entsog
european network
of transmission system operators
for gas

ENTSOG
SUMMER SUPPLY OUTLOOK

2024

WITH WINTER 2024/25 OVERVIEW

Contents

Executive Summary 3
Conclusions 6
1. INTRODUCTION 8
2. ASSUMPTIONS 8
2.1. Infrastructure 9
2.2. Demand 9
2.3. Supply 12
2.4. Storage inventory 15
3. MODELLING RESULTS FOR THE SUMMER SUPPLY OUTLOOK 2024 17
3.1. Reference summer scenario - 90% storage target by 30 September 2024 17
3.2. Summer supply dependence assessment – supply disruption from RU 21
3.3. Summer supply dependence assessment under LNG Low Scenario 24
4. MODELLING RESULTS FOR THE WINTER 2024/25 OVERVIEW 27
4.1. Reference winter scenario – same as initial storage target by 31 March 2025 27
4.2. Winter supply dependence assessment – supply disruption from Russia 30
4.3. Winter supply dependence assessment under LNG Low Scenario 33
Legal Notice 35
Annex A: UGS 36
Annex B: Demand, National Production, Supply Potential and Export 37
Annex C: Modelling approach 38
Annex D: Curtailment Rate Results 39
Abbreviations 40

Executive Summary

In line with Art. 8(3)(f) of Regulation (EC) 715/2009, ENTSOG has undertaken an assessment of the European gas network for the upcoming summer (1 April 2024 to 30 September 2024). Reaching a minimum filling level in the European gas storage facilities at the end of the summer season is essential to ensure security of supply in the winter. Therefore, the analysis investigates the possible evolution of the gas supply as well as the ability of the gas infrastructures to meet the demand, exports, and the storage injection needs during summer 2024.

Furthermore, following the interest expressed by institutions and stakeholders, ENTSOG has run an overview analysis for the winter 2024/25 season. The analysis investigates the possible evolution of supplies and UGS inventory along the next winter season as well as the ability of the gas infrastructure to meet the demand under different conditions.

Russia's invasion of Ukraine raises energy security concerns in Europe. Therefore, ENTSOG additionally assessed the dependence of the EU on the Russian supply during summer 2024 and winter 2024/25. ENTSOG further developed its model and topology, for the first time assessing the potential of additional seasonal flexibility provided by Ukrainian storages. ENTSOG also assessed different cases of LNG availability for Europe.

Summer Supply Outlook 2024 main findings

- On 1 April 2024, the EU gas stock level is in the higher range of the past 5 years at 59% with 663 TWh (667 TWh with UK). The decrease in gas consumption - as a result of relatively mild winter 2023/24 weather, high prices effect, dedicated measures introduced by the Member States and individual users' behaviour - contributed to the record volume of gas in storage at the beginning of the injection period.
- New gas infrastructure projects have been commissioned in the past year, mainly LNG terminals, boosting energy security in the EU.
- The gas infrastructure, including projects commissioned last year, allows for efficient cooperation among the Member States. However, under specific circumstances, some possible supply limitations and bottlenecks may occur.
- Transit contract between Ukraine-Russia expires in December 2024 and EU shippers are now storing gas in Ukraine which can return to EU or even flow to Moldova. This Outlook now includes the transit of EU gas through Ukraine (considering technical firm capacities available) together with a storage node to be used by EU shippers.
- Additional storage flexibility could be secured by storing further volumes in Ukrainian storage facilities with 10 bcm available for EU shippers, based on the information provided by TSO of Ukraine.

Summer Outlook – different scenarios (1 April to 30 September 2024)

- The European gas network can enable market participants to reach 90% stock level (and even 100%) in all underground gas storage facilities by the end of the summer season 2024 in all demand scenario cases.
- Most cases show the independence of the EU gas system from pipeline Russian supply, especially in scenario cases where some demand side actions are undertaken, and it is should be highlighted that this favourable situation is mainly due to very high stock levels at the beginning of April 2024 (59% on average). In case of high demand (5-year average), further approximate 110 TWh/11 bcm of LNG imports compared to 2023 would be needed to replace Russian imports.
- LNG supply (LNG Reference supply potential at the level of 966 TWh / ~96 bcm of natural gas in the form of LNG available for Europe during summer) and supply from Norway (695 TWh /~69 bcm available for Europe during summer) represent the largest sources of supply.
- In case of limited LNG supply availability (Low LNG supply sensitivity limited to 595 TWh / ~59 bcm of natural gas in the form of LNG available for Europe during summer) results show that demand side measures would be needed to reach a target of 90% of storage level across Europe.
- In case of Low LNG availability for Europe and no pipeline supplies from Russia it could be not possible to satisfy demand and also reach 90% of the gas in the storages at 1st October without any demand side response measures. Europe would need to secure more LNG and also possibly trigger demand side measures to assure winter preparedness.

Winter 2024/25 overview main findings

Winter Overview – different scenarios (October 2024 to March 2025)

- To test if infrastructure allows to satisfy demand and also reach relatively high storage level at the end of the winter period and to assess if this possibility is not limited or deteriorating, equally ambitious storage target levels were assumed for the winter overview simulation as at the beginning of April 2024. This should not be interpreted as a recommendation that equally ambitious storage levels should be an enforced target at this time of the year, but it would definitely make situation much more comfortable.
- Starting from a stock level of 59% on 1 April 2024, the injection and withdrawal capacities of the gas storage facilities combined with the supply flexibility of imports is sufficient to cover the demand and reach the inventory target level of 59% at the end of the winter in all EU countries.

- In case of combined full disruption of Russian supplies and low LNG availability the storage facilities would be used at their maximum in some countries to meet demand and cannot reach the 59% target by the end of winter, hindering the flexibility contribution usually provided by storage facilities during the high demand situations. Considering the 5 years average demand lowered by 15% demand response, simulations results show a 43% stock level on average in Europe at the end of March 2025 and would risk the winter preparedness of EU countries to reach at least the 90% target by the end of summer 2025 during the injection period. Only additional LNG supplies could enable higher levels for all storage facilities.
- Storage filling levels at the end of Winter 2024/25 in the case of high demand, similar to 5 years demand average of winters 2017-2021, LNG Low and no Russian pipeline supply are depleted to 11% (only strategic volumes are not used) and the results also show the risk of a potential demand curtailment. This is a strategic reserve gas in storage which is not freely available on the market under normal conditions and represents 11% of the total European storage working gas volume on average. Some European countries are reserving a part of their own gas stock to be constituted as strategic reserves and used only for the purpose of mitigating demand curtailment. Availability of strategic storage reserves are depending on the country's specific regulation.
- Low LNG supply sensitivity shows that demand side measures would be needed to mitigate the risk of demand curtailment, and that Europe needs to secure sufficient supply of LNG.
- Additional 10 bcm of storage offered for the European market in Ukraine could contribute to demand satisfaction and optimise usage of the other European storages. Ukraine storages offered to the EU market corresponds to an additional approximate 10% of total working gas volumes located in the EU.
- More scenarios for winter demand profiles, together with high demand cases like 2-week cold spell or peak day demand will be investigated in the future Winter Outlook as for previous editions.

Conclusions

- The gas infrastructure, including new projects commissioned last year, can efficiently reduce the dependence on Russian supply due to enhanced cooperation. Considering the high level of storage in the beginning of summer with given infrastructure, as well as assuming availability of other sources of gas supply, it is possible to satisfy demand and fill storages at the end of the injection season to the desirable level without using Russian pipeline gas.
- Even in the case of full pipeline Russian supply disruption, cooperation between the countries could allow for efficient injection during the summer 2024 and preparation for winter.
- Storages play an essential role to ensure security of supply, providing seasonal flexibility needed during the winter season. Early significant storage withdrawals would result in low storage levels at the end of the winter season. This might have a negative impact on the flexibility of the gas system. From the security of supply perspective, it would be important to inject gas during the summer season and maintain storages on an adequate level until the end of the winter.
- In case of full disruption of Russian pipeline supplies during winter, additional measures might be needed to save significant volumes of the gas for the end of the season, and to avoid risk of demand curtailment in case of high demand situations (5 years average).
- In the scenario where the availability of LNG to Europe is significantly limited (LNG Low) and there would be no pipeline supply from Russia (in winter where demand is at the level of 5 years average) the simulation results show the risk of full depletion of the storages and a potential demand curtailment. The situation can be improved by securing more supplies to Europe and demand side measures.
- Simulation results shows that the introduction of possible measures, decrease in gas demand by 15% (as a result of market behaviour reduction due to high prices or policy-based demand measures) would avoid demand curtailment risks and enable adequate storage levels to be reached. This would be further alleviated with access to additional LNG supply.
- Additional storage flexibility could be secured by storing additional volumes in Ukrainian storage facilities, with 10 bcm available, under a condition that this gas could be injected and later withdrawn during the winter season, and that market participants would be willing to use it. Potential transit of gas through Ukraine between Member States could improve interconnectivity between the CEE and SEE regions.

Important:

ENTSOG's Summer Supply Outlook 2024 with Winter 2024/25 overview is an assessment of the readiness of the gas infrastructure to cope with the upcoming summer and winter seasons under different scenarios, but this assessment is not a forecast of the expected gas supply situation and actual availability of gas from different sources is not guaranteed. The actual utilisation of the gas infrastructure, including the development of the gas storage levels, will be determined by the decisions of the market participants and influenced by external factors such as policy decisions.

Outlooks are not forecasts of the future. Rather, they identify potential resource adequacy risks at a specific point in time for the upcoming season which can be addressed proactively with preparation or mitigation measures. The identified risks are based on the assessment of a reference scenario and of various sensitivities, which consider uncertainties that could materialise.

1. INTRODUCTION

The Summer Supply Outlook 2024 with winter 2024/25 overview aims at assessing the ability of the European gas infrastructure to provide sufficient flexibility to shippers during the storage injection season and enough flexibility to meet different demand situations during the storage withdrawal season.

Russia's invasion of Ukraine raises energy security concerns in Europe. Therefore, ENTSOG additionally assessed the dependence of the EU on the Russian supply during summer 2024 and winter 2024/25 seasons.

ENTSOG also assessed different cases of LNG availability for Europe.

2. ASSUMPTIONS

The Summer Supply Outlook 2024 with winter 2024/25 overview is based on assumptions specific to the upcoming summer and winter seasons and short-term trends as detailed in the annexes. In any case, the actual injection, withdrawal, and supply mix will result from market behaviour and other external factors such as policy decisions.

Storage behaviour in the modelling is defined as follows:

- The actual gas storage level at the beginning of April 2024 according to AGSI+ platform. The target level is 90% to be reached at the end of injection season (Summer Supply Outlook 2024) and is defined for each storage facility. This target is not mandatory, i.e., the storage level goes below 90% if other supply sources otherwise cannot satisfy demand.

- The target level for the withdrawal season (winter 2024/25 overview) is to reach the same storage level as at the beginning of April 2024 and is defined for each storage facility. This target is not mandatory, i.e., the storage level goes below it if other supply sources otherwise cannot satisfy demand. This assumption is made to see if infrastructure is not limiting this possibility, it is worth to note that the filling level in April 2024 is the highest observed in the latest years.

- To test whether infrastructure allows to satisfy demand and also reach relatively high storage level at the end of the winter period and to see if this possibility is not limited or deteriorating, equally ambitious storage target levels were assumed for the winter overview simulation as at the beginning of April 2024. This should not be interpreted as a recommendation that equally ambitious storage level should be a target, but it would definitely make situation much more comfortable.

- The Ukraine Storage node is modelled as a last resort one – this means it is only filled after all the other EU storages are meeting the established target.

The model assumes cooperative behaviour among Member States as well as LNG distribution to terminals and storage utilisation according to security of supply needs. However, the model does not factorize commercial supply agreements.

Finally, some European countries could be reserving a part of their own gas stock constituted as strategic reserves to be used only for the purpose of satisfying their own demand. The model assumes the actual constraints on the utilization of the strategic storages and reserves[1]. Therefore, these strategic storage facilities cannot be depleted to avoid/reduce demand curtailment.

2.1. Infrastructure

A significant number of new gas infrastructure projects have been commissioned in the past year, boosting energy security in the EU. The main infrastructure commissioned has been the new LNG and FSRU terminals in Brunsbuettel Hafen and Stade FSRUs in Germany, Musel LNG terminal in Spain, Le Havre FSRU in France, Piombino (FSRU Golar Tundra) in Italy, the new IP Kalotina between Bulgaria and Serbia and the IP Strandzha flow direction upgrade from Turkey to Bulgaria.

The topology of the network model considers the existing European gas infrastructure, new upcoming projects (for example, LNG terminals in Greece, Germany and Italy), and the firm technical capacities provided by TSOs, which include maintenance plans known as of March 2024, including Balticconnector restart as from May 2024. The cross-border capacity from Germany to Czechia is partly conditioned and not freely allocable to whichever entry capacity.

Additionally, taking into account the transit contract between Ukraine and Russia expires in December 2024 and that the EU shippers are currently storing gas in Ukraine (which can return to EU or even flow to Moldova), the Outlook now includes the demand of the right bank of Dniester river in Moldova and the transit of EU gas through UA (considering technical firm capacities available) together with a storage node of 10 bcm to be used by EU shippers.

In order to capture the influence of the UGS inventory level on the injection and withdrawal capacities, ENTSOG has used the injection and deliverability curves made available by GIE. These curves represent a weighted average of the facilities (salt caverns, aquifers or depleted fields) of each area (see **Annex A**).

2.2. Demand

The Summer demand (from 1 April 2024 to 30 September 2024) is based on TSOs' estimates and is provided on a monthly granularity level. An average daily demand has been considered within each month (see **Annex B** for country detail). For comparison purposes, **Figure 1** shows

[1] The methodology used for strategic reserves and strategic storage facilities is explained in the Annex A

the European aggregated daily demand for the Summer 2024 compared to the historical daily demand over the last five summers. Despite the slight increase forecasted, demand is expected to be in the same range as the last three years and in line with the average of the last five summer seasons.

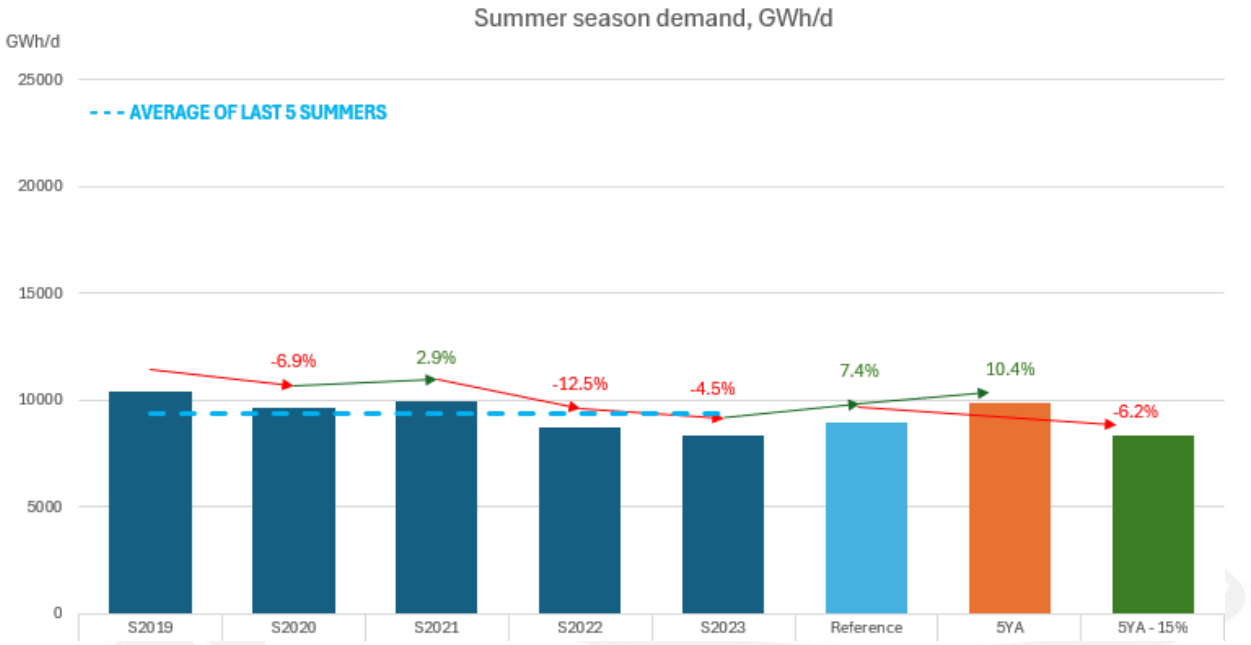


Figure 1 - Forecast Summer 2024 (GWh/d)

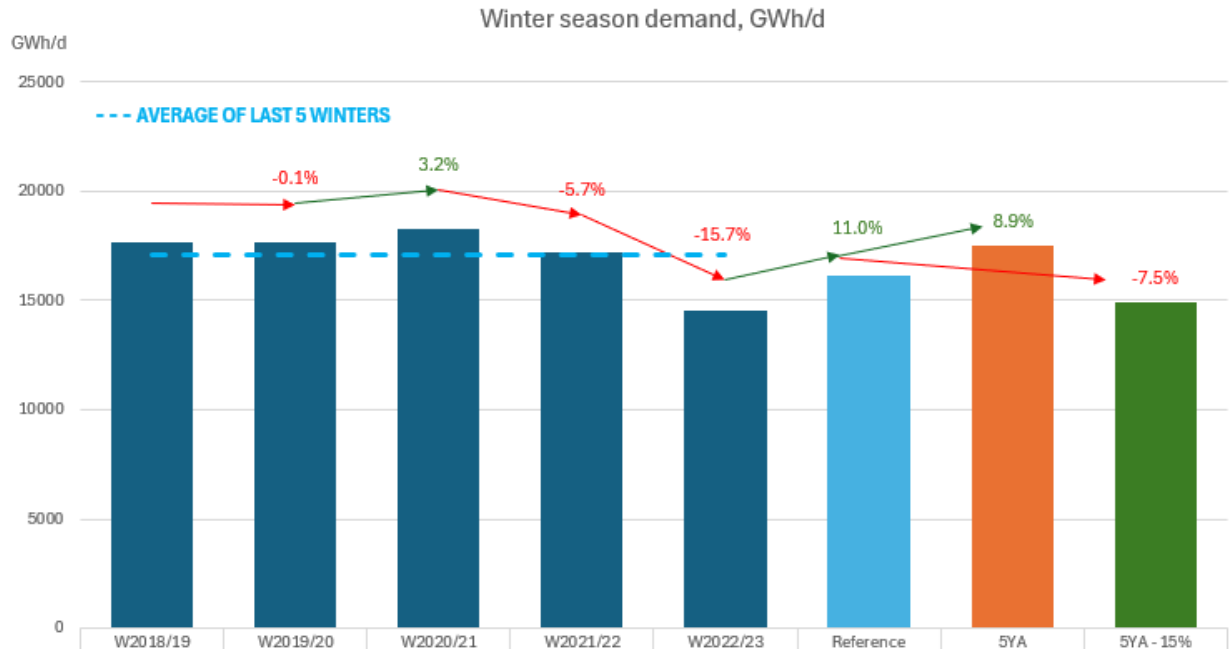


Figure 2 - Forecast Winter 2024 (GWh/d)

Three different demand scenarios were considered for the Summer Outlook. Reference Demand, 5 years average for the years (2017-2021/22) and 5 years average for the years (2017-2021/22) minus 15%. The **Figure 3** summarizes the Demand for all countries for each scenario used in the Summer and Winter season simulations.

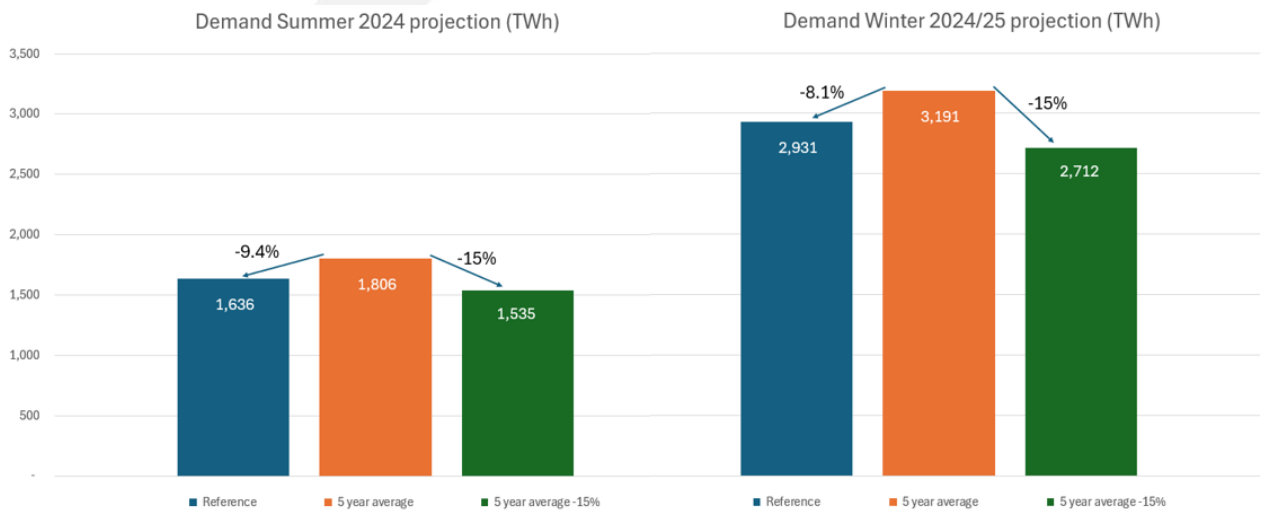


Figure 3 - Demand Summer 2024 and Winter 2024/25

2.3. Supply

The maximum supply potentials of the different sources providing gas to the EU (Caspian Sea, Algeria, Libya, Norway and Reference LNG) are based on the historical availability over the last five years or based on TSO information or the observed flows of the last year (Russia). Maintenance works on Norwegian gas fields is considered in the report in line with the published maintenance plan for September 2024.

Supply limitations are set for different cases (monthly values for winter and summer seasons) so that the maximum flows from each source cannot exceed reasonable levels based on historical observations.

The Russian pipeline supply potential is based on the last year's flows. It is thereby limited to flows through Ukraine (until December 2024) and TurkStream. In order to assess the EU dependence on Russian gas, all simulations minimised the use of this supply source to the possible extent. Other supply sources are used therefore in priority. There is also a sensitivity assuming a total disruption of Russian pipeline supply.

For LNG, three different cases of supply availability are considered: (1) Reference LNG supply, (2) Low LNG supply, and (3) High LNG supply.

The maximum supply potential for seasonal assessments is by default (if not specified by TSOs or Russian pipeline supply or a LNG sensitivity) calculated as the maximum 30 days rolling average supply from this source over the last five years per season. The Reference LNG supply case is calculated as explained above (maximum 30 days rolling average), while the Low LNG supply case is based on the last five-year average historical flows per season. Low LNG supply scenario is designed to simulate situation where, due to different possible reasons, LNG supply to Europe would be limited. The High LNG supply case is only limited by the European LNG terminal regasification capacities and TSO network capacities and not by the availability of importable LNG – answering question how much more LNG, thanks to existing infrastructure European gas system could intake.

GWh/day		Algeria	LNG	LNG Low	LNG High	Libya	Norway	Caspian	Russia
Winter Season	Max per 30 days	1365	5852	3538	Regas. capacity	207	3800	464	750
Summer Season	Max per 30 days	1217	5278	3252	Regas. capacity	164	3800 / 2830[2]	404	750

Table 1 - Maximum supply potential [GWh/d]

The supply assumptions (supply potential) are based on the supply observed in the last five winter and summer periods and should not be considered as a forecast. The actual supply mix

[2] Supply potential for September 2024 (according to maintenance plan).

will depend on market behaviour and other external factors. Moreover, the model does not factorize supply commercial agreements.

Regarding the European domestic production, **Figure 4** and **Figure 5** provide a comparison between the last six summer and winter seasons and the national production forecasted by the TSOs for summer 2024 and winter 2024/25. Domestic production is following the long-term dwindling trend, mainly due to the fall in production by the biggest gas producer in the EU – the Netherlands. However, gas production in the United Kingdom rose in 2022 driven by a range of factors, including the start-up of new fields in the Southern North Sea. What is more, the Danish National Production is showing a significant growth due to end of maintenance of the Tyra offshore gas platform.

Domestic production in the summer 2024 is estimated to be slightly higher (5%) from the previous summer, whereas for winter 2024/25 it is estimated to decrease by 13% over winter 2023/24.

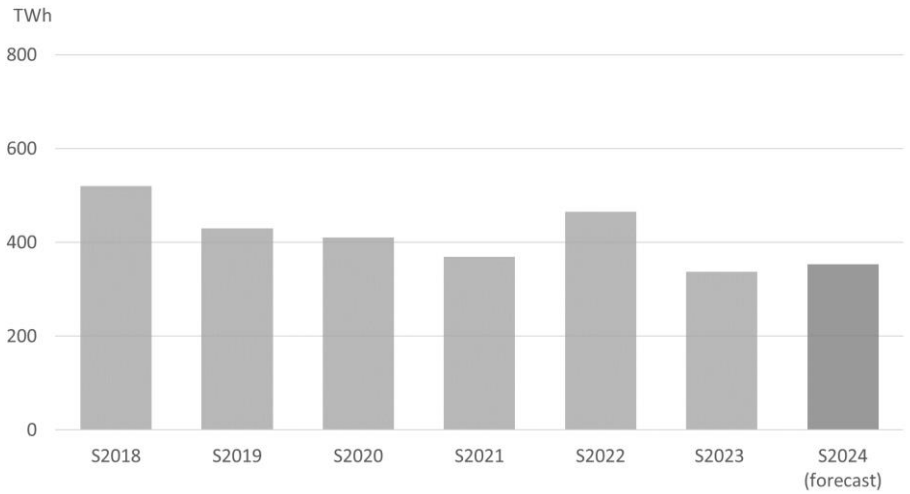


Figure 4. - European national production comparison with Summer 2024 (forecast), TWh

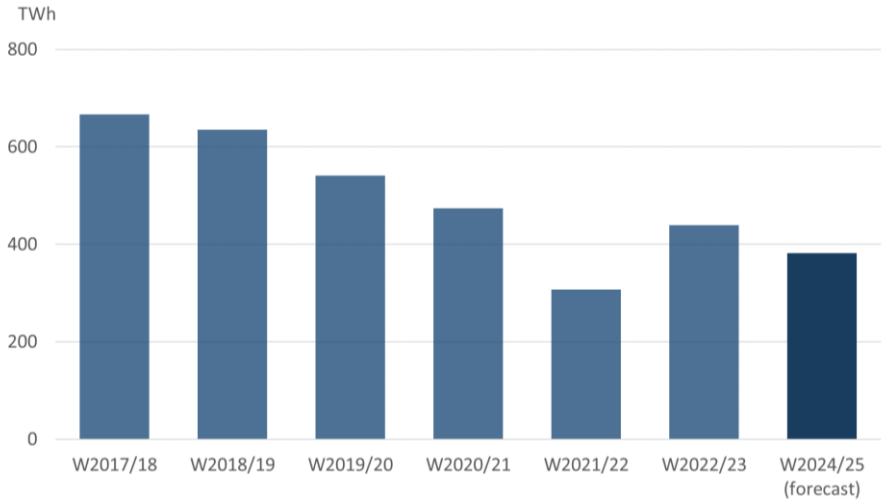


Figure 5. - European national production comparison with Winter 2024/25 (forecast), TWh

Consideration of non-EU countries

When assessing the supply adequacy at European level, ENTSOG takes into account the interactions with the countries neighbouring the EU: the United Kingdom, Switzerland, North Macedonia, Serbia, Bosnia Herzegovina, Ukraine, Turkey, and Moldova.

The analysis considers non-EU countries, including the Energy Community contracting parties, taking into account the geography and the actual supply situation:

- The United Kingdom, Switzerland, Bosnia and Herzegovina, North Macedonia, Serbia and Moldova (the right bank of Dniester river) are included in the modelling perimeter. Serbia and North Macedonia won't cooperate in case of full Russia supply disruption.
- Exports to Ukraine are based on the expected forecast provided by the Ukrainian TSO.
- Export to the Kaliningrad region of Russia is not considered.
- No export towards Turkey is considered. Caspian and Russian gas are considered to be transported through Turkey into the EU and additional gas imports from Turkey through the IP Strandzha 1 into the EU are allowed from Turkish LNG terminals.
- Albania, Montenegro and Kosovo are not connected to the gas grid.

2.4. Storage inventory

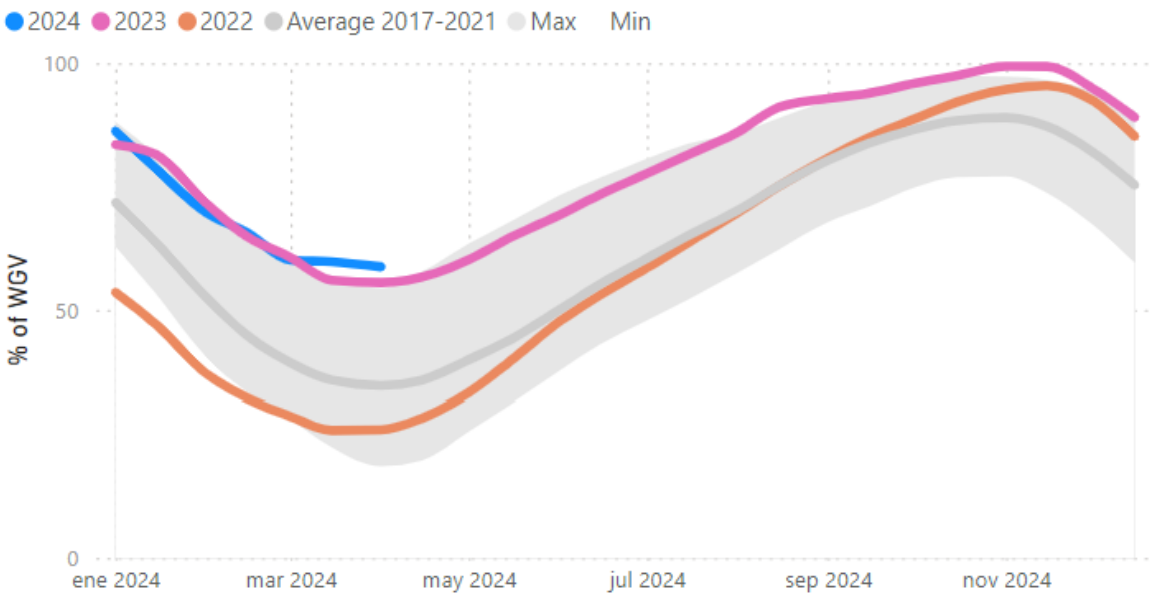
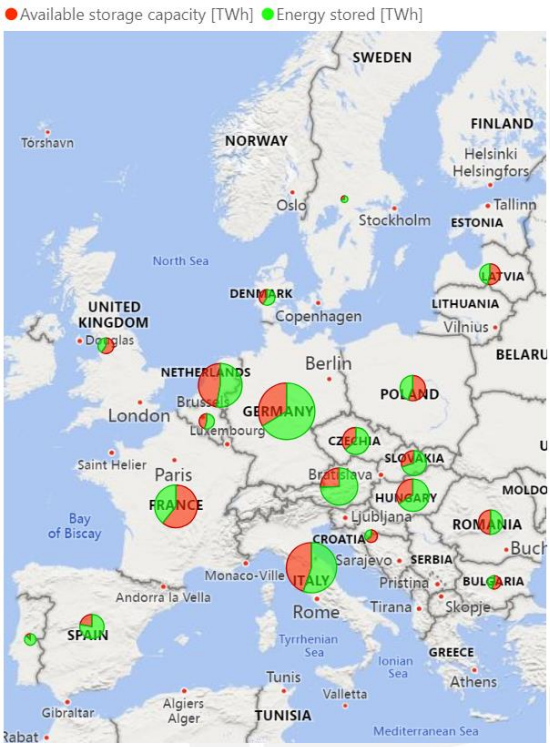


Figure 6. - Gas storage evolution compared to the storage evolution 2017-2021, % of WGV (Source: AGSI+)

On 1 April 2024, the EU gas stock level at the end of winter season is in the maximum of the range of the past 5 years with 667 TWh versus 628 TWh maximum in 2023. The decrease in gas consumption - as a result of relatively mild winter weather, high prices and dedicated measures introduced by the Member States and individual users behaviour contributed to the record volume of gas in storage.

For the modelling of the different scenarios, Summer Supply Outlook 2024 considers the initial situation of the storage inventory level per country on 1 April 2024 as shown in the table of **Figure 7.**



Country	WGV, GWh	Gas in storage, GWh	Full, %
Austria	97,973	72,999	75%
Belgium	8,830	4,799	54%
Bulgaria	5,890	2,605	44%
Croatia	4,773	1,708	36%
Czechia	44,817	28,648	64%
Denmark	9,822	5,762	59%
France	128,865	50,656	39%
Germany	246,322	163,203	66%
Hungary	70,069	46,397	66%
Italy	196,963	108,917	55%
Latvia	24,074	11,128	46%
Netherlands	144,029	76,152	53%
Poland	37,511	16,526	44%
Portugal	3,570	3,106	87%
Romania	33,864	17,222	51%
Spain	35,833	27,844	78%
Slovakia	36,458	25,482	70%
Sweden	102	72	71%
United Kingdom	9,864	3,965	40%
Total	**1,139,629**	**667,191**	**59%**
Serbia	4,532	2,655	59%
Ukraine	106,400	0	0%

Figure 7. - Actual storage inventory levels on 1 April 2024 (for some countries, the initial level includes strategic stocks).[3]

In terms of absolute volumes in gas storages and considering the higher total capacity of storages in these countries, the largest volumes on 1 April 2024 are stored in Germany, Italy, The Netherlands and Austria.

In percentage comparison, the highest filling levels (above 70%) are observed in Austria, Portugal, Sweden, Spain and Bulgaria; and the lowest (below 40%) are in Croatia and France. These storage levels per country have been used as a starting point for the Summer Supply Outlook 2024.

Some European countries reserving a part of their own gas stock constituted as strategic reserves to be used only for the purpose of mitigating demand curtailment. The model assumes actual strategic storage facilities constraints but simulation results do not consider the utilization of strategic storage reserves. This means that strategic reserves remain available to reduce or even avoid demand curtailment in some countries. Availability of strategic storage reserves is depending on the country's specific regulation and more information about it for selected countries is aggregated in **ANNEX A**.

[3] The Working Gas Volume and the gas in storage for each country is based on the AGSI+ platform. For Serbia, the initial storage is considered 59% (equal to EU average) due to no availability of data.

3. MODELLING RESULTS FOR THE SUMMER SUPPLY OUTLOOK 2024

The following table shows the most relevant information concerning the Summer Supply Outlook 2024 results in the different demand scenarios in combination with the main assumptions possible configurations. The simulation results are explained onwards in this chapter.

Summer Outlook Demand	Russian supply	Storage Target	LNG Scenario	Demand curtailment	Final UGS filling level *
Reference	Minimised	90%	Ref	No	90%
		90%	Low	No	90%
		Maximum	Low	No	96%
	Disrupted	90%	Ref	No	90%
		90%	Low	No	85%
		Maximum	Low	No	85%
5YA-15%	Minimised	90%	Ref	No	90%
		90%	Low	No	90%
		Maximum	Low	No	100%
	Disrupted	90%	Ref	No	90%
		90%	Low	No	90%
		Maximum	Low	No	97%
5YA	Minimised	90%	Ref	No	90%
		90%	Low	No	84%
		Maximum	Low	No	84%
	Disrupted	90%	Ref	No	90%
		90%	Low	No	70%
		Maximum	Low	No	70%

* Storage filling level on 2024 September 30

Table 2. – Summer Outlook Results Summary

3.1. Reference summer scenario - 90% storage target by 30 September 2024

For the Reference summer scenario the overall summer season injection is defined as the amount of gas necessary to reach 90% of the stock level in each European storage facility on 30 September 2024 starting with total European stock level of 59% on 1 April 2024 (see **Figure 7**).

The distribution of injection and supply during the summer months results from the modelling and the following assumptions:

- The monthly gas demand estimated by TSOs
- The monthly national gas production estimated by TSOs
- The monthly capacity provided by TSOs
- The storage injection capacities as defined in **Annex A**

- The flexibility given to the model for the definition of the supply potentials derives from the historical supply mix (see **Annex B**)

Based on these assumptions, the modelling has been used to check if any physical congestion or dependence on an import source may limit the injection.

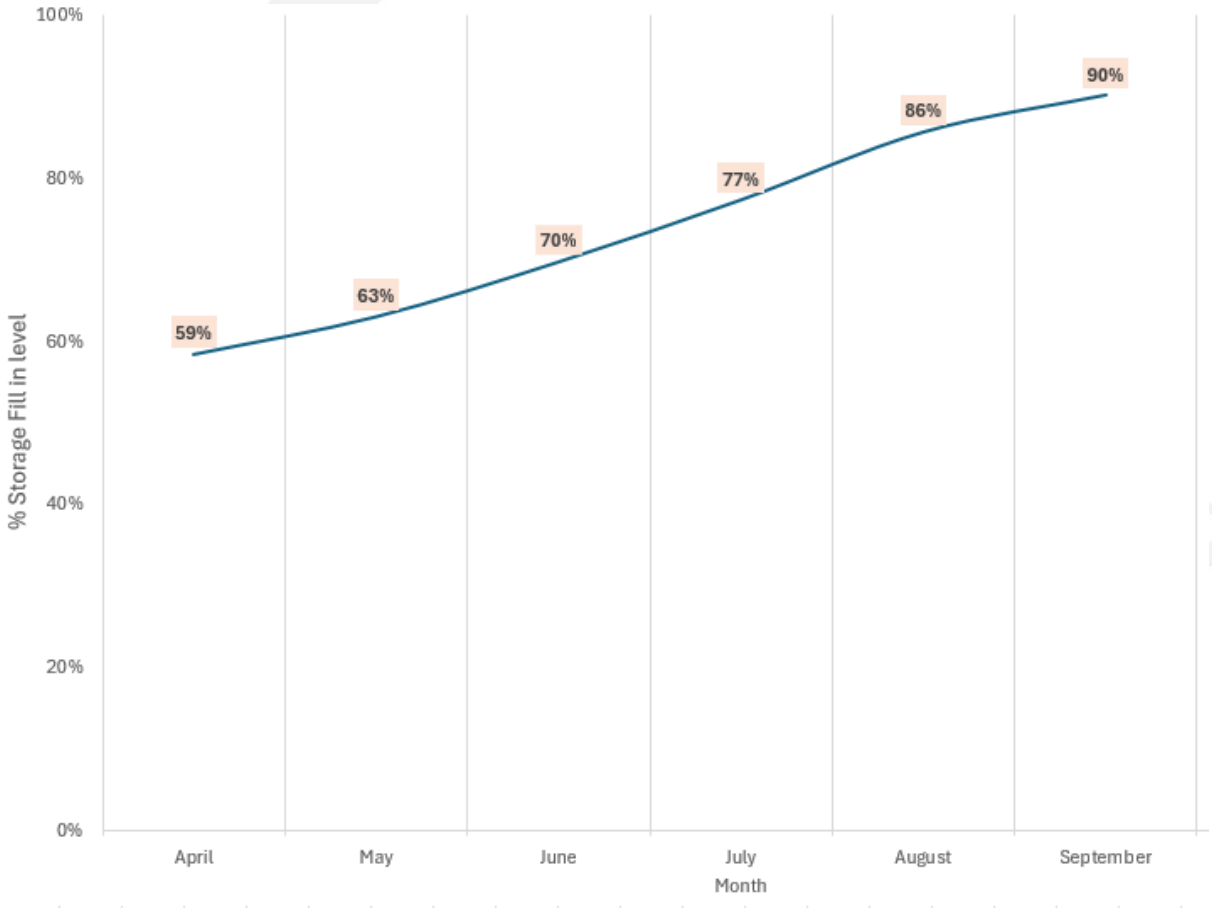


Figure 8. – Reference summer scenario. Evolution of the aggregated European UGS stock level, %

The simulation shows that if there is no supply disruption[4], a 90% stock level or more can be achieved by 30 September 2024 for all storage facilities.

Table 3 shows the evolution of the stock level per country as a result of the model for the Baseline Scenario.

[4] The pipeline supply from RU considers the option to flow through TurkStream and via Ukraine

Country	March	April	May	June	July	August	September
Austria	75%	75%	76%	78%	83%	88%	90%
Belgium	50%	50%	57%	58%	74%	87%	90%
Bulgaria	52%	52%	59%	68%	76%	84%	90%
Croatia	39%	39%	49%	62%	72%	83%	90%
Czechia	68%	67%	70%	73%	80%	86%	90%
Denmark	62%	61%	63%	66%	76%	86%	90%
France	40%	40%	48%	56%	70%	83%	90%
Germany	66%	66%	68%	70%	79%	86%	90%
Hungary	69%	69%	73%	78%	83%	88%	92%
Italy	55%	55%	62%	69%	75%	85%	90%
Latvia	47%	47%	57%	66%	72%	81%	90%
Poland	52%	52%	57%	63%	73%	83%	90%
Portugal	98%	90%	90%	90%	90%	90%	90%
Romania	52%	51%	58%	67%	75%	84%	90%
Serbia	58%	58%	64%	71%	78%	85%	90%
Slovakia	69%	67%	69%	73%	80%	86%	90%
Spain	78%	78%	79%	82%	85%	89%	90%
Sweden	70%	40%	40%	40%	63%	90%	90%
The Netherlands	54%	54%	60%	80%	80%	87%	90%
United Kingdom	37%	37%	37%	37%	70%	90%	90%

Table 3. - Reference Summer Scenario. Evolution of the aggregated UGS stock level per country, %

The main finding of the Summer Supply Outlook 2024 for the Reference summer scenario is that the European gas network is capable of enabling market participants to reach at least a 90% stock level in all underground gas storage facilities by the end of the summer season 2024. Results show that Ukrainian storages offered to EU market could be also filled up to 90%.

The results of the sensitivity analysis also show that the flexibility of the gas system infrastructure is sufficient to achieve higher storage filling level (100% stock level in all underground gas storage facilities) during the injection period.

Figure 9 shows the level and composition of the supply mix in the Reference summer scenario when the storage filling level at the end of September 2024 is 90%.[5]

[5] The import levels shown represent one possible supply option, with LNG providing import flexibility in this example, and modelling was done while minimizing Russia supply

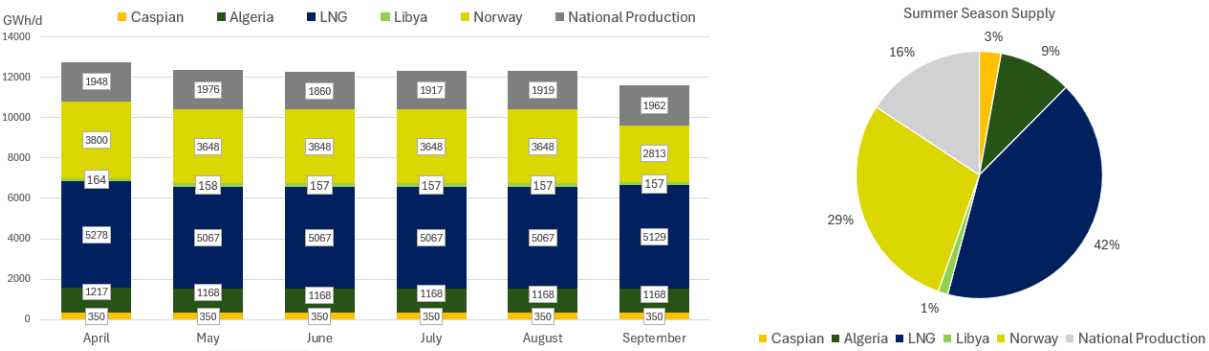


Figure 9. - Reference summer scenario. Monthly supply mix, GWh/d

The monthly supply mix is stable over the summer season 2024 period. LNG supply and supply from Norway represent the largest sources of supply with 42% and 29% respectively. Pipeline gas supply from Russia is fully minimized and not needed in summer reference demand scenario while the other sources are maximised but limited by the firm capacity of the gas network or the maximum supply potentials.

3.2. Summer supply dependence assessment – supply disruption from RU

This section investigates the potential impact of full disruption along the Russian supply routes during the injection period to reach 90% of the stock level in each European storage facility on 30 September 2023, starting with total European stock level of 59% on 1 April 2024 (see **Figure 10**).

The distribution of injection and supply during the summer months results from the modelling and the following assumptions:

- The monthly gas demand estimated by TSOs
- The monthly national gas production estimated by TSOs
- The monthly capacity provided by TSOs
- The storage injection capacities as defined in **Annex A**
- The flexibility given to the model for the definition of the supply potentials derives from the historical supply mix (see **Annex B**)

Based on these assumptions, the modelling has been used to check if any physical congestion or dependence on an import source may limit the injection. As no risk group is defined in regulation 1938/2017[6], all European countries cooperate as if they were part of a single European risk group except for Serbia and North Macedonia won't cooperate in case of full Russia supply disruption.[7]

[6] Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010

[7] Serbia and North Macedonia could still receive Russian gas but this flow is not displayed in the supply graphs.

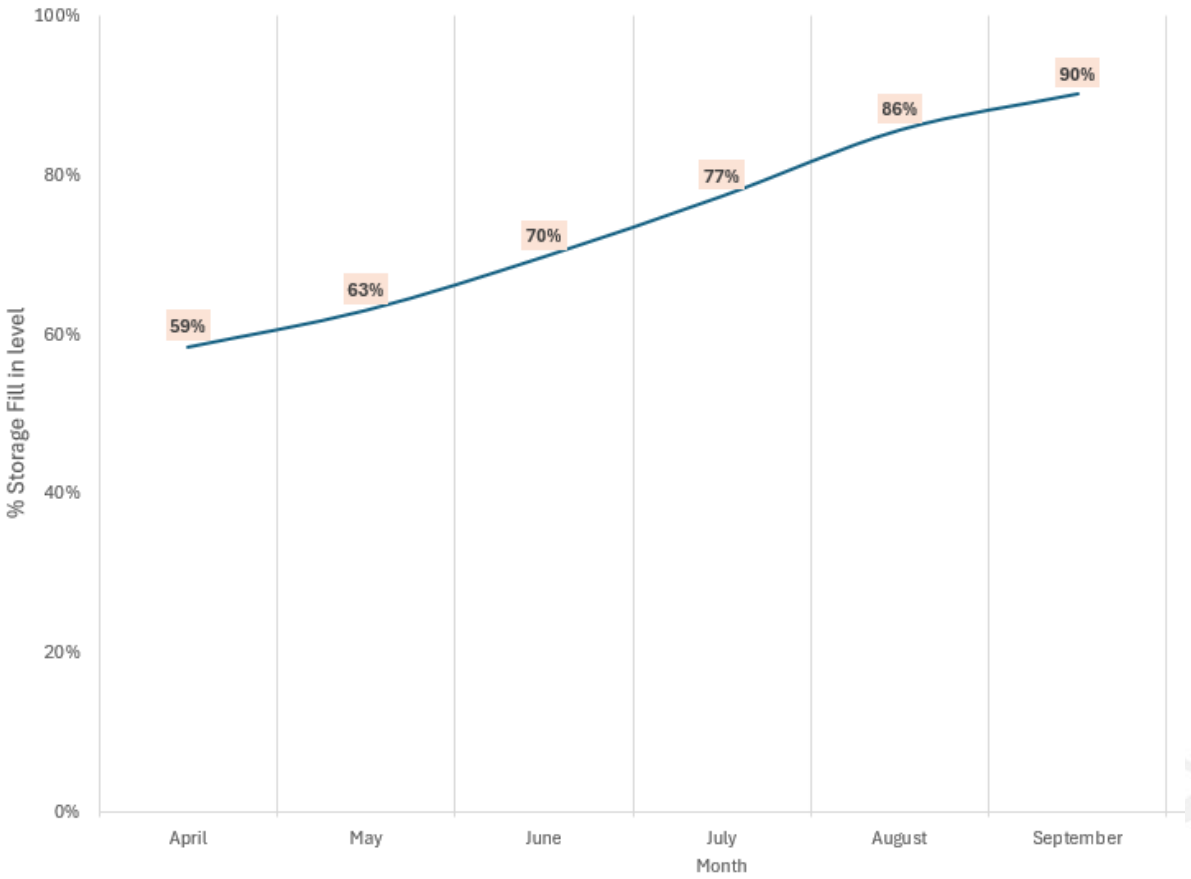


Figure 10. – Summer supply dependence assessment. Evolution of the aggregated European UGS stock level, %

In this scenario, Europe can also reach 90% (and also 100%) of its total working gas volume.

Table 4 shows the evolution of the stock level per country as a result of the model for the summer supply dependence assessment – supply disruption from RU. Results show that Ukrainian storages offered to EU market could be also filled up to 90%.

Country	March	April	May	June	July	August	September
Austria	75%	75%	77%	80%	84%	88%	90%
Belgium	50%	50%	58%	65%	77%	88%	90%
Bulgaria	52%	52%	59%	68%	76%	84%	90%
Croatia	39%	39%	49%	62%	72%	83%	90%
Czechia	68%	67%	69%	74%	80%	86%	90%
Denmark	62%	61%	63%	70%	79%	88%	90%
France	40%	40%	48%	59%	71%	83%	90%
Germany	66%	66%	69%	73%	80%	86%	90%
Hungary	69%	69%	73%	78%	83%	88%	92%
Italy	55%	55%	62%	69%	76%	86%	90%
Latvia	47%	47%	57%	67%	72%	81%	90%
Poland	52%	52%	57%	65%	74%	83%	90%
Portugal	98%	90%	90%	90%	90%	90%	90%
Romania	52%	51%	58%	67%	75%	84%	90%
Serbia	58%	58%	64%	72%	78%	85%	90%
Slovakia	69%	67%	70%	74%	80%	86%	90%
Spain	78%	78%	79%	82%	85%	89%	90%
Sweden	70%	20%	20%	40%	63%	90%	90%
The Netherlands	54%	54%	58%	66%	75%	84%	90%
United Kingdom	37%	37%	37%	40%	65%	90%	90%

Table 4. - Summer supply dependence assessment. Evolution of the aggregated UGS stock level per country, %

Under the maximum target configuration, all countries can also reach storage filling level of 100% of their working gas volume by the end of September 2024. Increasing LNG supplies provide a supply flexibility and opportunity to reach the higher target for almost all storage facilities.

Moreover, the European storage filling level could also increase during October 2024 as the injection season typically lasts until November 1 in some countries.

Figure 11 show the level and composition of the supply mix in the scenario the summer supply dependence assessment – supply disruption from Russia. According to the simulation results, the European storage filling level at the end of September 2024 is 90%.

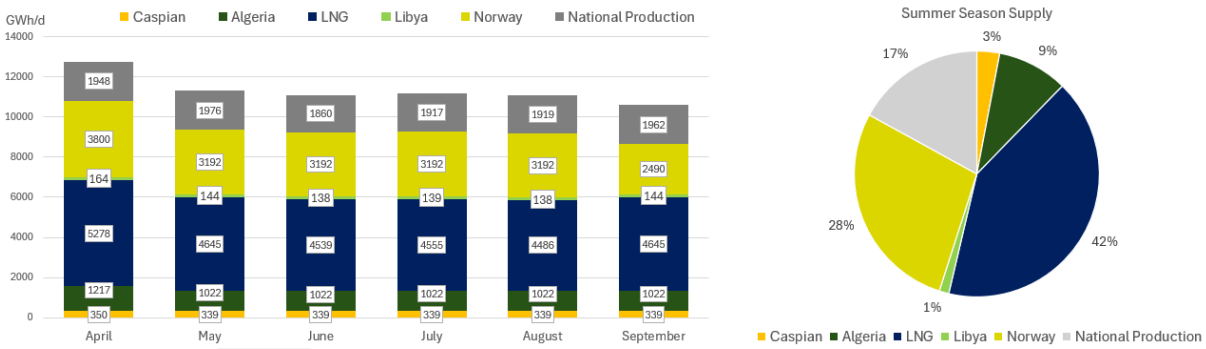


Figure 11. - Supply dependence assessment (Reference demand). Supply mix (GWh/d)

The monthly supply mix is stable over the summer season 2024 period. LNG and Norway represent the largest sources of supply, 42% and 28% respectively.

3.3. Summer supply dependence assessment under LNG Low Scenario

For the Reference demand scenario without Russian supply, the impact of introducing the LNG low sensitivity during summer is very limited and the storage filling level at the end of September 2024 is 85%.

Moreover, in the case of low LNG Supply and no Russian pipeline supply disruption together with the highest possible demand scenario (5 years average for the years (2017-2021/22)) the storages are filled in September up to 70% (only Czechia and Hungary remain higher due to strategic gas storage) without any demand curtailment as shown in **Figures 12 and 13**.

Country	Storages % Level
Austria	0.70
Belgium	0.70
Bulgaria	0.70
Croatia	0.70
Czechia	0.71
Denmark	0.70
France	0.70
Germany	0.70
Hungary	0.77
Italy	0.70
Latvia	0.70
Poland	0.70
Portugal	0.70
Romania	0.70
Slovakia	0.70
Spain	0.70
Sweden	0.70
The Netherlands	0.70
United Kingdom	0.70

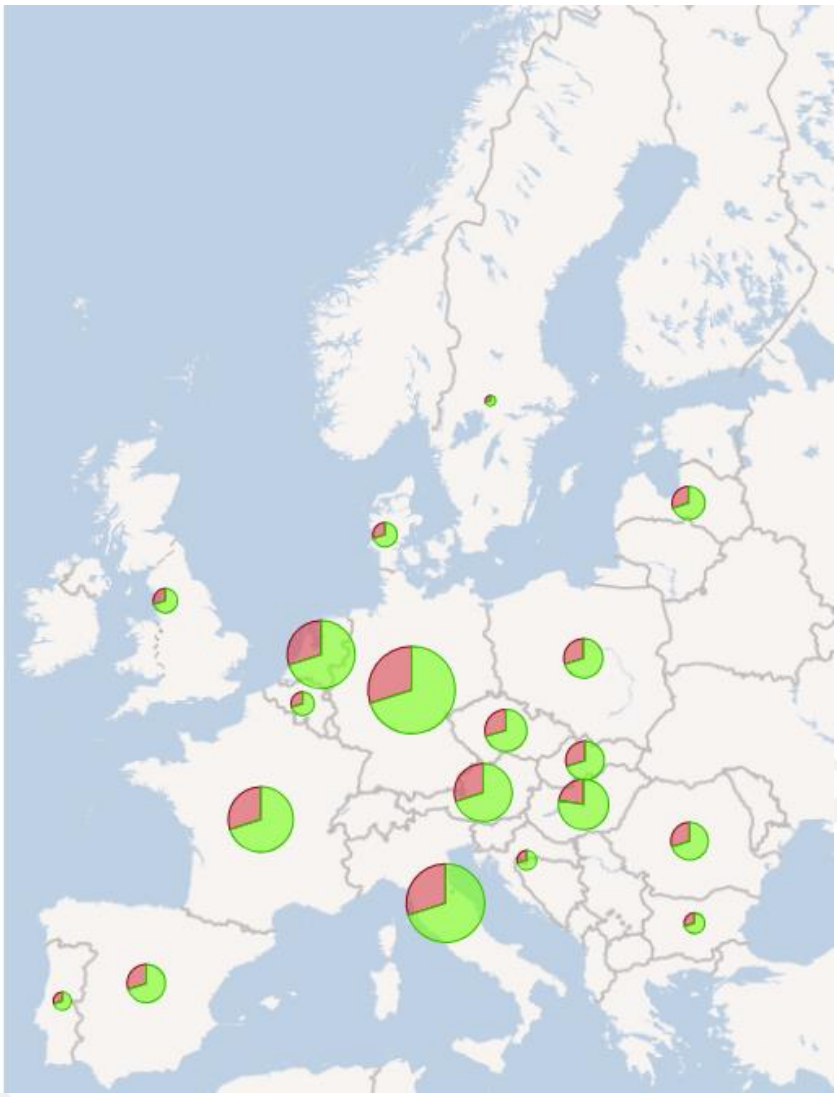


Figure 12 -LNG Low No Russia Disruption Demand 5 years average – storage % level

Country	Demand Curtailment
Austria	0.00
Belgium	0.00
Bosnia and Herzegovina	0.00
Bulgaria	0.00
Croatia	0.00
Czechia	0.00
Denmark	0.00
Estonia	0.00
Finland	0.00
France	0.00
Germany	0.00
Greece	0.00
Hungary	0.00
Ireland	0.00
Italy	0.00
Latvia	0.00
Lithuania	0.00
Luxembourg	0.00
Moldova	0.00
Poland	0.00
Portugal	0.00
Romania	0.00
Slovakia	0.00
Slovenia	0.00
Spain	0.00
Sweden	0.00
Switzerland	0.00
The Netherlands	0.00
United Kingdom	0.00

Figure 13 - LNG Low No Russia Disruption Demand 5 years average – Curtailment Rate

4. MODELLING RESULTS FOR THE WINTER 2024/25 OVERVIEW

The following table shows the most relevant information concerning the Winter Supply Overview 2024/25 results in the different demand scenarios in combination with the main assumptions possible configurations. The simulation results are explained onwards in this chapter.

Winter Overview Demand	Russian supply	Storage Target	LNG Scenario	Demand curtailment	Final UGS filling level *
Reference	Minimised	Same as initial (59%)	Ref	No	59%
		Same as initial (59%)	Low	No	29%
	Disrupted	Same as initial (59%)	Ref	No	59%
		Same as initial (59%)	Low	No	11%
5YA-15%	Minimised	Same as initial (59%)	Ref	No	59%
		Same as initial (59%)	Low	No	55%
	Disrupted	Same as initial (59%)	Ref	No	59%
		Same as initial (59%)	Low	No	37%
5YA	Minimised	Same as initial (59%)	Ref	No	49%
		Same as initial (59%)	Low	4-5%	11%
	Disrupted	Same as initial (59%)	Ref	No	41%
		Same as initial (59%)	Low	9-10%	11%

* Storage filling level on 2025 March 31

Table 5 . – Winter Overview Results Summary

4.1. Reference winter scenario – same as initial storage target by 31 March 2025

For the Reference Winter 2024/25 scenario, the overall winter season withdrawal is defined as the amount of gas necessary to meet demand and reach the same starting stock level in each European storage facility on 31 March 2025, starting with an average total European stock level of 59% on 1 April 2024. In this scenario the Reference demand, the 5-year average demand values[8] and the 5-year average demand values with 15% reduction for each country during the winter period were assumed.

The distribution of withdrawal, demand and supply during the winter months results from the modelling and the following assumptions[9]:

- The monthly gas demand provided by TSOs and the 5-years (2017-2021/22) average monthly gas demand
- The monthly national gas production estimated by TSOs
- The monthly capacity provided by TSOs
- The storage withdrawal capacities as defined in **Annex A**

[8] Some TSOs provided their own estimates of demand (Germany, France and Belgium for the market conversion from L-gas to H-gas), and demand values have been updated for the simulations to reflect evolution of the gas market

[9] Some European countries could be reserving a part of their own gas stock constituted as strategic reserves

- The flexibility given to the model for the definition of the supply potentials derives from the historical supply mix (see **Annex B**)

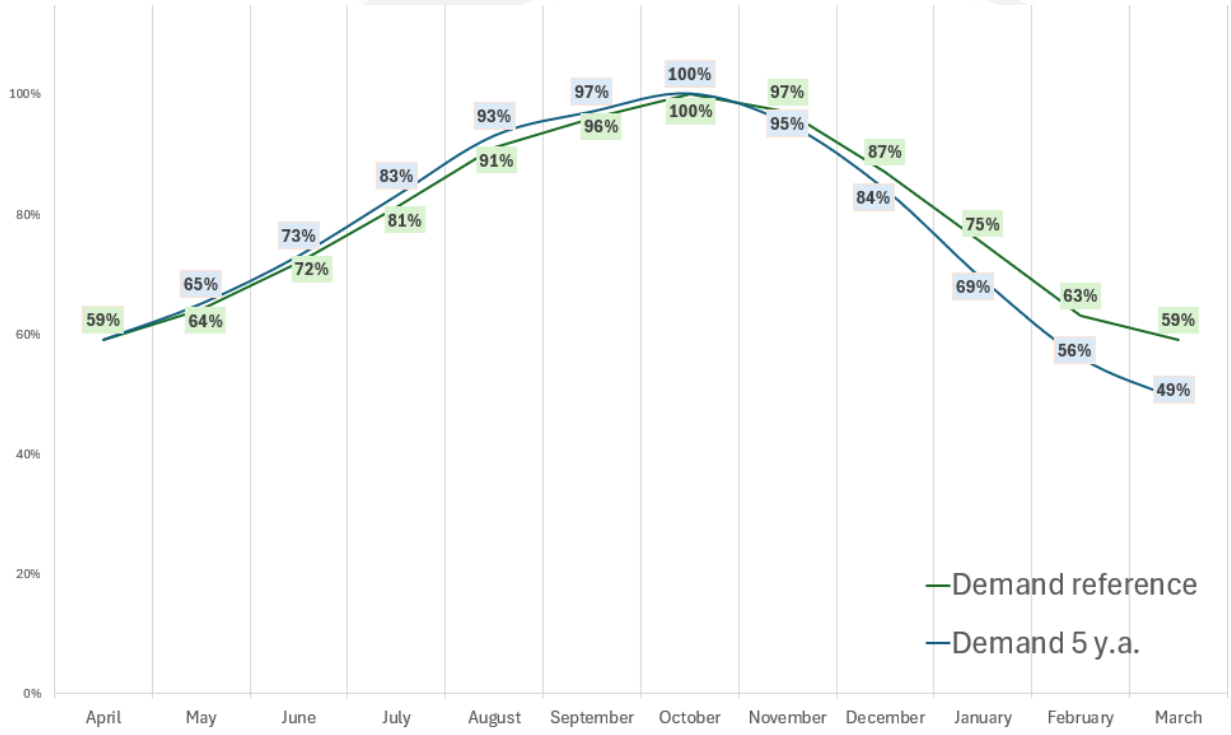


Figure 14. – Reference Winter scenario. Evolution of the aggregated European UGS stock level, %

The Reference Winter 2024/25 scenario simulation results show that withdrawal capacities of the gas storage facilities combined with the supply flexibility of imports is sufficient to cover the demand and reach an inventory target level of 59% at the end of the winter in EU average. Also, according to the results of the simulation, the EU countries continue to inject more gas during October.

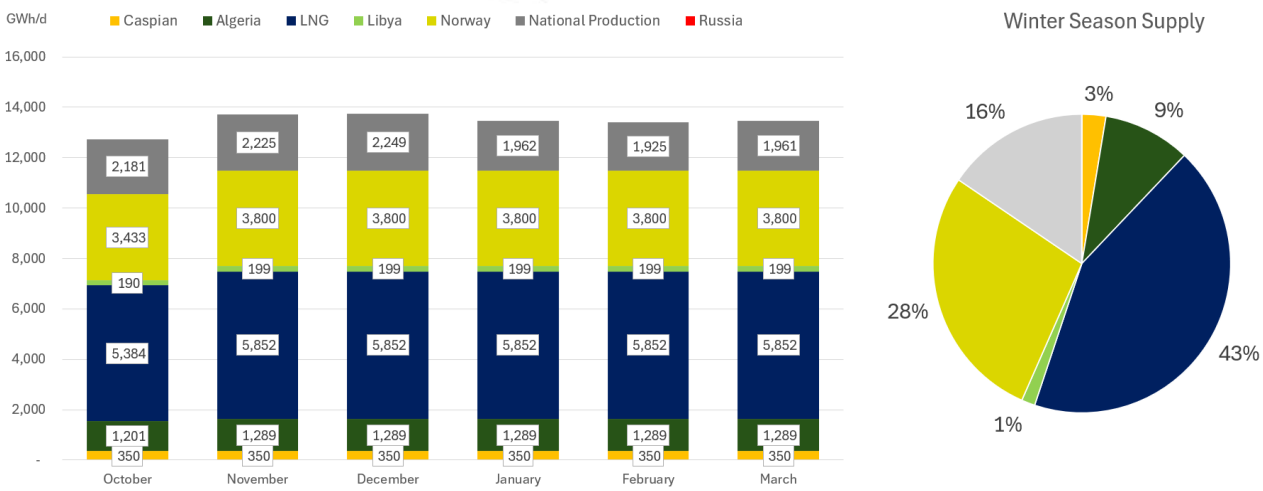


Figure 15. - Reference Winter Demand scenario. Supply mix, (GWh/d)

Figure 15 shows the level and composition of the supply mix in the Reference Winter Scenario. The storage filling level at the end of March 2025 is 59%[10]. Russian gas is not used and LNG (43%) and Norway (28%) represent the largest sources of supply.

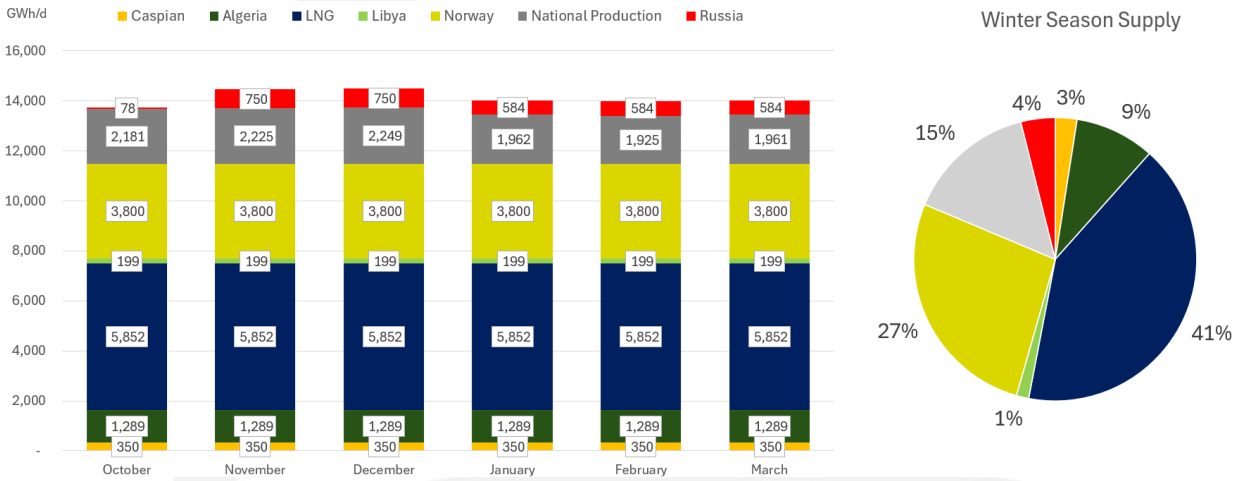


Figure 16 - 5 Years Average Demand Scenario. Supply mix (GWh/d)

In **Figure 16** the same case but for high demand situation is presented. In this demand situation (5 years average) there is a need to import around 4% of the total seasonal supply of Russian pipeline gas and LNG and Norway represent 41% and 27% respectively.

[10] The import levels shown represent one possible supply option, with LNG providing import flexibility in this example. Modelling was done while minimizing RU supplies

4.2. Winter supply dependence assessment – supply disruption from Russia

This section investigates the potential impact of full disruption along the Russia supply routes during the withdrawal period to satisfy the demand and reach 59% of the stock level in each European storage facility on 31 March 2025, starting with total European stock level of 59% on 1 April 2024. In this scenario the Reference demand, the 5-year average demand values[11] or the 5-year average demand values with 15% reduction for each country during the winter period were assumed.

The distribution of withdrawal, demand and supply during the winter months results from the modelling and the following assumptions[12]:

- The 5-year average monthly gas demand and 5-year average monthly gas demand with 15% reduction
- The monthly national gas production estimated by TSOs
- The monthly capacity provided by TSOs
- The storage withdrawal capacities as defined in **Annex A**
- The flexibility given to the model for the definition of the supply potentials derives from the historical supply mix (see **Annex B**)

Based on these assumptions, the modelling has been used to check if any physical congestion or dependence on an import source may limit the fulfilment of gas demand during the withdrawal period. As no risk group is defined in regulation 1938/2017[13], all European countries cooperate as if they were part of a single European risk group.

[11] Some TSOs provided their own estimates of demand (Germany, France and Belgium for the market conversion from L-gas to H-gas), and demand values have been updated for the simulations

[12] Some European countries could be reserving a part of their own gas stock constituted as strategic reserves. Therefore, storage facilities cannot be depleted to avoid/reduce demand curtailment

[13] Regulation (EU) 2017/1938 of the European Parliament and of the Council of 25 October 2017 concerning measures to safeguard the security of gas supply and repealing Regulation (EU) No 994/2010

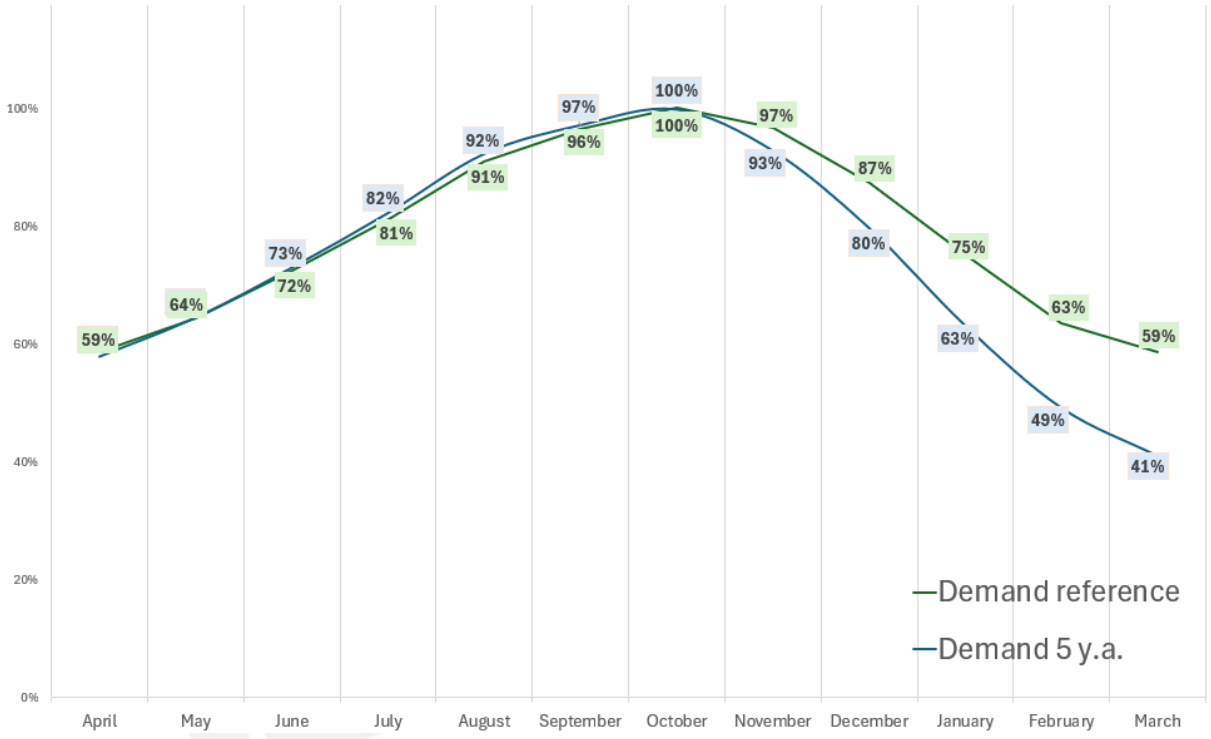


Figure 17. - Supply dependence assessment (RU disruption). Evolution of the aggregated European UGS stock level, %

In the winter scenario based on the 5-year average demand values in the case of full supply disruption from Russia, the storage facilities are used at their maximum to meet demand and can only reach a 41% level. This risk has to be anticipated if the EU countries are to reach the 90% target by the end of summer 2024 during the injection period. In case of 15% demand reduction, storage facilities can reach 59% of storage level in all countries.

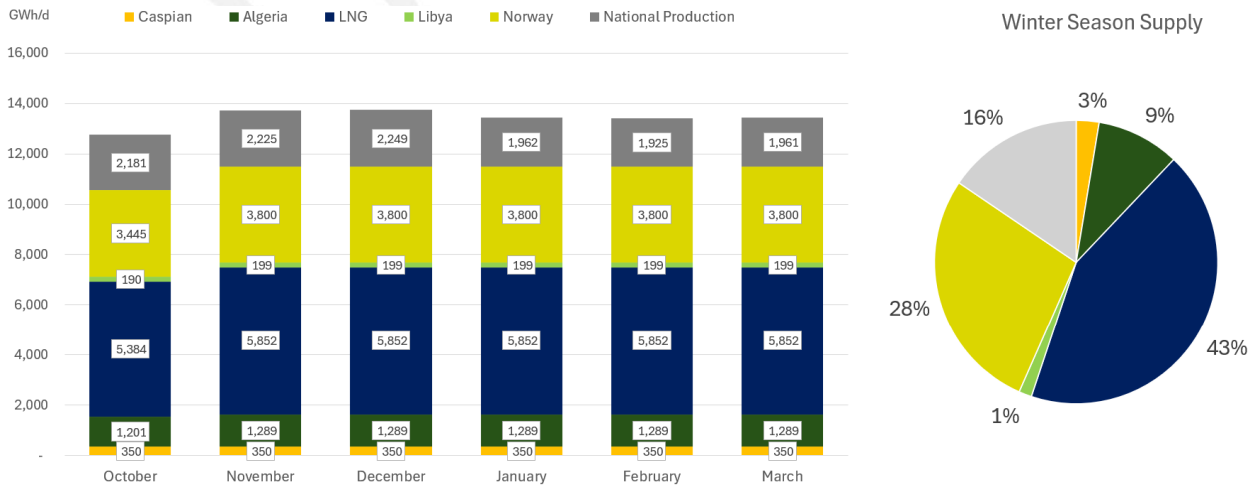


Figure 18. - Supply dependence assessment (Reference demand). Supply mix (GWh/d)

Figure 18 show the level and composition of the supply mix in the Winter supply dependence assessment scenario with the reference demand. The storage filling level at the end of March 2025 is 59%[14].

LNG and Norway represent the largest sources of supply in both cases. In the case of no demand reduction, import sources are maximised but limited by the capacity of the gas network or the LNG supply potential. Increasing LNG supplies, combined with the withdrawal capacities of the gas storage, provides a supply flexibility and opportunity to satisfy the demand and reach the target of 59%.

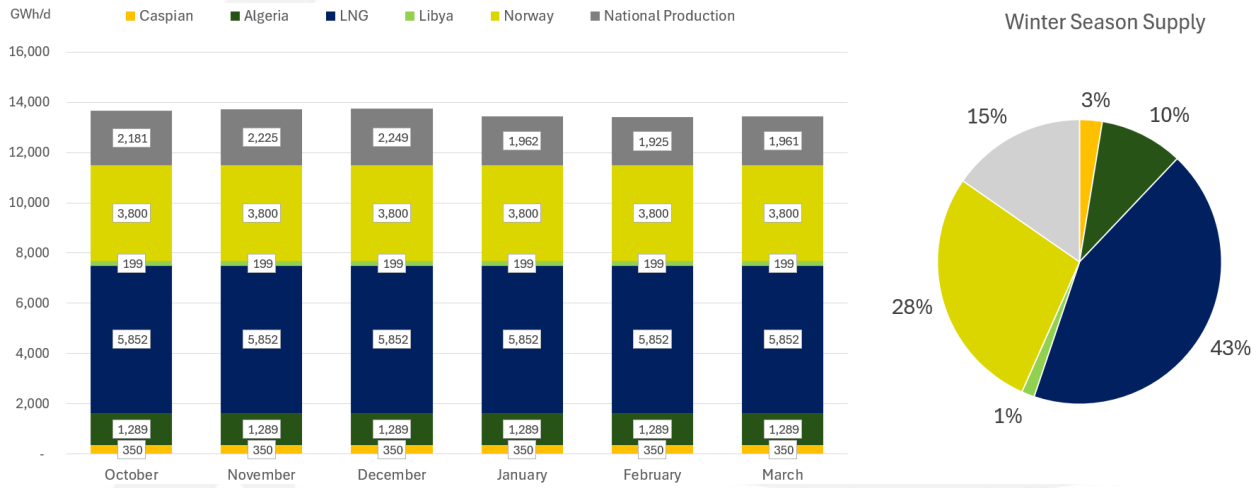


Figure 19. - Supply dependence assessment (5-year average demand). Supply mix (GWh/d)

Figure 19 show the level and composition of the supply mix in the Winter supply dependence assessment scenario 5 years average demand. Supply shares remain similar but the storage filling level at the end of March 2025 is 41%[15]. The decrease in the 5 years average demand by 15% would provide enough flexibility and the ability to meet the EU countries target of 59% average by the end of March 2025.

[14] The import levels shown represent one possible supply option, with LNG providing import flexibility in this example

[15] The import levels shown represent one possible supply option, with LNG providing import flexibility in this example

4.3. Winter supply dependence assessment under LNG Low Scenario

For the reference demand scenario without Russian supply, the impact of introducing the LNG low sensitivity during winter is that the storage filling level results at the end of March 2025 fall down from 59% (with reference LNG supply) to 11%.

In the case of low LNG Supply, no Russian pipeline supply and highest demand scenario (5 years average) the storages are also depleted down to 11% at the end of the winter (only strategic volumes are not used) and the results also show the risk of 9-10% potential demand curtailment.

Some European countries reserving a part of their own gas stock constituted as strategic reserves to be used only for the purpose of mitigating demand curtailment. The model assumes actual strategic storage facilities constraints but simulation results do not consider the utilization of strategic storage reserves. This means that strategic reserves remain available to reduce or even avoid demand curtailment in some countries. Availability of strategic storage reserves is depending on the country's specific regulation and more information about it for selected countries is aggregated in ANNEX A.

Country	Storages % Level
Austria	0.21
Belgium	0.09
Bulgaria	0.00
Croatia	0.00
Czechia	0.02
Denmark	0.20
France	0.00
Germany	0.00
Hungary	0.28
Italy	0.25
Latvia	0.07
Poland	0.39
Portugal	0.68
Romania	0.00
Slovakia	0.00
Spain	0.52
Sweden	0.00
The Netherlands	0.00
United Kingdom	0.00

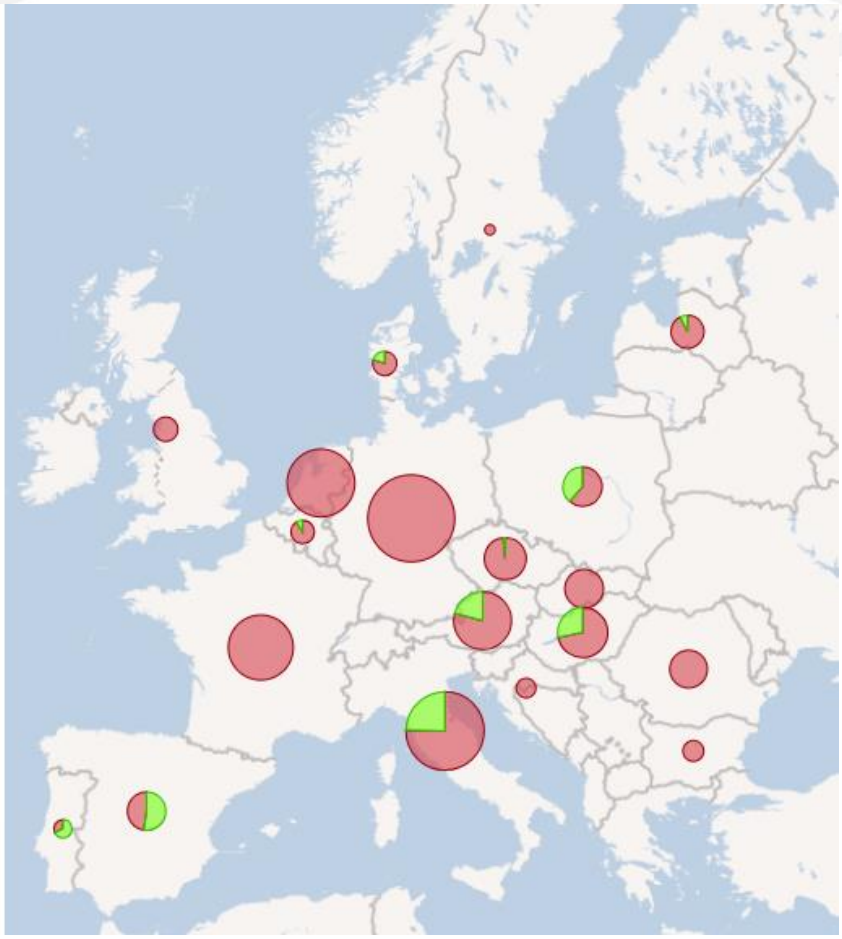


Figure 21 – Storage fill-in level LNG Low Winter No Russia pipeline Gas

Country	Demand Curtailment
Austria	0.09
Belgium	0.09
Bosnia and Herzegovina	0.10
Bulgaria	0.09
Croatia	0.09
Czechia	0.10
Denmark	0.09
Estonia	0.09
Finland	0.09
France	0.09
Germany	0.09
Greece	0.09
Hungary	0.10
Ireland	0.09
Italy	0.09
Latvia	0.09
Lithuania	0.09
Luxembourg	0.09
Moldova	0.10
Poland	0.09
Portugal	0.09
Romania	0.09
Slovakia	0.10
Slovenia	0.10
Spain	0.09
Sweden	0.09
Switzerland	0.09
The Netherlands	0.09
United Kingdom	0.09

Figure 22 - LNG low No Russia Disruption Demand 5 years average winter - Curtailment Rate

Even in the low LNG Supply with no Russian pipeline supply and the highest possible demand scenario (5 years average) the potential curtailment shows a high cooperation, without any bottlenecks, with 9-10% of the demand affected similarly all across Europe.

Legal Notice

The current analysis is developed specifically for this Summer Supply Outlook 2024 with Winter Overview. It results from TSOs experience, ENTSOG modelling and supply assumptions and should not be considered as a forecast. The actual supply mix and storage level on 30 September 2024 and 31 March 2025 will depend on market behaviour and global factors.

ENTSOG has prepared this Summer Supply Outlook 2024 with Yearly Overview in good faith and has endeavoured to prepare this document in a manner which is, as far as reasonably possible, objective, using information collected and compiled by ENTSOG from its members and from stakeholders together with its own assumptions on the usage of the gas transmission system. While ENTSOG has not sought to mislead any person as to the contents of this document, readers should rely on their own information (and not on the information contained in this document) when determining their respective commercial positions. ENTSOG accepts no liability for any loss or damage incurred as a result of relying upon or using the information contained in this document.

ANNEXES

Annex A: UGS

The data for Summer Supply Outlook 2024 is available online as an annex of this report. The data available is specifically:

- Working Gas Volume and Gas in storage on 1 April 2024.

For the modelling of the different scenarios, the Summer Supply Outlook 2024 considers the storage inventory level per country on 1 April 2024 as the initial situation. The gas in storage on 1 April 2023 for each country is based on the AGSI+ platform. For Serbia, the initial storage is considered 59% due to non-availability of data. The relative filling level has been calculated using the Working Gas Volume and gas in the storage from the AGSI+ platform.

- Strategic storages and reserves

European countries that are reserving a part of their own gas stock as strategic in a specific gas storage or generally in form of strategic reserves. The availability of these strategic storages or reserves are depending on the country's specific regulation.

- Injection and withdrawal curves.

In order to capture the influence of UGS inventory level on the withdrawal capacity, ENTSOG has used the deliverability curves made available by GSE. These curves represent a weighted average of the facilities (salt caverns, aquifers or depleted fields) of each area.

Annex B: Demand, National Production, Supply Potential and Export

The data for Summer Supply Outlook 2024 is available online as an annex of this report. The data available is specifically:

- Average daily Reference Winter and Reference Summer demand forecast, GWh/d.

The Reference demand (from 1 April 2024 to 31 March 2025) is based on TSOs' estimates.

- Average daily 5YA demand and 5YA with -15% demand response forecast, GWh/d.

The 5YA demand (from 1 April 2024 to 31 March 2025) is based on 5-year average demand from 2017-2021/22 and 5YA -15% is considering a 15% demand reduction .

- Average daily National production forecast, GWh/d.

The national gas production estimated by TSOs

- Supply potential and exports to Ukraine

For each of the winter and summer demand profiles and high demand situations in the winter season, specific maximum gas supply availabilities are used in the report. The maximum supply potentials of the different sources providing gas to the EU are based on the historical availability over the last five years (Caspian Sea, Algeria, Reference LNG) or based on TSO information (Libya, Norway) or the observed flows of the last year (Russia).

Export to Ukraine is based on the expected forecast provided by the Ukrainian TSO.

Annex C: Modelling approach

The topology of the network model considers the existing European gas infrastructure, new upcoming projects, and the firm technical capacities provided by TSOs, which include maintenance plans known as of October 2023.

ENTSOG is using Plexos modelling tool since spring 2021. The gas topology at European level and the Entsog model is modelling the European gas infrastructure with the most relevant accuracy. This enables the national assessment of relevant risks affecting the security of gas supply to benefit from the Union wide simulation of supply and infrastructure disruption scenarios and further extend the local assessment with a higher granularity.

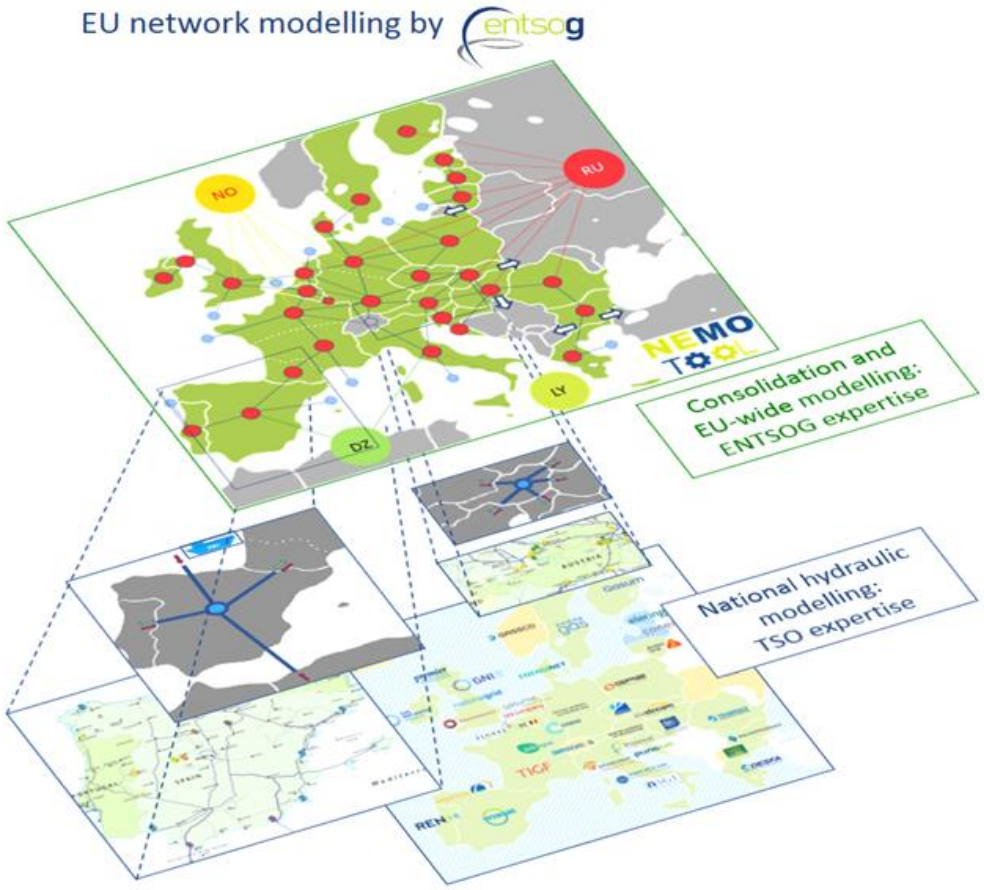


Illustration 1: Entsog model overview

The cooperative modelling is done on the basis of an optimal crisis management. That is, in case a country faces a demand curtailment, all the other countries will cooperate in order to share the same ratio of demand curtailment.

Annex D: Curtailment Rate Results

The data for Summer Supply Outlook 2024 is available online as an annex of this report. The data available is specifically:

- Curtailment Rate for Winter Outlook monthly simulations, %

For each demand situation and each zone, modelling results consist in the calculation of Curtailment Rate which is the potential level of demand curtailment representing the share of the gas demand that cannot be satisfied (calculated as a daily volume). The level of demand curtailment is assessed considering a cooperative behaviour between European countries in order to mitigate its relative impact. This means that all countries try to reduce the curtailment rate of other countries by sharing it.

Note: to give a comparable picture of the situation and avoid any distortion in the cooperative behaviour of ENTSOG's model, all indicators consider the demand as it is defined in the assumptions. However, in practice, a reduction of demand is observed in case of risk of inadequacy between supply and demand, generally as a consequence of increasing prices. This demand response to high prices is considered in the results (-15% demand reduction) and should be given due attention when interpreting the risk exposure to demand curtailment in the different countries. This is why an exposure to a few percentiles of demand curtailment observed in a country is generally considered as a limited risk in this assessment.

Abbreviations

TSO	Transmission System Operator
UGS	Underground Storage
LNG	Liquified Natural Gas
WGV	Working Gas Volume
UAe	Export to Ukraine

Supplies

CA	Caspian Area
DZ	Algeria
LY	Libya
NO	Norway
NP	National Production
RU	Russia

Countries

AT	Austria
BE	Belgium
BG	Bulgaria
CY	Cyprus
CZ	Czechia
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GR	Greece
HR	Croatia
HU	Hungary
IE	Ireland
IT	Italy
LT	Lithuania
LU	Luxembourg
LV	Latvia
MD	Moldova
MK	North Macedonia
MT	Malta
NL	The Netherlands
PL	Poland
PT	Portugal
RO	Romania
RS	Serbia
SE	Sweden
SI	Slovenia
SK	Slovakia
UK	United Kingdom
UKn	Northern Ireland

Other

ATti	Austria Tirol
ATvo	Austria Vorarlberg
BEh	Belgium H-gas
BEl	Belgium L-gas
DEl	Germany L-gas
DEn	Germany THE South
DEg	Germany THE North
FRnL	French Nord L-gas
LNG_FRn	French LNG zone North
LNG_FRs	French LNG zone South
LNG_ITa	Italian LNG zone Adriatic
LNG_ESa	Spain LNG zone Atlantic
STcAT	Austrian storage zone
STcATm	Austrian multi-country storage zone
STcATn	Austrian storage zone connected to THE South
STcCZd	Czech storage zone connected to Slovakia
STcDE	Germany storage zone
STcDEd	Germany Dutch storage zone
STcDEdL	Germany Dutch storage zone L-gas
STcDEg	Germany storage zone connected to THE North
STcDEm	Germany multi-country storage zone
STcDEmL	Germany multi-country storage zone L-gas
STcDEn	Germany storage zone connected to THE South
STcFRa	TSO GRTGaz storage zone Atlantic
STcFRn	TSO GRTGaz storage zone North
STcFRnL	TSO GRTGaz storage zone North L-gas
STcFRs	TSO GRTGaz storage zone South
STcFRt	TSO Terega storage zone

Publisher ENTSOG AISBL
Avenue de Cortenbergh 100
1000 Brussels, Belgium

Co-Authors Thilo von der Grün, Kacper Żeromski, Arturo de Onis Romero-Requejo, Diana Fathelbajanova, Hubert Bolesta

Cover picture Courtesy of SGI

ENTSOG AISBL
Avenue de Cortenbergh 100 | 1000 Brussels, Belgium
Tel. +32 2 894 51 00

info@entsog.eu | www.entsog.eu