ENTSOG
WINTER SUPPLY OUTLOOK

2019/2020

Contents

Executive summary

As part of its obligation under Art. 8(3)(f) of Regulation (EC) 715/2009, ENTSOG has undertaken an assessment of the European gas network for the upcoming winter (October 2019 to March 2020). The analysis investigates the possible evolution of supplies and UGS inventory along the season as well as the ability of the gas infrastructure to meet the demand, especially to face high demand situations. ENTSOG has used a sensitivity analysis to check if the European gas system is able to handle the winter under different demand conditions: Reference Winter and Cold Winter[1].

The **main findings of the Winter Supply Outlook** are:

- **the European indigenous production keeps on following a decreasing trend;**
- **the storage level on 1st October is the highest level of the last eight years (1060TWh) as a consequence of a high storage level (447TWh) at the beginning of the injection season and relatively high seasonal price spread during the injection season;**
- **LNG terminals utilisation has been significantly higher than the observed over the last eight years, imports last winter were comparable to pre-Fukushima disaster levels;**
- **the European gas system offers sufficient flexibility across the season in Europe, provided gas is available;**
- **the European gas system is also capable of supplying Energy Community Contracting Parties and other EU neighbouring countries with significant volumes of gas;**
- **infrastructure limitation in Bosnia and Herzegovina, could expose it to demand curtailment during the peak demand day during cold winter;**
- **South-East Europe would be significantly exposed in case of a transit disruption through Ukraine under high demand situations.**

[1] The Reference Winter and the Cold Winter are defined on the document.

1. Introduction

This edition builds on previous Winter Supply Outlooks as well as on the supply and demand assumptions of the Security of Supply Simulation Report 2017. It aims to assess the ability of the European gas network to provide sufficient flexibility to meet different demand situations and specially to face high demand situations. Likewise, it aims to verify the consistency is ensured between “Cold Winter” and the SoS simulation report assumptions.

Two different visions: winter period and high demand situations

As for previous reports, the Winter Supply Outlook 2019/20 captures two different visions of the season. The first one is an outlook of demand and supply and the resulting evolution of UGS inventory along the Reference Winter and the Cold Winter demands. The second one is the analysis of specific events being high demand situations (1-day Design Case and 2-Week Cold Spell), considering also an LNG supply sensitivity in the cold winter high demand situations.

As for previous WSO reports, these two visions are assessed separately in the Winter Supply Outlook 2019/20.

Observations of the supply situations in the past show that the underground gas storages are the most important flexibility assets in order to cope with the high demand variations during the winter season. Therefore, this report pays special attention to the storages. The winter months require storage withdrawal to cover both short high demand periods and the overall winter demand. The actual level of withdrawal by shippers varies from one country to the other and with climatic, price and legal parameters.

Currently, the European aggregated inventory level of underground gas storages levels on 1st October is 1060.4TWh. It is 176TWh higher than previous winter which was the lowest level observed over the past two years.

The main changes considered in this report from the previous Winter Supply Outlook are:

Consistency with SoS simulation report: The results obtained in the Union-wide Security of Supply Simulation Report 2017 are verified in the Winter Supply Outlook simulations considering the “Cold Winter” demand[2] and supplies[3] assumed in that report with the updated capacities sent by the TSOs for this winter.

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[2] The cold demand for Germany has been updated due to a decrease of Lgas demand and an increase of Hgas demand.
[3] In the case of LNG, the Reference Winter supply estimation has been considered for the Winter Period in order to be properly reflected, since it has increased.

Disruption assessment: in line with the previous editions of Winter Supply Outlooks, this report assesses the impact of the Ukrainian supply disruption, complemented by the assessment of the main supply disruption scenarios defined in the SoS EU Regulation 2017/1938. The WSO assesses the impact of supply disruptions occurring during a Peak day or a 2-week cold spell. The assessment of the impact of long supply disruptions on the EU gas system is available in the EU-wide SoS simulation report on ENTSOG website[4].

2. Assumptions

The simulations consider the existing European gas infrastructure as of 30th September 2019.

The modelling tool for the Winter Supply Outlook is the same as the one used in the TYNDP and the Summer Supply Outlook. It considers the existing gas infrastructure and the technical capacities updated by TSO[5] with every WSO exercise.

The Winter Supply Outlook 2019/20 is developed based on assumptions specific to the upcoming winter season as detailed in the annexes and short-term trends. In any case actual withdrawal and supply mix will result from shippers' decisions.

2.1. Seasonal Demand

The seasonal demand is used to check if the gas stored in the UGS is enough to cope with the winter demand (Reference and Cold) and, at the same time, reaching the end of the period with a sufficient gas volume in the storage in order to preserve the flexibility of the system.

A Reference Winter has been defined as representing a 1-in-2-year climatic condition. The demand data has been provided by TSOs on a monthly level. An average daily demand has been considered for each month.

The demand for the Cold Winter is based on demand assumptions considered in SoS simulations report[6] and represents an historical high demand winter (see Annex B for country detail). The Cold Winter shows an overall increase of 11.4% of the total demand compared to the Reference Winter submitted by TSOs.

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

[5] For the OPAL pipeline, the partial availability of the pipeline taking into account the current exemptions were considered. For TENP pipeline, the current capacity restrictions as provided by Fluxys TENP and Open Grid Europe were introduced in the WSO simulations.

[6] The methodology and assumptions performed to obtain the Cold Winter Demand in the three cases (whole winter, 2 weeks and peak day) are explained in SoS simulations report, point 3.1. (Pages 8-9).
https://www.entsog.eu/public/uploads/files/publications/sos/ENTSOG%20Union%20wide%20SoS%20simulation%20report_INV0262-171121.pdf

For comparison purpose, **Figure 1** shows the European aggregated demand for the Reference Winter and Cold Winter compared to the historical demand over the last 10 winters.

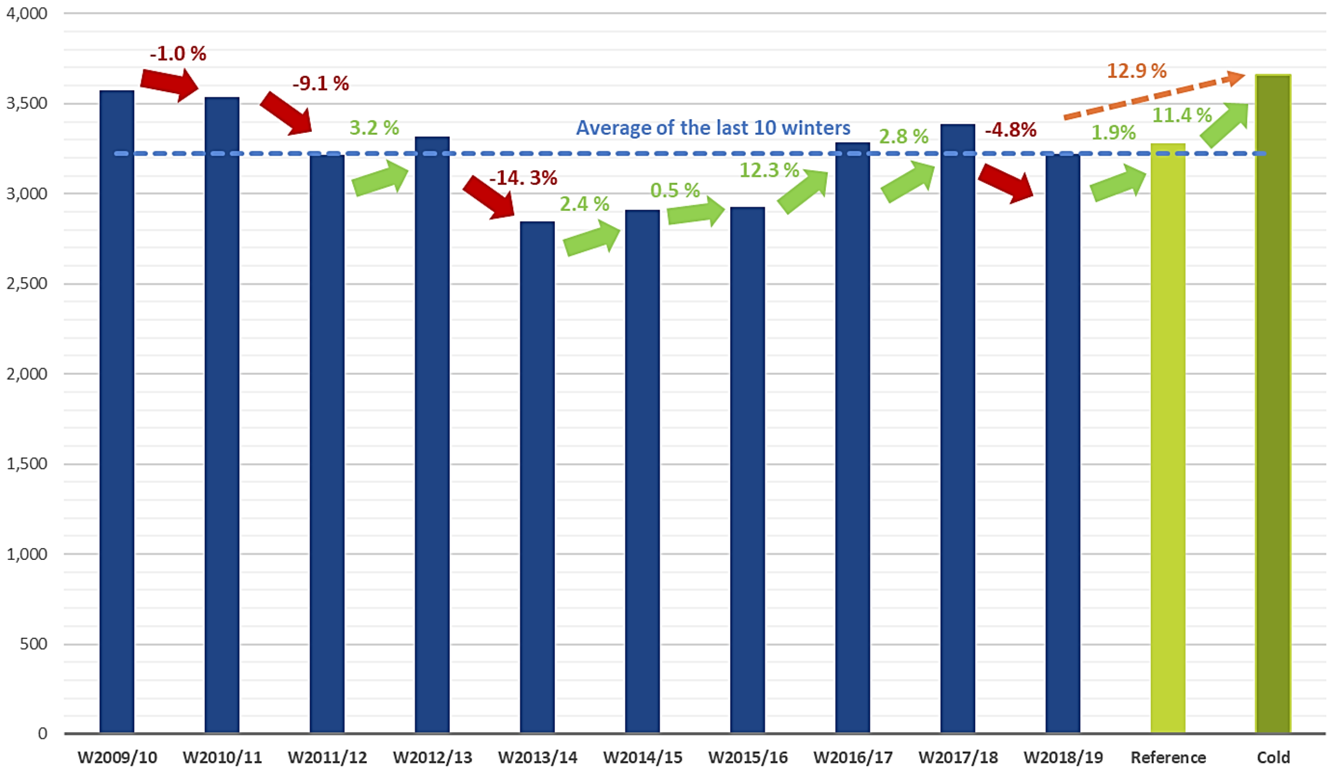


Figure 1. - European seasonal demand in the last 10 winters compared with the two visions.

The Reference Winter demand is slightly higher than the one observed during the last winter (+2%). The Cold Winter demand is higher than the last ten winters, it shows an overall increase of 13% of the total demand from W2018/19.

Furthermore, Reference and Cold Winter are higher compared with average demand of last ten winters, 1.9% and 13.5% respectively.

2.2. Peak demand

Two high demand situations are considered: Peak day demand and 2-week Cold Spell occurring in February. They are defined in the table below:

Period	Occurrence of the demand provided by each TSO
Peak day	National design standard for gas demand, taking place on 15th February
2-week Cold Spell	High demand during a 14-day period in February (cold spell), taking place 15th -28th February.

The peak day and 2-weeks demand is used to check if the withdraw capacity in the UGS is enough to cope with a peak day or cold spell events at the end of February when the storages are not at their maximum level (therefore, they are not at their maximum withdraw capacity).

As well as in the case of seasonal demand, the **Figure 2** shows the European aggregated 2-Week average demand for the Reference Winter and Cold Winter compared to the historical demand over the last 10 winters. Also, the **Figure 3** shows the European aggregated peak day demand.

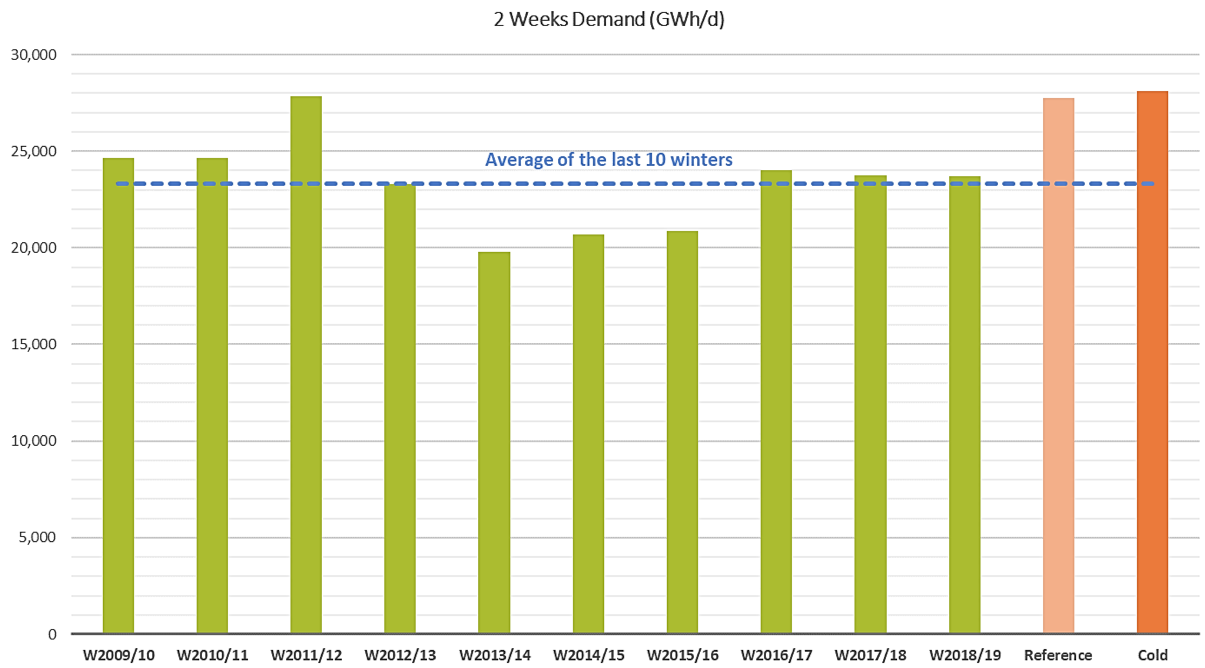


Figure 2.- European 2-week demand history (2009 – 2019) compared with Reference and Cold 2-week demand.

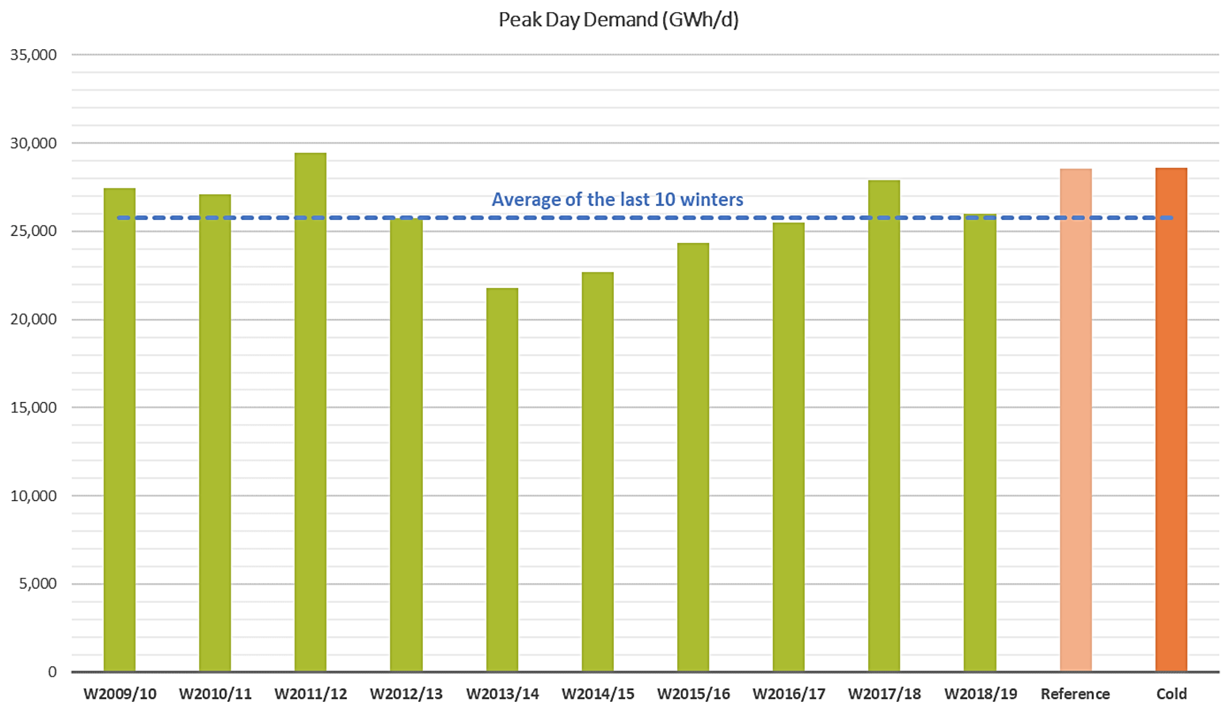


Figure 3.- European peak day demand history (2009 – 2019) compared with Reference and Cold winter.

The 2-weeks cold spell for Reference Winter demand is higher than the one observed during the last winter (+17.2%) and also higher to the average of the last ten winters (+19%). In the case of the 2-weeks cold spell[7] for Cold Winter the difference is even higher (+18.6%) compared with the Winter 2018/19.

Peak day demand for Reference Winter shows an overall increase of 10% and compared with the average of the last ten winters the increment is 10.8%.

2.3. Supply

The maximum supply potentials of the different sources providing gas to EU via pipeline (Algeria, Libya, Norway, and Russia) are based on eight years history for Winter Season and on five years history for 2-week Cold Spell and 1-day Design Case. In the case of LNG, an additional value will be considered (historical winter/monthly maximum + 20% for historical winter/monthly maximum). However, this historical winter and monthly maximum value + 20% will be tested against next TYNDP2020 value for 2020:

1. If TYNDP2020 value>Historical winter/monthly maximum + 20%, we take historical maximum + 20%.

[7] 2 weeks cold spell for Cold Winter: A period of 2 weeks of exceptionally high demand, occurring with a statistical probability of once in 20 years.
Peak day for Cold Winter: One day of exceptionally high demand, occurring with statistical probability of once in 20 years.

2. If TYNDP2020 value<Historical winter/monthly maximum, we take historical maximum.
3. Otherwise we take TYNDP2020 value for winter and monthly maximum.

A 20% increase has been applied as well for LNG historical values for 2-week Cold Spell and 1-day Design Case, in order to reflect the LNG increase.

Supply limitations are set for different time scales or profiles (winter season, month, 2 weeks and day) so that the maximum flow of each source cannot exceed reasonable levels based on historical observations[8]. The detailed data is provided in the annexes. For each of the winter demand profile and high demand situation, specific gas supply maximum availability has been defined in **Table 1**:

Table 1.- Gas supply maximum availability definitions.

<table>
<tr><th></th><th>National Production</th><th>UGS[9]</th><th>LNG**</th><th>Algeria, Norway, Libya, Russia</th></tr>
<tr><td>Winter Season</td><td>TSO forecast for winter.</td><td rowspan="3">Limited for each country (or zone) by the stored volumes and the deliverability associated with the inventory level.</td><td colspan="2">Limited for the whole winter period to the highest winter average supply observed during the last 8 winters and at monthly level to the to the maximum 30 days rolling average of the last 8 winters.</td></tr>
<tr><td>2-week Cold Spell</td><td rowspan="2">TSO forecast for high demand situations.</td><td>Week 1
Limited to the observed February flow in the model plus additional LNG that can be taken from the tanks to be shared with week 2.
Week 2
Limited to the maximum 14 days rolling average of the last 5 winters plus additional LNG that can be taken from the tanks to be shared with week 1.</td><td>Limited to the maximum 14 days rolling average of the last 5 winters.</td></tr>
<tr><td>1-day Design Case</td><td>Limited to the maximum daily supply of the last five winters plus additional LNG that can be taken from the tanks.</td><td>Limited to the maximum daily supply of the last five winters.</td></tr>
</table>

**In the case of LNG, the historical maximum + 20% values have been considered for the LNG maximum supply in order to properly reflect the LNG increased.

[8] The methodology and an example of the supply assumptions calculations can be found in SoS simulations report, point 3.4. (page13).https://www.entsog.eu/public/uploads/files/publications/sos/ENTSOG%20Union%20wide%20SoS%20simulation%20report_INV0262-171121.pdf

[9] UGS inventory on withdrawal deliverability has been considered using deliverability curves provided by GSE (see Annex A).

Figure 4 shows historical seasonal supply for last eight winters for pipeline imports and LNG imports. In the graph, the maximum supply potential considered are indicated[10].

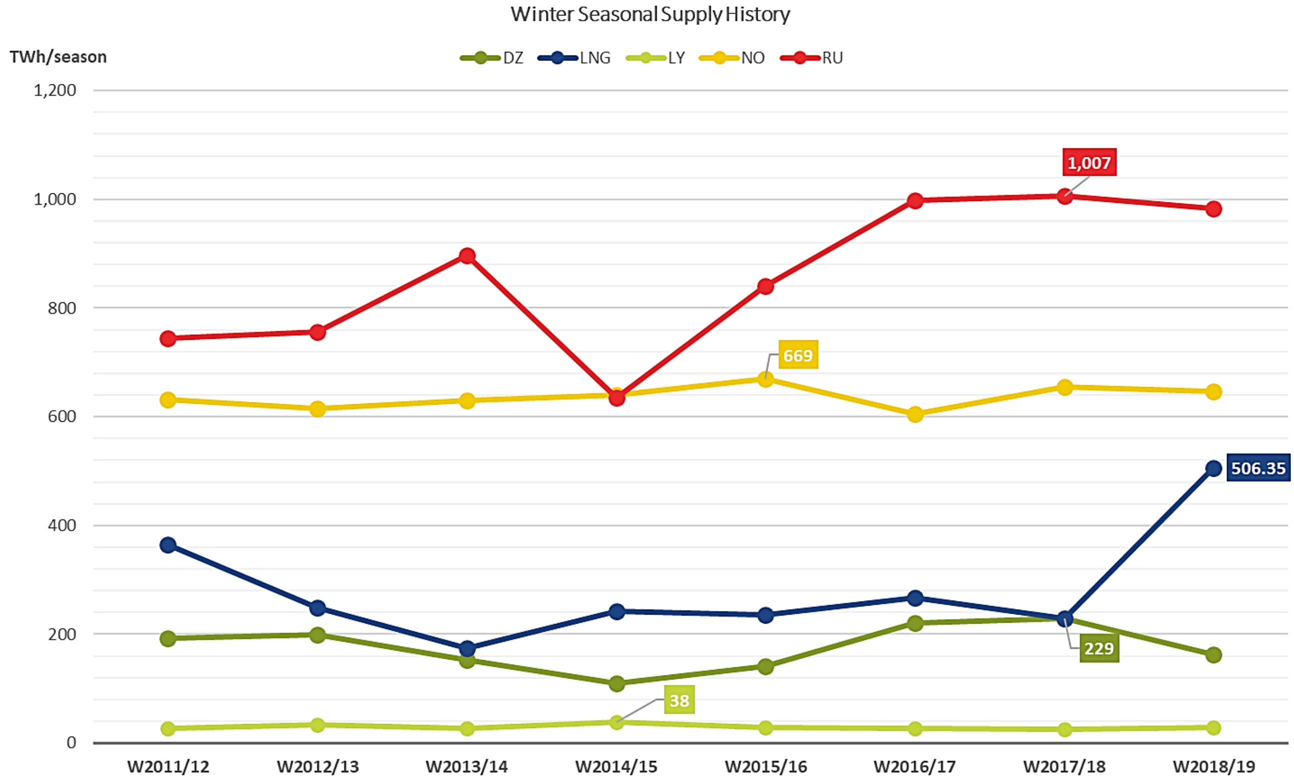


Figure 4.- Winter supply limitation.

Figure 5 shows historical 30-days rolling average supply for the last eight winters, in the graph, the maximum supply potential considered are indicated[11]. **Figure 6** shows historical 14-days rolling average supply for last five winters, the maximum supply potential considered are indicated.[12]

[10] After testing historical winter maximum value for LNG against TYNDP2020 value, the winter supply limitation for used for LNG is 611TWh/season.

[11] After testing historical monthly maximum value for LNG against TYNDP2020 value, the monthly supply limitation used for LNG is 4,196GWh/d.

[12] The Winter Maximum 14-d Supply History for LNG has been increased by 20%, the used value was 4,283GWh/d.

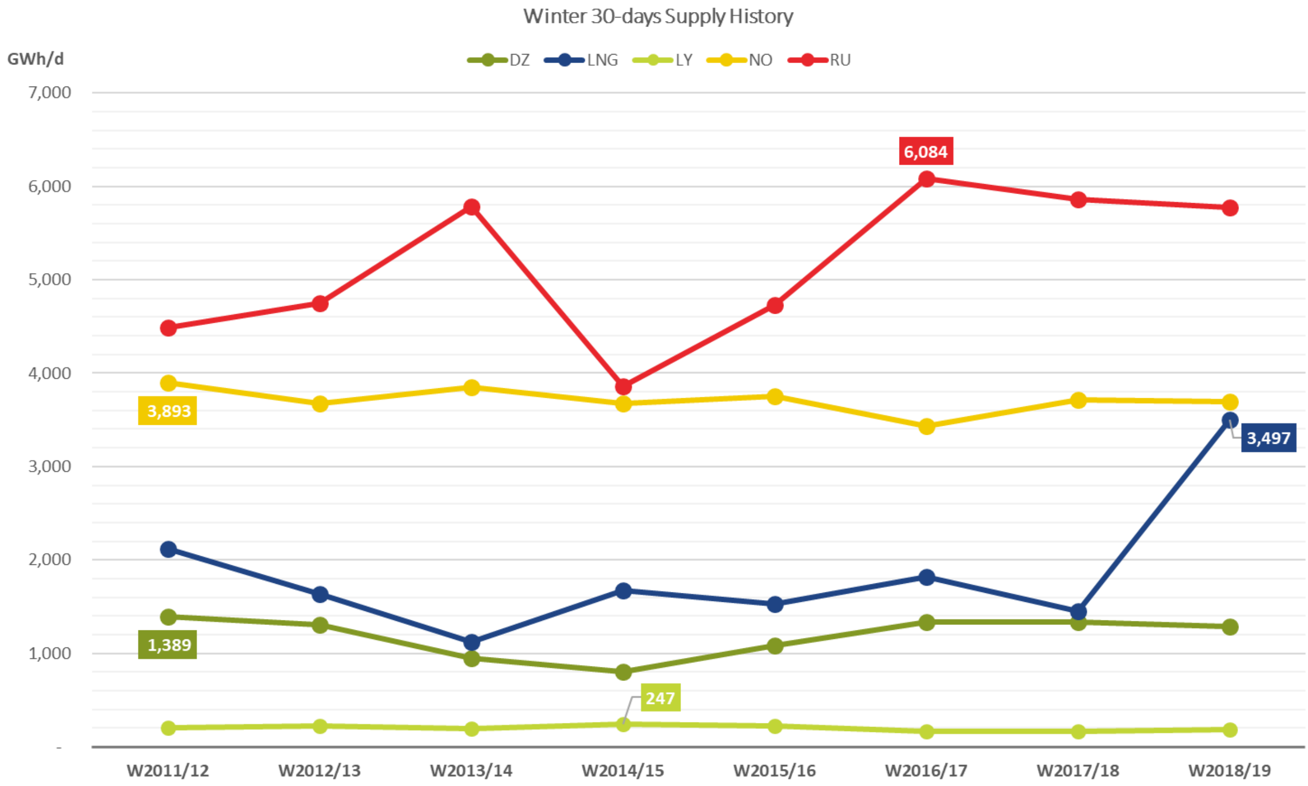


Figure 5.- 30-days supply limitation.

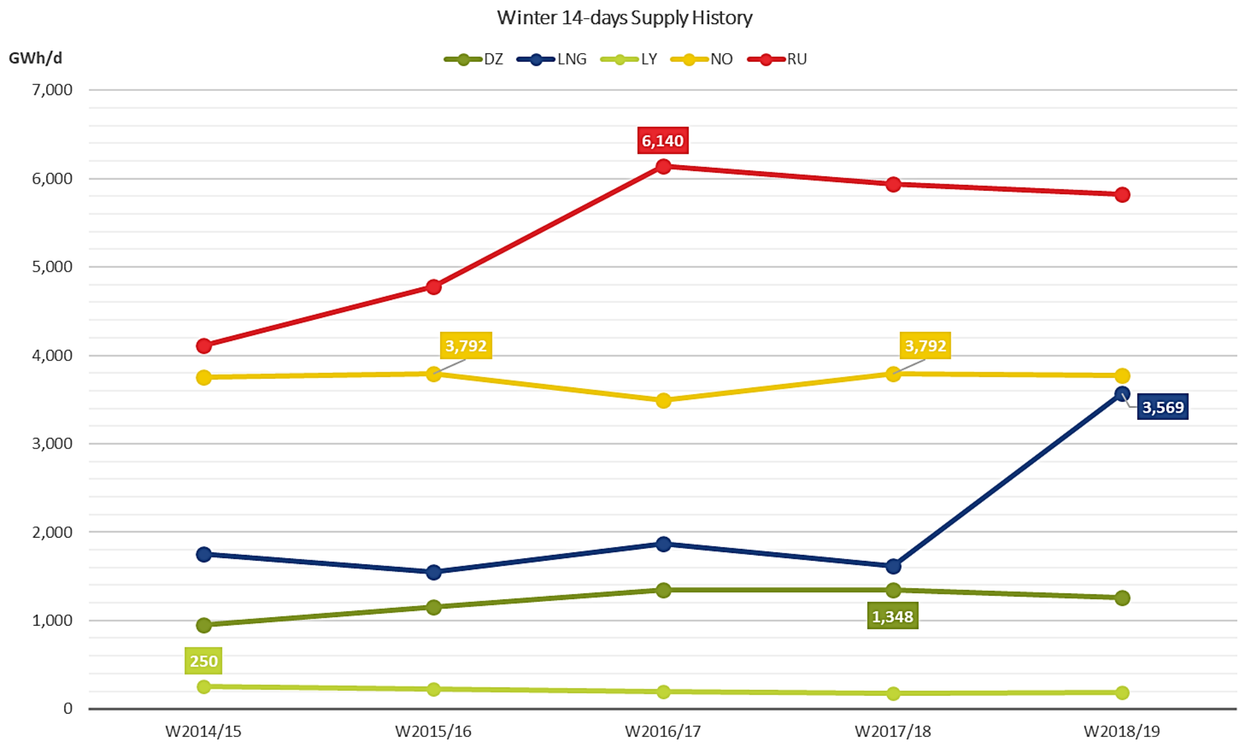


Figure 6.- 14 days supply limitation.

Figure 7 shows the historical daily maximum supplies during the last five winters. In the graph, the maximum supply potential considered are indicated[13].

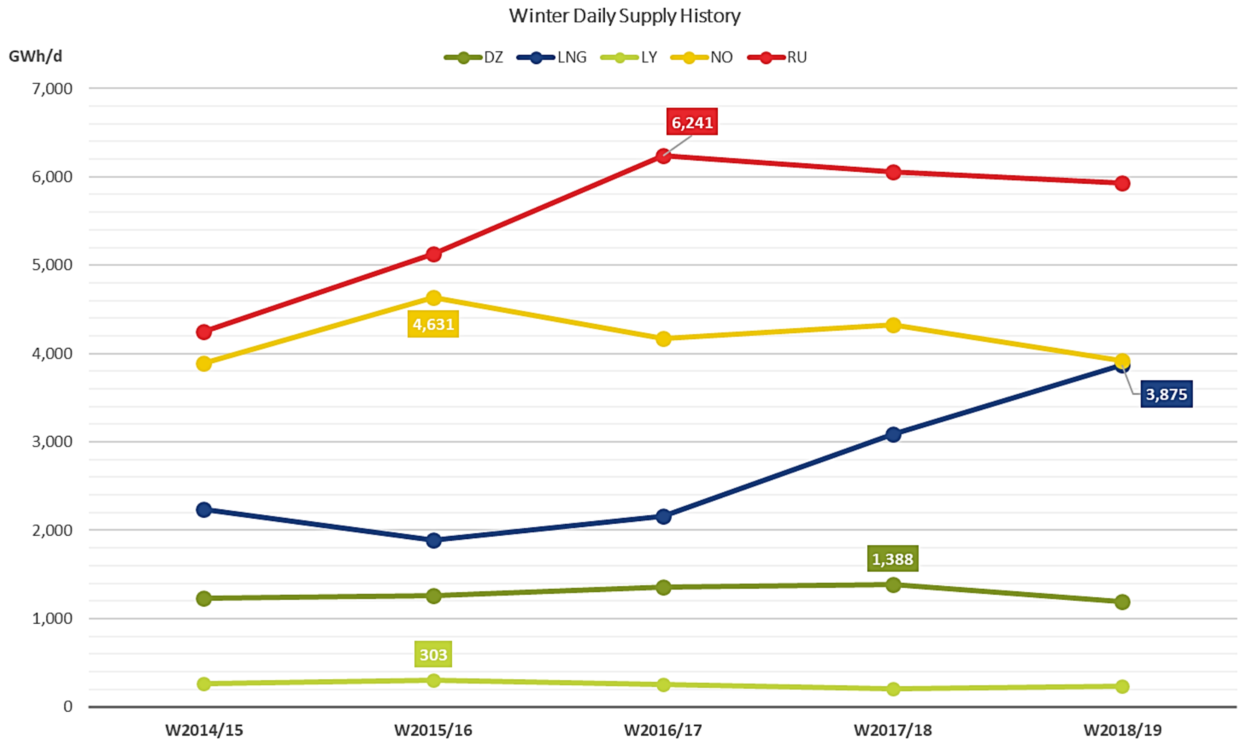


Figure 7.- Daily supply limitation.

In conclusion, we observe an increase in LNG with values close to those of Norway. The other supply values are stable.

2.4. Treatment of Non-EU countries

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

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

- Switzerland, Bosnia, North Macedonia, Serbia are included in the modelling perimeter.
- Ukraine is considered based on the observed exports during the last four years[14].

[13] The Winter Maximum Daily Supply History for LNG has been increased by 20%, the used value was 4,650GWh/d.

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

- Exports to Moldova have been set to zero following an investigation of the previous flows.
- The transits towards Turkey are included in the Russian supply while the Kaliningrad region in Russia are excluded from the Russian supply and the exports have been set to zero.
- Albania, Montenegro and Kosovo are not connected to the gas grid.

3. UGS inventory

3.1. Injection during summer

According to AGSI+, the gas storage data platform operated by GIE, the highest storage withdrawals of the whole winter (2018-2019) reached 9.2TWh on the 23rd January 2019.

On the 1st April, the gas in the storages was 447TWh, it is much higher compering with April 1st 2018 value 190TWh which was the lowest value from 2011 to start the injection period. **Figure 8** shows the total WGV, the initial gas in the storages on 1st April and the gas injected during the summer season from 2011.

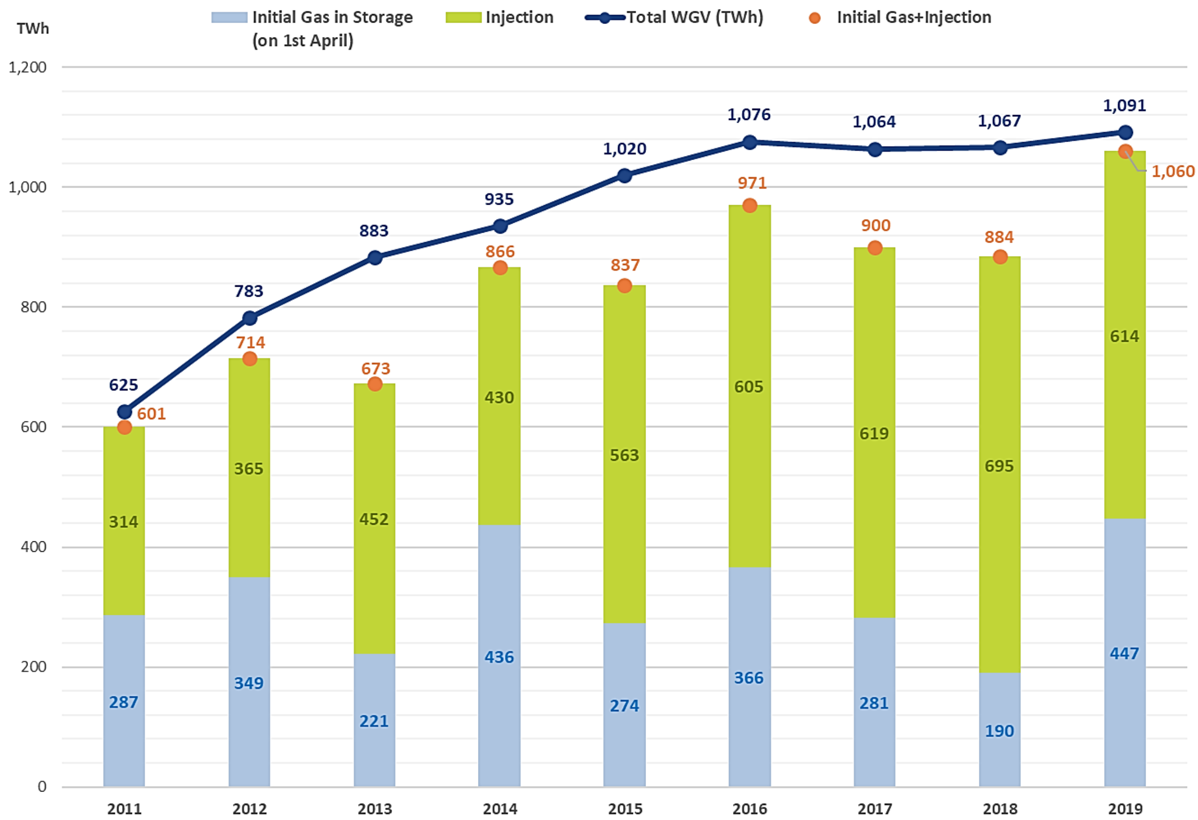
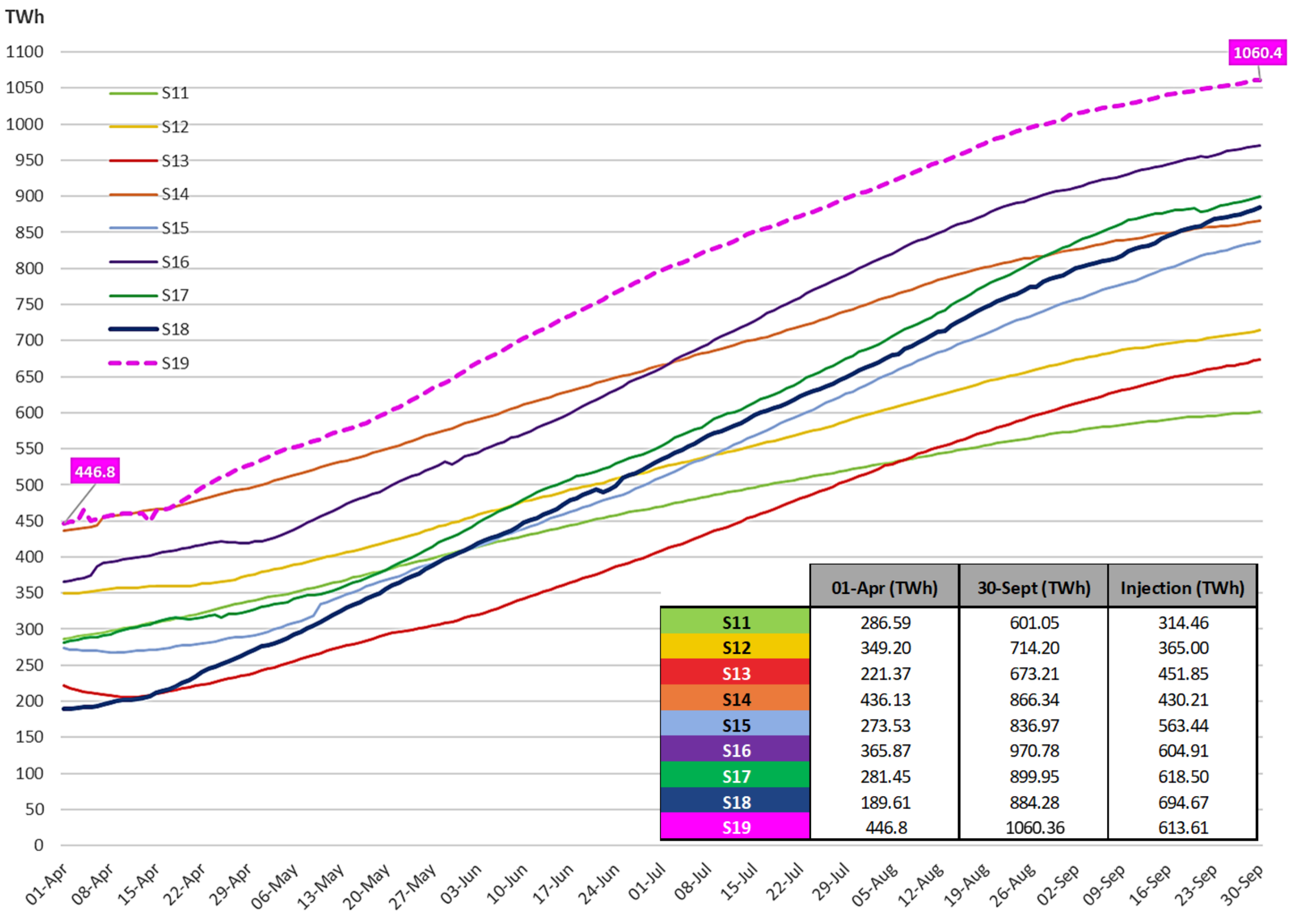


Figure 8.- Situation of the storages during summer season from 2011.

Summer 2019 has the historically highest gas level in storages on 1st April 2019 in last eight years. The volume of injected gas (614TWh) is less than last year, which was the highest in last eight years to compensate for the low gas in the storages in April 1st. Finally, the level of inventory is much higher than previous years due to the highest level at the beginning of the injection season and a low gas price on the different European gas hub Price (**Figure 10**).

Figures 9 compare the stock level evolution of the last eight summers highlighting the initial level on 1st April 2019.



	01-Apr (TWh)	30-Sept (TWh)	Injection (TWh)
S11	286.59	601.05	314.46
S12	349.20	714.20	365.00
S13	221.37	673.21	451.85
S14	436.13	866.34	430.21
S15	273.53	836.97	563.44
S16	365.87	970.78	604.91
S17	281.45	899.95	618.50
S18	189.61	884.28	694.67
S19	446.8	1060.36	613.61

Figure 9.- Evolutions of UGS stock level. Summers 2011-2019 (TWh) (Source: AGSI+).

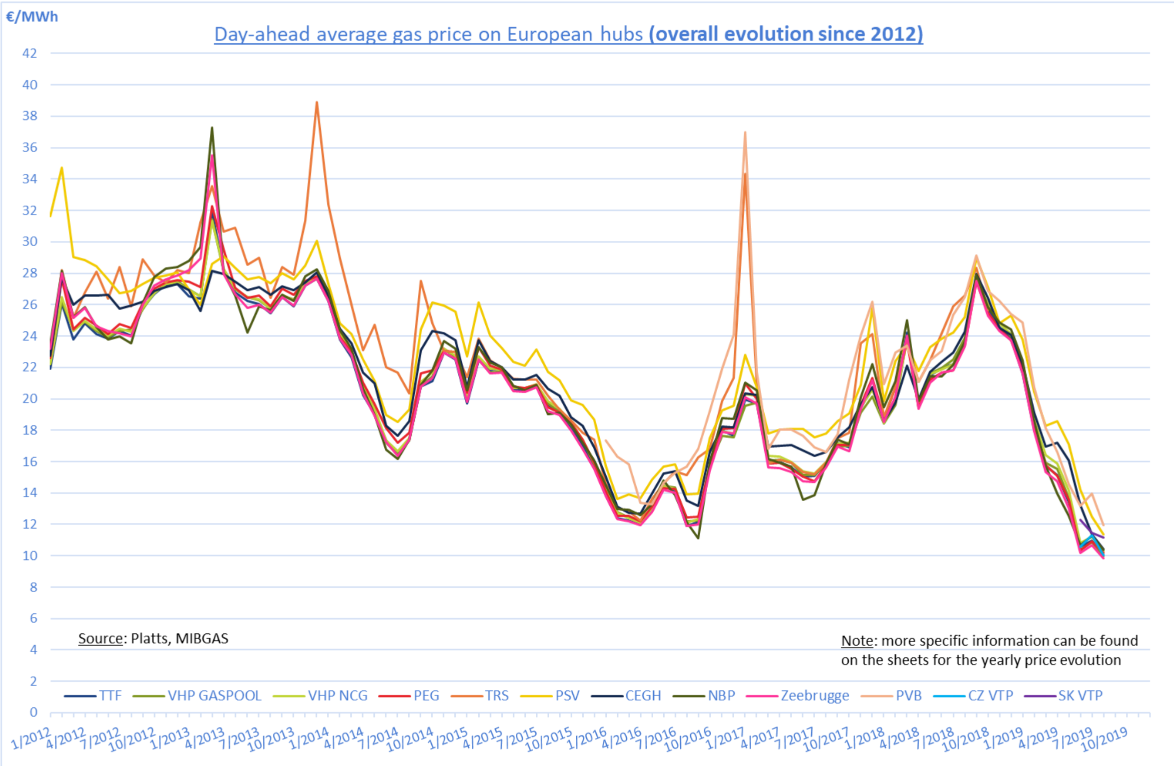
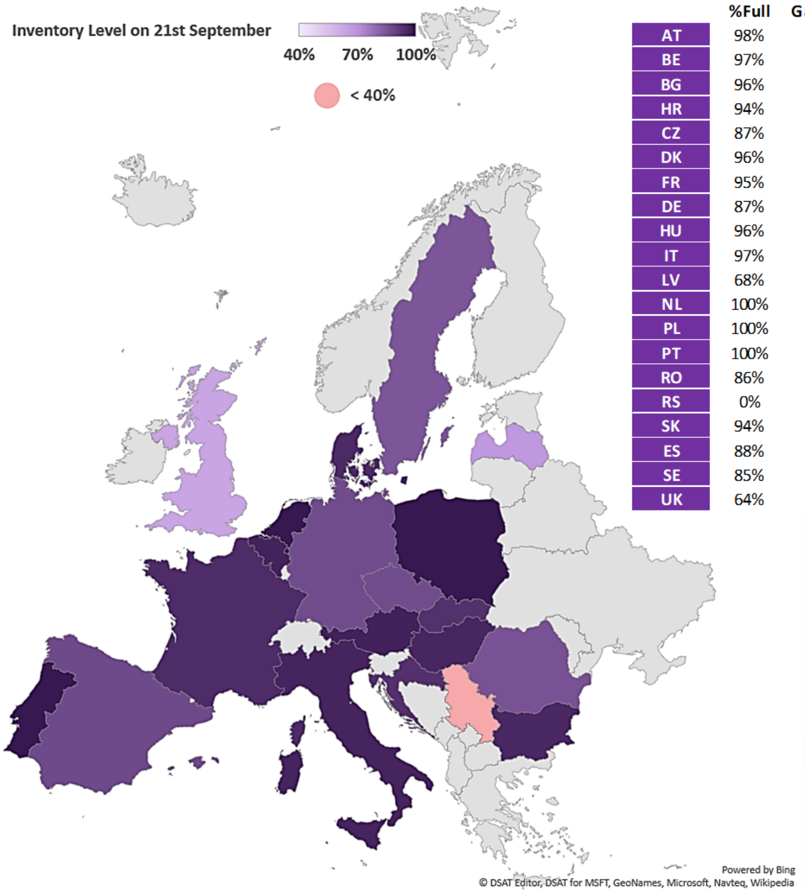


Figure 10. Day-ahead average gas price on European hubs (overall evolution since 2012).

3.2. Initial storage level on 1st October

The Winter Supply Outlook takes into account the actual storage inventory level per country as of 1st October 2019[15] as the initial situation exposed in **Figure 10.** As shown in the next map the storage inventory levels differ from country to country.

[15] The gas in storage on 1st October 2019 for each country is based on the AGSI platform captured on 1st October 2019 complemented by other information sources for storages not reported on AGSI. For Serbia, the initial storage is considered 0% due to no availability of data. The %Full has been calculated taking into account 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.



	%Full	Gas in the storages (TWh)
AT	98%	92.42
BE	97%	8.75
BG	96%	6.02
HR	94%	5.45
CZ	87%	35.33
DK	96%	10.34
FR	95%	128.53
DE	87%	232.23
HU	96%	67.09
IT	97%	190.34
LV	68%	17.38
NL	100%	129.81
PL	100%	34.17
PT	100%	3.57
RO	86%	29.07
RS	0%	0.00
SK	94%	39.93
ES	88%	29.08
SE	85%	0.09
UK	64%	9.04

Figure 11. - Actual storage inventory level on 1st October (for some countries, the initial level includes strategic stocks[16]).

In terms of absolute volumes in gas storages, the largest ones are located in Germany, Italy, France and the Netherlands. On October 1st 2019, the initial average UGS inventory is around 1060TWh while for the previous winter was 897TWh. It means 13 points lower (92% vs 79%) with a mixed picture across EU countries.

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 Winter Supply Outlook 2019/20.

These levels can change during the month October because the injection season continues in some countries until 1st November.

[16] Storages in Serbia are set as 0% due to no availability of the data.

4. Results for Reference Winter and Cold Winter

4.1. Supply and demand balance along the winter

The actual UGS inventory level at the beginning of the season, together with the supply availability and the demand levels considered, enable the supply and demand balance in all the countries along both a Reference Winter and a Cold Winter.

Figure 11 shows the supply and demand balance at European level for the Reference Winter and the Cold Winter demands.

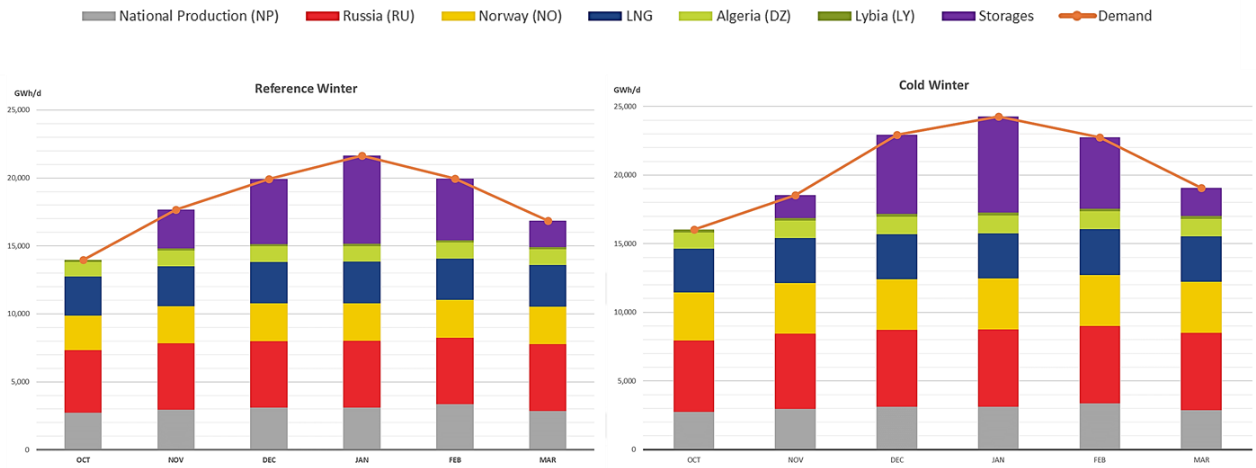


Figure 12. -Supply and demand adequacy - Reference Winter vs Cold Winter.

These graphs illustrate the changes in supply and demand[17] for the Cold Winter compared to the Reference Winter. The extra supply of LNG and storages allow for the flexibility in the cold winter demand.

As a result of this analysis there are no indications that supply flows will significantly differ from the ones noted in the last years, apart from LNG which has increased this year. The supply assumptions are based on the supply observed in the last eight winters and should not be considered as a forecast, the actual supply mix will depend on market behaviour and other external factors.

4.2. Evolution of UGS inventory level

Figure 12 shows the evolution of the European aggregated UGS inventory level resulting from the assumptions defined in the previous chapters for the Reference Winter and the Cold Winter:

[17] Demand data also considers exports and injection during October and November.

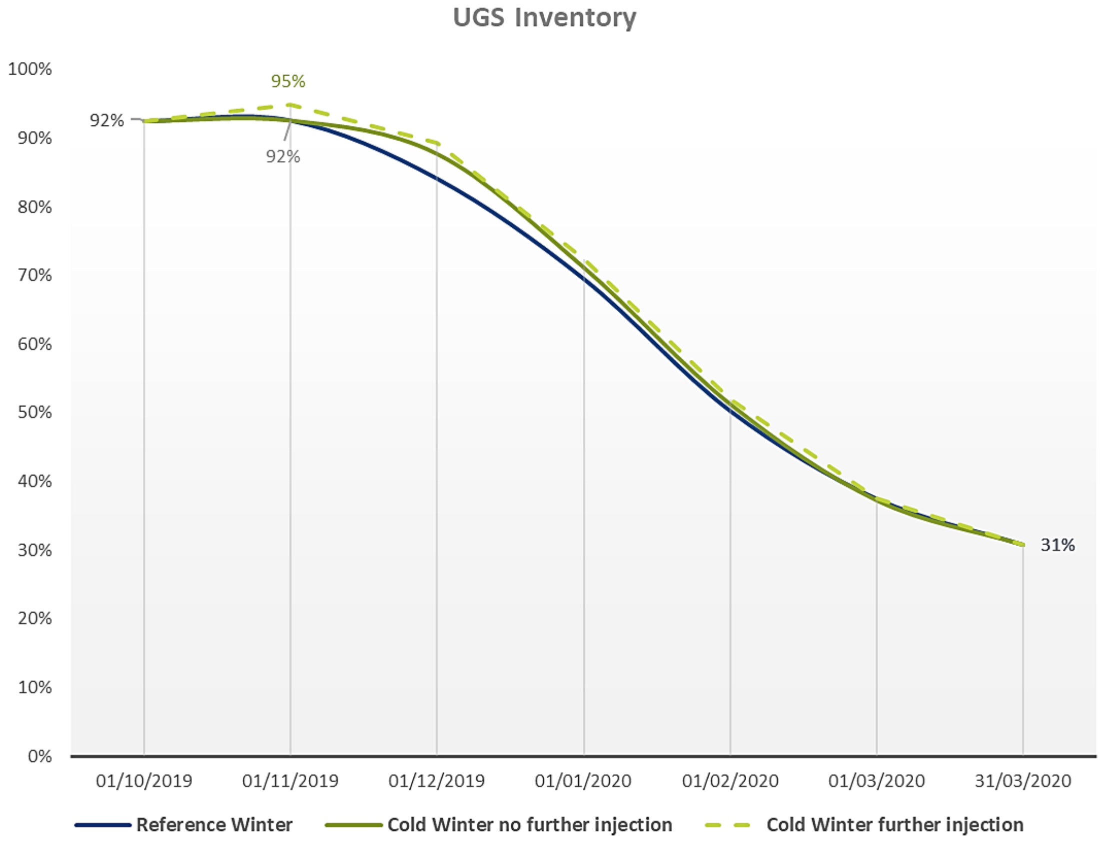


Figure 13. - Winter evolution of the aggregated UGS stock level.

The inventory levels targets (30% and 55%[18] in the case of Spain) can be reached at the end of the winter in all the EU countries for Reference Winter. The associated withdrawal of gas from storages combined with the supply flexibility is sufficient to cover the demand. There is also some injection in some countries until 1st November.

However, in order for shippers to get prepared for a cold winter, based on the assumed supply flexibility, further injection in October would be necessary and November only for Serbia. Under these assumptions, EU aggregated inventory level at the end of the Cold Winter would be 31%. It differs from previous winter seasons, since is not going below the 30% target, due to a slightly increase of the supply source and the high level of the storages at the beginning of the winter season.

Moreover, storage levels would be even lower if the LNG flexibility would not materialize at the significant levels that have been assumed for the Cold Winter. Such flexibility was last observed more than five years ago during the period of years 2009 to 2011, prior to the Fukushima nuclear disaster.

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

Table 2 provides the results of the UGS inventory level evolution:

Table 2. - Monthly EU inventory level evolution for Reference Winter and Cold Winter.

% WGV	01/10/2019	01/11/2019	01/12/2019	01/01/2020	01/02/2020	01/03/2020	31/03/2020
Reference Winter	92%	92%	84%	69%	50%	37%	31%
Cold Winter no further injection	92%	92%	88%	71%	51%	37%	31%
Cold Winter further injection	92%	95%	89%	72%	52%	38%	31%

4.3. Results for Reference Winter and Cold Winter

No demand curtailment has been spotted during regular demand situations for Reference and Cold Winter. Moreover, it is important to mention that due to the recent EU imposed of some restriction on Gazprom use of OPAL, it has been done some extra simulations applying a 50% reduction in OPAL capacity in order to reflect this restriction and analyse if there is any risk. This reduction was not applied for the maximum technical capacity for 2week period and DC. The results showed no risk of demand curtailment, they are aligned with the full OPAL capacity simulations, it has been spotted only some changes regarding the flows.

5. Results for high demand situations

5.1. Demand balance

The high demand situations are considered to happen in a Refence Winter situation or in the Cold Winter situation, taking place in February. The initial storages levels are based on the whole winter simulations for 14th February (end of day), for both Peak Day and 2-Week cold spell as shown as example in **Figure 13** for Cold Winter situation. The corresponding storage withdrawal deliverability curve is considered (Annex A).

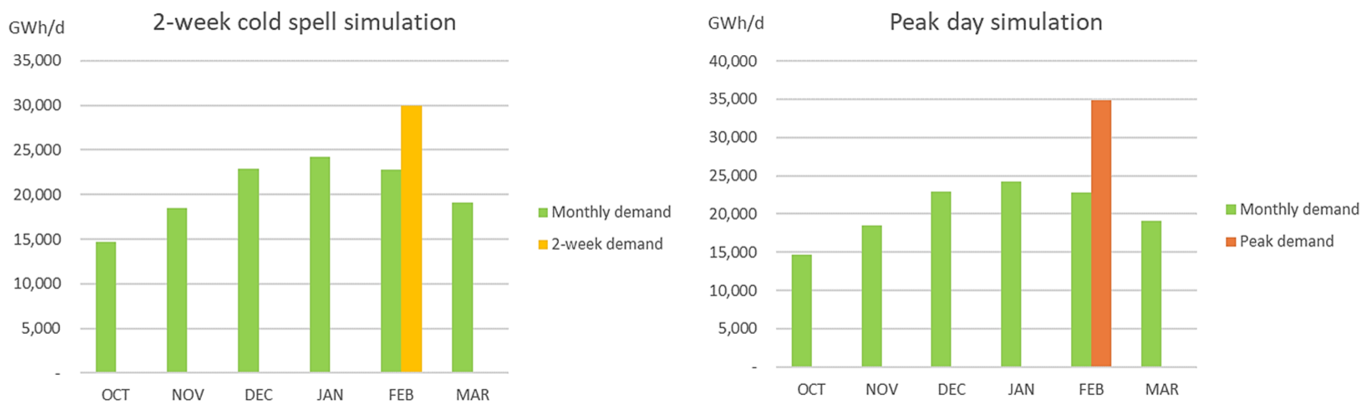


Figure 14.- 2-Week and Peak Day simulations.

Figure 14 compares the supply mix for the winter in February and the two high demand situations:

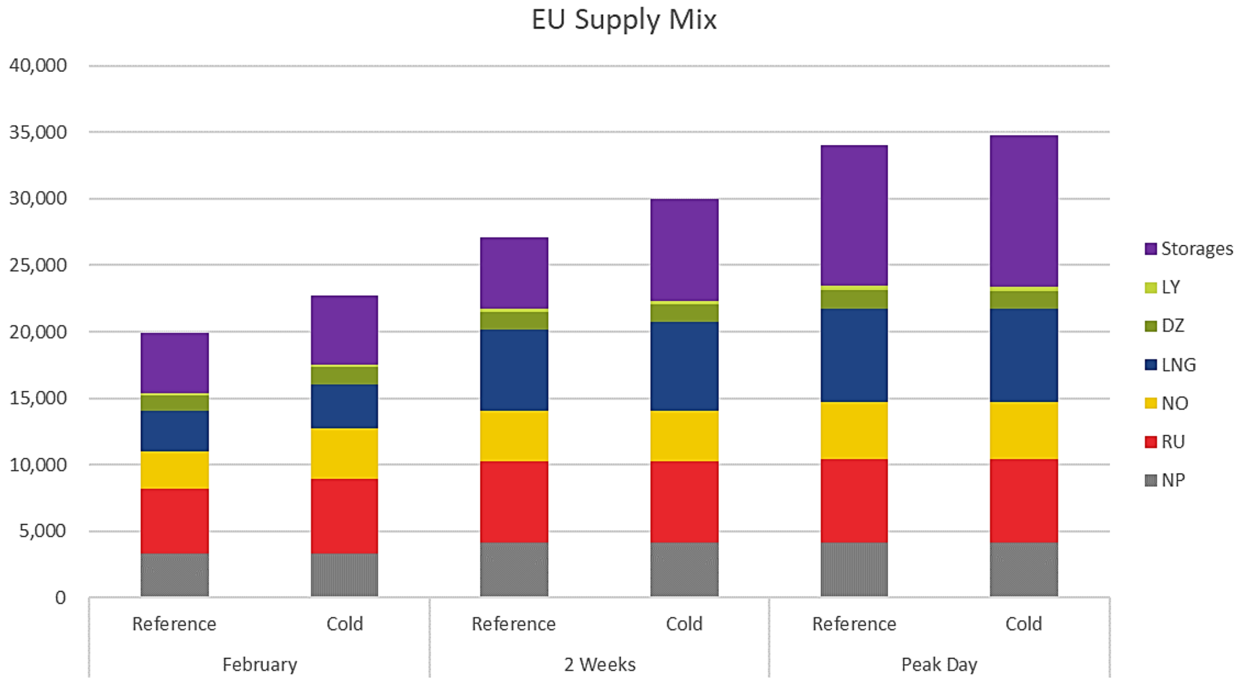


Figure 15. - Comparison of supply mixes in February vs high demand situations (LNG includes tanks withdrawal).

In high demand situations, there is an increment in all supplies sources compared with February flows. This increment is observed in LNG and storages.

In the 2-Week cold spell, there is a change between week1 and week2 due to the additional LNG flexibility from the tanks. In case of Peak Day demand, the LNG and storages flexibility are necessary to cover the demand.

5.2. Indicators

For each high demand situation and each zone, modelling results consist in the calculation of:

> The potential level of demand curtailment (curtailment rate). The curtailment rate represents the share of the gas demand that cannot be satisfied (calculated as a daily volume). The level of curtailment is assessed considering a cooperative behavior between European countries in order to mitigate its relative impact. This means that countries try to reduce the disrupted rate of other countries by sharing it.

> The Remaining Flexibility indicator measures resilience at balancing zone level to cope with climatic stress (see Annex C for detailed calculation process).

Table 3 represents the summary of all the results obtained:

Table 3. - Indicators results for high demand situations in Reference and Cold Winter.

		Reference Winter	Cold Winter
Peak Day	Curtailment	NONE	BA:13%
	Rem. Flexibility below 20%	BA: 8% DK: 15% MK: 5%	DK: 4% FI:7% SE:11% MK:7%
2Week	Curtailment	NONE	NONE
	Rem. Flexibility below 20%	MK:14 %	BA:17% MK:7%

The results for the **Reference Winter** indicate:

> **Peak day**: There is no demand curtailment, however some countries show a very low Remaining Flexibility (Bosnia and Herzegovina, Denmark and North Macedonia) below 20%.

> During the **2-week Cold Spell**: No demand curtailment has been spotted but North Macedonia still shows low Remaining Flexibility below 20%.

The main results for **Cold Winter** show:

> **Peak day**: Bosnia and Herzegovina faces demand curtailment of around 13% of its demand. Denmark, Finland, Sweden and North Macedonia show low Remaining Flexibility below 20%.

> During the **2-week Cold Spell:** No demand curtailment has been spotted. However, North Macedonia still shows low Remaining Flexibility below 20% and Bosnia and Herzegovina

shows low Remaining flexibility as well.

Moreover, there is no risk of demand curtailment for L-gas in Belgium, France and Germany. However, it has been spotted low Remaining Flexibility below 20% for L-gas in Germany for Peak Day, Reference Winter and Cold Winter.

Regarding domestic production in the Netherlands, in May 2019 a gas production induced earthquake occurred at Westerwijtwerd in the province of Groningen. Following the advice of the State Supervision of the Mines, the Dutch Minister of Economic Affairs and Climate Policy asked the Dutch TSO GTS to investigate the possibility to decrease the national production to the safe level of 12 bcm in an average gas year, while maintaining security of supply. To reach this goal, GTS advised the Minister to take several measures. The Minister has decided to implement these measures and in addition decided that the production from the Groningen field should be reduced to a maximum 12 bcm in an average gas year. To maintain security of supply he also decided an allowed additional production volume from the Groningen field in case of a colder than average winter. With these measures the gas production of Groningen reaches a safe level and GTS is still able to deliver enough L-gas to customers in Netherlands, Germany, Belgium and France.

Comparing with the indicators results of the previous WSO 18-19, same risk of Demand Curtailment has been spotted in Bosnia during Cold Winter simulation for Peak day. However, Remaining Flexibility shows some differences:

> **In Peak day, Reference Winter**: There is no risk of demand curtailment, same situation as in WSO2018/19. North Macedonia shows very low Remaining Flexibility, due to a small increase in the forecast demand. Bosnia and Herzegovina shows similar Remaining Flexibility (bellow 20%) compared with last year. On the other hand, Denmark shows low Remaining Flexibility (15%) due to a reduction of the Danish national production comparing with previous winter.

> **In Peak day, Cold Winter:** Bosnia faces demand curtailment of around 13% of its demand, in line with previous winter. North Makedonia show low Remaining Flexibility due to a capacity reduction. Denmark and Sweden show low Remaining Flexibility due to a reduction of the Danish national production as explained before. There is also low Remining Flexibility below 20% for Finland.

> **2-week Cold Spell, Reference Winter**: no risk of demand curtailment but North Macedonia shows a lower Remaining Flexibility due to a capacity reduction.

> **2-week Cold Spell, Cold Winter**: No risk of demand curtailment. Two countries show a low Remaining Flexibility (North Macedonia and Bosnia and Herzegovina).

5.3. Results for 1-day Design Case during Reference Winter vs. Cold Winter

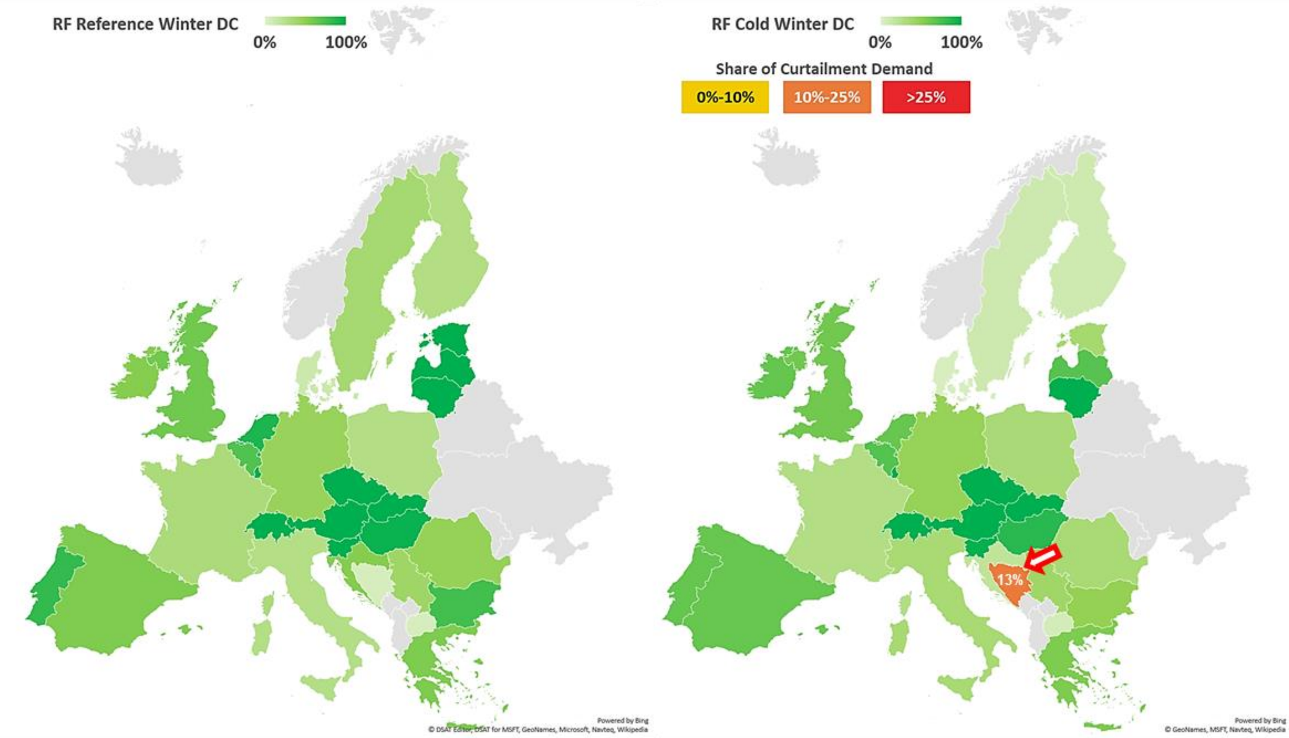


Figure 16.- Peak Day results (Remaining Flexibility and Curtailment Rate) in Reference and Cold Winters[19].

The results show that Bosnia and Herzegovina face risk of Demand Curtailment in case of peak day for Cold winter due to infrastructures limitations.

These indicator results are in line with the results obtained in Security of Supply Simulations Report (2017). The main difference is the curtailment in Denmark and Sweden. Denmark and Sweden are facing a period where the supply might be tight in the event of exceptional high demand or in case of a serious technical incident due to the upcoming reconstruction of the Tyra complex in the Danish North Sea. Denmark and Sweden will from November 2019 to July 2022 be almost fully dependent on gas supplies from Germany via the interconnection point Ellund. For this WSO has been considered this reduction of the Danish national production, however, it has been also taken into account the increase of the capacity at the interconnection point Ellund therefore there is not demand curtailment.

[19] In all maps, the value of RF for Germany is the weighted average by demand among the different balancing zones of H-gas. Also, the values for France of Belgium are for H-gas. The values for each balancing zone (including L-gas) are included in the Annex D.

5.4. Results for 2-Week Cold spell during a Reference Winter vs. Cold Winter

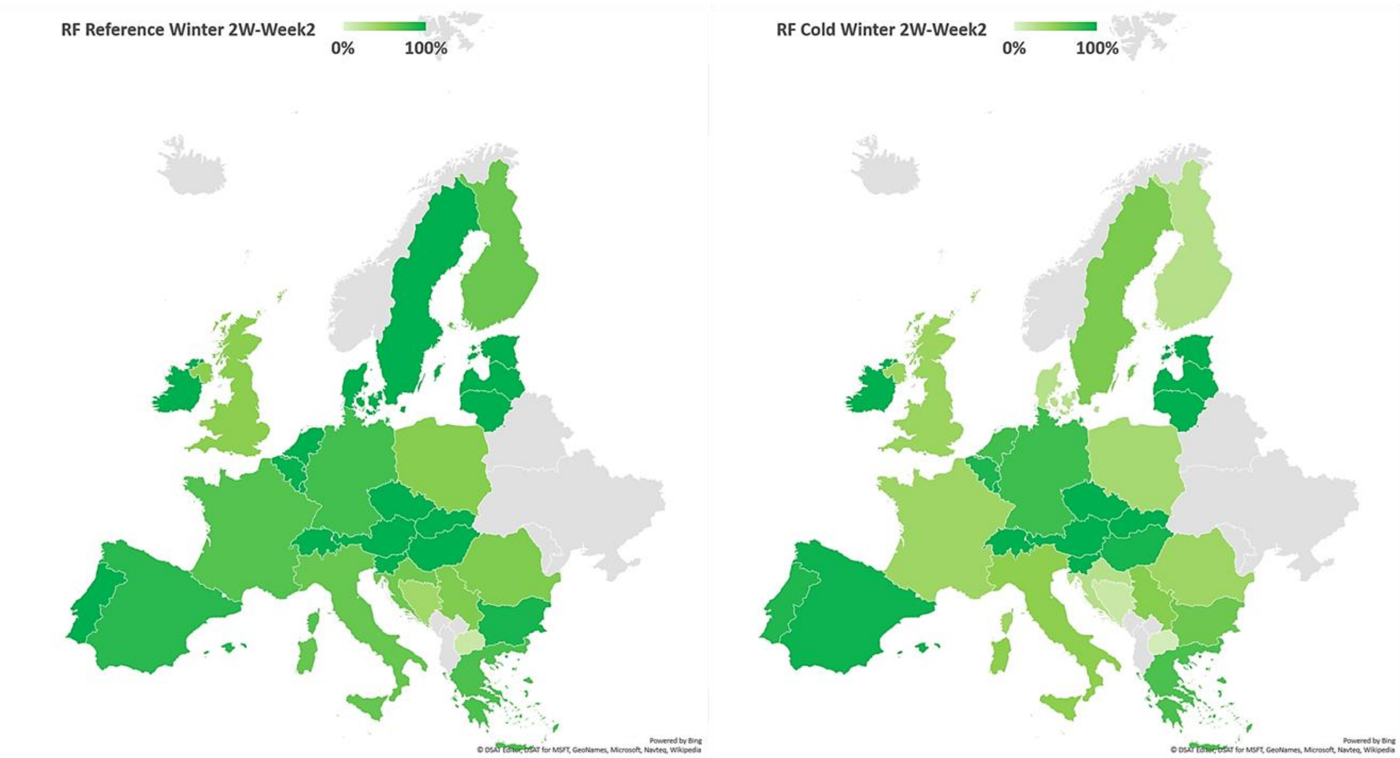


Figure 17.- 2-Weeks Cold Spell results (Remaining Flexibility and Curtailment rate) in Reference and Cold Winters [20].

No country faces demand curtailment in the 2-Weeks Cold spell in Reference Winter or Cold Winter.

North Macedonia shows low Remaining flexibility below 20% in all high demand situation cases, in both Reference and Cold Winter, due to a slightly increase in their peak demand and infrastructure limitations. Bosnia and Herzegovina low Remaining flexibility below 20%, especially during cold winter, is due the infrastructure limitations. Denmark and Sweden also show low Remaining flexibility below 20% reduction of the Danish national production. Finland shows low Remaining flexibility below 20% during Cold Winter for Peak Day due to their dependency of a single flow coming from Russia and no flow coming from Estonia.

As mentioned before, together with the storages, the LNG supply assumptions allow enough flexibility during the 2-week Cold Spell thanks to the LNG tanks.

[20] The results shown are for second week of the 2-week Cold Spell.

6. Results of disruption case event

This section investigates the impact of a supply route disruption during a high demand situation in the Remaining Flexibility and Curtailment Rate. Only the additional effect compared to the result from the situation without the route disruptions are analysed and highlighted in the maps.

This vision is included in ENTSOG's Winter Supply Outlooks since Winter Supply Outlook 2013/14. However, in 2017 the disruptions effects were developed in the Security of Supply Simulations Report. ENTSOG simulated 17 supply and infrastructure disruption scenarios. For this WSO, as well as the WSO18/19 the purpose is to verify consistency is ensured between the next Cold Winter and the SoS.

Consequently, in this point, the disruption scenarios in Peak Day and 2-Weeks Cold Spell are tested to confirm that the results are in line with the conclusion of SoS report, keeping in mind that the two months disruptions are not considered and the assumptions in SoS[21] were defined for the next four years.

The criteria to choose these disruptions is based on the effects that these disruptions show in SoS report and the risk groups considered are defined according with the Annex I of the 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.

6.1. Indicators

As in the case of high demand situations and no route disruption, modelling indicators results consist in the calculation of:

- The Remaining Flexibility indicator measures resilience at balancing zone level to cope with climatic stress and route disruption (see Annex C for detailed calculation process).
- The potential level of demand curtailment (curtailment rate). The level of curtailment is assessed considering a cooperative behaviour between European countries in order to mitigate its relative impact. This means that countries try to reduce the disrupted rate of other countries by sharing it. The route disruption considered are:
    - Ukraine
    - Belarus.
    - Baltics states and Finland supply.
    - Algerian pipes and LNG.

[21] The cold demand for Germany and Greece (2week Cold Spell and Peak Day) and the LNG supply have been updated, as explained in the introduction of the current report.

The approach for demand curtailment allocation is applied according with Security of Supply report:

> **Unified allocation:** All member States within the risk group defined in Annex I of Regulation 2017/1938 cooperate by avoiding a demand curtailment to the extent possible by transporting other supply and furthermore by sharing the curtailment equally in such a way that they try to reach the same curtailment rate.

6.2. Ukraine transit disruption

This case considers the disruption of the transit through Ukraine and the risk group is formed by Austria, Bulgaria, Croatia, Czech Republic, Germany, Greece, Hungary, Italy, Luxembourg, Poland, Romania, Slovenia and Slovakia.

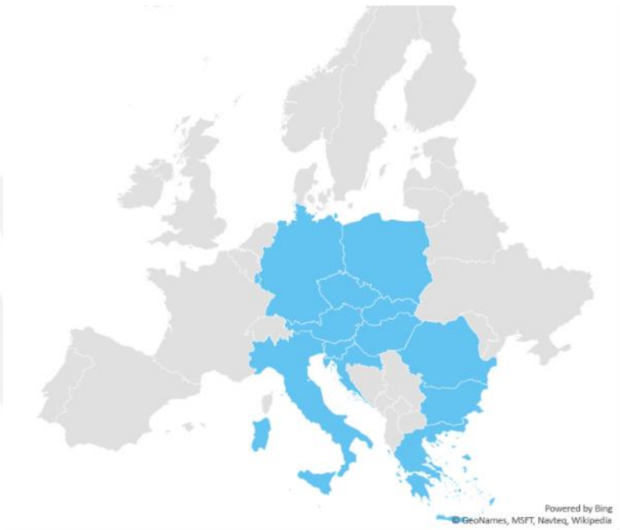


Figure 18.- Risk group for Ukraine transit disruption

<u>Results for a Ukraine transit disruption during a 1-in-20 years Peak day:</u>

The results show that in the case of a Peak Day combined with a disruption of Ukrainian transit, in addition to the countries affected in no route disruption case, some countries in the South-East Europe are facing demand curtailment. At the same time, in Cold Winter Hungary, Finland, Denmark and Sweden reduce their Remaining Flexibility.

It is important to highlight that all exports to Ukraine are maintained. Curtailment in the demand of South-East Europe is due to infrastructure limitations. The cease in the exports cannot help to avoid these curtailments.

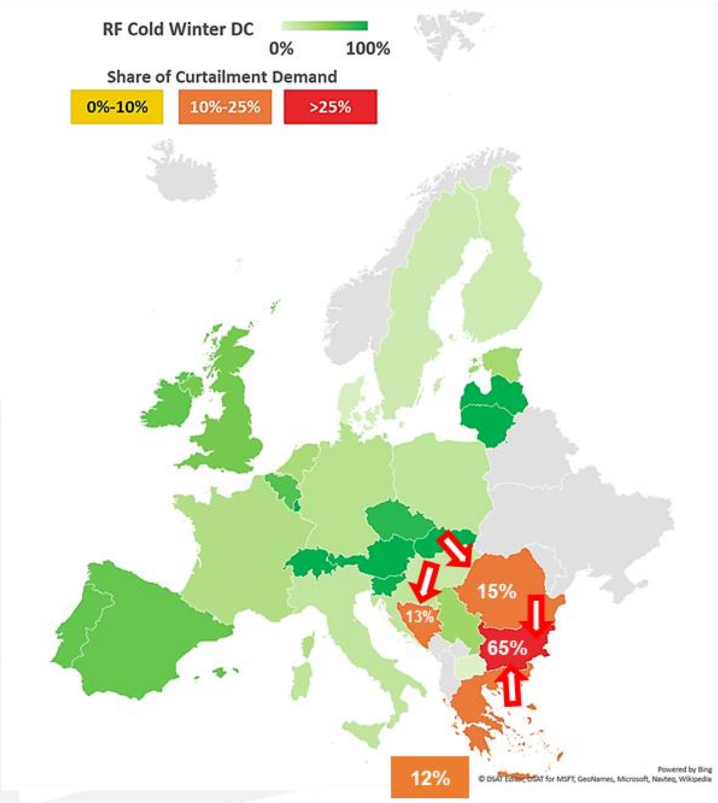


Figure 19.- Peak Day results (Remaining Flexibility and Curtailment Rate) for Ukraine transit disruption.

<u>Results for a Ukraine transit disruption during a 1-in-20 years 2-Week Cold Spell:</u>

As in the case of Peak Day, the results show that in case of 2-Week cold spell combined with a disruption of Ukrainian transit, in addition to the countries affected in no route disruption case, some countries in the South-East Europe could face demand curtailment. Differing from WSO2018/19 there is a small risk of Demand Curtailment in Greece (3%), due to an increase of capacity from Greece to Bulgaria due to the entry into the system of the 2nd upgrade of Revithoussa. At the same time, in Cold Winter Bosnia and Herzegovina and Hungary show low Remaining Flexibility. Also, all exports to Ukraine are maintained.

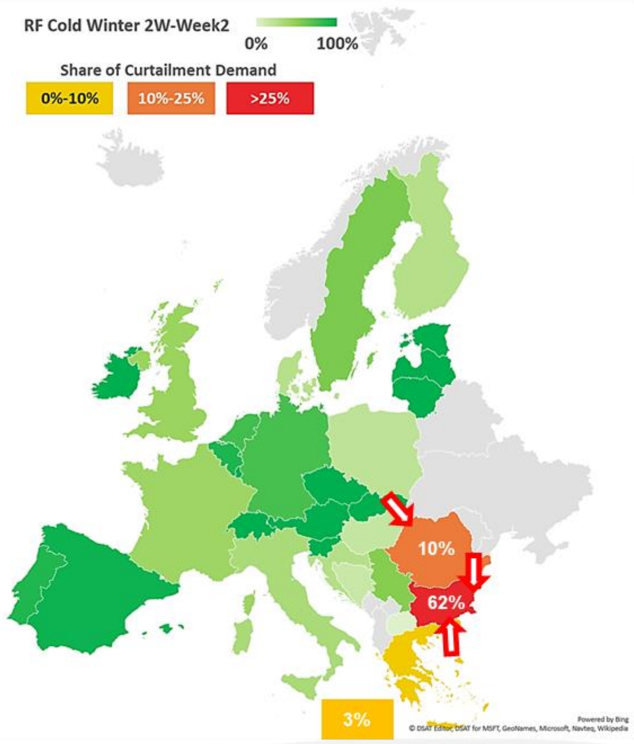


Figure 20.- 2-Weeks cold spell results (Remaining Flexibility and Curtailment Rate) for Ukraine transit disruption

6.3. Belarus transit disruption

This case considers the disruption of the transit through Belarus and the risk group is formed by Czech Republic, Belgium, Estonia, Germany, Latvia, Lithuania, Luxembourg, Netherlands, Poland, Slovakia

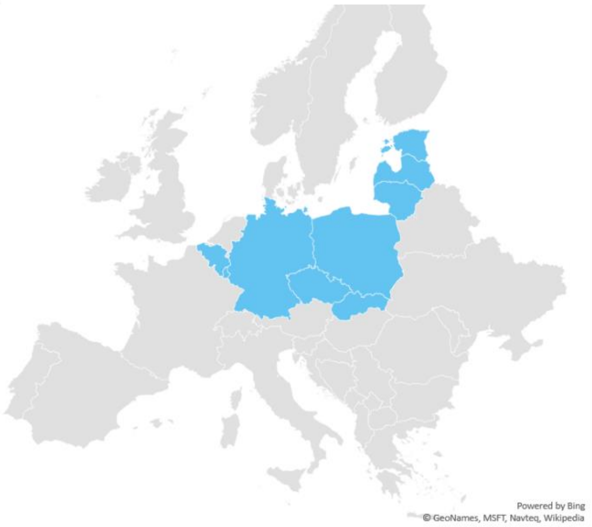


Figure 21.- Risk group for Belarus disruption.

Results for the disruption of Belarus transit during a 1-in-20 years Peak day:

The results show that in the case of a Peak Day combined with Belarus disruption, in addition to the countries affected in no route disruption case, there is no Demand Curtailment. Also, Bosnia faces demand curtailment. Poland, North Macedonia, Denmark, Finland and Sweden show a low level of Remaining flexibility.

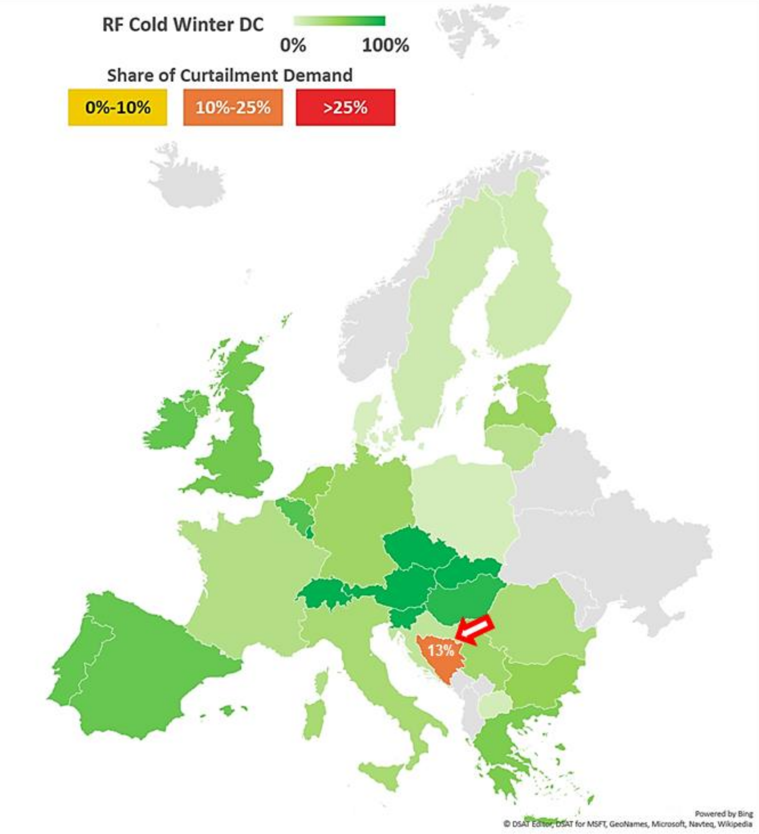


Figure 22.- Peak Day results (Remaining Flexibility and Curtailment Rate) for Belarus disruption.

<u>Results for the disruption of Belarus transit during a 1-in-20 years 2-Week Cold Spell:</u>
The results show that in the case of a 2-Week Cold Spell combined with Belarus disruption, no country faces demand curtailment. Poland, Bosnia and Herzegovina and North Macedonia show lower level of Remaining flexibility.

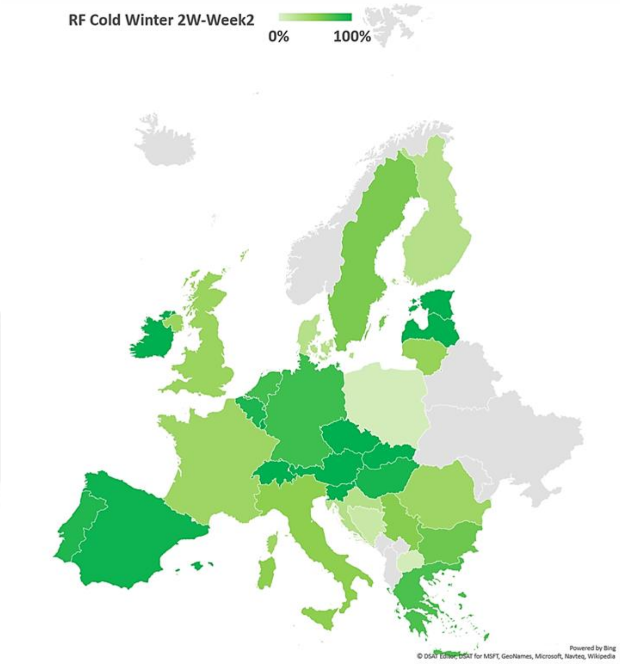


Figure 23.- 2-Weeks Cold Spell results (Remaining Flexibility and curtailment rate) for Belarus disruption.

6.4. Baltics Finland Disruption

This case considers the disruption of the imports to the Baltic states and Finland and the risk group is formed by Estonia, Finland, Latvia, Lithuania.

Figure 24.- Risk group for Baltic states and Finland disruption.

<u>Results for a disruption of all pipeline imports to the Baltic states and Finland during a 1-in-20 years Peak day:</u>

The results show that in the case of a Peak Day combined with a disruption of the imports to Baltic states and Finland, in addition to the countries affected in no route disruption case, Estonia and Finland are facing demand curtailment (85% and 86%) due to infrastructure limitations in the connection with other countries. Demand curtailment in Finland is presented excluding the country-specific possibility in terms of use of back-up fuels for gas. Actual level of exposure to demand curtailment could be close to zero for Estonia since little cooperation would be needed.

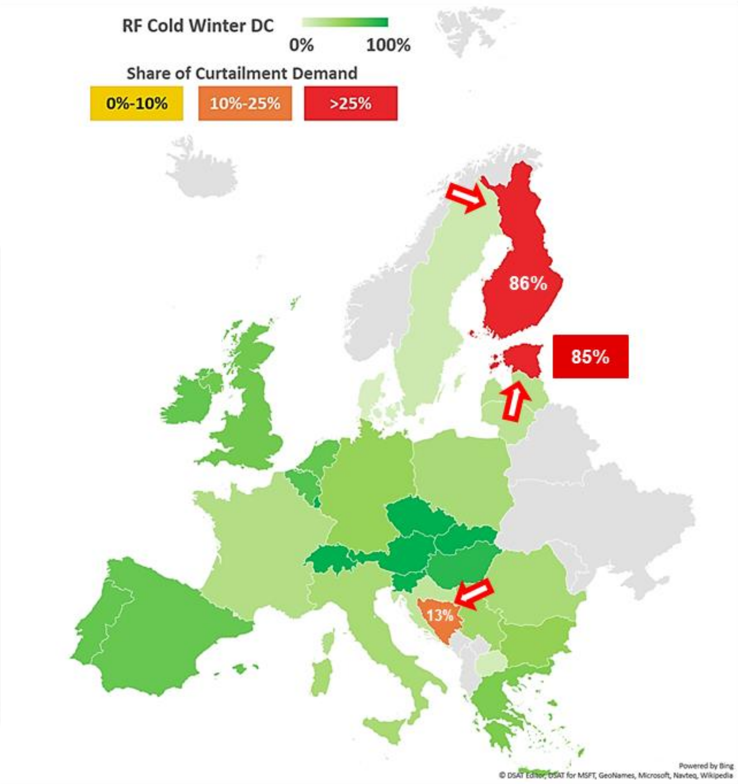


Figure 25.- Peak Day results (Remaining Flexibility and Curtailment Rate) for Baltic states and Finland disruption.

<u>Results for a disruption of all pipeline imports to the Baltic states and Finland during a 1-in-20 2-Week Cold Spell:</u>

The results show that in the case of a 2-Weeks Cold Spell combined with a disruption of the imports to Baltic states and Finland, in addition to the countries affected in no route disruption case, Finland is facing demand curtailment (85%) due to infrastructure limitation. By comparison with last year results, Estonia is now facing demand curtailment (83%) due to the cooperation mode between Estonia and Finland using Baltic Connector.

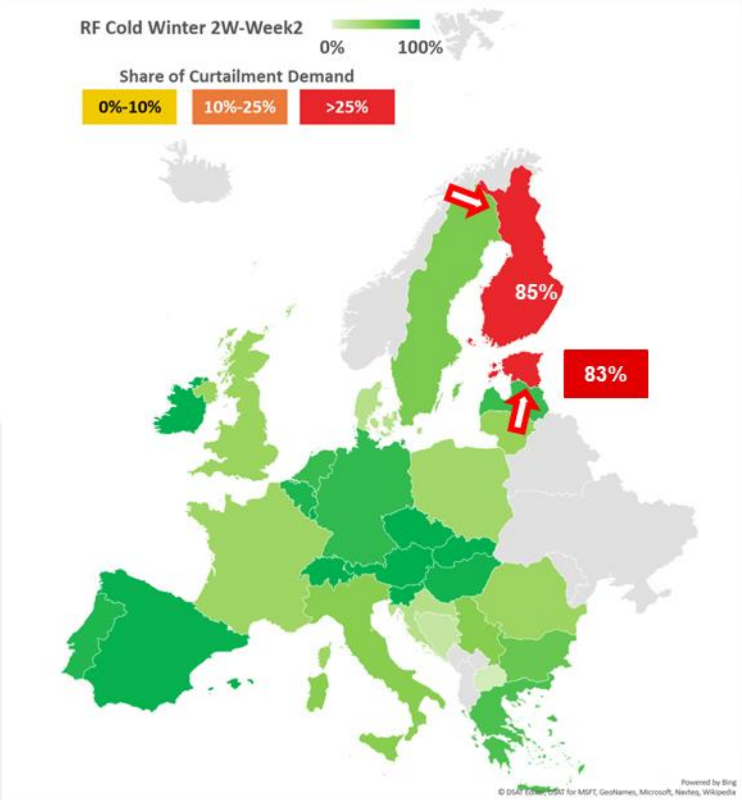


Figure 26.- 2-Weeks Cold Spell results (Remaining Flexibility and Curtailment Rate) for Baltic states and Finland disruption.

6.5. Algerian Pipes and LNG Disruption

This case considers the disruptions of the imports from Algeria via both pipelines and LNG cargos and the risk group is formed by Austria, Croatia, France, Greece, Italy, Malta, Portugal, Slovenia and Spain.

Figure 27.- Risk group for Algerian pipes and LNG disruption.

Results for a disruption of all pipeline imports and LNG from Algeria during a 1-in-20 years Peak day:

The results show that in the case of a Peak Day combined with Algerian disruption, no country faces demand curtailment apart from the countries affected in no route disruption case.

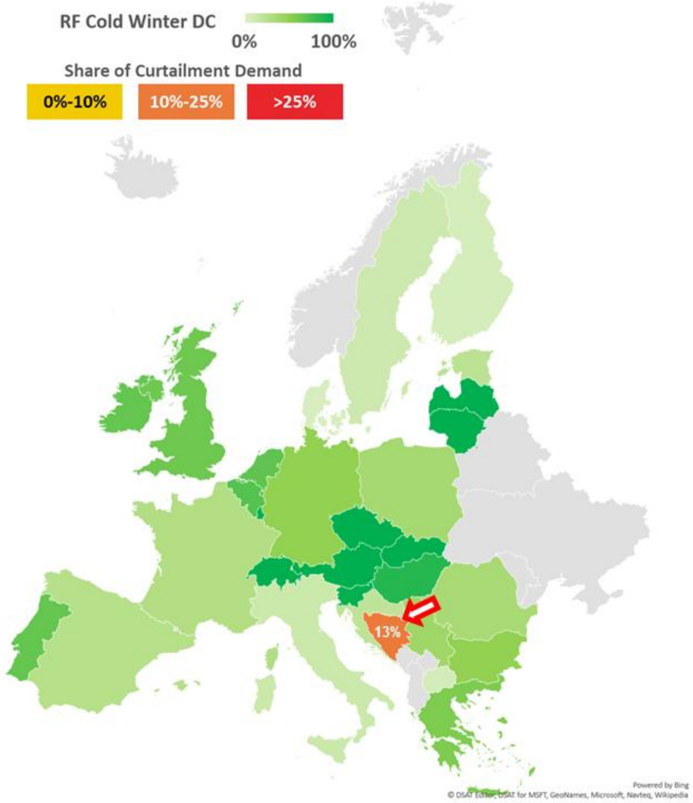


Figure 28Figure 28.- Peak Day results (Remaining Flexibility and Curtailment Rate) for Algerian disruption[22].

Results for a disruption of all pipeline imports and LNG from Algeria during a 1-in-20 years 2-Week Cold Spell:

The results show that in the case of a 2-Week Cold Spell combined with Algerian disruption, apart from the countries affected in no route disruption case, there is no more countries facing demand curtailment.

[22] The results for Unified allocation and Distance-Based are equal.

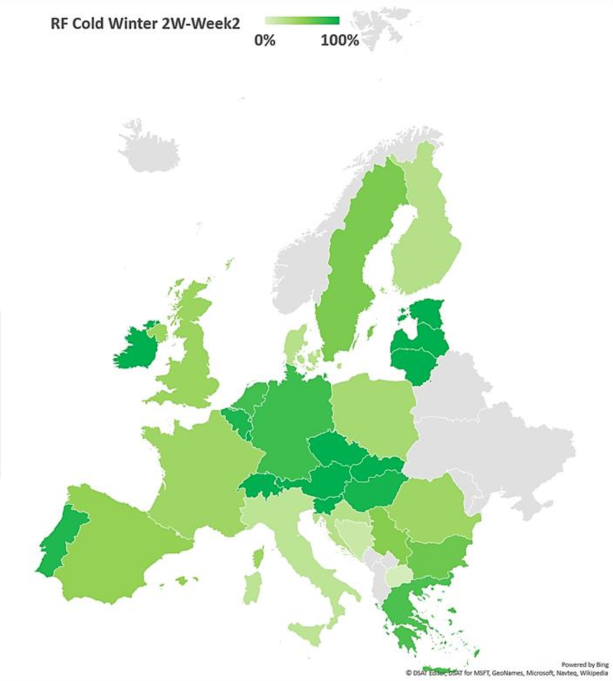


Figure 29.- 2-Weeks Cold Spell results (Remaining Flexibility) for Algerian disruption.

7. Conclusions

According to the ENTSOG modelling and supply assumptions, this Winter Supply Outlook confirms the ability of the European gas infrastructures to face a Cold Winter 2019/20 with sufficient flexibility in most parts of Europe. This assessment is valid throughout the season and under high demand situations.

Winter Supply Outlook 2019/2020 assessment highlights:

The **main findings of the Winter Supply Outlook** are:

- **the European indigenous production keeps on following a decreasing trend;**
- **the storage level on 1st October is the highest level of the last 8 years (1060TWh) as a consequence of a high storage level (447TWh) at the beginning of the injection season and relatively high seasonal price spread during the injection season;**
- **LNG terminals utilisation has been significantly higher than the observed over the last 8 years, imports last winter were comparable to pre-Fukushima disaster levels;**
- **the European gas system offers sufficient flexibility across the season in Europe, provided gas is available;**
- **the European gas system is also capable of supplying Energy Community Contracting Parties and other EU neighbouring countries with significant volumes of gas;**
- **infrastructure limitation in Bosnia and Herzegovina, could expose it to demand curtailment during the peak demand day during cold winter;**
- **South-East Europe would be significantly exposed in case of a transit disruption through Ukraine under high demand situations.**

Please note that the level of storages across Europe significantly contributes to the balance of demand across the season and also to the ability to physically send gas to neighbouring countries.

8. Legal Notice

The current analysis is developed specifically for this Winter 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 31st March 2019 will depend on market behaviour and global factors.

ENTSOG has prepared this Winter 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

UGS deliverability curve

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

Table 4. - UGS deliverability curves.

Country	Withdraw availability when working gas volume is at xx% level											
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	1%	0%
AT	100%	99%	99%	98%	98%	97%	90%	83%	73%	62%	53%	0%
BE	100%	100%	100%	100%	100%	100%	100%	100%	20%	20%	10%	0%
BG	74%	74%	100%	100%	100%	100%	89%	79%	79%	60%	0%	0%
HR	100%	100%	100%	100%	100%	96%	80%	65%	48%	32%	14%	0%
CY	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CZ	100%	100%	100%	100%	100%	97%	80%	70%	50%	40%	40%	0%
CZd*	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
DK	100%	100%	100%	100%	100%	100%	100%	100%	85%	33%	25%	0%
EE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
FI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Fra	100%	96%	91%	87%	82%	75%	65%	55%	45%	35%	20%	0%
FRn	100%	96%	91%	87%	82%	77%	69%	62%	54%	44%	29%	0%
FRnL	100%	100%	100%	100%	100%	100%	100%	96%	89%	82%	80%	0%
FRs	100%	98%	96%	95%	93%	91%	88%	83%	79%	67%	25%	0%
FRt	100%	100%	100%	100%	100%	100%	91%	74%	57%	39%	22%	0%
DE	100%	99%	99%	98%	98%	97%	86%	75%	63%	49%	36%	0%
GR	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
HU	100%	100%	100%	100%	100%	97%	94%	84%	73%	50%	37%	0%
IE	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IT	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
LV	100%	100%	100%	97%	92%	88%	78%	65%	48%	20%	20%	0%
LT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NL	100%	97%	95%	93%	90%	87%	80%	73%	64%	55%	46%	0%
PL	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
PT	100%	100%	100%	100%	85%	85%	85%	85%	85%	85%	85%	0%
RO	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
RS	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
SK	100%	99%	97%	96%	93%	88%	82%	74%	65%	55%	44%	0%
SI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
ES	100%	80%	72%	67%	63%	60%	55%	50%	45%	40%	30%	0%
SE	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%
UK	100%	98%	97%	95%	94%	91%	84%	75%	64%	51%	41%	0%

* UGS Dolni Bojanovice located in Czech Republic but only connected the Slovak market

Annex B - Data for Winter Supply Outlook 2019/20

Indigenous Production

Table 5. – Supply assumptions indigenous production

GWh/d	OCT	NOV	DEC	JAN	FEB	MAR	2W-Week1	2W-Week2	DC
National Poduction	2,746.2	2,959.0	3,107.2	3,121.2	3,355.6	2,866.6	4,162.3	4,162.3	4,162.3

Supply assumptions (maximum per period)

Table 6.– Supply assumptions imports.

GWh/d			DZ	LY	NO	RU	LNG	LNG*
Winter Period	Max on Whole Winter		1,261	208	3,677	5,530	3,339	3,339
	Max per 30 days		1,389	247	3,893	6,084	4,196	4,196
High Demand	2-week Cold Spell	Week 1	1,348	250	3,792	6,140	***	***
		Week2	1,348	250	3,792	6,140	4,283	6,318
	1-day Design Case		1,388	303	4,631	6,241	4,650	6,318

** LNG sensitivity for Cold Winter (in line with SOS report only for High Demand)*

LNG Tank flexibility

The LNG tank flexibility represents the difference between the actual fill level of the LNG tanks and the minimum operative tank level; it can be send-out as extra LNG during the 2-week Cold Spell and 1-Day Peak. These figures represent a weighted average of the LNG terminals of each area. ENTSOG has used the LNG tank flexibility as made available by the LSOs via GLE.

Table 7.-LNG tank flexibility

LNG Tank Flexibility	
BE	35%
ES	51%
FRn	76%
FRs	58%
GR	47%
IT	15%
LT	47%
NL	35%
PL	59%
PT	43%
UK	64%

Reference Winter Demand

Table 8.– Demand forecasts in Reference Winter

Country	October	November	December	January	February	March	2W-Week1	2W-Week2	DC
AT	238	337	381	403	402	316	547	547	547
BA	4	7	11	12	10	7	10	10	13
BEh	491	577	562	608	568	502	922	922	1,014
BEl	161	218	255	256	256	224	376	376	455
BGn	80	111	141	144	131	104	133	133	145
CH	93	140	163	180	165	130	220	220	230
CZ	250	324	409	419	452	323	592	592	727
DEg	1,060	1,294	1,394	1,619	1,344	1,123	1,825	1,825	2,274
DEgL	196	248	270	319	259	210	1,997	1,997	2,604
DEn	964	1,280	1,416	1,720	1,348	1,050	364	364	463
DEnL	392	503	551	658	527	422	755	755	968
DK	77	100	117	116	109	100	128	128	224
EE	15	18	20	27	23	20	40	40	53
ES	952	1,185	1,211	1,307	1,295	1,124	1,645	1,645	1,935
FI	50	70	80	105	110	85	180	180	220
FR	1,267	1,686	1,897	1,788	1,989	1,729	2,780	2,780	3,768
FRnL	109	156	196	203	188	154	285	285	387
GR	130	154	162	209	161	150	213	213	236
HR	75	101	125	132	108	78	122	122	131
HU	255	385	530	590	480	350	460	460	650
IE	160	153	196	174	199	169	223	223	303
IT	1,765	2,502	3,109	3,455	2,977	2,528	3,763	3,763	5,085
LT	65	79	89	96	41	75	97	97	110
LU	22	30	33	35	38	32	50	50	53
LV	40	54	55	67	64	51	89	89	110
MK	8	10	12	15	10	10	18	18	19
NL	942	1,317	1,454	1,593	1,520	1,258	2,572	2,572	3,220
PL	512	602	668	703	691	619	833	833	1,030
PT	168	183	158	183	165	141	195	195	228
RO	266	433	576	600	519	373	640	640	693
RS	62	62	62	62	62	62	95	95	104
SE	25	28	33	36	33	29	56	56	75
SI	24	31	37	41	37	31	44	44	59
SK	137	174	199	227	206	164	283	283	343
UK	2,220	2,729	2,985	3,165	3,081	2,713	4,181	4,181	5,141
UKn	43	49	49	58	52	52	69	69	96
TOTAL	13,318	17,330	19,604	21,324	19,620	16,509	26,800	26,800	33,713

Note: Germany and France balancing zones (DEg: GASPOOL, DEn: NCG, DEgL: GASPOOL L-gas, DEnL: NCG L-gas, FRnL: GRTgaz Nord L-gas).

Cold Winter Demand

Table 9.- Demand forecasts in SOS Cold Winter[23].

Country	October	November	December	January	February	March	2W-Week1	2W-Week2	DC
AT	302	335	441	414	412	339	471	471	471
BA	4	6	9	11	7	5	12	12	16
BEh	404	483	614	718	663	527	883	883	964
BEl	113	135	171	200	185	147	378	378	454
BGn	87	107	127	150	128	101	157	157	173
CH	109	151	184	219	162	119	225	225	230
CZ	259	303	479	421	432	315	592	592	727
DEg	1,024	1,241	1,454	1,630	1,469	1,269	1,825	1,825	2,274
DEgL	188	236	283	322	286	242	1,997	1,997	2,604
DEn	916	1,208	1,497	1,734	1,517	1,247	364	364	463
DEnL	375	478	579	663	586	492	755	755	968
DK	66	93	115	126	122	106	190	190	230
EE	16	22	39	37	31	36	57	57	70
ES	1,031	1,257	1,281	1,292	1,269	1,135	1,549	1,549	1,823
FI	103	114	148	152	131	140	220	220	240
FR	1,197	1,845	2,495	2,243	2,088	1,711	3,278	3,278	3,893
FRnL	143	206	265	223	187	150	336	336	391
GR	125	158	152	186	191	149	213	213	236
HR	91	121	107	107	145	93	161	161	175
HU	314	425	539	623	574	443	780	780	820
IE	146	166	193	202	201	188	220	220	282
IT	2,139	2,718	3,618	3,590	3,373	2,885	4,122	4,122	4,825
LT	76	74	82	98	68	76	128	128	151
LU	47	46	57	54	53	47	59	59	72
LV	49	60	89	79	95	70	104	104	135
MK	8	11	14	17	13	4	19	19	19
NL	1,189	1,297	1,742	2,058	1,921	1,496	3,454	3,454	3,706
PL	460	588	647	746	669	550	929	929	973
PT	160	180	176	198	181	176	221	221	252
RO	353	538	528	561	638	458	719	719	776
RS	62	62	62	62	62	62	95	95	104
SE	23	31	37	43	41	34	86	86	86
SI	33	40	42	47	46	39	56	56	62
SK	156	205	269	281	253	229	441	441	496
UK	2,450	3,165	3,969	4,325	4,107	3,551	4,403	4,403	5,144
UKn	61	66	68	74	72	68	93	93	94
TOTAL	**14,281**	**18,170**	**22,570**	**23,905**	**22,380**	**18,701**	**29,593**	**29,593**	**34,399**

Note: Germany and France balancing zones (DEg: GASPOOL, DEn: NCG, DEgL: GASPOOL L-gas, DEnL: NCG L-gas, FRnL: GRTgaz Nord L-gas).

[23] The Cold Demand for Germany has been updated due to the decrease of Las demand and the increase of Hgas demand. Greece high demand cases for Greece has been updated using the same values as for Reference Winter.

Exports to Ukraine

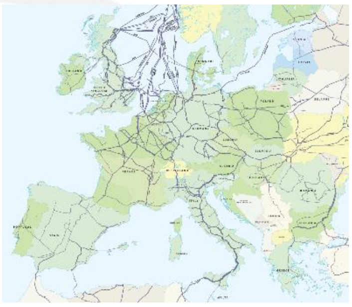
Table 10.-Exports to Ukraine.

Country	October	November	December	January	February	March
UAe	332	332	332	332	332	332

Annex C – Modelling approach

The simulations consider the existing European gas infrastructure as of 1st October 2018.

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.



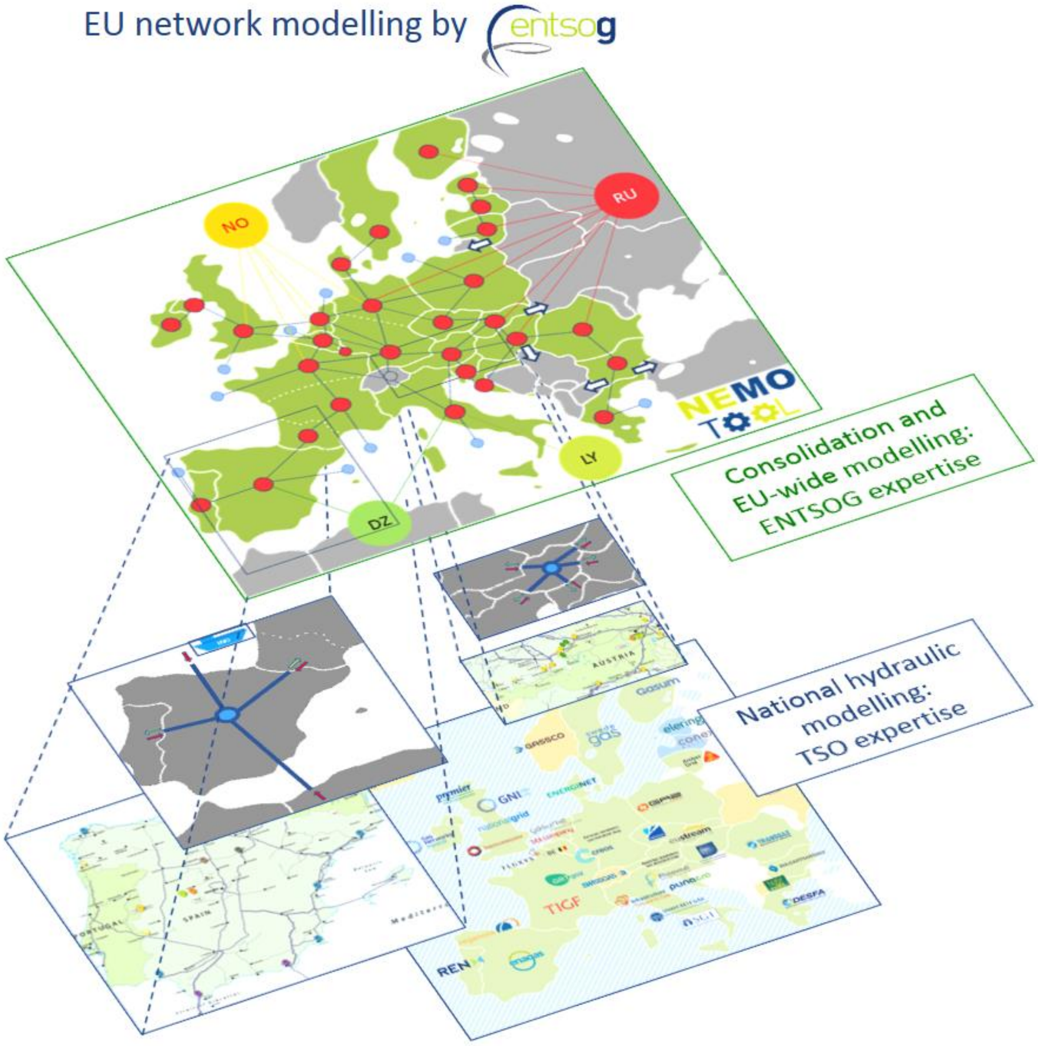


Illustration 1: NeMo tool simplistic overview

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.

Underground gas storages:

Dynamic modelling is applied for the underground gas storages (UGS), taking into account the influence of UGS inventory on withdrawal deliverability by using withdrawal deliverability curves. These deliverability curves[24] have been revised in cooperation with GSE.

LNG supply:

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

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

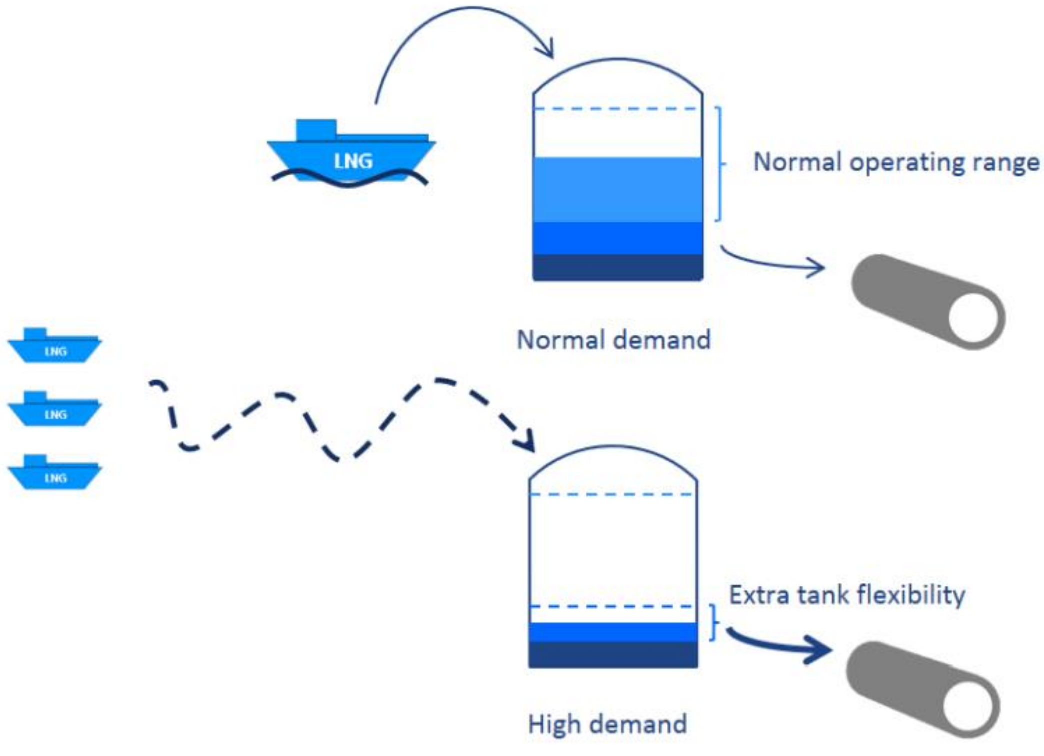
[24] See Annex A

LNG terminals tank flexibility

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

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

ENTSOG models this tank flexibility based on figures provided by the LSOs via GLE (Annex B).



Remaining Flexibility indicator

This indicator measures the resilience at balancing zone (zone) level to cope with climatic stress and route disruption. It aims at capturing the extra supply flexibility a country can access through its infrastructure.

This indicator is calculated as the increase (100%) of demand an area can accommodate before an infrastructure or supply limitation is reached somewhere in the European gas system. The value is expressed as 100% minus the percentage of disruption of the additional demand. The higher the value, the better the resilience is.

A zero value would indicate that the country is not able to fulfil any additional demand and experience disrupted demand. A 100% value would indicate that it is possible to supply a demand multiplied by a factor two.

The value of the indicator is set as the possible increase in demand of the Zone before an infrastructure or supply limitation is reached somewhere in the European gas system. Therefore, the approach enables the consideration of possible infrastructure or supply constraints beyond the entry into the Zone.
The Remaining Flexibility of the Zone Z is calculated as follows (steps 2 and 3 are repeated independently for each Zone):

1. Modelling of the European gas system under a given climatic case
2. Increase of the demand of the Zone Z by 100%
3. Modelling of the European gas system in this new case

Annex D – Results of Remaining Flexibility

The results for Remaining Flexibility are available online as an annex of this report. The data available is specifically:

- RF in Reference Winter. No disruption.
- RF in Cold Winter. No disruption.
- RF in Cold Winter. Disruptions (Algeria, Ukraine, Belarus and BalticFinland).

Abbreviations

CR	Curtailment Rate
DC	Design Case
LSO	LNG System Operator
PEG	Gas exchange point (Point d'échange de gaz, in French)
RF	Remaining Flexibility
SO	Supply Outlook
TRF	Trading Region France
TRS	Trading Region South
TSO	Transmission System Operator
UAe	Exports to Ukraine
UGS	Underground Storage
WGV	Working Gas Volume
WSO	Winter Supply Outlook

> Supplies

AZ	Azerbaijan
DZ	Algeria
LY	Libya
NO	Norway
NP	National Production
RU	Russia
TR	Turkey

> Countries

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

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