entsog
european network
of transmission system operators
for gas

ENTSOG
WINTER SUPPLY OUTLOOK

2024/2025

Including Summer 2025 Overview

Contents

Executive Summary

In line with Art 26 (3)(g) of Regulation EU) 2024/1789, ENTSOG has undertaken an assessment of the European gas network for the upcoming winter (1 October 2024 to 31 March 2025). The analysis investigates the possible evolution of supplies and underground gas storage facilities' (UGS) inventory along the season as well as the ability of the gas infrastructure to meet the demand, especially to face high demand situations. ENTSOG has used a sensitivity analysis to assess if the European gas infrastructure is able to handle the winter season under two different weather conditions: Reference Winter and Cold Winter.

Winter preparedness is repeatedly one of the most important topics being discussed by energy stakeholders and following findings of previous analyses it needs to be considered as early as possible. That is why in this report ENTSOG offers a wide variety of different sensitivities, not only for this winter assessment but also for the longer-term preparedness.

On the basis of the interest expressed by institutions and stakeholders, ENTSOG has also run an overview analysis for the summer 2025 season (1 April 2025 to 30 September 2025). This analysis addresses two different perspectives – active anticipation of the 90% UGS stock level target at the end of the investigated period (full gas year, 12 months simulation), and a lower UGS stock level of 30% at the beginning of summer season. The analysis investigates the possible evolutions of supplies and injections into UGS along the summer 2025 as well as the ability of the gas infrastructure to meet the demand.

Russia's invasion of Ukraine continues and preserves energy security concerns in Europe. Therefore, ENTSOG has additionally assessed Europe's dependence on the Russian gas supply during the winter 2024/25 and the summer 2025. This includes different cases of LNG availability for Europe, assuming the possibility to transit European gas between Member States through the Ukrainian system and investigating the availability of the European infrastructure to supply Moldova.

Winter Supply Outlook 2024/25 main findings

- On 1 October 2024, the EU's UGS reached 94% on average which translates to 1,083 TWh. The high storage filling level (59%) at the beginning of the injection period, lower gas consumption over the years and dedicated measures introduced by the Member States contributed to a high volume of gas in storage at the beginning of the winter period.
- The gas infrastructure, including the projects that have been commissioned during this year and the expansions to be commissioned over the upcoming winter, are boosting energy security in the EU and allow for a more efficient cooperation among the EU Member States. However, under specific circumstances, some possible supply limitations and bottlenecks may occur.
- The transit contract between Ukraine and Russia expires in December 2024. This Outlook includes the transit of EU gas through Ukraine (considering technical firm capacities

available), Ukrainian UGS capacities that can be used by EU shippers, the Moldovan gas infrastructure, and the Moldovan gas demand.

Reference Winter[1] scenario (1 October to 31 March 2025)

- In the case of the Reference Winter, the European gas network enables the demand to be met and still to keep more than 30% UGS stock level (on average) in all UGS by the end of the winter season in April 2025. Under assumptions of Reference winter demand and supply, the gas infrastructure enables to reach a 52% storage level on EU average.
- LNG supply and supply from Norway represents the largest sources of supply for the EU Member States and the Energy Communities' Contracting parties. Assuming availability of different gas sources, gas demand can be satisfied while keeping a minimum 30% storage level even in case of limited LNG availability (as investigated in the LNG Low supply scenario where a part of the LNG supply cannot be attracted by the European market).
- In the high demand cases (i.e.,2-week cold spell and peak day demand in the Reference Winter scenario) no EU Member State is exposed to the risk of demand curtailment. Moldova and Ukraine would need to introduce demand response measures or secure additional capacities from the EU countries to mitigate the risk of demand curtailment in peak day.

Winter supply dependence assessment in the Reference Winter scenario – supply disruption from Russia (1 October to 31 March 2025)

- Europe could still reach 40% UGS stock level at the end of the winter season for the Reference Winter case even without Russian pipeline gas, **demonstrating the independence of the EU gas system from Russian pipeline supply**.
- The LNG low sensitivity, situation where a part of the LNG supply (around 1000 GWh/d) cannot be attracted by the European market, demonstrates that demand measures or adequate volumes of gas need to be secured during the winter season to avoid depletion of UGS below the desired 30% minimum stock level before the end of March 2025.

Cold Winter[2] scenario (1 October 2024 to 31 March 2025)

- In the Cold Winter scenario, if no additional demand side measures would be introduced (either policy-based or price response-based) or additional volumes of gas secured, Europe would need to use UGS more extensively, resulting in reaching 18% of UGS stock level on EU average at the end of the winter season. In case of the LNG Low scenario, Europe would need a demand response estimated at the level of 3% of the Cold Winter demand, leaving only 11% of UGS strategic stock reserves on EU average at the end of the winter season.
- Additional usage of strategic UGS reserves could further improve the situation. These reserves are not freely available on the market under normal conditions and represent 11% of all European UGS working gas volume. Some European countries are reserving a part of their own gas stock to be constituted as strategic UGS reserves and used only for the

[1] The Reference Winter demand (from 1 October 2024 to 31 March 2025) is based on TSOs' estimates.
[2] The Cold Winter demand is based on demand assumptions considered in ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024, i.e., the historical highest winter demand since the winter 2009/10 on country level.

purpose of mitigating demand curtailment. The availability of strategic UGS reserves is depending on the country's specific regulation.

- In case of full disruption of Russian pipeline supplies in the Cold Winter situation, results show that gas withdrawal from UGS combined with the supply flexibility are not sufficient to cover the demand. Demand response measures and additional supplies in total at the level of 330 TWh (approx. 30 bcm) during winter season would be needed to avoid the risk of demand curtailment and to keep minimum 30% of the storage levels. This demand response or additional supply need would be within the range of 15% the Cold Winter demand.
- In the LNG Low supply scenario with no pipeline supply from Russia, European countries would need a demand response estimated at the level of 8% of the Cold Winter demand. 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. Availability of strategic storage reserves is depending on the country's specific regulation. Demand side response measures and additional supplies in total at the level of 500 TWh (approx. 45 bcm) during winter season would be needed to avoid the risk of demand curtailment and to keep minimum 30% of the storage levels. This demand response or additional supply need would be within the range of 15% the Cold Winter demand.

Winter Demand	RU supply	Storage Target	LNG Scenario	Demand curtailment	Final UGS filling level
Reference	Minimised	30%	Ref	No	32%
		30%	Low	No	32%
		Maximum	Ref	No	52%
	Disrupted	30%	Ref	No	32%
		30%	Low	No	25%
		Maximum	Ref	No	40%
Cold Winter	Minimised	30%	Ref	No	18%
		30%	Low	3%	11%
		30%	High	No	32%
	Disrupted	30%	Ref	3%	11%
		30%	Low	8%	11%
		30%	High	No	26%

Table 1. Winter Supply Outlook Results Summary

Strategic storage reserves account for 11% in EU average. An additional 225 TWh (approx. 20 bcm) during winter would be needed to reach the target and keep at least 32% on average of the storage levels at the end of the withdrawal season.

Summer 2025 overview main findings

The simulations considering the Reference demand scenario (1 April to 30 September 2025) and the 5-year average demand from 2017 to 2021 with 15% demand reduction (5YA-15%) in the spirit of the coordinated demand reduction measures defined in the Council Regulation (EU) 2022/1369 of 5 August 2022.

- Starting from a UGS stock level of 32%[3] on 1 April 2025, under the described supply and capacity assumptions, it could be possible to cover the EU demand and reach the 90% UGS stock level target under the 5YA-15% demand scenario.
- In the Reference demand scenario without any Russian pipeline supply, some additional measures could be needed to reach more than 82% on 1 of October 2025 or injection to UGS need to be prolonged during October.
- Without any pipeline supply from Russia and with LNG Low supply scenario, in the case of the Reference demand scenario, results for this assessment show that it would be possible to meet the 90% UGS stock level if the levels at the beginning of the summer would not go below 39%.

[3] The storage filling level is 32% (above 30%) due to national strategic reserves in some countries.

Conclusions

- Current high storage levels, along with the gas infrastructure (already existing infrastructure and newly commissioned infrastructure) reduce the dependence on Russian supply, allowing for more efficient usage of UGS (for injection or withdrawal), and import, as well as the transit, of more LNG using new LNG terminals. In case of high demand events, additional measures might be needed.
- UGS play an essential role to ensure security of supply, providing seasonal flexibility needed during the winter season. An early significant UGS withdrawal will 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 keep storage at an adequate level until the end of the winter. However, some European countries are reserving a part of their own gas stock, constituted as strategic reserves, and used only for the purpose of mitigating demand curtailment. The availability of strategic UGS reserves is depending on the country's specific regulation.
- In case of full disruption of Russian pipeline supplies during winter, additional measures might be needed to save adequate volumes of gas for the end of the season, and to avoid risk of demand curtailment in case of Cold Winter and peak demand situations. Simulation results showed that the introduction of possible measures, such as additional supplies, and a 15% decrease in gas demand, would avoid demand curtailment risks and allow for reaching an adequate storage level without any pipeline supplies from Russia. Even in case of a full Russian pipeline supply disruption, cooperation between the countries and demand measures could allow for a more efficient injection during the summer 2025 in preparation for the next winter.
- To achieve the 90% UGS stock level target by the end of summer 2025, it is necessary to maintain gas at the beginning of the injection season (between 30 and 40%) depending on the availability of LNG. In the Low LNG supply scenarios, some demand response may be necessary to reach the 90% target.
- EU UGS stock levels are considerably high on 1 October 2024 (94%). Additional UGS flexibility could be secured by storing additional volumes in Ukrainian UGS under the condition that this gas can be injected and later on withdrawn during the winter season and market participants would be willing to use it. Transit of gas through Ukraine between EU Member States could improve interconnectivity between the CEE and SEE regions.

Important:

ENTSOG's Winter Supply Outlook 2024/25 with Summer 2025 overview is an assessment of the readiness of the gas infrastructure to cope with the upcoming winter and summer seasons under different scenarios, but this assessment is not a forecast of the expected gas supply situation and the 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 by preparation or mitigation measures. The identified risks are based on the assessment of a reference scenario and a variety of sensitivities, which consider uncertainties that could materialise.

1. INTRODUCTION

This edition builds on previous Winter and Summer Supply Outlooks. It covers two different weather demand scenarios for the winter season: Reference Winter and Cold Winter. The assessments related to the Cold Winter case are based on the demand data assumptions of ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024[4].

The Winter Supply Outlook 2024/25 with Summer 2025 overview aims at assessing the ability of the European gas infrastructure to provide enough flexibility to meet different demand situations during the UGS withdrawal season and sufficient flexibility to shippers during the UGS injection season.

Russia's invasion of Ukraine triggers energy security concerns in Europe. Therefore, ENTSOG additionally assessed the dependence of the EU on the Russian supply during winter 2024/25 and summer 2025 seasons, including no transit through Ukraine after December 2024 in all cases.

ENTSOG also assessed different cases of LNG availability for Europe.

2. ASSUMPTIONS

The Winter Supply Outlook 2024/25 with summer 2025 overview is based on assumptions specific to the upcoming winter and summer seasons and short-term trends as detailed in the annexes. In any case, the actual withdrawal, injection, and supply mix will result from market behaviour and other external factors such as policy decisions.

UGS behaviour in the modelling is defined as follows:

- The actual UGS stock level on 1 October 2024 according to AGSI+ platform. A target UGS stock level of 30% should be reached at the end of the withdrawal season (Winter Supply

[4] https://www.entsog.eu/security-of-supply-simulation

Outlook 2024) and is defined for each storage facility. This target is not mandatory, i.e., the UGS stock level goes below 30% if other supply sources otherwise cannot satisfy demand.

- The UGS stock level target for the injection season (Summer 2025 overview) is 90% on 1 October 2025 and is defined for each storage facility. This target is not mandatory, i.e., the storage level cannot be achieved if other supply sources otherwise cannot satisfy demand. This assumption is made to check that infrastructure is not limiting this possibility.

- In the Summer Overview the Ukrainian UGS that is considered available for EU shippers is modelled as a last resort UGS, i.e., it is only filled after all the other EU UGS meet the established UGS stock level target.

2.1. Infrastructure

A significant number of new gas infrastructure facilities were commissioned over the past year, with a notable emphasis on the buildup of new LNG import capacities, boosting energy security in the EU. The new FSRUs have been commissioned in 2023 in Germany, Finland, the Netherlands, and Italy.

The topology of the network model considers the existing European gas infrastructure, the firm technical capacities[5] provided by TSOs, which include maintenance plans known as of September 2024 and new upcoming projects as of their respective expected start of commercial operations. For example:

- New Tyra production in Denmark from October 2024;
- Alexandropulus LNG in Greece in October 2024;
- Brunsbuettel Hafen and Wilhelmshaven expansions in Germany in the beginning of 2025;
- Ravenna FSRU import terminal in Italy from March 2025.

Additionally, taking into account that the transit contract between Ukraine and Russia expires in December 2024, the Outlook now includes the demand on the right bank of the Dniester River in Moldova (in the scenario that still assumes some Russian gas delivery to Europe) or additionally the demand on the left bank of Dniester River (in the scenario that assumes that no Russian gas is delivered to Europe anymore). Transit of EU gas through Ukraine (considering the technical firm capacities available) can be used by EU shippers.

In order to capture the influence of the UGS inventory level on the injection and withdrawal capacities, ENTSOG used injection and deliverability curves that were provided by GIE[6]. These curves represent a weighted average of the UGS of each area (see **Annex A**).

[5] According to EC Regulation 2024/1789 of 13 June 2024 'technical capacity' means the maximum firm capacity that can be offered to the network users, taking account of system integrity and the operational requirements of the transmission system operator; 'firm capacity' means natural gas and hydrogen transmission and distribution capacity contractually guaranteed as uninterruptible by the transmission system operator.
[6] https://www.gie.eu

2.2. Seasonal Demand

The Reference Winter demand (from 1 October 2024 to 31 March 2025) is based on TSOs' estimates and is provided with a monthly granularity. An average daily demand has been considered within each month (see **Annex B** for country details).

The demand for the Cold Winter is based on demand assumptions considered in ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024, i.e., the historical highest winter demand since the winter 2009/10 on country level.

For comparison, **Figures 1 and 2** show the European aggregated daily demand for the Reference Winter compared with the historical aggregated daily demand over the last five winters. The estimated demand is compared with the winter 2023/24 for the two assessed winter 2024/25 demand cases. The Reference Winter demand and the Cold Winter Demand are increased by +14.6% and +30.9% respectively. **Figure 2** is also comparing the respective Reference Winter and Cold Winter demand with the demand for the 5-year average winter seasons from 2017/18 to 2021/22 in units of TWh/season.

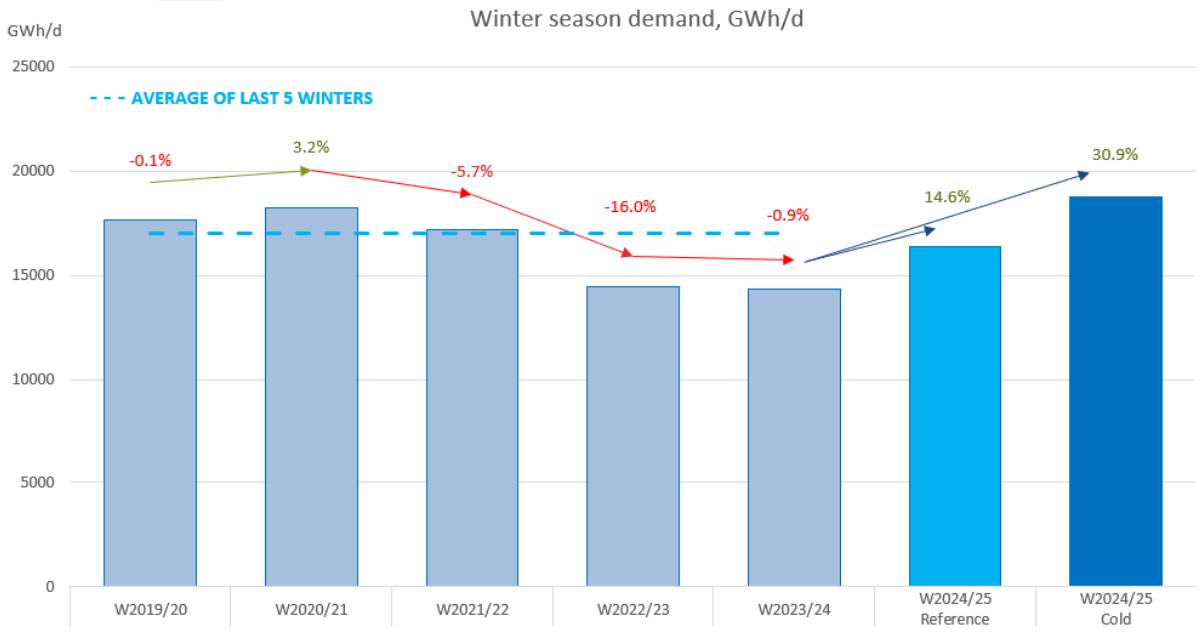


Figure 1. European daily average winter demand with forecasted Reference demand and Cold Winter demand for Winter 2024/25, GWh/d

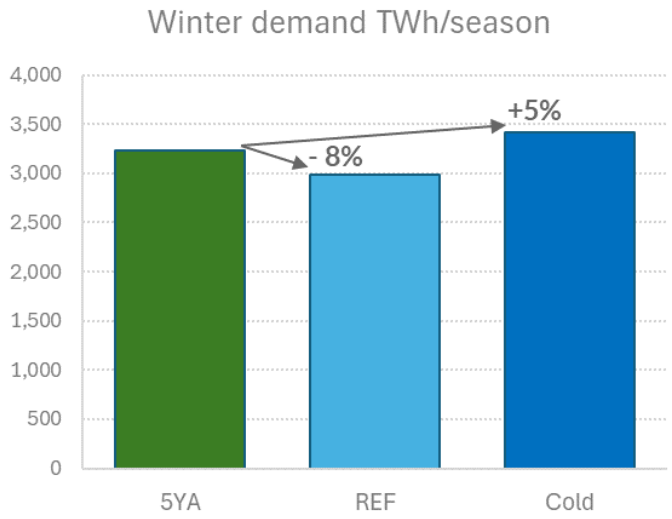


Figure 2. Forecasted Reference demand for Winter 2024/25 and comparison with Cold Winter demand and with 5-year average winter demand for period 2017/18 - 2021/22, TWh

The Yearly and Summer simulations consider Reference demand as well as the average historical demand of the five summer seasons from 2017 to 2021 reduced by 15% in the spirit of the coordinated demand reduction measures defined in the Council Regulation (EU) 2022/1369 of 5 August 2022. The 5-year average demand values have been updated for the simulations in this report to consider the latest market conversions from L-gas to H-gas in Germany, France, and Belgium. An average daily demand has been considered for each month (see **Annex B** for country details).

For comparison, **Figure 3** shows the European aggregated daily demand for the Summer 2025 overview and the historical daily demand over the summers of the years 2019 to 2023.

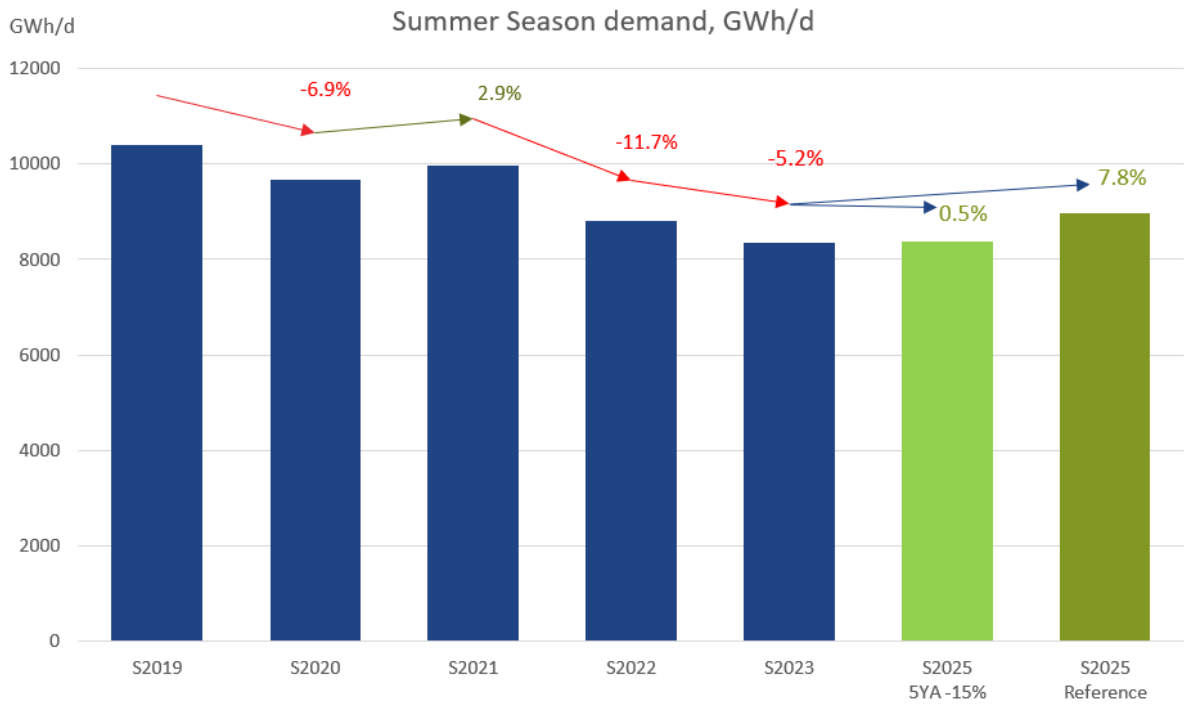


Figure 3. European daily average summer demand comparison with Reference summer demand and 5-year average -15% summer demand, GWh/d

2.3. Peak Demand

Two high demand situations are considered: Peak Day demand and 2-Week Cold Spell. They are defined in the table below:

Period	Occurrence of the demand provided by TSOs
Peak Day	One day (peak day) of exceptionally high demand, occurring with a statistical probability of once in 20 years
2-Week Cold Spell	A period of two weeks of exceptionally high demand, occurring with a statistical probability of once in 20 years

Table 2. Peak Day demand and 2-Week Cold Spell

The Peak Day and 2-Week Cold Spell demands are used to check if the withdrawal capacity from the UGS is sufficient during such events when the storage levels are reduced, and their maximum withdrawal capacity is therefore not available.

Figure 4 shows the European aggregated 2-Week Cold Spell demand. Reference Winter[7] and Cold Winter[8] demand values are compared with the historical demand over the last five winters.

[7] The 2-Week Cold Spell demand for Reference Winter is based on TSOs' estimates.
[8] The 2-Week Cold Spell demand for Cold Winter is based on demand assumptions considered in ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024.

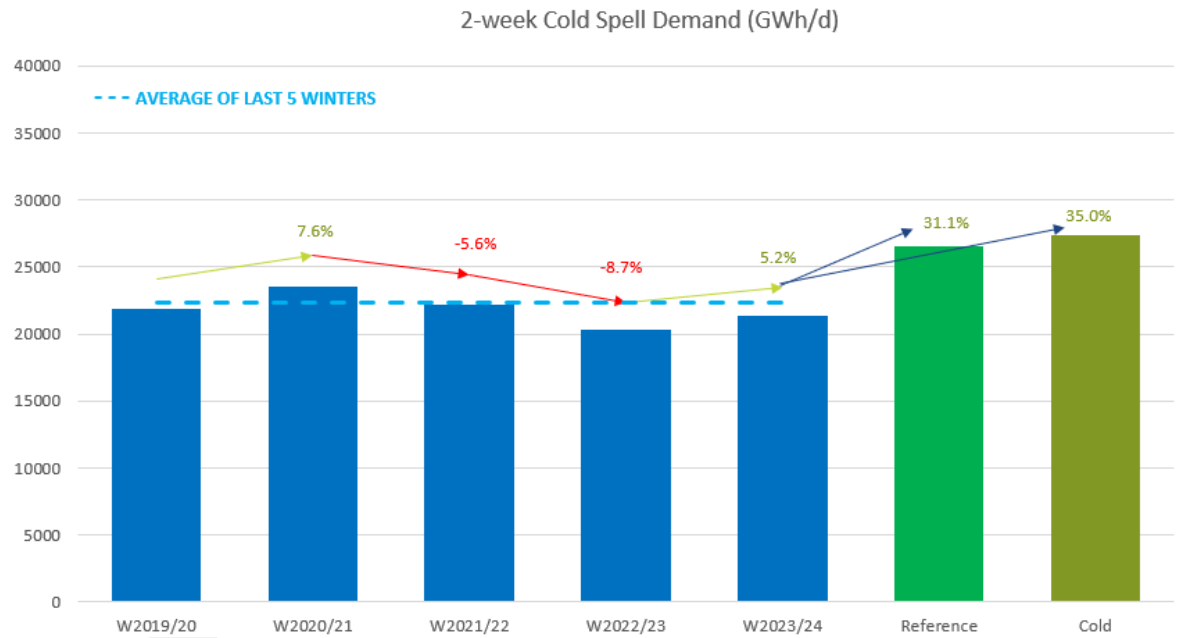


Figure 4. European 2-week cold spell demand history comparison with forecasted Reference Winter demand for winter 2024/25 and Cold Winter 2-Week Cold Spell demand, GWh/d

The 2-Week Cold Spell demand for the Reference Winter is higher than the highest two weeks of demand observed during the previous winter (+31.1%). In the event of a 2-Week Cold Spell during a Cold Winter, the demand could be +35.0% higher than in winter 2022/23.

Figure 5 shows the European aggregated Peak Day demand. Reference Winter[9] and Cold Winter[10] are compared with the historical demand over the last five winters.

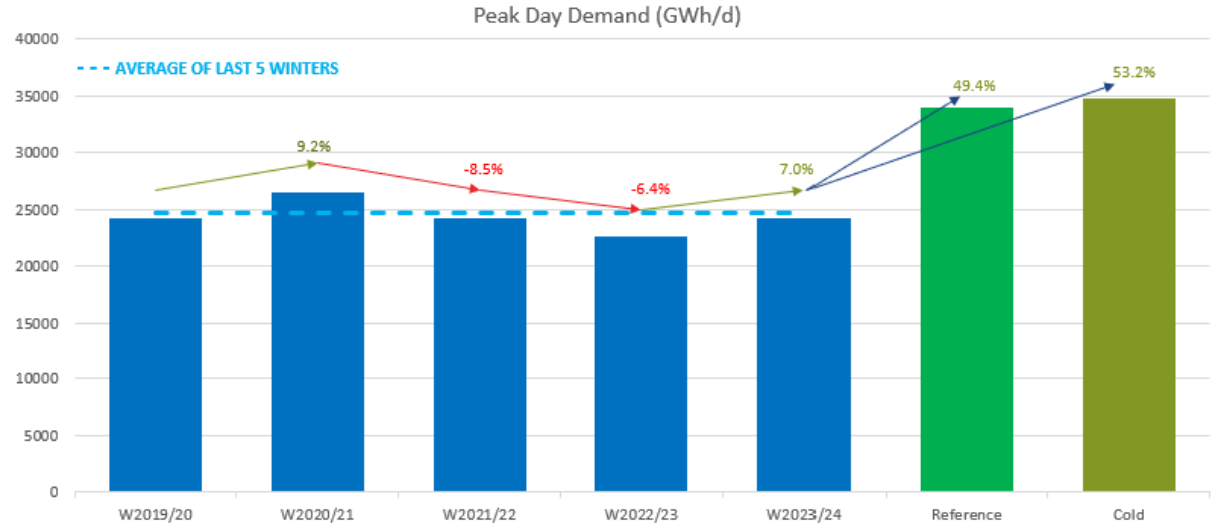


Figure 5. European Peak Day demand history comparison with forecasted Reference Winter Peak demand for winter 2024/25 and Cold Winter Peak demand, GWh/d

[9] Peak Day demand for Reference Winter is based on TSOs' estimates.

[10] Peak Day demand for Cold Winter is based on demand assumptions considered in ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024.

Due to the mild previous winters, the Peak Day demand for the Reference Winter is higher than that observed during the last winter (+49.4%) and higher than the average of the last five winters. In the event of a Peak Day during a Cold Winter, the demand could be higher by 53.3% than during the winter of 2023/24.

2.4. Import supply potential

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 two years (Russia). Maintenance works on Norwegian gas fields are considered in the report in line with the maintenance plan published in 2024[11].

Supply limitations are set for different cases (monthly values for winter and summer seasons, weekly values for the 2-Week Cold Spell case, daily values for the Peak Day case) so that the maximum flows from each source cannot exceed reasonable levels based on historical observations.

<table>
<tr><th></th><th>National Production</th><th>UGS</th><th>LNG</th><th>Caspian, Algeria, Norway, Libya</th></tr>
<tr><td>Winter Season</td><td>TSO forecast for winter</td><td rowspan="5">Limited for each country (or zone) by the stored volumes and the deliverability associated with the inventory level.</td><td colspan="2">Limited for the whole winter period at monthly level to the maximum 30 days rolling average of the last 5 winters[12].
For LNG, three different cases of supply availability are considered: (1) Reference LNG supply, (2) LNG Low supply, and (3) LNG High supply.</td></tr>
<tr><td rowspan="4">2-Week Cold Spell</td><td rowspan="3">TSO forecast for high demand situations</td><td>Week 1</td><td rowspan="4">Limited to the maximum 14 days rolling average of the last 5 winters.</td></tr>
<tr><td>Limited to the observed February flow in the model plus additional LNG that can be taken from the tanks to be shared with week 2.</td></tr>
<tr><td>Week 2</td></tr>
<tr><td>Limited to the maximum 14 days rolling average of the last 5 winters plus additional LNG that can be taken from the tanks to be shared with week 1.</td></tr>
<tr><td>Peak day</td><td>Limited to the maximum daily supply of the last 2 winters plus additional LNG that can be taken from the tanks.</td><td>Limited to the maximum daily supply of the last 5 winters.</td></tr>
<tr><td>Summer Season</td><td>TSO forecast for summer</td><td colspan="2">Limited for the whole summer period at monthly level to the maximum 30 days rolling average of the last 5 summers[13].
For LNG, three different cases of supply availability are considered: (1) Reference LNG supply, (2) LNG Low supply, and (3) LNG High supply.</td></tr>
</table>

Table 3. Gas supply maximum availability definitions

[11] Gassco website: https://umm.gassco.no/
[12] The Russian pipeline supply potential is based on the last year's flows.
[13] The Russian pipeline supply potential is based on the last year's flows.

The Russian pipeline supply potential is based on the previous 2 years' flows. It is thereby limited to recent supplies observed for TurkStream and Ukrainian transits (Ukrainian transit is only allowed until the end of 2024 in all the simulations). 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 therefore used with 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) LNG Low supply, and (3) LNG High supply.

The maximum supply potential for seasonal assessments is by default (if not specified by TSOs or Russian pipeline supply or 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 LNG Low supply represents a situation where a part of the LNG supply cannot be attracted by the European market. The LNG High supply case is only limited by the European LNG terminal regasification capacities and TSO network capacities and not by the availability of importable LNG.

The maximum supply potential for assessments of the 2-Week Cold Spell cases is by default (if not specified by TSOs or Russian pipeline supply or a LNG sensitivity) calculated as the maximum 14 days rolling average supply from this source over the last five years. The Reference LNG supply case is calculated as explained above (maximum 14 days rolling average), while the LNG Low supply case uses the relationship between the seasonal Reference LNG supply potential and the seasonal LNG Low supply potential and applies it to the Reference LNG supply potential for the 2-Week Cold Spell case. The LNG High supply case is only limited by the European LNG terminal regasification capacities and TSO network capacities and not by the availability of importable LNG. In all 2-Week Cold Spell cases, the modelling accounts for the additional amount of LNG that can be withdrawn from the tanks (see **Annex A**).

The maximum supply potential for assessments of the Peak Day cases is by default (if not specified by TSOs or Russian pipeline supply or a LNG sensitivity) calculated as the daily maximum from this source over the last five years. The Reference LNG supply case is calculated as explained above (daily maximum), while the LNG Low supply case uses the relationship between the seasonal Reference LNG supply potential and the seasonal LNG Low supply potential and applies it to the Reference LNG supply potential for the Peak Day case. The LNG High supply case is only limited by the European LNG terminal regasification capacities and TSO network capacities and not by the availability of importable LNG. In all Peak Day cases, the modelling accounts for the additional amount of LNG that can be withdrawn from the tanks (see **Annex A**).

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 as defined in **Table 4.**

GWh/day			DZ	LY	CA	NO	LNG Ref	LNG Low	LNG High	RU
Winter Season	Max per 30 days		1220	180	390	3800*	5500	4500	9000	1000
High Demand**	2-Week Cold Spell	Week 1	1225	190	395	4000	**	**	**	1200
		Week 2	1225	190	395	4000	5600	4600	9000	1200
	Peak day Cold Spell		1285	200	400	4000	6150	5150	9000	1300
Summer Season	Max per 30 days		1155	180	375	3800*	5300	4300	9000	950

* supply potential is recalculated for some months according to maintenance plan from Gassco
** limited to the observed supply potential in February plus additional LNG that can be taken from the tanks

Table 4. Maximum supply potential, GWh/d

Note: The supply assumptions (supply potentials) are based on the supply observed in the past and should not be considered as a forecast. The actual supply mix will depend on market behaviour and other external factors. Moreover, the model does not factorize commercial supply agreements.

European domestic production

Regarding the European domestic production**, Figure 6** and **Figure 7** provide a comparison between the last five winter and summer seasons and the national production forecasted by the TSOs for winter 2024/25 and summer 2025 (see **Annex B** for monthly details). Domestic production is following a long-term dwindling trend, primarily due to the end of production in October 2023 of the largest gas production in the EU, i.e., the Netherlands' Groningen field. However, the United Kingdom's gas production is in the same range after rising in 2022 due to a number of factors, including the commissioning of new fields in the Southern North Sea.

In the winter 2024/25, domestic production is estimated to decrease by 4% compared to the previous winter, while for summer 2025, it is forecasted to increase by approximately 2% compared to summer 2023.

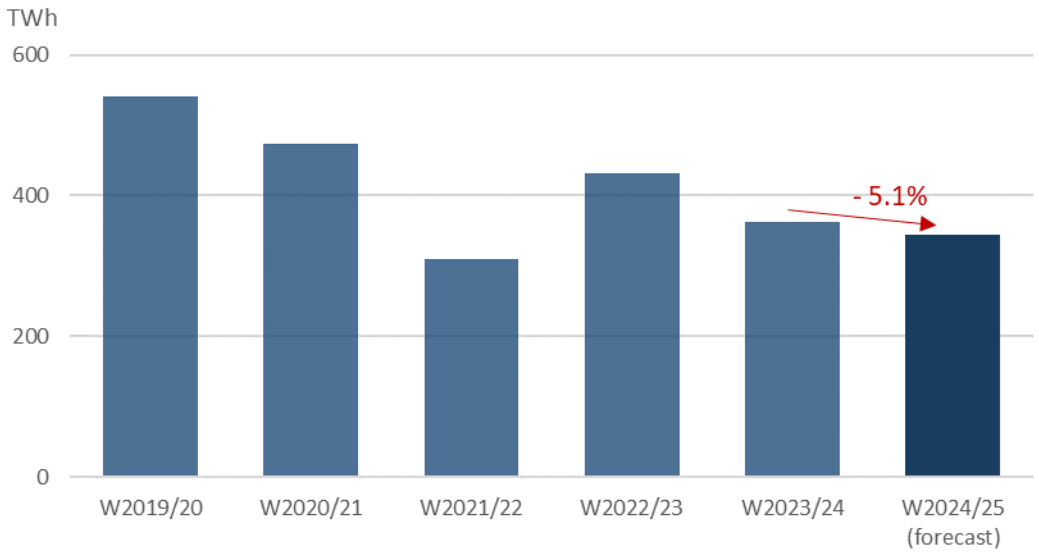


Figure 6. Historic European national gas production during winters compared with forecasted European national production in Winter 2024/25, TWh

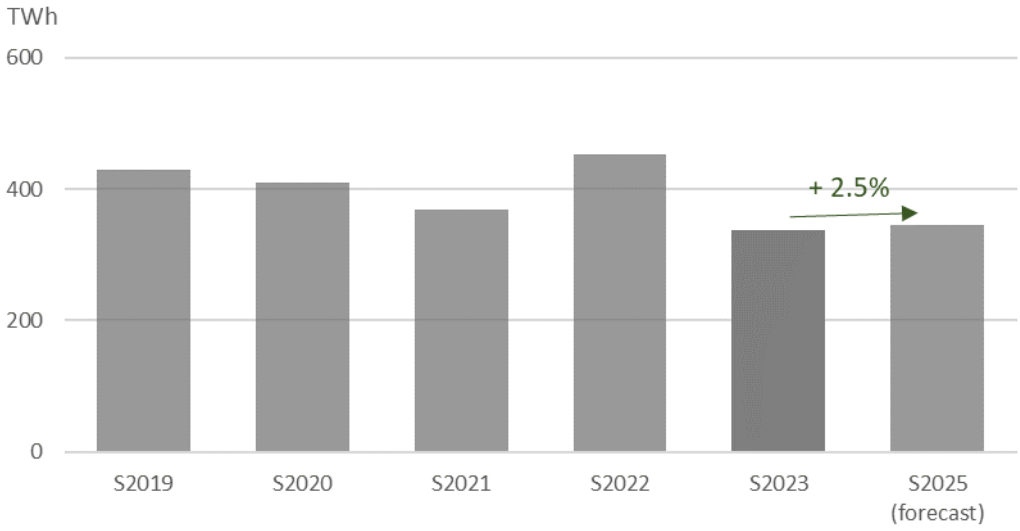


Figure 7. Historic European national gas production during summers compared with forecasted European national production in Summer 2025, TWh

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's Contracting parties, taking into account the geography and the actual supply situation:

- The United Kingdom, Switzerland, Bosnia and Herzegovina, North Macedonia, Serbia, and Moldova are included in the modelling perimeter.
- Export to Ukraine is 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.
- Gas flows through Strandzah 1 allow for additional imports from Turkish LNG terminals into the EU.
- Albania, Montenegro, and Kosovo are not connected to the gas grid.

2.5. Storage inventory

UGS behaviour in the modelling is defined as follows:

- **Winter Supply Outlook 2024/25**. The actual UGS stock level on 1 October 2024 according to the AGSI+ platform[14] is used. A target UGS stock level of 30% should be reached at the end of the withdrawal season (31 March 2025) and is defined for each storage facility. This target is

[14] https://agsi.gie.eu

not mandatory, i.e., the UGS stock level goes below 30% if other supply sources otherwise cannot satisfy demand.

Sensitivity analyses were also conducted with a maximum target. In these analyses, the model was allowed to exceed 30% to determine how high the storage level could potentially reach.

- **Summer 2025 overview.** The UGS stock level target for the injection season (Summer 2025 overview) is 90% on 1 October 2025 and is defined for each storage facility. This target is not mandatory, i.e., the storage level cannot be achieved if other supply sources otherwise cannot satisfy demand. This assumption is made to check that infrastructure is not limiting this possibility. Additionally, simulations are performed for the summer season starting with an initial storage filling level of 30% for each storage facility on 1 April 2025.

- In the Summer Overview the Ukrainian UGS that is considered available for EU shippers is modelled as a last resort UGS, i.e., it is only filled after all the other EU UGS meet the established UGS stock level target.

The model assumes cooperative behaviour among EU Member States. These concerns (i) an equal sharing of eventual demand curtailments between the EU Member States if technically possibly, (ii) LNG supply distribution between terminals according to security of supply needs, and (iii) 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 UGS 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 UGS and strategic reserves[15]. Therefore, these strategic UGS cannot be depleted to avoid/reduce demand curtailment in the simulations. The availability of strategic storage reserves is depending on the country's specific regulation.

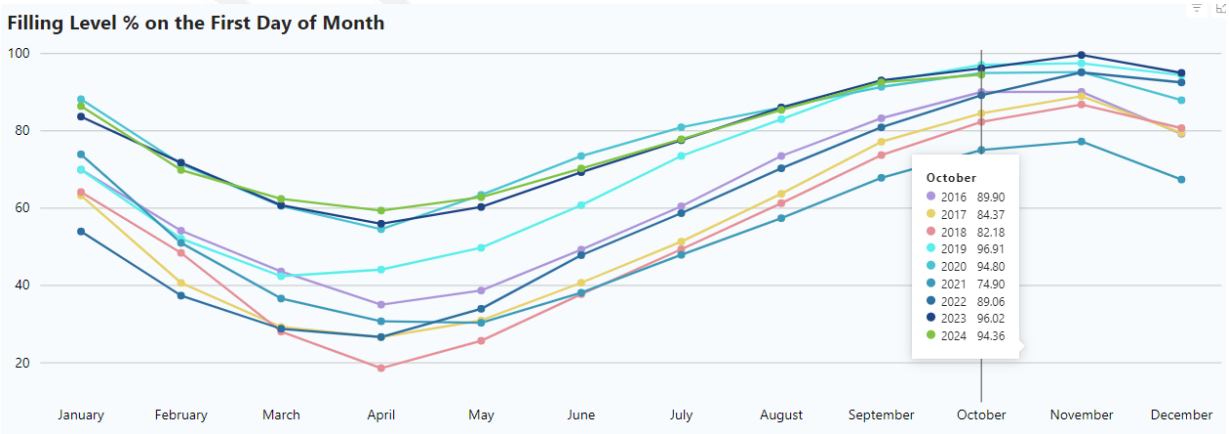


Figure 8. Monthly UGS stock level development since 2016, %

[15] The methodology used for strategic reserves and strategic UGS is explained in the Annex A.

On 1 April 2024, the EU UGS stock level reached the maximum of the range of the past 5 years with 669 TWh. The decrease in gas consumption (as a result of relatively mild winter weather, high prices, dedicated measures introduced by the EU Member States and individual users' behaviour) contributed to the record volume of gas in storage. **Figure 9** shows the total WGV, the initial gas in the storages on 1st April and the gas injected during the summer season (until end of September) between 2012 and 2024.

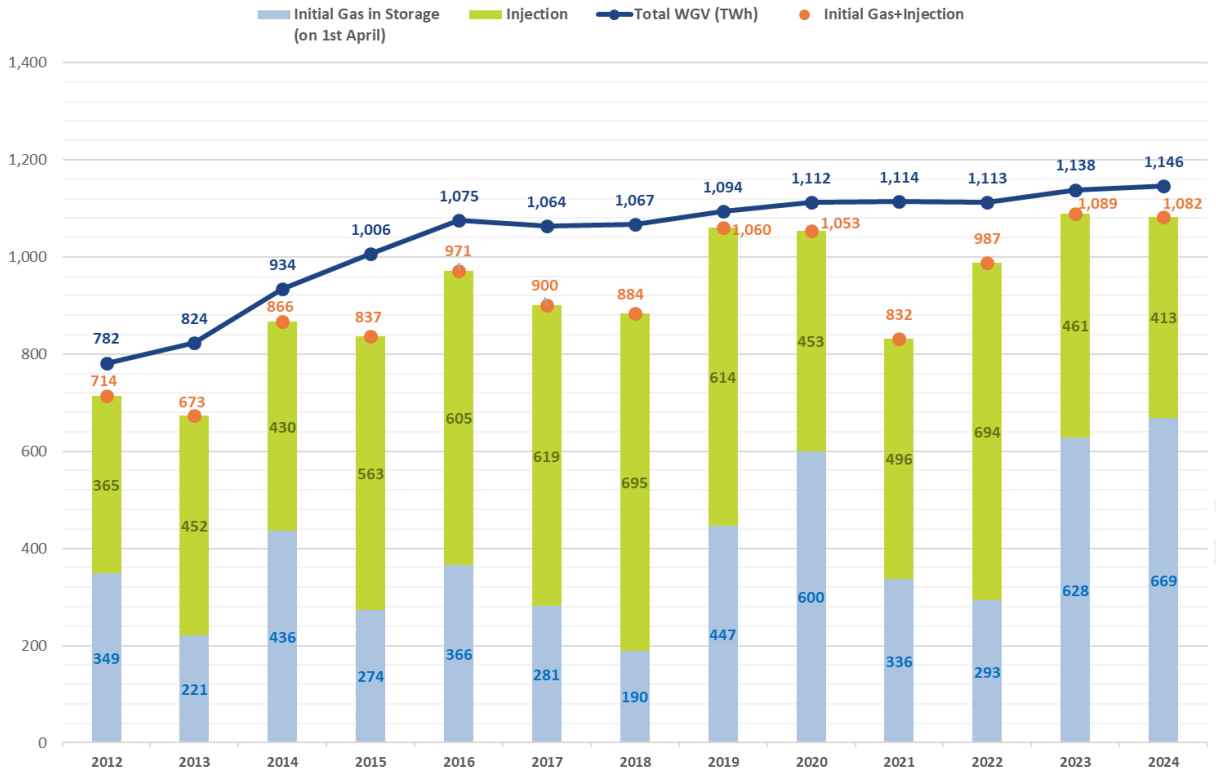
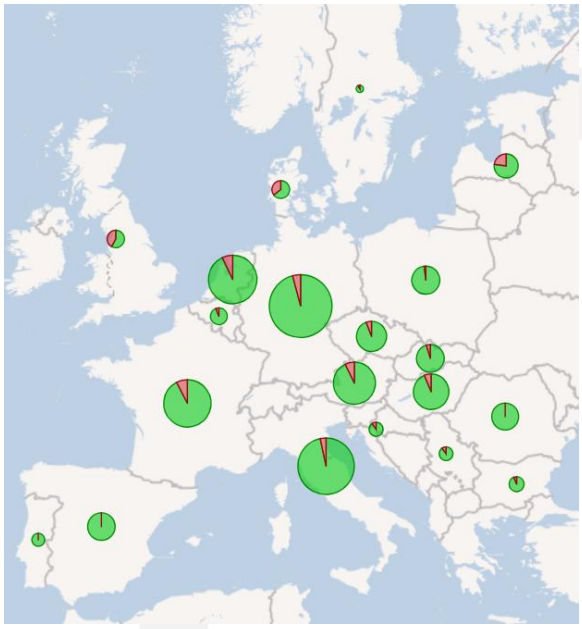


Figure 9. Situation of the storages during summer seasons (2012 to 2024).

- Initial storage level on 1 October 2024

On 1 October 2024, the European underground gas storage reached 94% of its filling level, equivalent to 1,083 TWh, achieving the EU's UGS stock level target of 90% ahead of the end of the injection period. Stocks were already high after the withdrawal season of 2023/24 and have accumulated slower than usual during the last months of the injection period.

For the modelling of the different scenarios, the Winter Supply Outlook 2024/25 considers the UGS stock level per country on 1 October 2024 as the initial situation as shown in Figure 10.



Country	Gas in storage	WGV, GWh	Full, %
Austria	94,156	101,587	93%
Belgium	8,319	9,130	91%
Bulgaria	5,547	5,890	94%
Croatia	4,309	4,773	90%
Czechia	42,390	45,247	94%
Denmark	6,699	10,372	65%
France	123,900	134,500	92%
Germany	241,478	251,138	96%
Hungary	63,624	67,991	94%
Italy	193,310	200,077	97%
Latvia	19,258	25,000	77%
Netherlands	133,364	144,029	93%
Poland	36,707	37,493	98%
Portugal	36,433	36,433	100%
Romania	34,384	34,384	100%
Serbia	3,950	4,396	90%
Slovakia	35,241	36,981	95%
Spain	35,913	35,913	100%
Sweden	93	102	91%
United Kingdom	5,714	9,864	58%

Figure 10. Actual UGS stock levels per country on 1 October 2024, GWh and %[16]

In absolute terms, the largest gas volumes on 1 October 2024 are stored in Italy and Germany. In relative terms, the storage level of all EU countries is higher than 90% except for Denmark. The highest filling levels (100%) are observed in Romania, Portugal and Spain, and the lowest in Denmark (65%) and the United Kingdom (58%). These storage levels per country have been used as a starting point for the Winter Supply Outlook 2024/25.

[16] The gas in storage on 1 October 2024 for each country is based on the AGSI+ platform. The relative filling level has been calculated using the Working Gas Volume and gas in the storage from the AGSI+ platform. For Serbia, the initial storage is considered 90% due to non-availability of data.

3. MODELLING RESULTS FOR THE WINTER SUPPLY OUTLOOK 2024/25

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

Winter Demand	RU supply	Storage Target	LNG Scenario	Demand curtailment	Final UGS filling level
Reference	Minimised	30%	Ref	No	32%
		30%	Low	No	32%
		Maximum	Ref	No	52%
	Disrupted	30%	Ref	No	32%
		30%	Low	No	25%
		Maximum	Ref	No	40%
Cold Winter	Minimised	30%	Ref	No	18%
		30%	Low	3%	11%
		30%	High	No	32%
	Disrupted	30%	Ref	3%	11%
		30%	Low	8%	11%
		30%	High	No	26%

Table 5. WSO Results Summary

3.1. Reference Winter scenario with 30% UGS stock level target for 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 30% stock level in each European UGS on 31 March 2025 when starting at an average European UGS stock level of 94% on 1 October 2024 (see Figure 10).

The distribution of withdrawal, demand, and supply over the winter months results from the modelling and the following assumptions:

- The monthly gas demand estimated by TSOs in **Annex B**
- The monthly national gas production estimated by TSOs in **Annex B**
- The monthly capacities provided by TSOs
- The storage withdrawal curves provided by GSE as defined in **Annex A**
- The flexibility given to the model for the definition of the supply potentials derived from the historical supply mix (see **Table 4**)

Based on these assumptions, the modelling has been used to check if any physical congestion or dependence on an import source may limit the satisfaction of gas demand during the withdrawal period, while all European countries cooperate.

The main finding of the Winter Supply Outlook 2024/25 for the Reference Winter scenario in combination with the Reference LNG supply potential is that the European gas network is

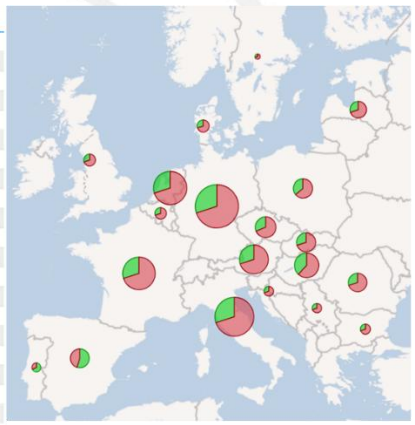
capable of enabling market participants to satisfy the demand and reach at least a 30%[17] stock level in all UGS by the end of the winter season 2024/25. In case of LNG Low supply potential, the UGS can still reach the 30% UGS stock level target.

A sensitivity simulation with the same input data but aiming at a maximisation of the UGS stock level at the end of the winter was run. This sensitivity shows that there is sufficient flexibility of the gas infrastructure to achieve a higher UGS stock level of over 52% at the end of the winter.

Figure 11. Reference Winter scenario. Evolution of the aggregated European UGS stock level, %

Figures 12 and **13** show the UGS stock level per country on 31 March 2025 as a result of the model for the Reference Winter.

Country	Average
Austria	30%
Belgium	30%
Bulgaria	30%
Croatia	30%
Czechia	31%
Denmark	30%
France	30%
Germany	30%
Hungary	38%
Italy	30%
Latvia	30%
Poland	36%
Portugal	68%
Romania	30%
Serbia	30%
Slovakia	30%
Spain	55%
Sweden	30%
The Netherlands	30%
United Kingdom	30%



Country	Average
Austria	51%
Belgium	52%
Bulgaria	52%
Croatia	51%
Czechia	52%
Denmark	51%
France	52%
Germany	51%
Hungary	53%
Italy	51%
Latvia	52%
Poland	51%
Portugal	68%
Romania	52%
Serbia	51%
Slovakia	51%
Spain	55%
Sweden	51%
The Netherlands	52%
United Kingdom	52%

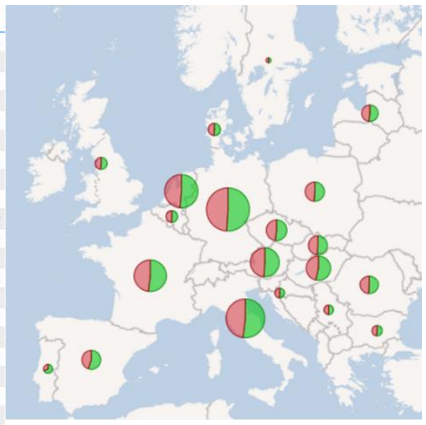


Figure 12 and Figure 13. Reference Winter and sensitivity with Maximum UGS stock level target potential. UGS stock level per country, %

[17] The storage filling level is 32% (above 30%) due to national strategic reserves in some countries.

Figures 14 and 15 show the level and composition of the supply mix in the Reference Winter scenario. The storage filling level at the end of March 2025 is 32%.

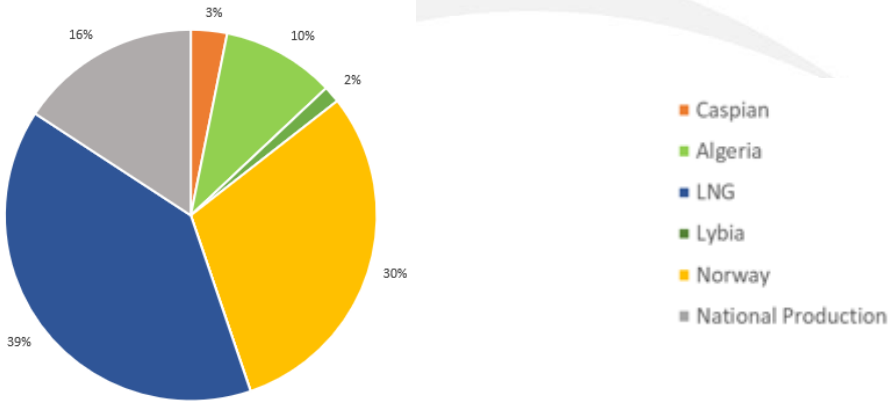


Figure 14. Reference Winter. Supply mix, %

The monthly supply mix is stable over the winter season 2024/25, maximising the usage of all available pipeline supply sources (except Russia) up to their maximum potentials. This shows that no capacity restrictions are limiting imports in this case. LNG supply and supply from Norway represent 39% and 30% respectively.

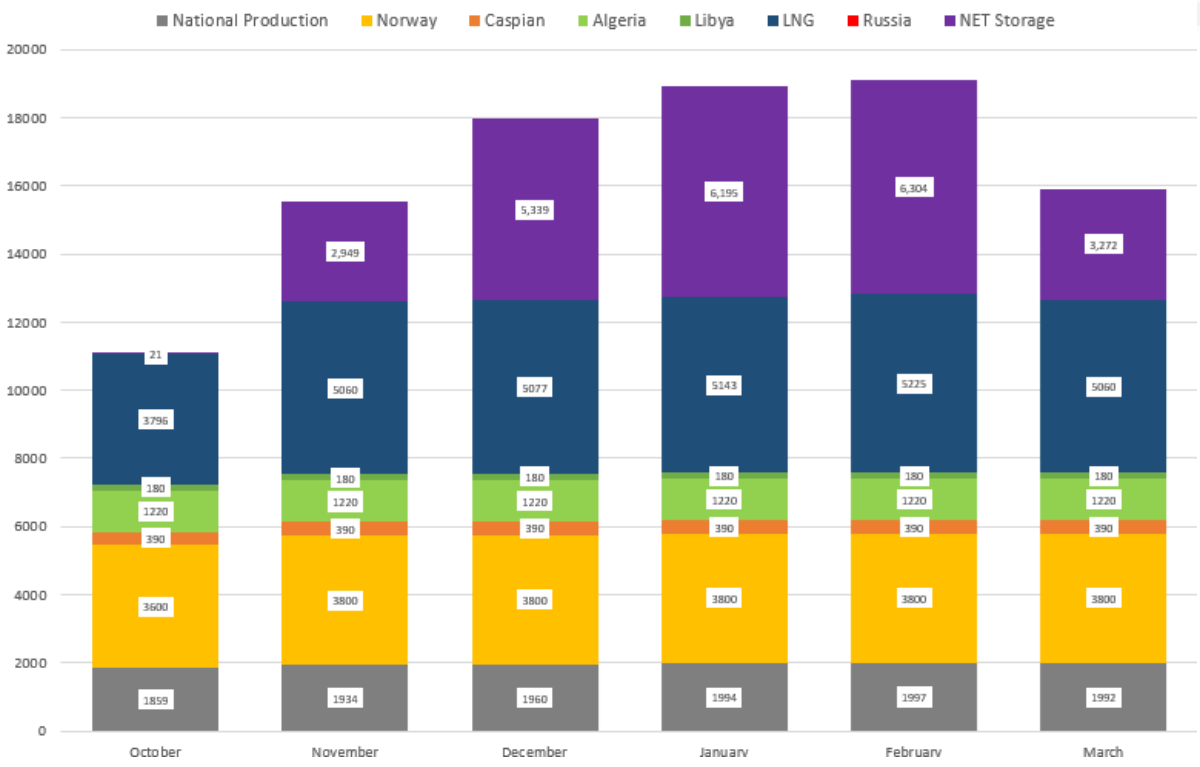


Figure 15. Reference Winter scenario. Monthly supply mix, GWh/d

The import levels shown represent one possible supply option, where LNG is providing the required import flexibility in this example, and modelling is minimising Russian pipeline supply showing that all the targets can be met even without Russian pipeline gas.

Reference Winter supply dependence assessment – Russian supply disruption

This section investigates the potential impact of the scenario described in section 3.1 but with the assumption of a full disruption of the Russian pipeline supply during the withdrawal period. Under this assessment there is additional demand considered on the left bank of Dniester River in Moldova.

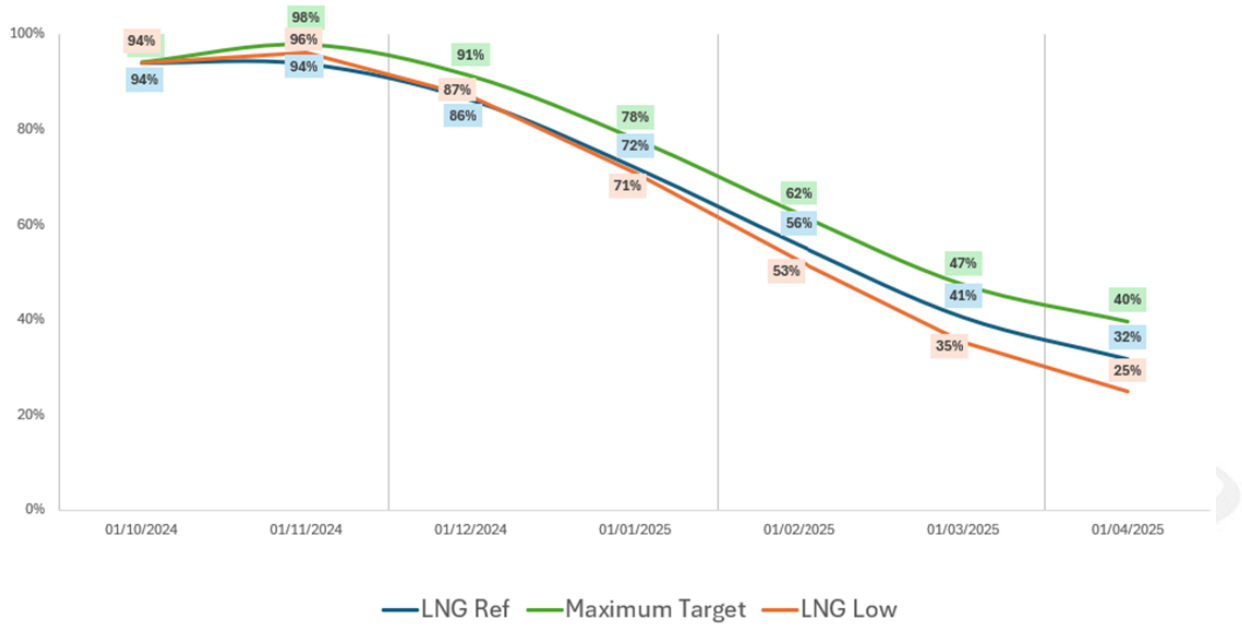
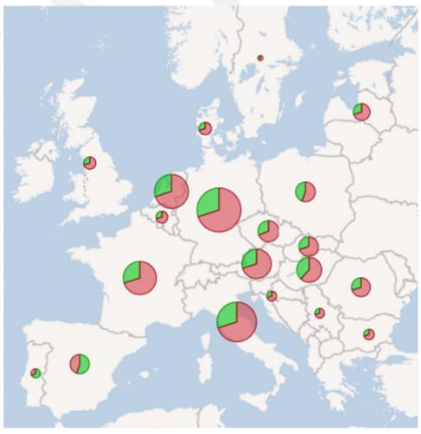


Figure 16. Winter Russian supply dependence assessment. Evolution of the aggregated European UGS stock level, %

Figures 17 and **18** show the stock level per country on 31 March 2025 as a result of the model for the winter supply dependence assessment for the Reference Winter.

Country	Average
Austria	0.30
Belgium	0.30
Bulgaria	0.30
Croatia	0.30
Czechia	0.31
Denmark	0.30
France	0.30
Germany	0.30
Hungary	0.38
Italy	0.30
Latvia	0.30
Poland	0.44
Portugal	0.68
Romania	0.30
Serbia	0.30
Slovakia	0.30
Spain	0.55
Sweden	0.30
The Netherlands	0.30
United Kingdom	0.30



Country	Average
Austria	0.22
Belgium	0.22
Bulgaria	0.22
Croatia	0.22
Czechia	0.22
Denmark	0.22
France	0.22
Germany	0.22
Hungary	0.32
Italy	0.25
Latvia	0.22
Poland	0.44
Portugal	0.68
Romania	0.21
Serbia	0.21
Slovakia	0.21
Spain	0.55
Sweden	0.22
The Netherlands	0.22
United Kingdom	0.22

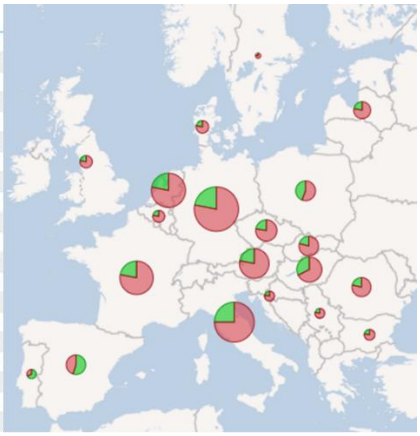


Figure 17 and Figure 18. Winter Russian supply dependence assessment. Reference Winter scenario and sensitivity scenario with LNG Low supply potential. UGS stock level per country, %[18]

[18] Values for Czech Republic include Slovakian storages located on the Czech Republic territory.

For the Reference Winter demand in combination with the Reference LNG supply potential, the European gas network is capable of enabling market participants to satisfy the demand and reach at least a 30%[19] filling level in all UGS by the end of the winter season 2024/25. The outcomes of a sensitivity analysis aiming at a maximum storage filling level at the end of the winter further indicate that the gas infrastructure exhibits sufficient flexibility to achieve storage filling levels over 40% at the end of the withdrawal period.

In the LNG Low supply potential sensitivity analysis, it is observed that UGS are fully utilised to meet demand, resulting in an y the end of the winter season, the European UGS stock level remains at 25%.

Figures 19 and 20 show the level and composition of the supply mix in the supply dependence assessment of the Reference Winter scenario – on pipeline supply disruption from Russia. The European UGS stock level at the end of March 2025 is 32%.

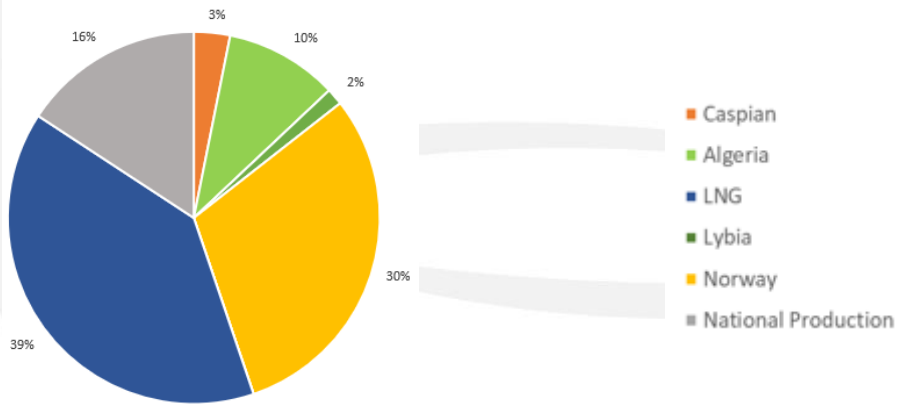


Figure 19. Winter Russian supply dependence assessment. Reference Winter scenario. Supply mix, %

[19] The storage filling level is 32% (above 30%) due to national strategic reserves in some countries.

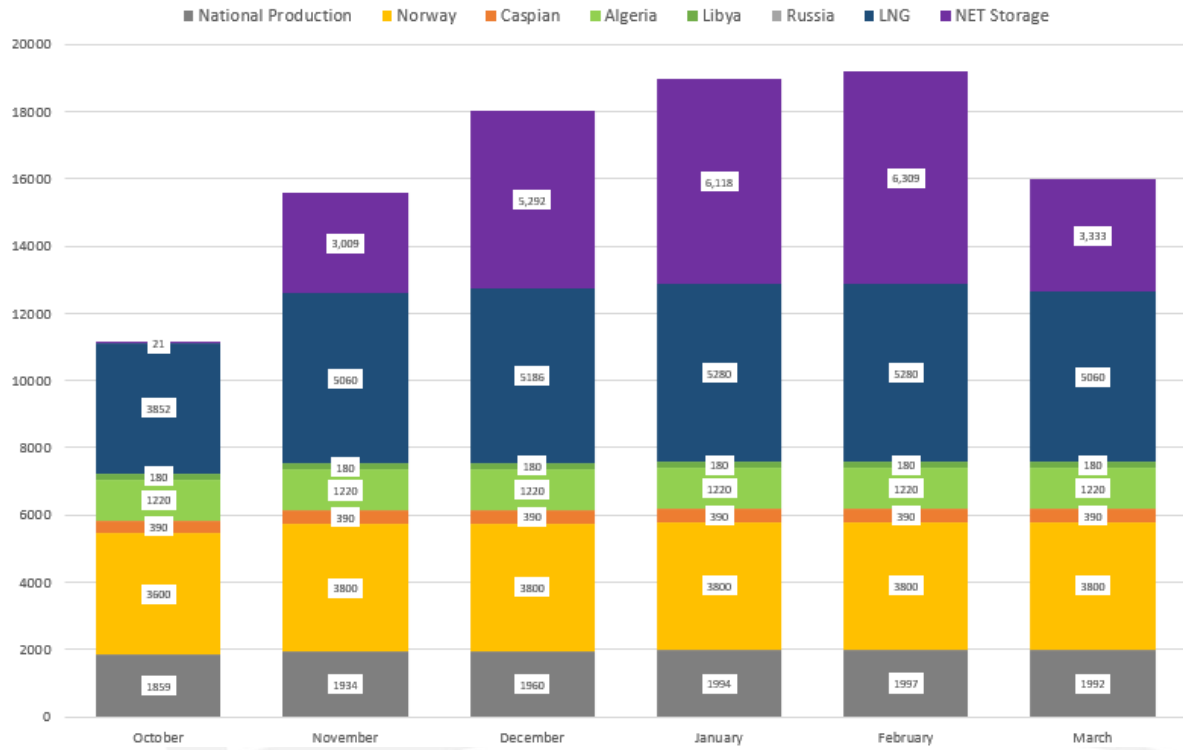


Figure 20. Winter Russian supply dependence assessment. Reference Winter scenario. Monthly supply mix, GWh/d

The monthly supply mix is stable over the winter season 2024/25 period. LNG supply and supply from Norway represent the largest sources of supply. In the Reference Winter scenario, they constitute 39% and 30% of the total supply, respectively. The simulation results reveal that LNG supply falls short of reaching its maximum potential based on the assumptions made for this scenario. This observation underscores the flexibility in LNG imports.

3.2. Cold Winter scenario with 30% UGS stock level target for 31 March 2025

For the Cold Winter 2024/25 scenario, the overall winter season withdrawal is defined as the amount of gas necessary to meet demand and reach 30% stock level in each European UGS on 31 March 2025 when starting at an average European UGS stock level of 94% on 1 October 2024 (see Figure 10). In this scenario, the Cold Winter demand values for each country during the withdrawal period were assumed.

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

- The Cold Winter monthly gas demand in **Annex B**
- The monthly national gas production estimated by TSOs in **Annex B**
- The monthly capacities provided by TSOs
- The storage withdrawal curves provided by GSE 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 **Table 4**)

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 Cold Winter withdrawal period while all European countries cooperate.

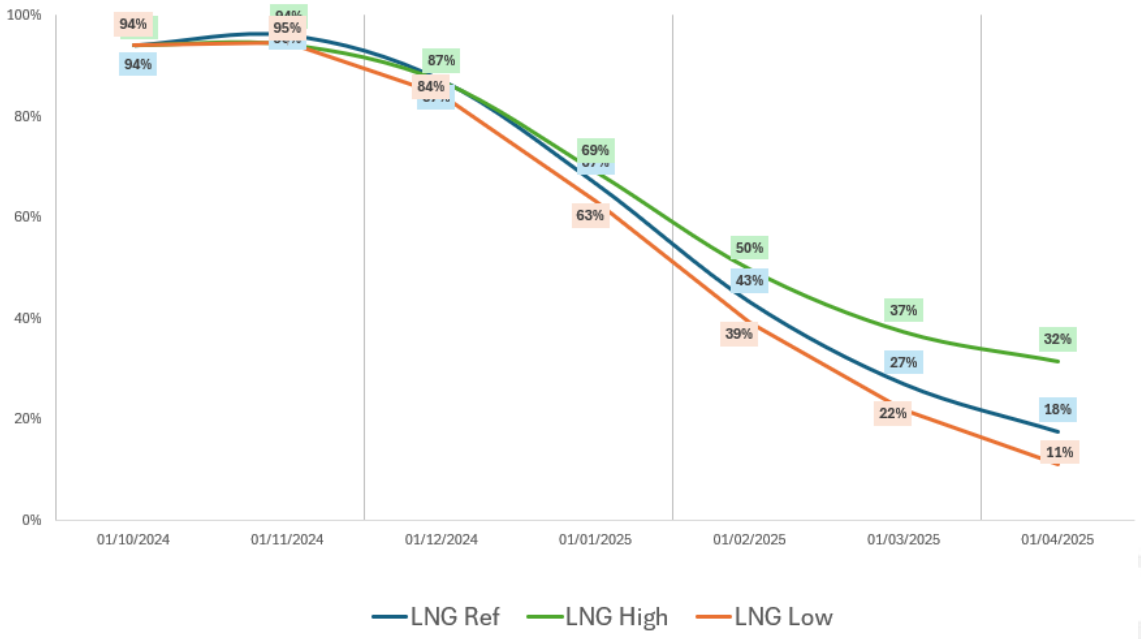


Figure 21. Cold Winter scenario. Evolution of the aggregated European UGS stock level, %

The Cold Winter 2024/25 scenario simulation results show that withdrawal capacities of the UGS combined with the supply flexibility of imports in some scenarios are not sufficient to cover the demand and reach the UGS stock level target of 30%. By the end of the winter season, the European UGS stock level remains at a mere 18% for Reference LNG supply and 11% for LNG Low supply.

Moreover, with LNG Low supply the European countries would face a risk of demand curtailment (or a demand response need) of 3% on average during the whole winter season, as shown in **Figure 22.** This situation underscores a noteworthy risk that must be pre-emptively addressed, particularly if EU Member States aim to achieve the 30% UGS stock level target at the end of the winter season 2024/25.

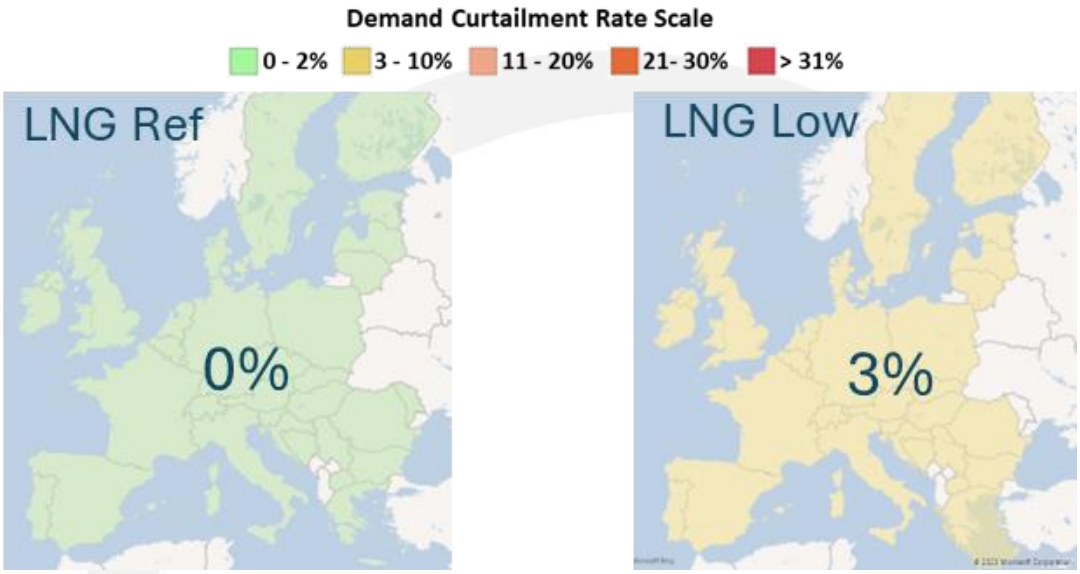


Figure 22. Cold Winter scenario. Demand Curtailment (average), %

However, some European countries are still reserving a part of their own gas stock, constituted as strategic reserves, to be used only for the purpose of mitigating demand curtailment. The availability of these strategic UGS reserves depends of the specific regulation in each country. The model assumes actual strategic UGS constraints but simulation results do not consider the utilisation of strategic UGS reserves and these remain available to avoid/reduce demand curtailment in some countries.

3.2.1. Cold Winter supply dependence assessment – Russian supply disruption

This section investigates the potential impact on the scenario described in section 3.2 but with the assumption of a full disruption of the Russian pipeline supply during the withdrawal period. Under this assessment there is additional demand considered on the left bank of Dniester River in Moldova.

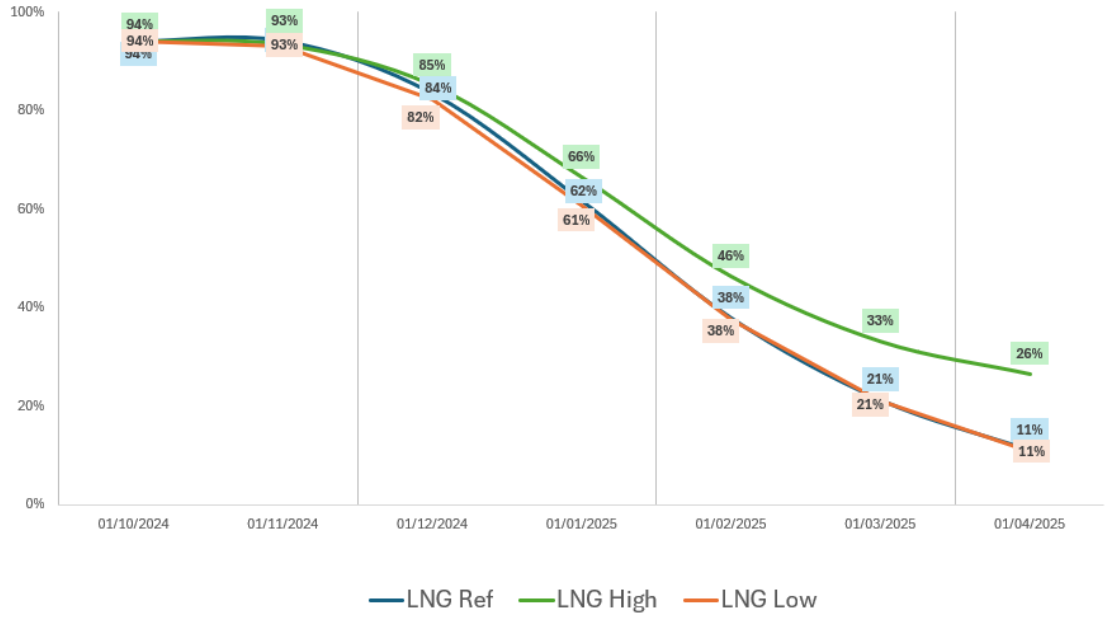


Figure 23. Cold Winter Russian supply dependence assessment. Evolution of the aggregated European UGS stock level, %

The Cold Winter 2024/25 with full Russian disruption scenario simulation results show that withdrawal capacities of the UGS combined with the supply flexibility of imports is not sufficient to cover the demand and reach the UGS stock level target of 30%. European countries would face a risk of demand curtailment or a demand response need of 3% (8% with LNG Low supply sensitivity) on average during whole winter season. The scenario is influenced by the dynamics of LNG imports as shown in **Figure 24**. In any case the simulation results reveal the gas supply for Europe is not enough in Cold Winter to meet all the targets.

By the end of the winter season, the European UGS stock level remains at a mere 11% (**Figure 23**). This figure encompasses only the strategic reserves of selected countries which is not freely available on the market under normal conditions. This situation underscores a noteworthy risk that must be pre-emptively addressed, particularly if EU Member States aim to achieve the 30% UGS stock level target at the end of the winter season 2024/25.[20]

[20] The shortfall is about 300 TWh for LNG reference supply and 480 TWh for LNG low supply according to the simulation results.

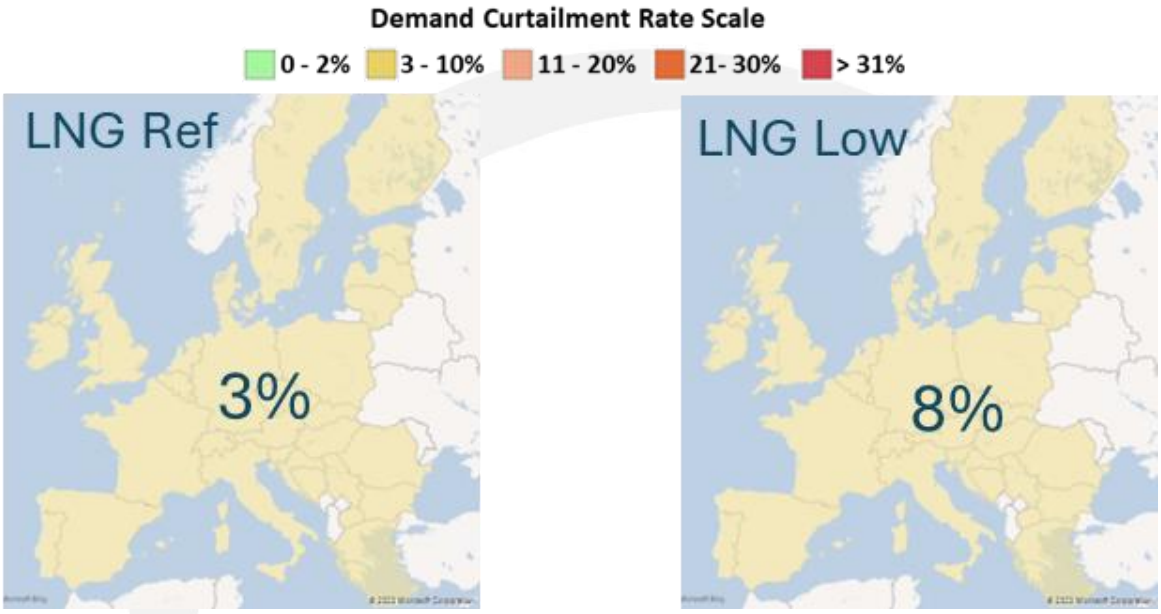


Figure 24. – Cold Winter Russian supply dependence assessment. Demand Curtailment (average), %

Results show that, without Russian Supply during a Cold Winter, Europe would need to adjust its consumption with a demand response from 3% for LNG Reference supply to 8% for LNG Low supply.

However, some European countries are still reserving a part of their own gas stock, constituted as strategic reserves, to be used only for the purpose of mitigating demand curtailment. The availability of these strategic storage reserves depends on the specific regulation in each country. The model assumes actual strategic UGS constraints but simulation results do not consider the utilisation of strategic storage reserves and these remain available to avoid/reduce demand curtailment in some countries.

3.3. High demand events with initial UGS stock level of 50%

For the high demand situation scenarios, meeting the demand for Peak Day and 2-week Cold Spell is defined as availability of the peak supply potential and sufficient withdrawal capacity, starting from an initial European UGS stock level of 50%.

High demand cases, such as Peak Day and 2-Week Cold Spell, are simulated as independent analyses. However, these high demand events are typically expected to occur late in winter, when UGS are no longer at their maximum stock level (therefore, they cannot deliver their maximum withdrawal capacity). At this stage, seasonal simulation results show that maintaining a UGS stock level of 50%, when high demand situations may arise, would enable an effective response to increased demand through efficient withdrawals from UGS. A lower UGS stock level leads to a decrease in withdrawal capacity, primarily due to reduced pressure in the UGS.

The distribution of withdrawal, demand, and supply during the high demand situation results from the modelling and the following assumptions:

- The Peak Day and 2-week Cold Spell gas demand estimated by TSOs for the Reference Winter in **Annex B**
- The Peak Day and 2-week Cold Spell gas demand for the Cold Winter in **Annex B**
- The peak national gas production estimated by TSOs in **Annex B**
- The peak capacities provided by TSOs
- The UGS withdrawal curves provided by GSE 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 **Table 4**) and plus additional LNG that can be taken from the tanks (see **Annex A**)

Based on these assumptions, the modelling has been used to evaluate the ability of the gas infrastructure to cope with high demand events such as a 1-in-20 years Peak Day and a 1-in-20 years 2-week Cold Spell during the winter period while all European countries cooperate.

➢ **In the case of Reference Winter (see Figures 25** and **26)**, the European gas infrastructure is capable of fully meeting the demand during a 2-week Cold Spell and also during the Peak Day, except for Moldova with a 4% of demand response required during the Peak Day. In peak day Ukraine needs to import gas from Europe together with Moldovan demand exceeds their availability of firm entry capacities from Europe.

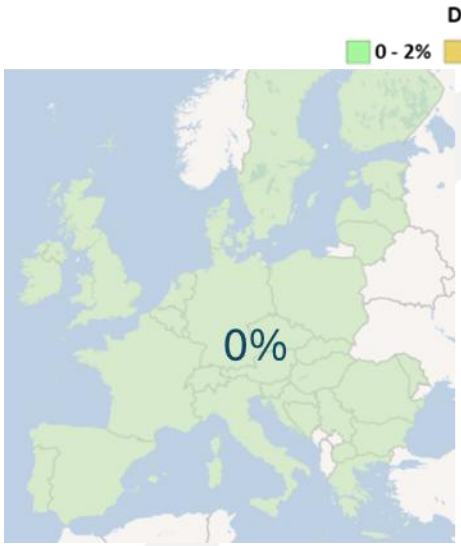


Figure 25. – Reference Winter. 2-week Cold Spell. Demand Curtailment, %

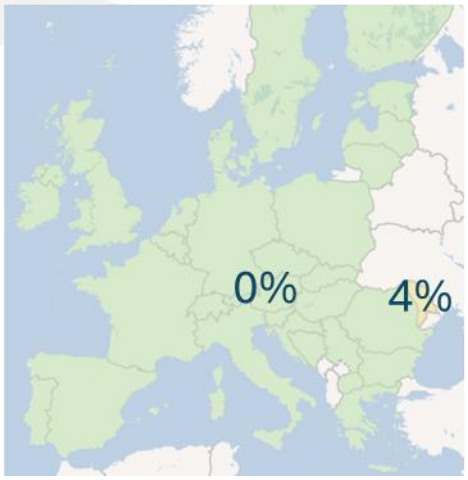


Figure 26. – Reference Winter. Peak Day. Demand Curtailment, %

➢ **In the case of Cold Winter (see Figures 27** and **28)**, the European gas infrastructure is capable of fully meeting the demand during a 2-week Cold Spell and also during the Peak Day demand, except for Moldova with a 4% of demand response required during the Peak Day (exports to Ukraine are also disrupted at the same level). In peak day Ukraine needs to import gas from Europe together with Moldovan demand exceeds their availability of firm entry capacities from Europe.

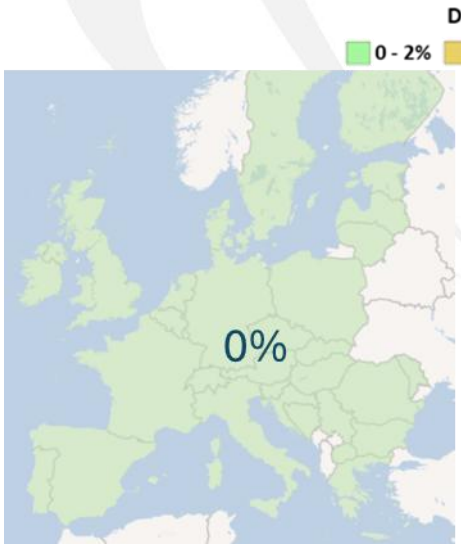


Figure 27. – Cold Winter. 2-week Cold Spell. Demand Curtailment, %

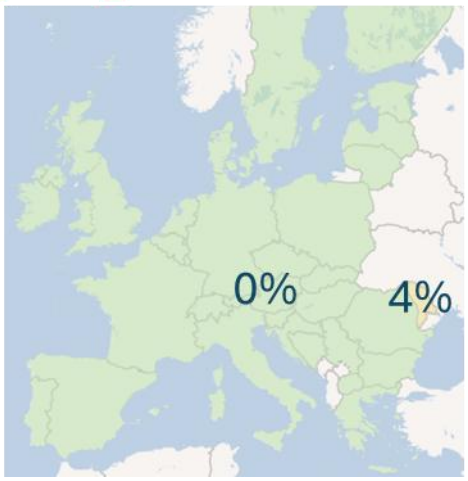


Figure 28. – Cold Winter. Peak Day. Demand Curtailment, %

3.3.1. High demand events supply dependence assessment – Russian supply disruption

This section investigates the potential impact of full disruption of Russian pipeline supply during the high demand situations on meeting the demand for Peak Day and 2-week Cold Spell, starting from an initial European UGS stock level of 50%. Under this assessment there is additional demand considered on the left bank of Dniester River in Moldova.

High demand cases, such as Peak Day and 2-Week Cold Spell, are simulated as independent analyses. However, these high demand events are typically expected to occur late in winter, when UGS are no longer at their maximum stock level (therefore, they cannot deliver their maximum withdrawal capacity). At this stage, seasonal simulation results show that maintaining a UGS stock level of 50%, when high demand situations may arise, would enable an effective response to increased demand through efficient withdrawals from UGS. A lower UGS stock level leads to a decrease in withdrawal capacity, primarily due to reduced pressure in the UGS.

- **In the case of Reference Winter (see Figures 29** and **30)**, the European gas infrastructure is capable of fully meeting the demand during a 2-week Cold Spell. During a Peak Day situation, countries are also capable of fully meeting the demand, except for Moldova with a 13% of demand response required during the Peak Day (exports to Ukraine are also disrupted at the same level). In peak day Ukraine needs to import gas from Europe together with Moldovan demand exceeds their availability of firm entry capacities from Europe.

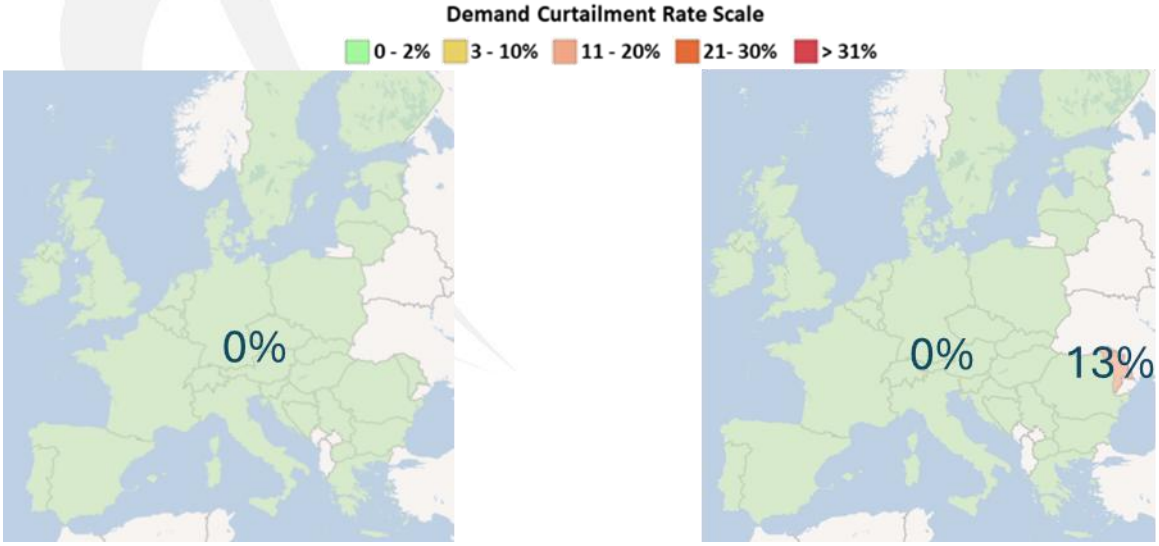


Figure 29. – Reference Winter RU supply dependence assessment. 2-week Cold Spell. Demand Curtailment, %

Figure 30. – Reference Winter RU supply dependence assessment. Peak Day. Demand Curtailment, %

➢ **In the case of Cold Winter (see Figures 31** and **32)**, the European gas infrastructure is capable of fully meeting the demand during a 2-week Cold Spell but most of the countries in the Southeast of Europe (Croatia, Bulgaria, Greece, Hungary, Romania, Serbia, Bosnia and Herzegovina, North Macedonia and Moldova) are exposed to an average need of demand response ranging from 11% to 13% during a Peak Day situation.

In Peak Day results, the bottlenecks to Hungary and between Southern European countries do not allow for more gas supply. Moreover, in Peak Day the exports to Ukraine are also disrupted at the same level.

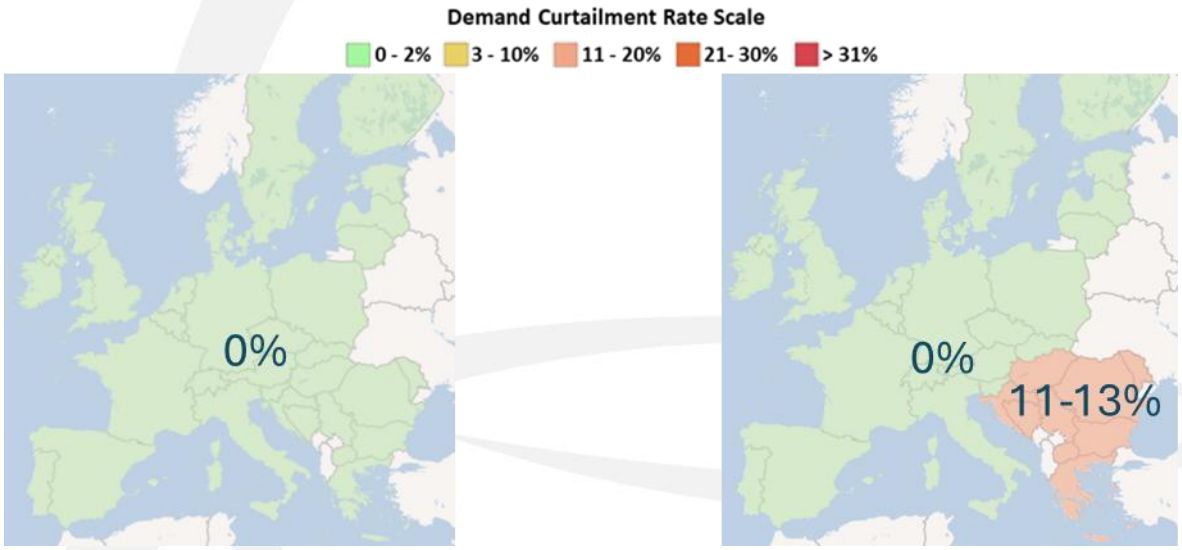


Figure 31. – Cold Winter RU supply dependence assessment. 2-week Cold Spell. Demand Curtailment, %

Figure 32. – Cold Winter RU supply dependence assessment. Peak Day. Demand Curtailment, %

However, some European countries are still reserving a part of their own gas stock, constituted as strategic reserves, to be used only for the purpose of mitigating demand curtailment. The availability of these strategic storage reserves depends on the specific regulation in each country. The model assumes actual strategic UGS constraints but simulation results do not consider the utilisation of strategic storage reserves and these remain available to avoid/reduce demand curtailment in some countries.

MODELLING RESULTS FOR THE SUMMER 2025 OVERVIEW

3.4. Reference summer scenarios with 90% UGS stock level target for 30 September 2025

For the Reference Summer 2025 overview scenario, two types of simulations were performed:

- Full year (12 months) simulations where the model anticipates reaching the UGS stock level target of 90% at the end of this period (after these 12 months) already from the beginning of the gas year, i.e., 1 October 2024. Monthly demand values for Reference demand and for 5-year average demand with 15% reduction (5YA-15%)[21] are assumed for each country.
- Summer season simulations investigating possibilities to reach the UGS stock level target of 90% at the end of the season but starting at an average UGS stock level of 30% at the beginning of summer, i.e., 1 April 2025. Monthly demand values for Reference demand and for 5-year average with 15% reduction (5YA-15%)[22] are assumed for each country.

The analysis investigates the possible evolution of the gas supply as well as the ability of the gas infrastructures to meet the demand, export, and storage injection needs to reach 90% of the stock level in each European UGS on 30 September 2025. For the full year simulation of the gas year 2024/25 (i.e., from 1 October 2024 to 30 September 2025), the simulation starts with an average European UGS stock level of 94% on 1 October 2024 (see Figure 10).

ENTSOG has run additional sensitivity analyses to evaluate the impact of the initial storage level at the start of the injection period. This sensitivity analysis was done with an average European UGS stock level of 30%n 1 April 2025 (the resulting storage filling level is 32% due to higher national strategic reserves in some countries).

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

- The **Reference** monthly gas demand and the **5-year average with 15% reduction** monthly gas demand in **Annex B**
- The monthly national gas production estimated by TSOs in **Annex B**
- The monthly capacities provided by TSOs
- The UGS withdrawal and injection curves provided by GSE as defined in **Annex A**
- The supply potentials from the historical supply mix (see **Table 4**)

With this configuration the results show that in the full year simulations (12 months) the European gas network is capable to enable market participants to meet demand and achieve a minimum UGS stock level of 90% in all UGS by the end of the summer season 2025. According to the simulation results, a minimum UGS stock level of 43% would be needed at the end of the winter to reach the 90% UGS stock level target at the end of summer 2025.

However, the outcomes of the sensitivity analysis further indicate that when the initial storage level in all countries is set at 30% at the beginning of the injection period, the gas infrastructure

[21] Council Regulation (EU) 2022/1369 of 5 August 2022 on coordinated demand-reduction measures for gas
[22] Council Regulation (EU) 2022/1369 of 5 August 2022 on coordinated demand-reduction measures for gas

is insufficient to achieve the UGS stock level target of 90% as it can only enable 83%. In such cases, an increase in LNG supplies would offer enough supply flexibility and the opportunity to reach the target for all UGS. Also, a higher initial UGS stock level at the beginning of the injection period can provide added flexibility to the gas infrastructure.

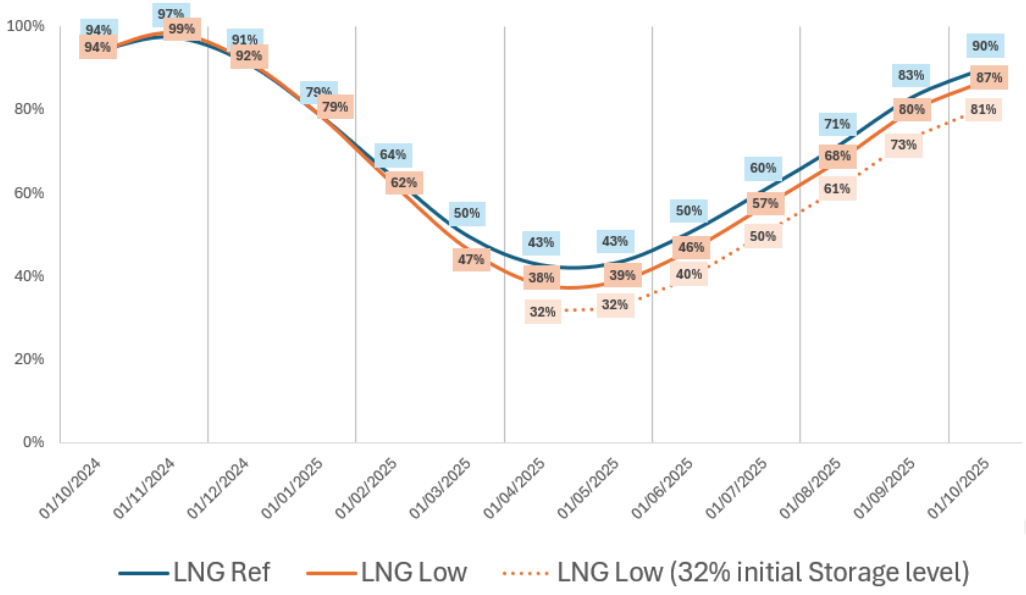


Figure 33. Reference demand scenario. Evolution of the aggregated European UGS stock level, %

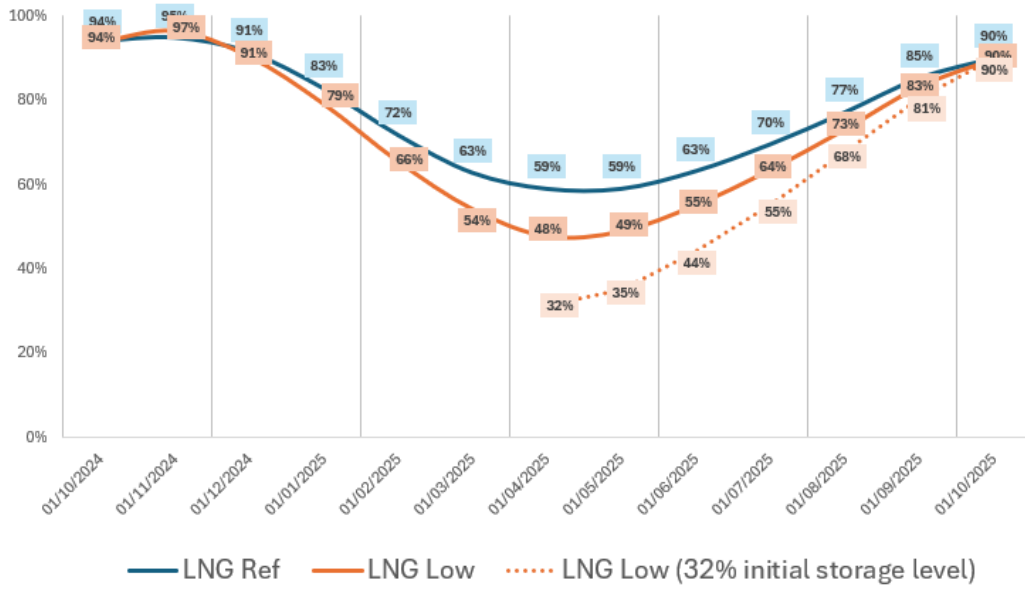
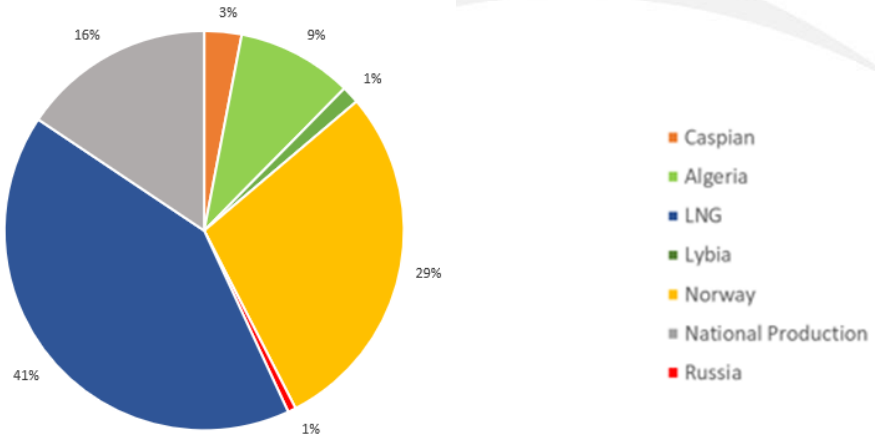


Figure 34. 5YA-15% Scenario. Evolution of the aggregated European UGS stock level, %

In the 5YA-15% demand case, all cases can meet the UGS stock level target of 90%, including the sensitivity starting with at 30% at the beginning of the injection period in combination with the LNG Low supply potential.

Figures 35 and 36 show the level and composition of the supply mix in the full year (12 months) simulation scenario and sensitivity scenario with LNG Low supply potential. The UGS stock level at the end of September 2024 is 90%.[23]



Figures 35. Reference Summer (full year) scenario. Supply mix, %

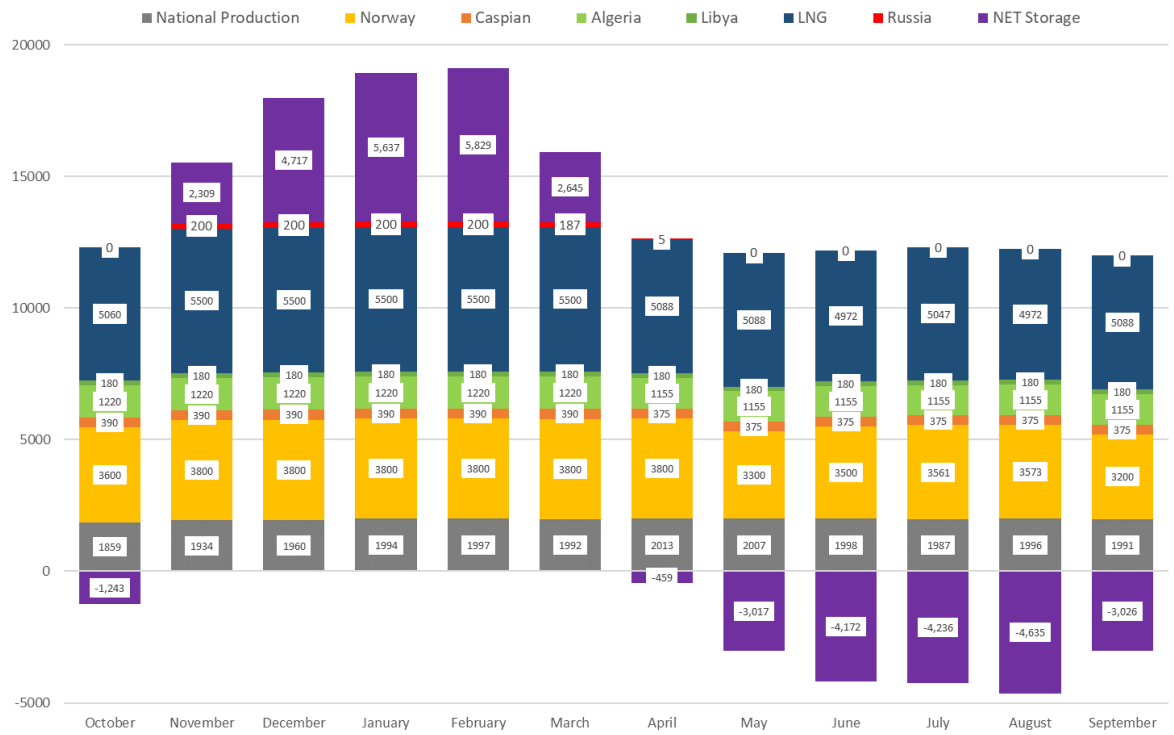


Figure 36. Reference Summer (full year) scenario. Monthly supply mix, GWh/d

LNG supply and supply from Norway represent the largest sources of supply. In the Reference Summer scenario, they constitute 41% and 29% of the total supply, respectively. The simulation results reveal that LNG supply is used at its maximum potential based on the

[23] 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.

assumptions made for this scenario to reach the UGS stock level target of 90% by the end of September 2025. Gas supply from Russia accounts for 1% of the total gas supply only while other sources are maximised but limited by the firm capacity of the gas network or to the LNG supply potential.

The monthly supply mix remains stable throughout the winter season of 2024/25. However, during the summer season 2025, the Norwegian supply is reduced due to extensive maintenance work on their fields during some months (in May, June and September 2025), which is anticipated to impact injection possibilities during that period of time. The European UGS stock level could potentially increase in October 2024, as the injection season typically extends until 1 November in some countries.

3.4.1. Summer supply dependence assessment – Russian supply disruption

This section investigates the potential impact of full disruption of the Russian pipeline supply during the withdrawal and injection period. The analysis investigates the possible evolution of the gas supply as well as the ability of the gas infrastructure to meet the demand, export, and storage injection to reach 90% of the stock level in each European UGS on 30 September 2025. For the full year simulation of the gas year 2024/25 (i.e., from 1 October 2024 to 30 September 2025), the simulation starts with an average European UGS stock level of 94% on 1 October 2024 (see Figure 10). In this scenario, the monthly gas demand estimated by TSOs and the 5-year average with 15% reduction demand (5YA-15%) values were assumed for each country. ENTSOG has run additional sensitivity analyses to evaluate the impact of the initial storage level at the start of the injection period. This sensitivity analysis was done for an average European UGS stock level of 30% on 1 April 2025 (the resulting storage filling level is 32% due to higher national strategic reserves in some countries).

The distribution of withdrawal and supply during the winter months results from the modelling and the following assumptions:

- The **Reference** monthly gas demand and the **5-year average with 15% reduction** monthly gas demand in **Annex B**
- The monthly national gas production estimated by TSOs in **Annex B**
- The monthly capacities provided by TSOs
- The storage withdrawal and injection curves provided by GSE as defined in **Annex A**
- The supply potentials **without Russia** from the historical supply mix (see **Table 4**)[24]

Based on these assumptions, the modelling has been used to check if any physical congestion or dependence on an import source may limit the satisfaction of gas demand during the withdrawal period, while all European countries cooperate.

According to the simulation results, with Reference LNG supply the European gas infrastructure is capable to enable market participants to meet demand and achieve a stock level of 90% in all UGS by the end of the summer season 2025. According to the simulation results, the optimal storage level is determined to be 39% on 1 April 2025. On the other hand, when simulations consider the LNG Low supply the UGS stock level at the end of the summer

[24] Under this assessment there is additional demand considered on the left bank of Dniester River in Moldova.

season 2025 can only reach 64% unless quantities of gas from other sources would be secured or some demand response action triggered.

The sensitivity analysis further indicates that when the initial UGS stock level in all countries is set at 30% at the beginning of the injection period, the gas infrastructure can achieve a European UGS stock level of 82%. Increase in LNG supplies offers supply flexibility and the opportunity to reach the UGS stock level target of 90% for all UGS.

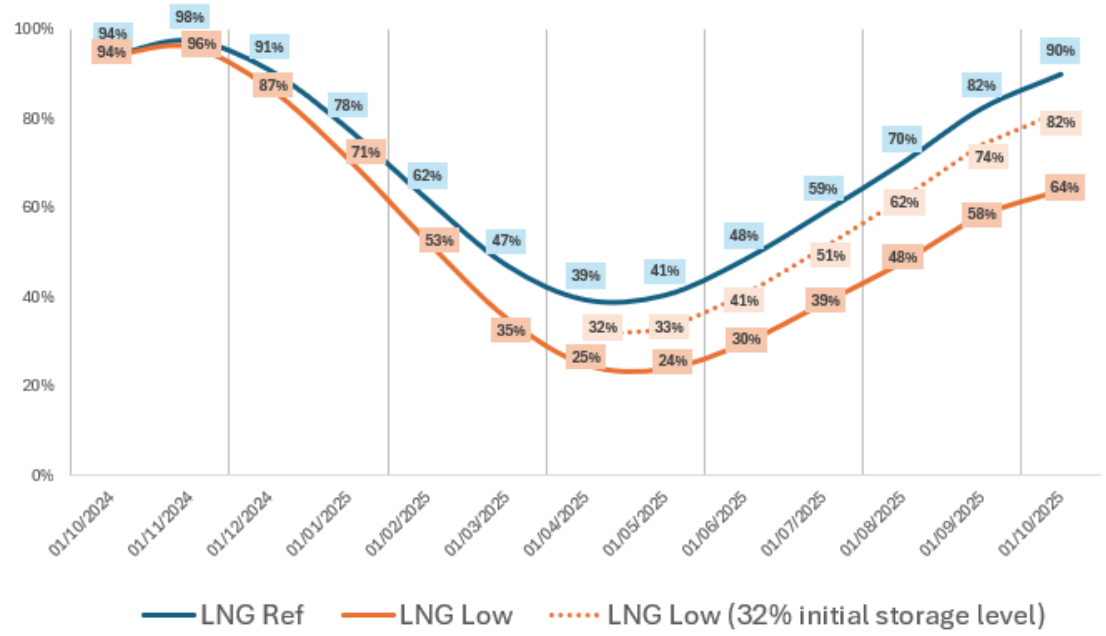


Figure 37. Reference demand (full year) RU supply dependence assessment. Evolution of the aggregated European UGS stock level, %

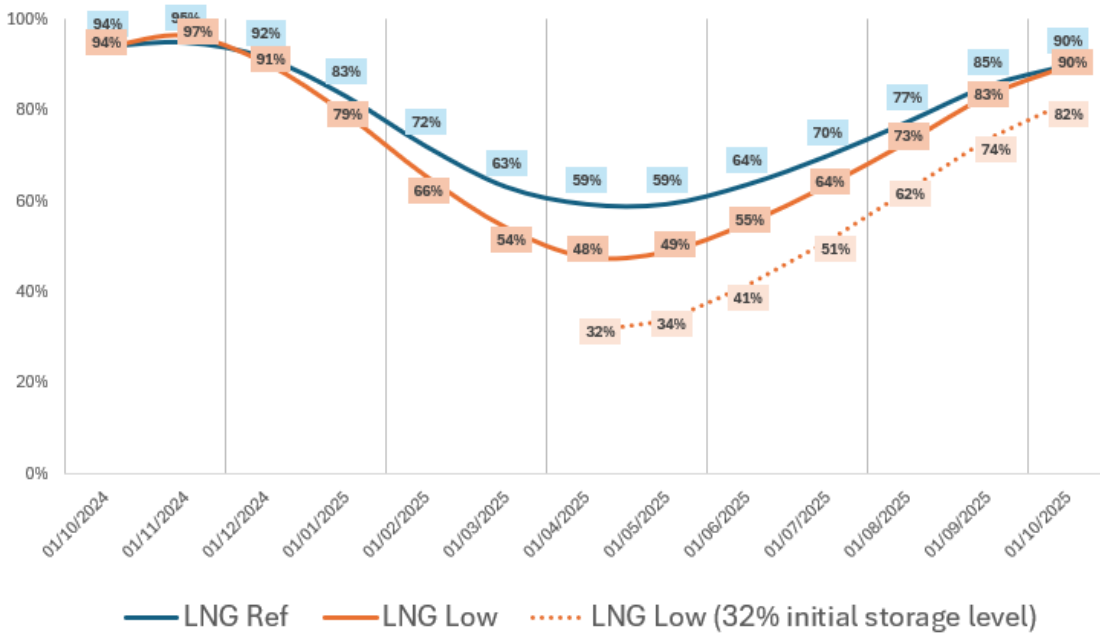


Figure 38. 5YA-15% demand (full year) RU supply dependence assessment. Evolution of the aggregated European UGS stock level, %

In the case of the 5-year average demand scenario with 15% demand response it would be possible to meet the UGS stock level target of 90% with the LNG Reference supply potential and with the LNG Low supply potential. However, in the sensitivity analysis for the LNG Low supply potential, when the initial UGS stock level at the beginning of the summer season is set to 32%, the 90% target would not be met and only 82% UGS stock level could be achieved. In such case, a higher initial UGS stock level at the beginning of the injection period, additional supply from other sources or demand response may be needed.

Figures 39 and 40 show the level and composition of the supply mix in the Reference demand (yearly) scenario where the storage filling level at the end of September 2025 is 90%.[25]

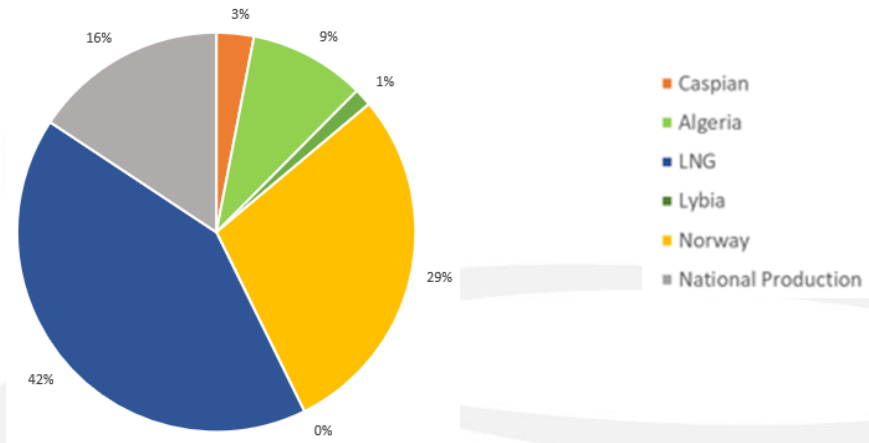


Figure 39.- Reference Summer (full year) scenario RU supply dependence assessment. Supply mix, %

LNG supply and supply from Norway represent the largest sources of supply. In the Reference Summer scenario, they constitute 42% and 29% of the total supply, respectively. The simulation results reveal that LNG supply used at its maximum potential based on the assumptions made for this scenario, to reach a target of 90% by the end of September 2024.

[25] The import levels shown represent one possible supply option, with LNG Reference providing enough import flexibility in this example, and modelling was done without Russian supply.

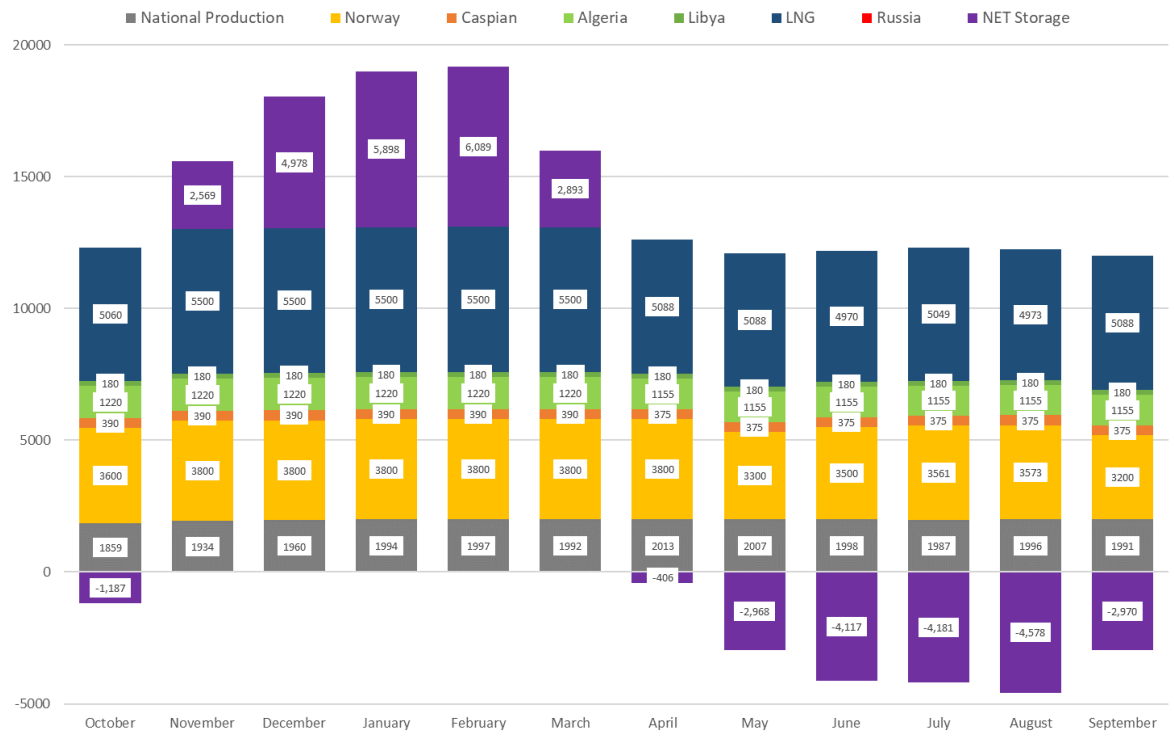


Figure 40. – 5YA-15% Summer (full year) RU supply dependence assessment. Monthly supply mix, GWh/d

Europe can still reach 90% UGS stock level at the end of the injection season for the Reference Winter case even without Russian pipeline gas, demonstrating the independence of the EU gas system from Russian pipeline supply.

The monthly supply mix remains stable throughout the winter season of 2024/25. However, during the summer season 2025, the Norwegian supply is reduced due to extensive maintenance work on the their fields during some months, which anticipate will impact injection possibilities for that month. The European storage filling level could potentially increase in October 2024, as the injection season typically extends until November 1 in some countries.

4. ENTSO-E INSIGHTS ON GAS CONSUMPTION FOR ELECTRICAL POWER SYSTEM

The operations of electricity and natural gas systems are historically interdependent. Gas-fired generators are key for covering the electricity demand during peak hours and during period of low renewable generation. This is especially true during the winter period and ENTSO-E remains prepared and in close cooperation with ENTSOG, especially in case winter 2024-2025 would be cold.

As performed in the last two winters, ENTSO-E will conduct again a critical gas volume (CGV) analysis to quantify the amount of gas needed to ensure adequacy on the electrical power system. (see figure here-under for more explanation and CGV results of winter 2023/2024). The CGV analysis will be part of ENTSO-E's Winter Outlook 2024-2025 publication.

Previous year, this CGV was estimated to be around a fifth of the European Working Gas volume, according to Figure 41. For the coming winter, although the CGV is still in process at the time of writing, no system adequacy issues are foreseen given that the input data indicates good nuclear availability, planned outages in line with last winter and a good filling level of reservoirs.

The new projected CGV volumes will come in the next ENTSO-E winter outlook, which will be released before December 2024.

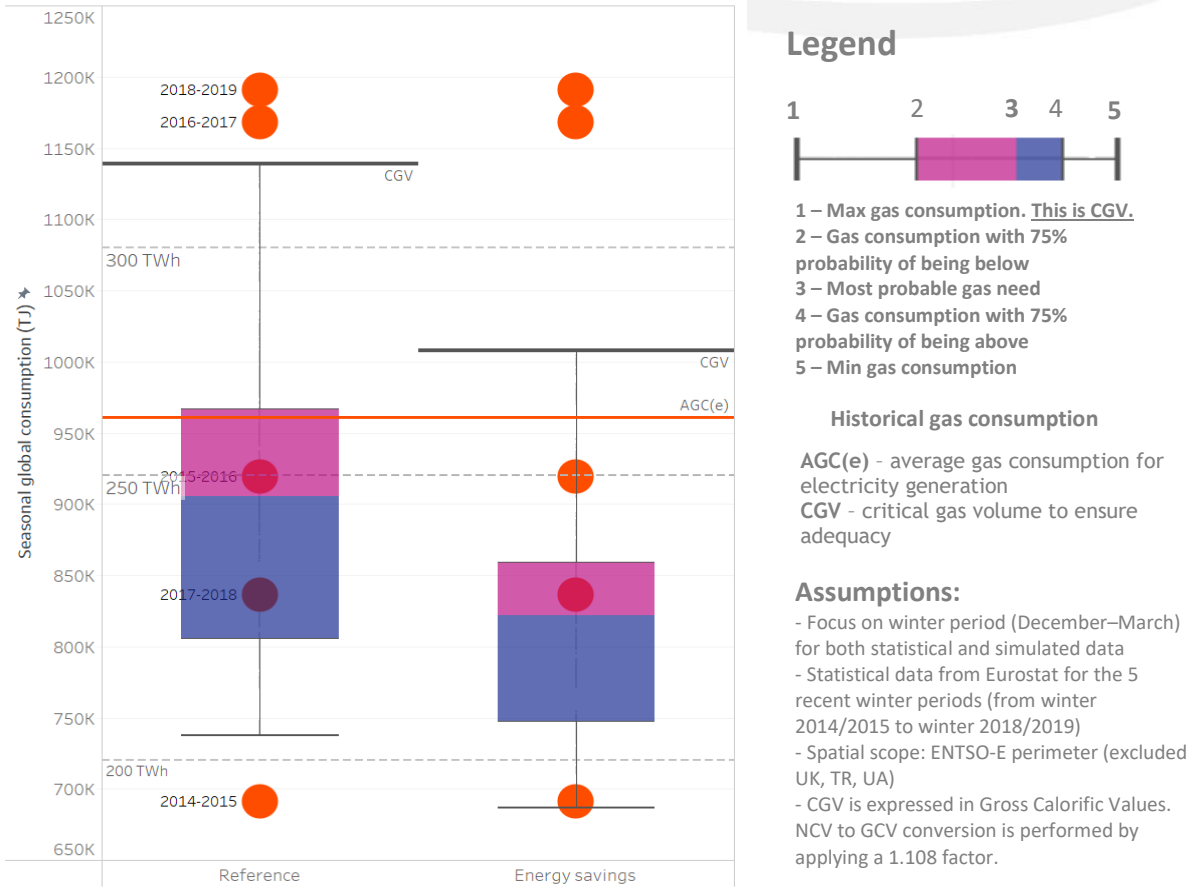


Figure 41 | CGV analysis overview for Winter Outlook 2023-2024

How to interpret the CGV chart:
Each orange dot represents a historical winter period of gas consumption for electricity generation. The significant differences between periods are primarily related to temperature and climate conditions but can also be influenced by the situation in the electricity market (prices, planned outages, changing generation fleet, etc.).
The AGC(e) (orange line) represents the average gas consumption for electricity generation for the 5 statistical years (orange dots).
The maximum gas consumption corresponds to the gas volume necessary to ensure adequacy in the worst- case simulated weather condition scenario. This maximum is indicated as the CGV to ensure adequacy.
The dark and light purple colours represent the range of simulation outcomes of gas volume needed to ensure adequacy for a given year, depending on the climate conditions (the simulation uses 34 climate condition scenarios). There is a 50% probability of a given year being in this range.

ENTSO-E keeps awareness of the developments in the gas system and in cooperation with ENTSO-G as the natural gas systems can play a crucial role in delivering electricity to sensitive consumers and ensuring grid stability. It is anticipated that gas and electricity markets will ensure optimal allocation of resources during winter season. In the event of limited gas supplies, some Member States' legislative framework would prioritize scarce gas resources for critical gas-fired power plants to ensure security of power system operations and supply of electricity to the sensitive electricity consumers.

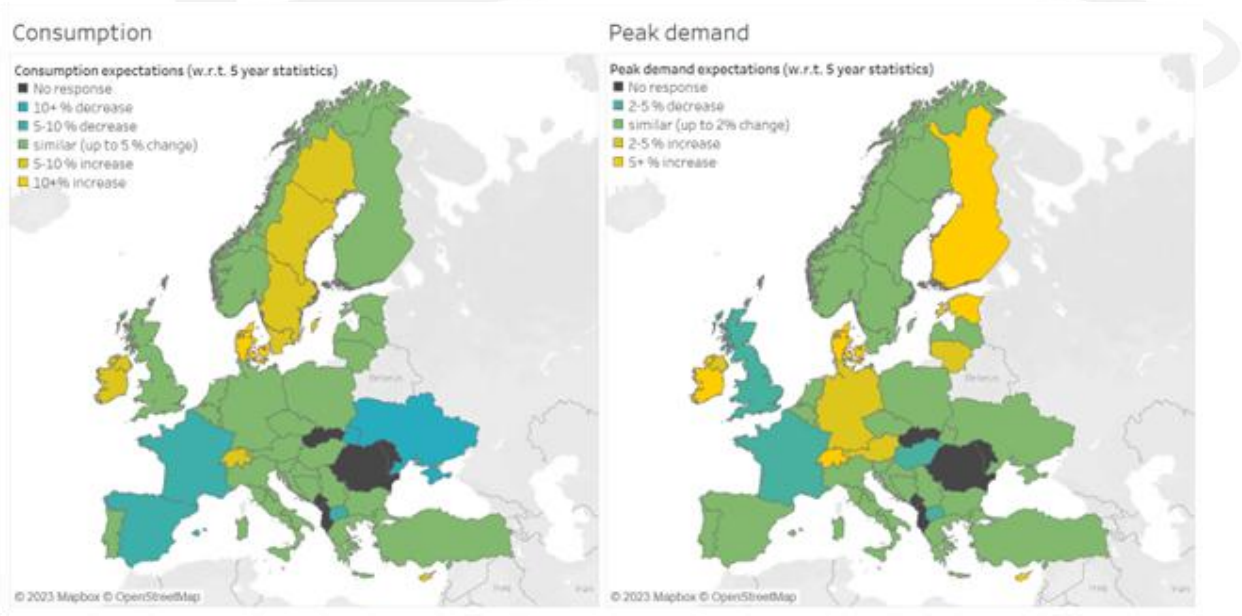


Figure 42 | European TSOs' expectation on electricity consumption and demand peaks against last 5 years' statistics (Winter Outlook 2023-2024)

Legal Notice

The current analysis is developed specifically for this Winter Supply Outlook 2024/25 with summer 2025 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 will depend on market behaviour and global factors.

ENTSOG has prepared this Winter Supply Outlook 2024/25 with summer 2025 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.

Annex A: UGS and LNG

The data for the Winter Supply Outlook 2024/25 is available online as an annex of this report. The data available is specifically:

- *Working Gas Volume and Gas in storage on 1 October 2024.*

For the modelling of the different scenarios, the Winter Supply Outlook 2024/25 considers the storage inventory level per country on 1 October 2024 as the initial situation. The gas in storage on 1 October 2024 for each country is based on the AGSI+ platform. For Serbia, the initial storage inventory level is considered as 90% 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.

- *Injection and withdrawal curves.*

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

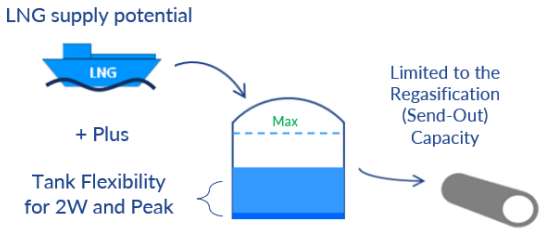
- *LNG Tank Volume and Flexibility.*

The send-outs from the terminals are modelled to represent the sum of both the off-loaded volumes of arriving cargos and gas from tanks. As for the previous Winter Outlook, the 2-Week Cold Spell is split in 2 periods to allow a differentiation of the LNG terminals' behaviour between the first and the second week.

- *During the first week, the model will determine the LNG send-outs using the level of LNG supply that reached LNG terminals in February as a result from the whole winter simulation, plus additional LNG that can be taken from the tanks.*
- *During the second week, importers are allowed to access a relevant number of cargos, so that the LNG supply reaching the terminals can reach the February maximum supply potential. In addition, the LNG send-outs can be taken from the remaining LNG stored in the tanks.*

LNG terminals tank flexibility:

LNG stocked in the tanks fluctuates within a normal operating range of LNG in the tanks following normal operation. Besides, there is a minimum amount of LNG that must be kept in the tanks for a safe operation.



However, in case of high demand events such as 2-week cold spells or peak demand days, this minimum amount can be lowered, and part of the tanks are therefore used as a buffer volume, waiting for more LNG carriers to unload.

ENTSOG models this tank flexibility based on historical figures from GIE ALSI.

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

The data for the Winter Supply Outlook 2024/25 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 Winter and Summer demand (from 1 October 2024 to 30 September 2025) is based on TSOs' estimates.

- *Average daily Cold Winter demand forecast, GWh/d.*

The Cold Winter demand is based on demand assumptions considered in ENTSOG's Union-wide Security of Supply Simulation Report 2021 revised by TSOs in July 2024, i.e., the historical highest winter demand since the winter 2009/10 on country level.

- *Average daily National production forecast, GWh/d.*

The national gas production is estimated by TSOs.

- *Exports to Ukraine*

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

- *Supply potential*

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).

Supply limitations are set for different cases (monthly values for winter and summer seasons, weekly values for the 2-Week Cold Spell case, daily values for the Peak Day case) so that the maximum flows from each source cannot exceed reasonable levels based on historical observations.

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 2024.

ENTSOG is using the Plexos modelling tool. The gas topology at European level is used to model 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.

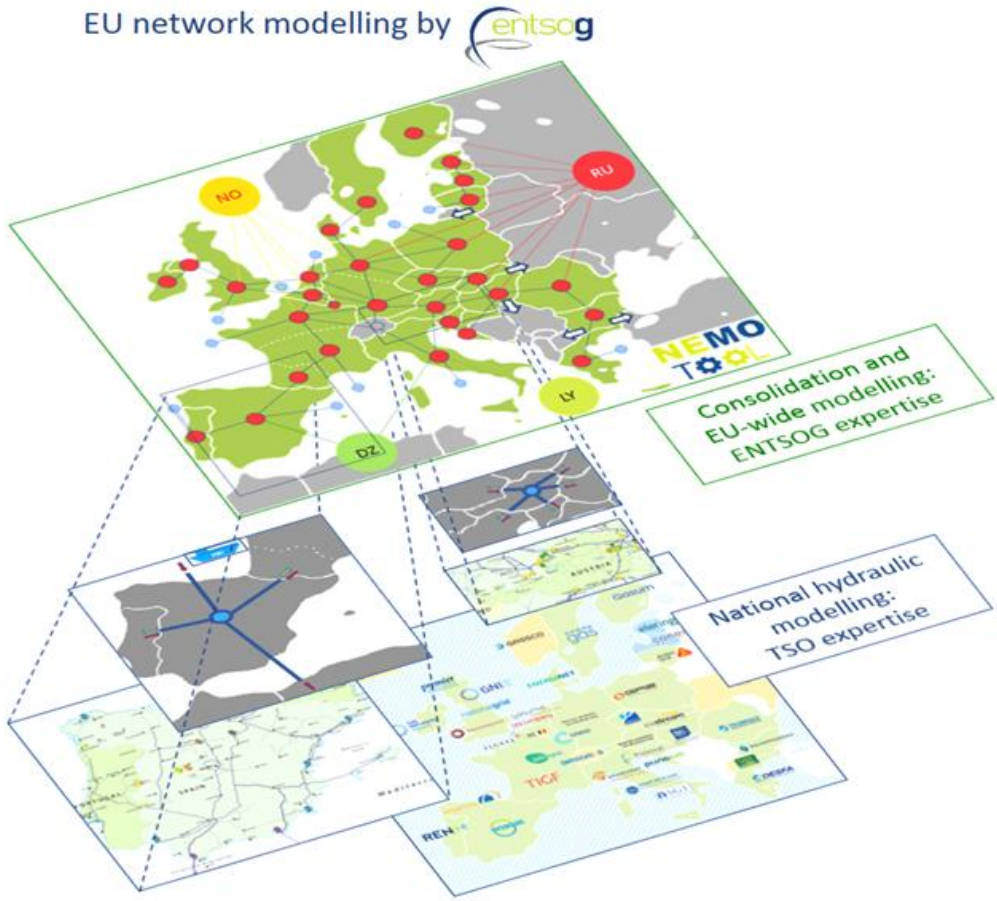


Illustration 1: Entsog model overview

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*

The data for the Winter Supply Outlook 2024/25 is available online as an annex of this report. The data available is specifically:

- *Curtailment Rate for Winter Outlook monthly simulations, %*
- *Curtailment Rate for High demand events – 2-week Cold Spell and Peak day simulations, %*

For each demand situation and each zone, the modelling results consist of the calculation of a 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 case of risk of inadequacy between supply and demand and an exposure to a few percentiles of demand curtailment observed in a country is generally considered as a limited risk in this assessment.

Abbreviations

CEE	Central and Eastern Europe
TSO	Transmission System Operator
UGS	Underground Gas Storage facility
LNG	Liquified Natural Gas
WGV	Working Gas Volume
UAe	Export to Ukraine
5YA-15%	5-Year average demand with demand reduction by 15%

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

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 storages to THE South
STcCZd	Czech storages to Slovakia
STcDEd	Germany Dutch storage zone
STcDEdL	Germany Dutch storage zone L-gas
STcDEg	Germany storage zone THE North
STcDEm	Germany multi-country storage
STcDEmL	Germany multi-country L-gas
STcDEn	Germany storage zone THE South
STcFRa	TSO GRTGaz storage zone Atlantic
STcFRn	TSO GRTGaz storage zone North
STcFRnL	TSO GRTGaz storage North L-gas
STcFRs	TSO GRTGaz storage zone South
STcFRt	TSO Terega storage zone

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