entsog

european network
of transmission system operators
for gas

ENTSOG
SUMMER SUPPLY OUTLOOK

2019

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 (April 2019 to September 2019). The analysis investigates the possible evolution of the supplies and the injection in the storages across the season as well as the ability of the gas infrastructures to meet the demand, the exports and the above mentioned storage injection needs during Summer 2019. ENTSOG has used a sensitivy analysis to cover different injection targets and to provide flexibility of injection to reach storage levels.

The **main findings of the Summer Supply Outlook** highlight that the European gas network is sufficiently robust in most parts of Europe to enable:

- At least 90% stock level of the gas storages in preparation of the upcoming Winter, except for the Latvian;
- maintenance to ensure infrastructure reliability on the long term;
- flexibility for the network users' supply strategy; and
- supply gas to Ukraine with volumes comparable to previous summer seasons;
- The storage inventory level reached on 1st April (38.4%) is the highest of the last 8 years.

1. Introduction

This edition builds on previous Summer Supply Outlooks as well as on the supply assumptions of the TYNDP 2018 Scenario Report. It aims to assess the ability of the European gas network to provide sufficient flexibility to shippers during their storage injection season.

The summer months (from April to September) provide shippers the opportunity to refill storages in anticipation of the winter months ahead. 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.

Modelling has been used to confirm the ability of the European gas network to provide flexibility of injection under different scenarios around a Reference Case targeting a 90% storage level by 30th September 2019. Additional scenarios cover alternative injection targets, to provide flexibility of injection to reach storage levels between 80% and 100%.

Like the previous edition and in order to take into account the latest development since the beginning of the summer, the modelling takes as a starting point the factual storage levels on 1st April 2019.

For an accurate consideration of the reduction of injection capacity when a storage reaches high stock levels, ENTSOG uses injection capacity curves provided by GSE members.

In line with the Winter Outlook 2018-2019 Report, for the Summer Outlook 2019 the changes in France's topology had been considered. The topology of the network model has been upgraded in order to reflect the new situation in France where both existing balancing zones were merged in November 2018. The result of this merger involved the creation of the single trading zone (TRF) instead of two balancing zones considered so far (TRS for France South and PEG north for France North). The new topology consists in one demand node for H-gas in France (FR) with a separate L-gas node.

2. Assumptions and results of the modelling

The simulations consider the existing European gas infrastructure as of 31st March 2019.

The modelling tool for the Summer Supply Outlook is the same as the one used in the TYNDP and the Winter Supply Outlook. It considers the existing gas infrastructure and the maintenance plans to be completed during the upcoming summer [1].

The Summer Supply Outlook 2019 is developed based on assumptions specific to the upcoming summer season as detailed in the annexes and short term trends. In any case actual injection and supply mix will result from shippers' decisions.

The demand data has been provided by TSOs on a monthly level. An averaged daily demand has been considered within each month.

For comparison purposes, **Figure 1** shows the European aggregated demand for the Summer 2019 compared to the historical demand over the last eight summers (from 1st April to 30th September). The demand for this Summer is forecasted to increase 3.7%, the highest demand since summer of 2017.

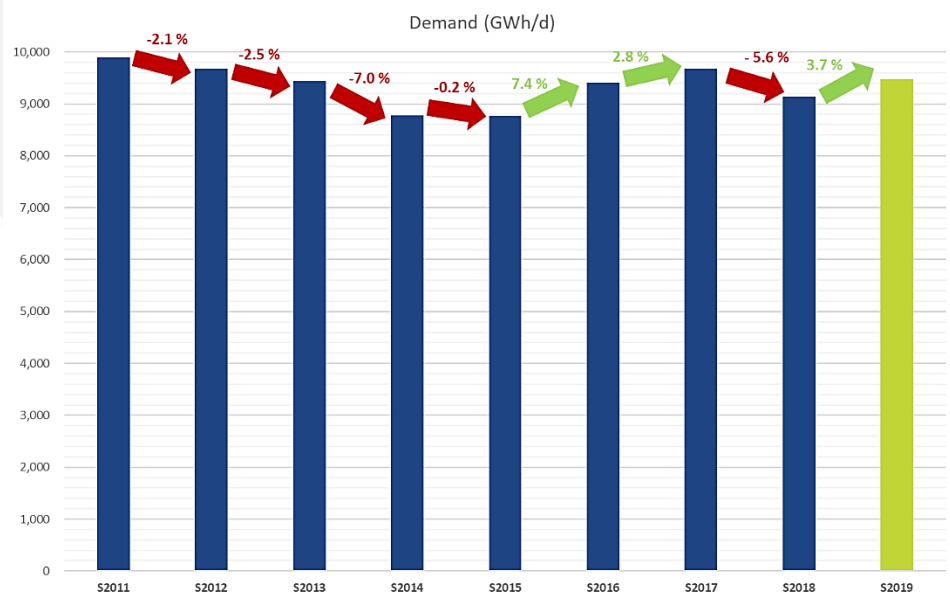


Figure 1. - European daily average demand comparison (Forecast for Summer 2019).

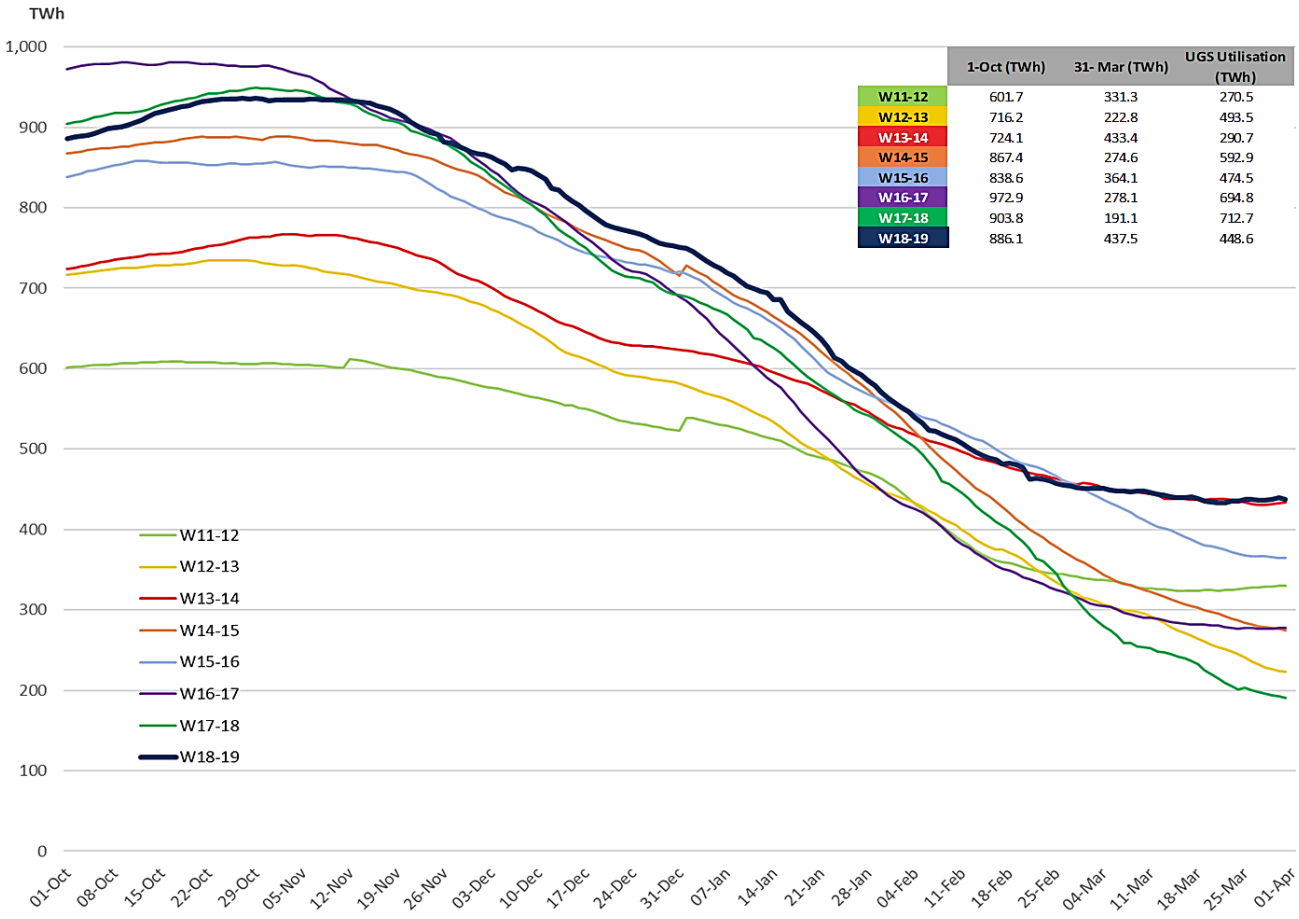
The maximum supply potentials of the different sources providing gas to EU (Algeria, Libya, Norway, Russia and LNG) are based on a five years history.

[1] Technical capacities and maintenance plans are updated by TSOs. For the OPAL pipeline a partial availability taking into account the current exemption is considered. For TENP pipeline, the current capacity restrictions as provided by Fluxys TENP and Open Grid Europe were taken into account in the SSO simulations.

3. UGS inventory

According to AGSI+, the gas storage platform operated by Gas Infrastructure Europe (GIE), the storage withdrawals reached 9.1 TWh on the 24th January 2019, the highest during the entire winter. This value is not as high as the value from previous year, 11.4 TWh on 28th February 2018, which is still the highest value since 2011 due to the cold spell on March 2018.

Figures 2 compares the stock level evolution of the last eight winters in volume highliting that the storages capacity is the highest of the last 8 winters, starting the injection period with a 437.5 TWh gas in the storages.



	1-Oct (TWh)	31- Mar (TWh)	UGS Utilisation (TWh)
W11-12	601.7	331.3	270.5
W12-13	716.2	222.8	493.5
W13-14	724.1	433.4	290.7
W14-15	867.4	274.6	592.9
W15-16	838.6	364.1	474.5
W16-17	972.9	278.1	694.8
W17-18	903.8	191.1	712.7
W18-19	886.1	437.5	448.6

Figure 2. - Evolution of UGS stock level. Winters 2011-2019 (TWh) (Source: AGSI).

Figure 3 shows the evolution of total WGV in 1st October and winter utilization (amount of WGV as a source to satisfy demand) for the last eight winters. Mainly due to the relatively mild temperatures during the Winter 2018-2019, the storages utilisation is less than previous year.

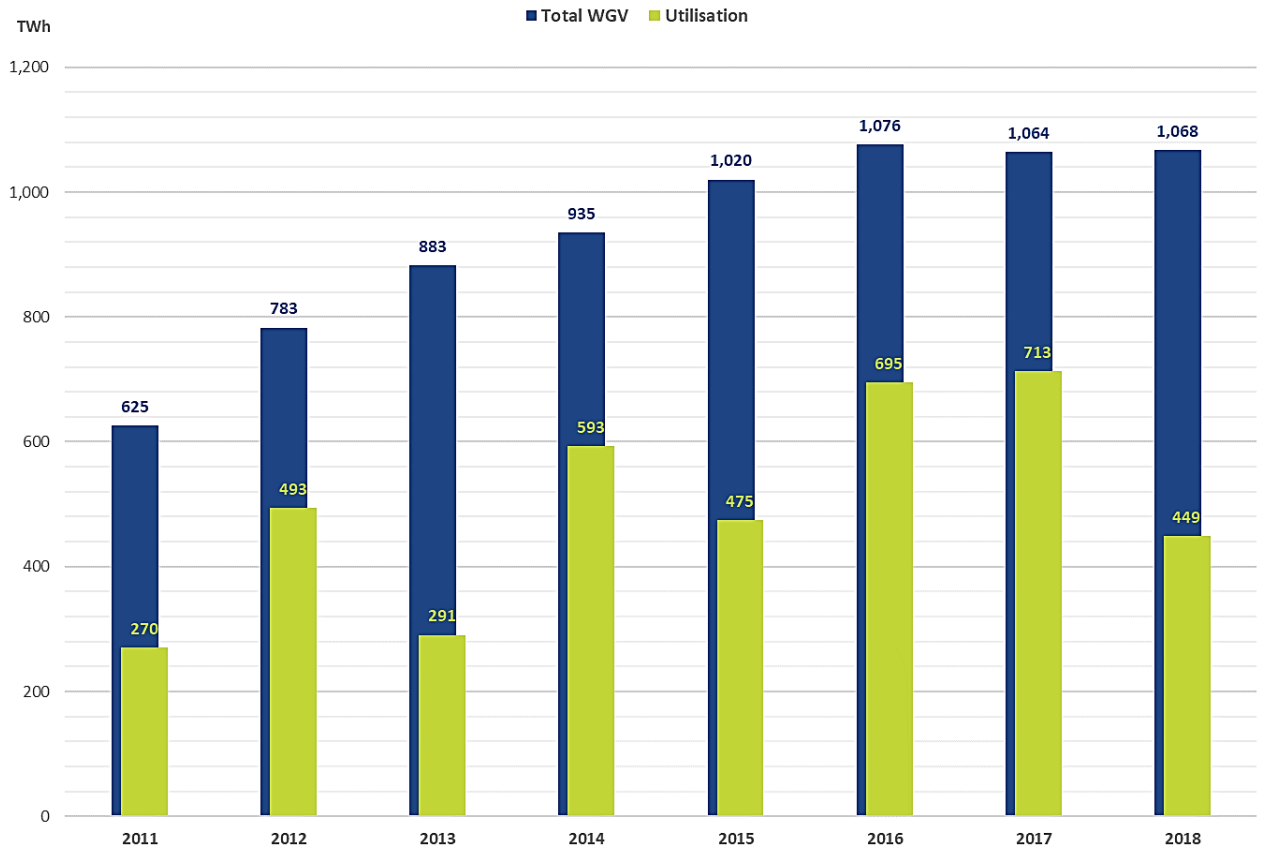


Figure 3. - Evolution of total WGV [2] and Winter Utilisation.

The Summer Supply Outlook takes into account the actual storage inventory level per country as of 1st April 2019 as the initial situation displayed in **Figure 4.** As shown on the map below the storage inventory levels differ depending on the country.

[2] Total WGV in 1st October of each year. Data from AGSI+ platform

	%full	Gas in the storages (TWh)
AT	50%	49.07
BE	35%	4.55
BG	25%	5.28
HR	24%	4.80
CZ	33%	31.01
DK	54%	8.61
FR	24%	117.81
DE	47%	186.55
HU	25%	48.06
IT	38%	185.83
NL	49%	118.84
PL	42%	32.64
PT	62%	1.81
RO	11%	22.97
SK	29%	24.40
ES	61%	23.21
SE	7%	0.01
UK	31%	5.82

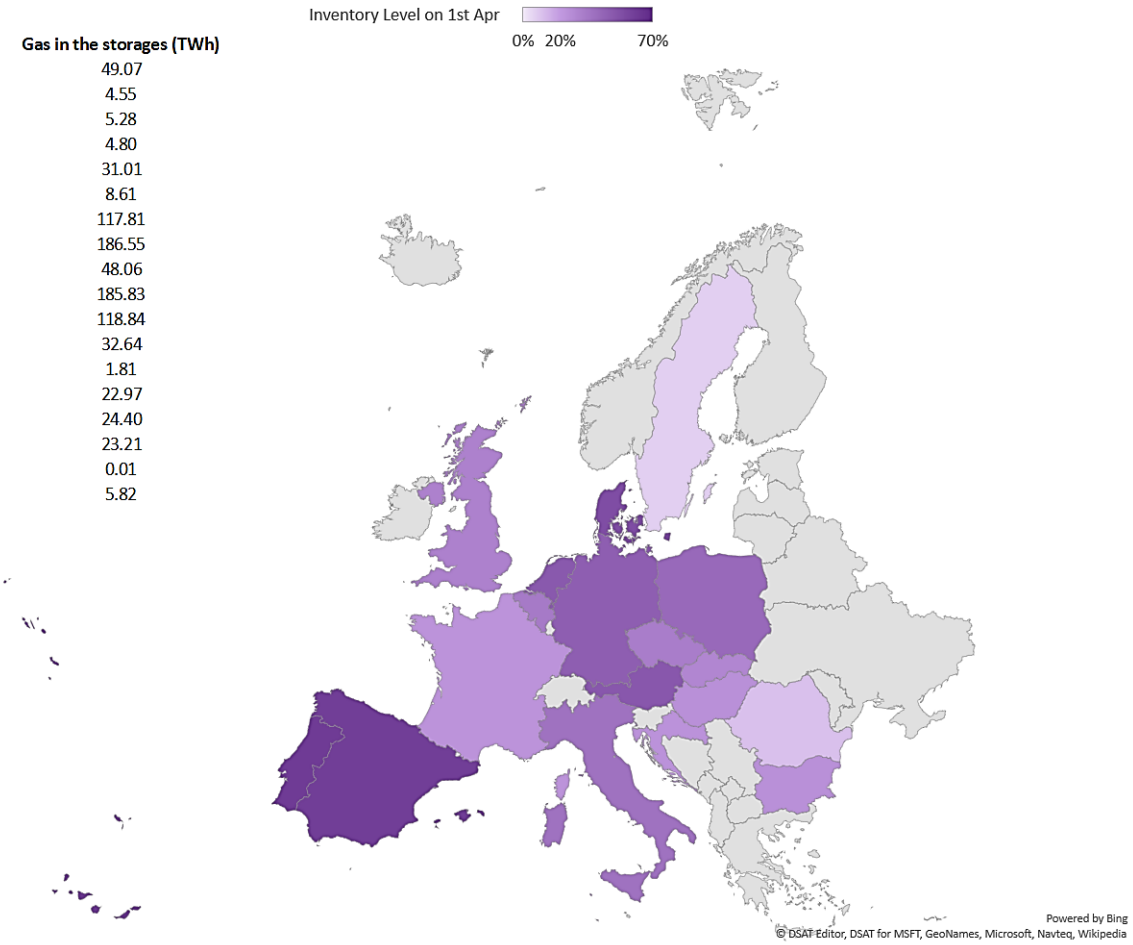


Figure 4. - Actual storage inventory levels on 1st April 2019 (For some countries, the initial level includes strategic stocks)[3].

In terms of **absolute volumes** in gas storages, the largest volumes on 1st April are located in Germany, Italy and The Netherlands. The initial average UGS inventory is higher than the one from the previous year (38.4[4]. vs. 18.7%). In particular, Sweden face an inventory level on the 1st April below 10%.

The actual levels for each country show substantial differences from one country to the other. These levels per country have been used as a starting point for the Summer Supply Outlook 2019.

[3]The percentage of the storage level is calculated considering the data from AGSI+ data platform (except for Latvia and Serbia) and from last GSE map for total WGV. For Latvia, the initial storage level is based in the information provided in the TSO website(https://capacity.conexus.lv/?id=159&lang=eng). For Serbia, the initial storage is considered 0% due to no availability of data.

[4] The WGV of the UGS with no firm injection capacity isn't consider, but still they can be used by the market participants and would increase the total volume of gas stored in EU.

4. Reference Case (90% storage target)

The overall "Summer injection" is defined as the quantity of gas necessary to reach a 90% stock level at each storage of EU on 30th September 2019 starting from above mentioned actual stock level of 38.4 % on 1st April 2019.

The repartition of injection and supply along the summer months result from the modelling and the following assumptions (further detailed in Annex A and B):

- The monthly gas demand forecast by TSOs;
- The monthly national gas production forecast by TSOs;
- Exports towards Ukraine[5];and
- The overall summer injection as defined in Annex A and D.

The flexibility given to the model for the definition of the supply patterns derives from the supply mix of the last five summers (See Annex B-Supply assumptions).

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

The simulations show that a 90% stock level may be achieved by 30th September 2019 in all the balancing zones except for the storage in Latvia and Bulgaria.

In the specific case of Latvian storage, the 90% of WGV is not achieved due to the limited entry capacity[6] in the country and the assumption that no gas coming from NW Russia will be injected. This assumption stems from the fact that in the summers of 2016 and 2017, mainly volumes of gas intended for customers in Latvia were injected into the storage. This resulted from the decision of Gazprom not to use Incukalns UGS for customers in Russia since, after enhancement of gas transmission network in the Russian NW region, there are enough capacities in the network to supply customers directly by pipeline. The final level in this storage is 48%[7] (11.7 TWh) on 30th September, starting from 15% (3.7 TWh) on 1st April.

[5] The exports to Ukraine were assumed to be on the summer 2015, 2016, 2017 and 2018 average levels.

[6] Technically, the capacity of the interconnection between Lithuania and Latvia is not enough to fill the storage during Summer. In order to reach the 90% of WGV level in this storage, imports from Russian route would be necessary.

[7] At this level of inventory in the storage of Latvia, the daily withdrawal capacity will be limited to cope with the peak demand during Winter.

Table 1 shows the evolution of the stock level per country as a result of the model for the reference case simulation[8].

Table 1 - Storage Evolution Reference Case . (*Actual stock level on AGSI platform, complemented by other information sources for storages not reported on AGSI. For some countries, the initial level includes strategic stocks).

Country	01/04/2019*	01/05/2019	01/06/2019	01/07/2019	01/08/2019	01/09/2019	30/09/2019
AT	51%	51%	57%	63%	73%	84%	90%
BE	35%	35%	47%	60%	72%	84%	90%
BG	25%	25%	34%	42%	58%	68%	77%
CZ	24%	24%	41%	60%	72%	85%	90%
CZd	86%	86%	86%	86%	86%	90%	90%
DE	47%	47%	53%	61%	71%	84%	90%
DK	54%	54%	60%	67%	77%	87%	90%
ES	61%	61%	61%	68%	75%	83%	90%
FR	24%	30%	45%	60%	71%	84%	90%
HR	24%	33%	46%	60%	73%	84%	90%
HU	25%	36%	47%	58%	69%	80%	90%
IT	38%	38%	49%	60%	71%	83%	90%
LV	15%	20%	27%	33%	38%	43%	48%
NL	49%	49%	56%	63%	73%	83%	90%
PL	42%	42%	49%	60%	72%	84%	90%
PT	62%	62%	62%	67%	73%	81%	90%
RO	11%	23%	38%	53%	66%	80%	90%
RS	0%	16%	35%	53%	64%	83%	90%
SE	7%	7%	40%	60%	60%	90%	90%
SK	29%	30%	46%	60%	70%	81%	90%
UK	31%	31%	31%	56%	80%	90%	90%

Figure 5 shows the breakdown of transported gas for each month (average daily values for each month including exports) for the **Reference Case**.

[8] Bulgaria does reach the storage target. Due to late submition of corrected data, the simulation results show a bottleneck in Bulgaria.

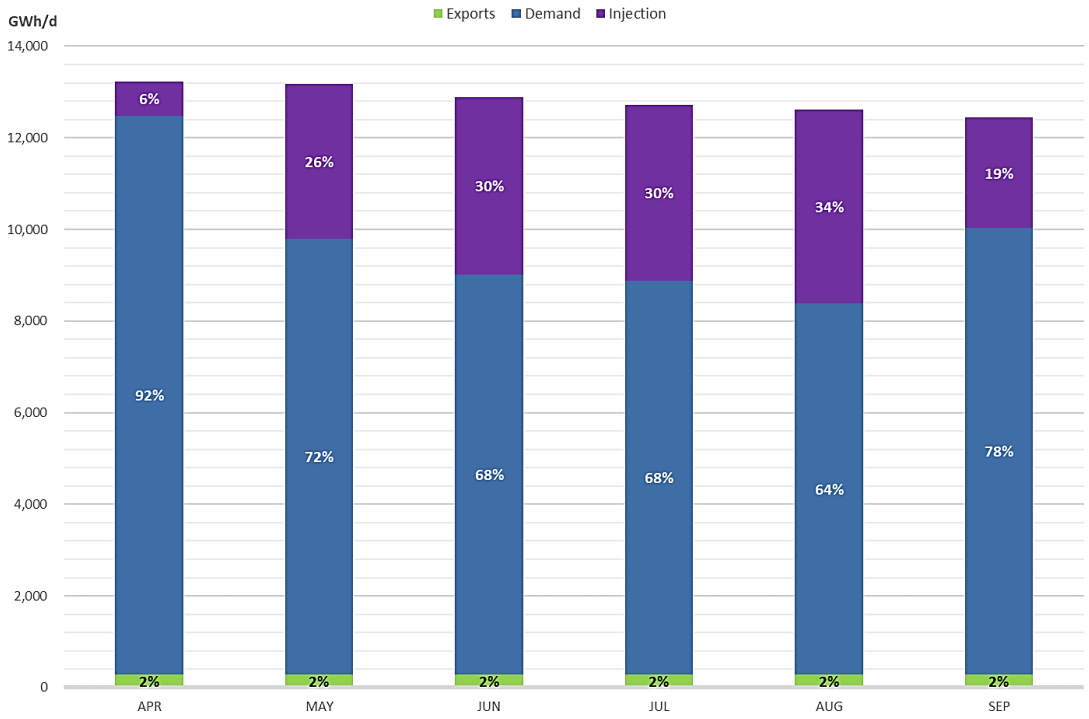


Figure 5 . - Transported Gas on Reference Case.

Figure 6 shows the level and composition of the supply mix for every month in the Reference (90%) case.

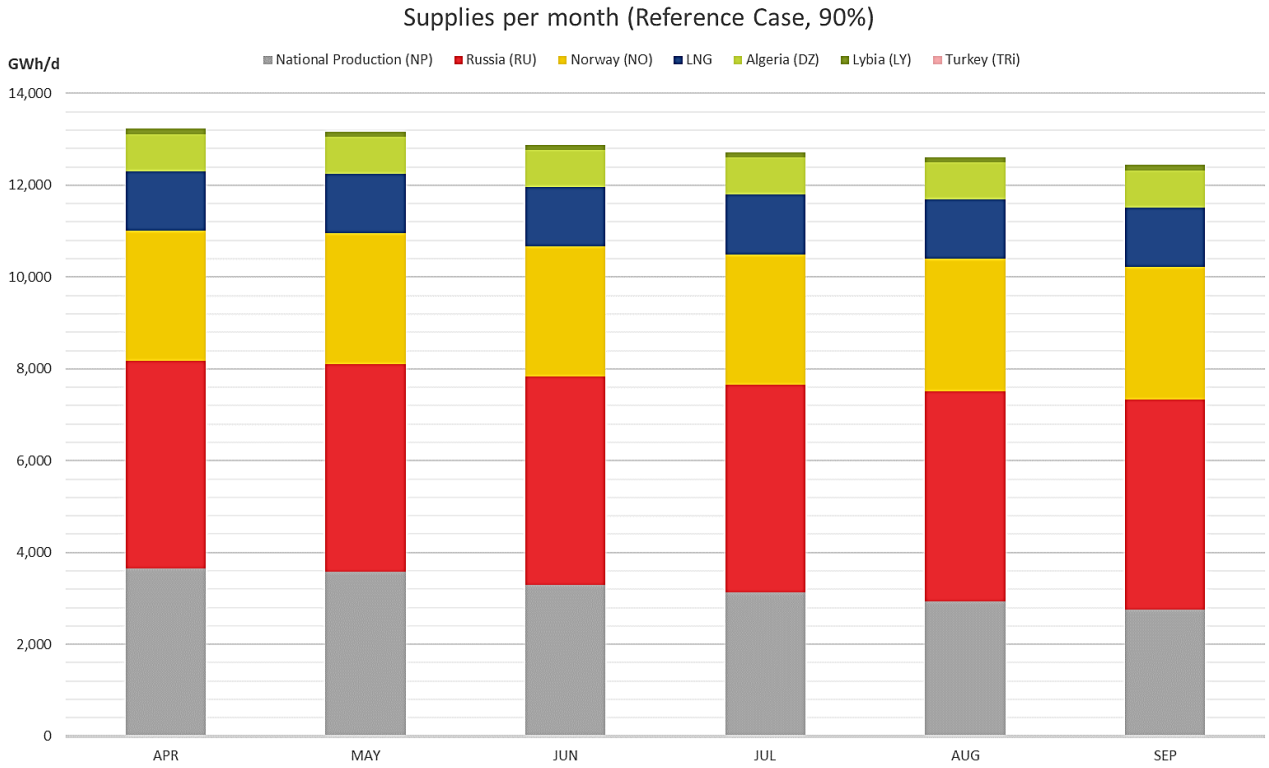


Figure 6. - Monthly supply mix.

5. Sensitivity-analysis – Alternative injection targets (80% and 100% targets)

Given the uncertainty on the level of stock at the end of the season resulting from the behaviour of market participants, two alternative targeted levels of storage have been considered: 80% and 100% on 30th September 2019.

The definition of the monthly injection and supply is following the same rules as for the Reference Case. The assumptions for the demand, export and indigenous productions are kept on the exact same level as in the Reference Case.

Figure 7 provides the stock level evolution curve as resulting from the modelling of Summer Supply Outlook 2019 (actual injection curve will derive from shippers' behaviour) and actual curves of last four summers.

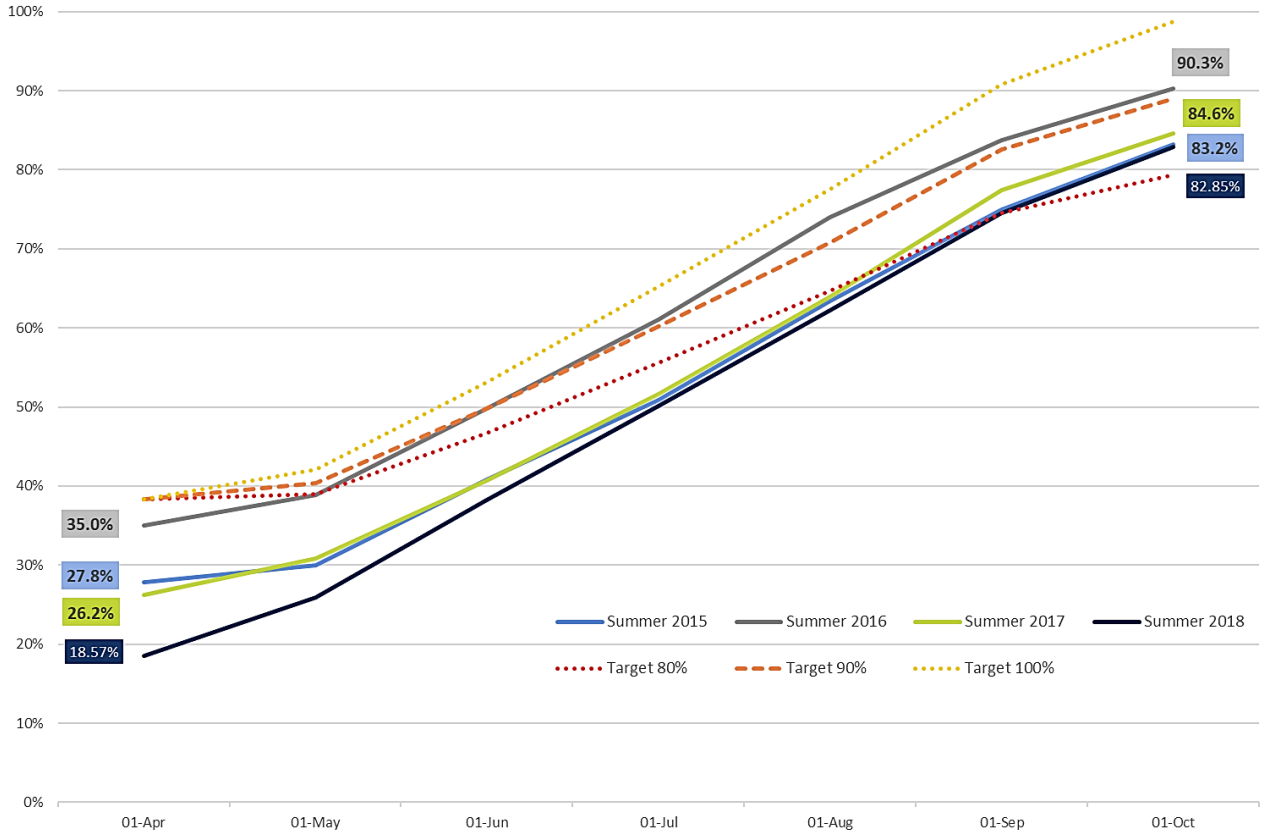


Figure 7. - Stock level development curve (% WGV).

In absolute terms, the target level of 90% represents a quantity of 993.6 TWh of gas in the storages at the end of the Summer. By comparing this value with the result of the previous

Summer Outlook (986 TWh). Nevertheless, this result of 993.6 TWh is higher compared with the final historical level in the storage over the last eight summers[9].

Considering the two alternative targeted levels of storage, all the European gas storages can achieve the 80% of the WGV and also the 100% of WGV at the end of the summer. The only exception continues to be Latvia does not reach the 80% and 100% target.

Still, for many operators the injection season continues in October enabling a full injection if decided by market players.

Given the supply constraints detailed in Annex A, the different injection targets are reached through fluctuation of the supply levels.

As shown in **Figure 7**, the flexibility of the European transmission system is high enough to allow for different supply patterns while reaching 80%, 90% and 100% stock level at the end of September 2019.

Figure 8 compares the maximum and minimum supply per source of **TYNDP18** Scenario Report[10], with the results of the supply shares modelled for Summer 2019 .

[9] The gas in the storages on 1st October for each year could be check in the Figure 2 of this report.

[10] Supply potentials forecasted for year 2019.

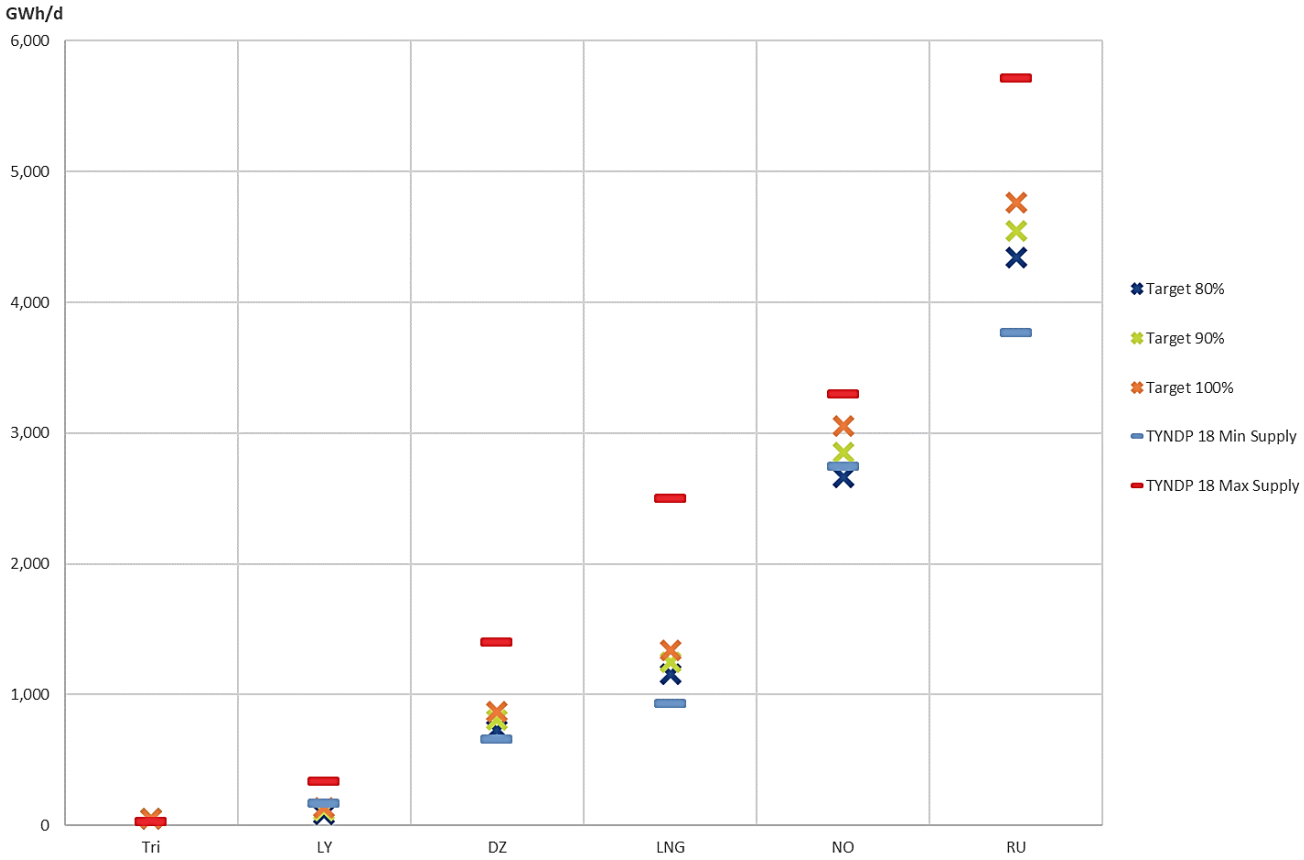


Figure 8. - Fluctuation of the supply patterns in the sensitivity analysis on the stock level.

Figure 9 shows a comparison between the supply shares in the Reference and the two alternative stock level targets (on a daily average basis) compared with historical supplies for four previous seasons.

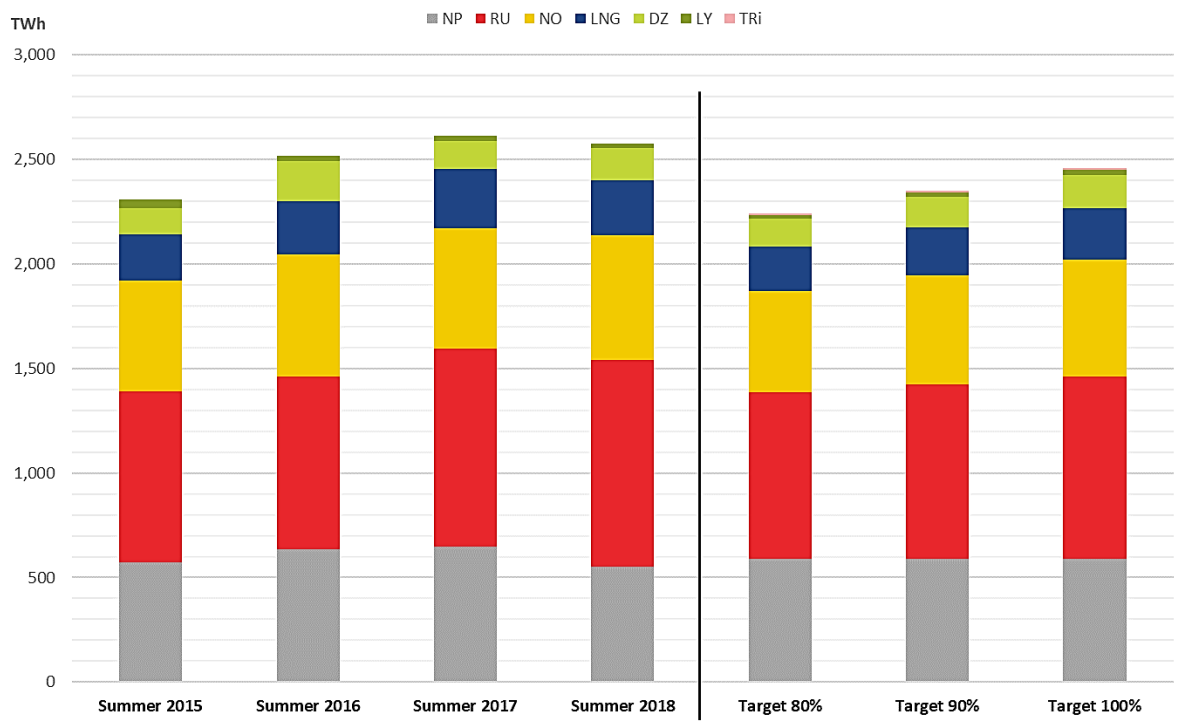


Figure 9. - Comparison between the summer supplies in the Reference and the two alternative stock level targets with historical data (TWh).

Regarding the National Production, **Figure 10** provides a comparison between the last four seasons and the National Production anticipated by TSO for Summer 2019. The increase in the National Production is around 7% (2019 vs.2018).

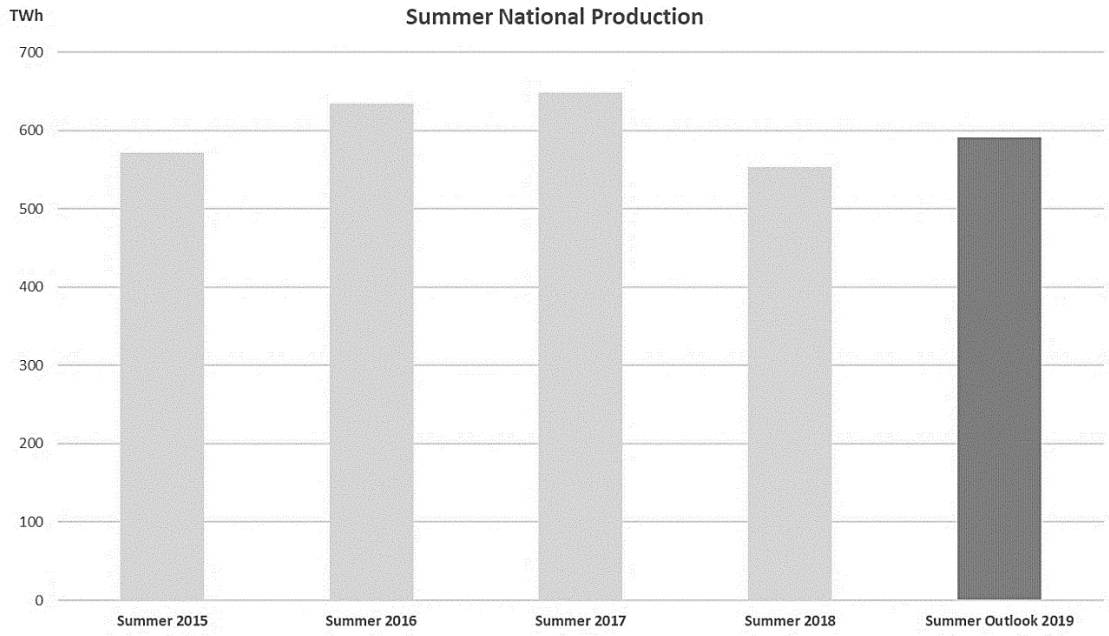


Figure 10. - National Production comparison (TWh).

Finally, **Figure 11** shows the difference between the supply shares in the Reference and the two alternative stock level targets.

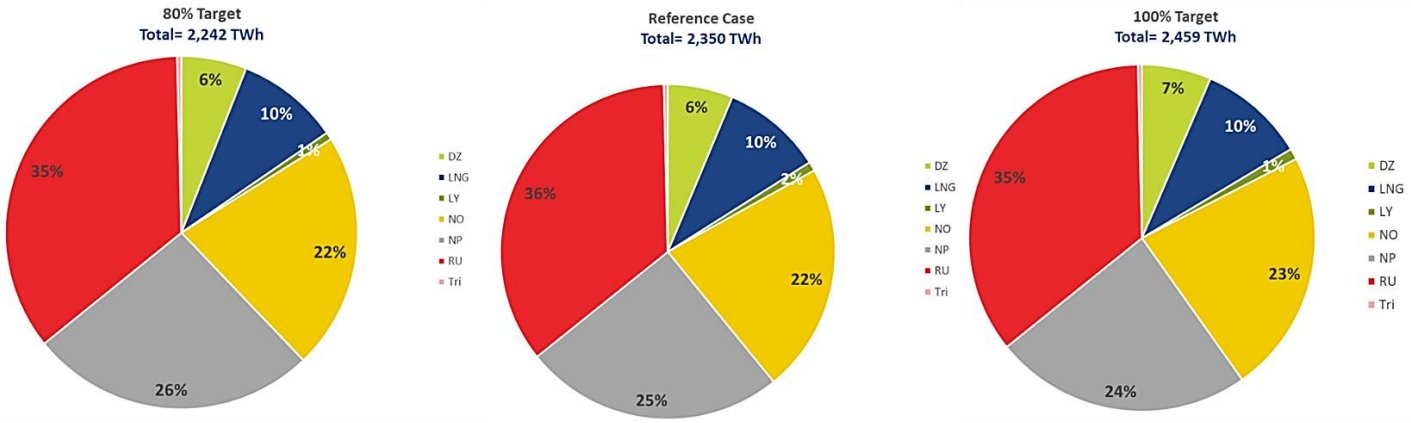


Figure 11. - Summer supply average share.

6. Conclusion

According to the ENTSOG modelling, under the given supply assumptions, this Summer Supply Outlook confirms the capability of the European gas network to enable shippers to reach at least a 90% stock level in all but one underground gas storage by the end of this Summer 2019 while ensuring the proper maintenance of the system.
The sensitivity analysis also shows that a 80% and a 100% stock level could be achieved in almost all of the countries.

The only exception in the three cases is the storage in Latvia due to the limited entry capacity in the country and the assumption that no gas coming from NW Russia will be injected.

Legal Notice

The current analysis is developed specifically for this Summer 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 September 2019 will depend on market behaviour and global factors.

ENTSOG has prepared this Summer 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

The total quantity of gas to be injected from 1st April to 30th September 2019 is defined as the difference between:

- the sum of the working volume of all European UGS times the targeted stock level, and
- the stock level of European UGS on 1st April 2019 (source: AGSI platform).

This quantity will be split per month by the model on the basis of the temporal optimisation, considering the limits set by the linearisation of the injection curves.

Figure 12 shows the average injection curve, based on the storage profiles provided by GSE members. Default values are used in case specific country profiles are not available, calculated based on the WGV-weighted average of the provided ones. The detail of the curves defined at country level is included in Annex D.

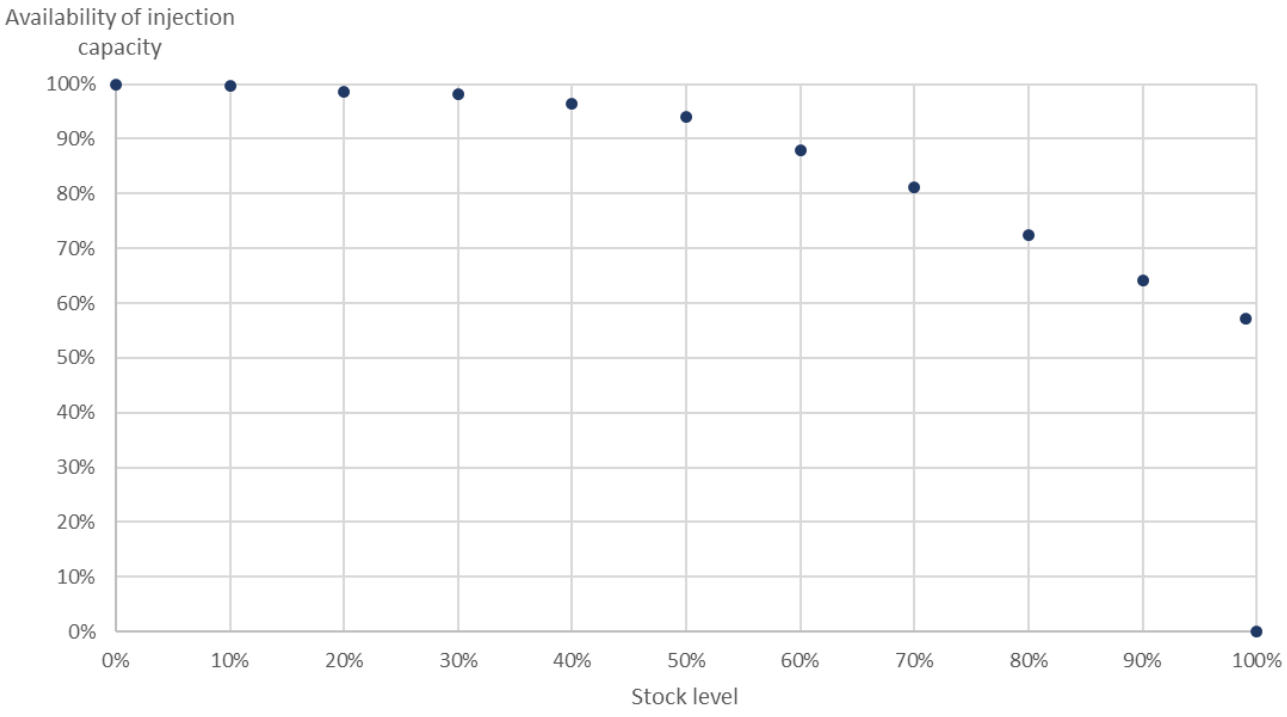


Figure 12. - Injection average curve.

Annex B – Supply assumptions

Minimum supply per source: The minimum supply per source, on daily average, is set as the average of minimum monthly supply of the last 5 summers (April to September for years 2014, 2015, 2016, 2017 and 2018) for each supply source.

Maximum supply per source: The maximum supply per source, on daily average, is set as the average of maximum monthly supply of the last 5 summers (April to September for years 2014, 2015, 2016, 2017 and 2018) for each supply source.

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

The model can access additional flexibility on Algeria, LNG, Norway and Russia only once all sources have reached their maximum. This way, the access to higher levels than these maximums will imply they will only be used by the model when it is necessary to avoid demand disruptions.

Additional Flexibility: The additional flexibility is based on the difference between the maximum supply per source (calculated as noted above) and the maximum of the maximum monthly supply of the last 30 summer months. We allow this flexibility only for the sources that have a difference higher than 150 GWh/d between the average of maximum monthly supply and the maximum of the maximum monthly supply.

Table 2. - Minimum, maximum and additional flexibility per supply source.

Sources (GWh/d)	Minimum	Maximum	Maximum+ Additional Flex.
Algeria	536.65	1,140.09	1,227.00
LNG	854.39	1,736.60	2,163.94
Libya	4.82	243.40	243.40
Norway	2,090.08	3,852.00	4,084.58
Russia	3,725.55	5,615.43	6,009.60
Turkey	30.14	30.14	30.14

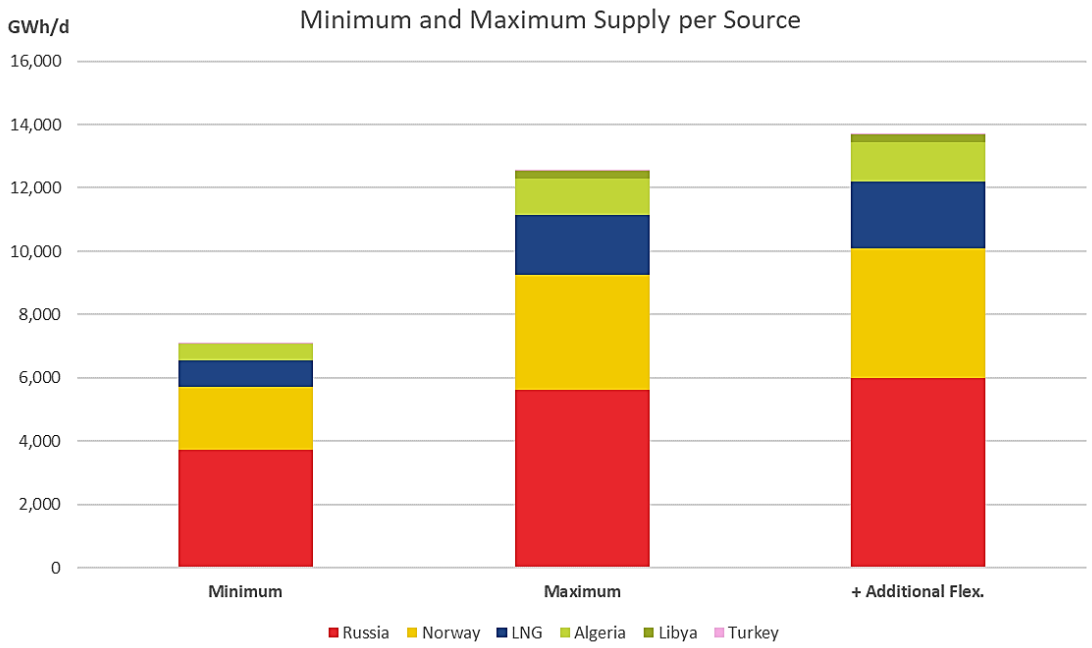


Figure 13. Minimum, maximum and additional flexibility per supple source.

Note: The gas supplies are a modelling result that depends on the supply assumptions, which are derived from the Summer Reviews.

Annex C – Summary of Summer Supply Outlook 2019 assumptions

Assumptions	Reference case
Demand and National Production	Average monthly demand and production anticipated by TSOs.
Monthly injection	> European aggregated injection over the Summer: quantity necessary to reach injection target (80%, 90% or 100%) on 30th September 2019. > Monthly injection (aggregated and per Zone) is a result of the modelling.
Overall supply	Sum of demand and injection for the whole summer.
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.
Exports towards Ukraine	292 GWh/d (average of four previous Summer seasons).

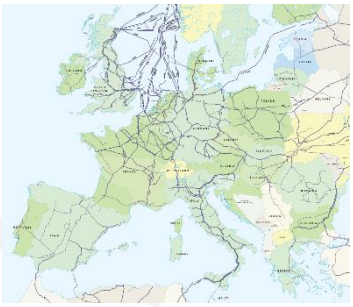
Annex D – Data for Summer Supply Outlook 2019

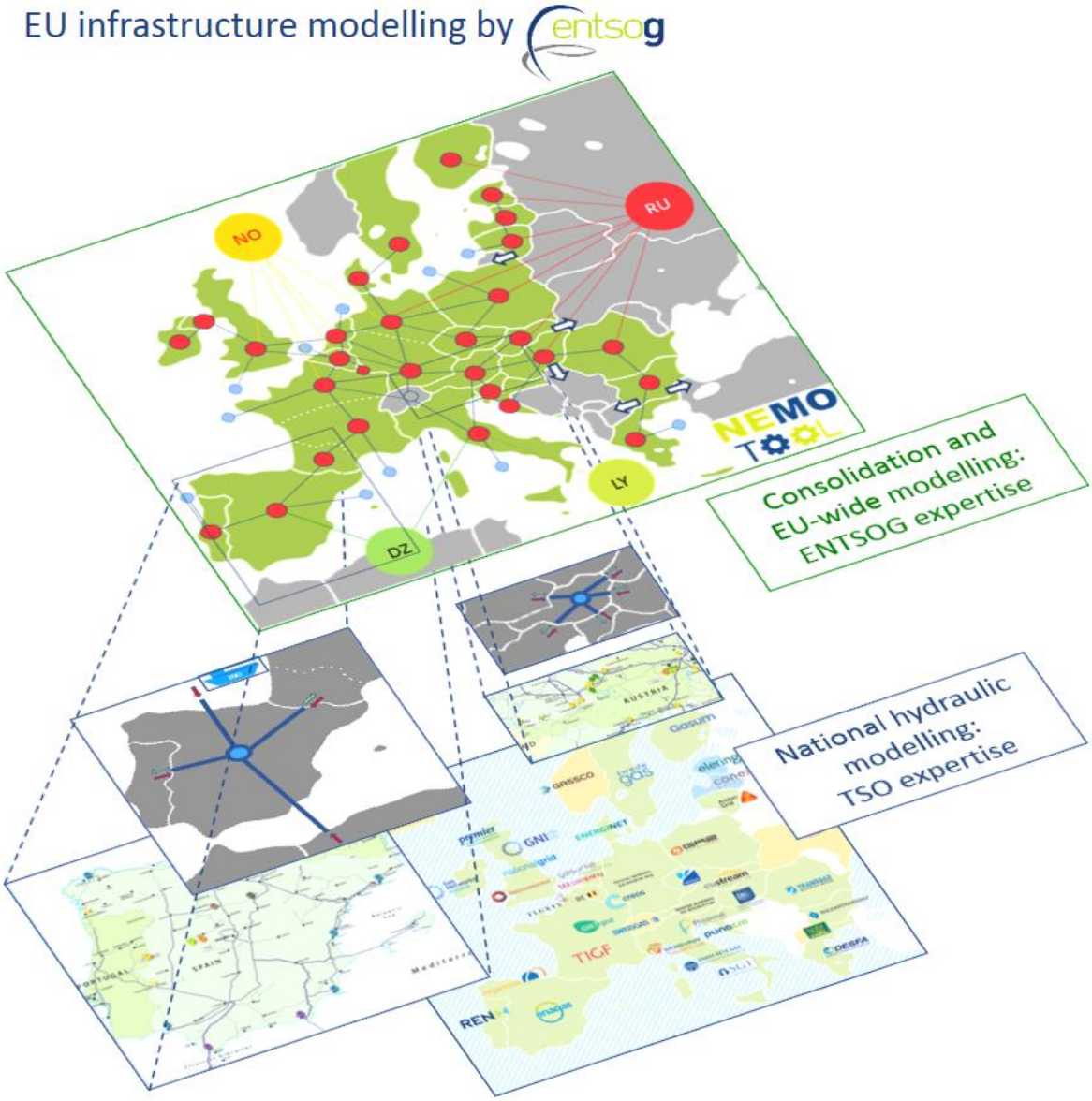
The data for Summer Suply Outlook 2019 is available online as an annex of this report. The data available is specifically:

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

Annex E – Modelling approach

ENTSOG modelling tool (NeMo) builds on TSO expertise and hydraulic modelling of national infrastructure to model the European 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.





The network used in this report is the same to the one used in the Winter Outlook 2017-2018.

The following elements are part of the modelling:

- Definition of six temporal periods, representing the months from April to September.
- Temporal optimization means the optimization of the summer 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 linearisation curves for storage injection 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 September 2019 being reached.

Annex F – List of Figures and Tables

> Figures:

> Tables:

Publisher ENTSOG AISBL
Avenue de Cortenbergh 100
1000 Brussels, Belgium

Co-Authors Jacques Reberol, Paula Di Mattia, Kacper Zeromski and Louis Watine

Cover picture Courtesy of Gascade

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

info@entsog.eu | www.entsog.eu