european network
of transmission system operators
for gas

Winter Supply Outlook 2017/2018

ENTSOG – A FAIR PARTNER TO ALL!

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 2017 to March 2018). The analysis investigates the possible evolution of supplies and UGS inventory across the season as well as the ability of the gas system to manage high demand situations. ENTSOG has used a sensitivity analysis to check if the European gas system can contend with the winter demand under different demand conditions: Reference Winter and a Cold Winter[1].
The main findings of the Winter Supply Outlook are:

- **The national production continues to follow a decreasing trend;**
- **UK Rough storage announced in June 2017 its closure;**
- **the peak demand has been revised upwards in many countries following the January 2017 cold spell;**
- **storage starting level on 1st October (84%) is close to its five year minimum and hence to the starting level defined for the ENTSOG Union Wide Simulation under revised SoS Regulation;**
- **in case of Cold Winter, the LNG utilization would need to be significantly higher than observed over the last five years, otherwise the storage level at the end of the season could fall to a historical low level;**
- **shippers continuing to fill storages by 1st November could secure higher flexibility**
- **nevertheless 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;**
- **limited capacity between Bosnia and Serbia could expose Bosnia to demand curtailment during the peak demand day.**

As part of the Union Wide Simulation of supply and infrastructure disruptions (revised SoS regulation) to be issued in November 2017, ENTSOG will assess a wide range of disruption cases defined with the Gas Coordination Group. Therefore the Ukraine disruption case will be addressed in this assessment.

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 2018 will depend on market behaviour and global factors.

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

1. Introduction

Two different visions: winter period and high demand situations

As for previous reports, the Winter Supply Outlook 2017/18 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 of high demand situations (1-day Design Case and 2-week Cold Spell), considering also a 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 2017/18.

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. The European aggregated inventory level of underground gas storages levels on 1st October (84%) is close to the lowest level observed over the past years, with much lower levels in some countries such as Latvia, Portugal, Sweden and UK.

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

Further reduction of The Netherlands national production: The current Groningen production plan has capped annual output by another 10% compared to the previous 24 bcm in gas year 2017. Therefore the production is considered to be limited to 21.6 bcm from October 2017. In case of a very cold year the production can be increased by approximately 6 bcm.

UK Rough storage: Centrica announced in June 2017 the cessation of operations at Rough storage. The recoverable cushion gas from the field, which is estimated at 5.2 bcm, could be withdrawn in the near future. Considering information received from UK Competent Authority and as a conservative approach it hasn't been considered in this report due to the timeline uncertainty for this winter season.

Disruption Scenarios: Disruption scenarios are this year assessed in the Union-wide simulation of supply and infrastructure disruption scenarios (SoS simulation).

Assessment of Cold winter demand in line with SoS simulation: The Cold Winter demand has been defined in line with the above mentioned SoS simulation as the historical maximums at country level since 2009/10. The exception is for the countries for which structural changes have implied an overall decrease of the gas demand over the last years.

L-gas modelling: The network modelling used for this Winter Supply Outlook has been upgraded by incorporating the L-gas zones of France (FRnL for France North L-gas) and Germany (DEgL and DEnL for Gaspool L-gas and NetConnect L-gas in Germany) and also by a more detailed granularity in the storages topology. Other transport restrictions, like the ones from odourisation, are reflected in the technical capacities used in the network model as provided for the concerned IPs by the related TSOs.

2. Assumptions

2.1. Demand

A Reference s been defined as representing a 1-in-2 year climatic condition. The demand data has been provided by TSOs on a monthly level[2]. A flat daily demand has been considered within each month.
The demand for the Cold Winter is based on historical data (see annex B for more detail including per country). The Cold Winter shows an overall increase of 13% of the total demand compared to the Reference Winter.

For comparison purposes, **Figure 1** shows the European aggregated demand for the Reference Winter and Cold Winter compared to the historical demand over the last 8 winters.

[2] The number of days within the months are according to the Gregorian calendar.

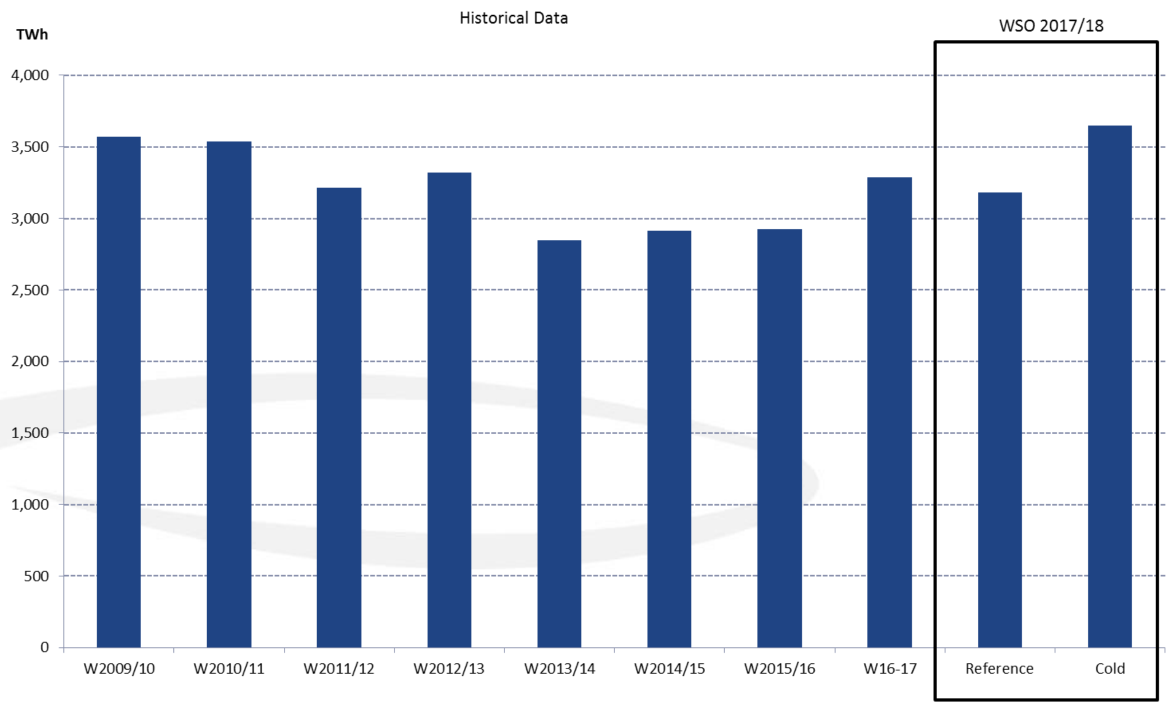


Figure 1: European aggregated demand in the past compared to the two visions

The Cold Winter demand is significantly higher than the one observed during the last five years and close to the Winter 2009/2010 demand.

2.2. Peak demand

Two high demand situations are considered: a 1-day Design Case and a 2-week Cold Spell occurring in February. They are defined in the table below:

Period	**Occurrence of the demand provided by each TSO**
1-day Design Case	National design standard for gas demand, taking place on 14 February
2-week Cold Spell	High demand during a 14-day period in February (Cold Spell), taking place 15-28 February

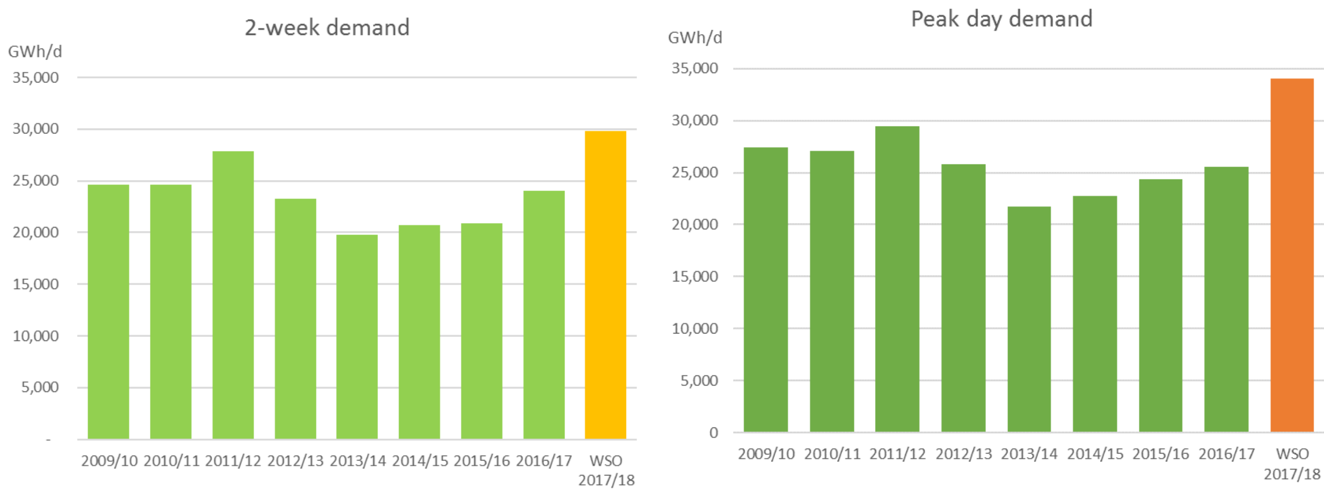


Figure 2: comparison 2-week and Peak Day demand history and assumptions

2.3. Supply

Figure 3 shows historical supply since winter 2009/10 for pipeline and LNG imports.

The maximum supply potentials of the different sources providing gas to EU via pipeline (Algeria, Libya, Norway, Russia) are based on a 5 years history.

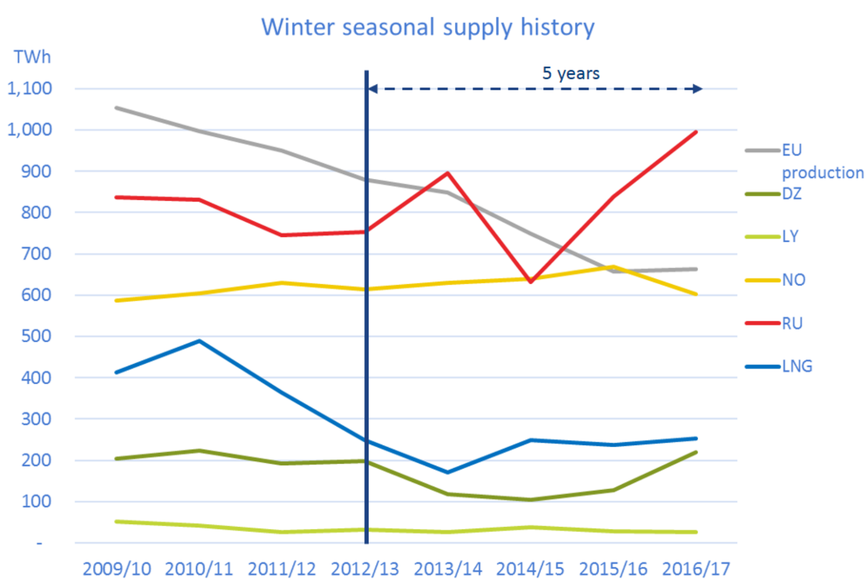


Figure 3: Winter supply limitation

Supply limitations are set for different time scales (winter season, monthly and daily) so that the maximum flow of each source cannot exceed reasonable levels based on historical observations.

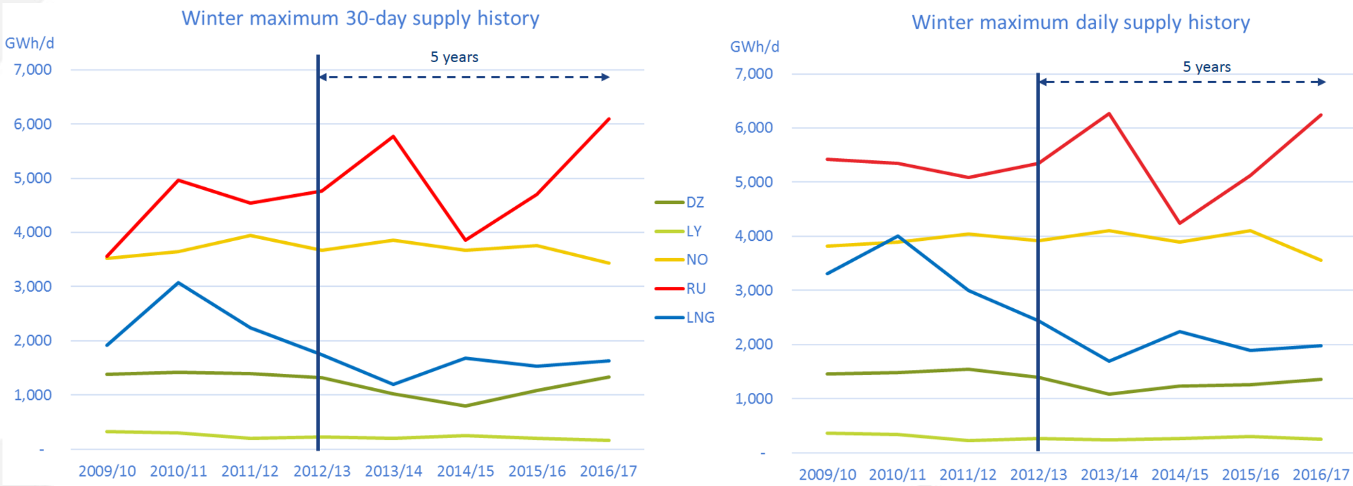


Figure 4: 30-day and daily supply limitation

For each of the winter demand profiles and high demand situations, specific gas supply maximum availability has been defined in the following table (also see Annex B):

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

* While the five last years' history reflects the pipeline supply flexibility, in order to face the Cold Winter demand it is necessary to consider a longer history for the LNG flexibility to be properly reflected.

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

2.4. UGS initial inventory

The Winter Supply Outlook takes into account the actual storage inventory level per country as of 1st October 2017 based on the information from the AGSI platform as the initial situation.

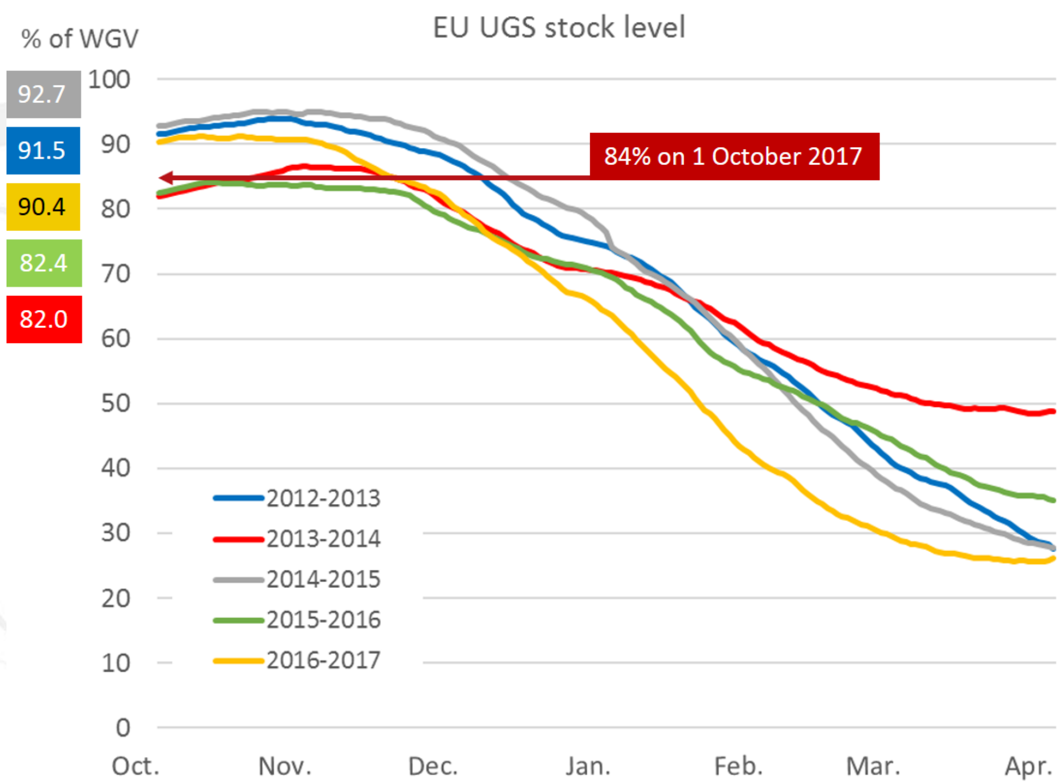
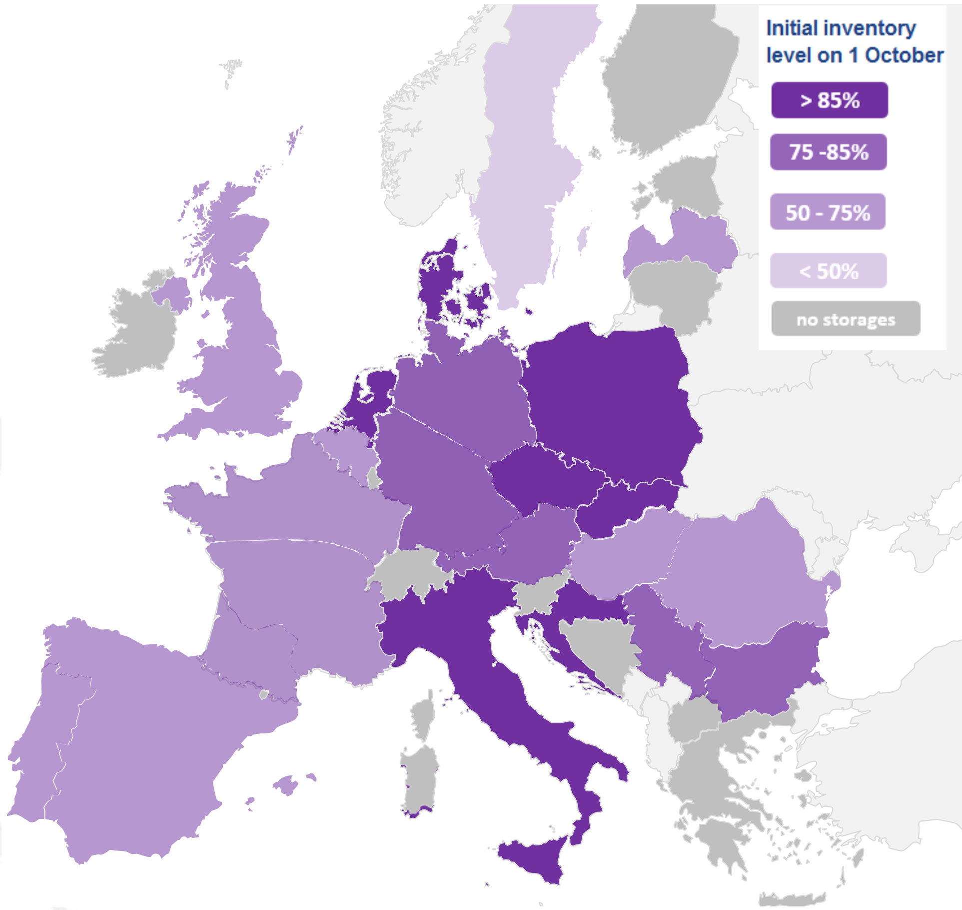


Figure 5: Actual storage inventory levels on 1st October 2017

As shown in the following map the storage inventory levels differ from country to country.



AT	83%
BE	76%
BG	82%
CZ	95%
DE	85%
DK	91%
ES	75%
FR	73%
HR	90%
HU	72%
IT	94%
LV	51%
NL	94%
PL	98%
PT	53%
RO	67%
SE	7%
SK	87%
UK	56%
RS	85%

Figure 6: Actual storage inventory levels on 1st October 2017 [4]

In terms of absolute volumes in gas storages, the largest ones are located in Germany, Italy and the Netherlands. On 1st October 2017, the initial average UGS inventory is 7 points lower than the one from the previous year (84% Vs 91%) with a mixed picture across EU countries. In particular Latvia, Portugal, Sweden[5] and UK face an inventory level on the 1st October below 60%.

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 2017/18.

[4] AGSI data platform except for LV: data from Latvian INČUKALNS UGS UTILISATION https://capacity.conexus.lv/?lang=eng

[5] Sweden initial inventory level is explained by its low WGV (105 GWh) which is also underutilised.

2.5. 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, FYROM, Serbia, Bosnia Herzegovina, Ukraine, Turkey, Moldova and Kaliningrad (Russia)[6].

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

- Switzerland, Bosnia, FYROM, Serbia are included in the modelling perimeter
- Ukraine is considered based on the observed exports during the last two years
- Exports to Moldova have been set to zero following an investigation of the previous flows
- The transits towards Turkey and the Kaliningrad region in Russia are included
- Albania, Montenegro and Kosovo are not connected to the gas grid

3. Results of Supply vs. Demand balance over the winter

3.1. 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 7 shows the supply and demand balance at European level for the Reference Winter and the Cold Winter demands.

[6] The levels of the different transits are indicated in the Annex B.

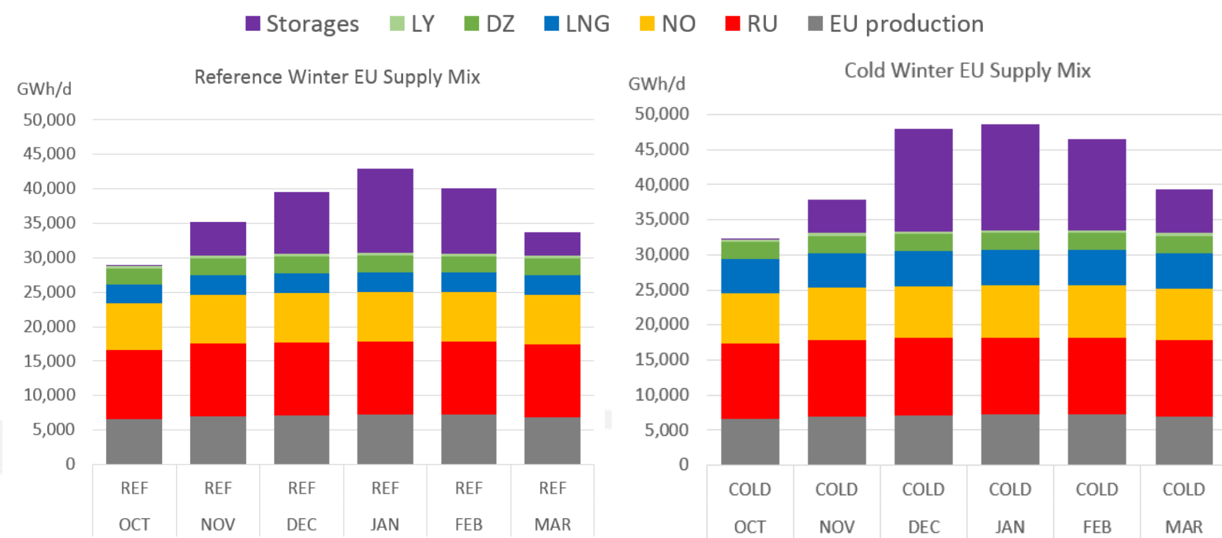


Figure 7: Supply and demand adequacy - Reference Winter vs Cold Winter

These graphs illustrate the changes in supply and demand for the Cold Winter compared to the Reference Winter. For the Cold Winter simulation all supplies are used at their maximum level, and the extra supply of LNG and the 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 observed in the recent past. The supply assumptions should not be considered as a forecast - the actual supply mix will depend on market behaviour and other general factors.

3.2. Evolution of UGS inventory level

As mentioned as part of the modelling assumptions, a target level of 30% inventory level is set for storages in every country during the Reference Winter.

This target inventory level can be reached at the end of the winter in all the EU countries as the associated withdrawal of gas from storages combined with the supply flexibility is sufficient for the supply and demand adequacy.

Figure 8 shows the evolution of the European aggregated UGS inventory level resulting from the modelling defined in the previous section for the Reference Winter and the Cold Winter:

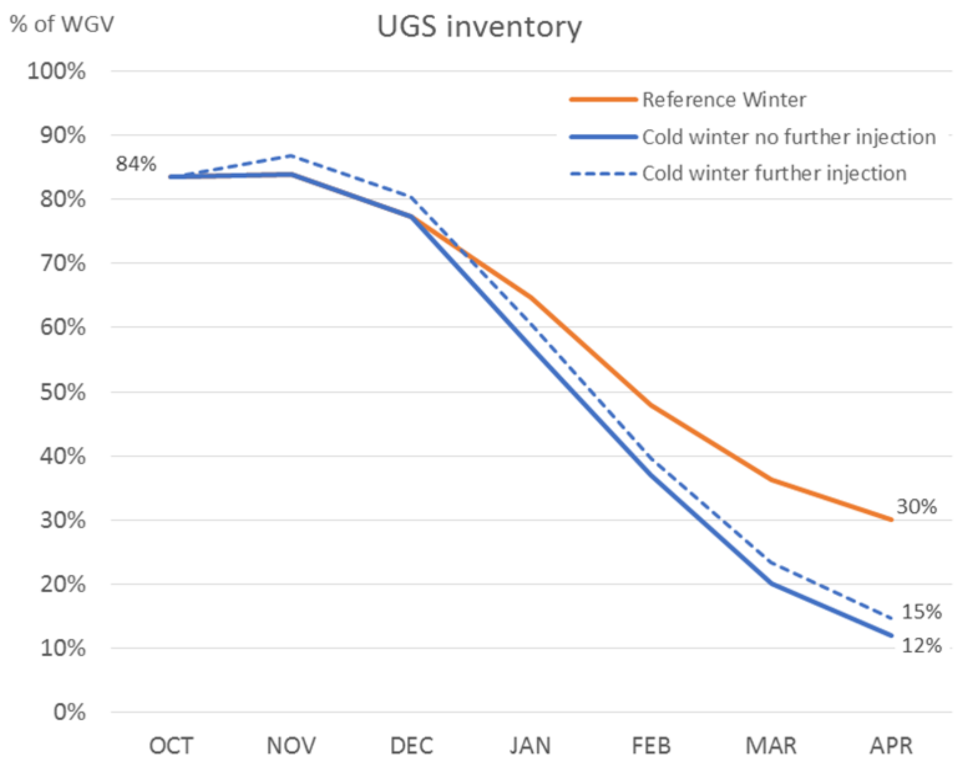


Figure 8: Winter evolution of the aggregated UGS stock level

In order for shippers to get prepared for a cold winter, based on the assumed supply flexibility, the storage level would need to continue to increase during October. Under these assumptions, EU aggregated inventory level at the end of the winter would be 15%. It could even drop 3 points lower if there would be no more injection at the beginning of the season.

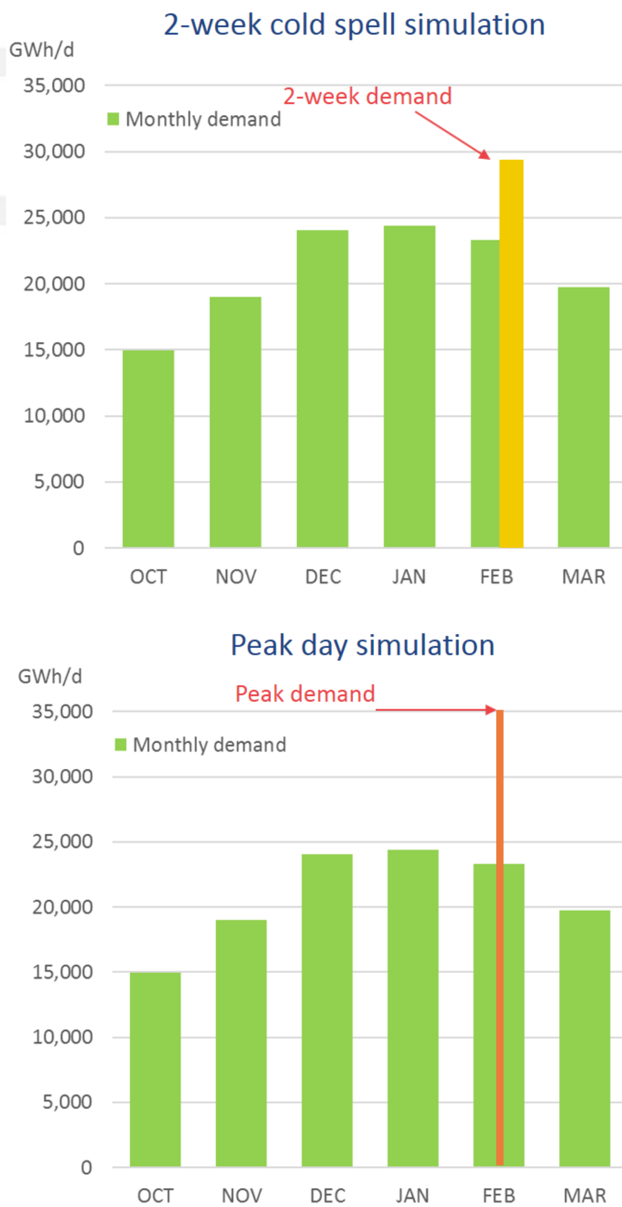
Moreover, storage levels would be even lower if the LNG flexibility would not materialise at the significant levels that have been assumed for the Cold Winter. Such flexibility was last observed more than five years ago during the period 2009 to 2011.

The following table provides the picture of UGS inventory level evolution results:

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Final Level
Reference Winter	84%	84%	77%	65%	48%	36%	30%
Cold Winter no further injection	84%	84%	77%	57%	37%	20%	12%
Cold Winter further injection	84%	87%	80%	60%	40%	23%	15%

4. Results of Supply balance during the high demand situations

The high demand situations are considered as taking place following a beginning of the winter season corresponding to the Cold Winter situation. The initial storage inventory levels on 14th February (End of Day), for both the Peak Day and the 2-week Cold spell, derive from the Cold Winter modelling as shown in the following graphs.



Figures 9: 2-week and Peak Day simulations

Figure 10 compares the supply mix for the winter in February and the two high demand situations:

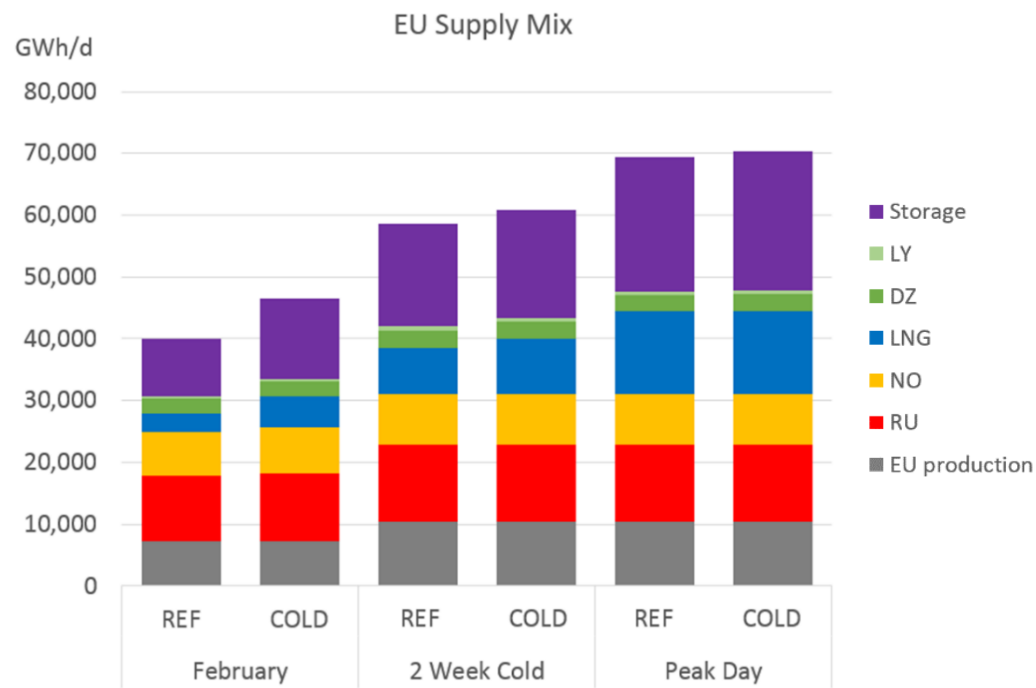


Figure 10: Comparison of supply mixes in February vs high demand situations

In both Reference and Cold Winter the supply mix is the same during week-1 and week-2. There is no change in the LNG supply share between week-1 and week-2 as the extra LNG required can be taken from the tanks.

In case of high or peak day demand, indigenous production peak applies and, in particular, the limitation applied to the Groningen production is lifted.

5. Results of the high demand situations indicators

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

- The potential level of demand curtailment
- The Remaining Flexibility representing the maximum demand increase of a country before facing curtailment (see Annex C for detailed calculation process)

Figure 11 represents the summary of all the results obtained:

Results Summary	WO Reference		WO Cold	
Peak Day Curtailment	NONE		BA disrupted 13%	
Peak Day Remaining Flexibility below 20%	BA	0%	BA	0%
	MK	7%	MK	7%
	FI	8%	FI	8%
	SE	12%	SE	11%
	DEnL	12%	DEnL	12%
	GR	16%	GR	16%
	HR	18%	HR	16%
			UK	17%
2 Week Curtailment	NONE		NONE	
2 Week Remaining Flexibility below 20%			SE	6%
			MK	7%
	BA	17%	BA	17%
	FI	18%	FI	18%

Figure 11: High demand situations results in Reference and Cold Winters

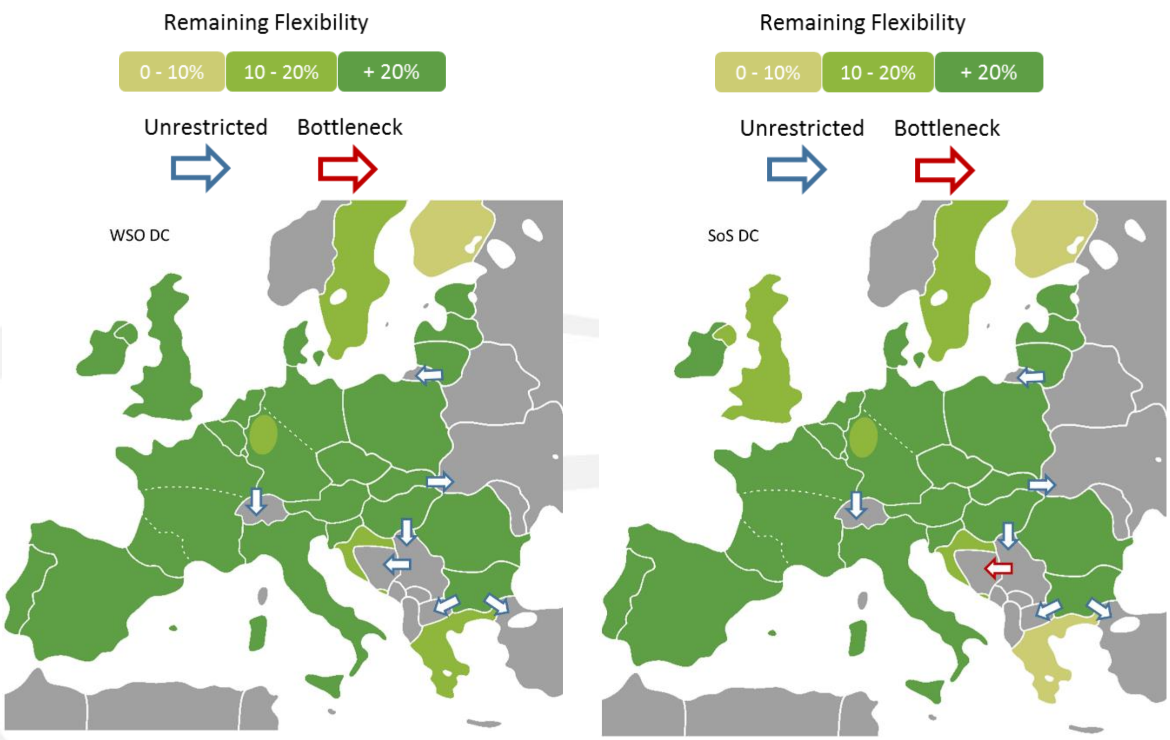
The results for the **Reference Winter** indicate:

- **1-Day Design Case**: No demand curtailment but some countries show a very low Remaining Flexibility (Bosnia, FYROM and Finland) and other countries below 20% (Sweden, Germany NetConnect L-gas, Greece and Croatia);
- During the **2-week Cold Spell**: Also no demand curtailment but two countries still show low Remaining Flexibility below 20% (Bosnia and Finland).

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

- **1-Day Design Case**: Bosnia faces demand curtailment and other countries a low Remaining Flexibility (Croatia, Finland, FYROM, Germany NetConnect L-gas, Greece, Sweden and UK);
- During the **2-week Cold Spell**: No country faces demand curtailment and only four countries a low Remaining Flexibility (Bosnia, Finland, FYROM, Greece and Sweden).

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



Figures 12: High demand situations results in Reference and Cold Winters

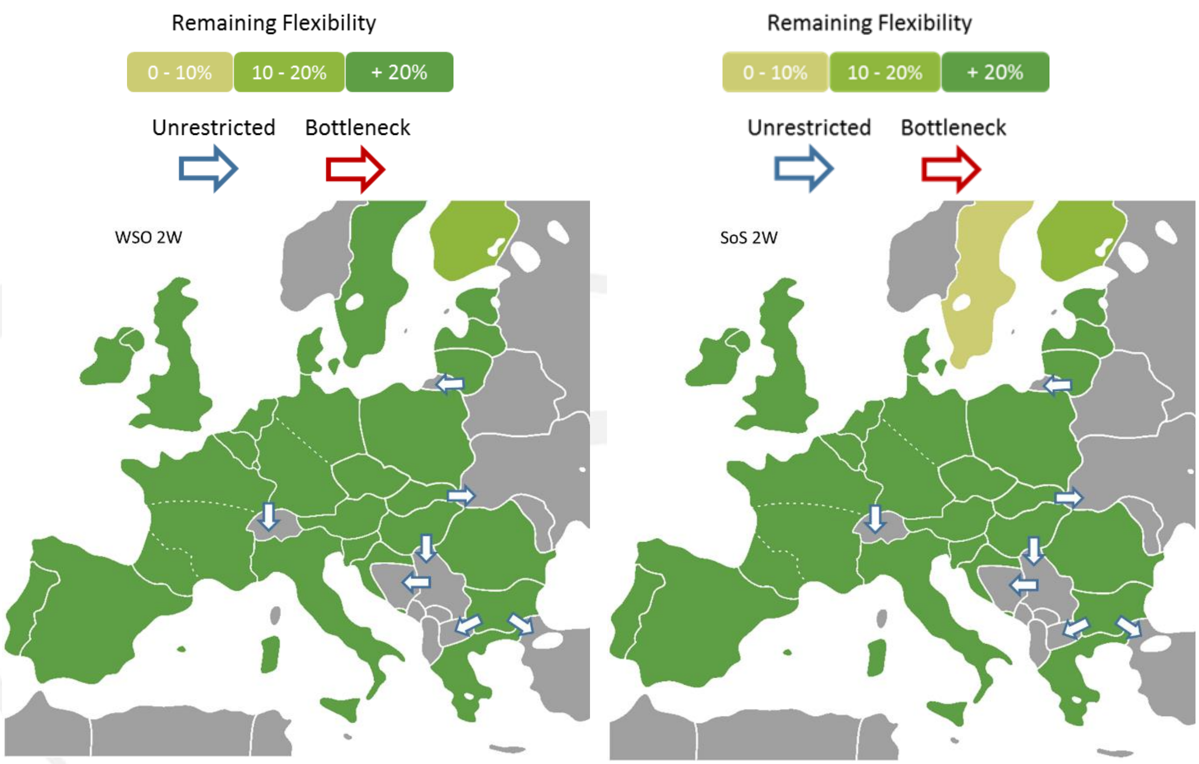
The results show that only Bosnia faces a potential demand curtailment in case of the Cold Winter peak day with a demand over the entry capacity of 2 GWh/d.

The remaining flexibility results for the German Net Connect L-gas zone are one of the new findings related to the improved L-Gas topology. This low remaining flexibility has been identified to be caused by a limited capacity in peak situations (which is caused by in the limited L-gas supply, not by transport restrictions).

Croatian and Greece higher peak demand identified in the last winter explains their lower remaining flexibility results in these two countries, especially during the Cold Winter.

UK low remaining flexibility situation in Cold Winter is, when compared to the previous Winter Supply Outlook, mainly caused by the lack of their biggest storage Rough in the analysis together with the low inventory level of the remaining storages (56%).

5.2. Results for **2-week Cold spell** during a Reference Winter vs. Cold Winter



Figures 13: High demand situations results in Reference and Cold Winters

No country faces demand curtailment in the 2-week Cold spell in Reference Winter nor in Cold Winter.

Finland shows low remaining flexibility in all the high demand situation cases, in both reference and cold winters, basically due to their dependence on the single capacity connection to Russia.

Sweden's low remaining flexibility results, especially during cold winter, are caused by the limited capacity coming from Denmark and their small storage, which is also underutilised.

The lower level of Remaining Flexibility for Finland and Sweden, especially in the Cold case, is consistent with the results shown in Winter Supply Outlook 2016/17 and previous outlooks.

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

6. 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 2017/18 with sufficient flexibility in most parts of Europe. This assessment is valid throughout the season and under high demand situations.

Winter Supply Outlook 2017/2018 assessment highlights:

- The national production continues to follow a decreasing trend;
- UK Rough storage announced in June 2017 its closure;
- the peak demand has been revised upwards in many countries following the January 2017 cold spell;
- storage starting level on 1st October (84%) is close to its five year minimum and hence to the starting level defined for the ENTSOG Union Wide Simulation under revised SoS Regulation;
- in case of cold winter, the LNG utilization would need to be significantly higher than observed over the last 5 years otherwise the storage level at the end of the season could fall to historical low level;
- shippers keeping on filling storages by 1st November could secure higher flexibility
- nevertheless 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;
- limited capacity between Bosnia and Serbia could expose Bosnia to demand curtailment during the peak demand day.

It should be noted 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.

Legal Notice

ENTSOG has prepared this Winter 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.

Withdraw deliverability	UGS inventory										
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
AT	100%	99%	98%	97%	96%	95%	90%	83%	73%	63%	51%
BE	100%	100%	100%	100%	100%	100%	100%	100%	35%	35%	24%
BG	74%	74%	100%	100%	100%	100%	89%	79%	79%	60%	36%
HR	100%	100%	100%	100%	100%	96%	80%	65%	48%	32%	14%
CZ	100%	100%	100%	100%	100%	97%	75%	70%	45%	40%	36%
CZd*	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
DK	100%	100%	100%	100%	100%	100%	100%	100%	85%	40%	30%
FRn	100%	98%	97%	95%	92%	88%	82%	74%	64%	54%	42%
FRs	100%	95%	91%	87%	82%	78%	70%	60%	55%	49%	32%
FRt	100%	98%	96%	93%	91%	89%	83%	73%	64%	55%	45%
DE	100%	99%	97%	96%	95%	93%	85%	75%	63%	51%	34%
HU	100%	100%	100%	100%	99%	97%	95%	87%	78%	62%	52%
IT	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
LV	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
NL	100%	97%	94%	92%	89%	86%	80%	72%	63%	54%	34%
PL	100%	100%	99%	98%	97%	92%	86%	79%	74%	63%	39%
PT	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
RO	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
RS	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
SK	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
ES	100%	80%	72%	67%	63%	60%	55%	50%	45%	40%	36%
SE	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%
UK	100%	98%	96%	95%	93%	91%	85%	75%	64%	54%	36%

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

Figure 14 - UGS deliverability curves

Annex B - Data for Winter Supply Outlook 2017/18

Indigenous Production

	October	November	December	January	February	March
GWh/day	W2017/18	W2017/18	W2017/18	W2017/18	W2017/18	W2017/18
NP	3,277	3,460	3,574	3,618	3,618	3,439
Peak	5,148	5,152	5,160	4,976	4,966	4,957

Figure 15 – Supply assumptions indigenous production

Supply assumptions (maximum per period)

GWh/d			DZ	LY	NO	RU	LNG	LNG *
Winter period	MAX on whole Winter		1,214	208	3,677	5,473	1,464	2,500
	MAX per month		1,335	247	3,945	6,089	1,798	2,500
High demand	2-week Cold Spell	Week 1	1,391	303	4,100	6,238	February Flows	February Flows
		Week 2	1,391	303	4,100	6,238	2,154	6,418
	1-Day Design Case		1,391	303	4,100	6,238	2,154	6,418

* *LNG sensitivity for Cold Winter*

Figure 16 – Supply assumptions imports

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.

LNG tank flexibility	
BE	35%
ES	41%
FRn	73%
FRs	58%
GR	35%
IT	15%

LT	3%
NL	35%
PL	33%
PT	32%
SE	35%
SI	35%
UK	35%

Figure 17: LNG tank flexibility

Reference Winter Demand

Demand	GWh/day						2W	DC
Reference	October	November	December	January	February	March	February	February
AT	274	331	386	414	368	299	471	471
BEh	467	531	573	572	546	487	883	964
BEl	130	196	238	239	239	203	378	454
BG	85	107	127	137	128	102	157	173
CZ	250	324	409	419	452	323	592	727
Degh	973	1,140	1,260	1,281	1,275	1,127	1,572	1,914
Degl	195	262	310	318	315	256	434	571
Denh	837	1,126	1,331	1,368	1,357	1,102	1,870	2,460
Denl	418	544	635	651	646	534	871	1,131
DK	66	93	115	126	122	106	190	230
EE	15	18	20	29	23	20	57	70
ES	786	1,031	1,092	1,158	1,142	966	1,460	1,718
FI	58	75	89	114	114	91	220	240
FRnh	617	983	1,190	1,306	1,340	1,019	2,112	2,456
FRnl	113	171	198	212	194	144	336	391
FRs	284	449	540	590	597	452	952	1,107
FRt	106	156	186	191	176	143	214	330
GR	111	106	168	164	116	116	185	228
HR	88	102	127	154	116	84	161	175
HU	295	405	520	660	510	360	695	780
IE	132	134	172	166	178	146	220	282
IT	1,675	2,287	2,896	3,311	3,256	2,398	4,122	4,825
LT	61	71	78	75	73	60	105	123
LU	23	29	31	36	37	30	50	53
LV	48	65	56	68	66	44	78	78
NL	953	1,195	1,338	1,556	1,455	1,220	3,454	3,706
PL	445	552	617	628	618	568	784	902
PT	160	180	176	198	181	176	221	252
RO	358	391	485	629	430	356	692	747
SE	23	31	37	43	41	34	76	86
SI	26	33	39	40	38	30	48	57
SK	132	176	201	238	227	177	268	346
UK	2,990	3,181	3,012	3,180	2,479	2,542	3,946	5,144
UKn	61	66	68	74	72	68	74	93
BA	4	7	10	12	10	7	12	14
CH	92	134	164	174	164	130	225	230
MK	5	6	7	9	5	3	14	19
RS	62	62	62	62	62	62	95	104
MDe	0	0	0	0	0	0	0	0
RUk	79	79	79	79	79	79	109	109
TRe	393	393	393	393	393	393	480	480
UAe	363	363	363	363	363	363	416	416

Note: Germany and France balancing zones (DEg: GASPOOL, DEn: NCG, FRn: GRTgaz Nord, FRs: GRTgaz Sud and FRt: TIGF) Moldova, Russia (Kaliningrad), Turkey and Ukraine represent net exports.

Figure 18 – Demand and exports forecasts in Reference Winter

Cold Winter Demand

Demand	GWh/day						2W	DC
Cold	October	November	December	January	February	March	February	February
AT	302	335	441	414	412	339	471	471
BEh	404	483	614	718	663	527	883	964
BEl	113	135	171	200	185	147	378	454
BG	87	107	127	150	128	101	157	173
CZ	259	303	479	421	432	315	592	727
Degh	912	1,165	1,482	1,384	1,387	1,255	1,572	1,914
Degl	187	265	397	344	343	286	434	571
Denh	801	1,141	1,710	1,478	1,477	1,229	1,870	2,460
Denl	398	553	801	703	703	595	871	1,131
DK	66	93	115	126	122	106	190	230
EE	16	22	39	38	31	36	57	70
ES	1,031	1,257	1,281	1,292	1,269	1,135	1,549	1,823
FI	103	114	148	152	131	140	220	240
FRnh	781	1,181	1,594	1,376	1,286	1,062	2,112	2,456
FRnl	143	206	265	223	187	150	336	391
FRs	344	550	718	681	633	516	952	1,107
FRt	72	113	154	186	169	133	214	330
GR	125	158	152	186	191	149	191	228
HR	91	121	107	107	145	93	161	175
HU	314	425	539	623	574	443	780	820
IE	146	166	193	202	201	188	220	282
IT	2,139	2,718	3,618	3,590	3,373	2,885	4,122	4,825
LT	76	74	82	98	68	76	128	151
LU	43	46	57	54	53	47	59	72
LV	49	60	89	79	95	70	104	135
NL	1,189	1,297	1,742	2,058	1,921	1,496	3,454	3,706
PL	460	588	647	746	669	550	929	973
PT	160	180	176	198	181	176	221	252
RO	353	538	528	561	638	458	719	776
SE	23	31	37	43	41	34	86	86
SI	33	40	42	47	46	39	56	62
SK	156	205	269	281	253	229	441	496
UK	2,450	3,165	3,969	4,325	4,107	3,551	4,403	5,144
UKn	61	66	68	74	72	68	93	94
BA	4	6	9	11	7	5	12	16
CH	109	151	184	219	162	119	225	230
MK	8	11	14	17	13	4	19	19
RS	62	62	62	62	62	62	95	104
MDe	0	0	0	0	0	0	0	0
RUk	79	79	79	79	79	79	109	109
TRe	393	393	393	393	393	393	480	480
UAe	363	363	363	363	363	363	416	416

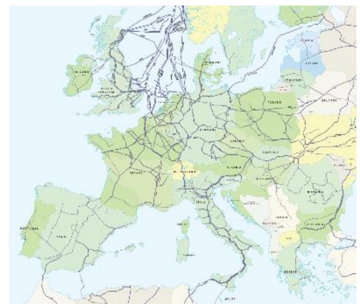
Note: Germany and France balancing zones (DEg: GASPOOL, DEn: NCG, FRn: GRTgaz Nord, FRs: GRTgaz Sud and FRt: TIGF) Moldova, Russia (Kaliningrad), Turkey and Ukraine represent net exports.

Figure 19 – Demand and exports forecasts in Cold Winter

Annex C - Modelling approach

The simulations consider the existing European gas infrastructure as of 1st October 2017[7].

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.



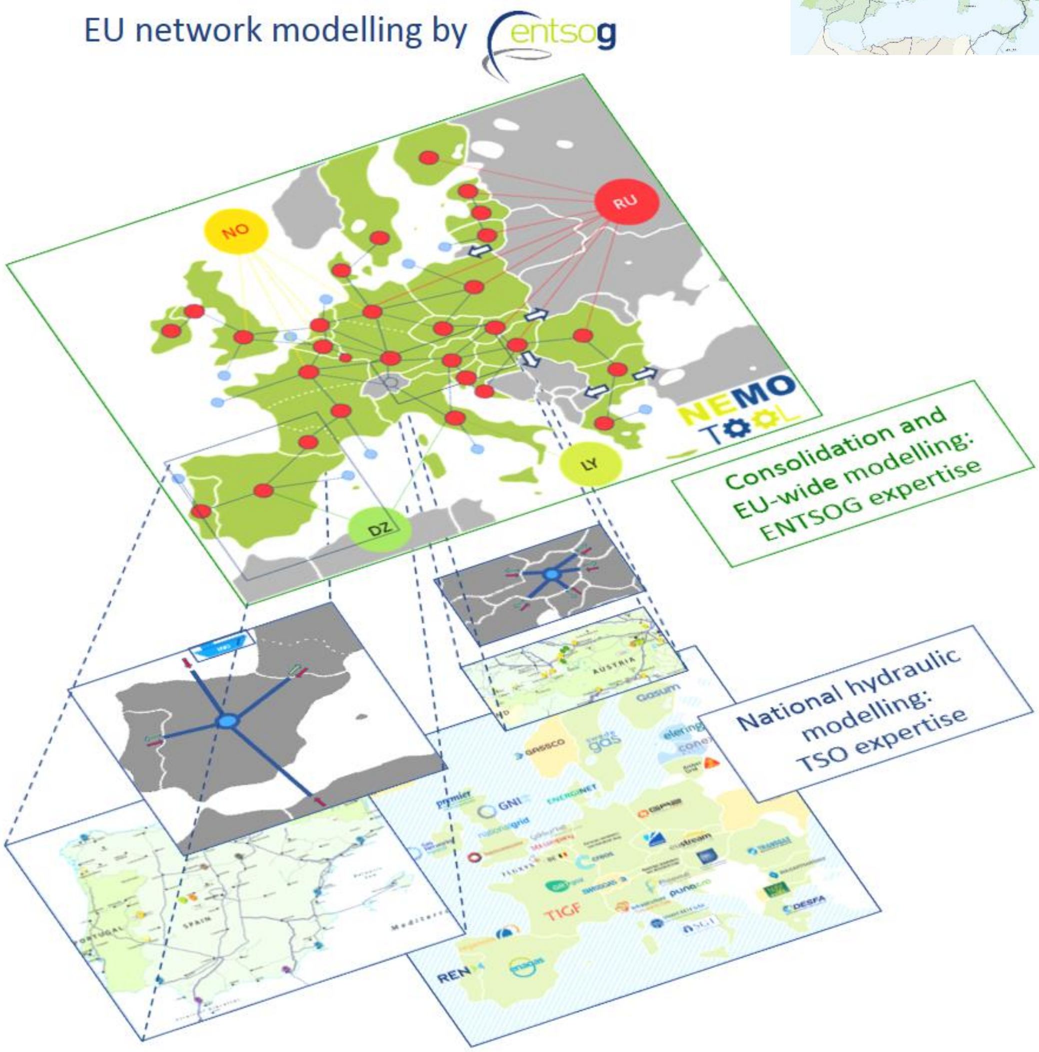


Illustration 1: NeMo tool simplistic overview

[7] On 27 September 2017, Fluxys announced capacity restrictions on TENP pipeline until 31st March 2019. This recent information, at the time of writing this report, is not considered in the WSO simulation.

In all cases, the cooperative modelling is undertaken 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[8] have been revised in cooperation with GSE. In addition, a 30% UGS inventory level is targeted at the end of the winter, if it does not prevent countries to be balanced.

LNG: The send-outs from the terminals are modelled to represent the sum of both the off-loaded volumes of arriving cargos and gas from tanks. As for the previous Winter Outlook, the 2-week Cold Spell is split in two 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 reaching LNG terminals as calculated in February of the Cold Winter case, 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.

[8] See Annex A

Remaining Flexibility indicator

This indicator measures the resilience of a balancing zone (Zone) as the room before being no longer able to fulfil its demand without creating new demand curtailment in other countries. 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.

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

The Remaining Flexibility of the considered Zone is defined 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 Zone is not able to fulfil an additional demand and a 100% value will indicate it is possible to supply a demand multiplied by a factor two.

The approach enables the consideration of possible infrastructure or supply constraints beyond the entry into the Zone.

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