

ENTSOG YEARLY SUPPLY OUTLOOK

2022/2023

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Executive Summary

The invasion of Ukraine by Russia has triggered severe energy security concerns in Europe. Therefore, ENTSOG decided to publish an extraordinary report focused on the full gas year disruption of the gas supply from Russia to Europe.

The analysis investigates the possible evolution of the gas supply as well as the ability of the gas infrastructures to meet the demand, the exports and the storage injection needs during the gas year 2022/2023 (from 1st of October 2022 to 30th of September 2023). ENTSOG has run additional sensitivity analysis to assess the impact of a full Russian supply disruption starting from 1st July 2022 and continuing for the entire 2022/2023 gas year and the possible measures that could be envisaged in the EU to mitigate this.

Yearly Supply Outlook 2022/2023 main findings

- > Without immediate market/political reaction (with respect to the actions listed below), most of the European gas storages would be depleted during the winter period and most Central Eastern European (CEE), North-Western (NW) and South-Eastern Europe (SEE) countries will not be able to fill storages during Summer 2023 to levels necessary to ensure security of gas supply for Winter 2023/2024.
- > The gas storages significantly contribute to security of gas supply. Therefore, it is important that all European storages continue to inject gas as much as possible during Summer 2022 (up to the maximum levels possible).
- > In case of supply disruption from Russia, some efficient actions can improve the security of the gas supply for the gas year 2022/2023:
 1. **Capacity enhancement** in Europe can additionally improve the cooperation possibilities between Member States and allow for more efficient storage utilization.
 2. **Additional LNG volumes** available on the global market along with enhanced transmission capacities and optimised LNG terminal capacity utilisation can allow for an additional 12 billion cubic meters (bcm) (~130TWh) of imports in Winter 2022/2023, therefore reducing demand curtailment (provided they are available on the global market).
 3. Storages play an essential role to ensure security of supply. However, without **preparedness for Winter 2023/2024**, the situation could deteriorate over the next gas year 2022/2023: storages would be depleted in April 2023 and sites located in Central and South-Eastern Europe would be filled less than 15% on 1 October 2023, leaving the EU more exposed to risks of SoS for the winter 2023/2024.
 4. In the event of a **mild winter, a demand reduction of ca. -15%** (as a result of organic reduction due to high prices or policy-based demand measures) **and Member States cooperation would be required to mitigate the risk demand curtailment in EU**

countries. Furthermore, additional measures would be required to ensure sufficient storage inventory for Winter 2023/24.

- > In case of a cold winter, EU demand curtailment would be higher than the results given in this report.
- > The assessment further identifies import capacity limitations in CEE as well as infrastructure bottlenecks in the NW and SEE preventing additional gas to flow from West – including France and Iberian Peninsula – and South to CEE, therefore limiting a possible mitigation of the gas storage deficit for the next winter 2023/2024.

Important:

ENTSOG Yearly Supply Outlook 2022/2023 is an assessment of the readiness of the gas infrastructure to cope with the upcoming gas year under different scenarios, but this assessment is not a forecast of the expected gas supply situation. The model assumes cooperative behaviour among Member States as well as LNG distribution to terminals and storage utilisation according to security of supply needs. The actual utilisation of the gas infrastructure, including the development of the gas storage levels, will be determined by availability of supply sources, the decisions of the market participants (e.g. price driven instead of security of supply) and influenced by external factors such as policy decisions.

When interpreting the results, it should be considered that in case of a supply disruption happening during the gas year 2022/2023, the storage levels at the end of the period are dependent on the storage levels at the date of the disruption. Hence, a disruption starting later than on 1 July 2022 would allow to fill the gas storages up by an additional volume compared to what is presented in this report.

1. Introduction

The invasion of Ukraine by Russia has triggered severe energy security concerns in Europe. Therefore, ENTSOG decided to publish an extraordinary report focused on the full gas year disruption (from October 2022 to the end of September 2023) of the gas supply from Russia to Europe.

This edition builds on previous Summer and Winter Supply Outlooks. It aims at assessing the ability of the European gas infrastructure to provide sufficient flexibility to shippers during the coming gas year and assesses the ability of the European gas network to use storages in case of Russian supply disruption.

The summer months (from April to September) provide shippers the opportunity to refill storages in anticipation of the next winter months (from October to March). The level of injection targeted by shippers varies from one country to the other and from one season to the other due to climatic, price and legal parameters.

The modelling considers as a starting point the actual storage levels as of 1st July 2022 with the assumption that gas stops flowing from Russia on that day and will not resume for the entire observed period of the yearly outlook 2022/2023.

Additionally, to the baseline scenario without Russian gas supplies for the whole year and firm capacities, ENTSOG also undertook 3 additional sensitivity assessments of possible mitigation actions as set out below:

1. Impact of the enhanced capacities (additional capacity enhancement that could be introduced in case of crisis to the benefit of European cooperation)
2. Impact of the additional LNG imports and enhanced capacities (exceeding historically observed LNG flow to EU) provided they are available on the global market
3. Impact of the demand reduction (ca. -15% demand reduction subtracted on a country level)

For an accurate modelling of the storage injection capacities – which vary with the storage levels – ENTSOG applies injection capacity curves provided by Gas Storage Europe (GSE) members.

The topology of the network model has been upgraded in order to reflect the firm technical capacities that are offered for the upcoming year and variety of the additional coordinated preparedness actions (see sensitivities assessed in the report). However, in the supply disruption scenario, those capacities may not reflect perfectly the situation, as gas flows and pressure may vary significantly from the usual operational conditions. Mechanism of this improvement is described in the annex F to this report.

2. Assumptions

The Yearly Supply Outlook 2022/2023 is developed based on assumptions specific to the upcoming gas year (12 months between October 2022 and September 2023). In any case actual usage of storages and supply mix (including LNG distribution to European terminals) will result from the decisions of market participants which may e.g. be price-driven instead of being optimised for security of demand. The demand data has been provided by TSOs on a monthly granularity level. An average daily demand has been considered within each month. The modelling tool used for the Yearly Supply Outlook 2022 is PLEXOS.

Infrastructure

The simulations consider the existing European gas infrastructure including the projects (gas pipelines and LNG terminals/FSRUs) to be commissioned during the investigated period¹ based on the information available as of July 1st 2022.

Demand

This Yearly Outlook assessment considers a standard (not cold) winter. **Figure 1** shows the European demand for the gas year 2022/2023. **Figure 2** presents geographical distribution of the European demand.

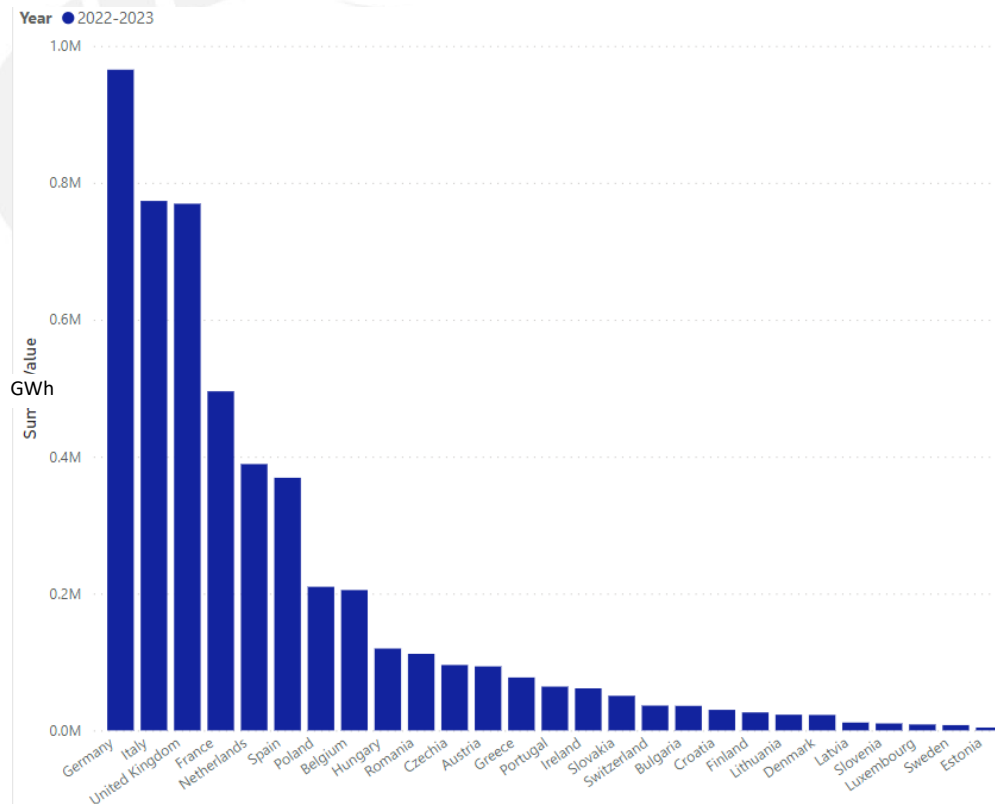


Figure 1. - European yearly demand [GWh] (forecast for gas year 2022/2023) (H and L gas).

¹ Technical (and enhanced) capacities are provided by TSOs.

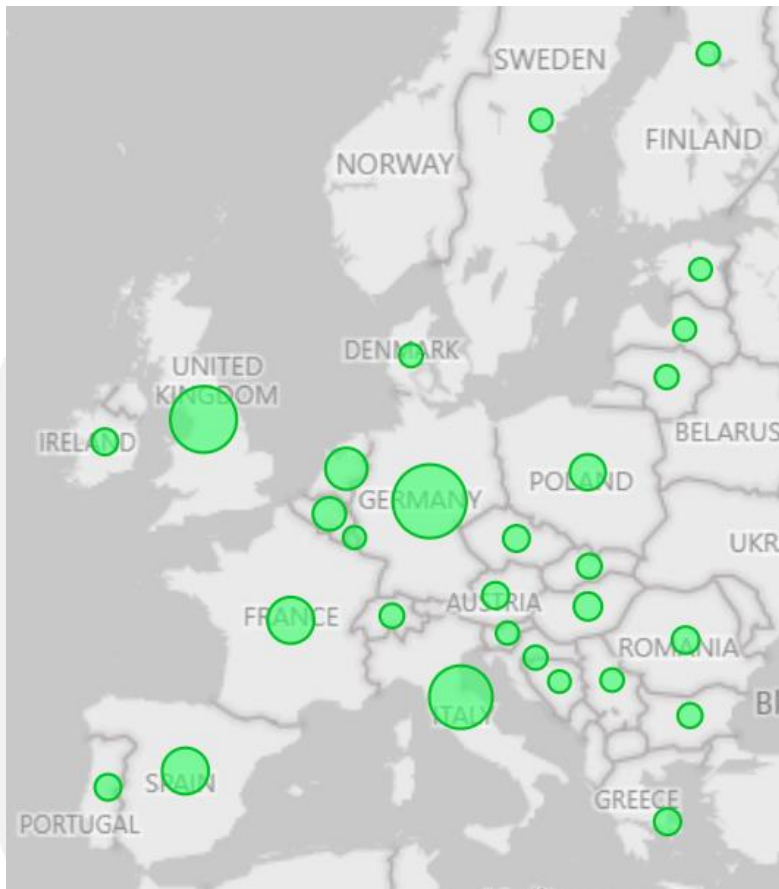


Figure 2. - Geographical distribution of the European gas demand

Supply

The maximum daily supply potentials of the different sources providing gas to EU are based on a ten-year history (historical availability) and presented in the **Figure 3**. The detailed data is provided in the annexes.

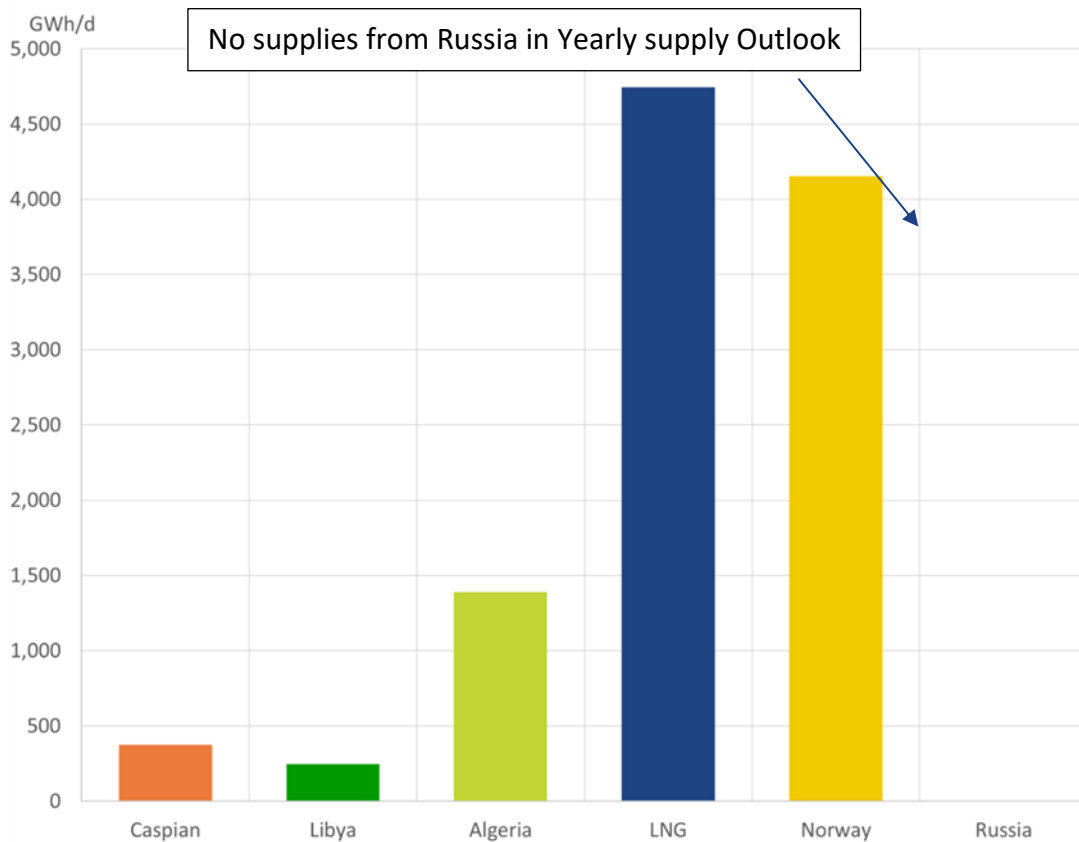


Figure 3. – Maximum supply potential

Regarding European (EU27+UK) domestic production, it is estimated to be 778 TWh during the gas year 2022/2023 which on average corresponds to ca. 2,150 GWh/d.

Cooperation

All countries cooperate to avoid demand curtailment or to share it when it is impossible to avoid it, and to inject to storages (and withdraw) in cooperative mode.

Underground Storage (UGS) inventory

Historical usage of the underground storage during injection and withdraw seasons can be found in Summer and Winter Supply Outlooks published by ENTSG² as well as evolution of working gas volume. In this Yearly Outlook simulation, the actual storage levels were taken from AGSI+³, the gas storage platform operated by GIE⁴. On 1st of July 2022, the average storage level over Europe reached 59% on average. In the simulations ENTSG assumes that countries, following a cooperative behaviour, would help themselves even by fully sharing gas in the storages, not considering constraints in the utilisation of the strategic reserves. In fact, some countries could be reserving part of their own gas stock constituted as strategic reserves

² <https://entsog.eu/outlooks-reviews>

³ <https://agsi.gie.eu>

⁴ The allocation of the storages in countries corresponds to the allocation on AGSI+.

for the country to be used only for the purpose of satisfying their own demand. However, it is not reflected in this analysis.

Figure 4 shows the evolution of the storage injection-withdraw curve in 2022 compared to the storage evolution 2015-2020. In the comparison 2021 data was not included as injection to the storages was historically slow. 75% storage level on the 1st of October 2021 was historically the lowest level recorded at the start of the Winter Season.

Storage evolution vs 2015-2020

● 2022 ● Average ● Maximum - Minimum

Storage evolution 2022 vs. 2015-2020

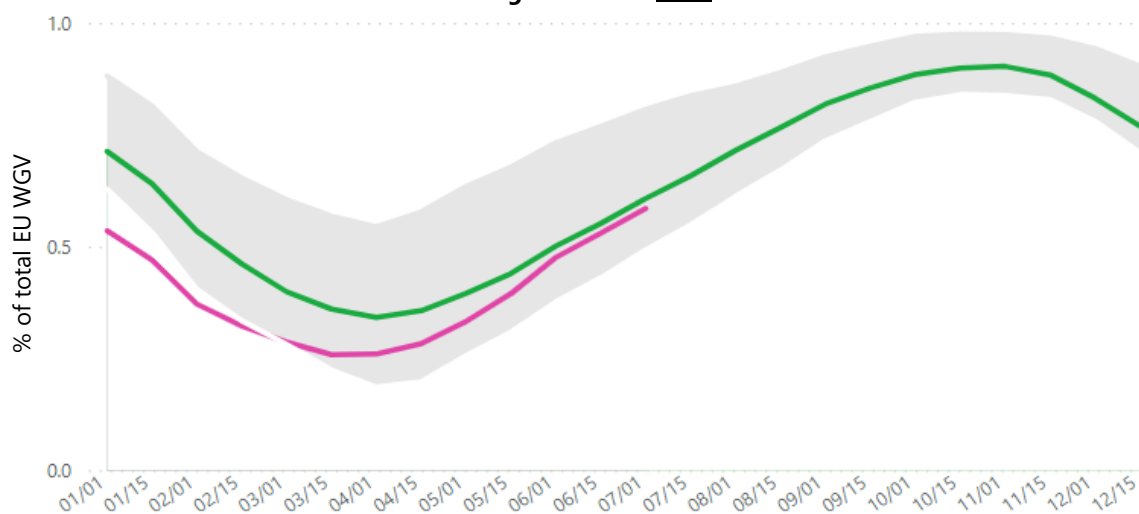


Figure 4. – Gas storage evolution 2022 compared to the storage evolution 2015-2020

For the modelling of the different scenarios, Yearly Supply Outlook 2022/2023 considers the storage inventory level per country on 1st of July 2022 as the initial storage level. These storage levels were used as an input to the summer supply outlook simulation for this report to estimate storage levels on 1st of October 2022 (the starting date for the Yearly Outlook simulation). The summer assumptions considered for this simulation are based on the Summer Supply Outlook 2022⁵ considering no gas supply from Russia. The estimated 1st of October 2022 storage levels per country⁶ used for the Yearly Outlook and provided by this simulation are shown in **Figure 5**. These values give an average EU storage filling level of **71%**.

⁵https://entsog.eu/sites/default/files/2022-04/SO0035-22_Summer_Supply_Outlook_2022_BOA_Rev8.1_220427%20for%20publication.pdf

⁶ For H and L gas

Attribute ● Gas in Storage [GWh] ● Remaining storage capacity [GWh]



Country	WGV [TWh]	[%] fill
Austria	95.5	71%
Belgium	9.0	100%
Bulgaria	6.3	35%
Croatia	5.2	31%
Czechia	36.0	68%
Denmark	9.1	74%
France	131.6	97%
Germany	237.2	62%
Hungary	67.7	40%
Italy	197.7	77%
Latvia	21.8	42%
Netherlands	145.3	78%
Poland	36.4	72%
Portugal	3.6	100%
Romania	33.0	43%
Slovakia	36.0	60%
Spain	35.0	97%
Sweden	0.0	8%
UK	9.6	100%

Figure 5. - Estimated H and L-gas storage inventory levels on 1st October 2022 for Yearly Supply Outlook simulations (result of the updated summer supply outlook simulation without Russian supply starting from 1st July and initial storage levels at 1st July). ⁷

The aggregated European storage level on 1st October is the average of the country level values. However, there are substantial differences from one country to the other. Storages in NW Europe could reach higher levels whereas countries located in SEE are in the lower range. These storage levels per country have been used as a starting point for the Yearly Supply Outlook 2022/2023.

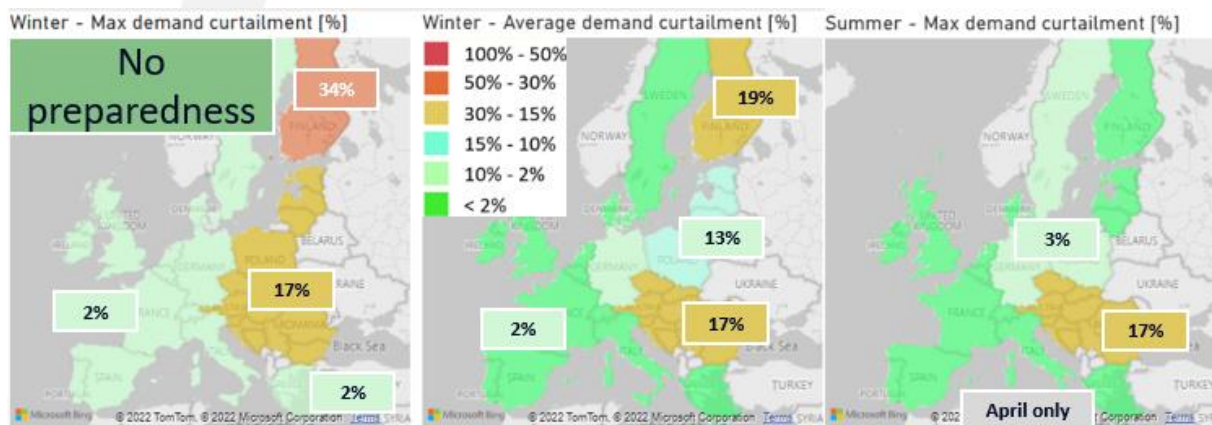
⁷ The %Full has been calculated using the gas in the storage from AGSI+ platform and the Working Gas Volume from GSE Storage MAP database; since the last update was January 2018, updated AGSI values for WGV have been taken into account for those storages with remarkable difference.

3. Modelling results

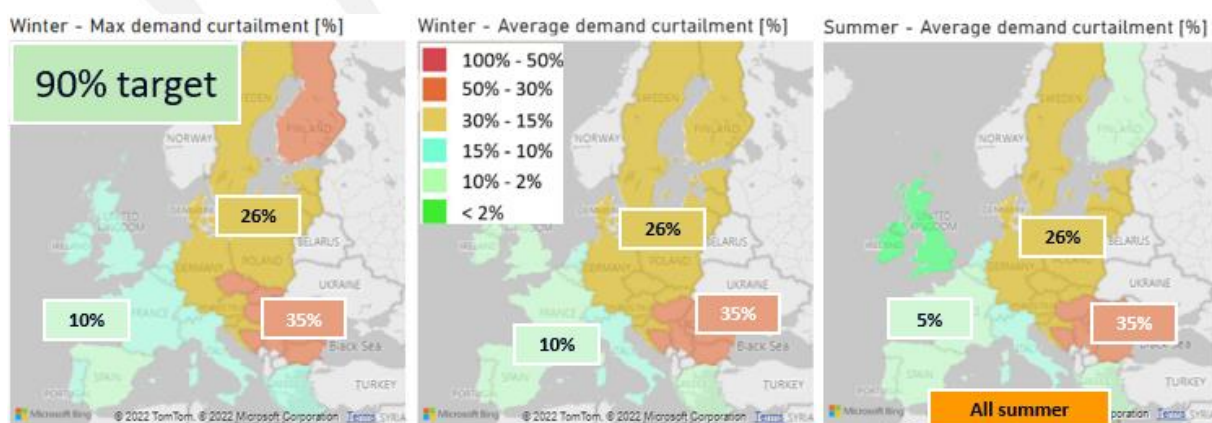
3.1 Baseline Scenario – Russian gas supply disruption starting on 1st of July 2022, firm technical capacities

Based on these assumptions, the modelling has been used to check how, during the entire year, the gas demand can be satisfied.

The simulations show that in the case of full Russian supply disruption (starting 1st of July 2022), demand cannot be satisfied during the winter season 2022/2023, with levels of demand curtailment that differs among EU countries and this divergence further increase if additional winter 2023/2024 preparedness (i.e. reaching 90% of the gas storages on 1st of October 2023 for all European gas storages) is taken into consideration.



**Figure 6. – Demand curtailment levels considering firm capacities and no winter 2023/2024 preparedness (target gas storages level at 90 % on 1st October 2023 is not considered) in situation without Russian gas supply entire year⁸.
Maximum monthly Winter curtailment; average winter curtailment; Summer maximum**



**Figure 7. – Demand curtailment levels considering firm capacities and winter 2023/2024 preparedness (target gas storages level 90 % on 1st October 2023 is considered) in situation without Russian gas supply entire gas year 2022/2023.
Maximum monthly Winter curtailment; average winter curtailment; Summer average**

⁸ Demand curtailment in Finland is presented excluding the country-specific possibility to use other back-up fuels for gas.

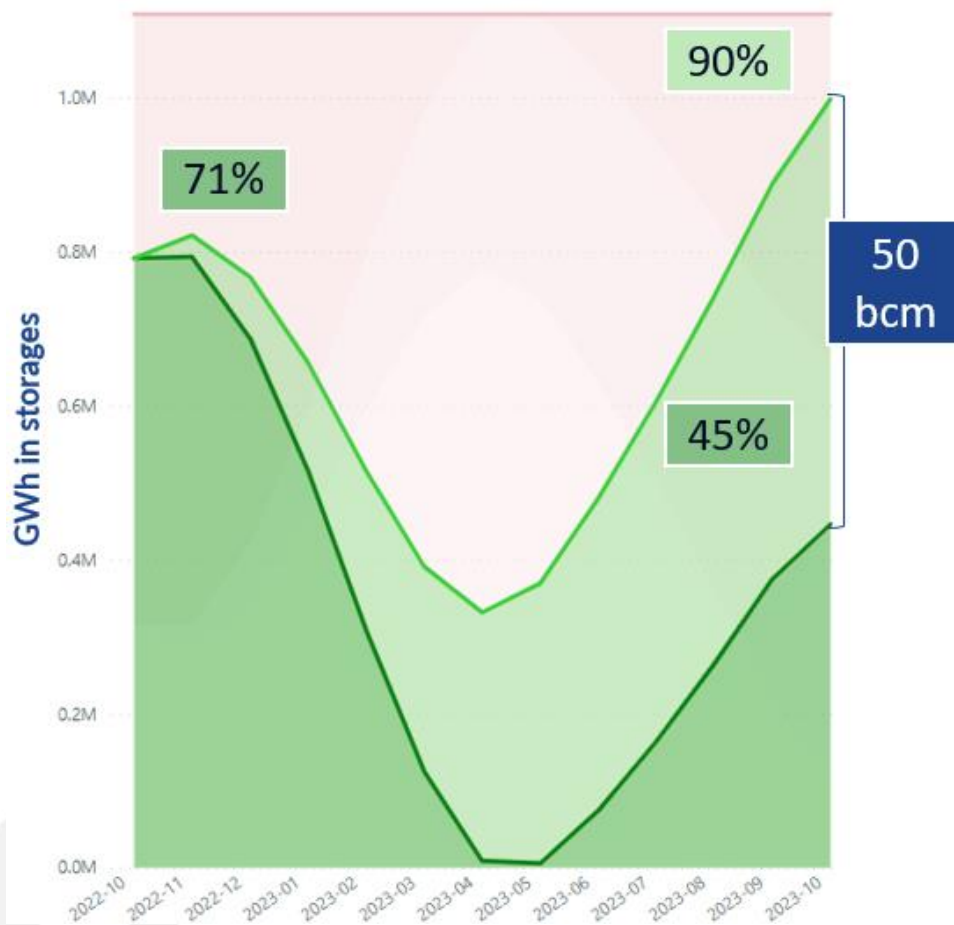


Figure 8. – gas storage utilisation – scenario with and without 90% storage target at the end of the investigated gas year 2022/2023

The simulations show that in case of full Russian supply disruption, demand in Europe cannot be satisfied fully during winter 2022/2023 without any further actions. Internal EU bottlenecks on infrastructure prevent sufficient transportation of gas from west to the east of Europe and from south to north, so disruption can only be evenly shared on a limited basis. CEE, SEE, the Baltic States and Finland could be curtailed at levels of 20% (on average) of their demand every day of winter season (including April). Curtailment in that scenario would correspond to a shortage of approx. 17 bcm (~190 TWh) of gas being supplied over the year, mainly in winter.

During the rest of the year, it is not possible to both satisfy demand for gas and store sufficient volumes in the gas storages. On average, Europe would be able to store about 45% of their total working gas volumes (which is a deterioration compared to the initial value on the 1st of October 2022) but it differs at country level (approximately 90% in NW Europe, and around 15% in CEE, SEE, the Baltic States and Finland) presented in **Figure 9**. Some storages could be fully depleted at the end of winter period 2022/2023 and this situation would continue for the first months after winter.

Considering the storage target of 90% on 1st of October 2023, curtailment over Europe during gas year 2022/2023 would be higher. To achieve the target the filling of storages has priority over satisfying customer demand. It corresponds to additional 50 bcm (~ 50 TWh) of gas to be stored in the gas storages which corresponds to ~2 % of the yearly European demand.

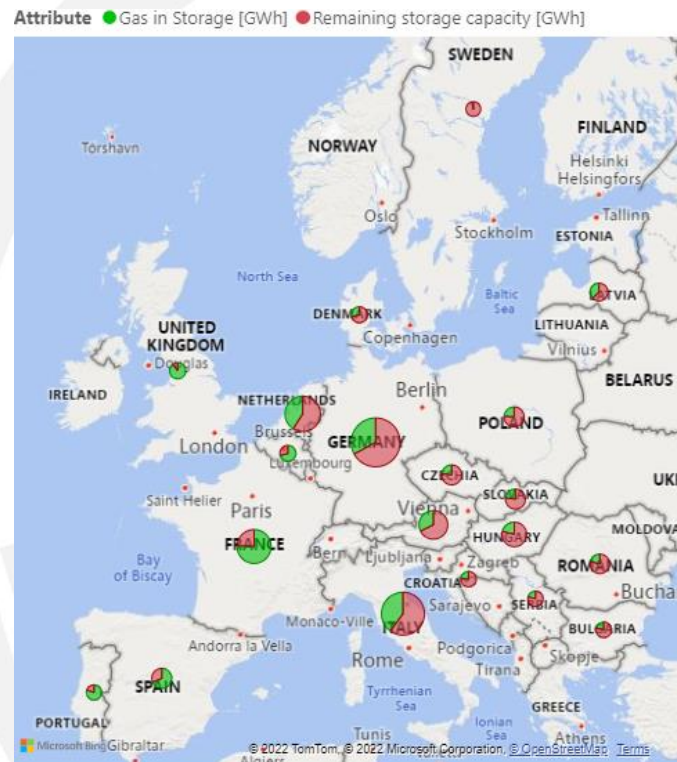


Figure 9. – Estimated gas storage levels at the beginning of 1st October 2023 considering only firm capacities and no specific measures

3.2 Sensitivity-analysis 1 – disruption starting on 1st of July 2022, **enhanced** capacities

Given the uncertainty of the situation, TSOs identified and estimated possible enhancements of capacity that could further improve internal bottlenecks and maximise gas flow from west to east.

Figure 10 provides the curtailment allocation results after capacity enhancements, taking into account an initial EU storage level of 71%. These further changes could improve the possibility to share curtailment through cooperation (South-Western Europe shares a bigger part of the curtailment to support rest of Europe). The total curtailment in this situation is not changing in comparison to the situation with only firm capacities and it corresponds to a level around 17 bcm (~190 TWh), but it is distributed more equally over Europe.

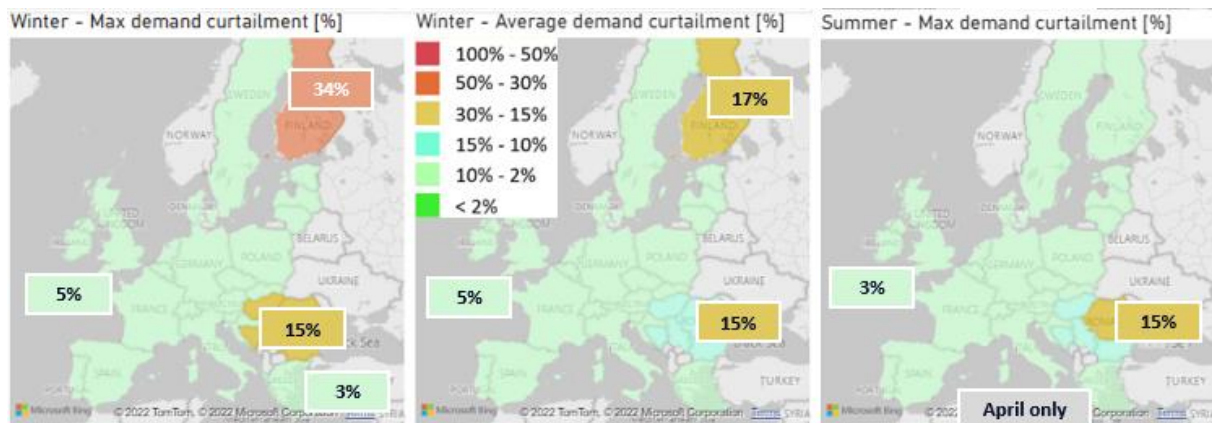


Figure 10. - Demand curtailment levels considering enhanced capacities and no winter preparedness in situation without Russian gas supply entire year.

Even if capacity enhancement allows for more cooperation, it cannot improve the overall gas storage situation at the end of the investigated period. Gas stock is slightly better distributed across Europe but on average European countries would be able to store about only 45% of their total working gas volumes (deterioration compared to 1st of October 2022 for all countries). **Figure 11** shows the possible gas stock level country by country considering enhanced capacity during the whole 2022/2023 gas year.

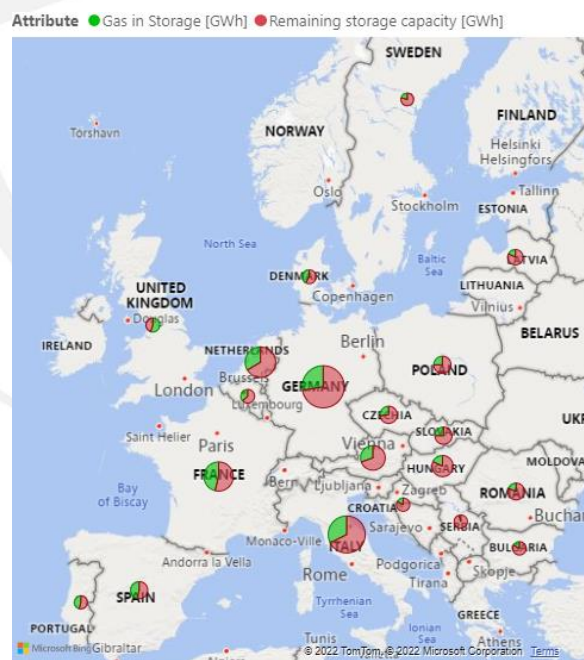


Figure 11. - Estimated gas storage levels at the beginning of 1st October 2023 considering only enhanced capacities no winter preparedness and with full Russian disruption starting already on 1th July 2022

Initial storage level

It is important to underline that a better storage situation on October 1st 2022 (80% or 90% for all storages) would directly improve the entire year situation in terms of reducing demand curtailment (especially in the CEE and SEE countries), providing additional volumes of gas to be used during the winter season 2022/2023. Every 10% additional storage level at EU level corresponds to an additional 10 bcm (~ 110 TWh) available for the market in winter. However,

without a preparedness action (according to sensitivities assessed in the report) and storage target for 1st October 2023, even with higher initial storage levels on 1st of October 2022, the European storages would end at similar fill levels, around 45% on 1st of October 2023 as the extra volumes will be used to mitigate disruption.

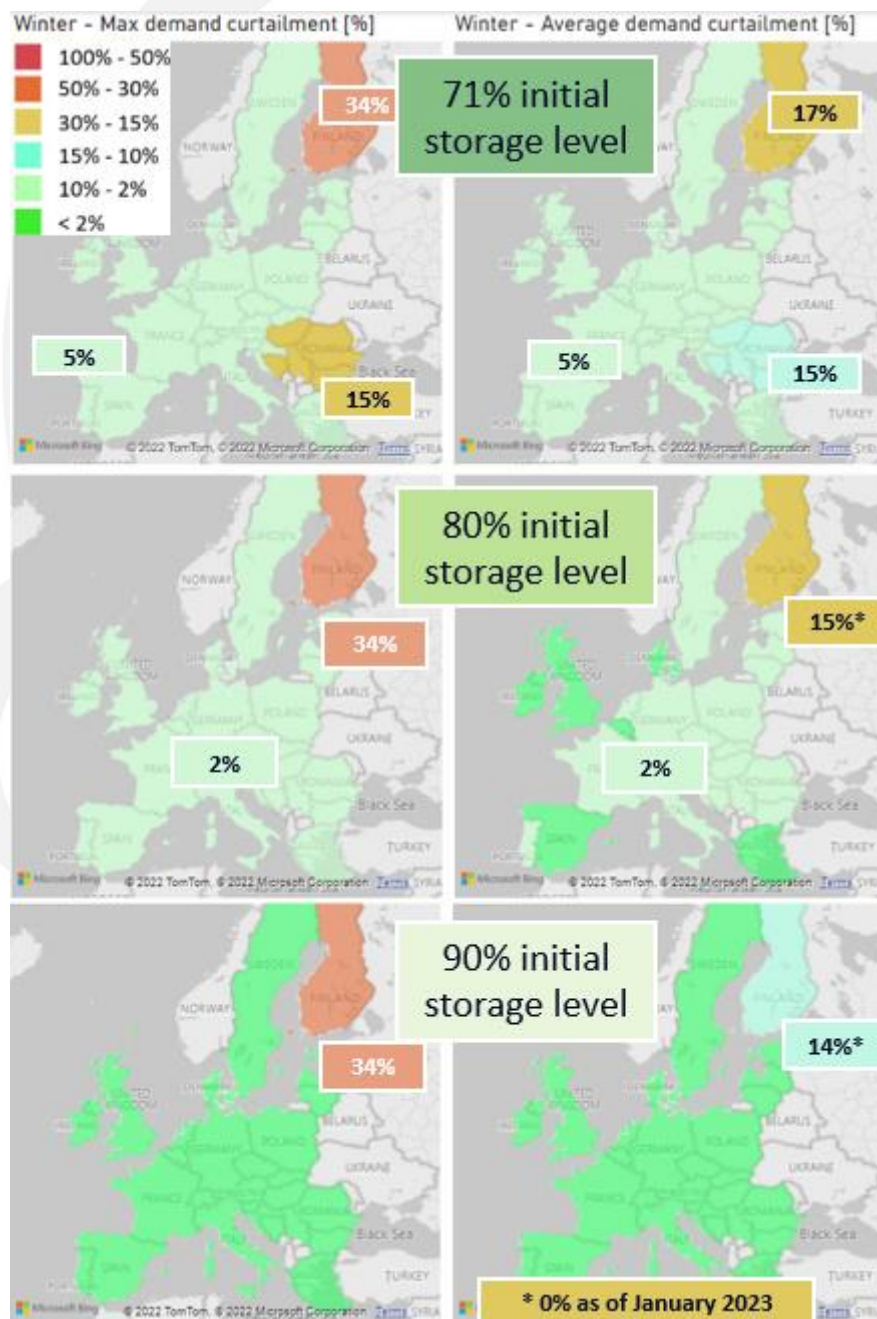


Figure 12 – Demand curtailment in winter depending on the initial storage level considered on 1 October 2022 with the winter 2023 preparedness (enhanced capacities)

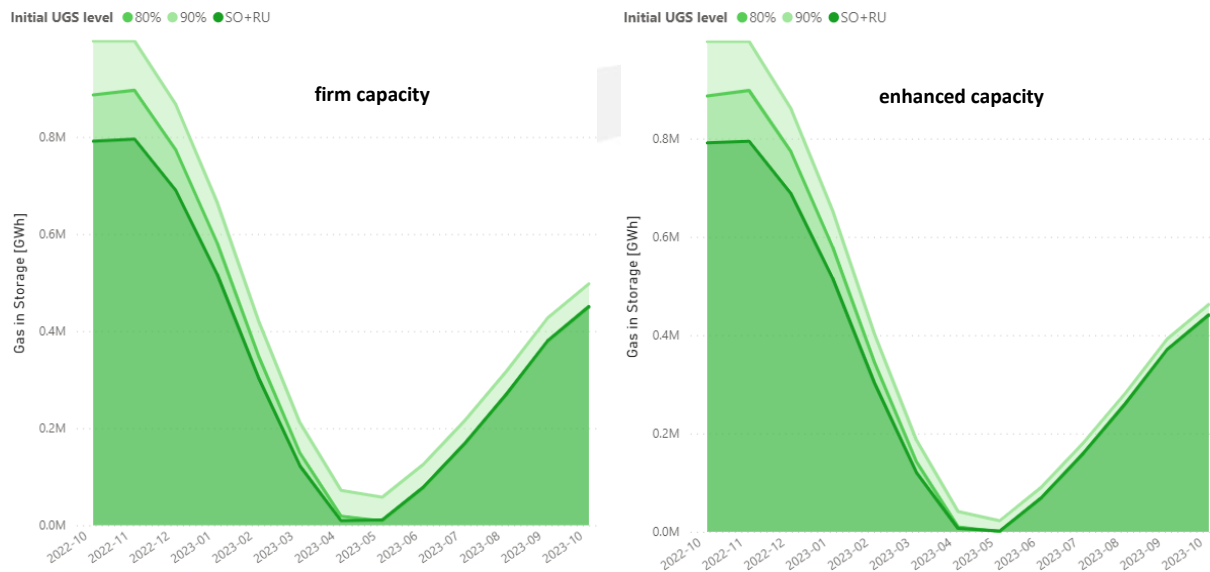


Figure 13 – Gas storage inventory with firm (left) and enhanced (right) capacities and no specific measures with an initial level of 71% (updated SSO 2022 simulation + full RU disruption from 1st of July 2022), 80% and 90%

3.3 Sensitivity-analysis 2 – Russian gas supply disruption starting on 1st July 2022, enhanced capacities, additional LNG

This sensitivity evaluates the ability of the European gas system to import additional LNG supplies (assuming the availability on the global market) after capacity enhancements are introduced. In this simulation, the global LNG supply potential is assumed unlimited – this way the European gas infrastructure system sets the import limitation due to infrastructure bottlenecks. This sensitivity assumes also enhanced capacities, since they are necessary for LNG import potential to be maximised. EU average initial storage levels are again at 71%.

Figure 14 provides the curtailment allocation results after capacity enhancement and additional LNG supplies. This enhanced capacity together with additional LNG could further improve the possibility to share curtailment through cooperation. Western Europe mitigates its demand curtailment and sends significant volumes in the Eastern direction. The total curtailment in this situation is estimated at the level around 6 bcm (~65 TWh), meaning 12 bcm (~130 TWh) of demand curtailment could be reduced compared to the baseline scenario thanks to additional LNG supplies (out of which 3 bcm (~30 TWh) could be possible with firm capacities alone and additional 9 bcm (~100 TWh) with optimised capacity). This reduction is mainly only possible over the winter period.

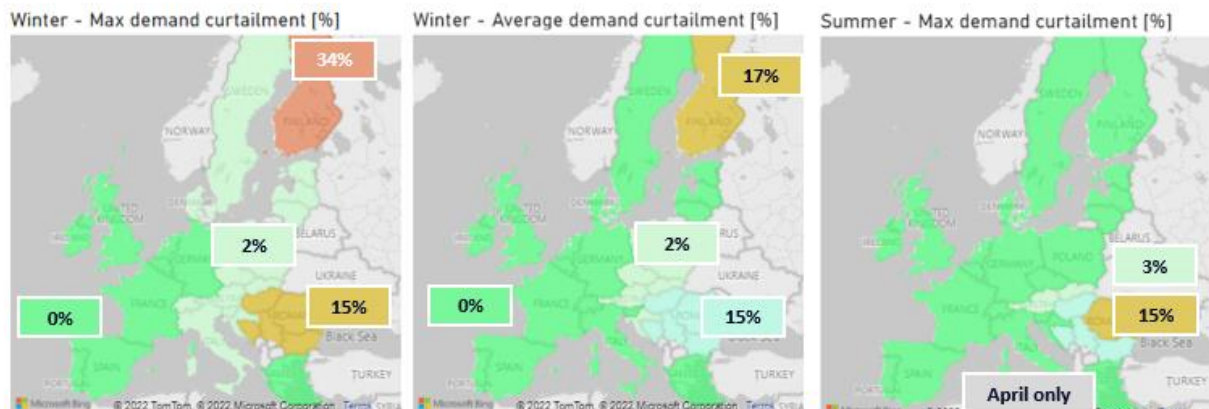


Figure 14. – Demand curtailment levels considering enhanced capacities, additional LNG supplies and no winter 2023/2024 preparedness (target gas storages level at 90 % on 1st of October 2023 is not considered) in situation without Russian gas supply entire year.

Figure 15 shows additional LNG vs. historical LNG max supply to EU over the entire simulated period and provides information on which months additional LNG could be imported to EU. Additional LNG imports could be possible during certain winter months, however during the summer demand can be satisfied without additional LNG. However, regarding global LNG export capacity and demand outside the EU, there is clearly significant uncertainty surrounding this additional availability of LNG.

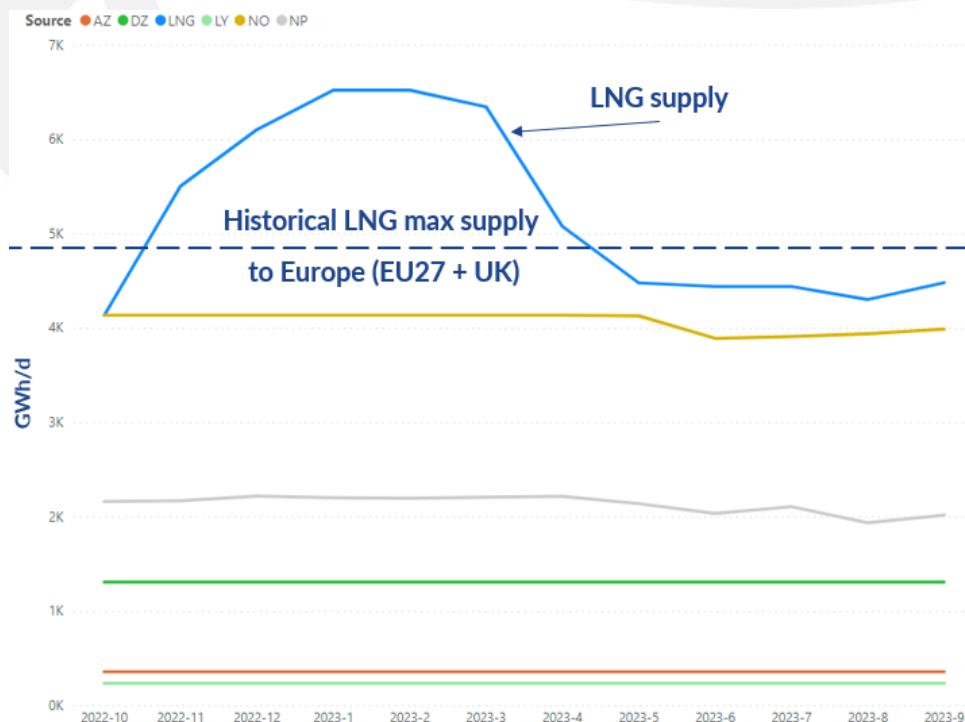


Figure 15. – additional LNG vs historical LNG max supply to EU.

A higher LNG supply (in combination with capacity enhancement allows for more cooperation and higher reduction of demand curtailment over Europe, but it cannot improve the overall gas storage situation at the end of the investigated period. Gas stocks are slightly better

distributed across Europe but on average Europe would still only be able to store about 45% of their total working gas volumes (deterioration compared to 1st of October 2022 for all countries). **Figure 16** shows the possible gas stock level country by country considering enhanced capacity (and additional LNG) during the whole 2022/2023 gas year.

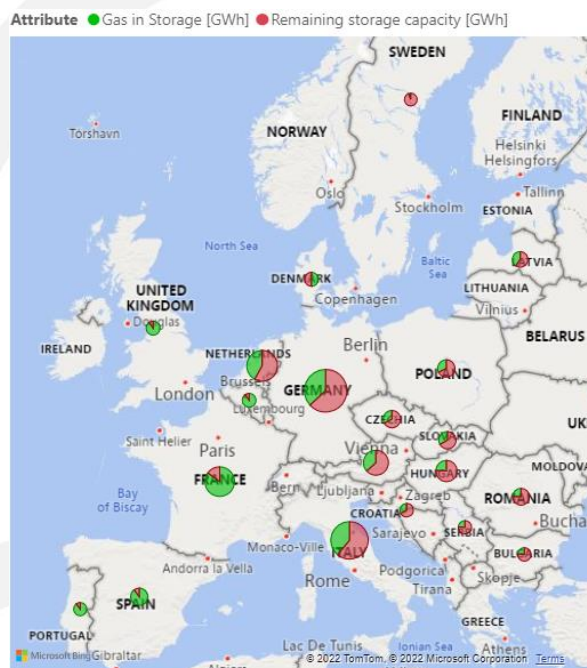


Figure 16. – Estimated gas storage levels at the beginning of 1st October 2023 considering enhanced capacities and additional LNG.

3.4 Sensitivity-analysis 3 – Russian gas supply disruption starting on 1st of July 2022, **enhanced capacities, demand reduction**

Coordinated long term demand reduction could be one of the possible actions that may improve the situation on the gas market during long term disruption. In comparison to the previous years, Europe has recently been experiencing some demand reduction, likely in response to high gas prices or other measures disrupting normal functioning of the market (e.g. COVID measures). Coordinated actions initiated by policy makers leading to an equal demand response over Europe cannot be omitted as a mitigating measure but at the same time it would be a major challenge.

Demand response at the level of 15% all over Europe together with enhanced capacities fully mitigates demand curtailment when no longer-term preparedness is considered (no storage target for 1st October 2023).

If a demand response to the extent of -15% would be evenly introduced all over Europe together with enhanced capacities, it would not fully ensure a better preparedness for the next winter in SEE (in the sense of allowing a uniform storage level of 90 % on 1st October 2023). Storage levels on the 1st of October 2023 are presented in **Figure 17**. Even if the gas stock situation improves, it still does not give a comfortable 90% fill level at the beginning of

October 2023 everywhere. On average, Europe could be able to store 70% with firm capacity (with a challenge to reach levels higher than 40% in CEE and SEE), or 85% with enhanced capacities (but still SEE would struggle to store more than 40%).

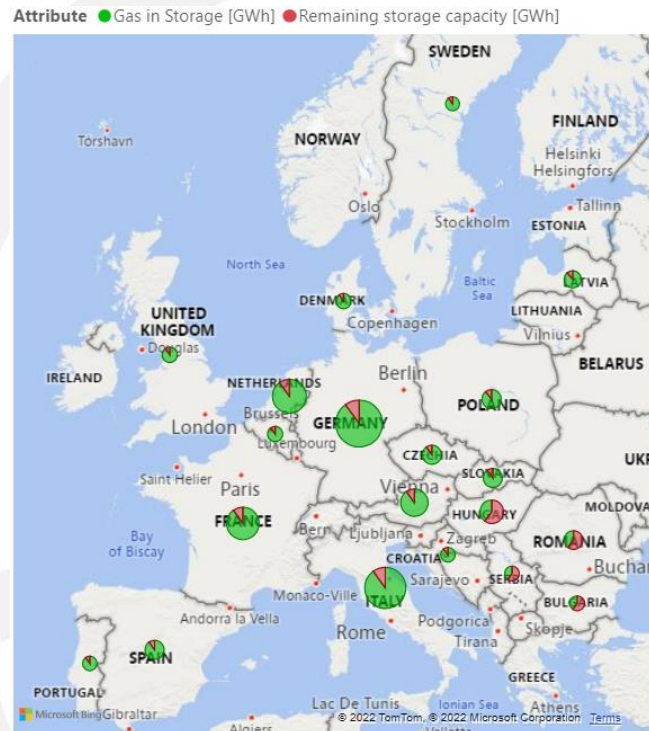


Figure 17. Estimated gas capacities and minus 15% demand response country by country.

Yearly Supply Outlook 2022/2023 main findings

- > Without immediate market/political reaction (with respect to the actions listed below), most of the European gas storages would be depleted during the winter period and most Central Eastern European (CEE), North-Western (NW) and South-Eastern Europe (SEE) countries will not be able to fill storages during Summer 2023 to levels necessary to ensure security of gas supply for Winter 2023/2024.
- > The gas storages significantly contribute security of gas supply. Therefore, it is important that all European storages continue to inject gas as much as possible during Summer 2022 (up to the maximum levels possible).
- > In case of supply disruption from Russia, some efficient actions can improve the security of the gas supply for the gas year 2022/2023:
 1. **Capacity enhancement** in Europe can additionally improve the cooperation possibilities between Member States and allow for more efficient storage utilisation.
 2. **Additional LNG volumes** available on the global market along with enhanced transmission capacities and optimised LNG terminal capacity utilisation can allow for an additional 12 billion cubic meters (bcm) (~130TWh) of imports in Winter 2022/2023, therefore reducing demand curtailment (provided they are available on the global market).
 3. Storages play an essential role to ensure security of supply. However, without **preparedness for Winter 2023/2024**, the situation could deteriorate over the next gas year 2022/2023: storages would be depleted in April 2023 and sites located in Central and Southern Eastern Europe would be filled less than 15% on 1st of October 2023, leaving the EU more exposed to risks of SoS for the winter 2023/2024.
 4. In the event of a **mild winter, a demand reduction of ca. -15%** (as a result of organic reduction due to high prices or policy-based demand measures) **and Member State cooperation would be required to mitigate the risk demand curtailment in EU countries**. Furthermore, additional measures would be required to ensure sufficient storage inventory for Winter 2023/24.
- > In case of a cold winter, EU demand curtailment would be higher than the results given in this report.
- > The assessment further identifies import capacity limitations in CEE as well as infrastructure bottlenecks in the NW and SEE preventing additional gas to flow from West – including France and Iberian Peninsula – and South to CEE, therefore limiting a possible mitigation of the gas storage deficit for the next winter 2023/2024.

Legal Notice

The current analysis is developed specifically for this Yearly Supply Outlook. 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 30th of September 2023 will depend on market behaviour and global factors.

ENTSOG has prepared this Yearly Supply Outlook 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 – Underground storages assumptions

Underground storage assumptions used in the Yearly Outlook are based on the Summer Supply Outlook 2022 assumptions and Winter Supply Outlook 2021/2022 assumptions⁹. Exceptions are the initial gas storage levels and full Russian gas supply disruption starting by 1st of July 2022.

Annex B – Supply assumptions

Minimum supply per source: The minimum supply per source, on daily average, is set 0 for all supply sources.

Maximum supply per source: The maximum supply per source, on daily average, is set as the average of maximum monthly supply of the last years for each supply source.

Use of Supplies: Modelling is handled as to ensure use of the different supply sources pro-rata of their maximum.

Sources	Minimum	Maximum [GWh/d]
Caspian	0	375
Libya	0	247
Algeria	0	1,389
LNG	0	4,745
Norway	0	4,153
Russia	0	0

Table 1. – Minimum and maximum supply source.

Note: The gas supplies are a modelling result that depends on the supply assumptions.

⁹ <https://entsog.eu/outlooks-reviews>

Annex C – Summary of Yearly Supply Outlook 2022/2023 assumptions

Assumptions	Reference case
Demand and National Production	Average monthly demand and production anticipated by TSOs.
Monthly injection	Monthly injection (aggregated and per Zone) is a result of the modelling.
Overall supply	Sum of demand (satisfied, i.e. without curtailment) and injection for the gas year 2022/2023.
Supply shares	Supply shares is a result of the modelling.
Import routes	Split between import routes is a result of the modelling.
Cross-border capacity	Firm technical capacity as provided by TSOs considering reductions due to maintenance.
Cross-border enhanced capacity	Conditional firm technical capacity as provided by TSOs to allow for more gas to be transported from Western to Eastern Europe.
Exports towards Ukraine	344.9 GWh/d each month

Annex D – Data for Yearly Supply Outlook 2022/2023

The data for Yearly Supply Outlook 2022/2023 was submitted by European TSOs and is available online as an annex of this report. The data available is specifically:

- Linearization curves of the injection and withdrawal in the storages (source GSE members).
- Average monthly national production forecast.
- Average monthly demand forecast.
- Average monthly final and power demand forecast.

Annex E – Modelling approach

The network used in this report is up to date at the time of data collection (June 2022) and reflects changes in topology submitted by TSOs. The simulation is based on firm and enhanced technical capacities between the individual European entry-exit-systems. However, the calculation is no hydrodynamical simulation and does not take all possible physical congestions caused by the distorted load situation within the entry-exit-systems themselves into account.

The following elements are part of the modelling:

- Definition of 12 temporal periods, representing the months from October 2022 to September 2023.
- Temporal optimization means the optimisation of the gas year as a whole period in a single simulation. This implies that the model anticipates an event, adapting the flows in the previous months and mitigating its impact.
- Use of linearization curves for storage injection/withdrawal capacities, as provided by GSE Members, to consider the reduction of injection capacity when the stock level increases.

Modelling enables the identification of potential capacity and supply limitations, if any, preventing the targeted stock level in each European storage by 30th of September 2023 being reached.

Annex F – RESULTS INTERPRETATION AND EXTRAPOLATION

Relation between Demand and Injection / Withdrawal Level

When a specific area has no supply flexibility due to infrastructure limitations (bottlenecks) at its borders, Demand and Storage injection/withdrawal are interdependent.

In such cases, a reduction in demand would allow additional storage injection to the extent the storage injection capacity is not fully used.

For instance, in case of a disruption scenario, a reduction of the demand (5 TWh) in a specific area with no additional flexibility could allow to additionally inject the same amount of gas in the storages of the same area (5 TWh)

Impact of a delayed disruption scenario (not starting on 1st July 2022)

Disruption scenarios are simulated from 1st of October 2022 to 30 September 2023, but as input data, to estimate initial storage levels on 1st of October disruption was assumed on 1st of July 2022. However, in case a disruption would start at a later stage, a combination of the baseline scenario and the disruption scenario should be considered as a proxy to assess the impact of such a variant scenario at EU level.

To understand this mechanism please follow the example below.

If the disruption started on 1st of August, the baseline scenario could be considered from 1 July 2022 to 1st of August 2022, and from 1st of August 2022 to 30th of September 2023, the evolution of the disruption scenario can be assessed by shifting the storage curve along the y-axis (storage level) so that the storage levels are aligned on 1 August.

However, this only gives a higher value for initial storages levels at the start of full year simulation for gas year 2022/2023. Unfortunately, the effect on demand curtailment and final storage levels cannot easily be estimated on the balance sheet without additional simulations.

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