gas and also the supply routes. In our modelling, we used the entry and exit tariffs of 2024 for each interconnection point, as well as for exits to national systems, storages, production and LNG facilities. These tariffs did not change between the scenarios. The TSO revenues are impacted by the change in flows. The detailed country level results are discussed in the Annex: Country factsheets of the Danube Region countries. The modelled TSO revenues increase compared to the baseline in 2024 (with Russian gas) to 2028 (with the REPowerEU in place) in Croatia (+1183%), Czechia (+415%) and in Romania (+197%). Some countries witness a huge decrease in TSO revenues: Austria (-92%, Bulgaria (-43%), Germany (-19%), Hungary (-49%), Serbia (-66%), Slovakia (-79%), Slovenia (-49%), Ukraine (-99%). This ***large change in TSO revenues implies that the regulated tariffs should also be reviewed and amended by the national regulators, that could have a backfire effect on the flows.***

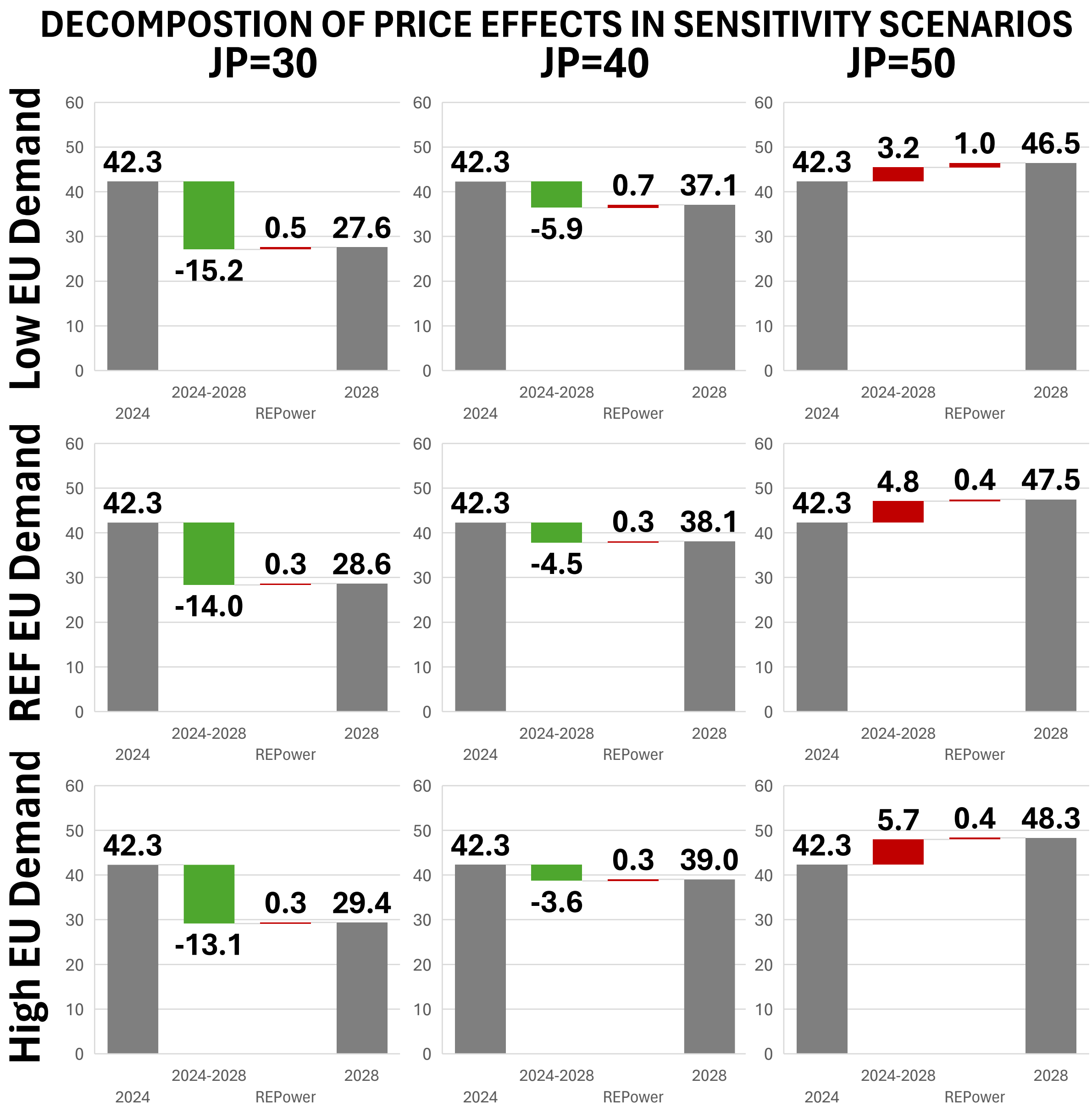
FIGURE 27. SUPPLY STRUCTURE CHANGE IN DR IN SENSITIVITY SCENARIOS, 2024-2028



Source: REKK modelling. DR north-west: border points with BE, CH, DK, FR, LU, NL, PL; DR East: border points with AL. GR, IT, MK, TR

The decomposition of price change for the Commission's scenario to changes in all sensitivity setups to market and regulation effects (€/MWh) gives a similar picture to what we could witness for the EU level results (Figure 28). The change in prices is driven by the market circumstances, mainly by the gas consumption level and the availability of new LNG supply on the global market by 2028. Market circumstance impact regional wholesale gas prices in a range of -15.2 €/MWh to +5.7€/MWh. The impact of the REPowerEU Regulation is much smaller, varies in the range of an increase between 0.1 €/MWh to 1.0 €/MWh.

FIGURE 28. DECOMPOSITION OF PRICE EFFECTS IN SENSITIVITY SCENARIOS FOR THE DR, EUR/MWH



6 CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to compare the impact of the prohibition of Russian gas supply from the European Union on natural gas prices and supply structure of the EU, the European countries and of the Danube Region, that comprises of both EU and non-EU countries.

To capture the differences, we applied scenario modelling where differences between the with and without Russian gas situation can be quantified. Two different timelines were proposed for the Russian gas phaseout. The Commission's proposal was modelled in a 2028 infrastructure and supply demand situation, while the early implementation proposal of the Parliament was modelled as an overnight ban on Russian gas deliveries.

Modelling results show that the Commission's proposal would result in a very modest price increase EU wide in 2028 without threatening the markets to fall apart into regionally different priced sub-markets.

However, these positive results change when the Regulation is implemented too early. As the overnight modelling results show, there is a pressing need for new alternative supplies, especially in the Central Eastern European region and in the Balkans. The new Romanian offshore gas resources and the additional supply of new LNG production facilities are key to balance the missing Russian volumes. Without them the price impact is much higher and more importantly the spread between gas markets would emerge that would necessarily spread over also to the electricity markets, as natural gas-fired power plants are usually the price setting units.

Considering all changes in the global LNG market and European demand, the difference between the timing of the Russian gas phase out boils down to an overall ***10% increase (in the Parliament scenario) or a 12% decrease (in the Commission's proposal scenario)*** in the total wholesale gas procurement cost for the Danube region.

Furthermore, in an early implementation setup a potential Russian response of cutting deliveries to non-EU markets in the Balkans would increase the cost of phasing out gas across Europe by a further €2/MWh.

This means that the Commission's original proposal is a well-designed plan to phase out Russian gas from the EU 27 without placing an excessive financial burden on the EU gas consumers. Even the minor burden is shared equally across Europe, as price increase does not differ between regions.

While modelling the effects of the proposed REPowerEU Roadmap regulation, several assumptions must be made on parameters.

We assumed that Ukraine mostly covers its domestic natural gas demand with own sources. In 2025, concerted and targeted attacks of Russia on the Ukrainian production and storage infrastructure increase the import need of Ukraine. To allow for a financially feasible alternative delivery route for Ukraine from the south, the gas tariffs on the Trans-Balkan route should be reviewed as it has already been on the agenda for some time.

We also assumed that Russia would continue to deliver the contracted gas volumes to Serbia, Bosnia and North Macedonia. Not having these volumes would add an additional demand need in the Balkans and would curb up the modelled price impacts.

On the demand side we adopted a conservative option by using a stagnating demand for future scenarios rather than assuming a continuous sharp decline of EU27 gas consumption. With that we acknowledge the risk that energy efficiency investments and switching away from gas to renewables can also be slower than planned. Any demand side measure, like switching away from gas to alternatives, especially to renewables in the heating sector and in the power sector could further strengthen the resilience to gas supply shocks not only on technical level but in terms of price changes as well.

The Commission's proposal suggests that the Turkish-Bulgarian network point Strandzha-Malkoclar is partly exempted from the regulation, therefore we opted to allow spot flows utilising this network point. Some amendments to the Commission's proposal aim to include this network point in the regulation which would require certification for the gas volumes utilising the Strandzha-Malkoclar point. While the certification of gas is necessary to avoid the relabelling of Russian sources, access to non-Russian gas molecules on the Turkish market is key to mitigate the price impact of the regulation on the Balkans.

The impact of tariff and tariff structure change will probably be one of the topics for discussion in the upcoming years therefore a more detailed analysis is needed on this topic.

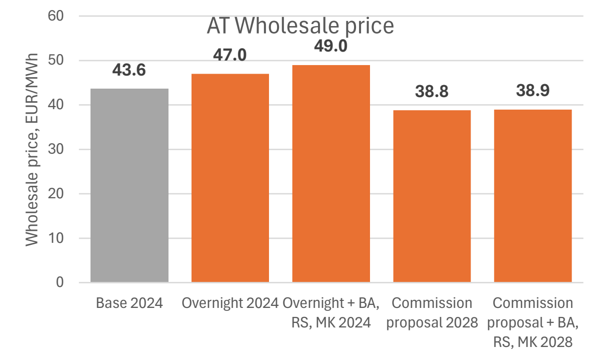
7 ANNEX: COUNTRY FACTSHEETS OF THE DANUBE REGION COUNTRIES

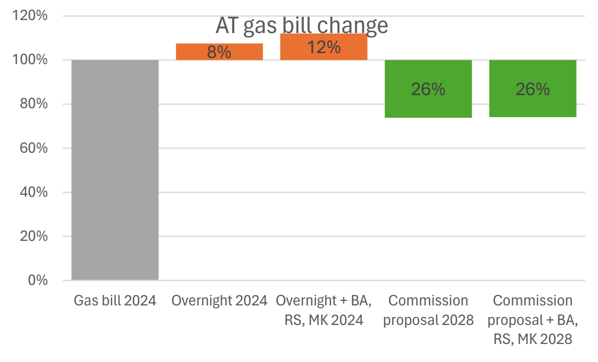
To provide a concise summary of the country-level results a one pager summary is provided for each country, offering an overview of the following indicators:

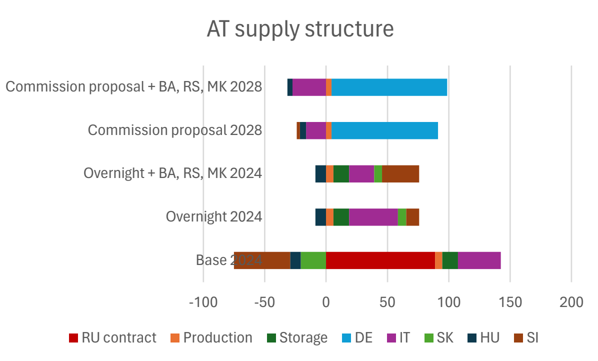
- Modelled yearly average wholesale gas price of the scenarios (€/MWh), in the core modelling setup (JP=40€/MWh, with reference demand)
- The country level gas bill change, modelled 2024=100% (%) calculated as wholesale price times the consumption
- The supply structure of each country for the scenarios in the core modelling setup (JP=40€/MWh, with reference demand) and historical baseline of 2024 (TWh/yr)
- The supply structure change from 2024 to 2028 in the REPowerEU scenario as proposed by the Commission in the core modelling setup (JP=40€/MWh, with reference demand) (TWh/yr)
- The monthly storage stock for the scenarios in the core modelling setup (JP=40€/MWh, with reference demand) (TWh/yr)
- The modelled TSO revenue change for the scenarios in the core modelling setup (JP=40€/MWh, with reference demand) (%) -compared to modelled baseline in 2024 calculated as the tariff times the flows, where tariffs do not change between years
- The decomposition of price change for the scenarios to changes in all sensitivity setups to market and regulation effects (€/MWh)

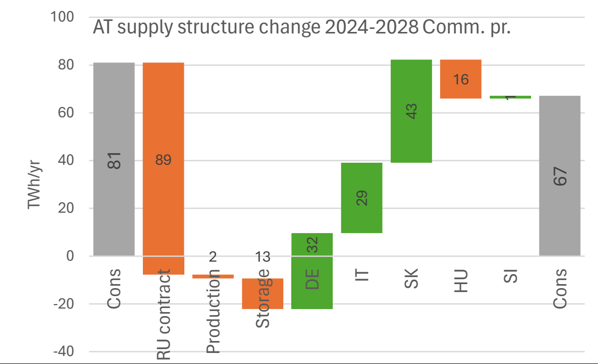
Finally, we provide a short text summary of these key indicators, focusing on the results of the REPowerEU scenario in the core modelling setup (JP=40€/MWh, with reference demand) as this scenario most closely resembles today's market setup and the scenario is closest to the provisionally agreed text of the Regulation. NOTE: As the modelling assumes that the storage obligation is in place, the storage target is always met, therefore we do not repeat on each text that storage utilization is high.

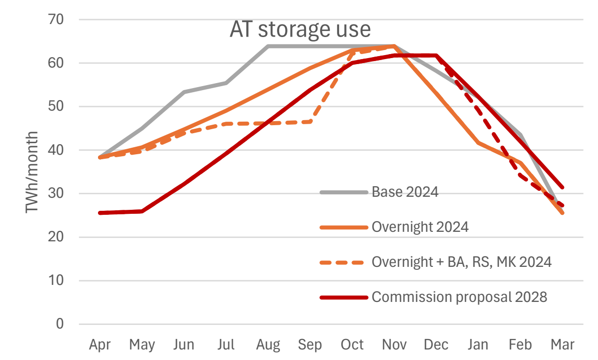
7.1 AUSTRIA

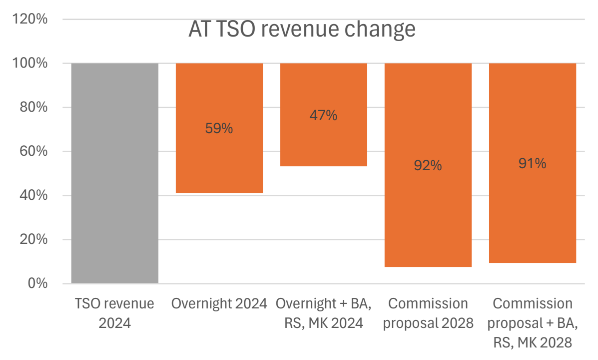


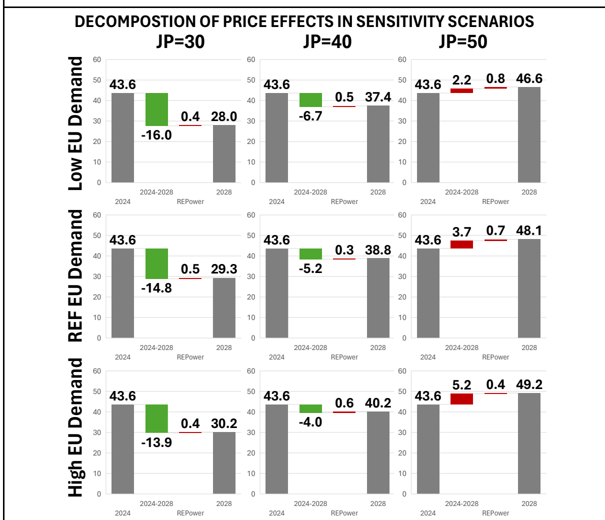












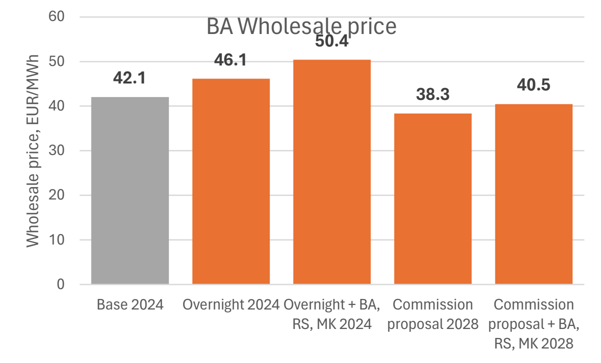
The price effect of implementing the REPowerEU Roadmap in Austria by 2028 results in a price increase ranging from 0.3 to 0.8 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Austria is 0.3 EUR/MWh.

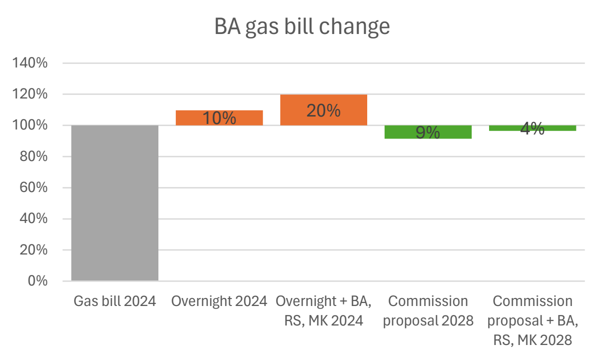
From 2024 to 2028, Austrian gas demand drops by 11%, and the modelled wholesale price drops from 47 EUR/MWh to 38.8 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall -26% decrease in the total wholesale gas procurement cost for Austria.

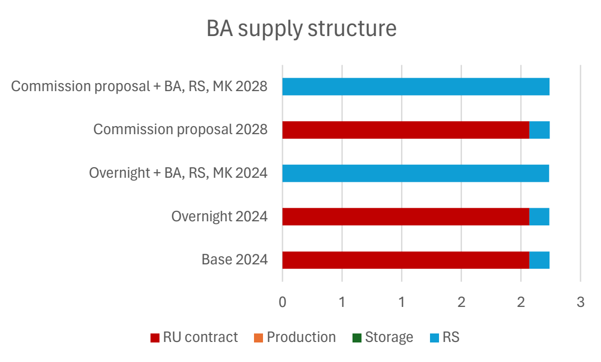
In our baseline 2024 scenario Austria still had a long term contract with Russia, which was actually terminated in the third quarter of 2024. The supply structure in Austria changed substantially. The Russian contract former delivered via the Ukrainian route disappeard and in 2028 is being replaced by spot flows via Italy and Germany, while exports from Austria towards Slovenia and Slovakia decrease or diminsh.

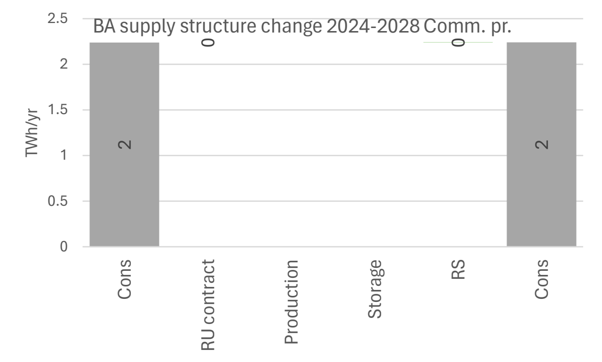
Furthermore, the transit of Russian gas disappears resulting in lower utilisation of the transmission system and reducing TSO revenues by 92%.

7.2 BOSNIA AND HERZEGOVINA









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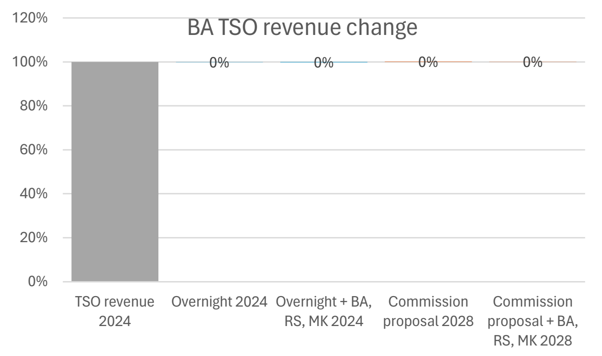
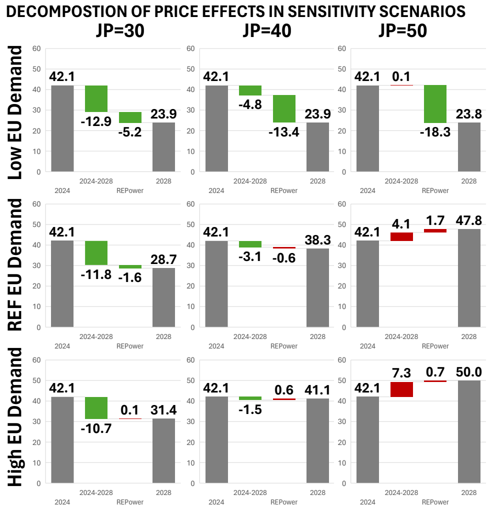


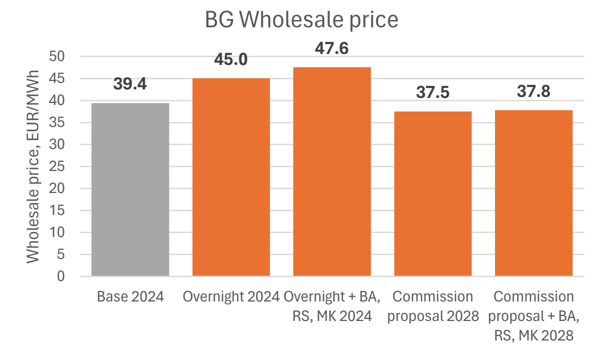


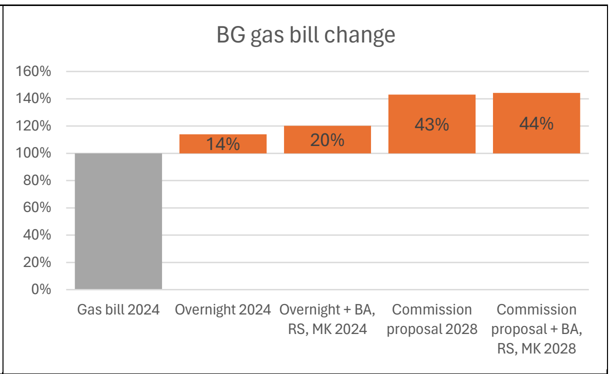
The price effect in Bosnia of implementing the REPowerEU Roadmap in the EU countries by 2028 results in a price increase ranging from -18.3 to 1.7 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Bosnia is -0.6 EUR/MWh.

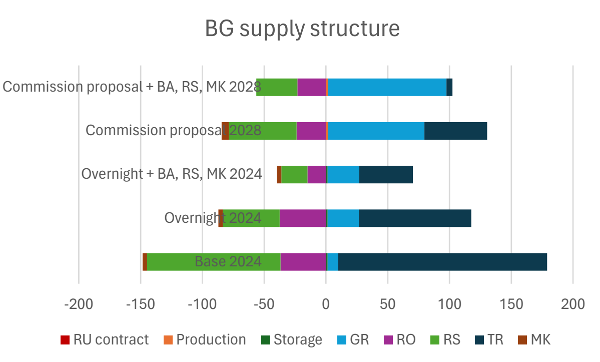
From 2024 to 2028, Bosnian gas demand was assumed to remain unchanged, and the modelled wholesale price drops from 42.1 EUR/MWh to 38.3 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall -9% decrease in the total wholesale gas procurement cost for Bosnia.

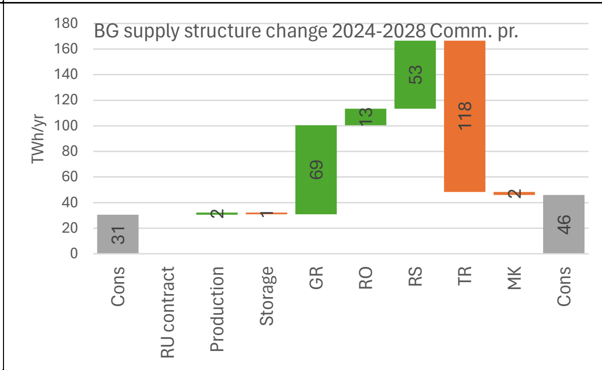
In our baseline 2024 scenario Bosnia still has a long term contract with Russia. Bosnia is not a member of the EU and the REPowerEU Roadmap does not imply prohibition for non-EU countries. Furthermore Bosnia is a landlocked country supplied by a Russian contract via the only existing interconnection point from Serbia. The TSO revenues are not impacted by the prohibition of Russian gas in the EU. Bosnia does not have any storage facility.

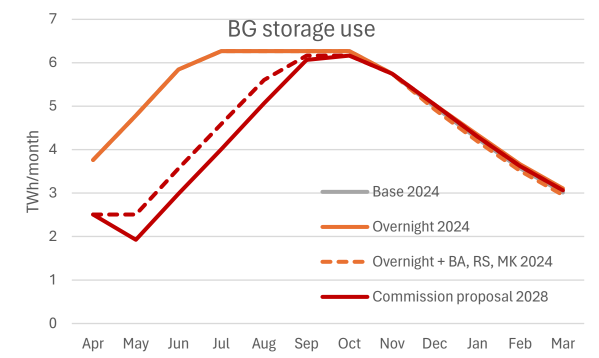
7.3 BULGARIA

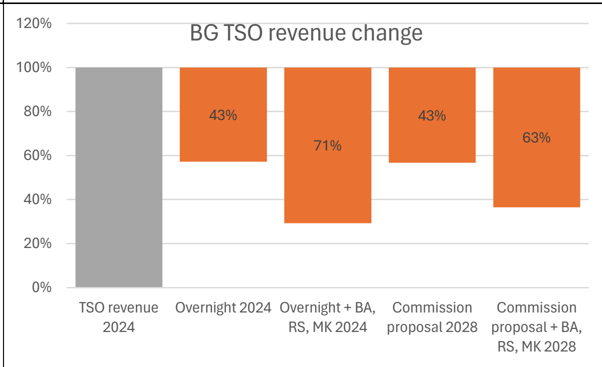


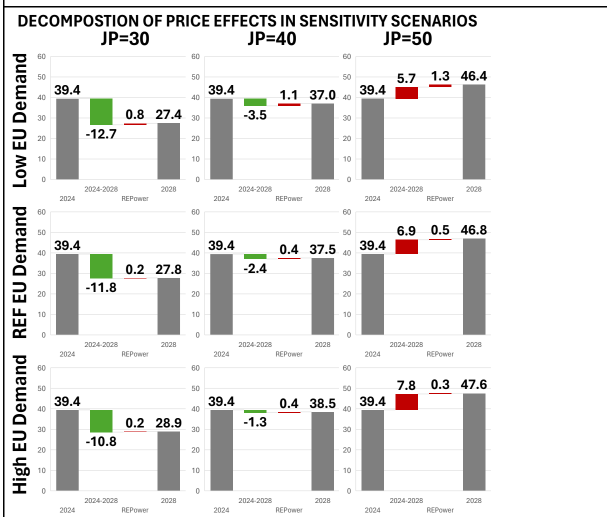










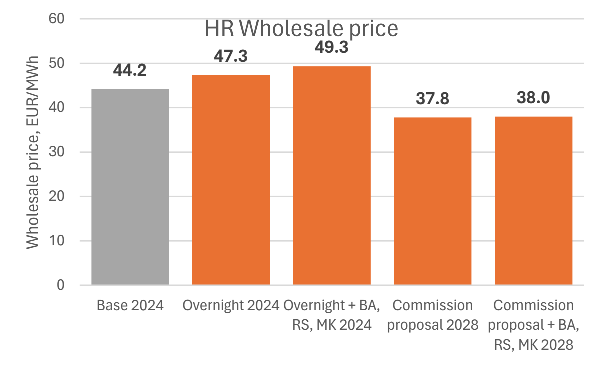


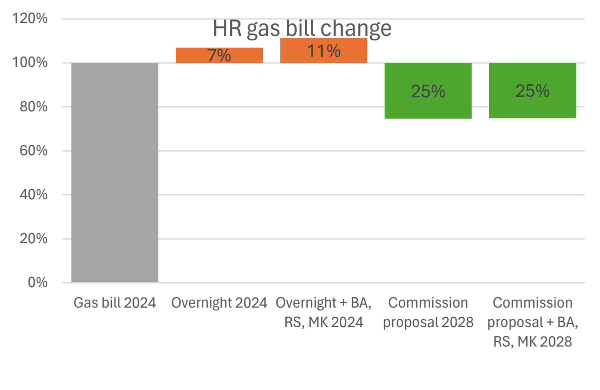
The price effect of implementing the REPowerEU Roadmap in Bulgaria by 2028 results in a price increase ranging from 0.2 to 1.3 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Bulgaria is 0.4 EUR/MWh.

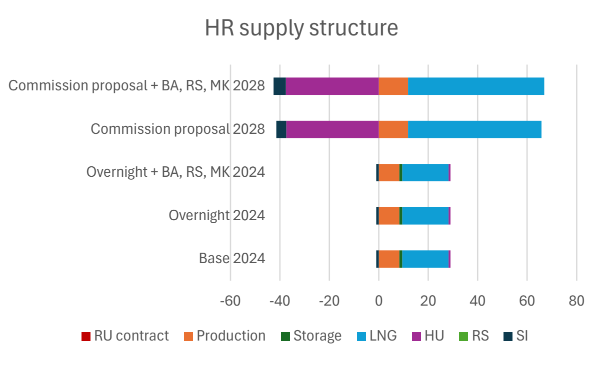
From 2024 to 2028, Bulgarian gas demand grows by 50% (due to planned coal phase out), but at the same time the modelled wholesale price drops from 39.4 EUR/MWh to 37.5 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 43% increase in the total wholesale gas procurement cost for Bulgaria.

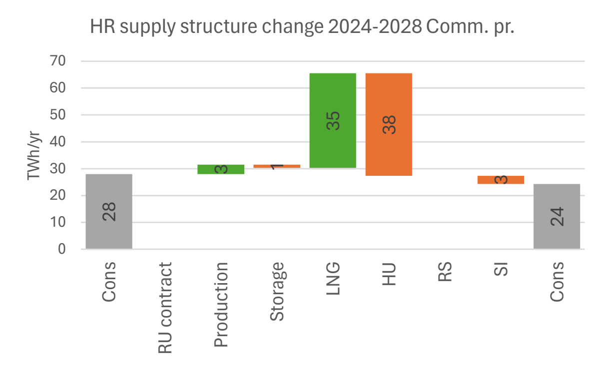
Bulgaria has no longer a Russian gas supply contract. Still, the supply structure in Bulgaria changes substantially as Russian LTC pipeline gas which transited from Turkey to Serbia is replaced by alternative sources, mainly LNG from Greece, and piped gas from Romania. The balance is supported by less spot deliveries to Serbia. The drop in shipped volumes results in lower utilisation of the transmission system and reducing TSO revenues by 43%.

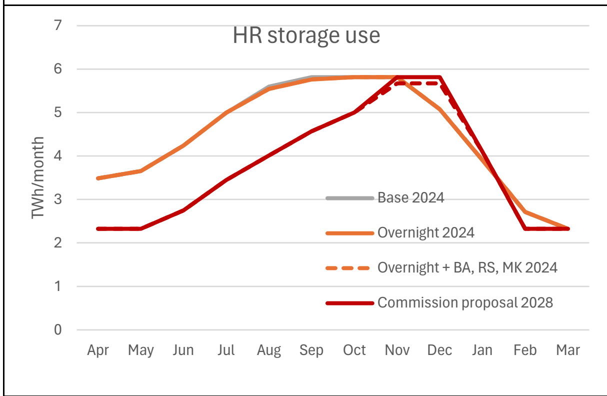
7.4 CROATIA

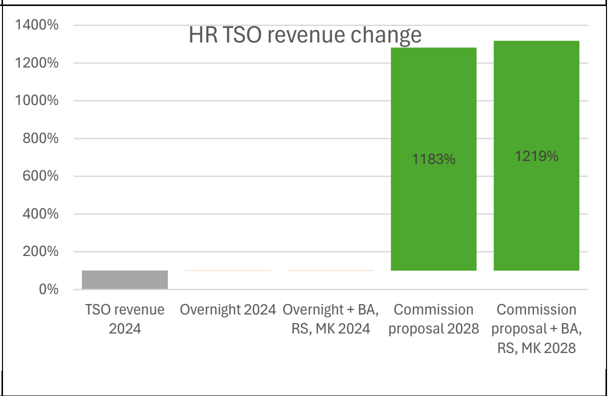


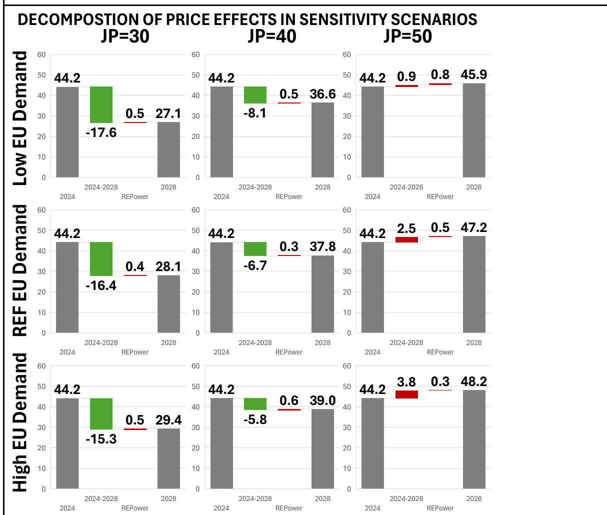










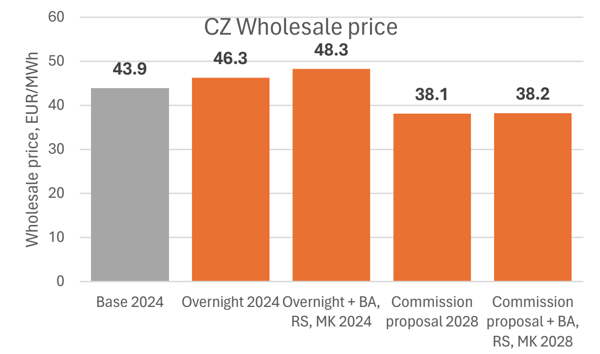


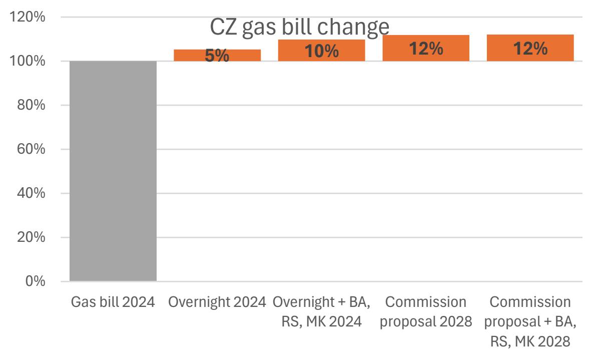
The price effect of implementing the REPowerEU Roadmap in Croatia by 2028 results in a price increase ranging from 0.3 to 0.8 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Croatia is 0.3 EUR/MWh.

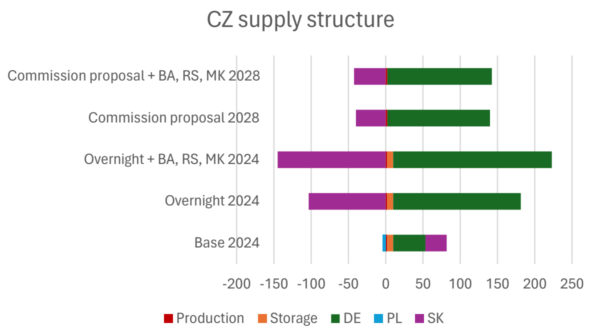
From 2024 to 2028, Croatian gas demand drops by -13%, and the modelled wholesale price drops from 44.2 EUR/MWh to 37.8 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall -25% decrease in the total wholesale gas procurement cost for Croatia.

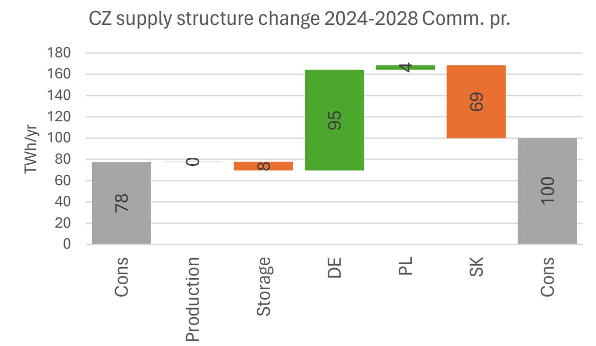
The supply structure in Croatia does not change substantially as Russian pipeline gas is replaced by alternative sources, as Croatia is already supplied by own production and LNG. However with the Russian gas phase out from Europe and the same time extension of the capacities of the Krk LNG terminal the exports to Hungary and Slovenia increase substantially. The increase in transited volumes result in better utilisation of the transmission system and increases TSO revenues by over 1000% despite the reduction of consumption in the domestic market.

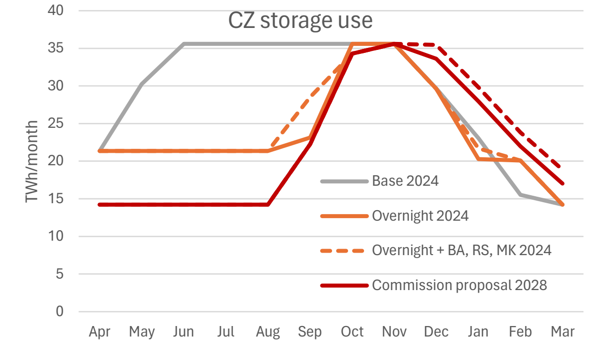
7.5 CZECHIA

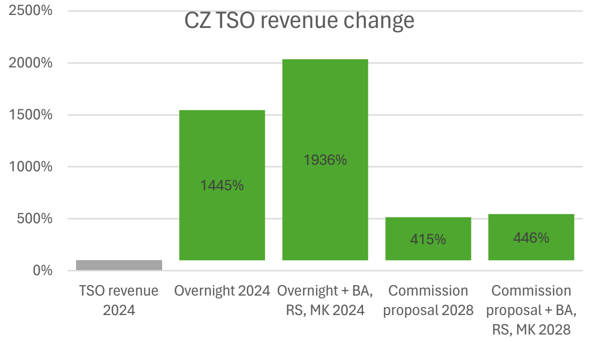


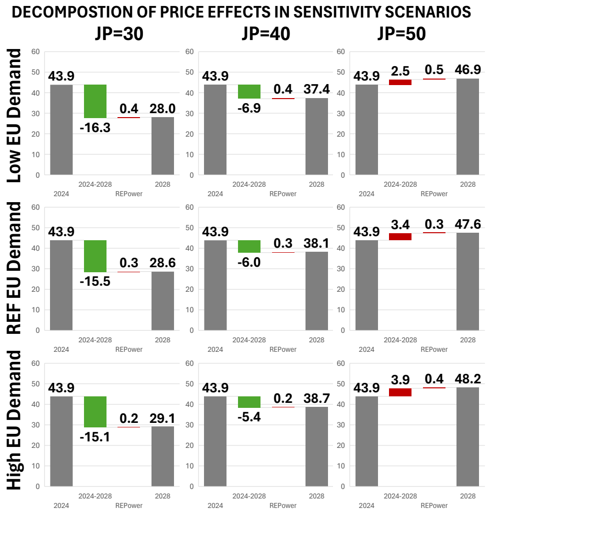










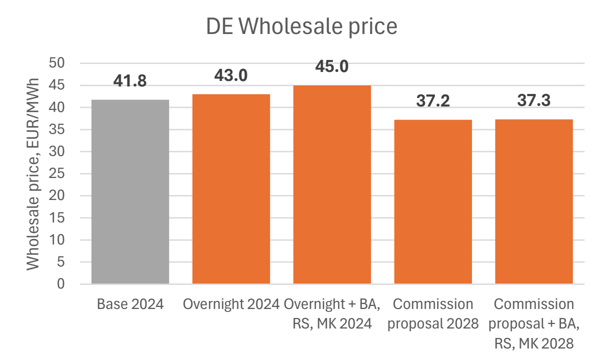


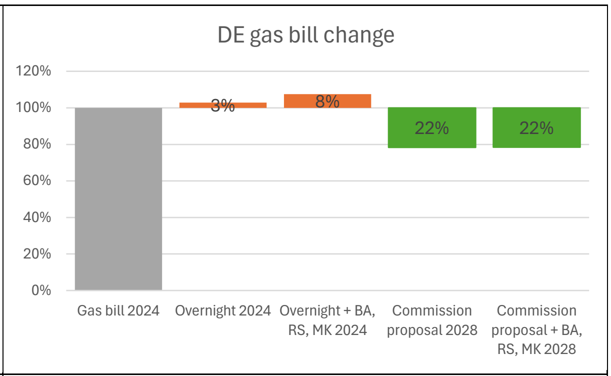
The price effect of implementing the REPowerEU Roadmap in the Czech Republic by 2028 results in a price increase ranging from 0.2 to 0.5 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for the Czech Republic is 0.3 EUR/MWh.

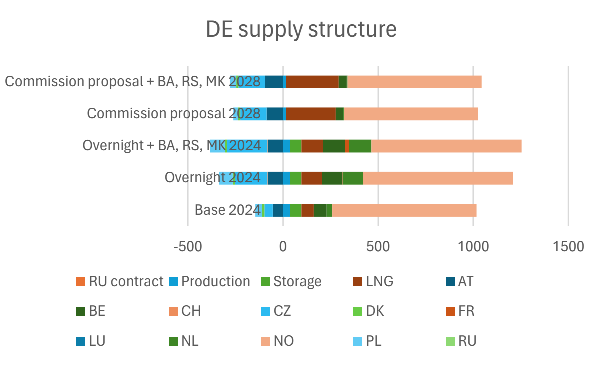
From 2024 to 2028, Czech gas demand grows by 29%, mainly due to decarbonisation of the power sector. The modelled wholesale price drops from 43.9 EUR/MWh to 38.1 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 12% increase in the total wholesale gas procurement cost for the Czech Republic.

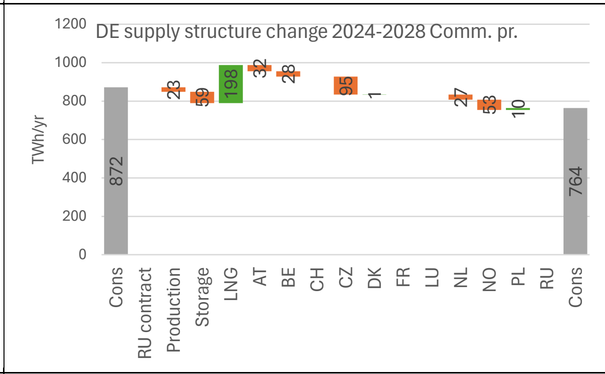
The transit role of the Czech Republic is highly enhanced in the future, as spot flows from Germany to Slovakia and further are using the Czech network. TSO revenues are expected to grow by over 400%. The Czech Republic stopped importing gas from Gazprom in 2022.

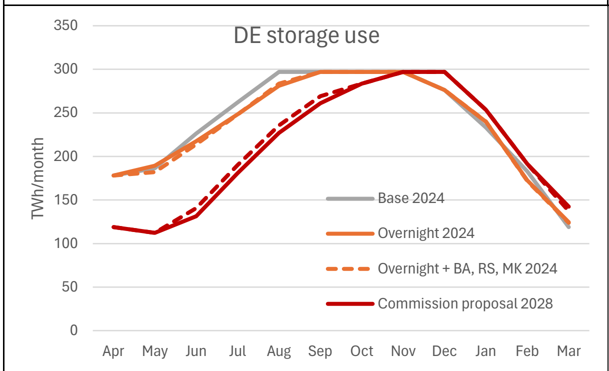
7.6 GERMANY

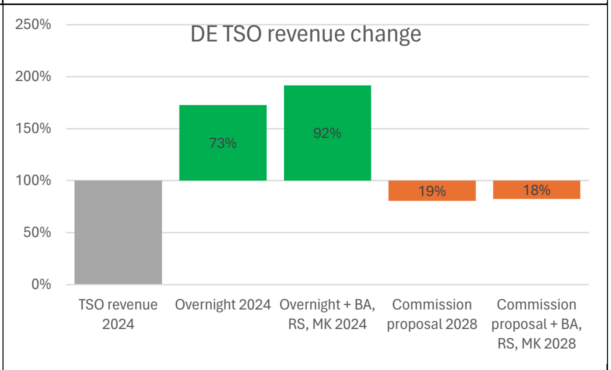


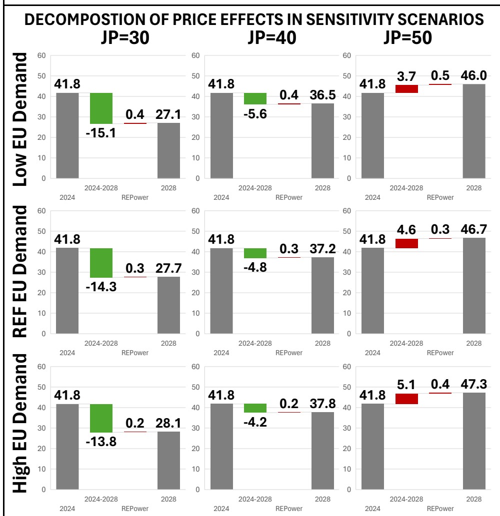












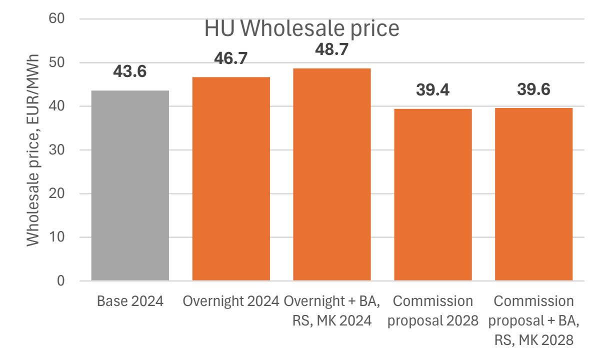
The price effect of implementing the REPowerEU Roadmap in Germany by 2028 results in a price increase ranging from 0.2 to 0.5 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Germany is 0.3 EUR/MWh.

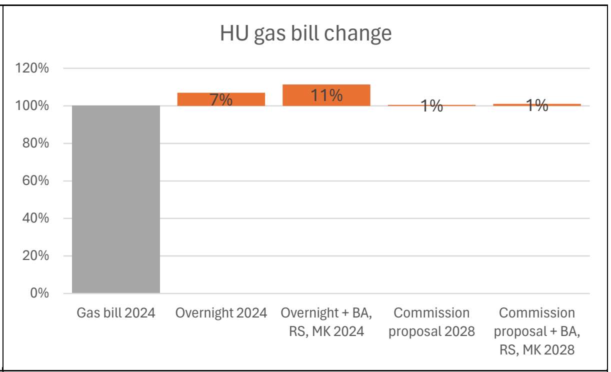
From 2024 to 2028, German gas demand decreases by 12%, and the modelled wholesale price drops from 41.8 EUR/MWh to 37.2 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 22% decrease in the total wholesale gas procurement cost for Germany.

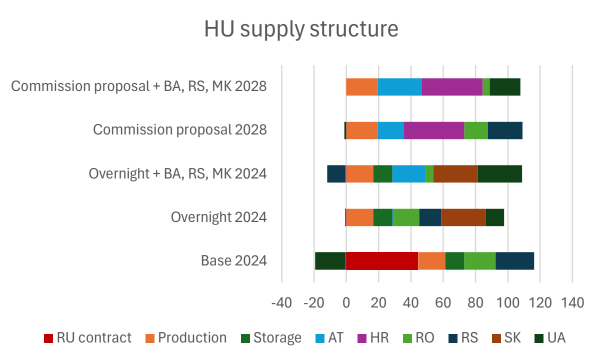
The supply structure in Germany changes substantially as more LNG is imported and shipped to land-locked countries in Central Eastern Europe. Flows towards Austria and the Czecz Republic nearly double from 2024 to 2028. Germany stopped importing Russian gas in September 2022 when the Nord Stream pipeline explosion took place.

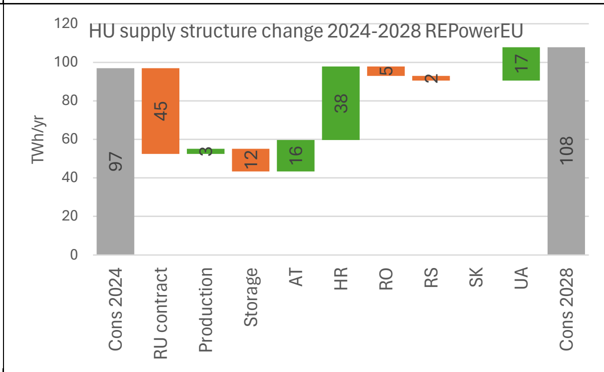
The lower gas demand and the restructured flow patterns result in a 19% lower revenue stream for the TSO.

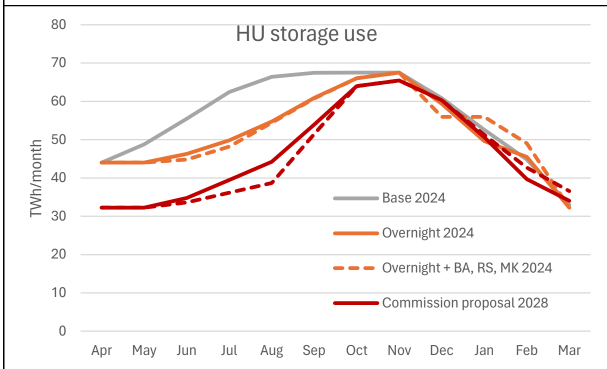
7.7 HUNGARY

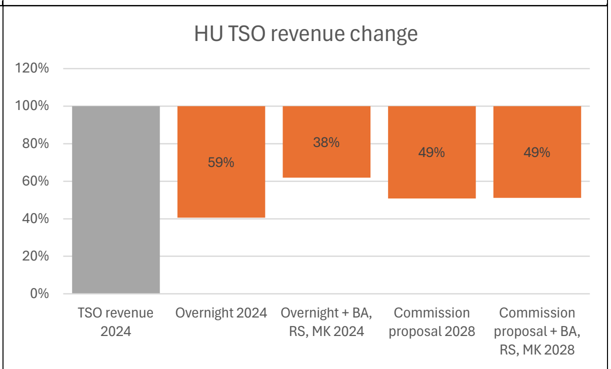


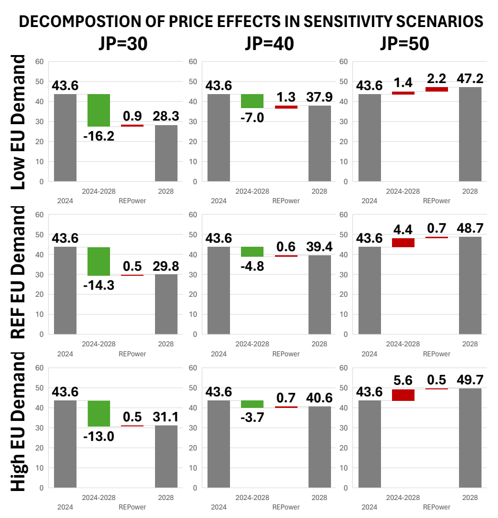












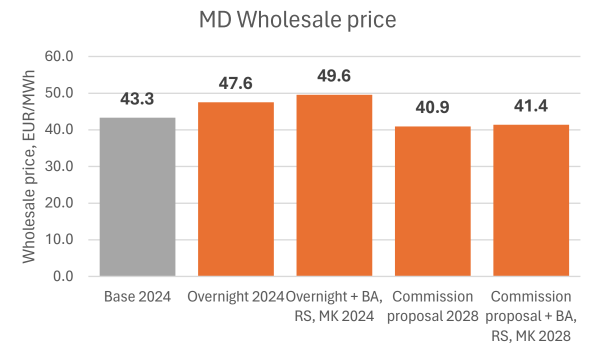
The price effect of implementing the REPowerEU Roadmap in Hungary by 2028 results in a price increase ranging from 0.5 to 2.2 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Hungary is 0.6 EUR/MWh.

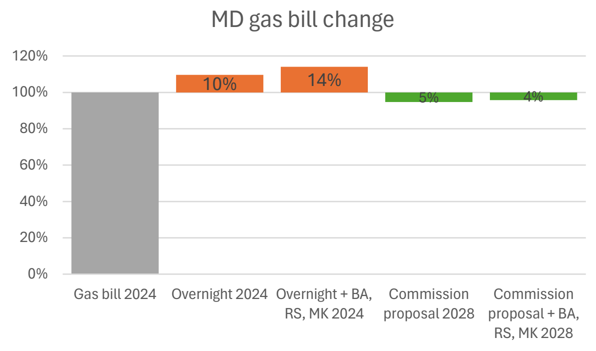
From 2024 to 2028, Hungarian gas demand grows by 11%, and the modelled wholesale price drops from 43.6 EUR/MWh to 39.4 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 1% increase in the total wholesale gas procurement cost for Hungary.

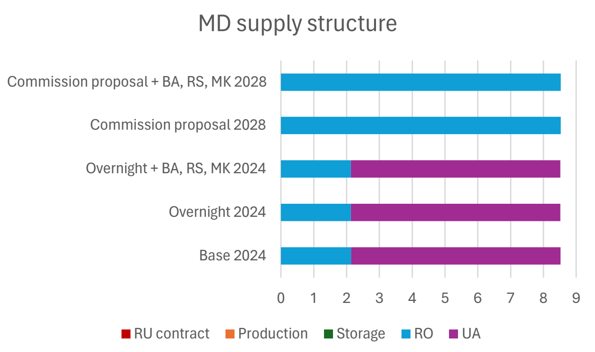
The supply structure in Hungary changes substantially as Russian pipeline gas is replaced by alternative sources. The Russian contract delivered via the Serbian route disappears being replaced by spot flows via Croatia (LNG) and Austria, while exports from Hungary towards Ukraine diminish.

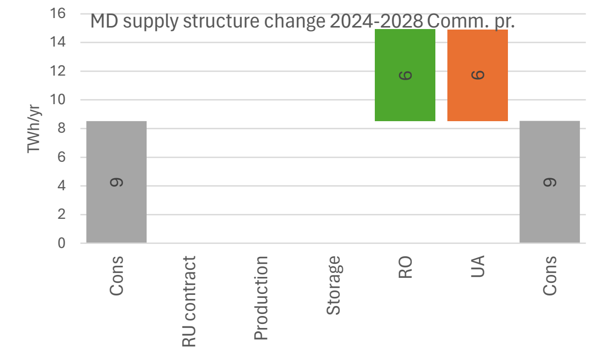
Furthermore, the transit of Russian gas to Slovakia via Hungary disappears resulting in lower utilisation of the transmission system and reducing TSO revenues by 49%.

7.8 MOLDOVA









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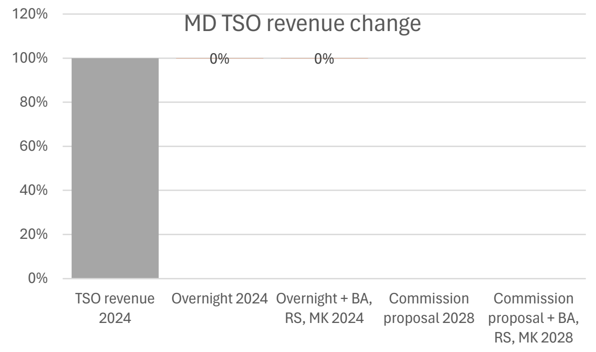
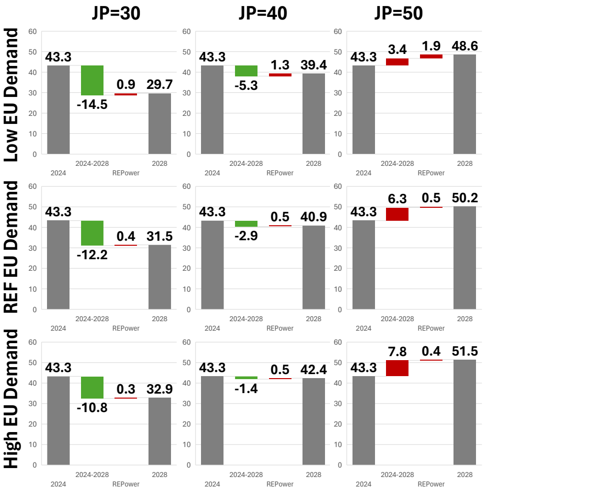


DECOMPOSTION OF PRICE EFFECTS IN SENSITIVITY SCENARIOS



The price effect of the REPowerEU Roadmap in Moldova by 2028 results in a price increase ranging from 0.3 to 1.9 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Moldova is 0.5 EUR/MWh.

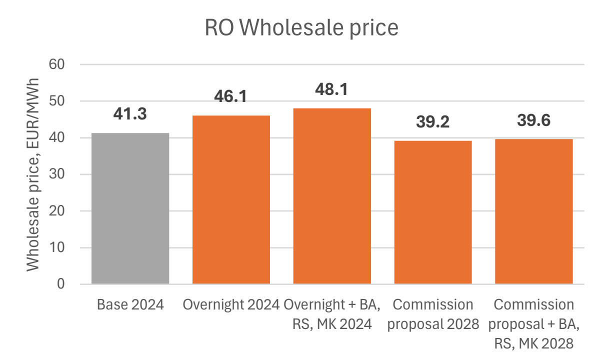
From 2024 to 2028, Moldovan gas demand was assumed to stagnate, and the modelled wholesale price drops from 43.3 EUR/MWh to 40.9 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 5% increase in the total wholesale gas procurement cost for Moldova.

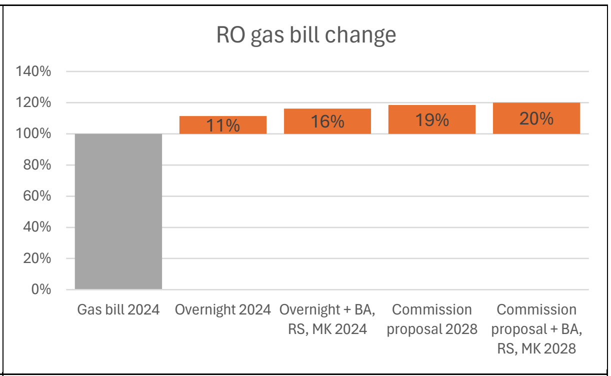
The supply structure in Moldova changes to some extent by shifting the main source of import from Ukrainian entry points to the Romanian entry point.

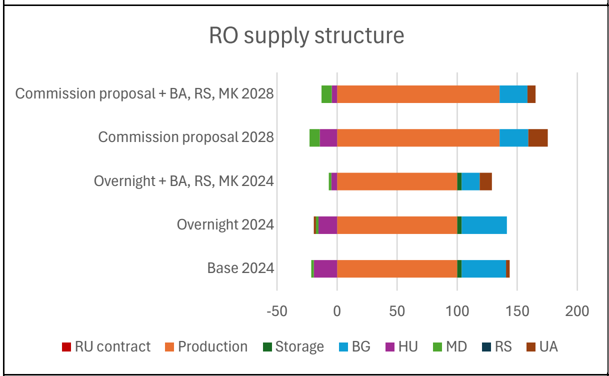
There is no storage facility in Moldova.

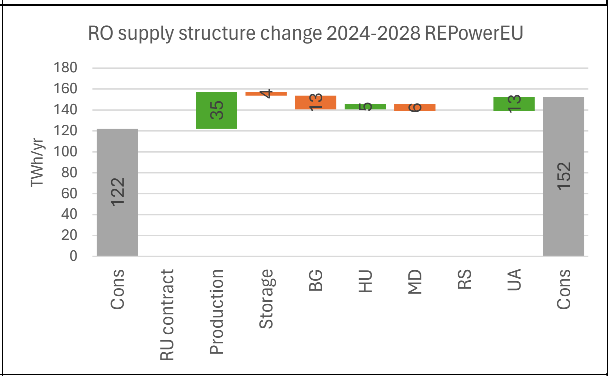
TSO revenues are unaffected.

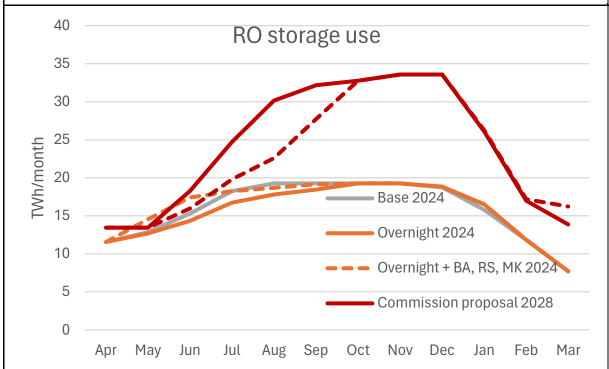
7.9 ROMANIA

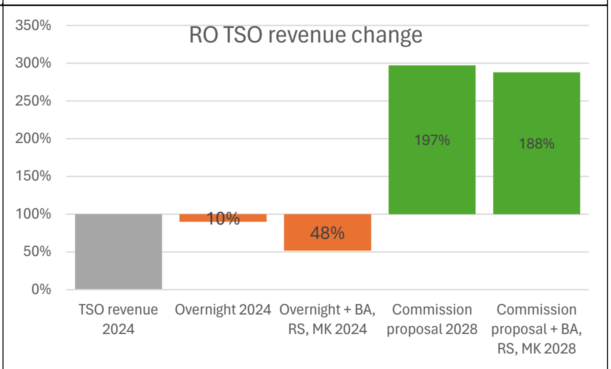


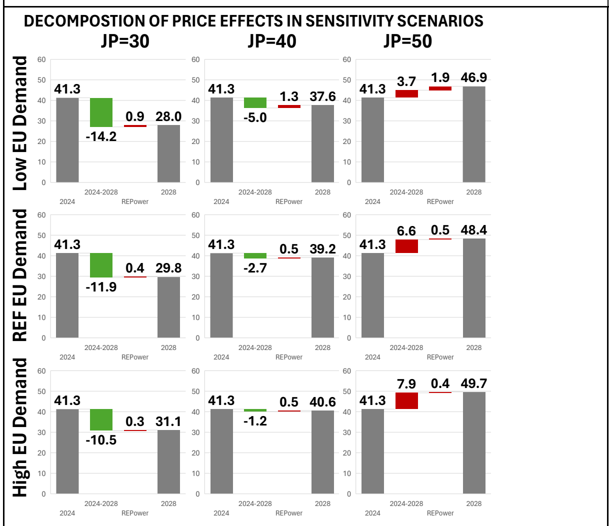












The price effect of implementing the REPowerEU Roadmap in Romania by 2028 results in a price increase ranging from 0.3 to 1.9 EUR/MWh, depending on global market and European demand scenarios. In the central scenario, the price effect for Romania is 0.5 EUR/MWh.

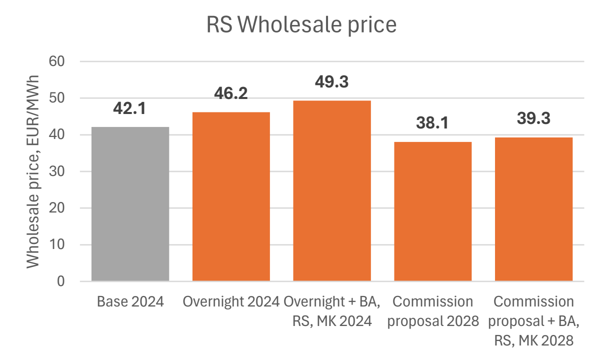
From 2024 to 2028, Romanian gas demand grows by 25%, and the modelled wholesale price drops from 41.3 EUR/MWh to 39.2 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 19% increase in the total wholesale gas procurement cost for Romania.

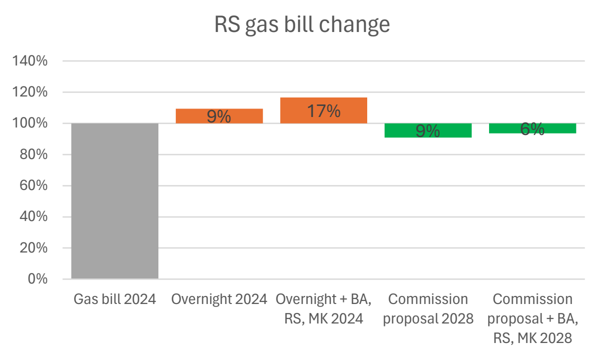
The supply structure in Romania changes to some extent as new offshore gas production comes online. The additional produciton is mainly consumed in Romania, but some is exported to the neighbouring Hungary and Moldova. Romania stopped importing Russian pipeline gas in 2021.

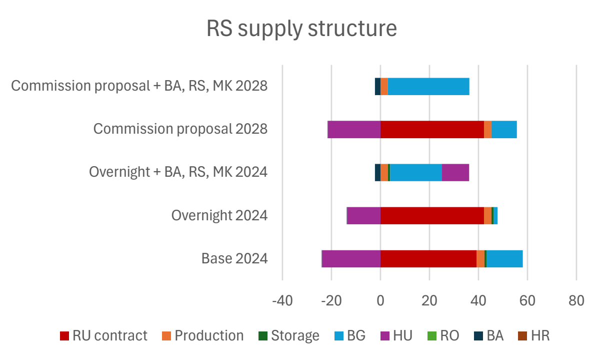
The storage obligation is still assumed for 2028, resulting in high utilisation of existing infra-structure.

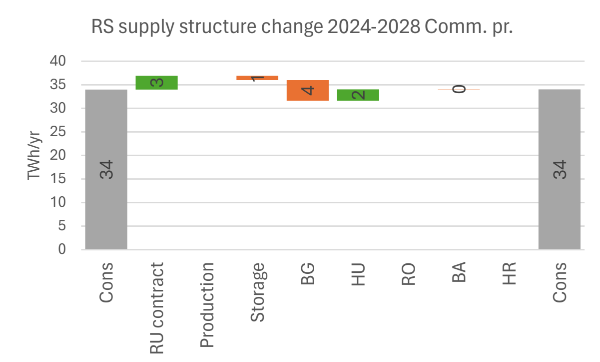
Increased production and flows on the network result in higher TSO revenues.

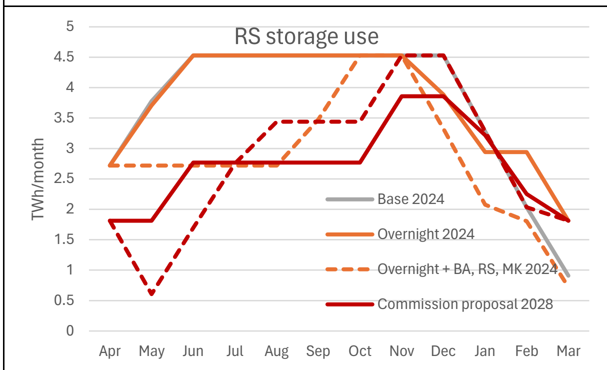
7.10 SERBIA

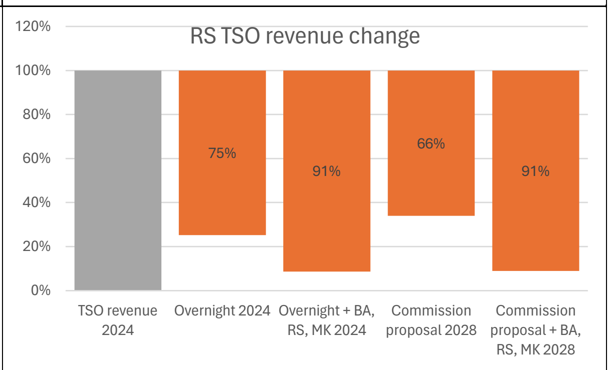


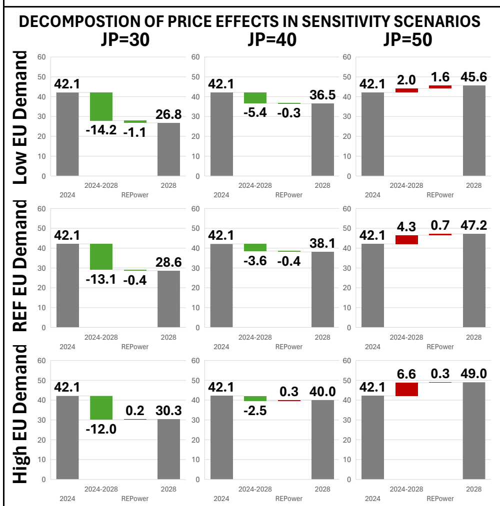












The price effect of implementing the REPowerEU Roadmap in Serbia by 2028 results in a price change ranging from -1.1 to 1.6 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Serbia is -0.4 EUR/MWh.

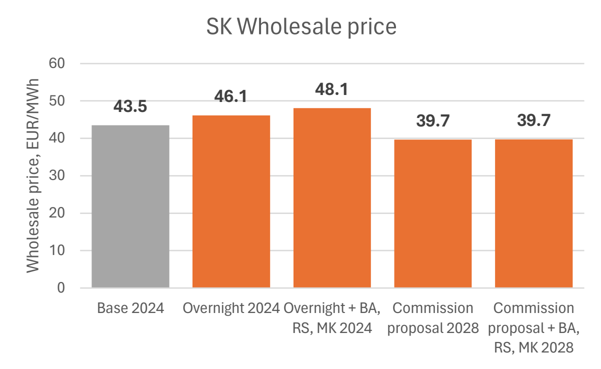
From 2024 to 2028, Serbian gas demand is considered to stagnate, and the modelled wholesale price drops from 42.1 EUR/MWh to 38.1 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 9% decrease in the total wholesale gas procurement cost for Serbia. Even with the Russian response scenario triggered, Serbian gas bill would drop by 6%.

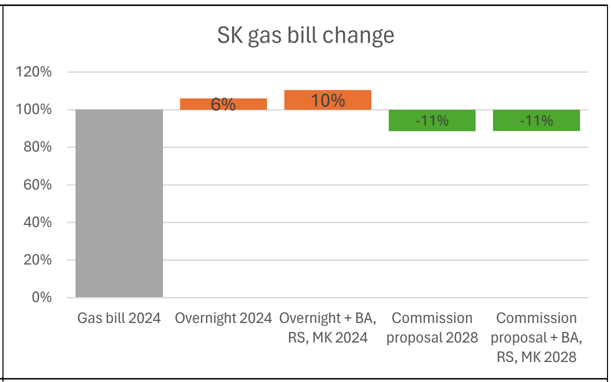
The supply structure in Serbia is unaffected in the REPowerEU scenario, as the regulation does not apply to Serbia. However, if the Russian response scenario is triggered, Russian long-term contracted volumes are replaced by alternative flows from Bulgaria.

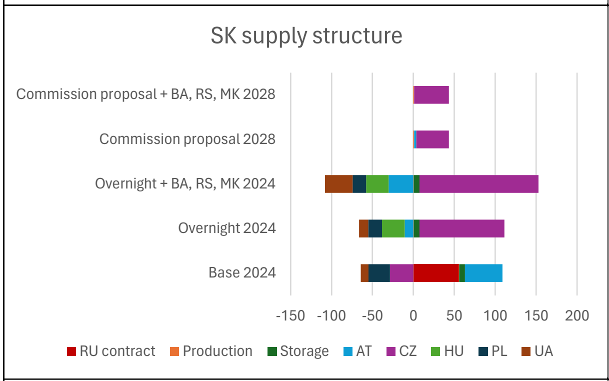
Serbian storages help keep up the seasonal balance.

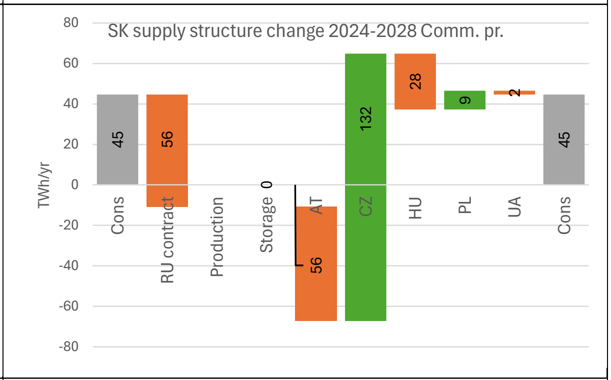
Furthermore, due to the loss of Russian gas transit to Hungary revenues of the TSO decrease by 66%.

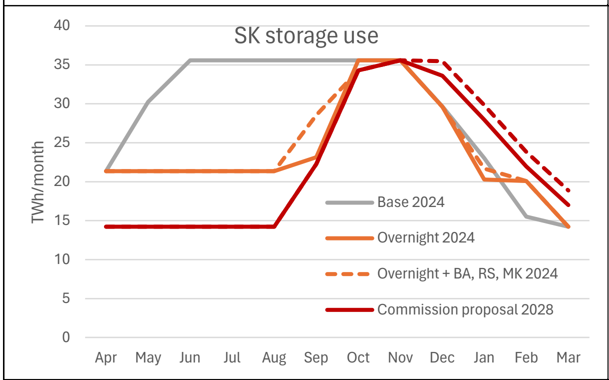
7.11 SLOVAKIA

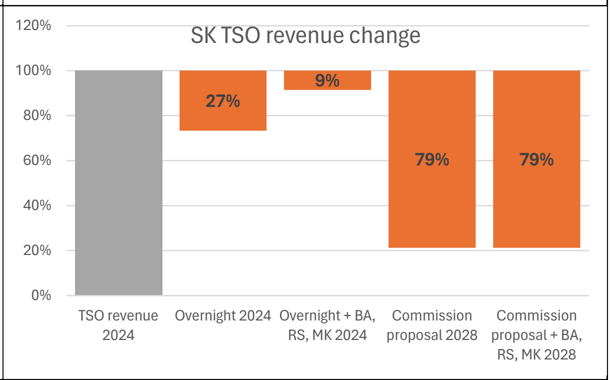


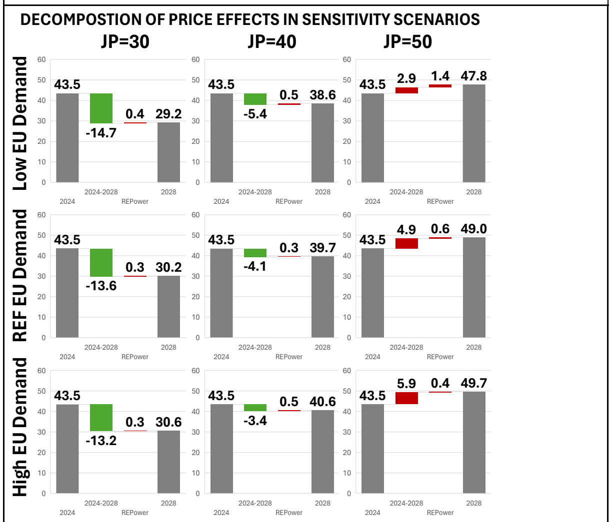












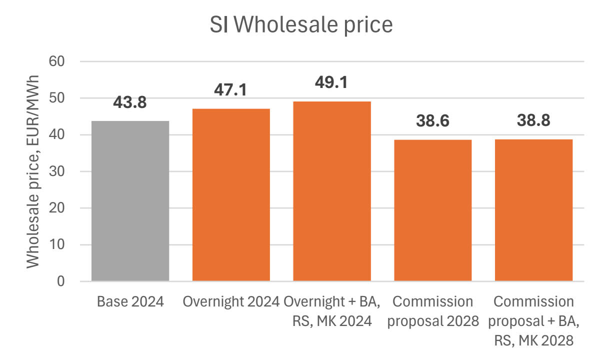
The price effect of implementing the REPowerEU Roadmap in Slovakia by 2028 results in a price increase ranging from 0.3 to 1.4 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Slovakia is 0.3 EUR/MWh.

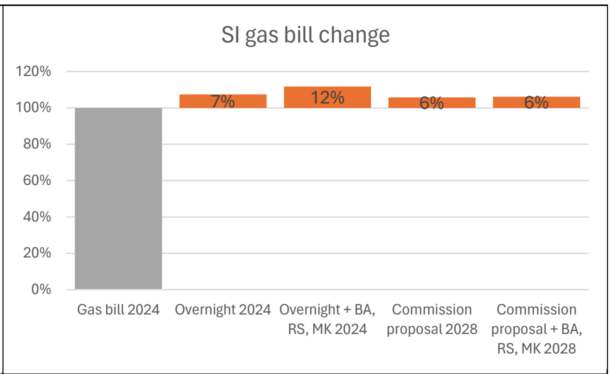
From 2024 to 2028, Slovakian gas demand drops by 3%, and the modelled wholesale price drops from 43.5 EUR/MWh to 39.7 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 11% decrease in the total wholesale gas procurement cost for Slovakia.

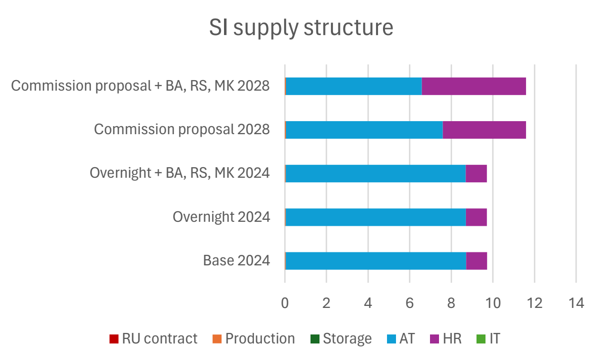
The supply structure in Slovakia changes substantially as Russian pipeline gas is replaced by alternative sources. The Russian contract delivered via the Serbian and Hungary disappears being replaced by spot flows via Czech Republic Poland. At the same time transit to Austria and exports to Hungary and Ukraine drop.

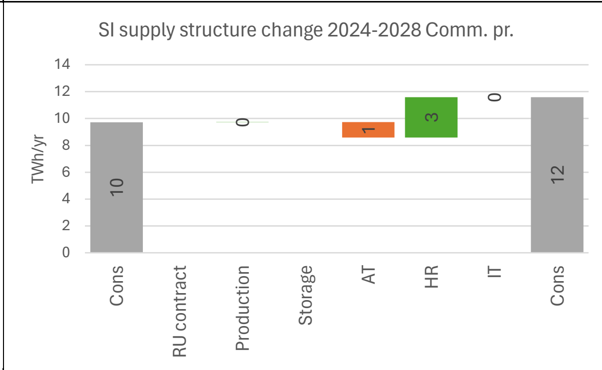
Furthermore, the transit of Russian gas to Austria (in 2024) via Slovakia disappears resulting in lower utilisation of the transmission system and reducing TSO revenues by 79%

7.12 SLOVENIA

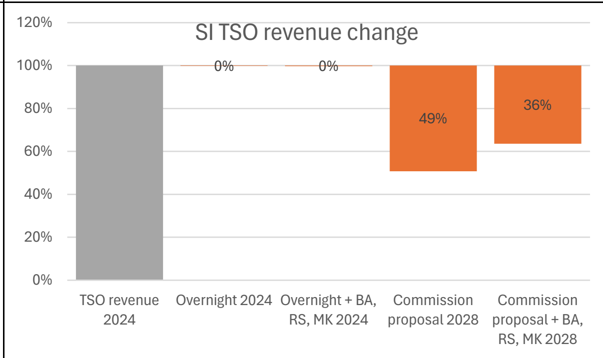


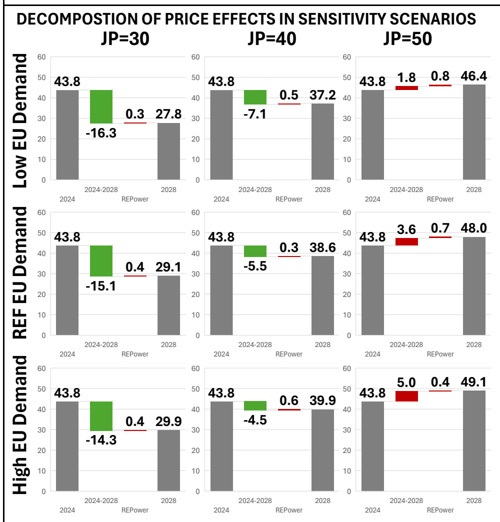






No storages





The price effect of implementing the REPowerEU Roadmap in Slovenia by 2028 results in a price increase ranging from 0.3 to 0.8 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Slovenia is 0.3 EUR/MWh.

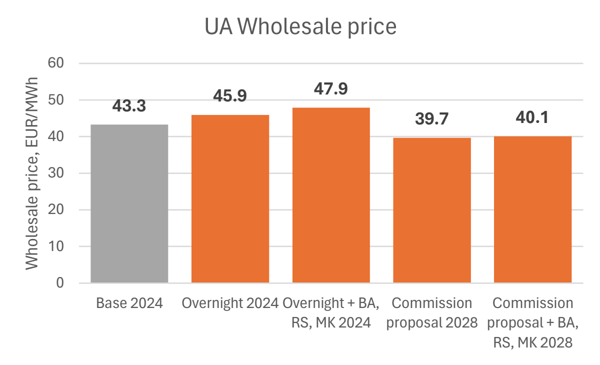
From 2024 to 2028, Slovenian gas demand grows by 19%, and the modelled wholesale price drops from 43.8 EUR/MWh to 38.6 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 6% increase in the total wholesale gas procurement cost for Slovenia.

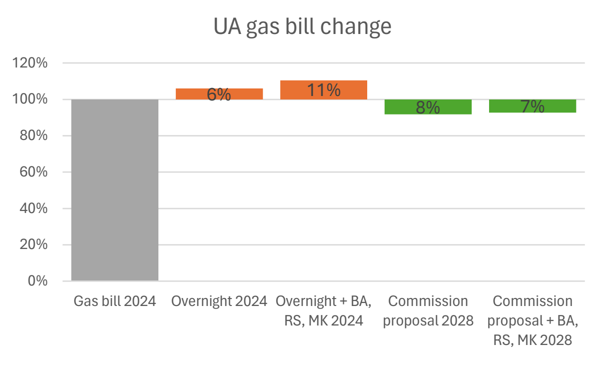
Russian pipeline gas deliveries to Slovenia stopped already in 2022. The main flow direction is from Austria. To 2028, increased flows from Croatian LNG are expected.

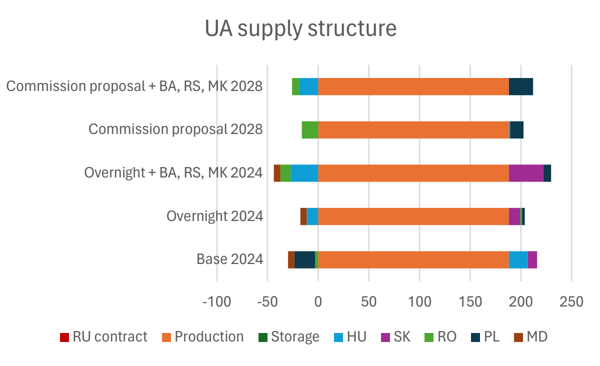
There is no storage facility in Slovenia.

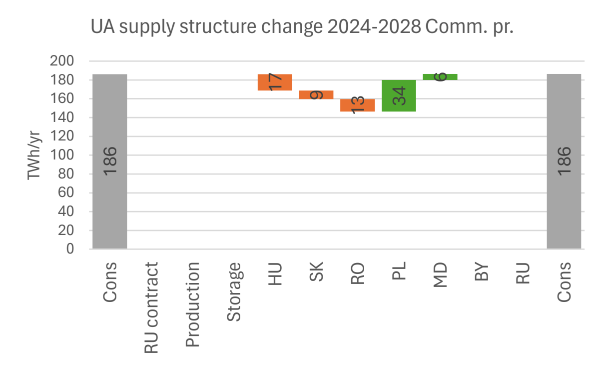
TSO revenues are reduced by 45% due to the changing flow patterns.

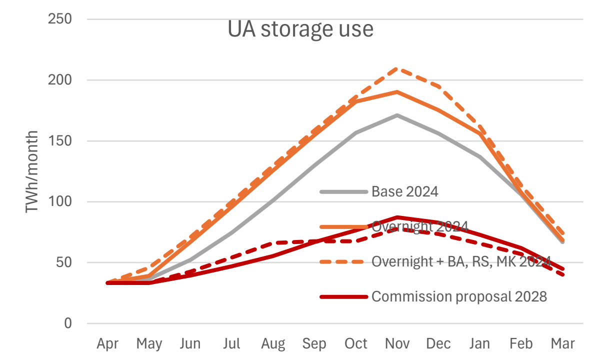
7.13 UKRAINE

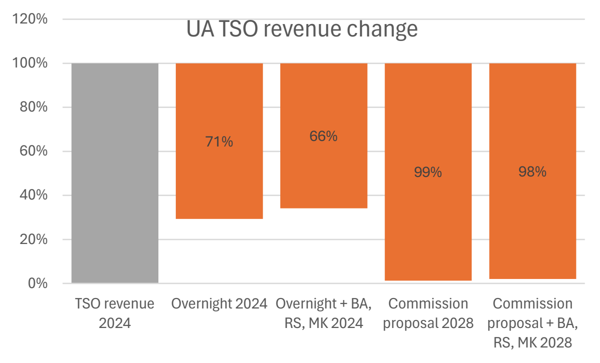


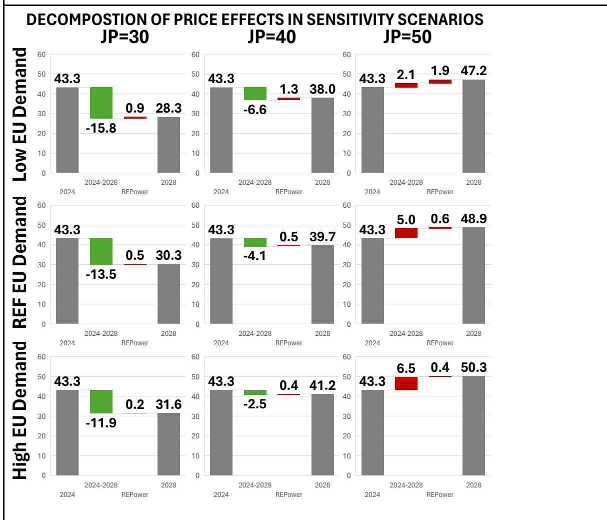












The price effect of the REPowerEU Roadmap for Ukraine by 2028 results in a price increase ranging from 0.5 to 1.9 EUR/MWh, depending on global market and European demand scenarios. In our central scenario, the price effect for Ukraine is 0.5 EUR/MWh.

From 2024 to 2028, we assumed no change in Ukrainian gas consumption and the modelled wholesale price drops from 43.3 EUR/MWh to 39.7 EUR/MWh. Considering all changes in the global LNG market and European demand, this results in an overall 8% decrease in the total wholesale gas procurement cost for Ukraine.

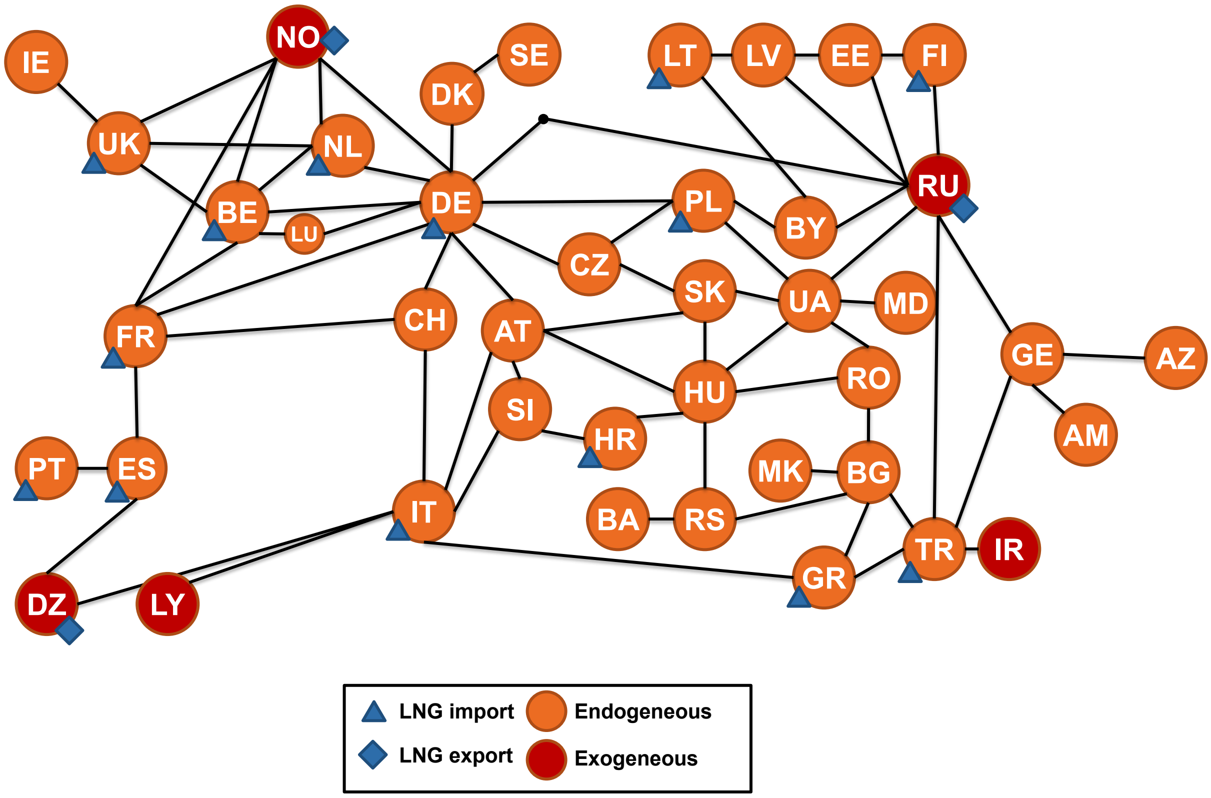
The supply structure in Ukraine is not changed greatly, as the consumption is mainl covered by own production. Increased flows are modelled from Poland replacing the spot volumes from Hungary, Romania and Slovakia.

TSO revenues are greatly reduced, as own production of gas is covering the demand and no major transit flows occur on the system.

8 ANNEX: 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 29. 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.