ENTSOG Winter Outlook 2012/13

Executive Summary

ENTSOG has undertaken an assessment of the European gas network to analyse which flexibility for supply the grid is able to provide when meeting High Daily Demand conditions and the evolution of UGS stock level during Winter 2012/13 (October to March). The conclusions are:

Gas in UGS on 1 October 2012 is sufficient to cover at least a 10% increase in the overall European winter demand in comparison with an average winter (equivalent to about 343 TWh of additional consumption which is as high as the French total winter demand).

The European gas network is sufficiently robust in all parts of Europe to offer significant flexibility under High Daily Demand conditions both on a single day and on a 2-week period.

In case of a disruption of transit through Ukraine during a 2-week period, most of the countries of South-Eastern Europe would not be able to meet the whole of their required demand[1].

Sensitivity studies have been carried out to further illustrate:

- The impact of a change in winter demand on UGS stock level (volume perspective)
- The flexibility offered by the network to enable shippers to optimize their supply under High Daily Demand conditions (capacity perspective)

The integrated flow patterns used in the analysis are developed specifically for this Winter Supply Outlook. They should not be considered as forecast not withstanding that they result from TSOs experience and ENTSOG modelling and supply assumptions.

[1] This case has been introduced based on Gas Coordination Group feedback. Results are consistent with the analysis of the ENTSOG TYNDP 2011-2020

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The Winter Supply Outlook was prepared in a professional and workmanlike manner by ENTSOG on the basis of information collected and compiled by ENTSOG from its members and from stakeholders and contains its own assumptions on the usage of the gas transmission system based upon this information.

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Introduction

As part of ENTSOG obligation under REG-715 Article 8(3) and as a continuous efforts to ensure greater transparency and knowledge regarding the development and operation of the European gas transmission network, ENTSOG presents this Winter Supply Outlook 2012/13. This Outlook aims to provide an overview of the ability of both the European gas network and potential supply to face winter demand. This ability has been tested along both the whole winter and potential High Daily Demand periods.

The winter months require storage withdrawal to cover both short peak periods and the overall winter additional demand. The level of withdrawal by shippers varies from one country to the other and from time to time due to climatic, price and legal parameters.

In order to handle such uncertainty, ENTSOG has used a sensitivity study around a Reference case to check if the European gas infrastructures are able to:

- cover the full winter demand under different supply and demand conditions
- enable shippers to meet High Daily Demand in each country as it can occur in January and March with some flexibility in their supply strategies
- enable shippers to face a disruption of gas transit through Ukraine during a 2-week period of High Daily Demand

When assessing the supply adequacy at European level both through TYNDP and Outlooks, ENTSOG aims at enlarge the geographical scope of the study behind its own perimeter. Winter Supply Outlook 2012/13 covers the EU-27 plus Croatia, Serbia, FYROM and exports to Turkey and Kaliningrad (Russia).

Additional to last edition

Consideration of ACER opinion on:

- When defining supply potential for the outlook cases, all data are based on the last 2 winters in order to capture the short term trend in supply.

- The outlook now considers some disruption cases defined by Members States through the Gas Coordination Group. For this edition the feedback has been inspired by the February 2012 cold spell and the January 2009 gas transit disruption through Ukraine. It has led to the modelling of a Ukraine disruption during 2-week High Daily Demand conditions (same conditions without disruption for comparison purpose).

Consideration of methodological improvements developed for the upcoming TYNDP 2013-2022:

- Under High Daily Demand conditions, LNG is considered both as an import source and a short term storage. This last component is considered as for UGS as last resort supply.

- For the 2-week case, LNG tank management has been defined in coordination with GLE.

- Report is now only based on a dual commodity-capacity approach where imports are always limited to the lower limit between potential supply[2] and import capacity. Therefore the minimization cases are now only based on compensation by UGS and LNG terminals.

Applied methodology

Winter Supply Outlook 2012/13 will capture 2 different but still linked visions of the season. The first one is an outlook of demand and supply evolution along the winter and especially UGS stock level evolution. The second one is the addition of three pictures of very specific and potential events being High Daily Demand on one day in January, in March 2013 and on a 2-week period based on a common probability of harsh climatic conditions during the winter.
These two visions are linked as the level of stock in UGS facilities has some influence on deliverability. This may impact UGS ability to cover peak demand especially in March and then shippers would consider this fact when managing their supply portfolio.

[2] *methodology is defined in Annex A and values provided in Annex C*

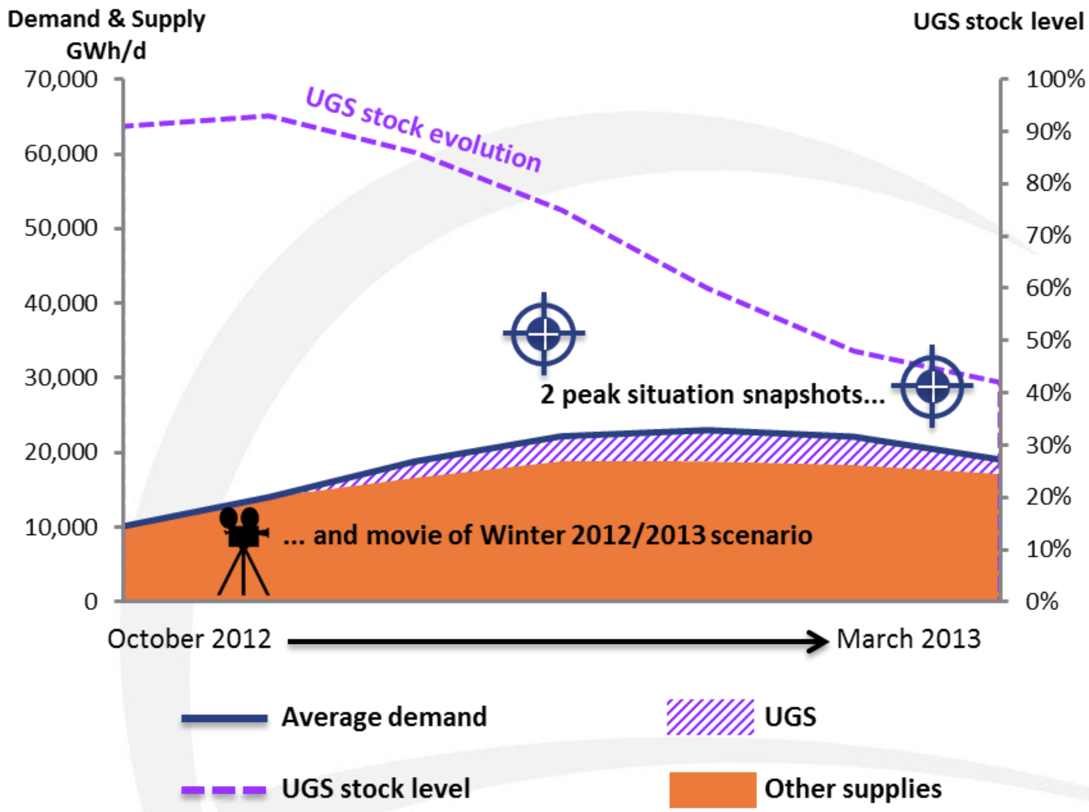


Figure 1 - Dual seasonal / potential even vision

Winter Supply vs. Demand balance (volume perspective)

This part of the report intends to capture the temporal dimension of Winter supply by considering the evolution of UGS level.

In order to assess the influence of supply and demand on UGS stock evolution, a sensitivity study has been carried out around a Reference Case. For each month and source, supply is defined by the average supply of last 2 winters[3] using UGS to balance demand. Such supply definition is a standard approach to define a reference case and not the forecast of shippers' supply strategies.

In order to investigate the impact of supply and demand variation on UGS stock levels, the sensitivity study has been carried out by respectively increasing and decreasing winter demand by 10% under different supply cases.

[3] *except Libya where date have been based on Winter 2011/12 only to cancel the influence of the recent Libyan turmoil*

High Daily Demand coverage (capacity perspective)

As last year's report, the Winter Supply Outlook 2012/13 has checked if the capacity of the European gas network is sufficient to cover High Daily Demand in January and March in each country. Upon the feedback received from some Member States through the Gas Coordination Group, an additional 2-week case has been added in order to capture the volume impact of a longer High Daily Demand event as faced during February 2012. Such case has also been considered under complete disruption of transit through Ukraine.

In order to assess the range of possible supply patterns, a sensitivity study has been carried out around a Reference Case.

Supply is defined by the highest flows by source reached last 2 winters using UGS and LNG Terminal as last resort supply. Such supply definition is a standard approach to define a reference case and not the forecast of shippers' supply strategies.

In order to investigate which supply flexibility shippers may enjoy, a sensitivity study has been carried out by minimizing each supply source (except National Production) while increasing UGS withdraw and LNG terminal send-out. Results from market integration scenarios of ENTSOG TYNDP 2011-2020 (§"Capacity limitation to supply predominance on Average daily demand", page 67) showed no limitation to single supply predominance between 2011 and 2015, except for LNG spread from Spain to France and Greece to Bulgaria. These only limitations disappear under High Daily Conditions when higher demand reduces transmission distances as additional supply is consumed locally due to high level of demand.

Results of Supply vs. Demand balance over the Winter (volume perspective)

Reference Case

European Monthly Demand is defined as the sum of the national monthly average demand values as it occurs statistically every 2 years. A flat daily demand has been considered within each month.

For each supply source (being Algeria, Libya, LNG, National Production, Norway and Russia), the average level of last 2 winters has been considered month by month.

UGS are used as last resort supply in order to balance supply with demand. The contribution of LNG short term storage component has been considered as neutral over a 6-month duration.

Aggregated European UGS level decrease has then been calculated day by day, taking into account the influence of stock level on withdrawal deliverability (see Annex B). Initial level on 30 September 2012 comes from AGSI platform (same relative stock of 88% has been used for SSOs facilities not being part of GSE).

Cold Winter

This part of the sensitivity study investigates the impact of a colder winter (higher demand) on the evolution of UGS stock level.

Demand is increased by 10% evenly across the Winter. This additional demand is faced either:

- By UGS only
- First by an increase of alternative supplies at 105% of Reference Case level (except National Production) then by UGS

Warm Winter

This part of the sensitivity study investigates the impact of a warmer winter (lower demand) on the evolution of UGS stock level.

Demand is decreased by 10% evenly across the Winter. This reduced demand is impacted either:

- on UGS only
- first on alternative supplies decreased at 95% of the Reference Case level (except National Production) then on UGS

Summary of demand and supply

TWh on Winter 2012/2013	Reference Case	Cold Winter		Warm Winter	
		UGS only	Imports & UGS	UGS only	Imports & UGS
Winter demand *	3,434	3,777		3,091	
National production	994				
Other supplies (incl. LNG)	2,091	2,091	2,196	2,091	1,986
Net UGS supply **	349	693	588	6	110
UGS level on 31 March 2013	49%	11%	23%	87%	76%

(*) including exports to Kaliningrad and Turkey
(**) European aggregated UGS stock level evolution can be found in Annex B

Under the Reference Case UGS stock level at the end of Winter 2012/13 could still be as high as 49%. When demand is 10% higher (cold winter), demand can still be met, either through additional UGS withdrawal, or a combination of UGS and additional import. When the winter will be warmer than average, significant storage volumes could still be available after the end of the winter period.

The extreme case of a Cold Winter whose additional demand is only covered by UGS, leads to a 11% stock level at the end of Winter. This does not reflect the behaviour of shippers and SSOs using injection opportunities to have even at the end of the season sufficient gas in stock to face potential peak.

For comparison purpose, Winter Supply Outlook 2012/13 Reference Case demand is:

- 3% lower than actual Winter 2010/11 demand
- 7% higher than actual Winter 2011/12 demand.

According to the Cold Winter scenario (with other supplies including LNG at 105% of the Reference Case) and UGS deliverability curve (see Annex B), aggregated European stock level of UGS is above (see Annex B for comprehensive results):

- 46% until end of January (94% deliverability in comparison with full storage situation)
- 23% until end of March (62% deliverability in comparison with full storage situation)

Results of High Daily Demand conditions (capacity perspective)

Reference Cases

European High Daily Demand is defined as the sum of the national High Daily Demand values reported by TSOs according to:

- a single day case in January and March applying their Design methodology (labelled further as January Case and March Case)
- a 2-week period based on a common probability occurrence using the percentile 5% on the climatic parameter (labelled further as 2-Week Case)

For each supply source (being Algeria, Libya, LNG, National Production, Norway and Russia), the highest daily flow level (respectively on one day and two weeks) of last 2 winters has been considered. Transit routes from each supply source to Europe have been limited to the highest level reached last 2 winters (respectively on one day and two weeks). These levels do not represent actual maximum supply but help to define a realistic still conservative supply when facing peak conditions.

UGS, together with the storage component of LNG terminals, are used as last resort supply in order to balance supply with demand. Compared to their maximum deliverability, resulting usages for UGS are 69% for January Case, 41% of March Case and 60% for the 2-Week Case. These loads are consistent with UGS deliverability on those periods (see results of “Supply vs. Demand balance over the Winter” chapter).

Maps on next page illustrate the remaining flexibility offered by the different European systems. This indicator is defined at entry/exit zone level as below:

$$1 - \frac{\sum Entering\ flows}{\sum Entry\ capacity}$$

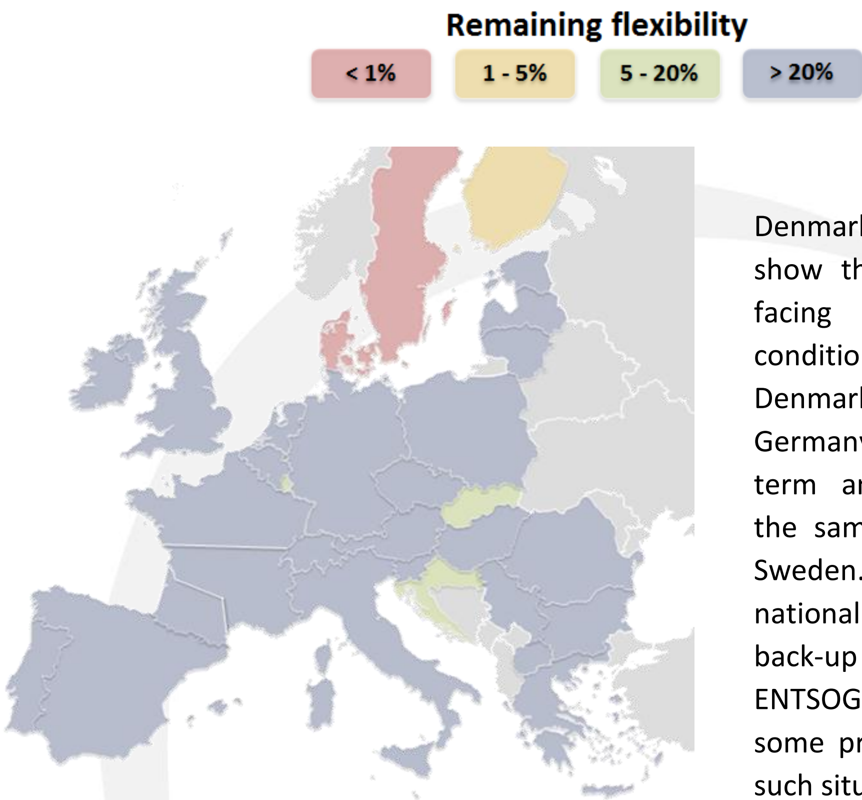


Figure 2 - January Case

Denmark, Sweden and Finland show the lowest flexibility when facing High Daily Demand conditions in January. For Denmark, entry capacity from Germany is proposed but on short term and/or interruptible basis, the same between Denmark and Sweden. For Finland, a large part of national demand can switch to a back-up fuel.

ENTSOG TYNDP 2011-2020 shows some projects helping to mitigate such situation.

Uncovered demand is 29 GWh.

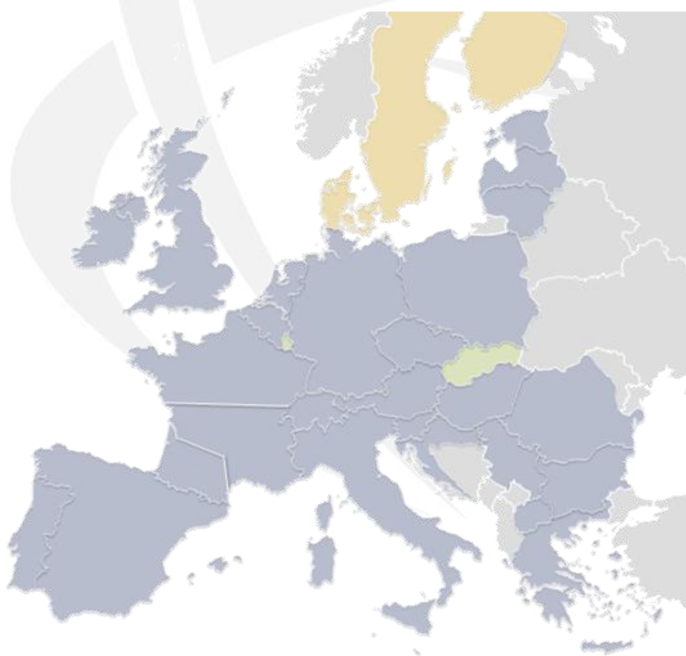


Figure 3 - March Case

In the March Case and at European aggregated level, decrease in demand is higher than the one in UGS withdrawal deliverability. Then transmission capacity is sufficient to ensure an increased remaining flexibility in all parts of Europe.

Finland faces the same situation than under January situation.

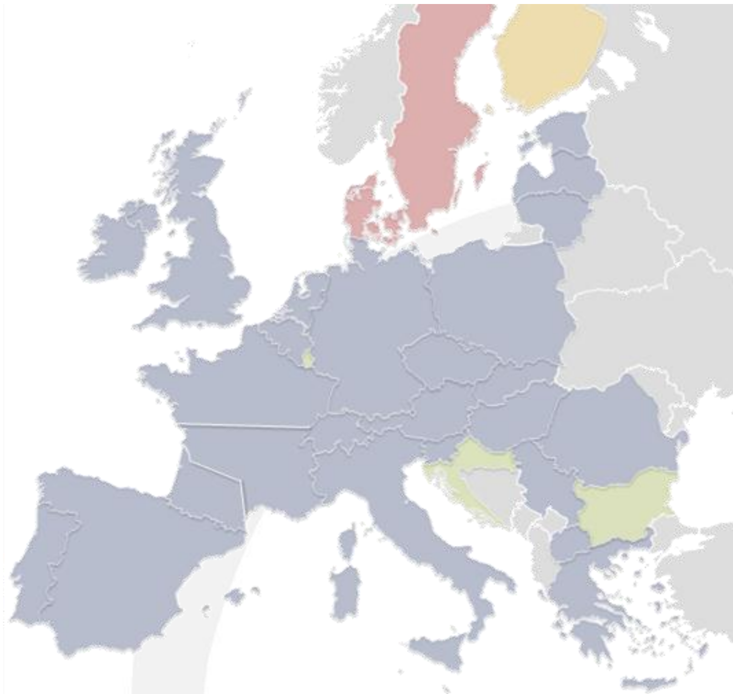


Figure 4 - 2-Week Case

If such case induces a lower stress on transmission network in term of transported energy, it requires a minimum stock level in UGS prior to the event.

Taking into account the decrease of UGS deliverability when stock level decreased, an initial stock level of 47% is necessary in order to enable a daily withdrawal of 11,101 GWh at the end of the event.

Ukraine disruption

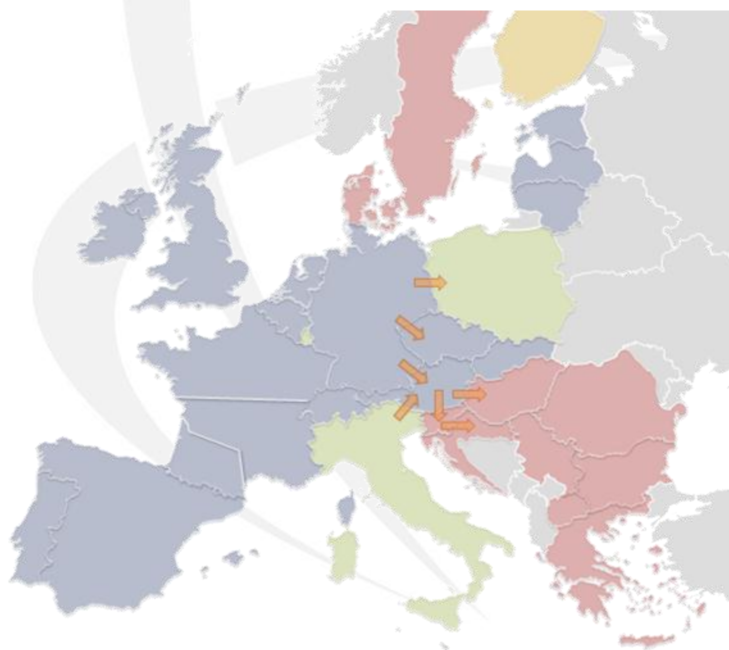


Figure 5 - 2-Week Case with Ukraine disruption

This event is applied to the 2-Week Case as described above. The considered disruption results in the complete interruption of flows at all borders of Ukraine with EU countries.

In case of disruption, complete rerouting of Russian supply is not possible (despite full use of alternative routes). Then there is an increase in UGS needs leading to a minimum stock level prior to the event of 58% in order to ensure a daily withdrawal of 12,891 GWh at the end of the event.

Nevertheless most of South-Eastern Europe countries would not be able to meet their whole demand and transit to Turkey cannot be ensured properly (total daily gas deficit is 1,026 GWh representing 42% of the needs). Orange arrows show the maximum use of cross-border capacity helping to mitigate the disruption.
Results are consistent with the ones of the one day disruption as pictured in ENTSOG TYNDP 2011-2020.

Supply source minimisation (capacity analysis)

This part of the sensitivity study investigates flexibility of the European gas network when facing different supply patterns.

Each supply source has been minimized one by one. Missing gas has been compensated through additional storage withdrawal and LNG terminal send-out.

Following tables summarize the results of modelled scenarios providing the minimum level for each supply required to balance demand in each country:

For January Case:

GWh/d	Reference Case	Import minimization compensated by additional UGS and LNG	
		Min. level	Comment
Algeria	1,487	0	
Libya	354	0	
LNG	5,043	2,042 (-60%)	Minimum send-out of 20% of capacity not reached in ES, PT and GR
Norway	3,884	0	
Russia	6,271	1,878 (-70%)	
UGS	12,383	Non applicable	
Nat. Prod.	6,527		

For March Case:

GWh/d	Reference Case	Import minimization compensated by additional UGS and LNG	
		Min. level	Comment
Algeria	1,487	0	
Libya	354	0	
LNG	4,361	1,916 (-54%)	Minimum send-out of 20% of capacity not reached in ES, PT and GR
Norway	3,884	0	
Russia	8,001	1,115 (-82%)	
UGS	7,784	na	
Nat. Prod.	6,527	na	

For 2-Week Case:

GWh/d	Reference Case	Ukraine disruption *
Algeria	1,431	
Libya	348	
LNG	3,452	4,023
Norway	3,726	
Russia	5,945	2,580
UGS	11,101	12,891
Nat. Prod.	6,527	

(*): sum of supply is equal to Reference Case demand minus uncovered demand (1,026 GWh/d)

Under all scenarios, flexibility to decrease supply is quite high (at least 60% during January peak and 54% during March one) especially when comparing the minimum level with the historical values of last 2 winters (see Annex C – graph "Historical supply ranked by level").

It has to be noticed that if Russian supply under minimization case is lower than the one resulting from a Ukraine transit disruption, it is more evenly spread along the different import routes. Result is then much less stressful.

Modelled scenarios show that under High Daily Demand conditions, the European gas network still offers a lot of supply flexibility to shippers when optimizing their supply portfolio with the exception of Greece and Iberian Peninsula where large LNG supplies remain necessary to balance these systems.

Conclusion

According to the ENTSOG modelling and supply assumptions, this Winter Supply Outlook confirms the ability of the European gas infrastructures to face Winter 2012/13 with significant flexibility.

On volume:
Import and UGS stock level are sufficient to face at least a winter demand as high as 110% of the average winter demand. The corresponding deliverability in January and March is high enough when facing the High Daily Demand cases (January, March and 2-Week).

On capacity:
The European gas network will provide significant flexibility when facing High Daily Demand conditions in most parts of Europe. This flexibility would enable shippers to cover peak demand through a wide range of supply strategies requiring a large share of LNG in the case of Greece and Iberian Peninsula given their interconnection with the rest of Europe.

In case of a Ukraine disruption during a 2-week of High Daily Demand, the ability of Europe to face such event will highly depend on the level of UGS and LNG terminals prior to the event. Nevertheless in this scenario countries of South-Eastern Europe will not have access to sufficient gas to meet their whole demand. This result is consistent with the one day Ukraine transit disruption under High Daily Demand conditions as modelled in ENTSOG TYNDP 2011-2020.

Please note that the integrated flow patterns used in this report is a hypothetical case just for the purposes of this Winter Supply Outlook.

Annex A - Methodology

Modelling tool for High Daily Demand conditions

Modelling has been carried out with an enhanced tool using linear programming of cross-border flows. Simulation uses entry/exit zones as basic blocks with specific blocks for transit systems:

- OPAL and Gazelle: modelled as separate blocks through Germany and Czech Republic
- Poland: separate blocks for Gaz-System zone and Yamal Europe
- Romania: separate blocks for Transgaz zone and the pipe between Isaccea (UA/RO border) and Negru Voda (RO/BG border)

Following tables show the assumptions used by ENTSOG

	Volume analysis - 1-in-2 Winter				
	Ref. Case	Cold winter		Warm winter	
Demand	Average monthly demand forecast provided by TSOs	Ref. Case +10%		Ref. Case -10%	
NP	Monthly average of last 2 winters				
Import (including LNG)	Monthly average of last 2 winters	Same level as Ref. Case	Ref. Case level +5%	Same level as Ref. Case	Ref. Case level -5%
UGS	Last resort supply				
X-border capacity	Firm technical capacity as provided by TSOs				

	January and March Cases	
	Ref. Case	Supply minimization
Demand	Design Case daily demand forecast provided by TSOs	
NP	Daily maximum of last 2 winters	
Pipe import	Daily maximum of last 2 winters	Decrease one-by-one down to minimum possible
LNG	110% of yearly average of last 2 years + Use as last resort supply	Decrease one-by-one down to 20% of send-out capacity
UGS	Last resort supply	
X-border capacity	Firm technical capacity as provided by TSOs	

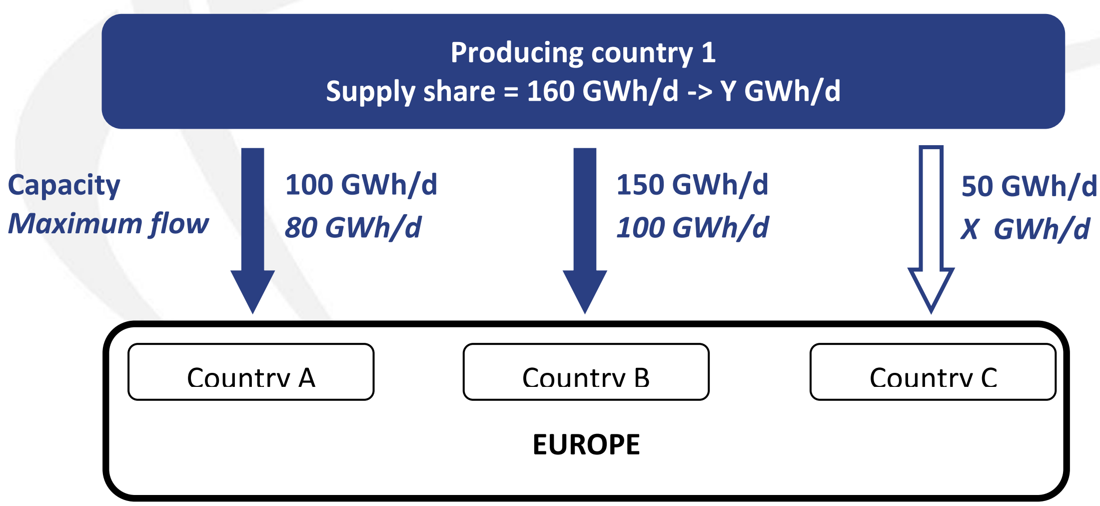
	2-Week Case	
	Ref. Case	**Supply minimization**
Demand	Simultaneous daily demand forecast provided by TSOs	
NP	Daily maximum of last 2 winters	
Pipe import	Daily maximum of last 2 winters on a 2-week period	Decrease one-by-one down to minimum possible
LNG	Yearly level plus minimization of stock level	Decrease one-by-one down to 20% of send-out capacity
UGS	Last resort supply	
X-border capacity	Firm technical capacity as provided by TSOs	

Supply definition of new import route under High Daily Demand Day conditions

When a new import infrastructure will come on stream in comparison with last winter, initialisation methodology has been:

Supply route maximum load factor: average of maximum load factor of the other routes coming from the same supply source

Update of the supply share: supply is increased based on the prorate between the sum of route maximum flows and supply before the new route comes on stream



Maximum flow of the new infrastructure:
X = [(80 + 100) / (100 + 150)] x 50 = 36 GWh/d

Update supply provided to Europe by Producing country 1:
Y = [(80 + 100 + 36) / (80 + 100)] x 160 = 192 GWh/d

This supply approach for new infrastructure favors imports against UGS as they are used as last resort supply. Regarding potential physical congestion, this is a conservative approach as imported gas has to be transported on longer distance.
Actual use of new infrastructure will be factored in next report through historical value serving as a basis of the whole supply approach.

Annex B - Under Ground Storages assumptions and outputs

UGS deliverability curve

In order to capture the influence of UGS stock level on the withdrawal capacity, ENTSOG has used a standard curve not considering at this stage differences between aquifers, salt caverns and depleted fields. Nevertheless the curve being conservative it still guarantees trustful results.

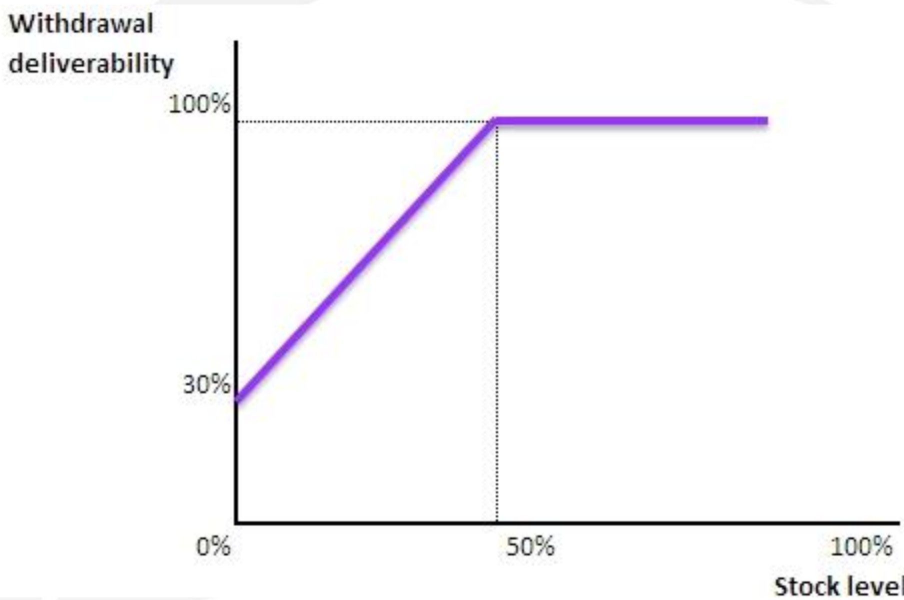


Figure 6 - Normative UGS delivery curve

Winter 2012/13 stock evolution according modelled scenarios

Below table provides the picture of UGS stock evolution under Results of Supply vs. Demand balance over the Winter 2012/13 (volume perspective):

Stock level at the end of each month		Sept. 2012	Oct. 2012	Nov. 2012	Dec. 2012	Jan. 2013	Feb. 2013	Mar. 2013
Reference CA		88%	92%	87%	76%	63%	53%	49%
Cold Winter	UGS only		87%	77%	59%	38%	21%	11%
	Imports & UGS		89%	80%	64%	46%	31%	23%
Warm Winter	UGS only		96%	98%	94%	88%	85%	87%
	Imports & UGS		95%	94%	88%	81%	75%	76%

Annex C - Data for Winter Supply Outlook 2012/13

Demand forecast

GWh/d	Average conditions						High Daily Demand conditions		
	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Jan	March	2 weeks
AT	296	366	420	451	435	350	767	767	767
BE	654	786	873	856	887	752	1,500	1,323	1,386
BG	70	105	110	125	130	100	180	140	180
HR	94	105	122	109	125	99	132	112	132
CZ	200	272	421	338	326	282	776	426	675
DK	105	146	177	196	200	173	296	253	296
EE	19	26	30	31	30	26	57	48	44
FI	102	126	140	155	32	214	244	244	244
FR	1,210	1,969	2,252	2,405	2,300	1,977	4,512	4,485	3,821
FY	3	4	6	5	4	5	14	16	14
DE	2,335	3,017	3,674	3,602	3,863	2,883	5,215	4,102	4,699
GR	130	148	154	181	183	162	239	241	205
HU	286	460	470	495	466	330	958	577	862
IE	136	155	192	183	189	169	264	215	264
IT	1,798	2,604	3,181	3,600	3,442	2,658	5,193	4,499	4,662
LV	40	60	70	75	85	65	120	90	121
LT	56	85	102	58	89	107	187	143	187
LU	42	45	52	56	53	46	71	71	72
NL	1,144	1,393	1,763	1,870	1,741	1,413	4,468	4,468	3,793
PL	391	458	547	590	590	508	833	597	833
PT	145	121	120	159	152	142	295	288	278
RO	469	596	593	597	600	402	756	700	756
RS	57	76	89	93	89	77	140	119	140
SK	136	201	249	272	255	203	406	326	361
SI	25	35	40	45	40	30	65	37	55
ES	919	1,189	1,187	1,229	1,236	984	2,142	2,020	1,951
SE	44	62	70	70	70	64	90	90	83
CH	77	95	123	127	117	94	191	159	191
UK	2,068	2,700	3,081	3,304	3,271	2,891	5,334	3,869	4,959
TK*	343	356	430	437	417	407	468	417	468
KAL*	21	24	30	33	36	33	95	73	81
Total	**13,414**	**17,783**	**20,768**	**21,747**	**21,454**	**17,645**	**36,008**	**30,915**	**32,580**

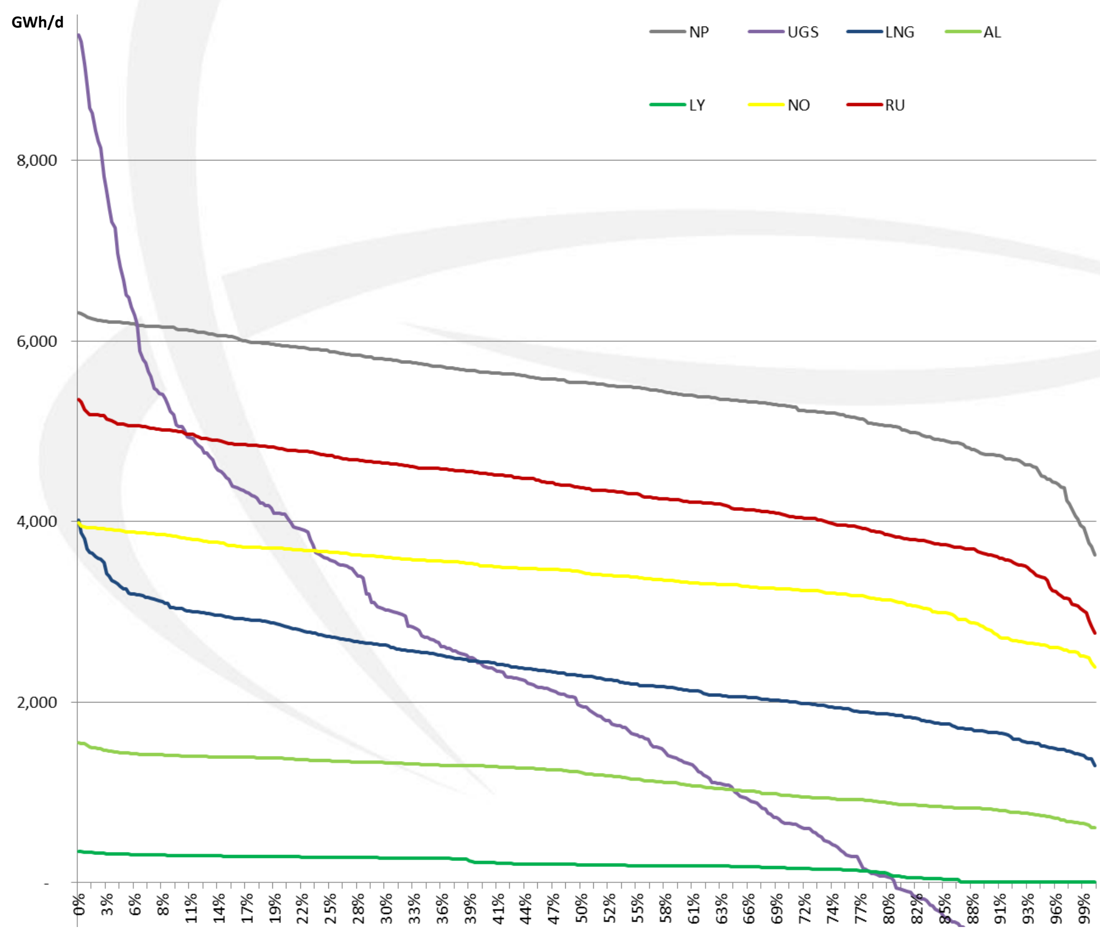
(*): Export to Turkey and Kaliningrad

Supply assumption

GWh/d	Average Supply						High Daily Supply		
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Jan.	Mar.	2-week
NP	4,705	5,403	5,739	5,754	5,790	5,230	6,527	6,527	6,527
AL	843	888	1,029	1,199	1,243	1,208	1,487	1,487	1,431
LY	282	273	284	284	230	338	354	354	348
LNG	2,090	2,328	2,472	2,492	2,468	2,166	5,043	4,161	3,452
NO	2,823	3,260	3,491	3,619	3,647	3,434	3,884	3,884	3,726
RU	3,814	4,319	4,576	4,562	4,694	4,231	6,271	6,271	5,945
Total	**14,557**	**16,472**	**17,592**	**17,911**	**18,073**	**16,606**	**23,566**	**22,684**	**21,429**

Historical supply ranked by level

Below graph illustrates for each supply source, levels met last 2 winters and their occurrence:



This graph confirms the ENTSOG assumptions on:

- Supply level, as the highest values are in line with winter profiles of each source
- UGS being used as last resort supply as they are used as a flexibility tool

It could be also pointed out that the sharp profile of LNG when reaching the highest values is linked to its role of peak shaving through LNG tank in some countries. This storage function of some LNG terminals explains also the sharp decrease on the left hand side when facing low demand. This profile justifies the 2-step approach of LNG first as import than as short term storages.

Zero values for Libya are explained by the fact that historical reference period covers the Green Stream shut down due to political events in the supplying country.

Winter 2011/12 Review

Executive Summary

ENTSOG has completed the review of the European gas supply and demand pictures for Winter 2011/12 (October to March) investigating actual demand and supply with a particular attention to the February cold spell. The seasonal Reviews aim a deeper comprehension of the development of the demand and supply in the previous seasons and the identification of trends that cannot be captured at national or regional level. They also help to build experience and solid background for the assumptions considered in the Outlook. Such knowledge is also factored in the recurrent TYNDP process in order to ensure consistence and continuous improvement of ENTSOG reports.

If Winter 2011/12 may stay notable because of the cold spell faced in February 2012, the overall season had been relatively mild compared to previous winter. This situation had helped the industry to face the cold spell with high stock level in UGS helping to compensate a relative limitation in Russian supply to deliver their maximum flexibility with large decrease on certain routes.

The review also highlights the link between gas and electricity markets. When most of the season has been characterized by low gas demand for power generation partially due to low coal and carbon emission prices, the cold spell has illustrated how situation can change under stressed situation.

The gas infrastructures have proved their ability to react according to the market needs when facing the February cold spell as well as the rest of the season.

Stakeholders' comments on this seasonal analysis are welcomed and would enable ENTSOG to improve its knowledge of seasonal and market dynamics influencing the use of infrastructure. This feedback would then be beneficial to the quality of further reports.

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The Winter Review was prepared in a professional and workmanlike manner by ENTSOG on the basis of information collected and compiled by ENTSOG from its members and from stakeholders and contains its own assumptions on the usage of the gas transmission system based upon this information.

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Introduction

This review, part of ENTSOG Annual Program 2012, is published on a voluntary basis and aims at providing an overview of demand and supply balance during Winter 2011/12. The report brings transparency on the internal analysis carried out by ENTSOG for the purpose of developing seasonal Supply Outlook and Union-wide TYNDP.

The report aims to provide an overview of European trends that could not be captured at a national level and to build experience for future reports. This report should not be seen as a direct review of the Seasonal Outlooks as outlooks do not aim to provide a forecast but to better explore infrastructure resilience.
Regarding European dynamics, the report highlights the wide heterogeneity of national demand profiles and supply sources. These differences are directly linked to physical rationales such as climate, demand breakdown or producing field flexibility for example.

The report is structured along demand and supply directions. For each one, it first gives an overview of the dynamic of the whole season before focusing on the February cold spell. As part of the cold spell analysis an overview of within EU cross-border flows is also provided.

Demand

Winter 11/12 gas demand was 3,191 TWh, significantly lower (-9.5%) than in the previous winter.

For the countries where the demand breakdown is available, the gas demand for power generation represented 26% out of 467 TWh, showing a decrease of 18% in comparison with previous winter.

The Figure 2 represents the evolution of the cumulative demand during the winter, its decrease shows a maximum (16.8%) on the 6th of January – coming from the warm temperatures registered in the first half of the winter- , followed by a recovery up to the final levels of 10%, due to the severe cold snap in February.

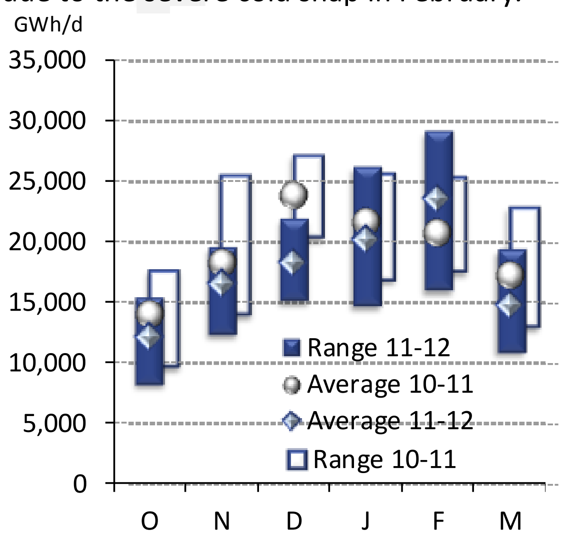

Figure 7 – Total gas demand

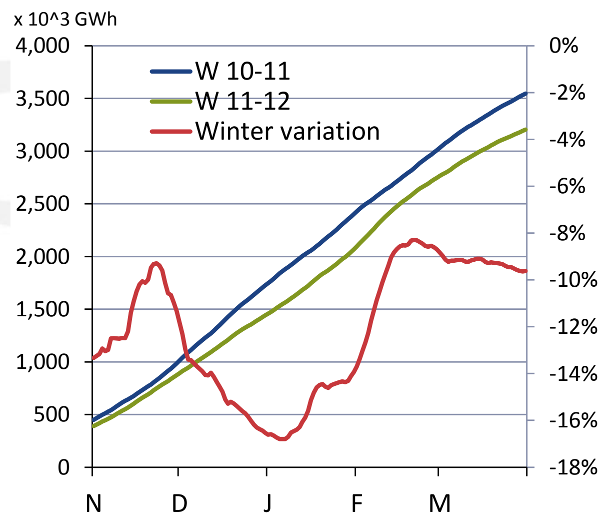

Figure 8 – Cumulative demand

While the low levels of demand could be explained by the mild winter – but for the cold snap -, the reduction in gas demand for power generation was sustained again with the February exception. This has been explained by gas having been replaced by coal in the generation mix, due to their relative prices and the low price of carbon emissions.

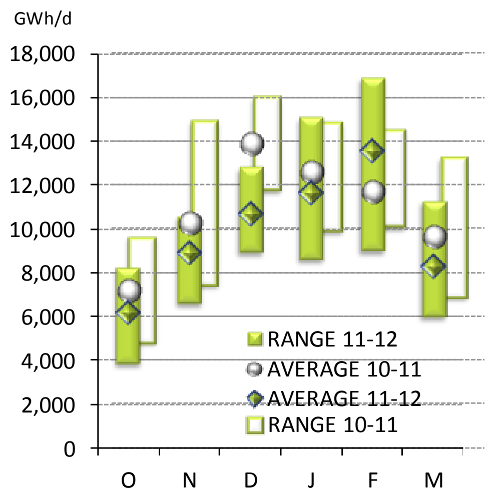

Figure 9 – Residential, commercial and industrial[4]

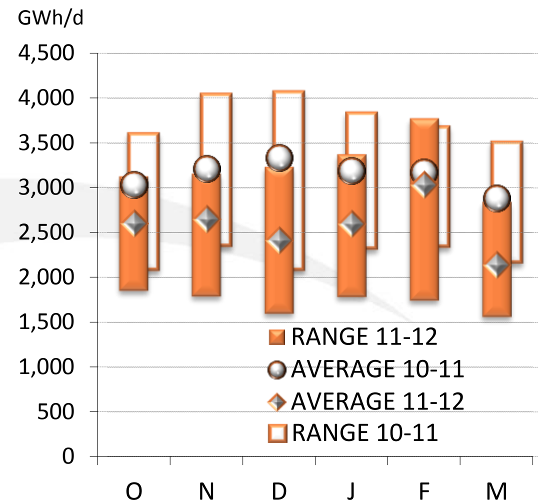

Figure 10 – Power generation[5]

Geographically the contraction was general, being more severe in those countries with higher shares of power generation in the demand break down, and flexibility to switch from one fuel to another, reaching a decrease up to 39% in Finland. The seasonal gas consumption increased in Croatia (+1%), Bulgaria (+2%) and Greece (+16%).

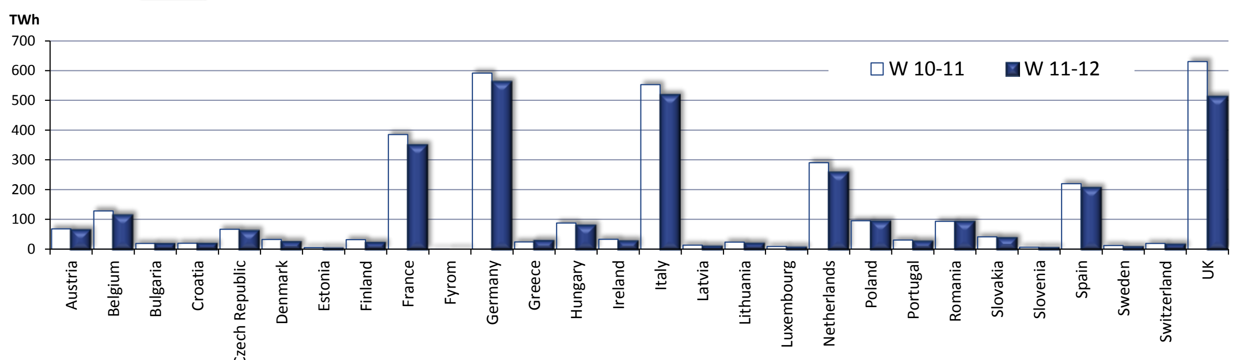

Figure 11 – Seasonal demand

The total electricity generated in Europe decreased around 2% from previous winter. While fossil fuels maintained their share in the electricity mix (43%), the electricity generated with gas decreased from a 18% to a 15% of the electricity mix (19% in absolute terms), being replaced mainly by coal.

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[4] [5] These graphs refer to the countries for which demand breakdown is available (Belgium, Croatia, Denmark, Finland, France, Greece, Hungary, Ireland, Italy, Lithuania, Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden and United-Kingdom).

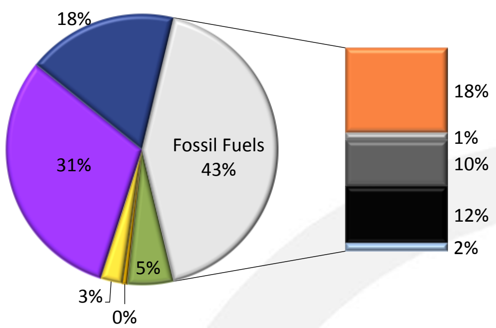


Figure 12 – Winter 2010/11 Total electricity production 1,826 TWh

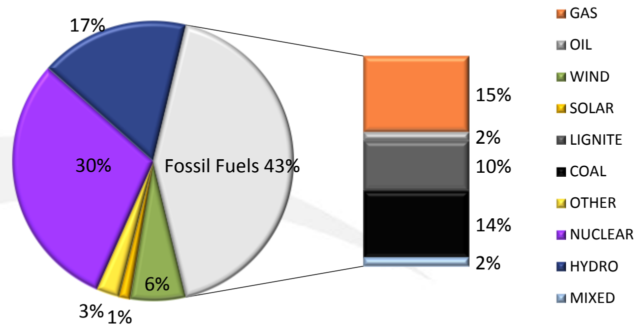


Figure 13 – Winter 2011/12 Total electricity production 1,782 TWh

Source: Own calculations based on data provided by ENTSO-E

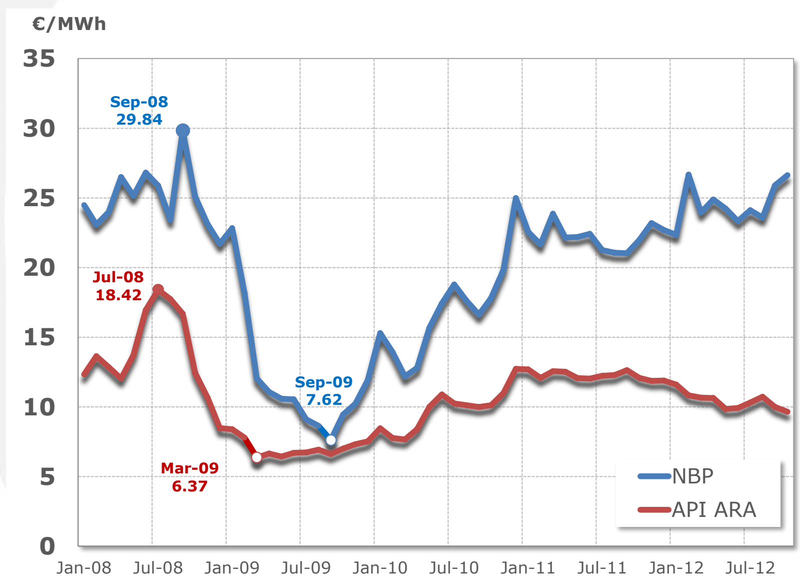


Figure 14 – Natural gas and coal prices

While the monthly patterns followed the gas demand for power generation are basically flat, there is a strong weekly pattern.

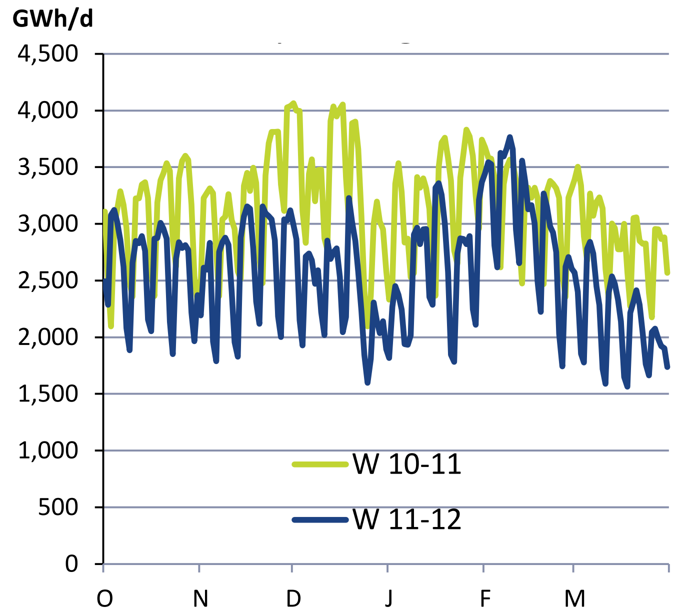


Figure 15 – Gas for power generation[6]

Cold snap February 2012

Due to the cold snap that took place during the first half of February, affecting most countries in Europe, high gas consumptions were registered during a 14-day period starting on 31 January and going on until 13 February.

This cold snap was characterized not only by its sharpness, but especially for its duration, with an average gas consumption of 27,644 GWh/d during the 14-day period, that is a 12% more than the 14 days of highest consumption of the previous winter.

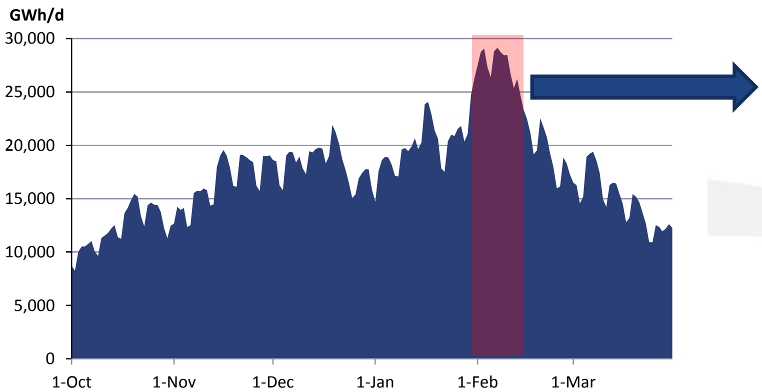


Figure 16 – Winter 2011/12 demand profile

Peak period	31/01/2012 - 13/02/2012
Average consumption	27,644 GWh/d
Peak day	7/02/2012
Peak consumption	29,141 GWh/d
Peak consumption +8% (ref peak consumption W10/11)	
Peak period +12% (ref 14 days of higher consumption W10/11)	

Even when it can be said that it was a global phenomenon affecting the continent, neither the severe weather conditions nor the high levels of gas consumption were homogeneous across Europe.

The map below shows at country level the comparison of the average consumptions during the 14-day period in February, with the average consumptions in the 14 days period of highest consumption in Europe in Winter 2010/11 (starting on the 9 December 2010). As can be seen, the increase in the demand level was particularly significant in France, Germany, Poland, Czech Republic, Austria, and Slovenia reaching average demands more than a 25% over the demands registered during the equivalent period the previous winter. Nevertheless, it was significantly softer on the west, with average demands only slightly higher than those of the previous winter in Spain and Portugal and decreasing 14-days average in UK and Ireland.

Other countries where the 14-day demand increases strongly are Croatia and Greece, being those variations strongly influenced by the yearly growth.
The same way, Danish reduction can also be explained by a decreasing trend in the gas consumption. On the contrary, Finnish decreases in the 14-day period are more linked with power generation consumptions and the possibility of fuel switching.

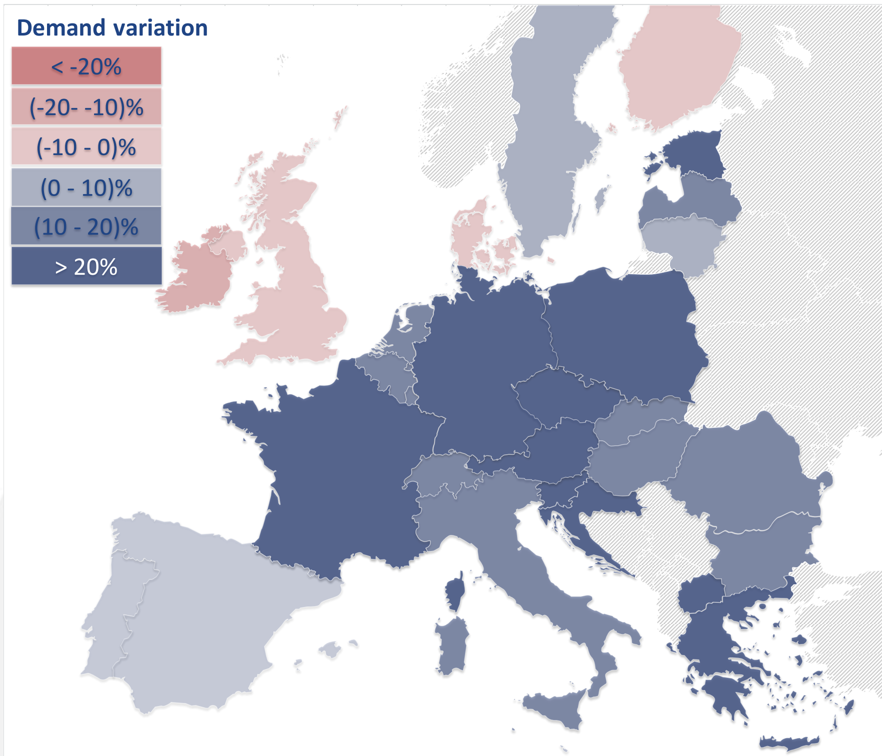


Figure 17 – Demand comparison between the highest 14-day periods of Winter 2010/11 and Winter 2011/12

The day of maximum gas demand reached 29,141 GWh/d, on the 7 February, a 8% over the maximum of the previous winter, but only a 5% over the average demand during the cold snap.

As happened with the 14-days average demand, the variation of the maximum day demand from the one of previous winter was not homogeneous through Europe. On a country level, differences ranged between the -26% of Ireland and the +28% of Germany.

The decrease on maximum daily consumptions in countries like UK, Ireland, Portugal and Spain is partly explained not by the milder weather conditions but due to the general decrease of power generation consumptions (-30% IE, -40% PT, -44% ES, -28% UK).

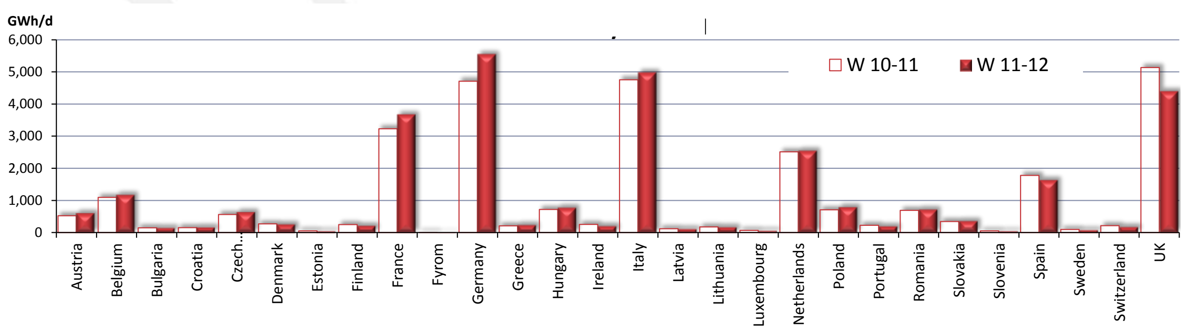


Figure 18-Maximum daily demand

The map below shows at country level the comparison of the daily demand during the day of European maximum consumption (7 February), with the daily demand values in the European day of highest consumption in Winter 2010/11 (17 December 2010).

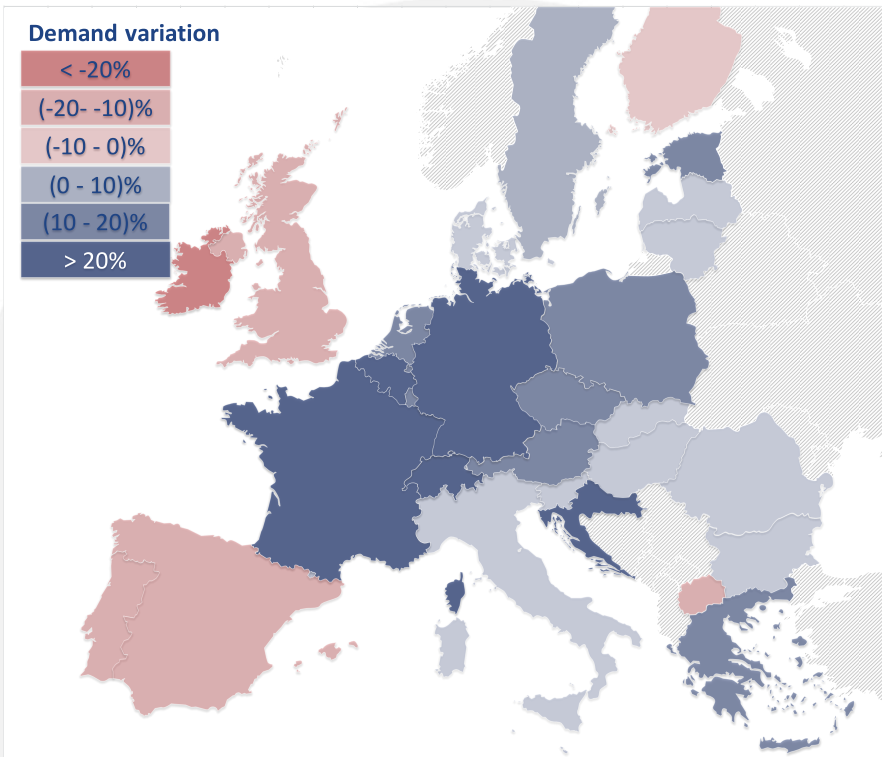


Figure 19– Demand comparison between the highest single day of Winter 2010/11 and Winter 2011/12

In order to measure the simultaneity between the peak days in different countries, the "Un-simultaneous Peak" is described as the sum of the peak day demands of the individual countries having occurred un-simultaneously, defining:

- the European Peak Simultaneity (EPS)
  - EPS = European Peak Demand / Un-simultaneous Peak (%)
- the individual Country in the European Peak day Simultaneity factor (CPS)
  - CPS = Country demand on the European peak day/Country peak demand (%)

So defined, the European peak simultaneity during the peak day on 7 February 2012, was 96%, while in the peak day of Winter 2010/11 it reached 94%.

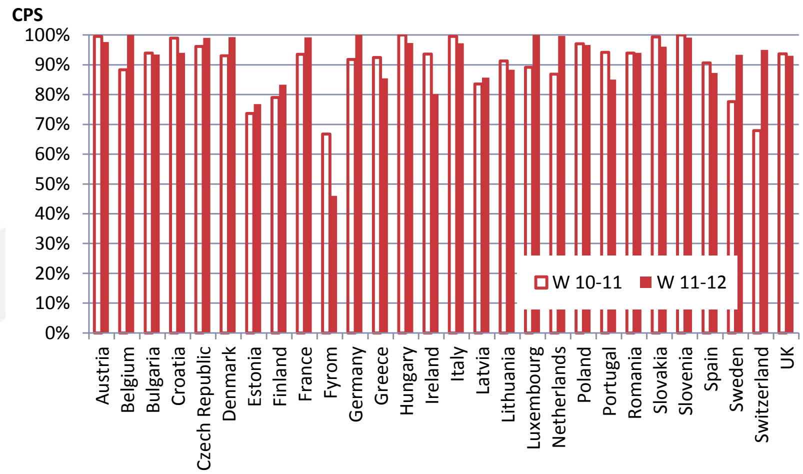


Figure 20 – Simultaneity of highest single day between last 2 winters

Supply

The next graph provides an overview of Import, National production and UGS supply shares during Winter 2011/12 and 2010/11 in absolute and relative terms.

Total Winter Supply:
3,2x10^3 TWh

The decrease in the seasonal demand has been translated in the general decrease of each supply source with the exception of Norway. The reduction of LNG supplies has been particularly strong, influenced by the increase of LNG consumptions in Asia after Fukushima.

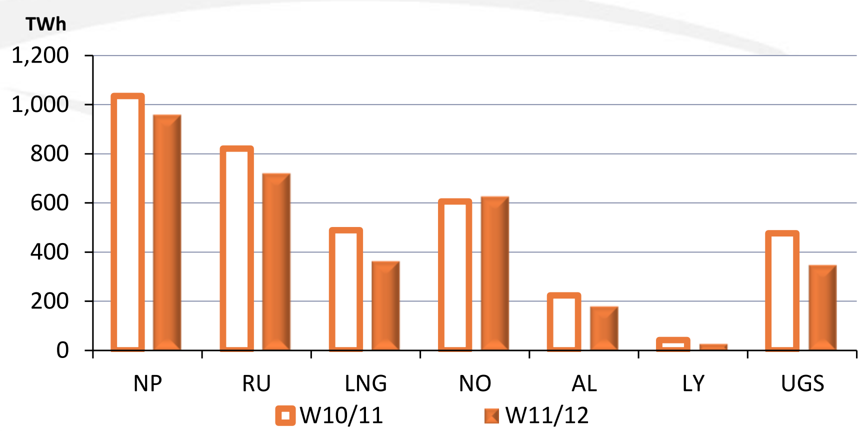


Figure 21 – Seasonal supply

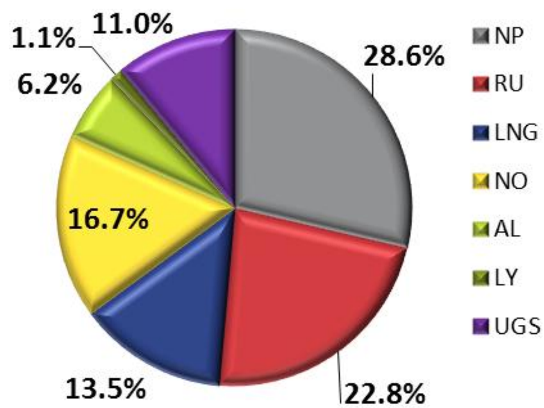


Figure 22 – Winter 2010/11 supply shares

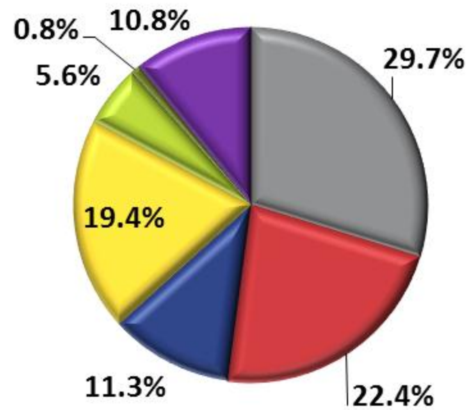
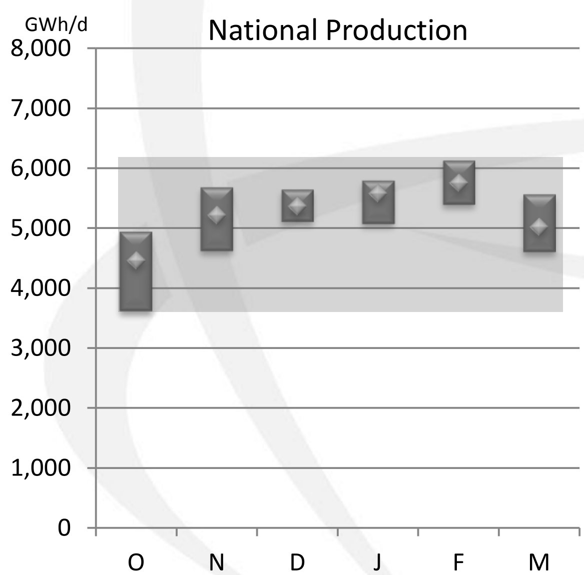
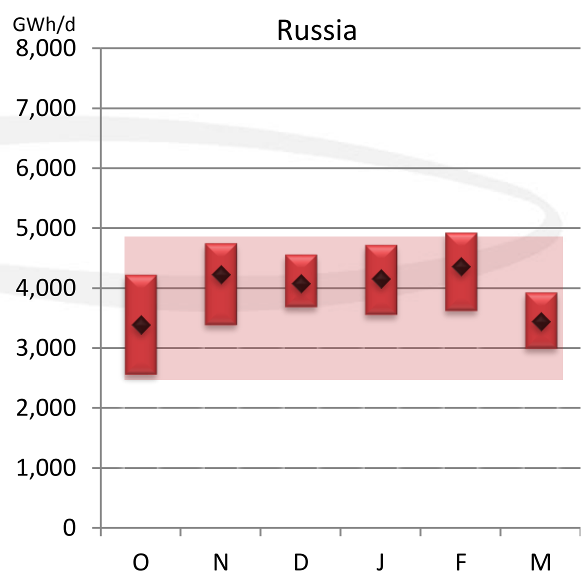
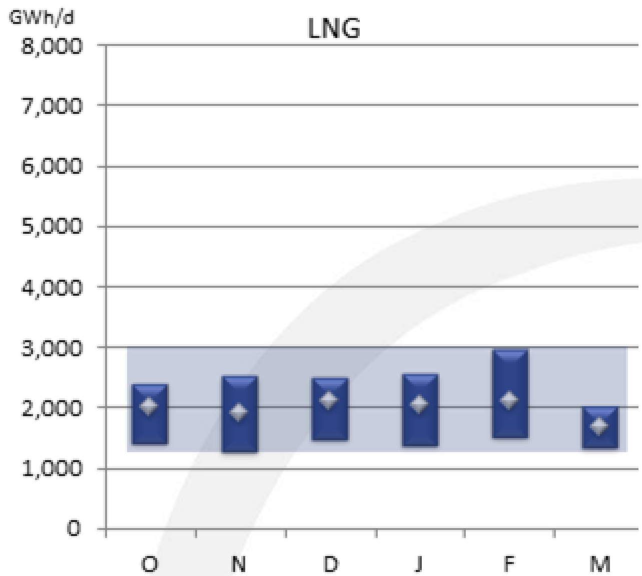


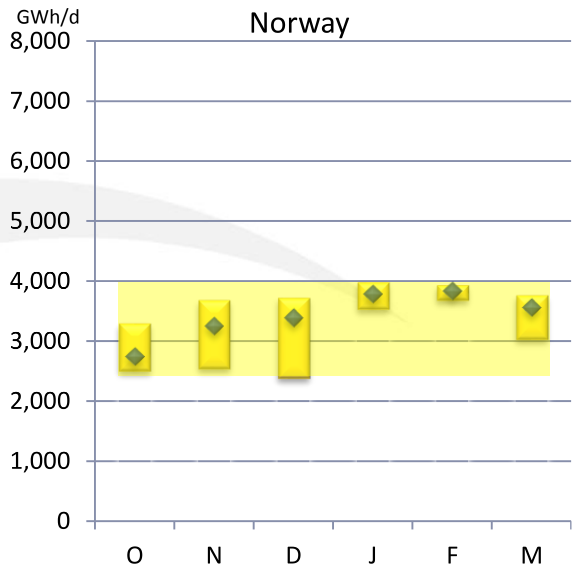
Figure 23 – Winter 2011/12 supply shares

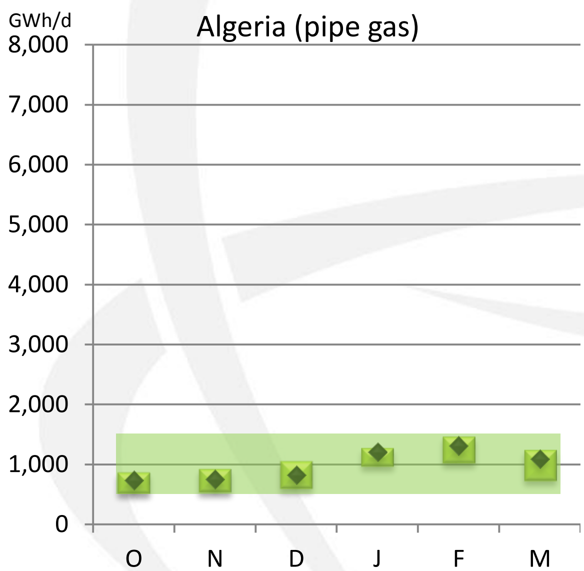
The following graphs illustrate for national production and each import supply source and month the average flow and the monthly and seasonal range (between the lowest and highest daily flow of each month and for the whole Winter 2011/12):

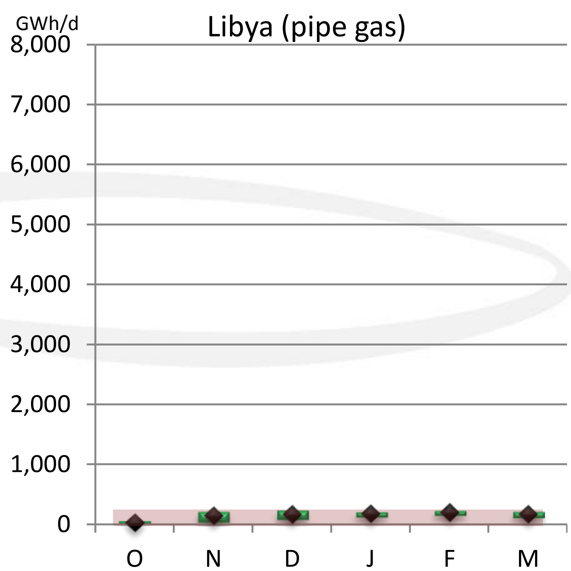





LNG
GWh/d
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
O
N
D
J
F
M


Norway
GWh/d
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
O
N
D
J
F
M


Algeria (pipe gas)
GWh/d
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
O
N
D
J
F
M


Libya (pipe gas)
GWh/d
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
O
N
D
J
F
M

Underground Storages

The next graph shows the average withdraws and daily range between the lowest and the highest withdraw for the whole Europe for every month of the Winter 2011/2012.

The utilization of the Underground Storages season depends on many factors, linked to price signals such as summer-winter spread or climatic and economic considerations having impact on gas demand.

During Winter 2011/12 the low level of withdraws during the first four months – driven by the warm temperatures – provided a high level of stock at the beginning of the cold snap in February, and as result with enough deliverability to secure the gas supply during the cold snap.

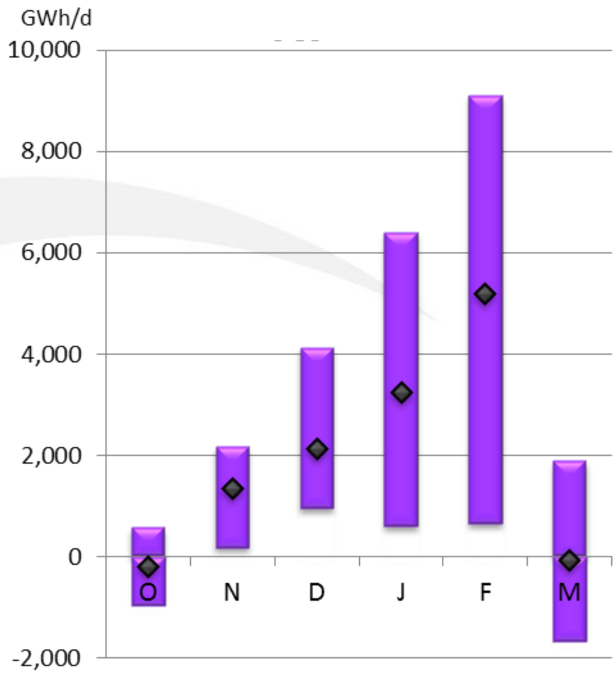


Figure 24 – UGS use in Winter 2011/12

The next table provides the level of stock evolution (%) during winter for GSE operator areas (source GSE AGSI platform):

Hub area*		1-Oct-11	1-Nov-11	1-Dec-11	1-Jan-12	1-Feb-12	1-Mar-12	31-Mar-12
Baumgarten	AT,CZ,HU,PL,SK	88.47	87.98	81.71	74.11	61.22	43.05	40.18
France (PEG Nord)		94.12	94.95	88.56	68.22	55.23	28.81	18.3
France (PEG Sud)		56.9	62.67	61.12	54.16	42.55	21.7	25.44
France (PEG TIGF)		99.35	98.59	91.33	75.22	53.35	27.07	23.25
Germany		96.01	95.71	92.45	82.6	70.1	48.63	47.94
Iberian	PT,ES	95.7	99.91	91.82	85.52	76.42	65.24	60.62
NBP		95.96	96.53	96.36	88.35	72.88	46.83	59.08
PSV		97.87	99.92	92.16	78.81	63.76	48.51	48.88
TTF		89.96	89.48	87.01	85.64	78.86	54.75	58.54
ZEE		100	100	93.44	74.61	62.5	38.79	33.11

(*): Areas as the ones defined under the AGSI platform

Figure 25 – UGS stock evolution during Winter 2011/12 (AGSI perimeter)

As seen when comparing the import average values by source in February, UGS played a substantial role in covering the high peak consumptions, moving from an average share of 11% in the winter supplies up to a 33% during the peak day.

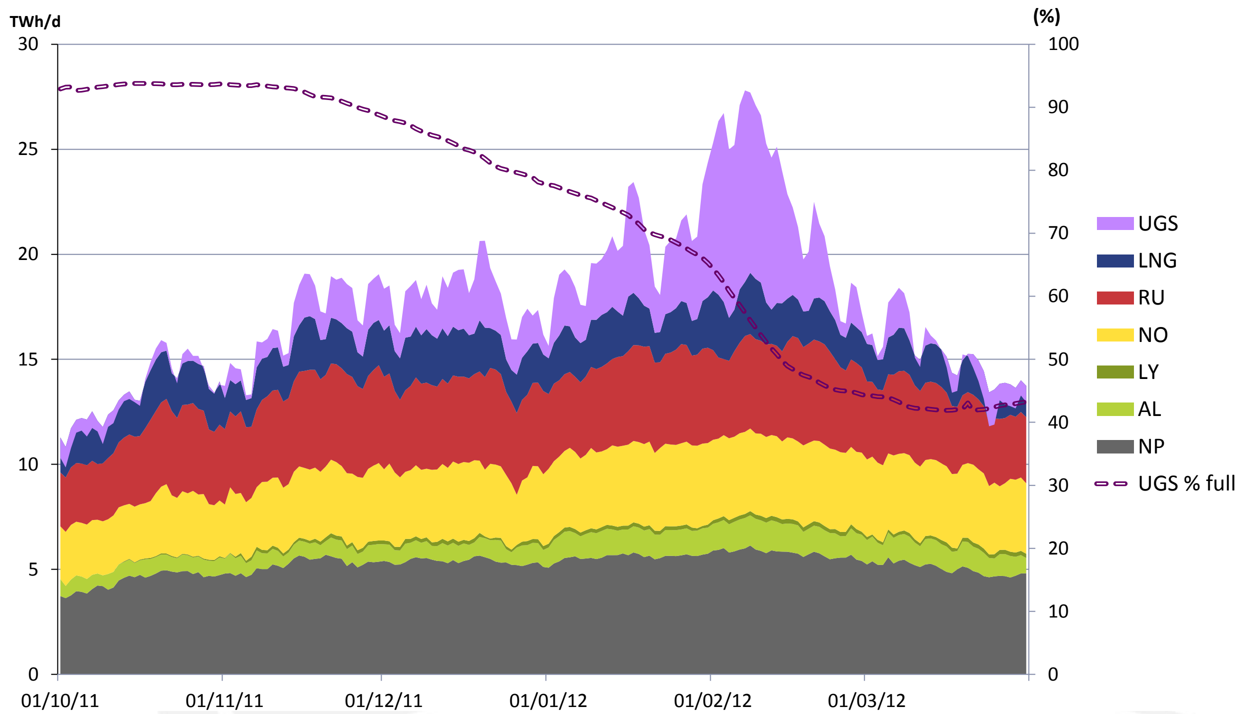


Figure 26 – Winter 2011/12 supply profile

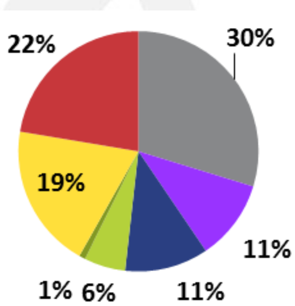


Figure 27 – Winter average

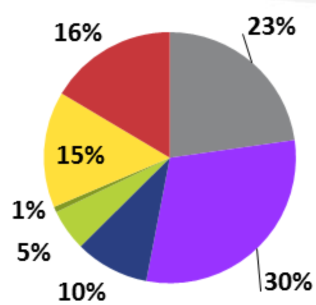


Figure 28 – 14-day cold spell

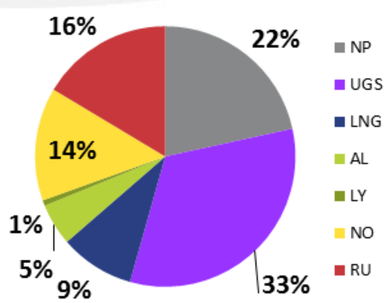


Figure 29 – 7 February 2012

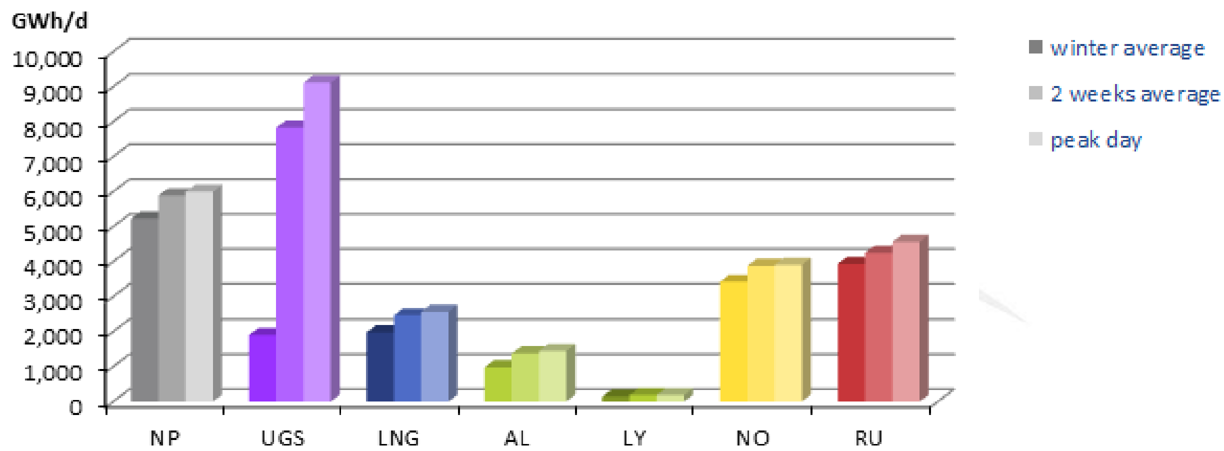


Figure 30 – Supply contribution under different situation of Winter 2011/12

The following graphs show the evolution of the Russian supplies during the two first months of the year, with detail of the flows through the Ukrainian routes. Quite significant was the decrease in the flows through Slovakia that come down on the 5 February more than 30% from the winter average.

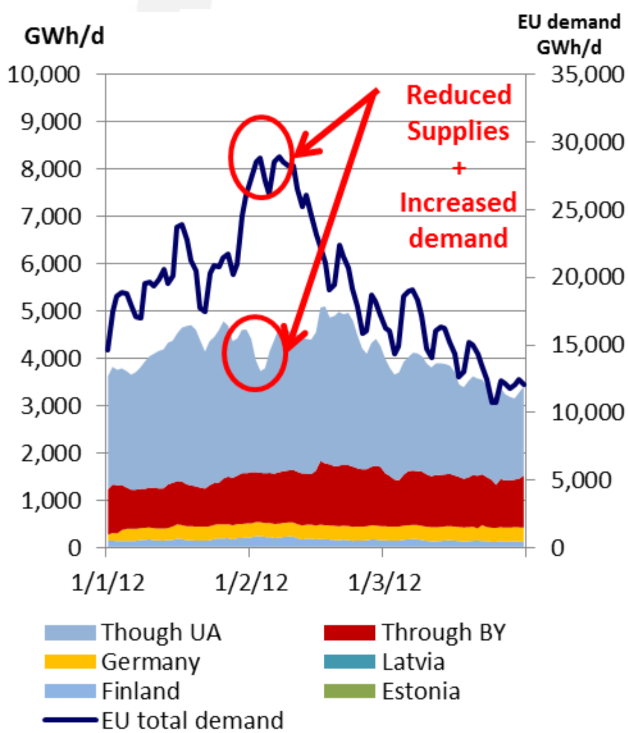


Figure 31 – Russian supplies

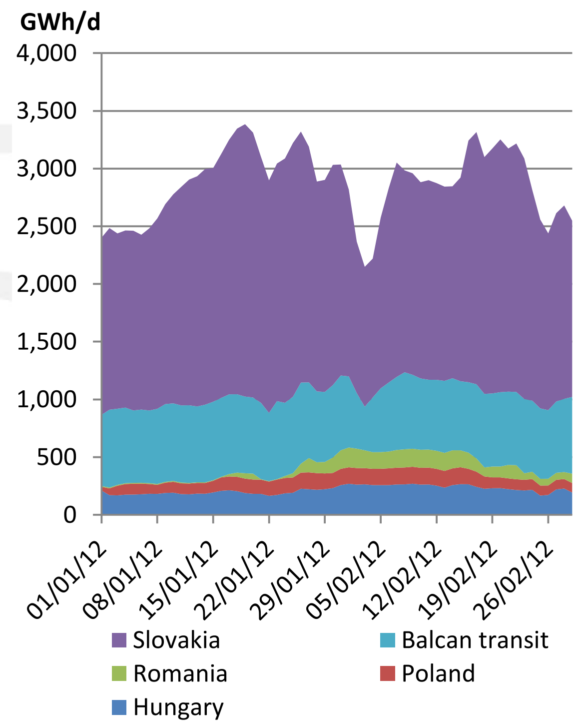


Figure 32 – Ukrainian routes

Restrictions to LNG send-out were also reported in Greece and Italy, in both cases, the send-out was limited by lack of LNG stock in the tanks, obeying to different factors: While in Italy the bad sea weather conditions (wind, wave height and wave frequency) prevented the arrival of LNG cargos into the terminal, in Greece the relatively low number of vessels having already asked for a compatibility certification from the L/TSO (DESFA), impeded maintaining the LNG stock to support the required send-out.

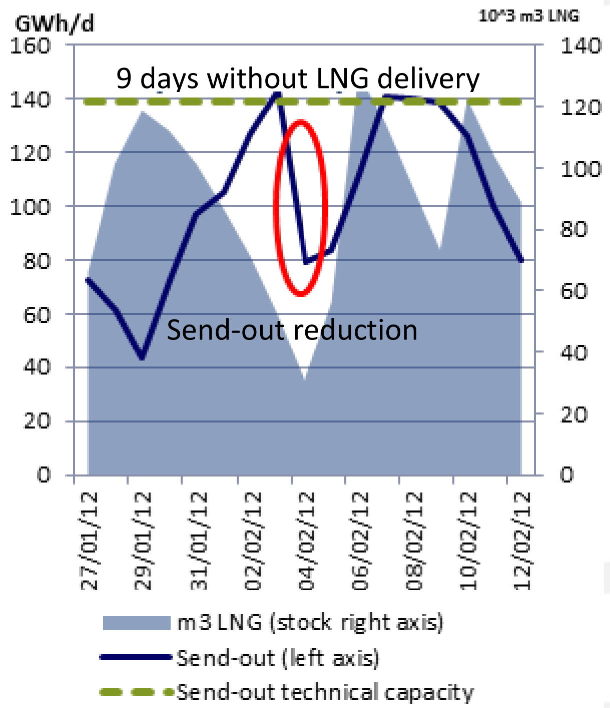


Figure 33 – Greek LNG terminal

Figure 34 – Italian LNG terminals

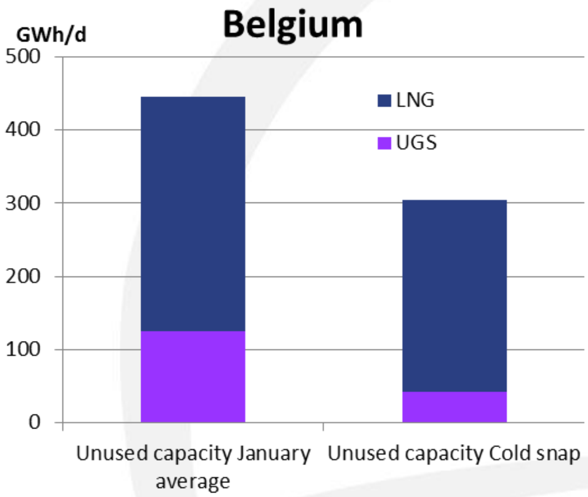
Note: The stock volumes in Italy have been estimated from the operational data published by ADRIATIC LNG and GNL ITALIA websites.

This section shows what had been the use of LNG and UGS by the market and the ability of such infrastructures to face additional gas needs. At European level, LNG send-out has increased by 25% in absolute terms. With the exception of Greece and Italy, where the bottleneck was in the interface Ship-Terminal, the remaining available Send-out capacity was not used in the same proportion as UGS for different reasons.

In France, Belgium and Netherlands, where the increase in gas demand during the cold snap was significant, as well as in the UK – with a moderate increase of gas demand - there was a clear higher use of UGS. That can be explained by the high stock level available in the storages, coming from the low demand experienced during the first months of the winter, and the relative role of UGS in the entry capacity especially in France.

In Spain the increase of gas demand during the cold snap was moderated, and almost negligible in Portugal. In Spain, most of the flexibility required was provided by LNG terminals, while in Portugal the deliveries from UGS even decreased from the January's average level.

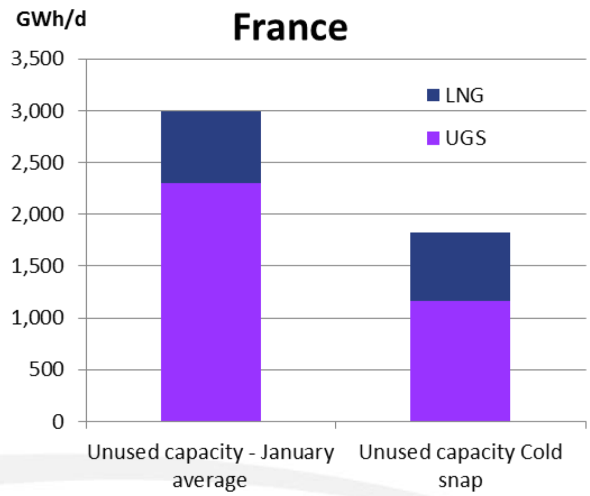
The following graphs show the evolution of the respective LNG and UGS shares in the unused capacity for some countries*:*



Demand increase vs. January average 37%

42% of the increase in the capacity use was LNG

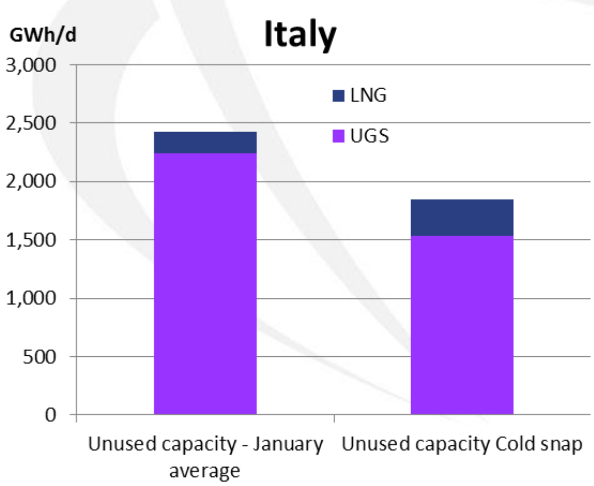
58% of the increase in the capacity use was UGS



Demand increase vs. January average 35%

3% of the increase in the capacity use was LNG

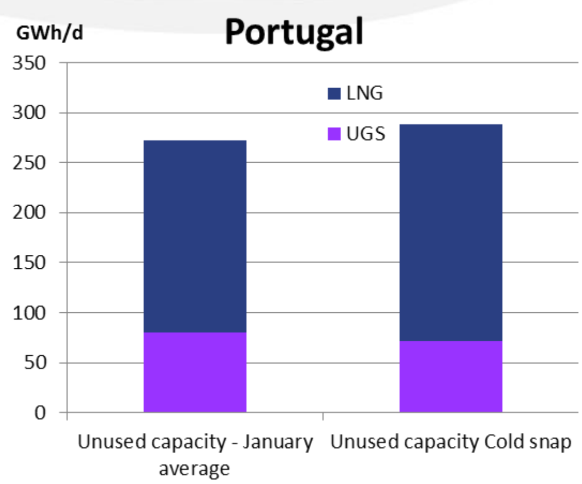
97% of the increase in the capacity use was UGS



Demand increase vs. January average 24%

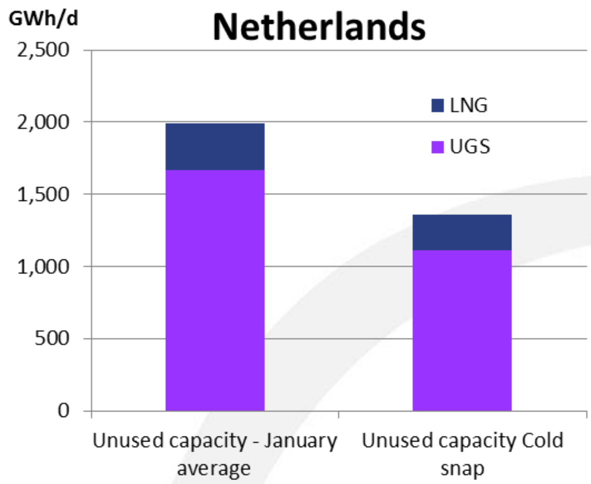
22% decrease in LNG use (see explanation above)

100% of the increase in the capacity use was UGS

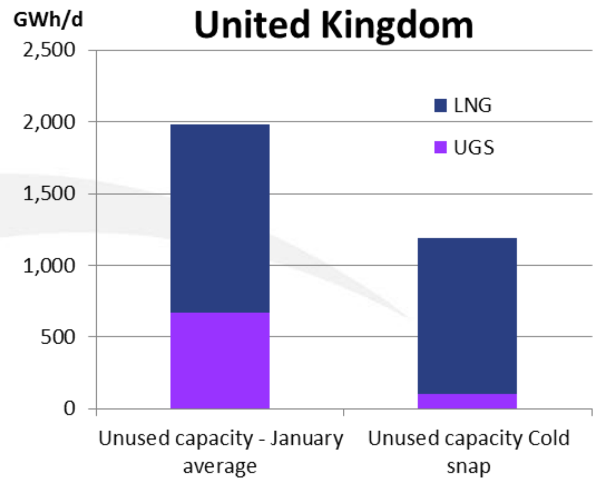


Demand increase vs. January average 2%

UGS in Portugal are saline caverns, having both injection and withdraw during January or the cold snap



Demand increase vs. January average 33%
11% of the increase in the capacity use was LNG
89% of the increase in the capacity use was UGS



Demand increase vs. January average 21%
29% of the increase in the capacity use was LNG
71% of the increase in the capacity use was UGS

Transmission Network

During the cold snap, the high level of gas demand combined with the mentioned reductions in some supply sources caused a significant stress on the transmission network.

The following graph summarizes the main flows entering Europe and through the European cross-borders on the maximum demand day, 7th of February. It should be noticed that the showed flows reflect a specific daily situation, derived from many factors as duration and intensity of the cold period, contractual clauses, global gas prices, etc.

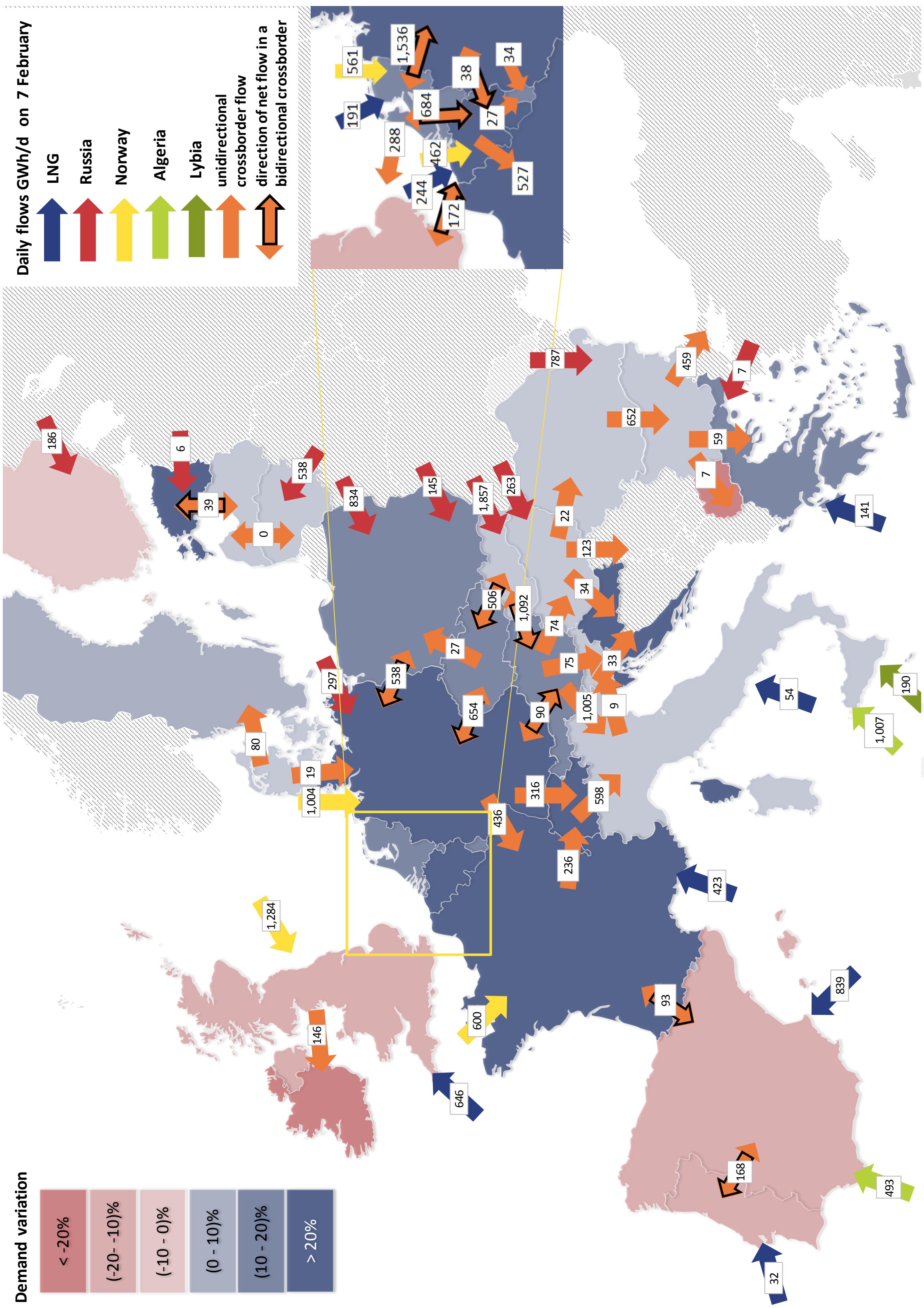
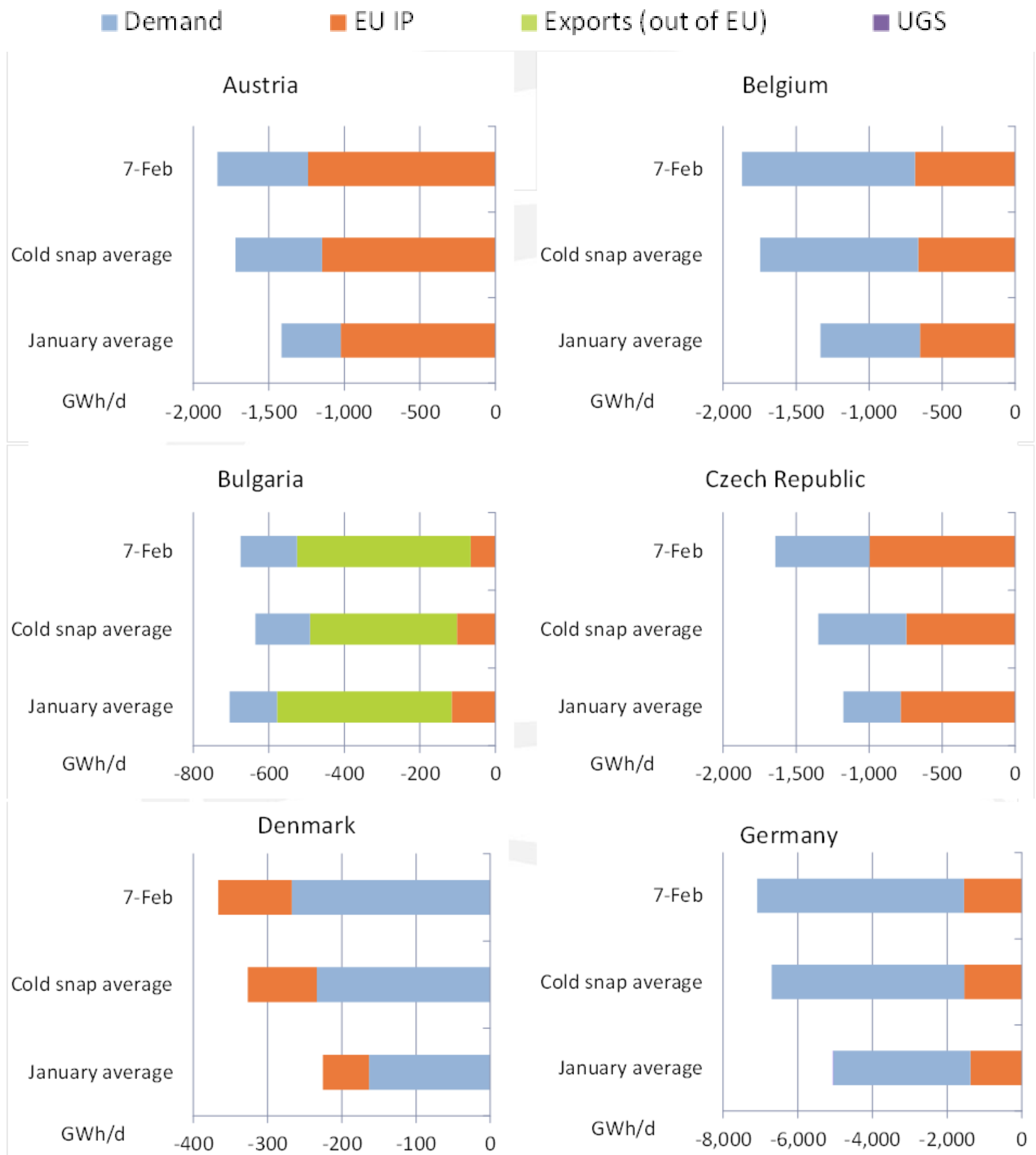
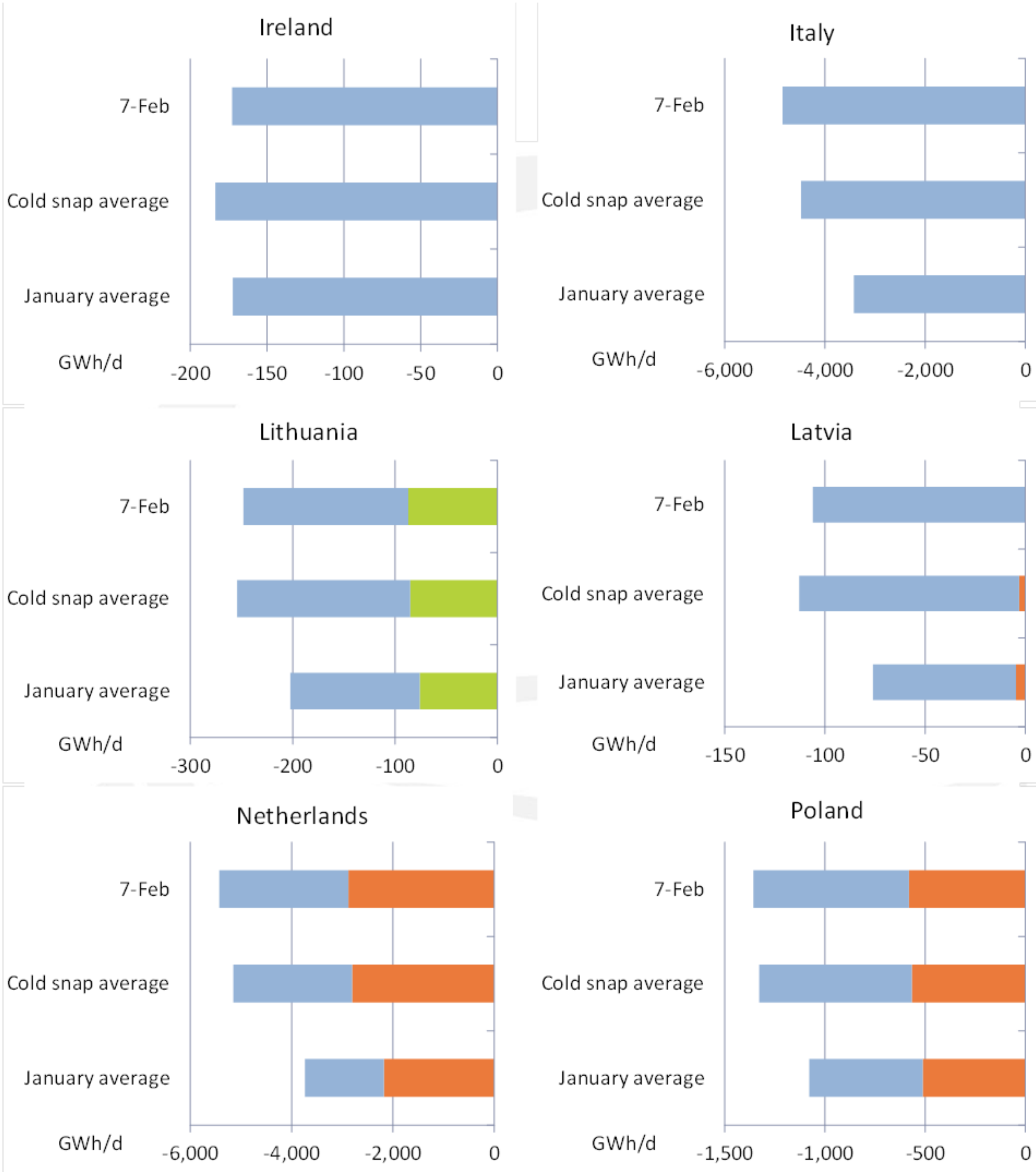
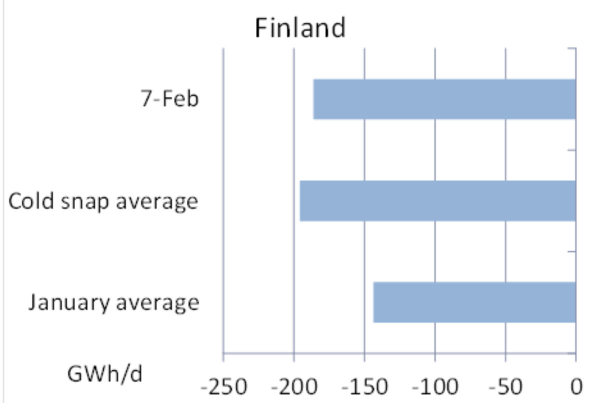


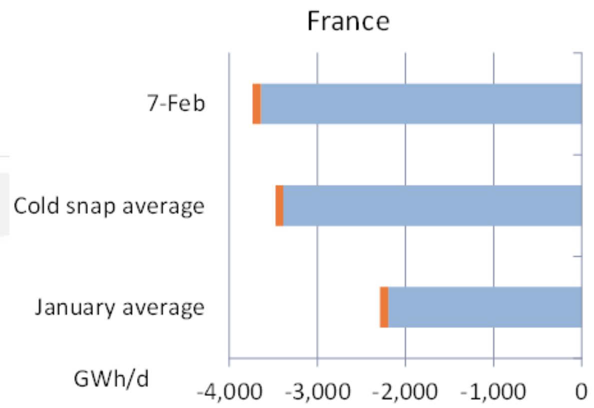
Figure 35 - Net flow pattern on 7 February 2012

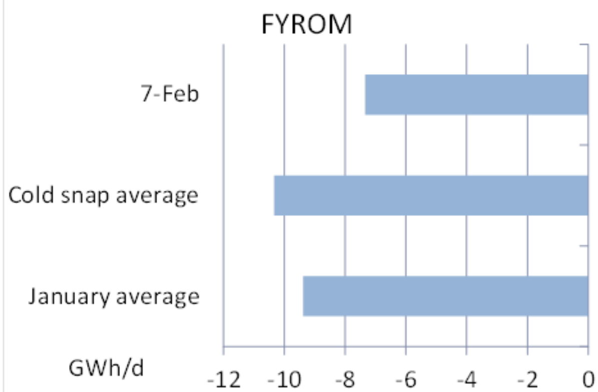
The graphs below show at country level the different stress on the network, as transported flows (demand + exports) comparing between the average day in January, the average day during the 14-day cold snap, and the peak day.

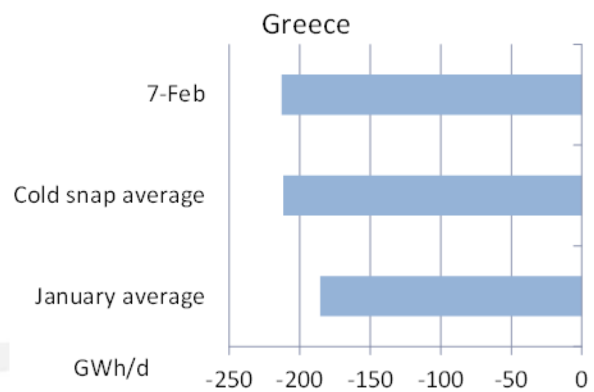


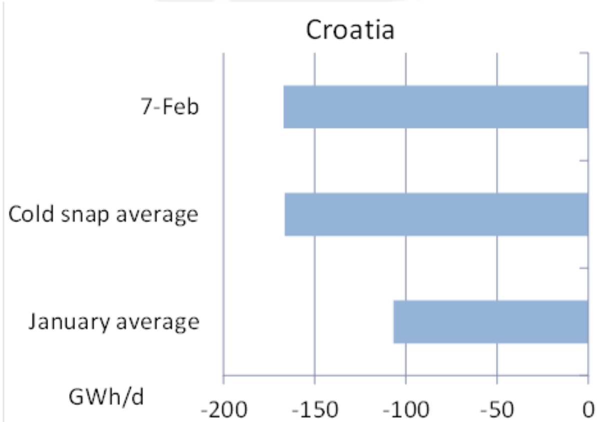

Ireland
7-Feb
Cold snap average
January average
GWh/d
-200 -150 -100 -50 0
Italy
7-Feb
Cold snap average
January average
GWh/d
-6,000 -4,000 -2,000 0
Lithuania
7-Feb
Cold snap average
January average
GWh/d
-300 -200 -100 0
Latvia
7-Feb
Cold snap average
January average
GWh/d
-150 -100 -50 0
Netherlands
7-Feb
Cold snap average
January average
GWh/d
-6,000 -4,000 -2,000 0
Poland
7-Feb
Cold snap average
January average
GWh/d
-1,500 -1,000 -500 0

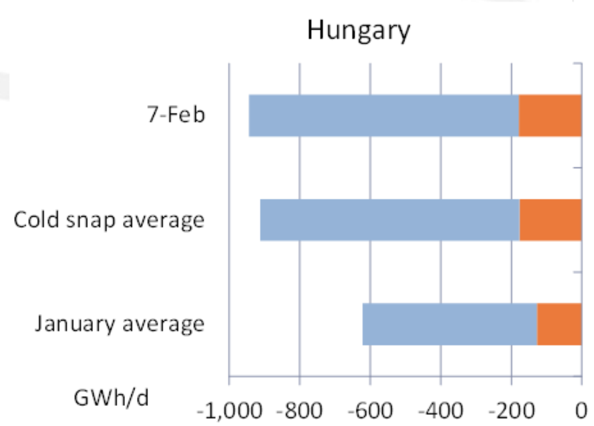

Finland
7-Feb
Cold snap average
January average
GWh/d
-250
-200
-150
-100
-50
0

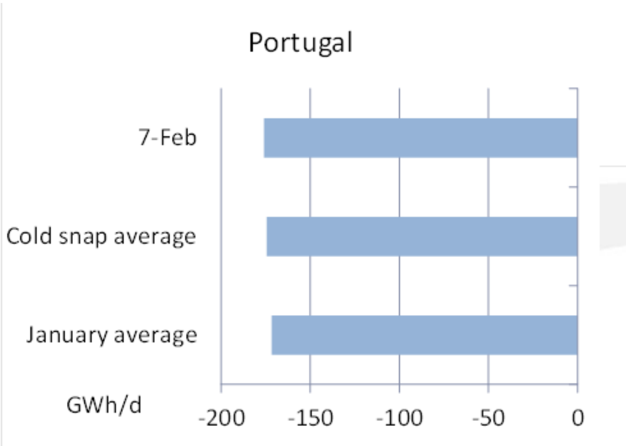

France
7-Feb
Cold snap average
January average
GWh/d
-4,000
-3,000
-2,000
-1,000
0

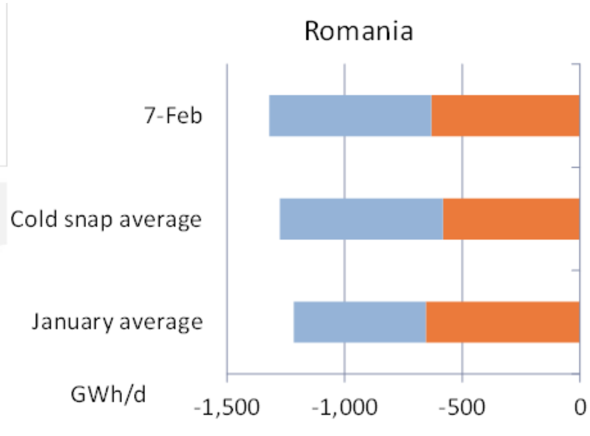

FYROM
7-Feb
Cold snap average
January average
GWh/d
-12
-10
-8
-6
-4
-2
0

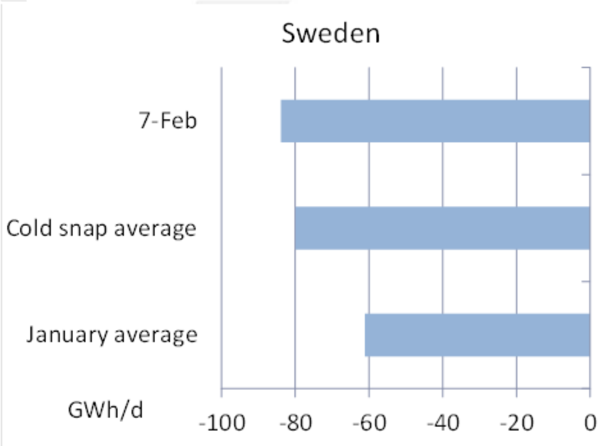

Greece
7-Feb
Cold snap average
January average
GWh/d
-250
-200
-150
-100
-50
0

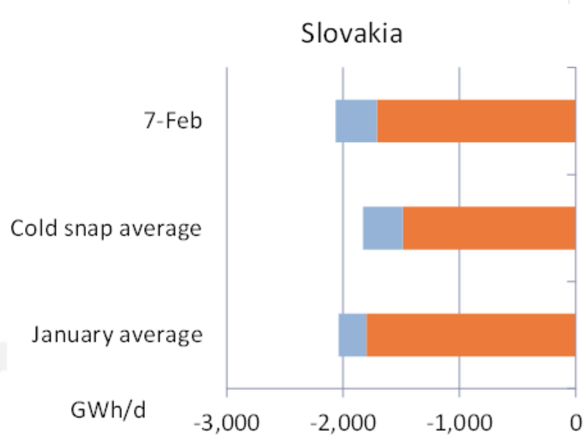

Croatia
7-Feb
Cold snap average
January average
GWh/d
-200
-150
-100
-50
0

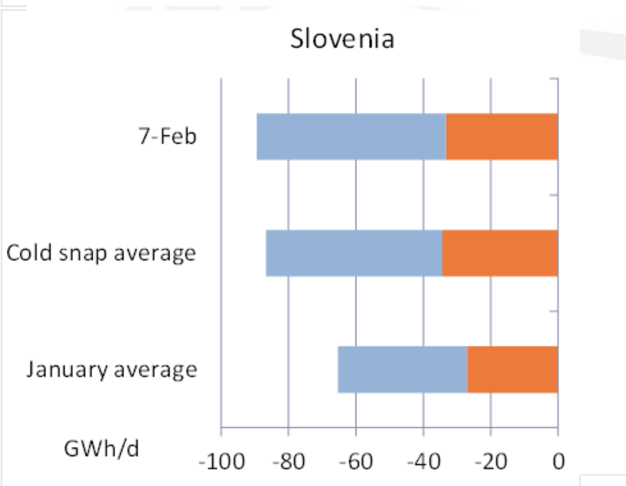

Hungary
7-Feb
Cold snap average
January average
GWh/d
-1,000
-800
-600
-400
-200
0

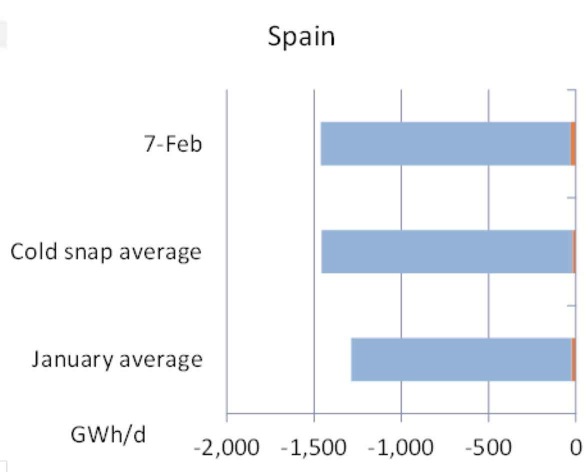

Portugal
7-Feb
Cold snap average
January average
GWh/d
-200
-150
-100
-50
0

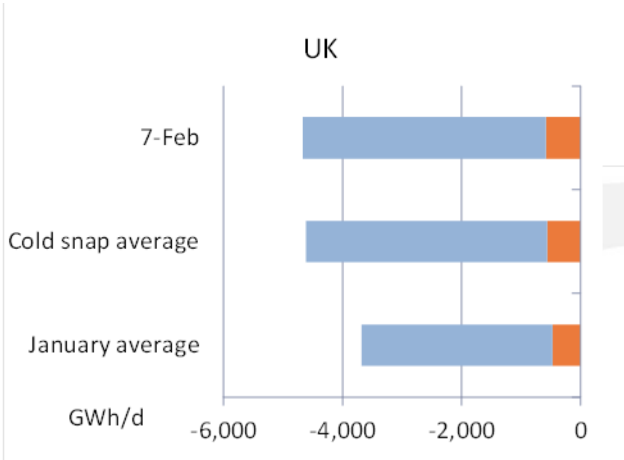

Romania
7-Feb
Cold snap average
January average
GWh/d
-1,500
-1,000
-500
0

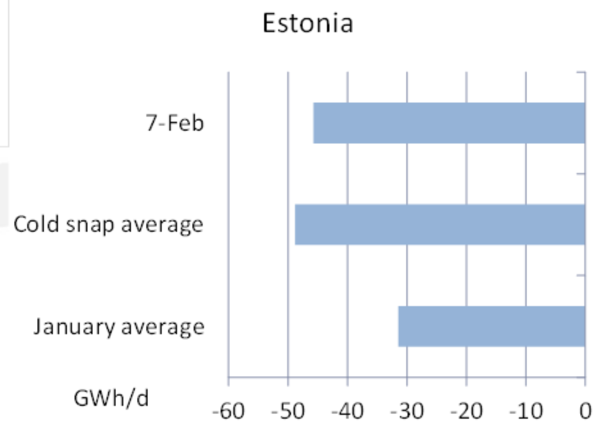

Sweden
7-Feb
Cold snap average
January average
GWh/d
-100
-80
-60
-40
-20
0


Slovakia
7-Feb
Cold snap average
January average
GWh/d
-3,000
-2,000
-1,000
0


Slovenia
7-Feb
Cold snap average
January average
GWh/d
-100
-80
-60
-40
-20
0


Spain
7-Feb
Cold snap average
January average
GWh/d
-2,000
-1,500
-1,000
-500
0





Conclusion

The Seasonal Review highlights the value of a bottom-up approach as a way to capture national or supply specificities that could be factored in future top-down approaches. In this regard, the review illustrates that gas demand being influenced by many factors (e.g. climate, power generation mix, yearly trends…), Winter 2011/12 has presented a very diverse picture with a harsh cold spell in February when the overall season had been quite mild compared to previous winters.

The same diversity can be found on the supply side with a very different use of sources. During the cold spell, such variations in supply had been amplified at route level with strong decrease of Russian export through Ukraine partially compensated through alternative routes.

In any case, the gas infrastructures have proved their ability to react according to the market needs when facing this cold spell.

This report provides a mostly quantitative analysis and intends to be the basis of fruitful discussion with stakeholders on the orientation to be given to such report. Stakeholder feedback is crucial as a large part of the seasonal analysis is beyond TSOs scope.