entsog
european network
of transmission system operators
for gas

ENTSOG
SUMMER SUPPLY OUTLOOK

2023

WITH WINTER 2023/24 OVERVIEW

Contents

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 2023 to 30 September 2023). 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 2023.

Furthermore, following the interest expressed by institutions and stakeholders, ENTSOG has run an overview analysis for the winter 2023/24 season. Starting from the simulation results obtained for the 2023 summer period, 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 demand conditions.

Russia's invasion of Ukraine has triggered energy security concerns in Europe. Therefore, ENTSOG additionally assessed the dependence of the EU on the Russian supply during summer 2023 and winter 2023/24.

Summer Supply Outlook 2023 main findings

- On 1 April 2023, the EU gas stock level is in the higher range of the past 5 years with 625 TWh. The decrease in gas consumption - as a result of relatively mild winter 2022/23 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, 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 are identified.

<u>Reference summer scenario (1 April to 30 September 2023)</u>

- 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 2023.

- LNG supply and supply from Norway represent the largest sources of supply. Assuming that this gas would be available, gas supply from Russia would account for at least 2% of the total gas supply while other sources are maximised but limited by the firm capacity of the gas network or the supply potential in the case of LNG supply.

Summer supply dependence assessment – supply disruption from Russia (1 April to 30 September 2023)

- Despite the absence of Russian supply, Europe can reach 90% of its total working gas volume. Western-European countries such as Belgium, Spain, France, Portugal, and United Kingdom could reach 100% of their working gas volume by the end of September 2023. Assuming injection during October storage levels could be higher for all storage facilities.
- Additional LNG supplies, above historically observed import levels, could allow to reach higher target for all storage facilities before the end of September 2023. However, the situation is not improving for Bulgaria, Hungary, Romania, and Serbia due to infrastructure limitations.
- Enhanced capacities, provided by TSOs, would contribute to the increase of import route capacities from the Caspian Area and Norway, as well as boost the possibility for the cooperation between Germany and Austria, Belgium, France, Czech Republic, and the Netherlands and resulted in the increase of gas supply flow from West to East.

Winter 2023/24 overview main findings

Reference winter scenario based on 5-year average demand 2017-2021 (1 October 2023 to 31 March 2024)

- Starting from a stock level of 90% on 1 October 2023, the 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 30% at the end of the winter in all EU countries assuming that gas from Russia would be still available.[1]
- In case of full disruption of Russian supplies, the storage facilities would be used at their maximum in some countries to meet demand and cannot reach the 30% target by the end of winter, hindering the flexibility contribution usually provided by storage facilities during the high demand situations. This would mean an 11% stock level on average in Europe at the end of March 2024 and would put a risk on the winter preparedness of EU countries to reach the 90% target by the end of summer 2024 during the injection period.

[1] The pipe supply from Russia considers flow through TurkStream and via Ukraine

- In case of full disruption of Russian supplies, the combination of the enhanced capacities, decrease in gas demand by 15% and additional LNG supplies would improve ability to maintain 30% of the stock by the end of March 2024 for all EU countries.

Cold winter scenario based on once in 20 years demand values (1 October 2023 to 31 March 2024)

- Starting from the simulation results obtained for the summer 2023 period in case of full disruption of Russian supplies and cold winter situation, scenario simulation results show that withdrawal capacities of the gas storage facilities combined with the supply flexibility are not sufficient to cover the demand and reach the 30% inventory target level. European countries would be exposed to a risk of a demand curtailment between 6 to 13 % during whole winter.
- In case of full disruption of Russian supplies and the cold winter, the combination of the enhanced capacities, decrease in gas demand by 15% and additional LNG supplies would be needed to avoid a risk of demand curtailment and improve the ability to maintain 30% of the stock level by the end of March 2024 for all EU countries.

Conclusions

- The gas infrastructure, including new projects commissioned last year, can efficiently reduce the dependence on Russian supply thanks to enhanced cooperation.
- Even in case of the full Russia supply disruption, cooperation between the countries could allow for efficient injection during the summer 2023 and preparation for winter.
- Storages play an essential role to ensure security of supply, providing seasonal flexibility needed during the winter season. An early significant storage withdrawals 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 on adequate level until the end of the winter.
- In case of full disruption of Russian 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 cold winter and peak demand situations. Simulation results showed that the introduction of possible measures such as enhanced capacities, additional supplies and decrease in gas demand by 15% (as a result of organic reduction due to high prices or policy-based demand measures) would avoid demand curtailment risks and to reach adequate storage level.

Important:

ENTSOG Summer Supply Outlook 2023 with winter 2023/24 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

This edition builds on previous Summer and Winter Supply Outlooks as well as on the demand data assumptions of the Security of Supply Simulation Report 2021 for the cold winter 2023/24 overview part.

The Summer Supply Outlook 2023 with winter 2023/24 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 has triggered energy security concerns in Europe. Therefore, ENTSOG additionally assessed the dependence of the EU on the Russian supply during summer 2023 and winter 2023/24 seasons.

2. ASSUMPTIONS

The Summer Supply Outlook 2023 with winter 2023/24 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 2023 according to AGSI+ platform. The target level is 90% to be reached at the end of injection season (Summer Supply Outlook 2023) 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 initial storage level is 90% for each storage facility at the beginning of October 2023. The target level is 30% for the withdrawal season (winter 2023/24 overview) and is defined for each storage facility. This target is not mandatory, i.e., the storage level goes below 30% if other supply sources otherwise cannot satisfy demand.

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.

The model does not anticipate the need to save some gas in the storage facilities to prepare for the next winter. 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. However, following cooperative behaviour, the model assumes that countries could help themselves by fully sharing gas in the storage facilities, not considering actual constraints

on the utilization of the strategic reserve[2]. Therefore, storage facilities can 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 new infrastructures have been commissioned - new interconnectors between Poland and Lithuania (Gas Interconnection Poland-Lithuania – GIPL), Poland and Slovakia (Poland-Slovakia Gas Interconnection) Greece and Bulgaria (Greece-Bulgaria Gas Interconnector – IGB) as well as Norway to Denmark and from Denmark to Poland (both Baltic Pipe). The new LNG and FSRU terminals in Germany, Finland and the Netherlands were also commissioned in the second half of 2022.

Actions have also been implemented to improve available capacity between Lithuania and Latvia, France to Germany and Spain to France (under certain conditions), Romania to Hungary.

The topology of the network model considers the existing European gas infrastructure, new upcoming projects (for example, LNG terminals in France, Germany and Italy), and the firm technical capacities provided by TSOs, which include maintenance plans known as of March 2023. In the supply disruption scenario, those capacities may not reflect the situation accurately as gas flows and pressure may vary significantly from the usual operational conditions. However, in the disruption case of full Russian supply disruption studied in this report, some TSOs estimated and provided enhanced capacities to increase and maximise gas flow from Western to Eastern Europe.

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 2023 to 30 September 2023) 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 the European aggregated daily demand for the Summer 2023 compared to the historical daily demand over the last five summers. Despite the forecasted slight decrease, demand is

[2] Strategic storage facilities could be withdrawn according to timeframes and amounts that are compliant with the technical constraints in order to preserve the integrity of the fields and considering their deterioration profile of withdrawal capacity

expected to be in the same range as the last three years and in line with the average of the last five summer seasons.

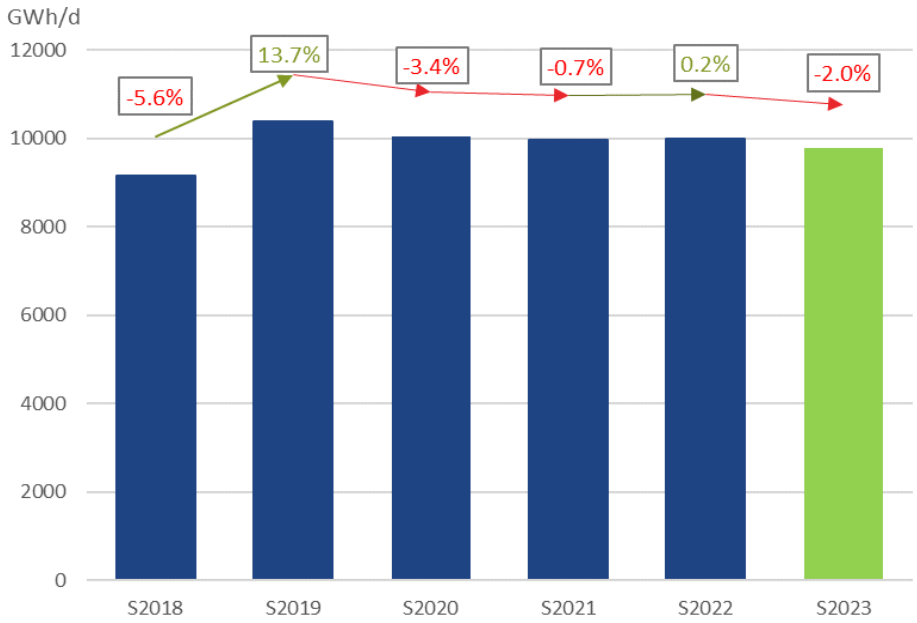


Figure 1. - European daily average summer demand comparison with Summer 2023 (forecast), GWh/d

The Reference Winter Demand (from 1 October 2023 to 31 March 2024) represents average climatic conditions with a once in 2 years probability of occurrence and is based on a calculation of the five-winter average historical demand for the Winter 2023/24 overview. However, some TSOs provided their own estimates of demand (Germany, France and Belgium for the market conversion from L-gas to H-gas; Italy), and demand values have been updated for the simulations in this report. An average daily demand has been considered for each month (see **Annex B** for country detail).

The demand for the Cold Winter is based on demand assumptions considered in the Union-wide SoS Simulation Report and represents a historical once in 20 years high demand winter[3]. Cold Winter Demand values have been updated in view of the publication of the updated Union-wide SoS Simulation Report 2021. Cold Winter demand values have not been updated for the simulations in this report to consider infrastructure and market last changes (Germany, France and Belgium for the market conversion from L-gas to H-gas).

For comparison purposes, **Figure 2** shows the European aggregated daily demand for the Reference Winter and Cold Winter for Winter 2023/24 overview compared to the historical daily demand over the last five winters. The aggregated reduced demand values with a 15% reduction (Reference Winter and Cold Winter) are also compared with historical values.

[3] with a probability of occurrence once in 20 years (see **Annex B** for country detail)

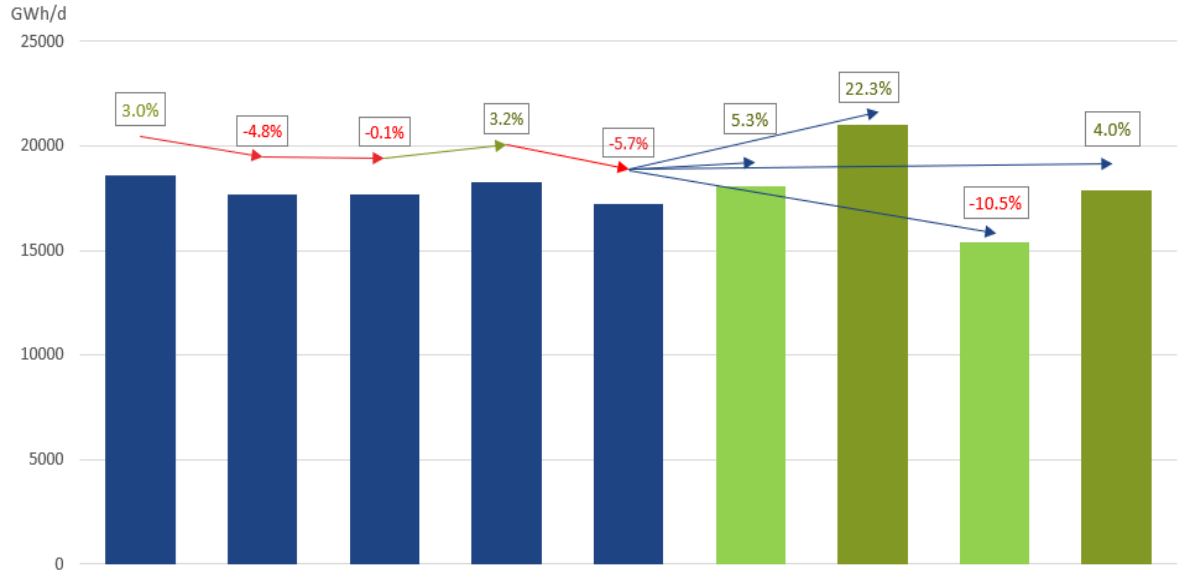


Figure 2. - European daily average winter demand comparison with Reference (5-year average) and Cold Winter, GWh/d[4]

2.3. Supply

The maximum supply potentials of the different sources providing gas to the EU (Caspian Sea, Algeria, Libya, Norway, LNG) are based on a five-year history (historical availability).

The pipe supply from Russia considers flow through TurkStream and via Ukraine in the simulations. 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.

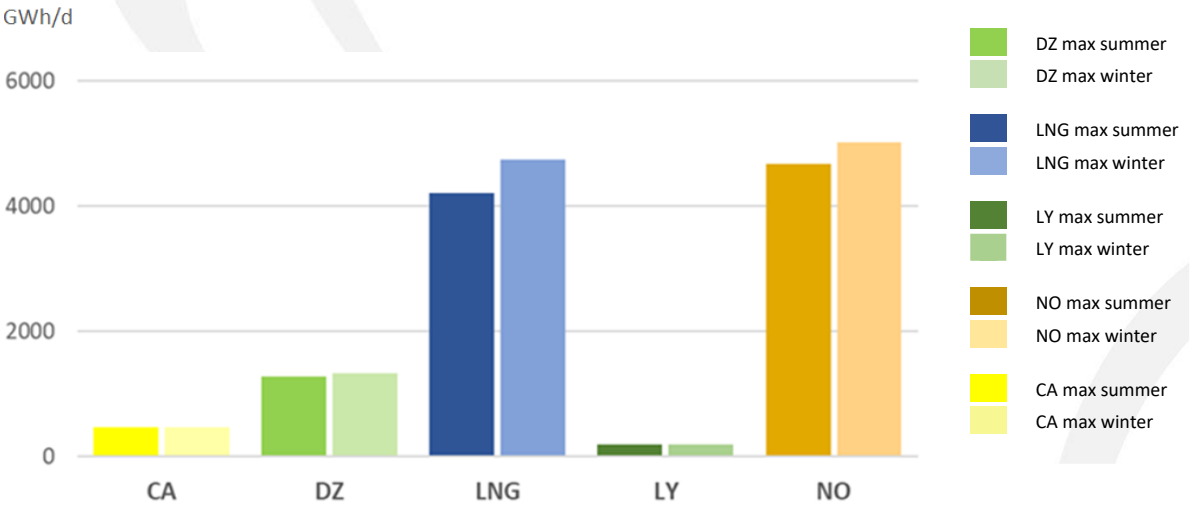


Figure 3. – Maximum supply potential, GWh/d

[4] Forecast values for the winter 2023/24 overview were not collected from TSOs due to the long period prior to the winter season and the difficulty of estimating for TSOs (the data collection process was initiated in December 2022). The forecast demand values provided by TSOs will be used in the Winter Outlook 2023/24 modelling

Note: 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 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 five summer and winter seasons and the national production forecasted by the TSOs for summer 2023 and winter 2023/24. 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.

Domestic production in the summer 2023 is estimated to be down about 18% from the previous summer, whereas for winter 2023/24 it is estimated to increase by 35% over winter 2021/22.

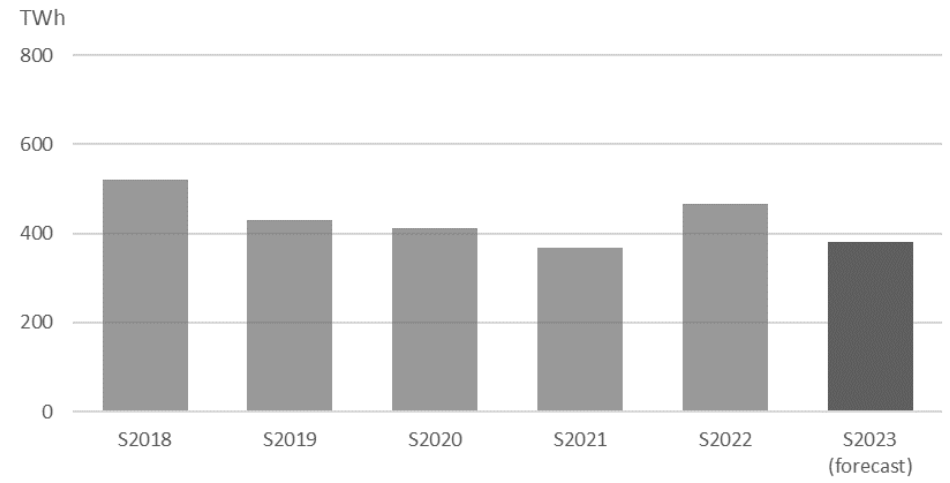


Figure 4. - European national production comparison with Summer 2023 (forecast), TWh

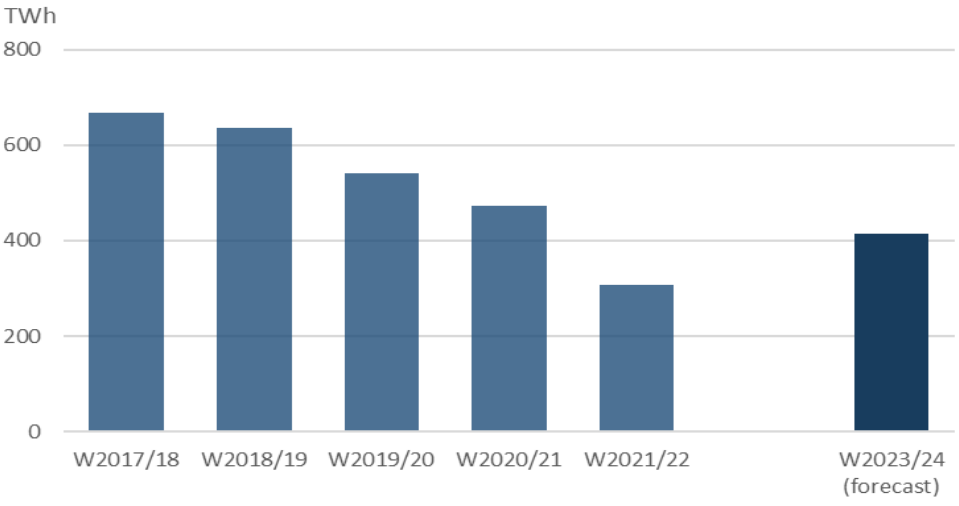


Figure 5. - European national production comparison with Winter 2023/24 (forecast), TWh

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, Moldova and Russia (Kaliningrad).

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 are included in the modelling perimeter
- Export to Ukraine is based on the observed export of the last five years[5]
- Export to Moldova has been set to zero following an investigation of the previous flows
- Export to the Kaliningrad region of Russia is not considered
- No export towards Turkey was considered since Turk Stream pipeline was commissioned
- Albania, Montenegro and Kosovo are not connected to the gas grid

2.4. Storage inventory

On 1 November 2022, the EU underground gas storage reached 95% of filling level, equivalent to 1,059 TWh. Despite high prices in all European Hubs during the previous summer, by implementing ad-hoc and extraordinary measures, EU countries were able to reach the target set by the European Commission[6], i.e. 90% or 35% of the average annual gas consumption of EU Member States over the last five years.

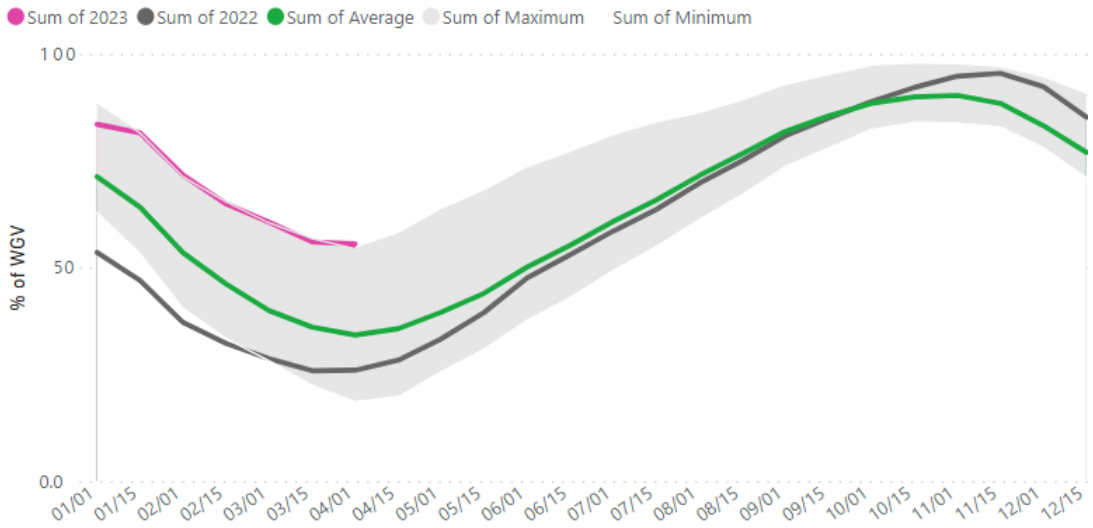


Figure 6. - Gas storage evolution compared to the storage evolution 2015-2022, % of WGV (Source: AGSI+)

[5] The value of the flow is indicated in the **Annex B**.

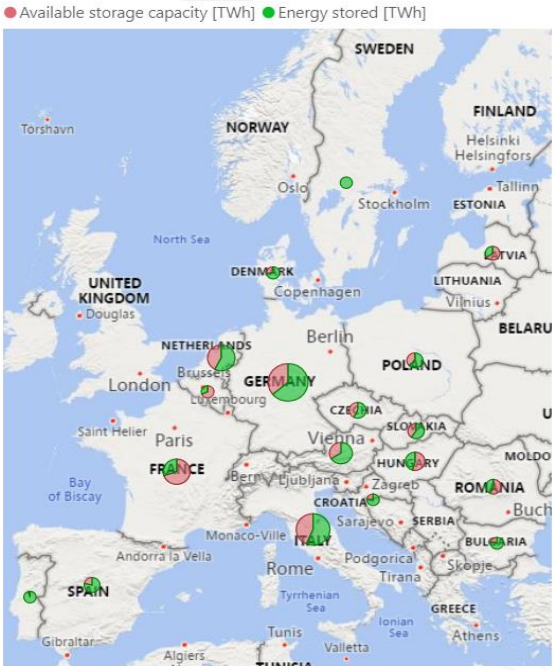
[6] Regulation (EU) 2022/1032 of the European Parliament and of the Council of 29 June 2022 amending Regulations (EU) 2017/1938 and (EC) No 715/2009 with regard to gas storage

On 1 April 2023, the EU gas stock level is in the maximum of the range of the past 5 years with 625 TWh versus 293 TWh in 2022 and only just above 614 TWh in 2020. The decrease in gas consumption - as a result of relatively mild winter weather, high prices effect, 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 2023 considers the storage inventory level per country on 1 April 2023 as the initial situation as shown in **Figure .**

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 2023 are stored in Italy and Germany.

In percentage comparison, the highest filling levels (above 70%) are observed in Portugal, Sweden, Spain, Bulgaria, Croatia and Denmark; the lowest (below 35%) - in Belgium and Latvia. These storage levels per country have been used as a starting point for the Summer Supply Outlook 2023.



Country	Gas in storage, TWh	WGV, TWh	Full, %
Austria	62.620	96.039	65%
Belgium	2.679	9.007	30%
Bulgaria	4.499	5.803	78%
Czech Republic	24.743	43.810	56%
German (H)	145.306	223.640	65%
German (L)	11.605	22.918	51%
Denmark	7.392	9.940	74%
Spain	27.627	35.250	78%
France	37.297	133.603	28%
Croatia	3.615	4.773	76%
Hungary	30.408	67.703	45%
Italy	113.006	193.443	58%
Latvia	8.069	24.074	34%
Netherlands	82.131	138.991	59%
Poland	19.953	36.410	55%
Portugal	3.789	3.967	96%
Romania	13.794	32.794	42%
Serbia	1.360	4.532	30%
Sweden	0.097	0.101	95%
Slovakia	22.631	38.848	58%
United Kingdom	5.945	17.470	34%
TOTAL	**628.565**	**1143.114**	**55%**

Figure 7. - Actual storage inventory levels on 1 April 2023 (for some countries, the initial level includes strategic stocks).[7]

[7] The gas in storage on 1 April 2023 for each country is based on the AGSI+ platform. For Serbia, the initial storage is considered 30% due to no availability of data. The %Full has been calculated using the gas in the storage from AGSI+ platform and the Working Gas Volume from GSE Storage MAP database. Since the last update of GSE Storage MAP database was July 2021, updated AGSI+ values for WGV have been taken into account for those storage facilities with a significant difference.

3. MODELLING RESULTS FOR THE SUMMER SUPPLY OUTLOOK 2023

3.1. Reference summer scenario - 90% storage target by 30 September 2023

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 2023 starting with total European stock level of 55% on 1 April 2023 (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.

The simulation shows that if there is no supply disruption[8], a 90% stock level can be achieved by 30 September 2023 for all storage facilities.

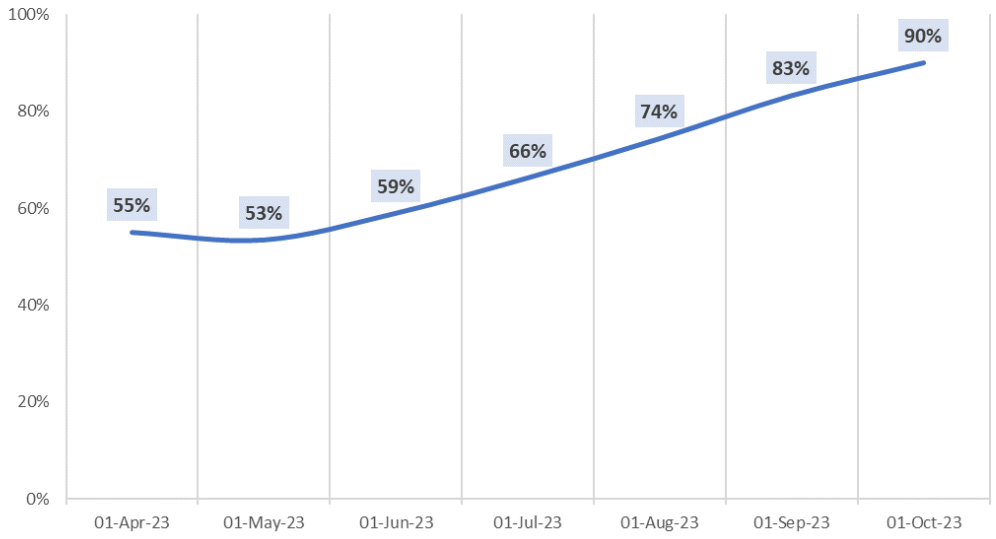


Figure 8. – Reference summer scenario. Evolution of the aggregated European UGS stock level, %

[8] The pipe supply from RU considers flow through TurkStream and via Ukraine

Table 1 shows the evolution of the stock level per country as a result of the model for the Baseline Scenario.

COUNTRY COD	01-Apr-23	01-May-23	01-Jun-23	01-Jul-23	01-Aug-23	01-Sep-23	01-Oct-23
AT	65%	62%	65%	69%	76%	83%	90%
BE	30%	30%	30%	48%	63%	77%	90%
BG	78%	78%	78%	80%	84%	87%	90%
CZ	56%	56%	61%	68%	75%	83%	90%
DE	64%	62%	64%	70%	77%	84%	90%
DK	74%	74%	77%	82%	87%	90%	90%
ES	78%	78%	78%	85%	85%	87%	90%
FR	28%	28%	39%	51%	65%	79%	90%
HR	76%	68%	73%	81%	84%	88%	90%
HU	45%	45%	54%	63%	72%	81%	90%
IT	58%	58%	65%	72%	78%	86%	90%
LV	34%	34%	47%	57%	66%	79%	90%
NL	59%	59%	65%	71%	78%	84%	90%
PL	55%	50%	55%	64%	70%	80%	90%
PT	96%	90%	90%	90%	90%	90%	90%
RO	42%	42%	49%	59%	69%	80%	90%
RS	30%	30%	41%	53%	66%	78%	90%
SE	95%	90%	90%	90%	90%	90%	90%
SK	58%	58%	60%	67%	74%	83%	90%
UK	34%	0%	0%	10%	41%	76%	90%

Table 1. - Reference Summer Scenario. Evolution of the aggregated UGS stock level per country, %[9]

The main finding of the Summer Supply Outlook 2023 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 2023. The results of the sensitivity analysis also show that the flexibility of the gas system infrastructure is sufficient to achieve higher storage filling level during the injection period.

Figure and **Figure 10** show the level and composition of the supply mix in the Reference summer scenario. The storage filling level at the end of September 2023 is 90%.[10]

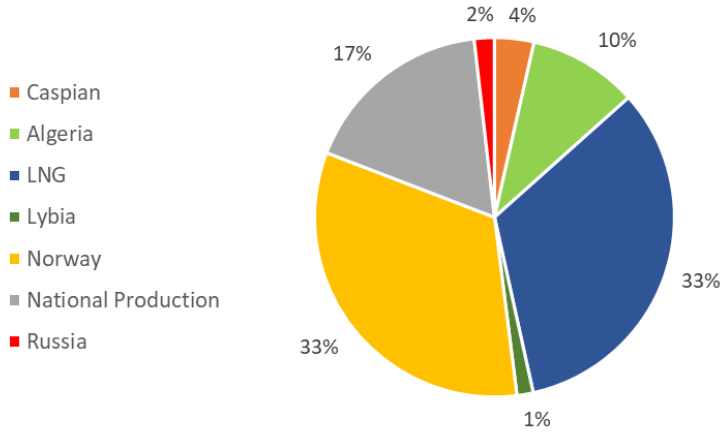


Figure 9. - Reference Summer Scenario. Supply mix, %

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

[10] 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

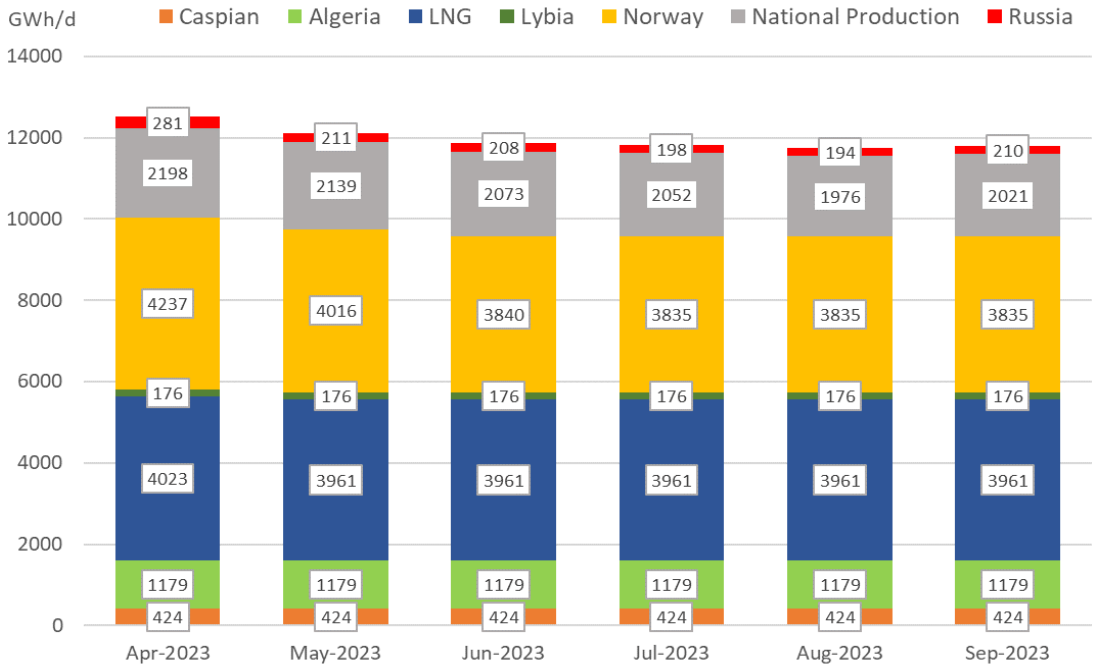


Figure 10. - Reference summer scenario. Monthly supply mix, GWh/d

The monthly supply mix is stable over the summer season 2023 period. LNG supply and supply from NO represent the largest sources of supply – 33% each. Gas supply from RU accounts for at least 2% of the total gas supply while other sources are maximised but limited by the firm capacity of the gas network or the supply potential in the case of LNG supply.

3.1.1. 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 55% on 1 April 2023 (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 enhanced 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[11], all European countries cooperate as if they were part of a single European risk group.

In this scenario, Europe can reach 90% of its total working gas volume.

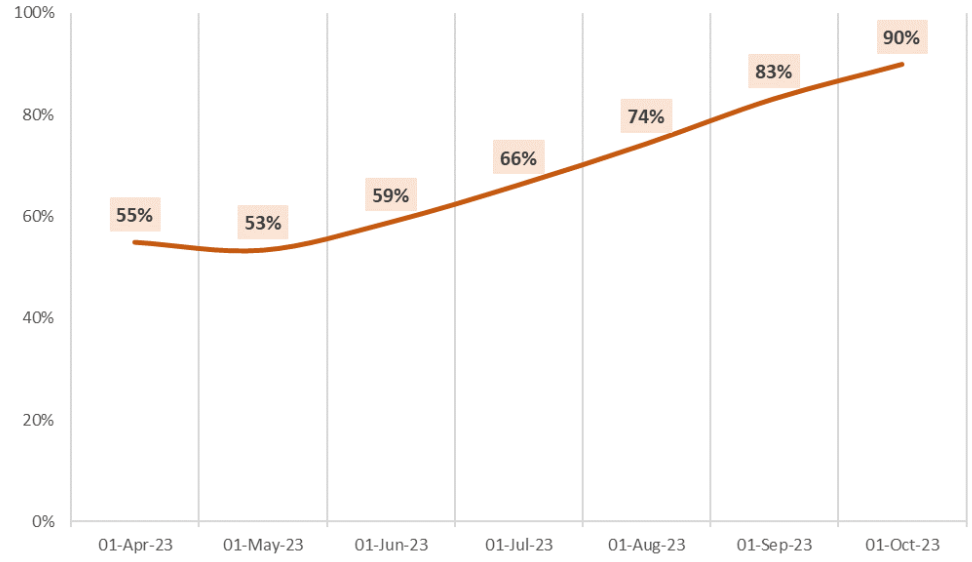


Figure 11. – Summer supply dependence assessment. Evolution of the aggregated European UGS stock level, %

Table 1 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.

COUNTRY CODE	01-Apr-23	01-May-23	01-Jun-23	01-Jul-23	01-Aug-23	01-Sep-23	01-Oct-23
AT	65%	61%	64%	67%	75%	83%	90%
BE	30%	27%	27%	46%	61%	75%	90%
BG	78%	78%	78%	78%	79%	88%	90%
CZ	56%	56%	61%	68%	75%	83%	90%
DE	64%	60%	63%	69%	76%	84%	90%
DK	74%	73%	75%	81%	85%	90%	90%
ES	78%	78%	78%	85%	85%	88%	90%
FR	28%	28%	40%	52%	66%	79%	90%
HR	76%	74%	77%	83%	85%	88%	90%
HU	45%	46%	54%	63%	72%	81%	90%
IT	58%	58%	65%	72%	78%	87%	90%
LV	34%	34%	47%	57%	66%	79%	90%
NL	59%	59%	64%	70%	77%	84%	90%
PL	55%	52%	57%	66%	72%	81%	90%
PT	96%	90%	90%	90%	90%	90%	90%
RO	42%	42%	49%	59%	70%	80%	90%
RS	30%	31%	43%	54%	66%	78%	90%
SE	95%	60%	60%	80%	80%	90%	90%
SK	58%	58%	62%	67%	74%	82%	90%
UK	34%	0%	0%	10%	39%	75%	90%

Table 2. - Summer supply dependence assessment. Evolution of the aggregated UGS stock level per country, %[12]

[11] 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

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

The Western-European countries such as Belgium, Spain, France, Portugal, and the United Kingdom can reach storage filling level of 100% of their working gas volume by the end of September 2023.

Increasing LNG supplies provides a supply flexibility and opportunity to reach the higher target for almost all storage facilities. However, the situation is not improving for Bulgaria, Hungary, Romania, and Serbia due to limited capacity between Croatia to Hungary and Greece to Bulgaria, which is used at the maximum level to supply gas imported to LNG terminals in these countries.

In case of short-term coordinated preparedness (increased capacities for some interconnections), European countries can further cooperate to fill storage facilities in Central and Eastern Europe and can more equally distribute gas through the different storage facilities. However, some countries are limited by import or internal capacity limitations to provide more gas.

One possible solution for gas supplies to eastern countries is to supply gas from Poland/Slovakia/Hungary via Ukraine to Romania.

The European storage filling level could also increase during October 2023 as the injection season typically lasts until November 1 in some countries.

Figure and **Figure 13** 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 2023 is 90%.

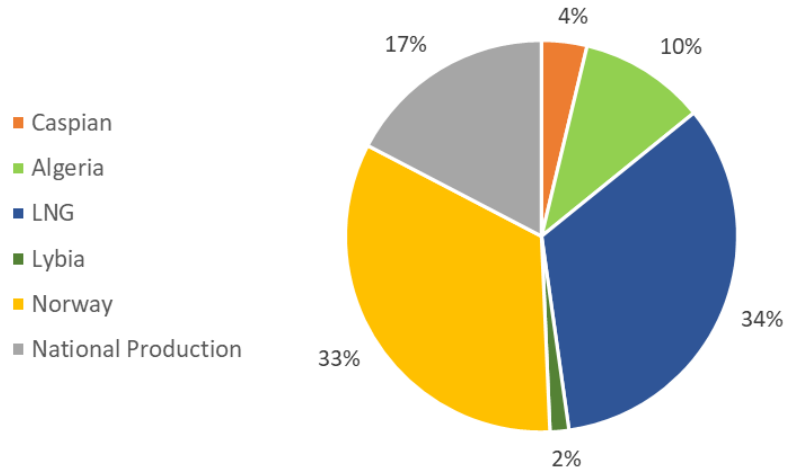


Figure 12. - Summer supply dependence assessment. Supply mix, %

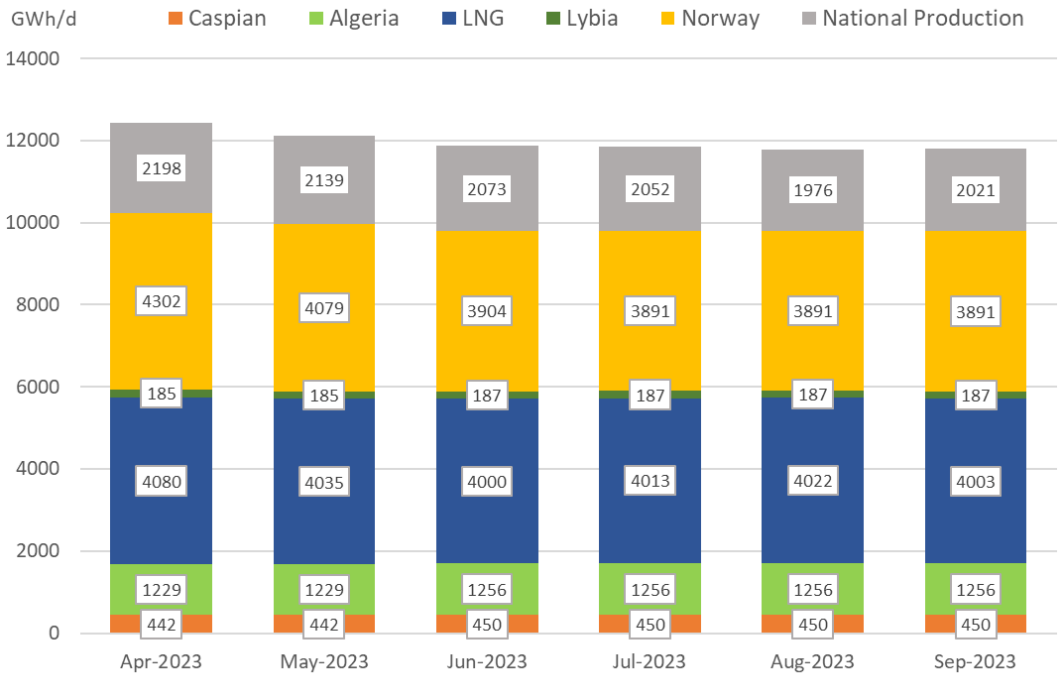


Figure 13. - Summer supply dependence assessment. Monthly supply mix, GWh/d

The monthly supply mix is stable over the summer season 2023 period. LNG and Norway represent the largest sources of supply – 34% and 33% respectively.

Enhanced capacities, provided by TSOs in the case of full supply disruption from Russia, contributed to the increase of gas supply to the EU - the increase of import route capacities from the Caspian Area and from Norway as well as the increase of interconnection capacities between Germany and Austria, Belgium, France, Czech Republic, and the Netherlands.

4. MODELLING RESULTS FOR THE WINTER 2023/24 OVERVIEW

4.1. Reference winter scenario - 30% storage target by 31 March 2024

For the Reference Winter 2023/24 scenario, the overall winter season withdrawal is defined as the amount of gas necessary to meet demand and reach 30% of the stock level in each European storage facility on 31 March 2024, starting with total European stock level of 90% on 1 October 2023. In this scenario, the 5-year average demand values for each country during the winter period were assumed.[13]

The distribution of withdrawal, demand and supply during the winter months results from the modelling and the following assumptions[14]:

- The 5-year 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**
- The flexibility given to the model for the definition of the supply potentials derives from the historical supply mix (see **Annex B**)

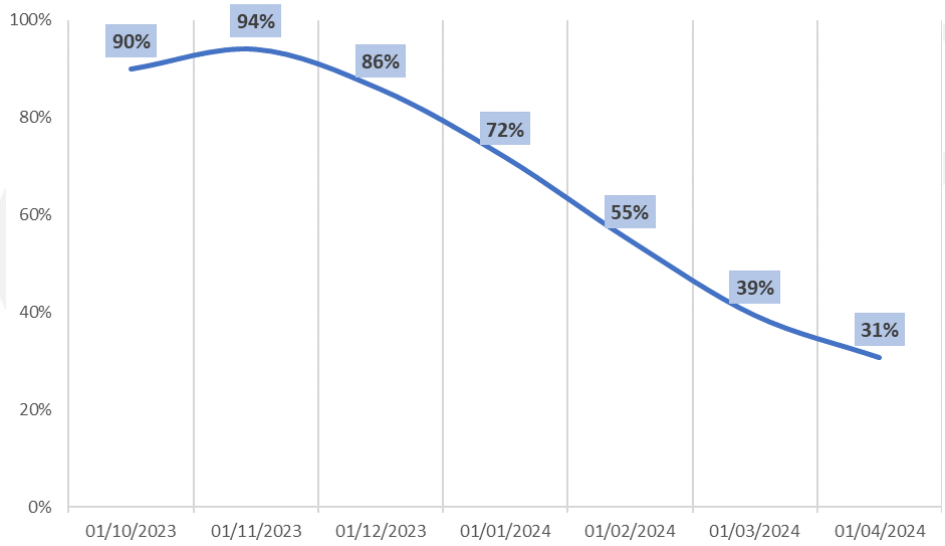


Figure 14. – Reference Winter scenario. Winter evolution of the aggregated European UGS stock level, %[15]

The Reference Winter 2023/24 scenario simulation results[16] show that withdrawal capacities of the gas storage facilities combined with the supply flexibility of imports is sufficient to cover

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

[14] 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. However, following cooperative behaviour, the model assumes that countries could help themselves by fully sharing gas in the storage facilities, not considering actual constraints on the utilization of the strategic reserve. Therefore, storage facilities can be depleted to avoid/reduce demand curtailment

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

[16] The pipe supply from Russia considers flow through TurkStream and via Ukraine

the demand and reach an inventory target level of 30%[17] at the end of the winter in all EU countries. Also, according to the results of the simulation, the EU countries continue to inject more gas during October.

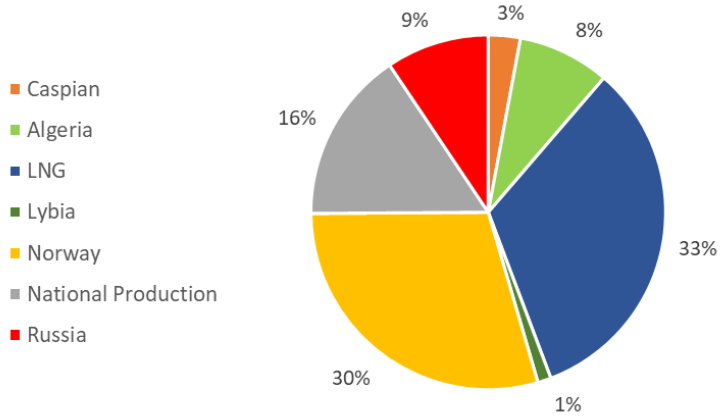


Figure 15. - Reference Winter scenario. Supply mix, %

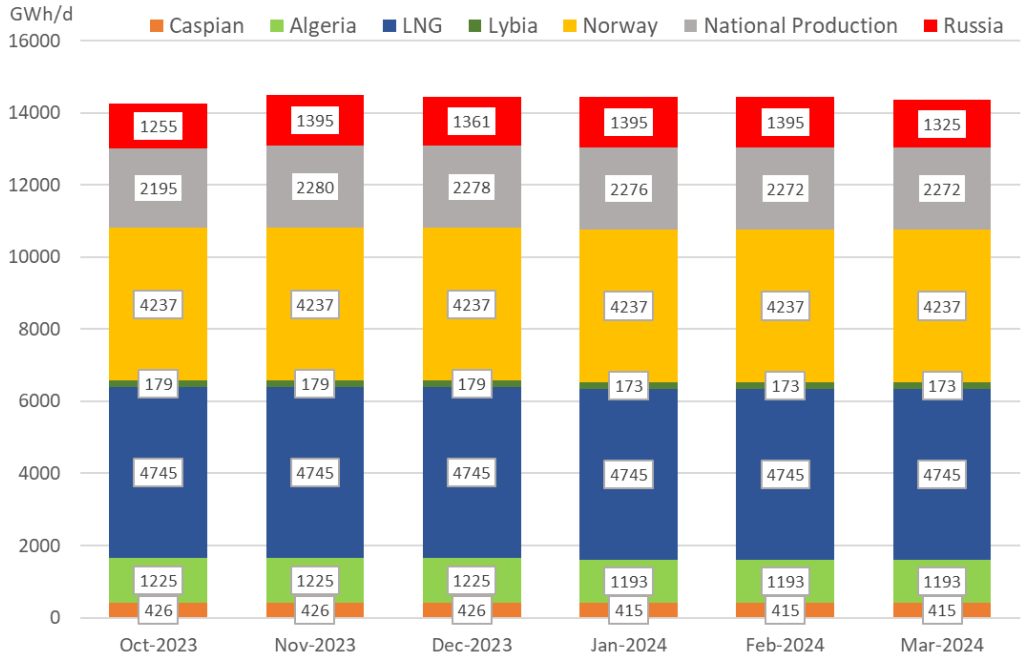


Figure 16. - Reference Winter scenario. Monthly supply mix, GWh/d

Figure and **Figure 16** show the level and composition of the supply mix in the Reference Winter Scenario. The storage filling level at the end of March 2024 is 30%[18].

LNG and Norway represent the largest sources of supply – 33% and 30% respectively. Gas from Russia accounts for at least 9% of the total gas supply while other sources are maximised but limited by the firm capacity of the gas network or the supply potential in the case of LNG supply.

[17] 55% in the case of Spain. The Spanish TSO has confirmed that storage facilities in Spain should not be used below 55%. Storage reserves can be used for particularly stressful situations as in the case of the Algerian Disruption.

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

4.1.1. 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 30% of the stock level in each European storage facility on 31 March 2024, starting with total European stock level of 90% on 1 October 2023. In this scenario the 5-year average demand values[19] 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[20]:

- 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 enhanced 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[21], all European countries cooperate as if they were part of a single European risk group.

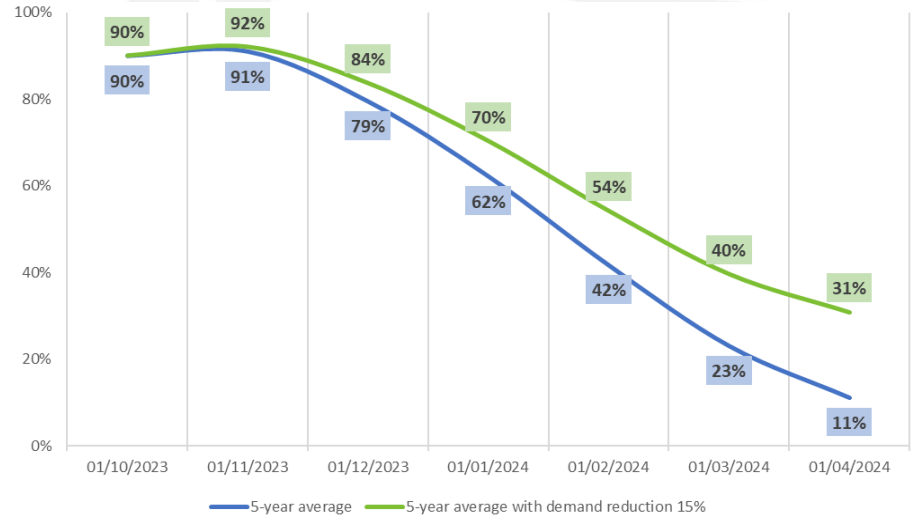


Figure 17. - Supply dependence assessment. Winter evolution of the aggregated European UGS stock level, %[22]

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

[20] 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. However, following cooperative behaviour, the model assumes that countries could help themselves by fully sharing gas in the storage facilities, not considering actual constraints on the utilization of the strategic reserve. Therefore, storage facilities can be depleted to avoid/reduce demand curtailment

[21] 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

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

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 cannot reach the 30%[23] target. At the end of the winter, the storage volume at the European level is 11% of the working gas volume. 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 30% of storage level in all countries.

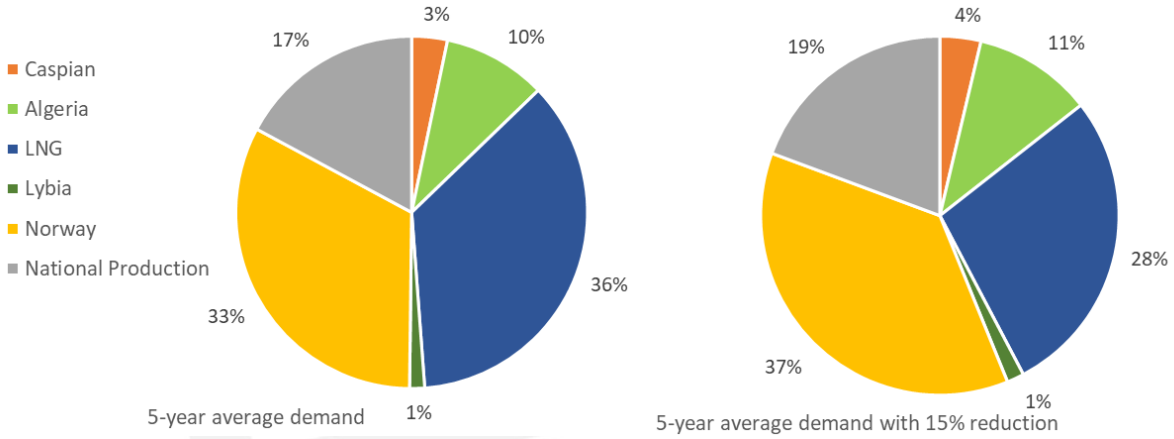


Figure 18. - Supply dependence assessment. Supply mix, %

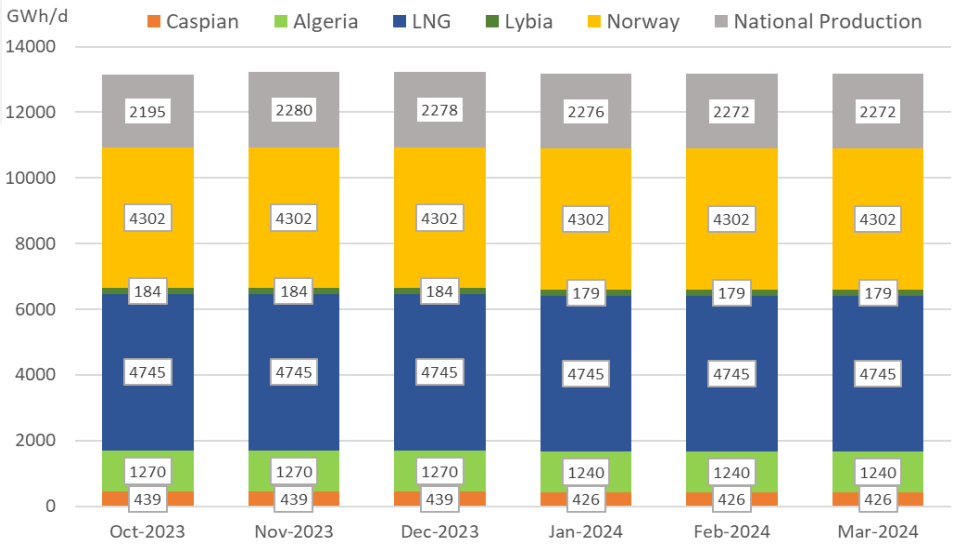


Figure 19. - Supply dependence assessment (5-year average demand). Monthly supply mix, GWh/d

[23] 55% in the case of Spain. Spanish TSO has confirmed that storages in Spain should not be used below 55%. It can be used for particularly stressful situations as in the case of Algerian Disruption

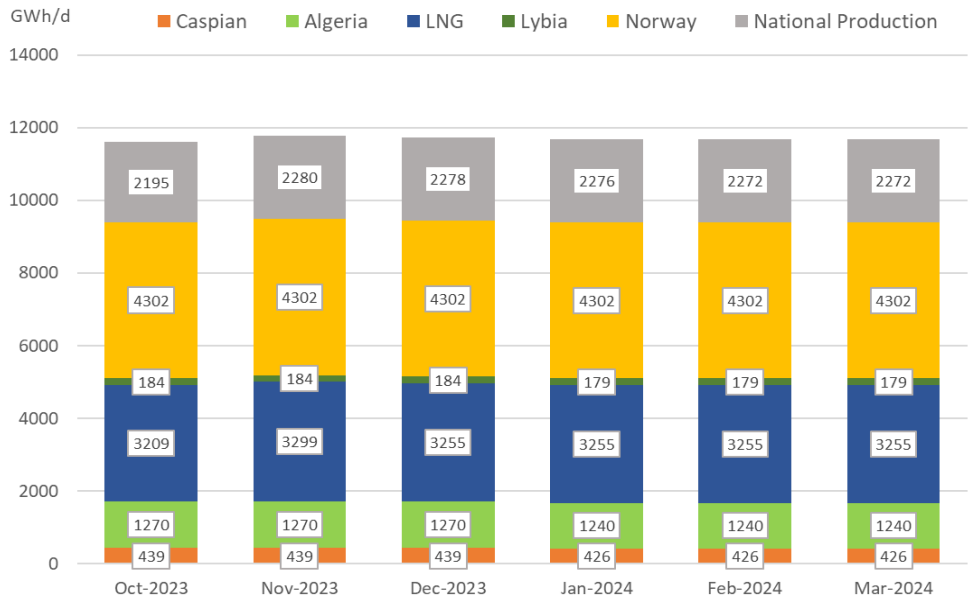


Figure 20. - Supply dependence assessment (5-year average demand with 15% reduction). Monthly supply mix, GWh/d

Figure Figure 19, and **Figure 20** show the level and composition of the supply mix in the Winter supply dependence assessment scenario for two cases – 5-year average demand and 5-year average demand with 15% reduction. The storage filling level at the end of March 2024 is 11% and 30%[24] respectively.

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 30%. Decrease in gas demand by 15% also provides import sources flexibility and the ability to meet the 30% target by the end of March 2024 for all EU countries.

4.2. Cold winter scenario - 30% storage target by 31 March 2024

For the Cold winter 2023/24 scenario, the overall winter season withdrawal is defined as the amount of gas necessary to meet demand and reach 30% of the stock level in each European storage facility on 31 March 2024, starting with total European stock level of 90% on 1 October 2023. In this scenario, the cold winter demand values and cold winter demand values with 15% reduction 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[25]:

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

[25] 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. However, following cooperative behaviour, the model assumes that countries could help themselves by fully sharing gas in the storage facilities, not considering actual constraints on the utilization of the strategic reserve. Therefore, storage facilities can be depleted to avoid/reduce demand curtailment

- The cold winter monthly gas demand and cold winter 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[26], all European countries cooperate as if they were part of a single European risk group.

In the Cold winter scenario[27], the storage facilities are used at their maximum in some countries to meet demand and can reach only 14% of the working gas volume at the European level. This risk has to be anticipated if the EU countries are to reach the 90% target next summer 2024 during the injection period. In case of 15% demand reduction, storage facilities can reach 30%[28] of storage level in all countries. Also, according to the results of the simulation, the EU countries continue to inject more gas during October.

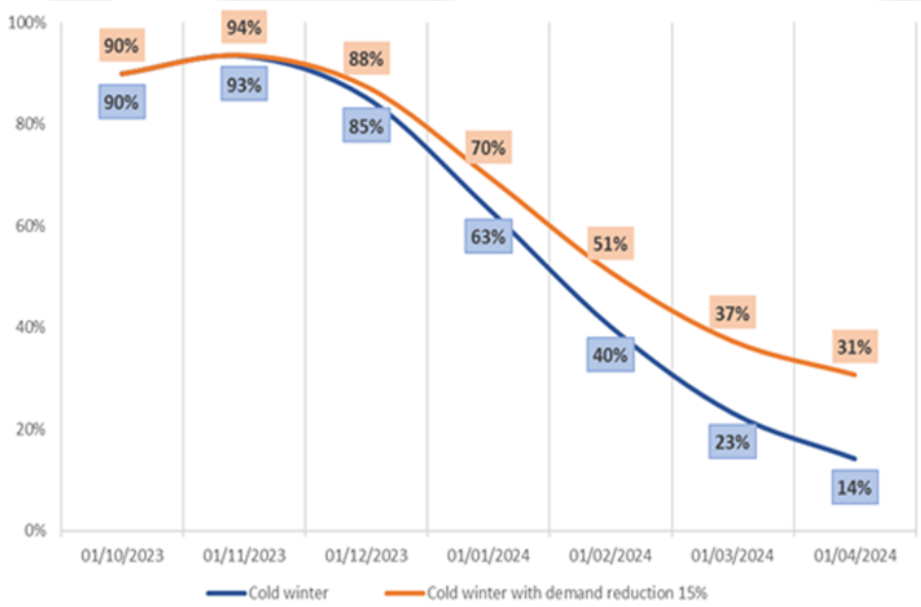


Figure 21. – Cold winter scenario. Evolution of the aggregated European UGS stock level, %[29]

[26] 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

[27] The pipe supply from Russia considers flow through TurkStream and via Ukraine

[28] 55% in the case of Spain. Spanish TSO has confirmed that storages in Spain should not be used below 55%. It can be used for particularly stressful situations as in the case of Algerian Disruption

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

Figure Figure 23, and **Figure 24** show the level and composition of the supply mix in the Cold winter scenario for two cases – Cold winter demand and Cold winter demand with 15% reduction. The storage filling level at the end of March 2024 is 14% and 30%[30] respectively.

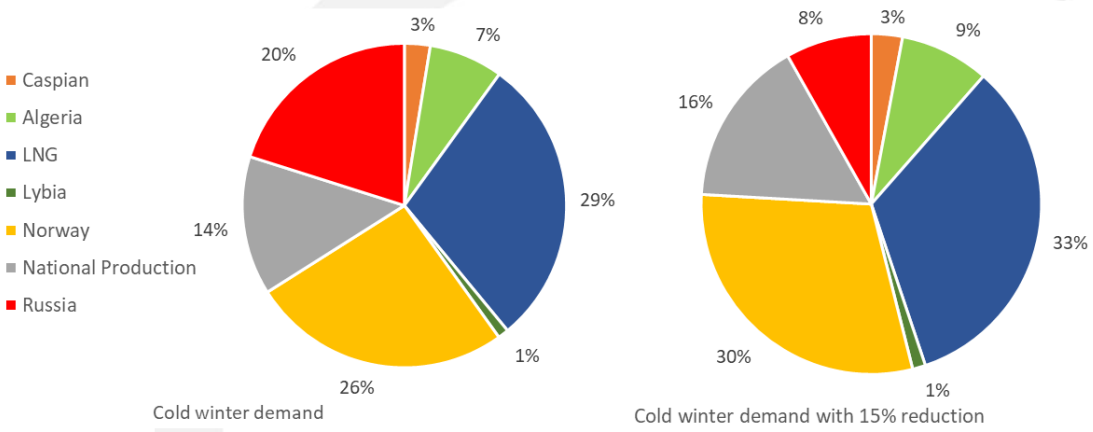


Figure 22. - Cold winter scenario. Supply mix, %

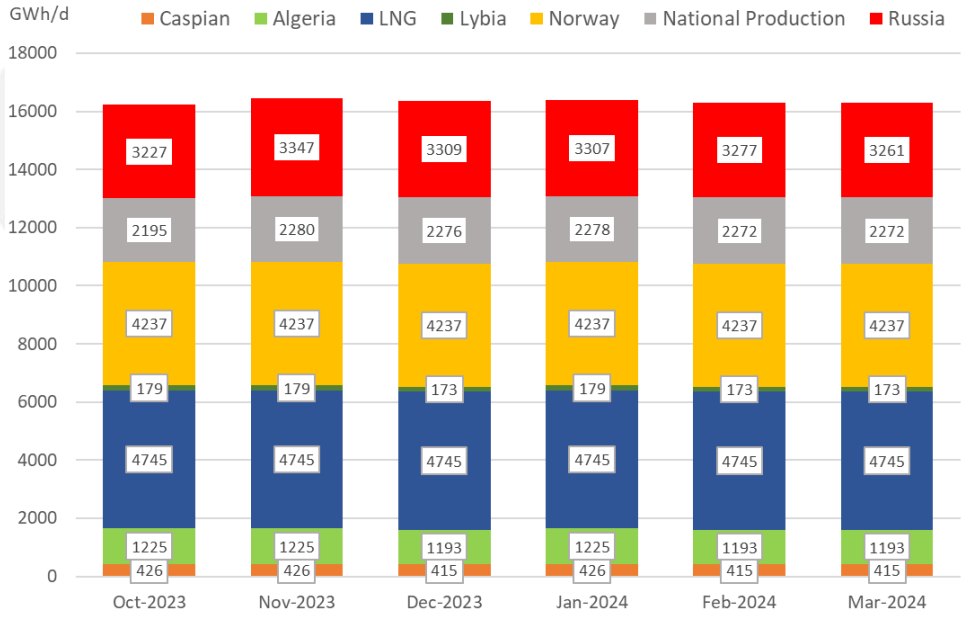


Figure 23. - Cold winter scenario (Cold winter demand). Monthly supply mix, GWh/d

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

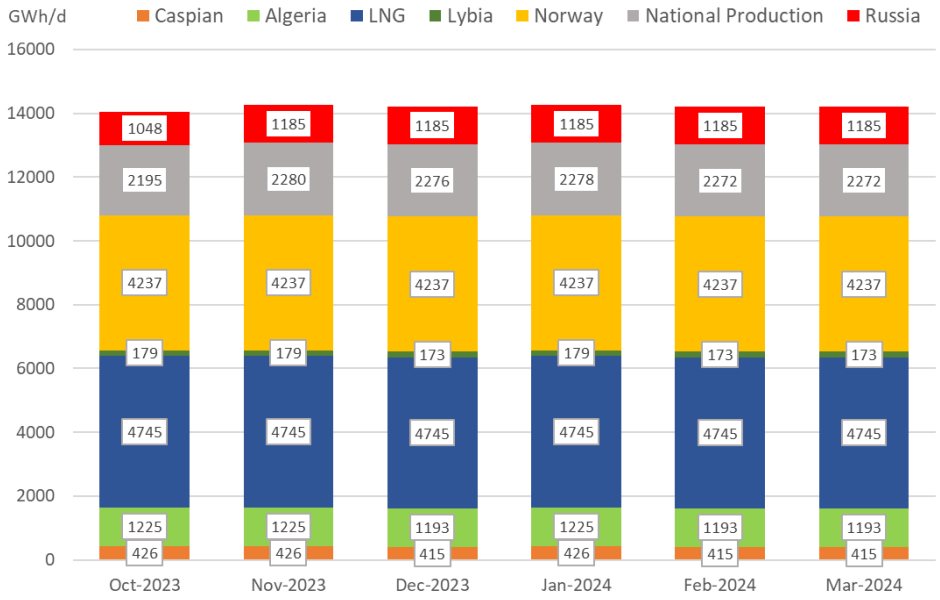


Figure 24. - Cold winter scenario (Cold winter demand with 15% reduction). Monthly supply mix, GWh/d

LNG and Norway represent the largest sources of supply in both cases. Gas from RU accounts for at least 20% of the total gas supply in the case of Cold winter demand, and at 8% - in the case of Cold winter demand with 15% reduction. Other sources are maximised but limited by the firm capacity of the gas network or the supply potential in the case of LNG supply.

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 30%.

Decrease in gas demand by 15% also provides import sources flexibility and the ability to meet the 30% target by the end of March for all EU countries.

4.2.1. Cold winter supply dependence assessment – supply disruption from RU

This section investigates the potential impact of full disruption along the RU supply routes during the withdrawal period to satisfy the demand and reach 30% of the stock level in each European storage facility on 31 March 2024, starting with total European stock level of 90% on 1 October 2023 (see **Figure 6**). In this scenario the cold winter demand values and the cold winter demand values with 15% reduction 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[31]:

- The cold winter monthly gas demand and cold winter monthly gas demand with 15% reduction

[31] 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. However, following cooperative behaviour, the model assumes that countries could help themselves by fully sharing gas in the storage facilities, not considering actual constraints on the utilization of the strategic reserve. Therefore, storage facilities can be depleted to avoid/reduce demand curtailment

- The monthly national gas production estimated by TSOs
- The monthly enhanced 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[32], all European countries cooperate as if they were part of a single European risk group.

The Cold winter 2023/24 scenario simulation results show that withdrawal capacities of the gas storage facilities combined with the supply flexibility of imports in the case of full supply disruption from RU is no sufficient to cover the demand and reach an inventory target level 30% (in absolute value, the volume not reached for injection into the storage is around 324 TWh). European countries are facing 6 to 13 % of demand curtailment in average during whole winter.

In case of 15% demand reduction, storage facilities are used at their maximum in some countries to meet demand and cannot reach the 30%[33] target. At the end of the winter, the storage volume at the European level is 14% of the working gas volume (in absolute value, the volume not reached for injection into the storage is around 180 TWh). This risk has to be anticipated if the EU countries are to reach the 90% target next summer during the injection period.

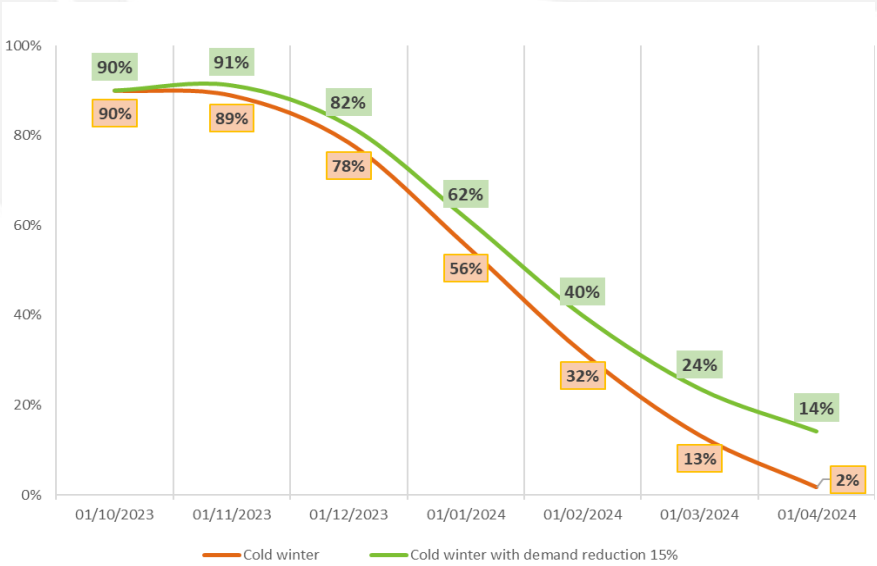


Figure 25. - Supply dependence assessment. Cold winter evolution of the aggregated European UGS stock level, %

[32] 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

[33] 55% in the case of Spain. Spanish TSO has confirmed that storages in Spain should not be used below 55%. It can be used for particularly stressful situations as in the case of Algerian Disruption

Figure Figure 27, and **Figure 28** show the level and composition of the supply mix in the Cold winter supply dependence assessment scenario for two cases – cold winter demand and cold winter demand with 15% reduction. The storage filling level at the end of March 2024 is 2% and 14%[34] respectively. The figures presented for the two cases are identical because they represent the maximum ability of the gas system, considering supply potential and infrastructure capacity.

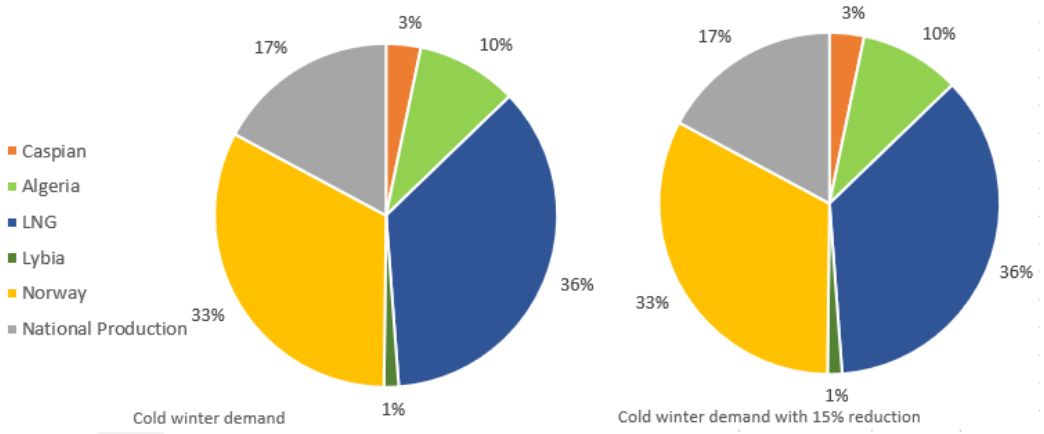


Figure 26. - Supply dependence assessment. Supply mix, %

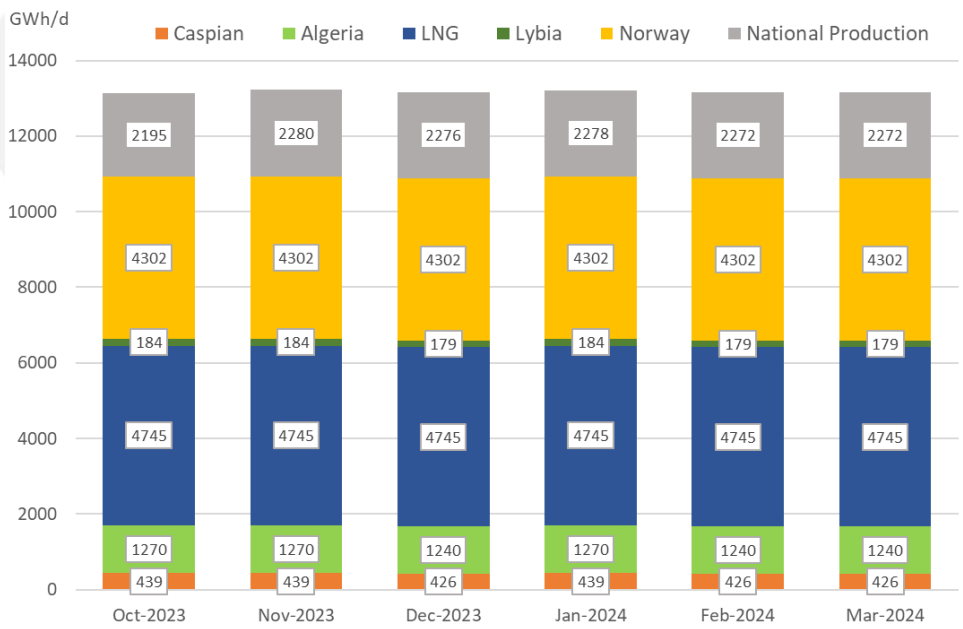


Figure 27. - Supply dependence assessment (Cold winter demand). Monthly supply mix, GWh/d

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

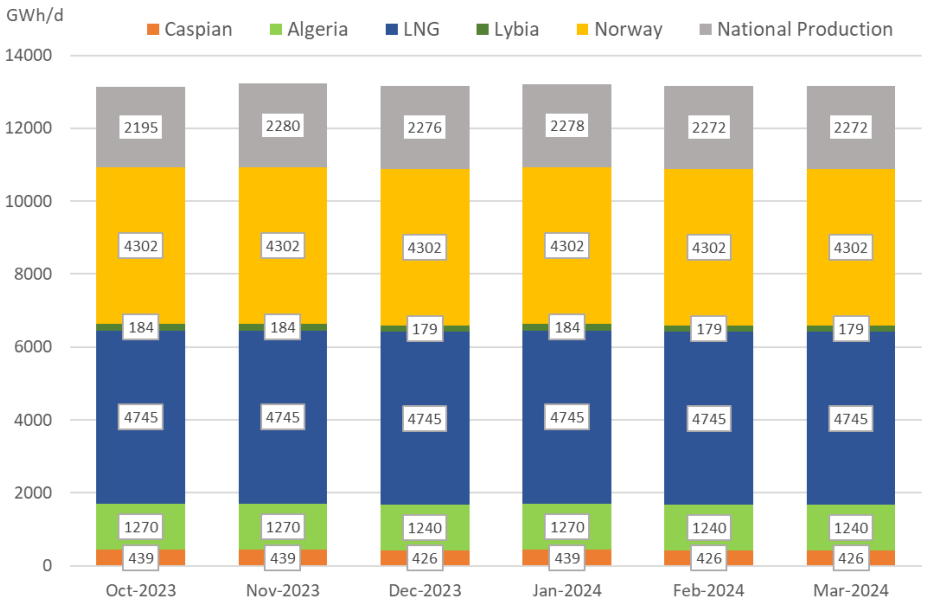


Figure 28. - Supply dependence assessment (Cold winter demand with 15% reduction). Monthly supply mix, GWh/d

LNG and NO represent the largest sources of supply in both cases. Other sources are maximised but limited by the firm capacity of the gas network or the supply potential in the case of LNG supply.

Increasing LNG supplies, combined with the withdrawal capacities of the gas storage, provides an opportunity to partially satisfy the demand (the demand curtailment averages 1%).

Decrease in gas demand by 15% also provides import sources flexibility and the ability to satisfy the demand during the winter season.

Legal Notice

The current analysis is developed specifically for this Summer Supply Outlook 2023 with winter 2023/24 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 2023 and 31 March 2024 will depend on market behaviour and global factors.

ENTSOG has prepared this Summer Supply Outlook 2023 with winter 2023/24 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 – Assumptions for underground storage facilities

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.

Country	Injection availability when WGV is at XX% level										
	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%	100%
AT	100%	99%	99%	97%	96%	93%	90%	85%	78%	65%	0%
ATm	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
ATn	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
BEh	100%	100%	100%	100%	100%	100%	35%	35%	18%	18%	0%
BGn	100%	100%	100%	100%	100%	100%	100%	63%	63%	56%	0%
CZ	100%	100%	100%	100%	100%	85%	75%	60%	40%	30%	0%
CZd	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DE	100%	99%	99%	98%	96%	89%	81%	73%	62%	50%	0%
DEd	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DEdL	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DEg	100%	99%	99%	98%	96%	89%	81%	73%	62%	50%	0%
DEl	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DEm	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DEmL	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
DEn	100%	99%	99%	98%	96%	89%	81%	73%	62%	50%	0%
DK	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	0%
ES	100%	100%	100%	100%	95%	90%	90%	90%	85%	85%	0%
FRa	100%	100%	100%	96%	92%	88%	84%	80%	76%	76%	0%
FRn	100%	100%	100%	98%	95%	93%	85%	77%	68%	62%	0%
FRnL	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%
FRs	96%	92%	88%	82%	76%	70%	65%	60%	57%	42%	0%
FRt	100%	100%	100%	100%	100%	100%	100%	99%	99%	98%	0%
HR	100%	100%	100%	100%	100%	100%	100%	100%	83%	33%	0%
HU	100%	100%	100%	100%	95%	94%	92%	91%	89%	88%	0%
IT	100%	100%	100%	79%	79%	62%	62%	62%	31%	15%	0%
LV	100%	100%	100%	100%	100%	100%	100%	100%	60%	50%	0%
NL	99%	98%	97%	93%	91%	86%	82%	78%	68%	58%	0%
PL	97%	90%	89%	88%	87%	86%	83%	83%	70%	54%	0%
PT	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%
RO	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
RS	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
SE	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
SK	98%	95%	93%	91%	87%	83%	80%	75%	71%	68%	0%
SKm	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%
UK	99%	99%	98%	94%	92%	85%	80%	75%	62%	48%	0%

Table 2. - UGS injection curves[35]

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

Country	Withdrawal availability when WGV is at XX% level										
	90%	80%	70%	60%	50%	40%	30%	20%	10%	1%	0%
AT	99%	98%	97%	96%	95%	88%	80%	71%	63%	57%	0%
ATm	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
ATn	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
BEh	100%	100%	100%	100%	100%	100%	20%	20%	10%	10%	0%
BGn	100%	100%	100%	100%	100%	95%	85%	75%	66%	57%	0%
CZ	100%	100%	100%	100%	97%	80%	70%	50%	40%	20%	0%
CZd	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DE	100%	100%	99%	99%	99%	86%	74%	60%	46%	31%	0%
DEd	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DEdL	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DEg	100%	100%	99%	99%	99%	86%	74%	60%	46%	31%	0%
DEl	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DEm	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DEmL	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
DEn	100%	100%	99%	99%	99%	86%	74%	60%	46%	31%	0%
DK	100%	100%	100%	100%	100%	100%	100%	85%	33%	25%	0%
ES	80%	72%	67%	63%	60%	55%	50%	45%	40%	40%	0%
FRa	95%	90%	85%	80%	75%	66%	57%	48%	39%	30%	0%
FRn	96%	91%	87%	83%	78%	72%	65%	58%	49%	38%	0%
FRnL	100%	100%	100%	100%	100%	100%	100%	100%	93%	85%	0%
FRs	97%	94%	91%	88%	85%	79%	73%	66%	56%	27%	0%
FRt	100%	100%	100%	100%	100%	91%	74%	57%	39%	22%	0%
HR	100%	100%	100%	100%	96%	80%	65%	48%	32%	14%	0%
HU	100%	100%	100%	100%	97%	95%	84%	72%	52%	40%	0%
IT	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
LV	100%	100%	90%	80%	70%	50%	40%	25%	20%	20%	0%
NL	98%	96%	95%	93%	91%	81%	70%	59%	48%	37%	0%
PL	100%	99%	98%	97%	90%	84%	72%	65%	51%	29%	0%
PT	100%	100%	100%	85%	85%	85%	85%	85%	85%	85%	0%
RO	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
RS	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
SE	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
SK	99%	97%	96%	93%	88%	82%	74%	65%	55%	44%	0%
SKm	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%
UK	100%	99%	98%	98%	98%	84%	70%	56%	41%	27%	0%

Table 4. - UGS deliverability curves[36]

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

Annex B – Data for Summer Supply Outlook 2023 with winter 2023/24 overview

> Summer demand based on TSOs' estimates

GWh/d	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
AT	257.1	212.8	187.3	168.5	134.6	119.9
BA	4.6	2.7	2.0	2.2	1.9	2.4
BEh	420.3	297.1	294.8	292.5	319.8	319.7
BEl	126.7	80.3	26.9	23.3	24.3	29.2
BGn	73.6	65.9	64.3	59.7	44.3	45.4
CH	92.5	68.3	43.8	35.5	37.6	55.1
CZ	242.4	171.5	137.4	126.9	127.3	158.5
DEg	1167.0	901.3	847.2	780.7	812.5	786.2
DEl	453.4	360.8	342.0	318.8	329.9	320.7
DEn	1091.3	596.2	495.4	371.5	430.8	381.9
DK	40.3	32.4	25.6	29.7	36.9	52.7
EE	11.1	8.0	5.0	4.6	4.6	5.9
ES	842.2	979.2	934.2	954.3	856.7	865.5
FI	36.0	32.0	32.0	29.0	31.0	36.0
FR	1116.9	687.3	602.5	585.2	533.6	692.1
FRnL	88.0	54.1	47.4	46.1	42.0	54.5
GR	112.5	116.3	110.3	156.1	172.7	168.2
HR	63.0	39.8	39.5	46.0	43.5	43.0
HU	230.0	170.0	140.0	140.0	130.0	150.0
IE	196.7	166.8	172.2	153.4	146.0	149.9
IT	1804.9	1431.7	1450.9	1578.0	1349.1	1605.8
LT	47.5	39.6	40.0	37.6	40.4	44.8
LU	23.2	20.2	14.5	14.1	12.5	15.5
LV	25.5	12.1	17.5	16.4	18.2	18.5
MK	2.5	1.3	1.2	6.8	7.2	7.3
NL	983.5	737.9	604.3	577.1	557.7	615.8
PL	531.5	369.1	339.0	333.6	301.9	319.8
PT	167.2	167.7	180.5	200.6	192.9	198.7
RO	250.0	170.0	150.0	150.0	150.0	170.0
RS	33.0	33.0	33.0	33.0	33.0	33.0
SE	16.5	14.3	14.0	12.7	14.1	14.9
SI	24.8	21.0	19.6	19.5	19.3	21.4
SK	113.1	104.4	69.3	68.5	58.8	62.5
UAe	345.0	345.0	345.0	345.0	345.0	345.0
UK	2029.3	1510.2	1208.0	1087.9	1089.5	1278.7
UKn	48.9	46.3	42.6	29.0	28.2	36.4

Table 5.– Summer demand forecast[37]

[37] Gas zones: Germany (GASPOOL and NCG are considering in one market zone in H-Gas, DE and L-Gas, DEL), French (FRnL: GRTgaz Nord L-gas), Belgium (BEh: H-gas zone, Bel: L-gas zone), UKn (Northern Ireland), Bulgaria (BGn). UAe: export to Ukraine

> Reference Winter demand based on 5-year average demand 2017-2021[38]

GWh/d	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24
AT	251.3	344.1	380.9	412.7	377.6	320.3
BA	4.7	7.0	9.4	10.5	9.1	7.7
BEh	448.1	610.8	638.5	691.2	630.1	553.3
BEl	36.2	57.0	66.5	72.6	67.3	56.6
BGn	75.1	101.8	119.2	128.6	120.8	108.6
CH	96.7	147.5	170.2	179.6	167.0	119.3
CZ	236.5	336.1	379.2	411.9	392.4	334.7
DEg	992.4	1335.1	1474.2	1401.0	1701.1	1478.9
DEl	392.6	512.0	560.4	534.9	639.5	562.0
DEn	766.0	1404.5	1663.6	1527.3	2086.4	1672.3
DK	75.1	102.2	112.0	111.8	112.8	97.3
EE	11.9	15.9	20.9	21.9	22.2	18.7
ES	957.6	1188.5	1163.9	1259.6	1141.3	1018.0
FI	61.9	69.3	88.2	98.0	99.6	85.6
FR	1096.6	1745.2	1906.0	2051.3	1925.6	1593.3
FRnL	65.1	137.4	150.1	161.5	114.2	94.5
GR	148.4	166.7	189.3	209.9	181.1	164.2
HR	85.1	108.9	114.5	120.3	115.3	96.9
HU	282.6	402.4	485.8	534.3	478.9	396.3
IE	147.6	170.1	164.5	174.7	162.5	167.1
IT	1743.2	2557.8	2933.3	3302.3	3061.5	2508.0
LT	62.4	72.8	83.6	85.5	84.3	75.9
LU	22.3	30.6	32.0	35.0	35.8	30.2
LV	32.9	43.7	52.9	57.1	56.7	45.2
MK	8.8	12.0	13.0	13.3	12.4	9.4
NL	941.8	1257.7	1400.6	1491.4	1445.7	1252.5
PL	497.3	619.3	702.6	734.2	717.2	644.4
PT	179.4	187.6	160.7	189.8	167.5	153.7
RO	273.1	414.4	510.7	550.1	504.0	419.4
RS	61.6	61.6	61.6	61.6	61.6	61.6
SE	22.2	27.5	32.1	33.9	35.0	28.0
SI	25.2	32.6	36.1	39.1	37.0	33.1
SK	136.1	186.2	226.3	245.2	228.3	194.7
UAe	345.0	345.0	345.0	345.0	345.0	345.0
UK	2150.7	2754.2	3096.1	3375.5	3104.8	2768.5
Ukn	39.4	46.6	45.2	52.6	49.7	48.9

Table 6.– 5-year average demand in Reference Winter[39]

[38] The Reference Winter Demand is based on a calculation of the five-winter average historical demand. Some TSOs provided their own estimates of demand (Germany, France and Belgium for the market conversion from L-gas to H-gas; Italy)

[39] Gas zones: Germany (GASPOOL and NCG are considering in one market zone in H-Gas, DE and L-Gas, DEL), French (FRnL: GRTgaz Nord L-gas), Belgium (BEh: H-gas zone, Bel: L-gas zone), UKn (Northern Ireland), Bulgaria (BGn). UAe: export to Ukraine

> Cold Winter Demand (once in 20 years)[40]

GWh/d	Oct-23	Nov-23	Dec-23	Jan-24	Feb-24	Mar-24
AT	302.1	335.2	440.5	414.0	412.0	339.1
BA	4.9	7.2	10.3	12.9	8.0	6.0
BEh	680.9	781.0	981.7	984.7	974.4	782.3
BEl	162.4	178.5	216.7	216.7	216.7	182.5
BGn	87.6	119.7	125.7	140.8	140.4	137.3
CH	91.0	153.6	185.4	159.2	202.8	159.6
CZ	269.0	345.0	436.0	440.0	478.0	352.0
DEg	1115.0	1375.6	1722.1	1785.4	1383.0	1285.4
DEl	433.7	577.6	768.9	803.8	581.7	527.8
DEn	1009.1	1455.0	2047.9	2156.3	1467.6	1300.6
DK	73.0	105.5	115.9	131.3	127.7	109.7
EE	16.3	21.9	39.4	37.3	31.0	35.9
ES	1030.8	1257.4	1281.1	1291.9	1269.5	1135.3
FI	30.0	40.0	47.0	51.0	53.0	37.0
FR	1211.1	1865.2	2521.5	2265.6	2106.6	1725.9
FRnL	128.6	185.2	238.8	200.8	167.9	135.0
GR	153.2	184.8	211.7	221.0	174.9	190.3
HR	80.8	103.6	129.2	130.0	159.3	90.3
HU	361.9	468.3	600.1	645.7	658.5	450.8
IE	144.3	163.8	189.9	199.2	197.6	185.7
IT	2154.8	2734.9	3635.9	3606.6	3389.2	2899.2
LT	75.9	82.9	95.4	99.5	106.0	85.4
LU	46.8	46.3	57.0	53.9	53.4	46.6
LV	59.5	78.7	79.0	91.5	116.5	102.4
MK	8.5	12.3	13.6	15.2	15.9	14.0
NL	920.5	1459.6	1901.8	1896.4	1856.7	1484.9
PL	612.5	741.5	829.8	888.6	902.4	781.8
PT	206.4	209.1	206.0	220.6	211.2	211.2
RO	351.0	536.0	526.0	559.0	635.0	483.0
RS	61.6	61.6	61.6	61.6	61.6	61.6
SE	24.1	40.6	41.5	58.6	48.7	37.7
SI	33.7	40.9	43.5	49.7	47.1	40.2
SK	156.4	204.7	268.7	281.4	252.8	229.1
UAe	345.0	345.0	345.0	345.0	345.0	345.0
UK	2450.1	3164.6	3968.6	4325.4	4107.1	3551.2
UKn	61.4	66.4	68.3	73.7	72.4	68.3

Table 7.- Demand in SOS Cold Winter[41].

[40] Cold Winter Demand values have been updated in view of the publication of the updated Union-wide SoS Simulation Report 2021. Cold Winter demand values have not been updated for the simulations in this report to consider infrastructure and market last changes (Germany, France and Belgium for the market conversion from L-gas to H-gas).

[41] Gas zones: Germany (GASPOOL and NCG are considering in one market zone in H-Gas, DE and L-Gas, DEL), French (FRnL: GRTgaz Nord L-gas), Belgium (BEh: H-gas zone, Bel: L-gas zone), UKn (Northern Ireland), Bulgaria (BGn). UAe: export to Ukraine

> Indigenous production

Summer	Apr-23	May-23	Jun-23	Jul-23	Aug-23	Sep-23
GWh/d	2198	2139	2073	2052	1976	2021
Winter	**Oct-23**	**Nov-23**	**Dec-23**	**Jan-24**	**Feb-24**	**Mar-24**
GWh/d	2195	2280	2278	2276	2272	2272

Table 8. – Supply assumptions. Indigenous production

> Supply assumptions (maximum per period)

The maximum supply potentials of the different sources providing gas to the EU are based on a five-year history (historical availability).

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.

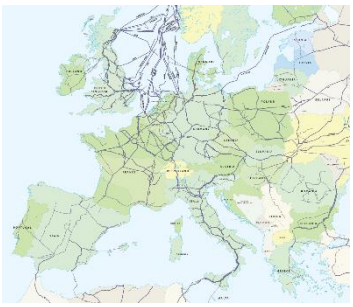
GWh/d	CA	DZ	LNG	LY	NO	RU
Max Summer	464	1286	4201	191	4669	5903
Max Winter	464	1336	4745	193	5009	5857

Table 9.– Supply assumptions. Import

Annex C – Modelling approach

The topology of the network model considers the existing European gas infrastructure, new upcoming projects (for example, LNG terminals in France, Germany and Italy), and the firm technical capacities provided by TSOs, which include maintenance plans known as of March 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.



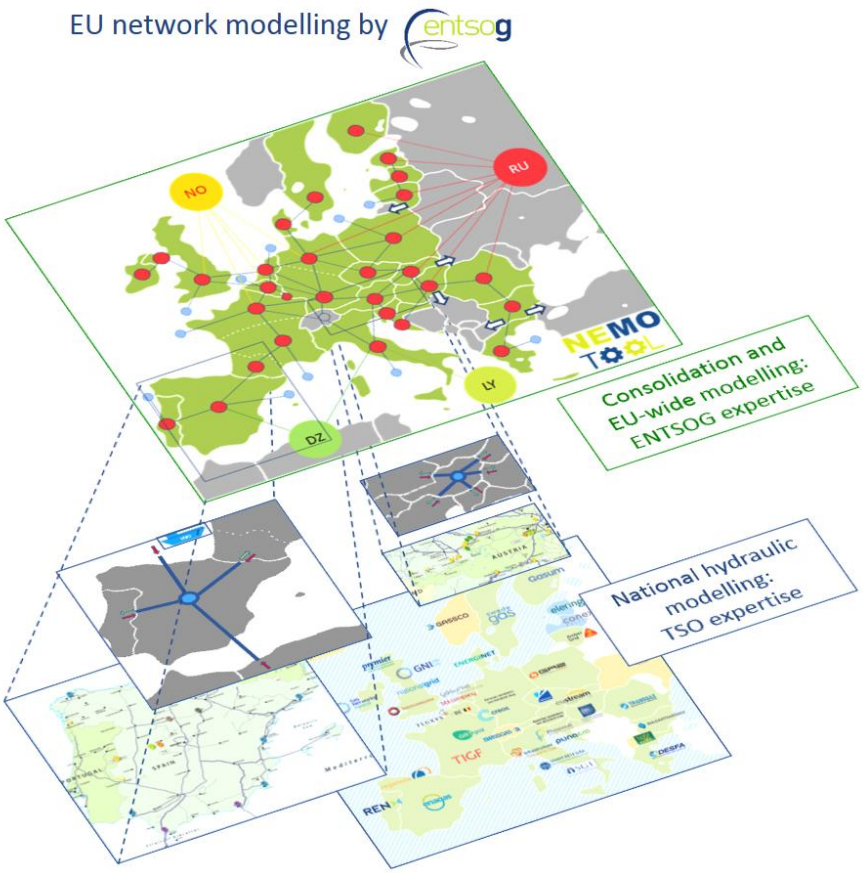


Illustration 1: Entsog model overview

In all cases, 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 – Abbreviation

TSO	Transmission System Operator
UAe	Exports to Ukraine
UGS	Underground Storage
WGV	Working Gas Volume

Supplies

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

Countries

AT	Austria
BE	Belgium
BGn	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
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

Low calorific gas zones

DEl	Germany L-gas
BEl	Belgium L-gas
FRnL	French Nord L-gas

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