

Winter Supply Outlook 2015/16

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 2015 to March 2016). The analysis focuses on the possible evolution of UGS inventory along the season and the ability of the gas system to face high demand situations. It assesses the potential of gas infrastructures under a given demand and supply situation. Under such assumptions and compared to last Winter Supply Outlook, conclusions are:

- > **The European gas infrastructure offers sufficient flexibility across the season in most parts of Europe, provided gas is available**
- > **The European gas infrastructure is capable of supplying Ukraine with significant volumes of gas**
- > **A disruption of transit through Ukraine under high demand situations still strongly impacts South-East Europe¹**
- > **With the commissioning of the second step of the project at Ellund, Denmark has the ability to cope with high demand situations**
- > **The balance of the Swedish market under high demand situations, during a cold winter, still depends on the availability of interruptible capacity or storage measures**
- > **The lower demand expectations enable Luxembourg to face high demand situations**

ENTSOG has used a sensitivity analysis to check if the European gas infrastructure is able to:

- > cover the full winter demand under different demand conditions: a Reference Winter and a Cold Winter²
- > enable shippers to meet different high demand situations in each country under different supply conditions
- > enable shippers to face disruption of Russian gas through Ukraine under high demand situations

¹ Reduced demand expectations improve the situation compared to last winter.

² The Reference Winter and the Cold Winter are defined on page 5 of the document.

The current analysis is developed specifically for this Winter Supply Outlook. It results from TSOs experience and ENTSGO modelling and supply assumptions and should not be considered as a forecast.



Introduction

As part of ENTSG continuous effort to ensure greater transparency and knowledge regarding the development and operation of the European gas network, ENTSG presents this Winter Supply Outlook 2015/16. 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 high demand periods.

The winter months require storage withdrawal to cover both short high demand periods and the overall winter 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. Compared to last winter the actual European aggregated inventory level of underground gas storages levels on 1 October is lower. The actual levels for each country show substantial differences from one country to the other. These actual levels per country have been used as a starting point for the Winter Supply Outlook 2015/16.

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When assessing the supply adequacy at European level through TYNDP and Outlooks, ENTSG aims to enlarge the geographical scope of the study beyond its own perimeter. Winter Supply Outlook 2015/16 covers the EU-28 (less Cyprus and Malta) plus Switzerland, Bosnia, Serbia, FYROM as well as exports to Ukraine, Turkey, Kaliningrad and St. Petersburg³.

³ There were no more significant exports observed to Moldova. For this reason export flows to Moldova are not considered in this Winter Supply Outlook.

Two different visions: winter period and high demand situations

As for previous reports the Winter Supply Outlook 2015/16 captures two different but still linked visions of the season.

The first one is an outlook of demand and supply evolution along the winter and the resulting evolution of UGS inventory.

The second one is the analysis of specific and hypothetical events being high demand situations (1-day Design Case and 2-week Cold Spell) and a transit disruption occurring under such high demand situations. For the 2-week Cold Spell three different supply cases have been considered to assess the flexibility of different supply sources:

- Case 1: high supply by pipeline and low supply from LNG (pipeline supply flexibility)
- Case 2: high supply from LNG and low supply by pipeline (LNG supply flexibility)
- Case 3: low supply by pipeline and low supply from LNG (underground gas storages flexibility).

These two visions are assessed separately in the Winter Supply Outlook 2015/16.

Assumptions

Modelling approach

The network model for the Winter Supply Outlook is the same as used in the TYNDP. It is handled on country level and takes into account the existing gas infrastructure and the infrastructure planned to be commissioned during the upcoming winter. The technical capacities taken into account were based on the figures from TYNDP 2015⁴. LNG and gas storages modelling have been improved following proposals from GLE and GSE.

In the model, the send-outs from the terminals are modelled to represent the sum of the off-loaded volumes of arriving cargos and gas from tanks. In collaboration with GLE, an improved approach is applied for send-outs during the 2-week Cold Spell, allowing differentiation of the LNG terminals behaviour between the first and the second week. During the first week, the model will determine the LNG send-outs using the level of LNG supply reaching LNG terminals as calculated for the same period for the Cold Winter case, plus additional LNG that can be taken from the tanks. The following 7 days allow importers to access a relevant number of cargos, so that the LNG send-outs are only limited by the send-out capacities during the second week. As a result, the send-outs are expected to be modelled in a more realistic way. The figures for the additional LNG from the tanks have been checked with GLE (see Annex B).

For the underground gas storages (UGS), dynamic modelling is applied, taking into account the influence of UGS inventory on withdrawal deliverability by using withdrawal deliverability curves. These deliverability curves⁵ have been revised in cooperation with GSE. As an additional modelling assumption, a 30% UGS inventory level is targeted at the end of this winter, if it does not prevent countries to be balanced.

Under high demand situations and disruptions the modelling is done on the basis of an optimal crisis management, so that each country tries to minimize the impact on itself before exporting gas to other countries. Whilst avoiding a demand curtailment in each country, the given level of interconnection capacity is used as far as possible to minimize the relative impact on all other countries.

⁴ Updated where necessary by TSOs

⁵ See Annex A

Demand

A Reference Winter has been defined as representing a 1-in-2 year climatic condition. The demand data has been provided by TSOs on a monthly level⁶. A flat daily demand has been considered within each month.

For the purpose of the sensitivity analysis, a Cold Winter has been defined on the basis of the Reference Winter, using a demand deviation. The demand deviation for the Cold Winter is computed country by country based on the demand figures observed over the last 5 years (see annex B for more detail including per country). This deviation has been applied to the demand of the Reference Winter for each country. The Cold Winter shows an overall increase of 10% of the total demand compared to the Reference Winter.

For comparison purpose, the European aggregated demand for the Reference Winter and Cold Winter are compared to the historical demand as well as average demand (red line) over the last 6 winters below:

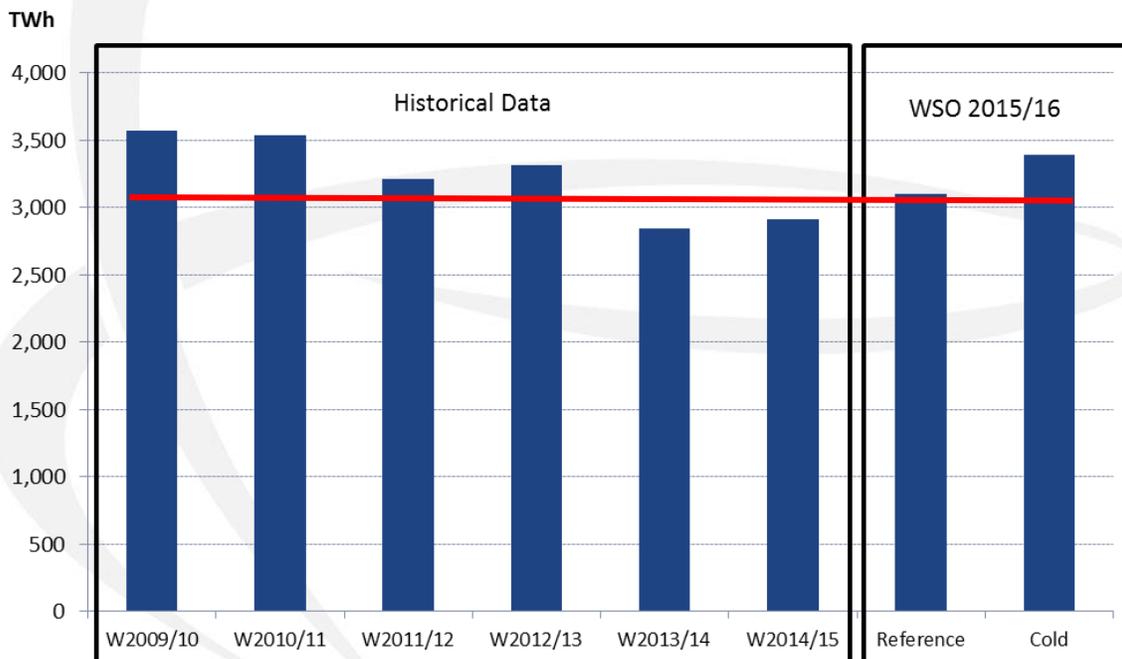


Figure 1: European aggregated demand in the past compared to the visions

These values differ from one country to the others.

⁶ The number of days within the months are according to the Gregorian calendar.

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 ⁷	National design standard for gas demand, taking place on 31 January
2-week Cold Spell ⁸	High demand during a 14-day period in February (Cold Spell), taking place 16-29 February

Export from Europe

The analysis considers the following transit from Europe to other regions: Kaliningrad from Lithuania, Saint-Petersburg from Latvia, Ukraine from Slovakia and Turkey from Bulgaria. The levels of the different transits are indicated in the Annex B.

⁷ For the Design Case, compared to previous ENTSSOG Winter Supply Outlooks, TSOs provide figures for the total demand including the gas demand for power generation.

⁸ Same as for the Design Case

Supply

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

	National Production	UGS ⁹	LNG	Algeria, Norway, Libya, Russia ¹⁰	
Reference Winter	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 supply observed during the last 5 winters and at monthly level to the maximum supply observed during the last 2 winters.		
Cold Winter			Case 1: high supply pipeline and low supply LNG		
2-week Cold Spell	TSO forecast for high demand situations		Limited to the observed February flow in the Cold Winter vision in week 1, increased by 20% in week 2	Limited to the highest level reached during 2 weeks over the last 4 years.	
			Case 2: low supply pipeline and high supply LNG		
			Limited to the observed February flow in the Cold Winter vision in week 1, and terminal send-out capacity in week 2	Limited to the monthly maximum of the last two winters	
Case 3: low supply pipeline and low supply LNG					
			Limited to the observed February flow in the Cold Winter vision in week 1, increased by 20% in week 2	Limited to the monthly maximum of the last two winters	
1-day Design Case		Limited by terminal send-out capacity	Limited to the highest level observed on 1 day over the last 4 years ¹¹ .		

⁹ The influence of UGS inventory on withdrawal deliverability has been considered using deliverability curves provided by GSE (see Annex A). The initial storage level on 1 October 2015 for each country comes from AGSI platform and SSO websites.

¹⁰ All simulations are carried out with partial availability of OPAL taking into account the current exemptions for all simulations cases except for disruptions cases where full availability is considered.

¹¹ Approach from Winter Supply Outlook 2014/15 is conserved.

For the Reference Winter and Cold Winter, by the approach of defining maximum supply availability based on historical values from the last 5 winters and the last 2 winters, it is intended to consider the long-term experience and the latest development at the same time.

Results of Supply vs. Demand balance over the winter

The Winter Supply Outlook takes into account the actual storage inventory level per country as of 1 October 2015¹² as initial situation. As shown in the map below the storage inventory levels differ from country to country.

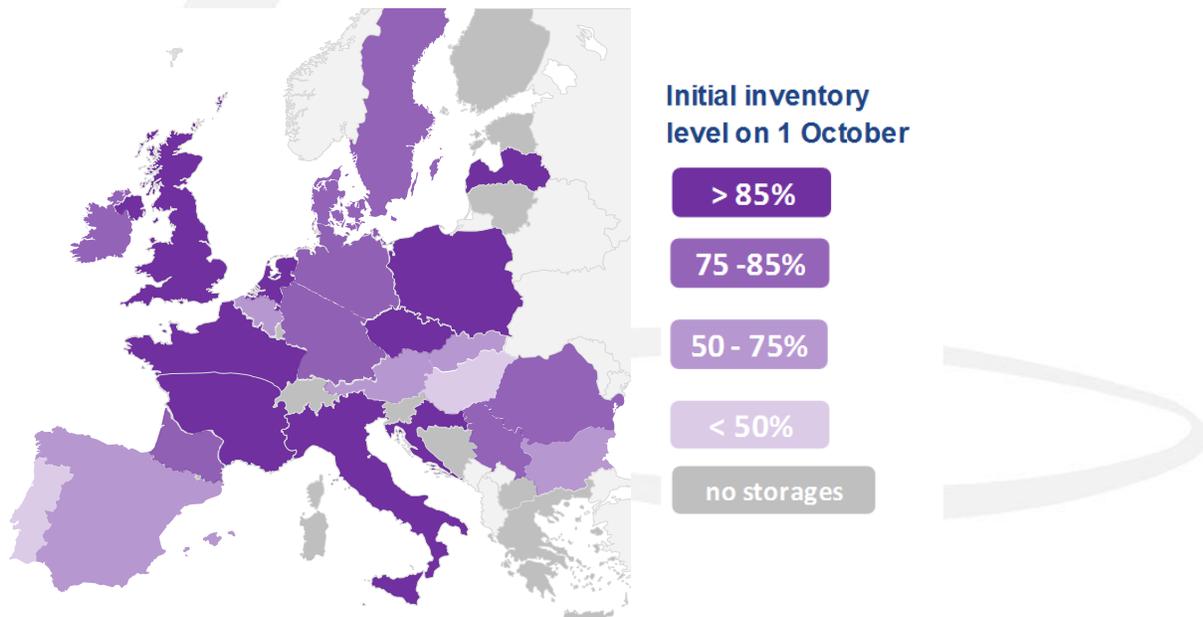


Figure 2: Actual storage inventory levels on 1 October

In terms of absolute volumes in gas storages, the largest volumes are in Germany, Italy and the Netherlands.

¹² The initial storage level on 1 October 2015 for each country is based on the information on the AGSI platform and SSO websites captured on 1 October.

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 each country along a Reference Winter and a Cold Winter.

The graph below shows the supply and demand balance at European level for the Reference Winter.

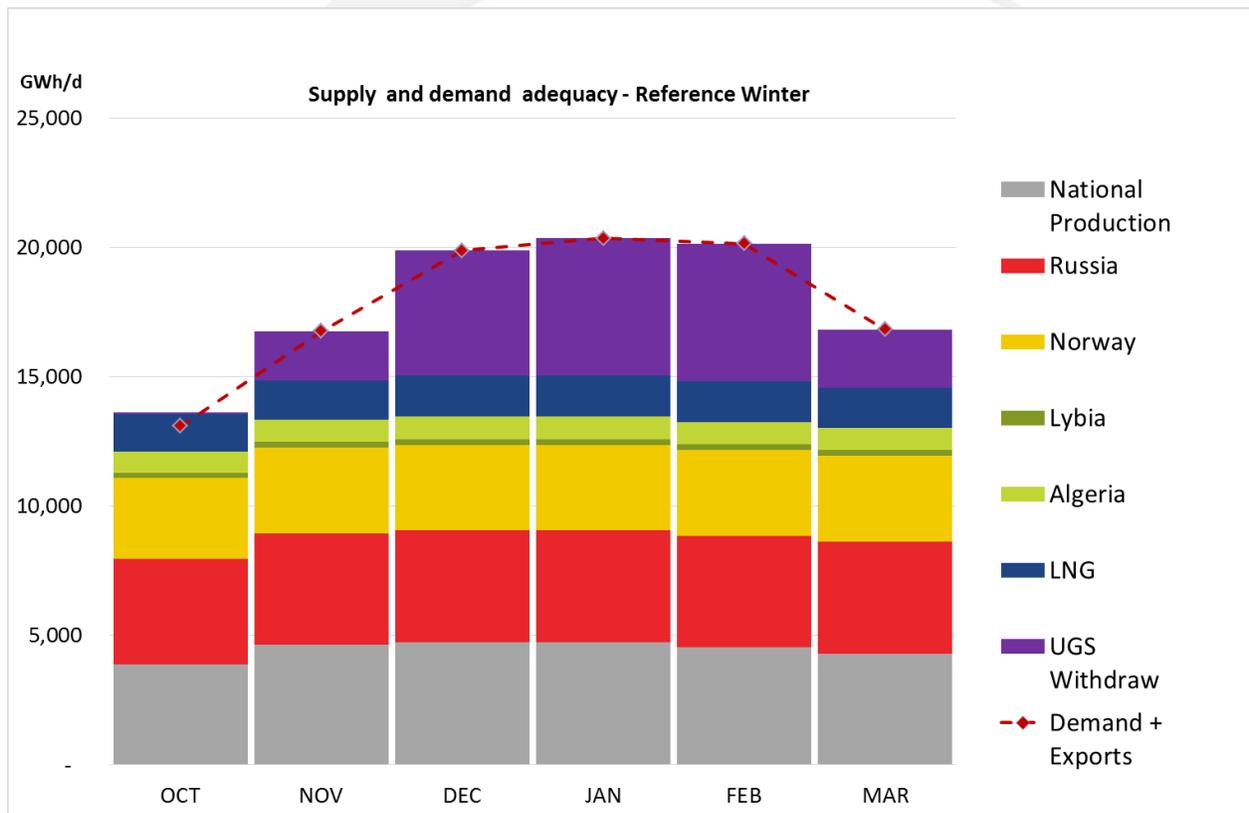


Figure 3: Supply and demand adequacy - Reference Winter

The graph below shows the changes in supply and demand at European level for the Cold Winter compared to the Reference Winter.

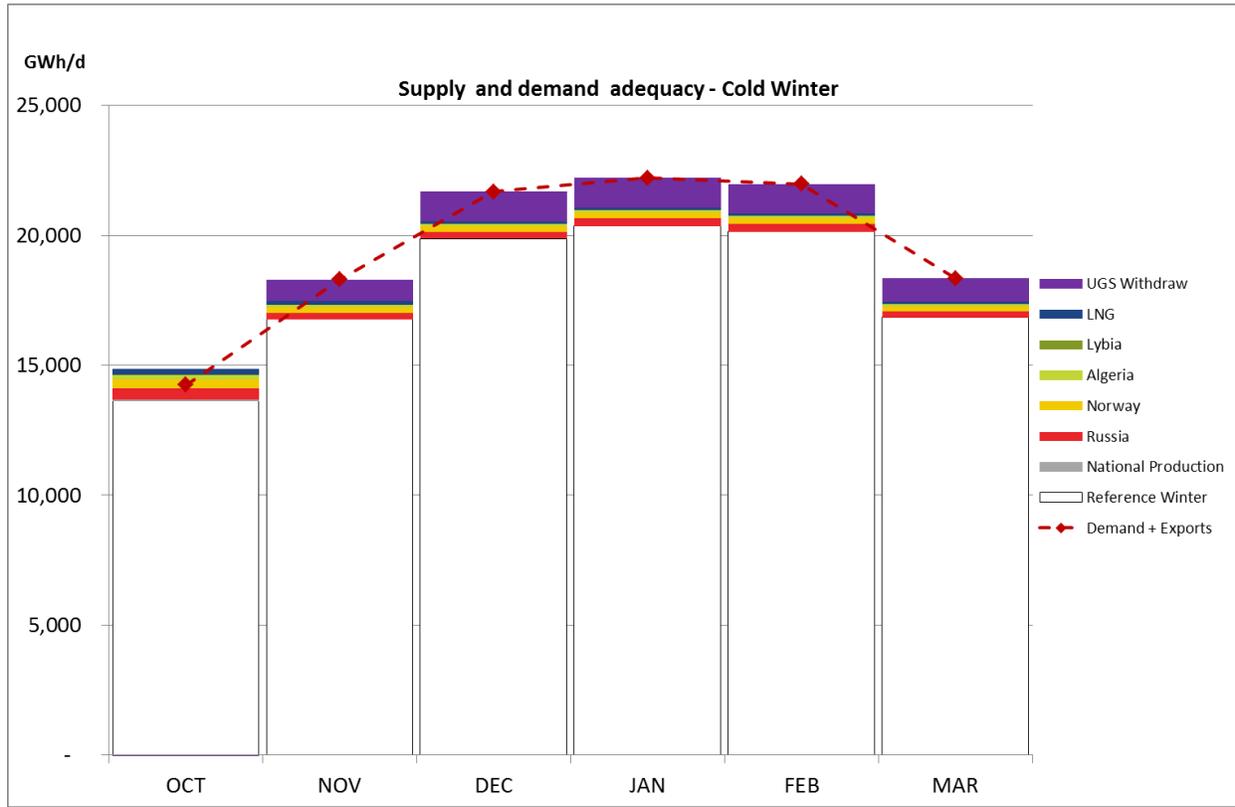


Figure 4: Supply and demand adequacy - Cold Winter

Evolution of UGS inventory level

The graph below shows the evolution of the European aggregated UGS inventory level resulting from the modelling defined in the previous chapter for the Reference Winter and the Cold Winter:

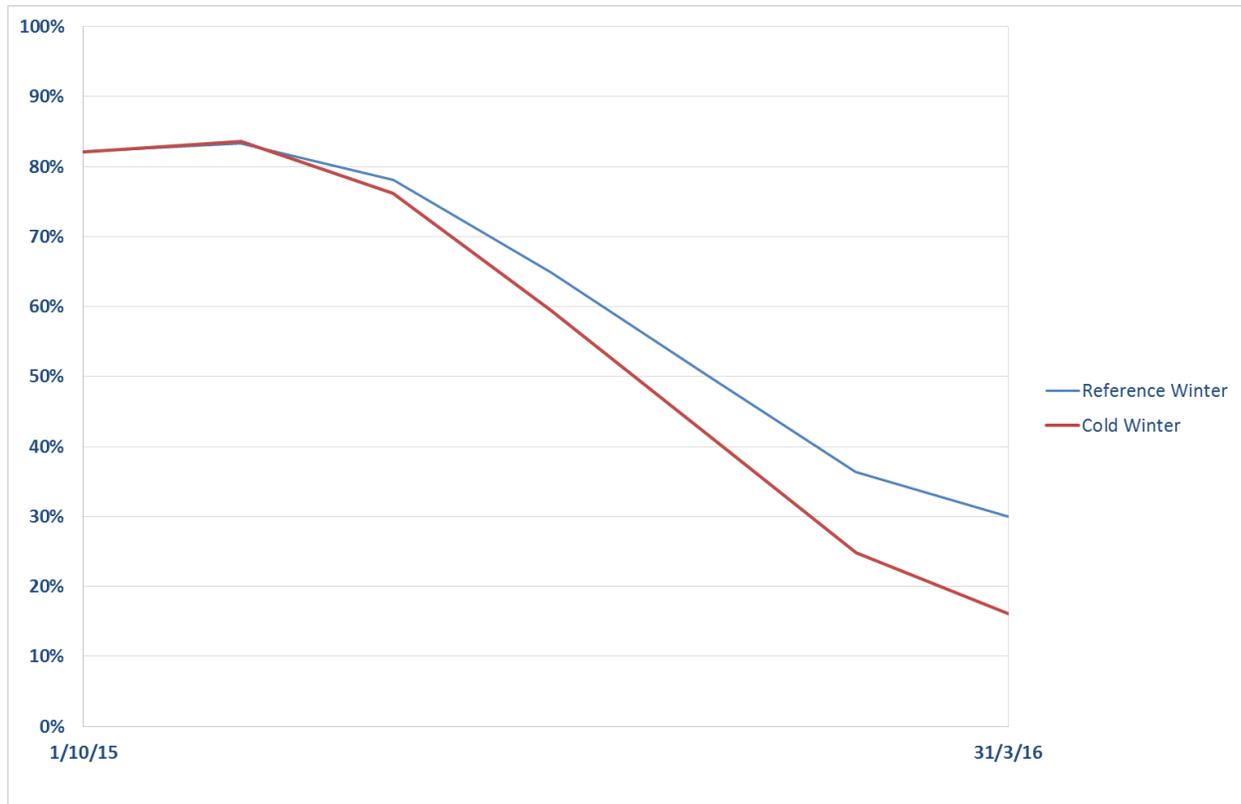


Figure 5 - Winter evolution of the aggregated UGS stock level

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 of 30% at the end of the winter can be reached. The associated withdrawal of gas from storages combined with the assumed supply flexibility is sufficient for the supply and demand adequacy.

During the Cold Winter, based on the assumed supply flexibility, additional volumes are needed from the storages, leading to an EU aggregated inventory level at the end of the winter beyond the 30% target.

Results of Supply vs. Demand 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 30 January for the Design Case and on 15 February for the 2-week Cold spell are therefore derived from the Cold Winter modelling. The corresponding storage withdrawal deliverability is considered (see Annex A).

The main results are the following ones:

- > No country faces demand curtailment, but some show low Remaining Flexibility;
- > During the 2-week Cold Spell some countries show low Remaining Flexibility, and Sweden faces a demand curtailment. The demand curtailment in Sweden can be fully mitigated under the condition of interruptible capacity from Denmark to Sweden or a lower withdrawal of gas from storage during the beginning of the winter period.

For the high demand cases during a Cold Winter the results of the evolution of the pan-EU storage inventory level are shown in the table below. The low and high supply assumptions for the pipeline and LNG supply allow flexibilities during the 2-week Cold Spell, which are reflected in the results for the final inventory level.

		Level before event	Level after event
1-day Design Case	31 January	42%	41%
2-week Cold Spell	16 – 29 February	33%	21%*
			23%**
			20%***

(*): Case 1: high supply pipeline and low supply LNG

(**): Case 2: low supply pipeline and high supply LNG

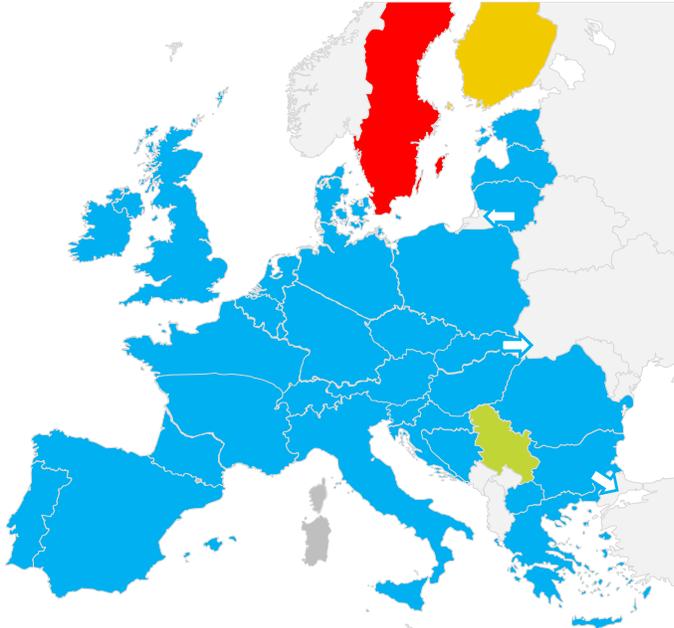
(***): Case 3: low supply pipeline and low supply LNG

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

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

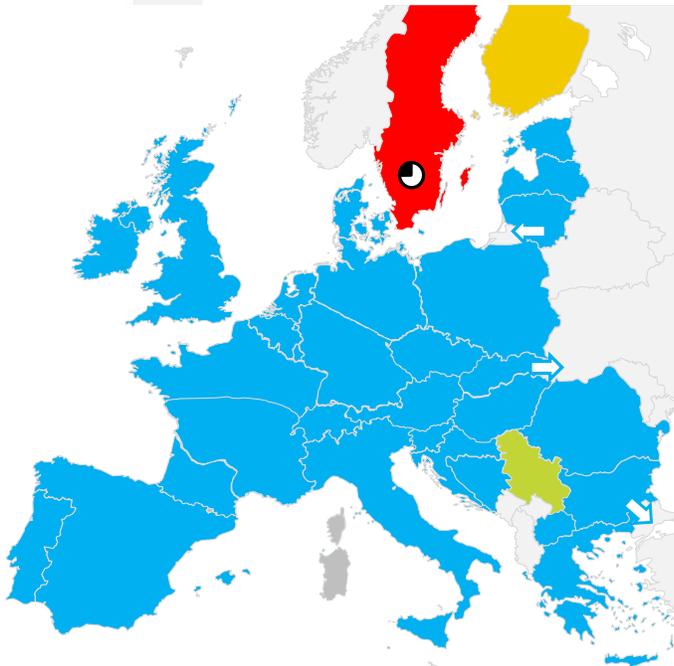
Since these modelling results are very close to each other for the three supply cases, the below graphs show the average of the three results.

Results for 1-day Design Case during a Cold winter



No country faces demand curtailment. The lack of Remaining Flexibility for Finland, Serbia and Sweden is consistent with the previous Winter Supply Outlook. Compared to the previous Winter Supply Outlook changes for Bosnia, Portugal, Romania and Luxembourg result from an update of high demand figures.

Results for 2-week Cold spell during a Cold Winter



Sweden faces a demand curtailment that can be fully mitigated using interruptible capacity or storage measures. The lack of Remaining Flexibility for Finland and Serbia is consistent with the previous Winter Supply Outlook. Compared to the previous Winter Supply Outlook changes for Bosnia, Portugal, Romania and Luxembourg result from an update of high demand figures.

Remaining Flexibility



Share of curtailed demand



Transit from Europe



The different supply cases during the 2-week Cold Spell result in a different supply mix for each case and of the two weeks. This supply mix differs from the supply mix during a February in Cold Winter without the Cold Spell.

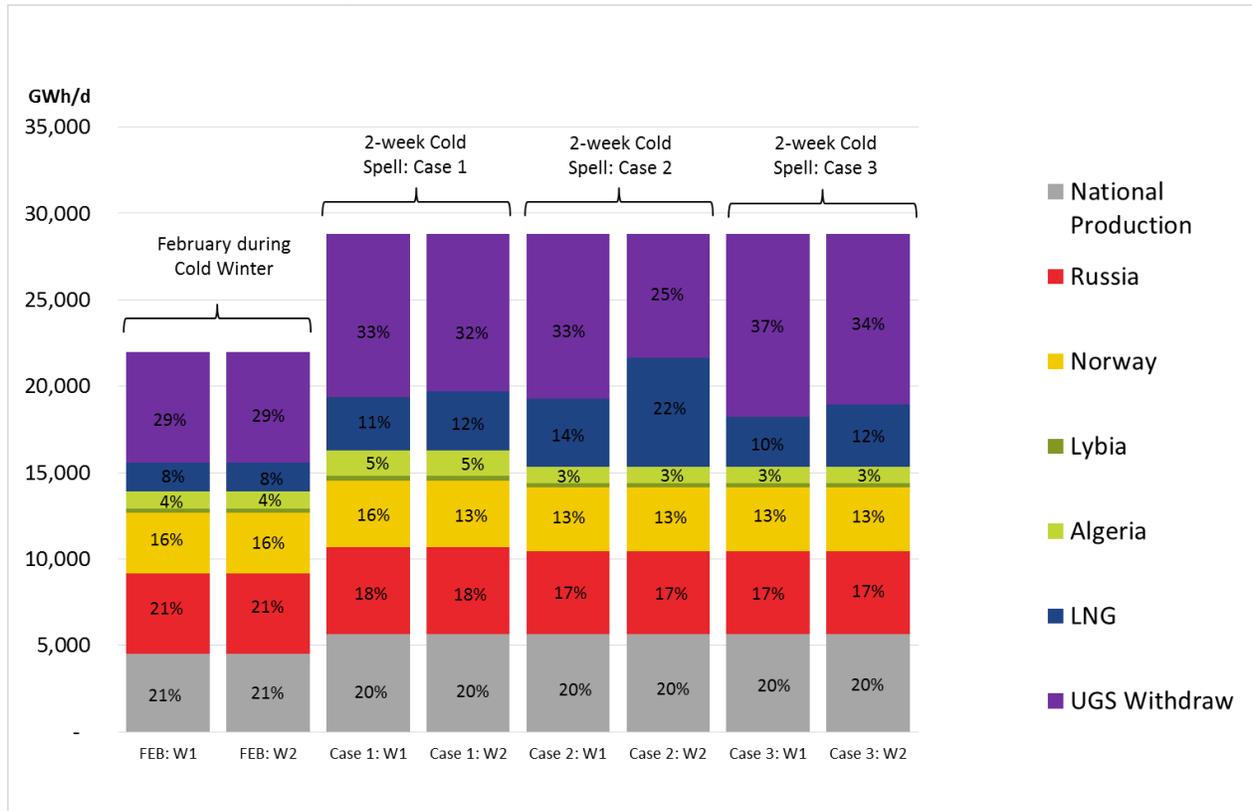


Figure 6: Comparison of supply mixes in February during Cold Winter and during 2-week Cold Spell¹³

¹³ FEB: February, W1: first week (16-22 February), W2: second week (23-29 February)

Results of disruption case event

Transit disruptions of Ukraine

This vision is included in ENTSOG's Winter Supply Outlooks since Winter Supply Outlook 2013/14. The disruptions of the Ukrainian transit are assessed during the 1-day Design Case and the 2-week Cold Spell.

Imaginable scenarios for such a vision might be:

- > A technical disruption event caused by:
 - the age and state of the upstream transit system or
 - an unpredictable incident
- > A political disruption resulting from
 - an escalation of the Ukrainian-Russian conflict
- > A disruption resulting from economic reasons
 - offtakes for domestic demand above the contracted volumes in the upstream transit system

On 30 October 2014 a 'winter package' to secure the gas supply for Ukraine and the EU was agreed on in EU-Ukraine-Russia talks¹⁴. A similar result was announced by the European Commission on 25 September 2015¹⁵ for the upcoming winter season.

While the transits through Ukraine appear to be politically secured earlier this year compared to last year, the supply situation within the Ukraine seems to be tighter than in the past. The main reason for that are the Ukrainian storage levels, which were on 1 October 2015 about 6% below the level of 2014.

¹⁴ <https://ec.europa.eu/energy/en/news/eu-ukraine-russia-talks-agree-46-billion-secure-gas-supplies>

¹⁵ [http://europa.eu/rapid/press-release STATEMENT-15-5724_en.htm](http://europa.eu/rapid/press-release_STATEMENT-15-5724_en.htm)

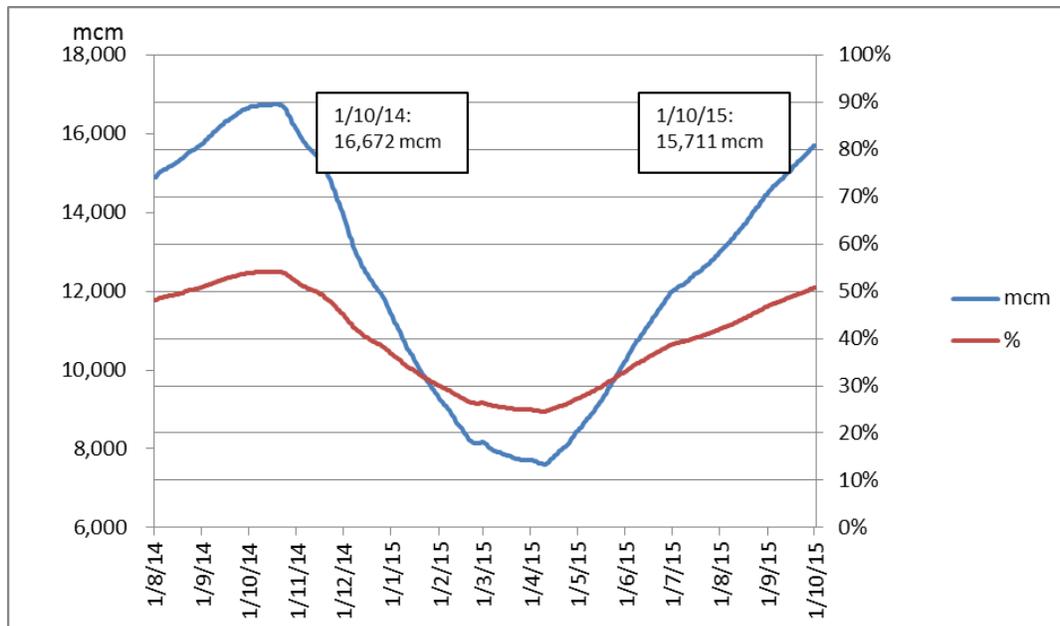


Figure 7: Gas storages in Ukraine (source GIE's AGSI platform)¹⁶

Please note that the vision on transit disruption of Ukraine in this report is a hypothetical case just for the purposes of this Winter Supply Outlook.

Modelling results

For the transit disruption through Ukraine during each high demand situation and each zone, modelling results consist in the calculation of:

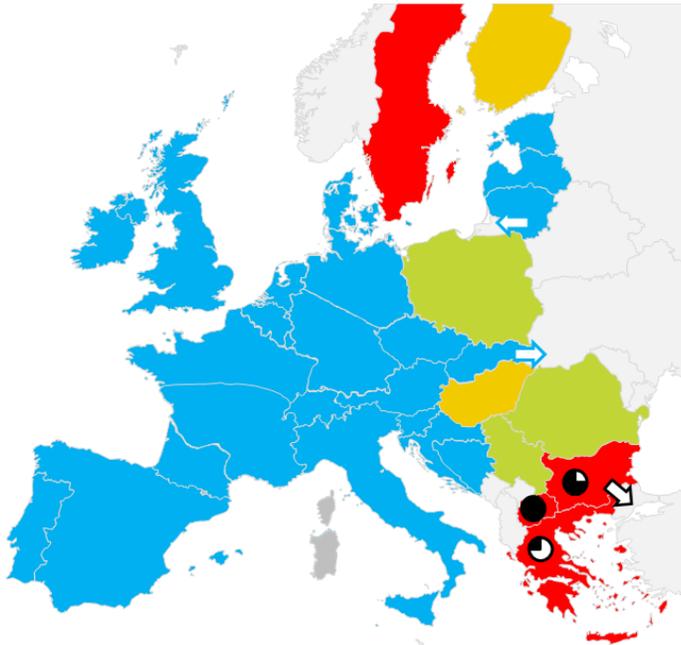
- > The Remaining Flexibility as the maximum demand increase of a country before facing curtailment (see Annex C for detailed calculation process)
- > The potential level of demand curtailment

The results show that in case of a high demand situation combined with a disruption of Ukrainian transit, in addition to the countries affected in the Design Case and 2W-Cold Spell situation, some countries in the South-East Europe are facing demand curtailment.

As part of its Winter Outlook 2015-16 ENTSO-E will have an analysis of the gas disruption risk in case of transit disruption through Ukraine, focusing on the countries facing gas demand curtailment. ENTSG will cooperate with ENTSO-E on this analysis.

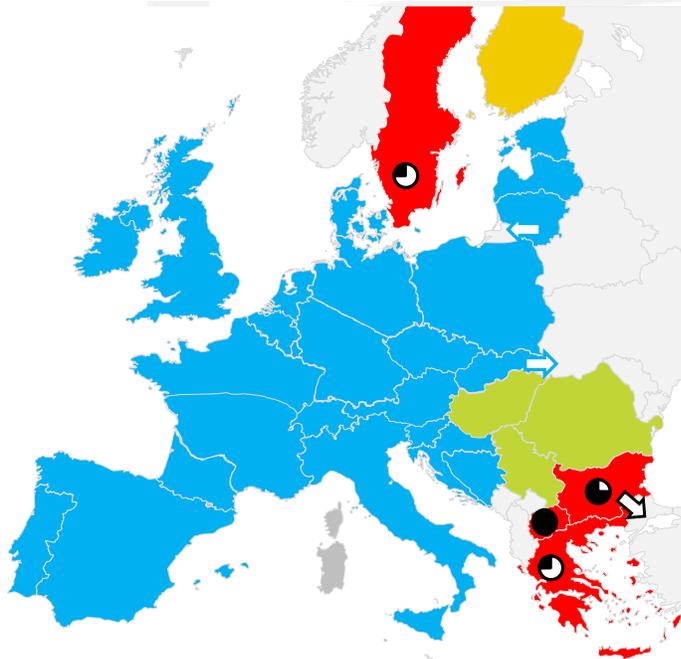
¹⁶ Excluding the gas storages on Crimea, for which updates are temporarily unavailable according to GSE.

Results for 1-day Design Case during a Cold Winter with transit disruptions through Ukraine

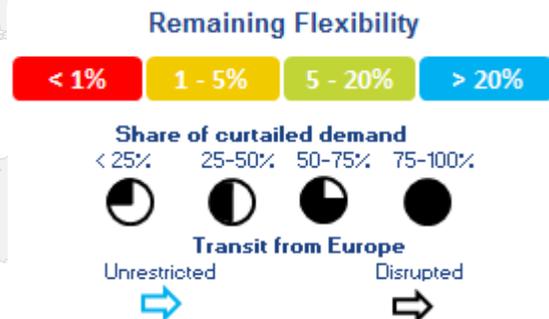


The disruption will induce curtailment in South-East Europe. The curtailments in Bulgaria, FYROM and Greece are consistent with former results. The lower Remaining Flexibility for Poland compared to last Winter Supply Outlook is resulting from an increased demand under the 1-day Design Case.

Results for 2-week Cold spell during a Cold Winter with transit disruptions through Ukraine



Impact of the disruption is similar to the one under the Design Case. Due to lower demand, Hungary and Poland perform better in the Remaining Flexibility.



Conclusion

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 2015/16 with sufficient flexibility in most parts of Europe. This assessment is valid throughout the season and under high demand situations.

As for TYNDP 2015 and previous Winter Supply Outlooks, the assessment of high demand situation confirms:

- > the capability of the gas infrastructure to supply Ukraine with significant volumes of gas
- > the ability of the gas infrastructure to face high demand situations and provide flexibility to the gas market.
- > the lack of infrastructure resilience of South-East Europe in case of an interruption of Russian gas transit through Ukraine

The level of storages across Europe significantly contributes to the balance of demand across the season. It also contributes to the ability to physically send gas to Ukraine especially in case of disruption of transit through Ukraine.

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

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 and outputs

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.

UGS inventory												
	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%	
AT	100%	100%	100%	100%	100%	96%	96%	92%	82%	73%	23%	Withdrawal deliverability
BE	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
BG	74%	74%	100%	100%	100%	100%	89%	79%	79%	60%	6%	
HR	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
CZ	100%	100%	100%	100%	100%	97%	75%	70%	45%	40%	4%	
CZd*	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
DK	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
FRn	100%	99%	97%	94%	91%	88%	82%	72%	63%	51%	43%	
FRs	100%	99%	99%	98%	98%	97%	91%	74%	62%	48%	27%	
FRt	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
DE	100%	100%	100%	100%	100%	100%	86%	72%	57%	42%	29%	
HU	100%	100%	100%	100%	99%	96%	93%	83%	72%	62%	52%	
IE	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
IT	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
LV	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
NL	100%	95%	90%	86%	81%	76%	71%	67%	62%	57%	53%	
PL	100%	100%	99%	99%	97%	93%	90%	81%	65%	51%	36%	
PT	100%	100%	100%	100%	80%	80%	80%	80%	80%	40%	4%	
RO	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
RS	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
SK	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
ES	100%	80%	72%	67%	63%	60%	55%	50%	45%	40%	4%	
SE	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	
UK	100%	98%	97%	95%	94%	91%	83%	73%	61%	50%	35%	

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

Figure 8 - UGS deliverability curves

Winter 2015/16 inventory level evolution

Below table provides the picture of UGS inventory level evolution as resulting from modelling:

UGS level at the beginning of each period	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	final level
Reference Winter	82%	84%	78%	65%	50%	36%	30%
Cold Winter		84%	76%	60%	42%	25%	16%

Figure 9 – Evolution of UGS inventory level

Annex B - Data for Winter Supply Outlook 2015/16

Demand and export figures

GWh/d	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	1-day DC	2-week
AT	224	283	346	365	354	285	635	635
BA	5	7	10	11	9	7	11	11
BE	596	696	787	807	811	706	2,424	1,321
BG	69	99	111	116	111	100	145	145
CH	160	170	180	190	200	190	202	202
CZ	239	315	406	410	448	322	722	709
DEg*	1,101	1,416	1,648	1,671	1,680	1,387	2,811	2,104
DEn*	1,293	1,663	1,934	1,961	1,972	1,629	3,300	2,469
DK	75	99	127	143	136	104	244	241
EE	15	20	23	26	22	20	44	44
ES	765	890	1,020	1,100	1,120	920	1,785	1,643
FI	101	116	126	137	139	109	244	240
FRn*	814	1,182	1,483	1,452	1,295	1,086	2,902	1,875
FRs*	316	459	577	565	503	422	1,128	729
FRT*	63	130	151	163	154	120	341	223
GR	66	77	102	147	127	98	194	156
HR	81	87	95	83	106	87	124	85
HU	235	336	426	447	443	322	810	701
IE	129	133	170	161	175	142	272	266
IT	1,710	2,331	3,015	3,001	2,976	2,391	4,812	4,149
LT	60	74	85	88	86	76	146	141
LU	21	28	33	38	38	32	63	58
LV	32	47	62	64	63	44	163	163
MK	3	5	7	9	6	5	14	14
NL	922	1,242	1,448	1,550	1,591	1,400	4,054	3,496
PL	421	515	571	629	646	534	888	723
PT	140	138	153	152	154	148	202	202
RO	285	349	461	431	404	328	538	538
RS	64	97	105	102	126	74	153	153
SE	24	36	48	52	54	43	94	94
SI	21	28	33	36	37	31	43	43
SK	127	189	229	239	202	177	302	302
UK	2,087	2,715	2,995	3,079	2,998	2,607	4,960	3,913

TR**	334	278	390	420	434	377	468	468
UA**	375	375	375	375	375	375	416	416
RUK**	59	80	81	78	85	73	104	98
RUsp**	61	61	61	61	61	61	61	61
Total	12,960	16,664	19,777	20,264	20,108	16,797	35,758	29,811

(*): Germany and France demand provided by balancing zone (DEg: market area GASPOOL, DEn: market area NCG, FRn: GRTgaz Nord, FRs: GRTgaz Sud and FRt: TIGF)

(**): Net exports to Turkey and Russia (Kaliningrad and St-Petersburg regions)

Figure 10 – Demand forecast

Cold Winter demand

The weather sensitivity of winter demand has been estimated, by country, as the positive maximum deviation of the winter final gas demand of the last five winters from its average by country. These relative seasonal deviations were applied to the average final gas demand of the respective countries. The share of the final gas demand and the power demand was estimated on the average level of the last two winters.

GWh/d	Demand deviation (%) from the reference case Cold winter (+)	GWh/d	Demand deviation (%) from the reference case Cold winter (+)	GWh/d	Demand deviation (%) from the reference case Cold winter (+)
AT	13%	FR	10%	PL	7%
BA	6%	MK	8%	PT	8%
BE	6%	GR	8%	RO	8%
BG	5%	HR	16%	RS	6%
CH*	0%	HU	4%	SE	12%
CZ	10%	IE	6%	SI	9%
DE	11%	IT	17%	SK	10%
DK	26%	LT	6%	UK	10%
EE	19%	LU	20%	Total	10%
ES	3%	LV	4%		
FI	26%	NL	13%		

(*): Demand provided for CH was already for a cold winter

Figure 11 – Weather sensitivity of winter demand

Supply assumption (maximum per period)

GWh/d		DZ	LY	NO	RU	LNG	
Winter period	MAX on whole Winter	1,231	227	3,511	4,568	2,686	
	MAX per month	964	247	3,668	4,802	1,663	
High demand	2-week Cold Spell	Case 1: Week1	1,477	278	3,820	5,053	1,663
		Case 1: Week2	1,477	278	3,820	5,053	1,996
		Case 2: Week1	964	247	3,668	4,802	1,663
		Case 2: Week2	964	247	3,668	4,802	6,322
		Case 3: Week1	964	247	3,668	4,802	1,663
		Case 3: Week2	964	247	3,668	4,802	1,996
	1-Day Design Case MAX	1,548	289	3,904	5,347	6,322	

Figure 12 – Supply assumptions imports

GWh/d	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	1-day DC	2-week
NP	3,931	4,631	4,738	4,741	4,540	4,311	5,657	5,657

Figure 13 – Supply assumptions indigenous production

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. ENTSG has used the LNG tank flexibility made available by GLE. These figures represent a weighted average of the LNG terminals of each area.

LNG tank flexibility		LNG tank flexibility	
BE	35%	LT	3%
ES	41%	NL	35%
FRn	10%	PT	35%
FRs	17%	SE	35%
GR	35%	UK	35%
IT	15%	Total	34%

Figure 14: LNG tank flexibility

Annex C – Definition of the 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 and the exiting flows to adjacent systems. 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 its 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. It also focuses more on the demand of the country as in the calculation process transiting flow through the zone stays constant.

Winter 2014/15 Review

Executive Summary

ENTSOG has completed the review of the European gas supply and demand picture for Winter 2014/15 (October to March). The Seasonal Reviews aim at 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 a solid background for the assumptions considered in the Winter Outlook. Such knowledge is also factored in the recurrent TYNDP process in order to ensure consistence and continuous improvement of ENTSOG reports, and will be factored in the ongoing R&D plan.

- **Seasonal gas demand in Europe was 2% higher (67 TWh) than the previous winter. Peak day consumption increased by 4% (866 GWh/d).**
- **UGS working gas volume utilisation was the highest of the last six winters while the share of Russian gas in the European supply was reduced by 6% (191 TWh).**

Detailed data for the cross-border flows is available on the Transparency Platform¹⁷.

Stakeholders' comments on this seasonal analysis are welcome and would enable ENTSOG to improve its knowledge of seasonal and market dynamics influencing the use of infrastructures. Comments would serve as a basis for the R&D plan and are beneficial for the quality of further reports.

¹⁷ Transparency Platform: <https://transparency.entsog.eu/>

Introduction

This review, as part of the ENTSOG Annual Work Program 2015, is published on a voluntary basis and aims at providing an overview of the demand and supply balance during Winter 2014/15. The report brings transparency on the internal analysis carried out by ENTSOG for the purpose of developing the seasonal Supply Outlooks and the Union-wide TYNDP, as well as for the ongoing R&D plan.

The report aims to provide an overview of European trends that could not be captured at national level and to build experience for future reports. This report should not be seen as a direct review of previous 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 linked among others to physical rationales such as climate, demand breakdown or producing field flexibility for example.

Overview

The following section gives impressions on specific disruption and market events which occurred during the period between October 2014 and March 2015.

Disruption events

Some occurrences on the European gas market caused fluctuations in the supply and demand balance, the major ones were:

October

- UK: Outage of Rough storage (unavailability of injection) for two weeks

November

- NO: Outage of the Skarv field for nine days (impact of 10.9 million m³/d)
- NO: Three weeks reduced capacity of the Troll field (impact of 12 million m³/d)

December

- NO: Reduction in production of the Snohvit LNG plant for eight days

January/February

- NO: Diverse outages at the Norwegian continental shelf (unspecified impact)

Market events

Some general gas related topics and information came up or were noticeable, major ones were:

October

- UK LNG stocks hit record volume with 1,199 bcm in tanks and surpassed previous high from October 2011 (average flow rates over the Winter were over 300 GWh/d, up from 164 GWh/d in 2013/14)
- A \$4.6 billion 'Winter Package' was agreed between Russia and Ukraine to secure gas supplies for Ukraine and the EU until the end of March 2015.

December/January

- Russia announced to abandon the construction of the South Stream gas pipeline and plans to replace it with a pipeline ending on the European section of Turkey ("Turkish Stream")
- The JKM LNG spot price for January delivery dipped below \$10/MMbtu, the lowest price on record since the day of the Fukushima disaster on March 11, 2011. The spot prices had a decreasing trend in subsequent months as well.

February

- Following the initial limits placed on gas extraction from the Groningen field in the Netherlands for 2014 and 2015, further restrictions were announced by the Government in February 2015

Gas Prices and quantities at European hubs

The following graphs show the evolution of gas prices in Europe during the winter 2014/15:

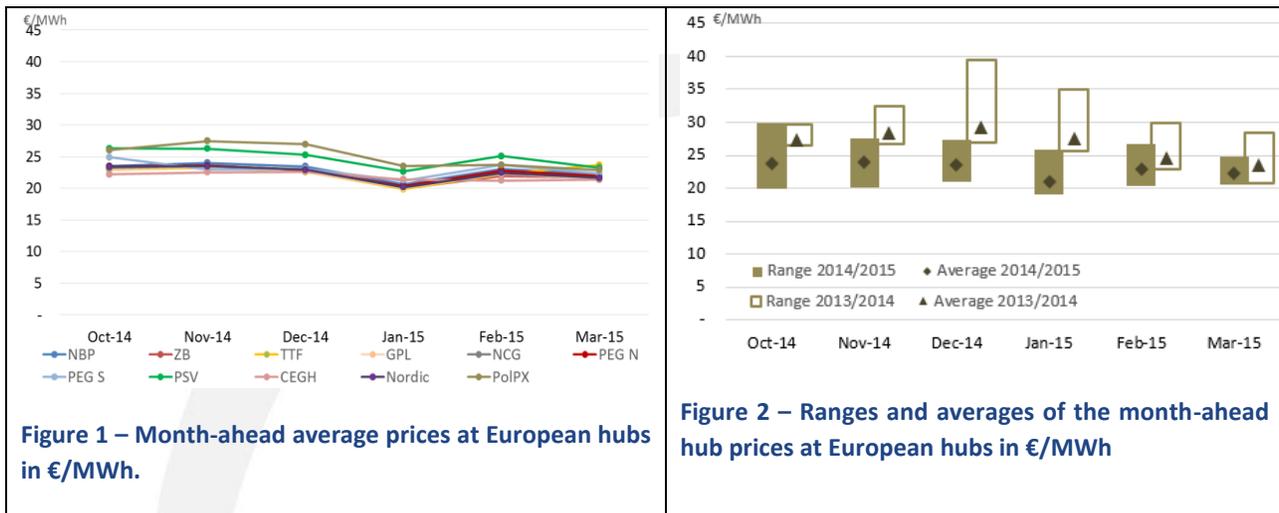


Figure 1 shows the evolution of the month-ahead winter average prices at different European gas hubs and figure 2 shows the maximum range and average of the month-ahead winter price for the last two winters over all the European hubs (source Bloomberg).

The average price over all hubs was slightly lower and more stable than seen in the previous winter. Except for January and February, the maximum price range was lower than in winter 2013/2014. As the previous winter review already covered, price convergence between the different European hubs continued with the exception of the Italian PSV and the Polish PolPX prices, which were a bit above the other hubs. Nevertheless, all European hubs showed generally a similar up- and downward trend, meaning that the hubs basically reacted in the same direction when facing gas-related events.

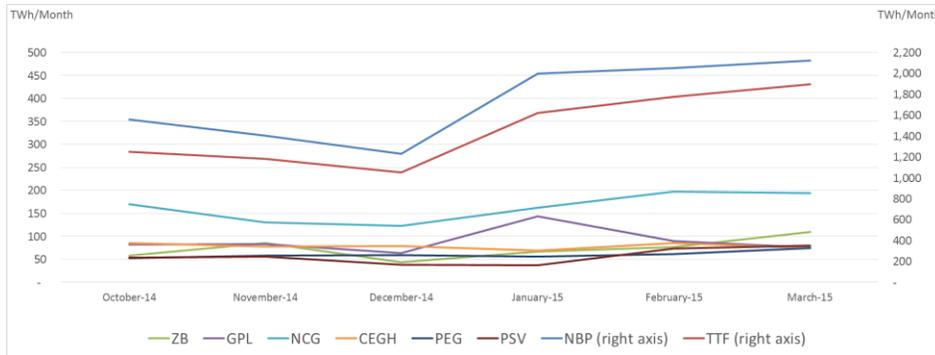


Figure 3 – Total traded quantities at European gas hubs in TWh/month¹⁸.

Figure 3 shows the evolution of the total traded quantities at the different European gas hubs seen in winter 2014/15 (source Platts). In terms of trading quantities, the highest level has been reached at the NBP and the TTF with both at around 2,000 TWh. Except for those two hubs, maximum traded quantities were still far behind and ranged between 75 TWh for the PEGs and 197 TWh for the NCG hub. However, all hubs showed a quite big fluctuation in trading quantities throughout all the winter period.

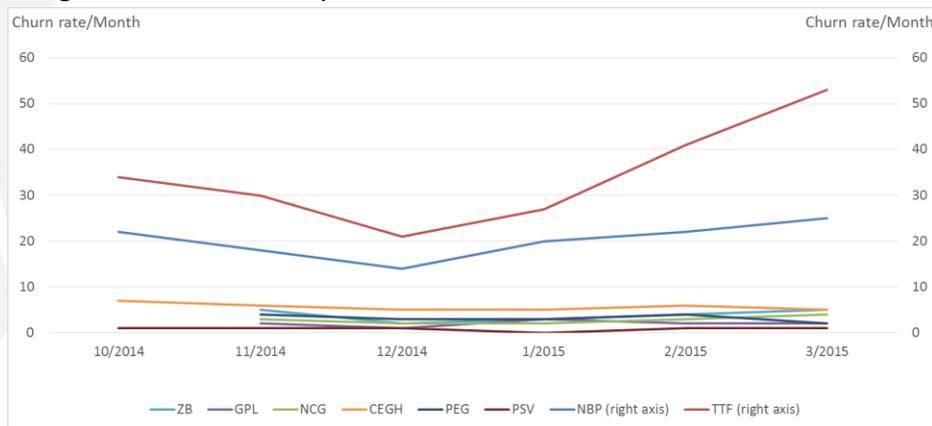


Figure 4 – Evolution of the churn rate per month for the different European gas hubs in the previous winter.

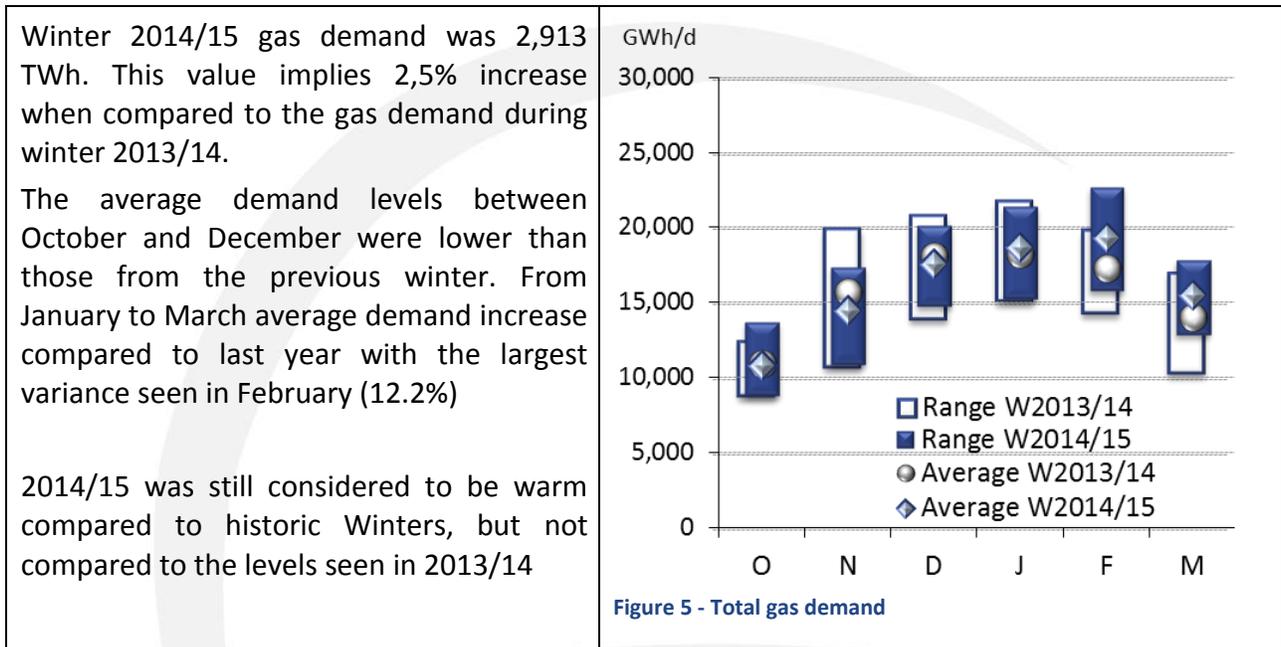
Figure 4 shows the evolution of the churn rate between the different European gas hubs for the previous winter¹⁹. As seen for the total traded volumes at the hubs, the spread between the NBP and TTF and the rest of the European gas hubs was quite big implying more trading action at these two hubs.

¹⁸ Total traded quantities means the sum of all energy units (here in the unit of TWH) which have been traded at a hub in the specific month regardless the underlying product.

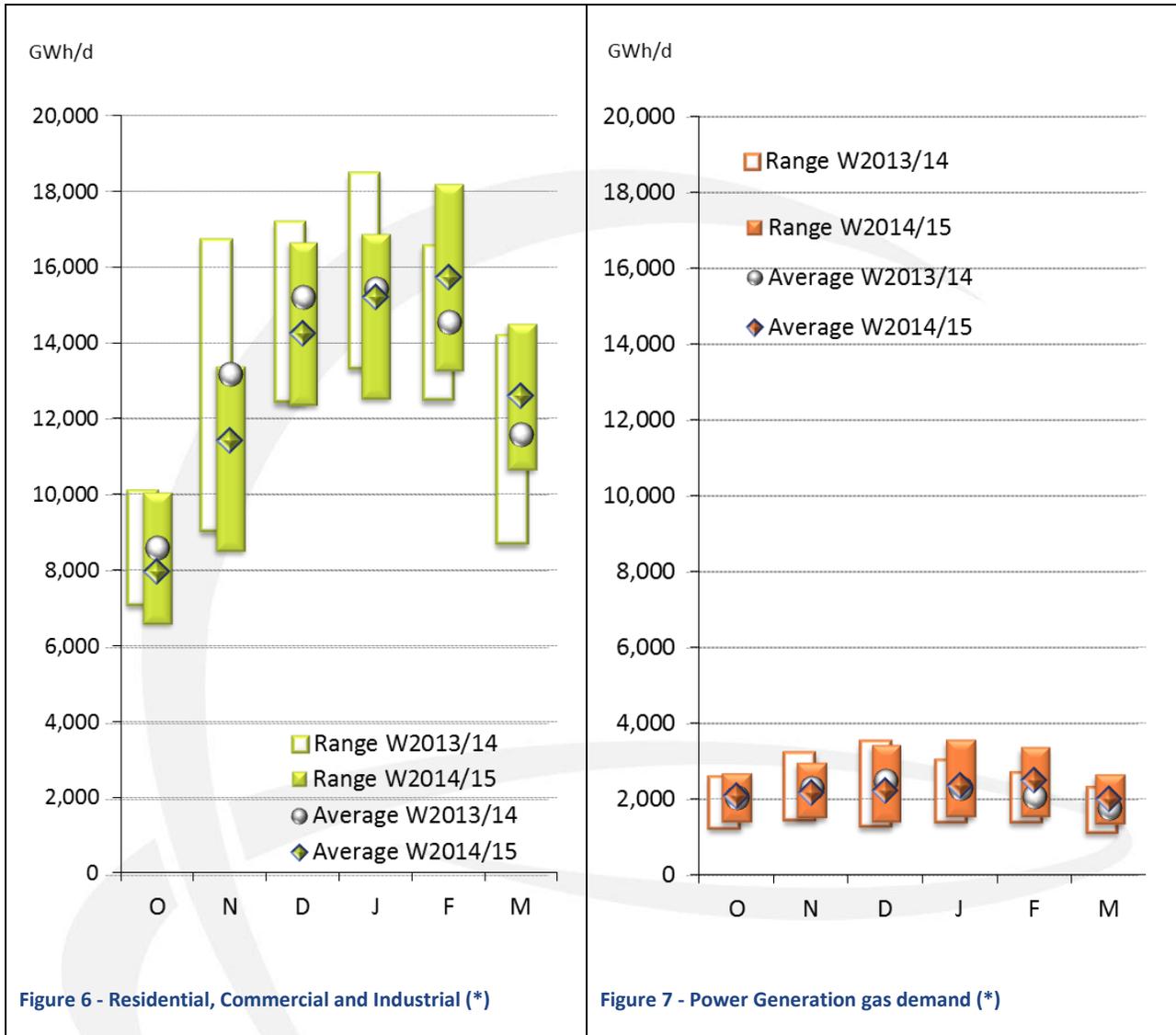
¹⁹ The churn rate is the ratio between traded volume and physical gas throughput at a gas hub.

Demand

> European seasonal gas demand



Figures 6 and 7 show the demand range and average on a monthly basis when split into Residential, Commercial and Industrial or Power Generation sectors, for the countries where the demand breakdown is available. Residential, Commercial and Industrial sector represented 85.7% out of 2,741 TWh.



(*) These graphs refer to the countries for which demand breakdown is available (Belgium, Croatia, Czech Republic, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom).

▪ **Electricity power generation from gas**

For the first time in 5 winters, generation of electricity from Gas increased marginally, whereas Coal and Other sources reduced.

This is despite the reduction in Gas prices as Coal overall remained a more economical option.

Source: own elaboration based on data provided by ENTSO-E

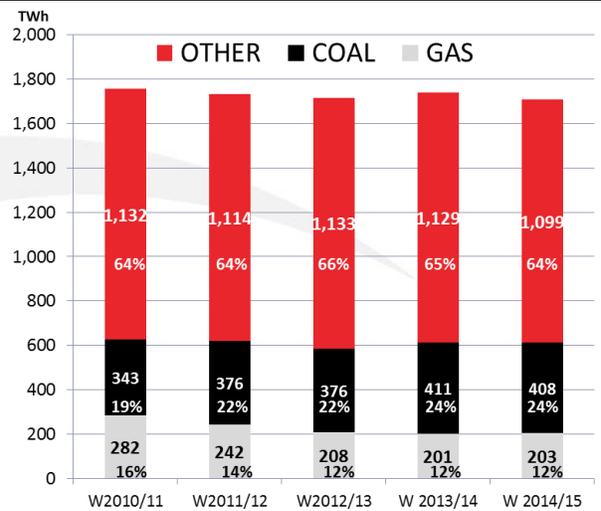


Figure 8 - Gas and coal in the electricity mix Winters 2010-15

Figure 9 shows the evolution of the minimum and maximum month ahead clean spark spread²⁰ (gas) and clean dark spread²¹ (coal) of the previous winters²². Previous market conditions for power generation from coal and gas are quite divergent, showing stable high maximums and minimum spreads at around zero for coal. In contrast, maximum spreads for gas showed a downward trend and generally an upward trend for the minimum spreads. Generally these spreads are driven by the respective input prices for gas and coal, the price of CO2 allowances and the power prices in the different countries.

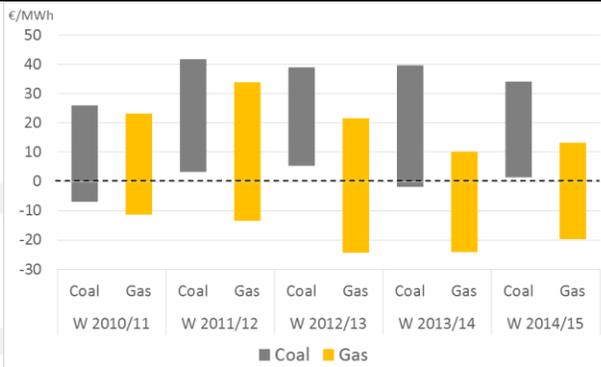


Figure 9 – Range of clean dark vs. clean spark spread over the season in €/MWh

Source: based on data provided by Bloomberg

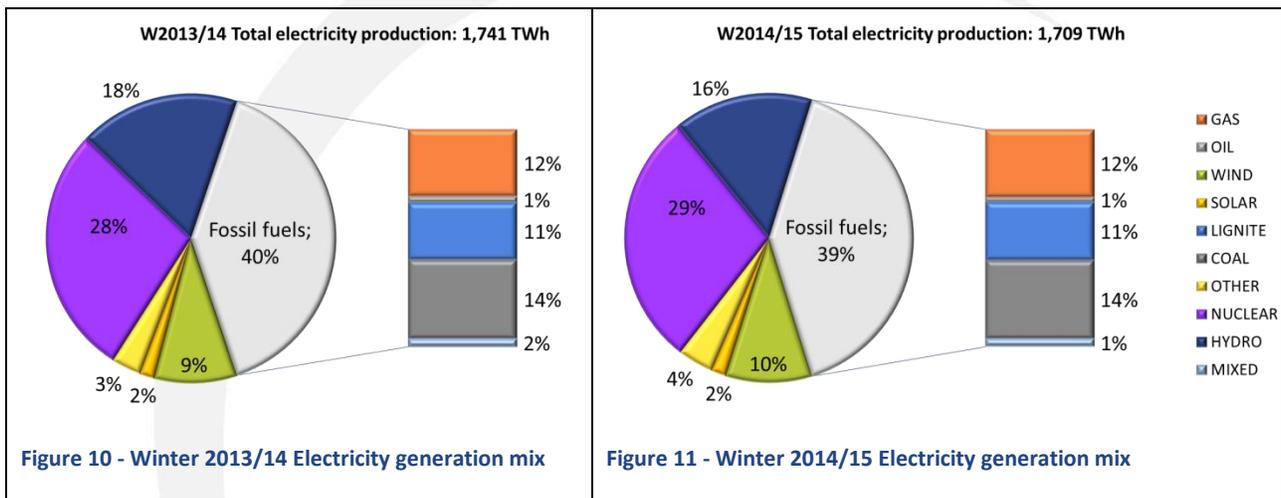
²⁰ The clean spark spread is the difference between the price received by a generator for electricity produced and the cost of the natural gas needed to produce that electricity, including any carbon costs

$$\text{Clean Spark Spread} = \text{Price of Electricity} - [(\text{Price of Gas}) * (\text{Heat Rate})] - \text{Carbon Price}$$

²¹ The clean dark spread follows the same methodology as the clean spark spread but applies to coal rather than gas

²² This graph represents data for the countries Germany, United Kingdom, the Netherlands, Italy, Spain, France and Czech Republic. Even though there are European countries missing, it could generally give information on the European market conditions for power generation from coal and gas seen in the previous winters. Data retrieved from Bloomberg.

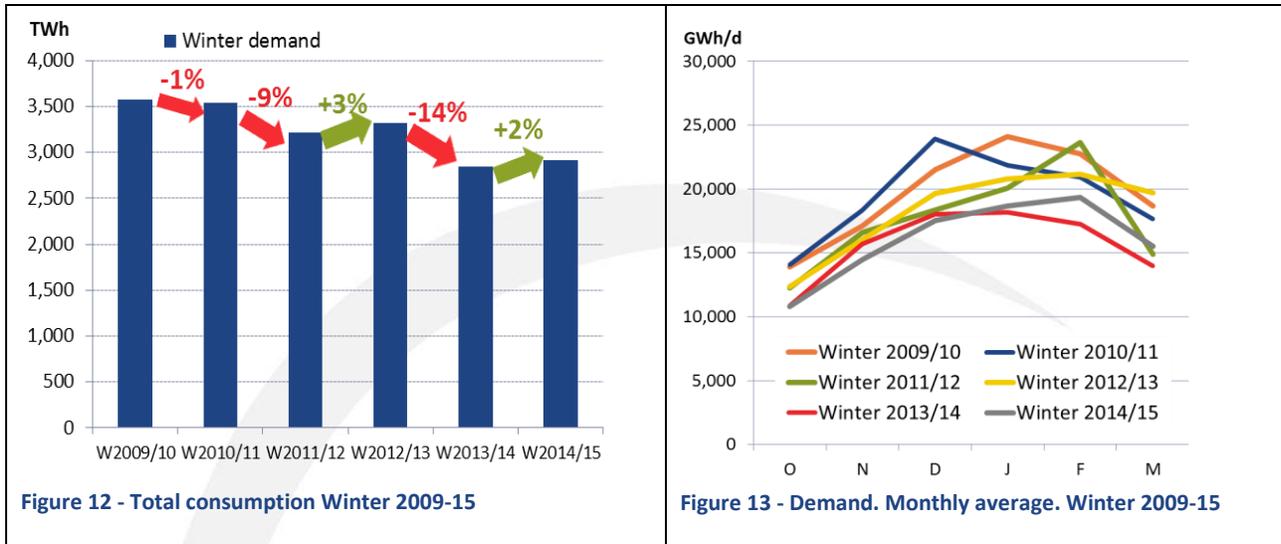
In absolute terms, the electricity produced from gas was 203 TWh in Winter 2014/15, representing 12% of the generation mix. As shown in the graphs below, the share of fossil fuels in the power generation dropped to 39%, a reduction of 1% compared to the previous winter. The composition of the fossil fuel generation remained largely similar in percentage terms. Non fossil fuels also saw variations from the previous year, with reductions from Hydro (-2%), Nuclear (-1%) and increases from Wind (+1%) and Other (+1%).



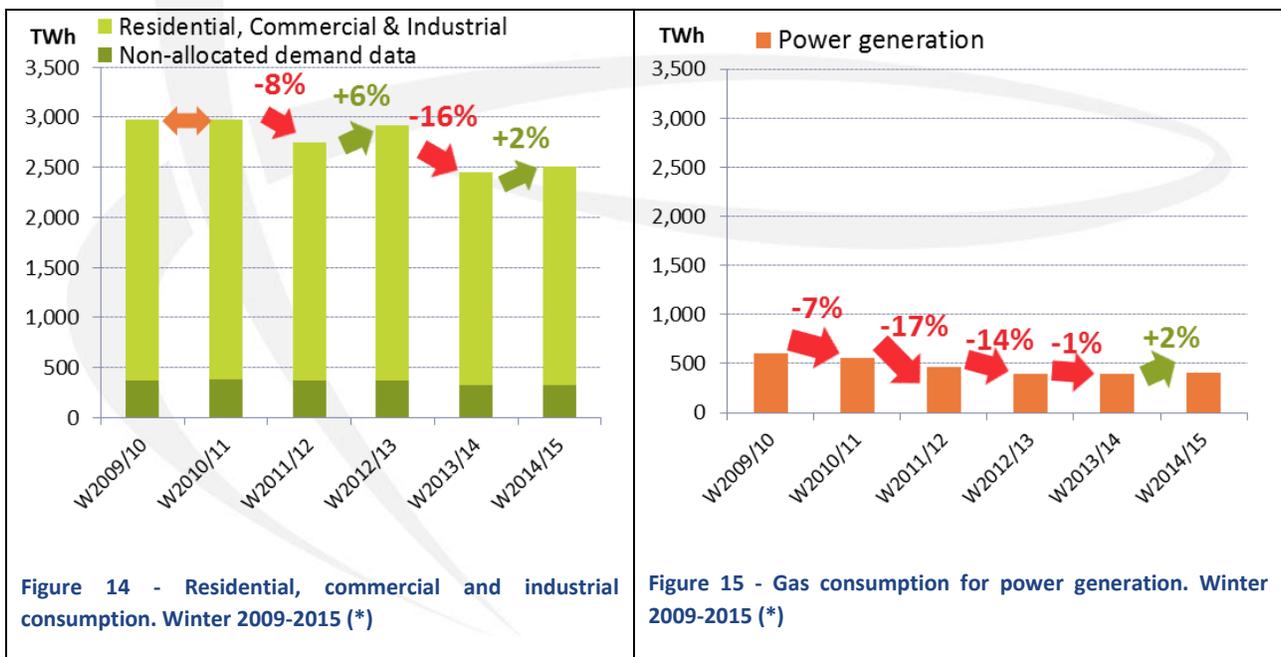
Source: own elaboration based on data provided by ENTSO-E.

▪ **Winter demand evolution 2009-2015**

After the 14% decrease in Winter 2013/14 which had been largely driven by the mild temperatures, the gas demand in Winter 2014/15 increased by 2%. However, it was statistically still a warm winter and apart from 2013/14, demand was lower than the previous 5 winters.



By sector, for those countries where the demand breakdown is available, Residential, Commercial and Industrial consumption increased during Winter 2014/15. As shown below, demand for power generation also increased for the first time in the last 5 winters.



(*) These graphs use data from the countries for which demand breakdown is available (Belgium, Croatia, Czech Republic, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom). In years and countries where the data breakdown has not been provided, then demand forms part of Residential, Commercial and Industrial.

▪ **Country detail**

Whereas last winter there was decrease of gas demand compared to previous winter gas homogeneous all along Europe part from FYROM, largely due to the mild temperatures, for winter 2014/15 there is a significant mix between countries with positive and negative variances.

However, the majority of negative variances come from countries with relatively small gas demand, hence the increase in overall demand.

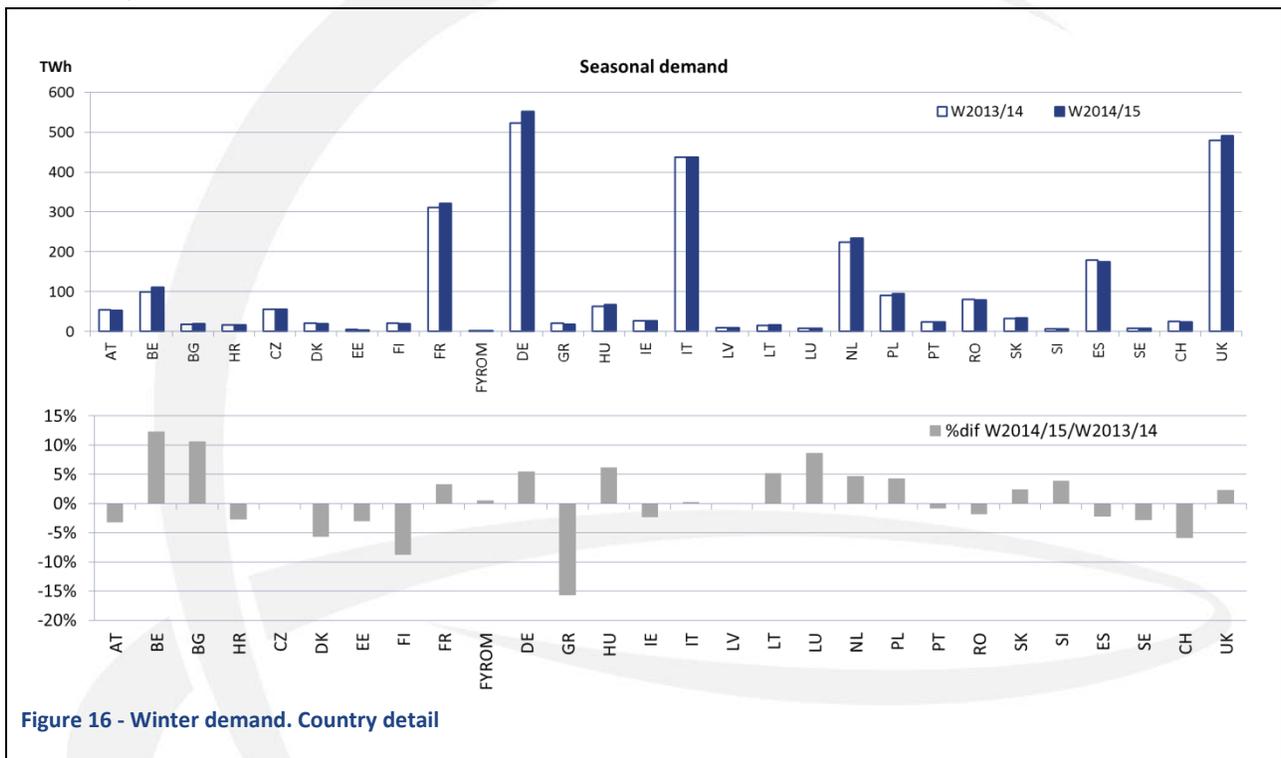
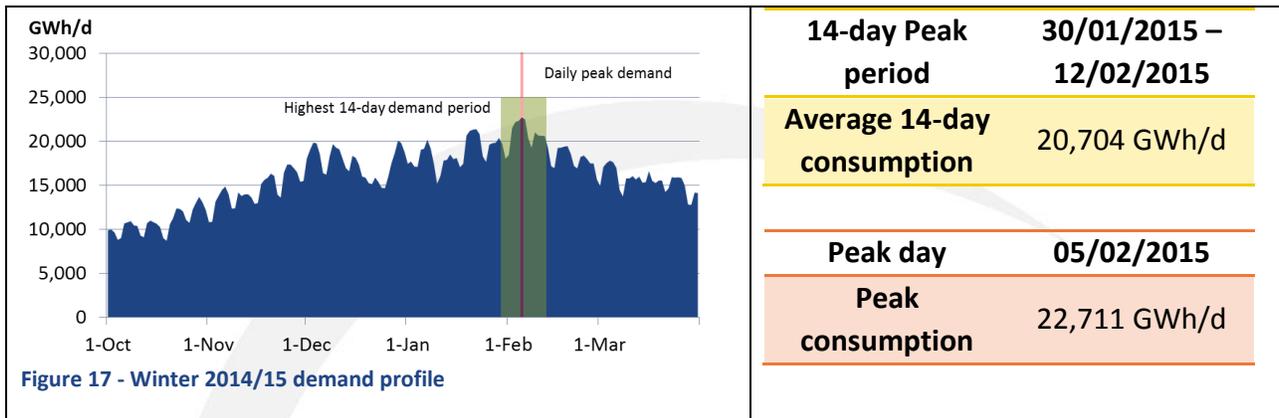


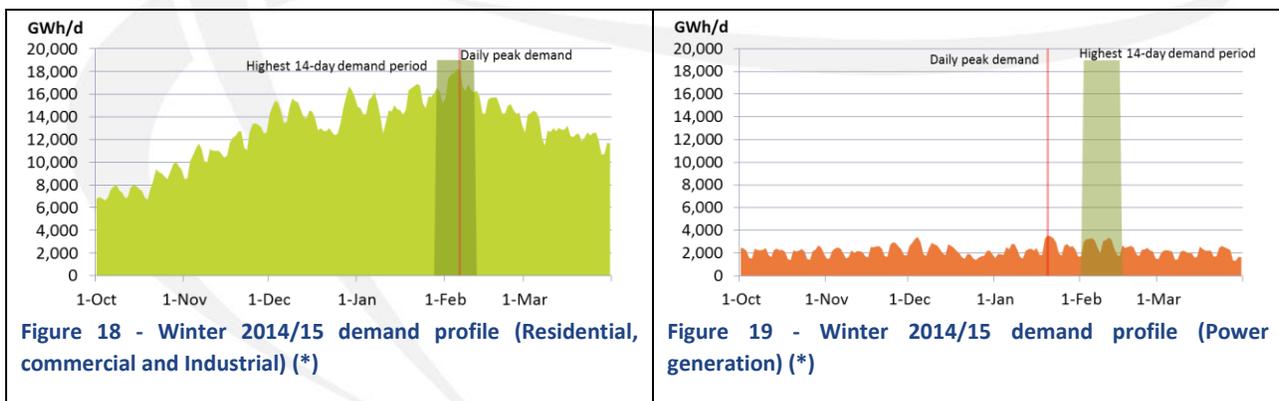
Figure 16 - Winter demand. Country detail

> **European peak demand**



Peak demand was reached by the beginning of February, in the heart of the 14-day peak period. Nevertheless, it should be noted that the demand level during these days was not significantly higher than the demand reached during December 2014, as once again the winter was characterized by the lack of any particular cold period.

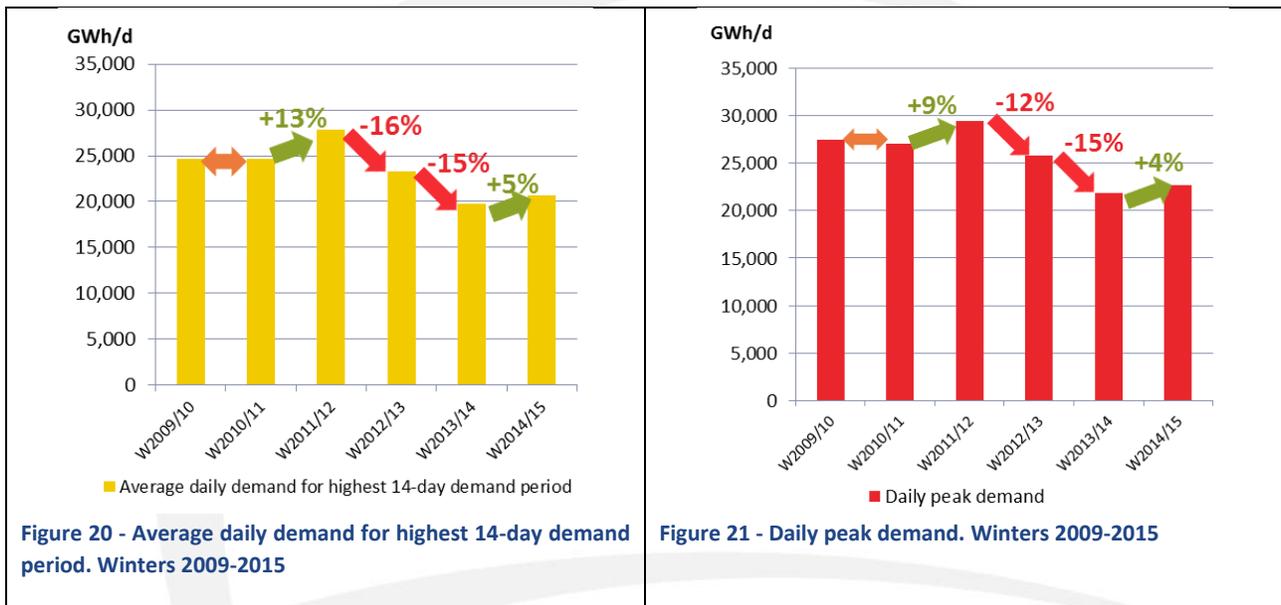
Observed by sector in the graphs below, while the peak 14 day period for the residential, commercial & industrial and power generation consumption coincided with the one for the total gas demand, the peak day for the power generation sector happened in January 2015.



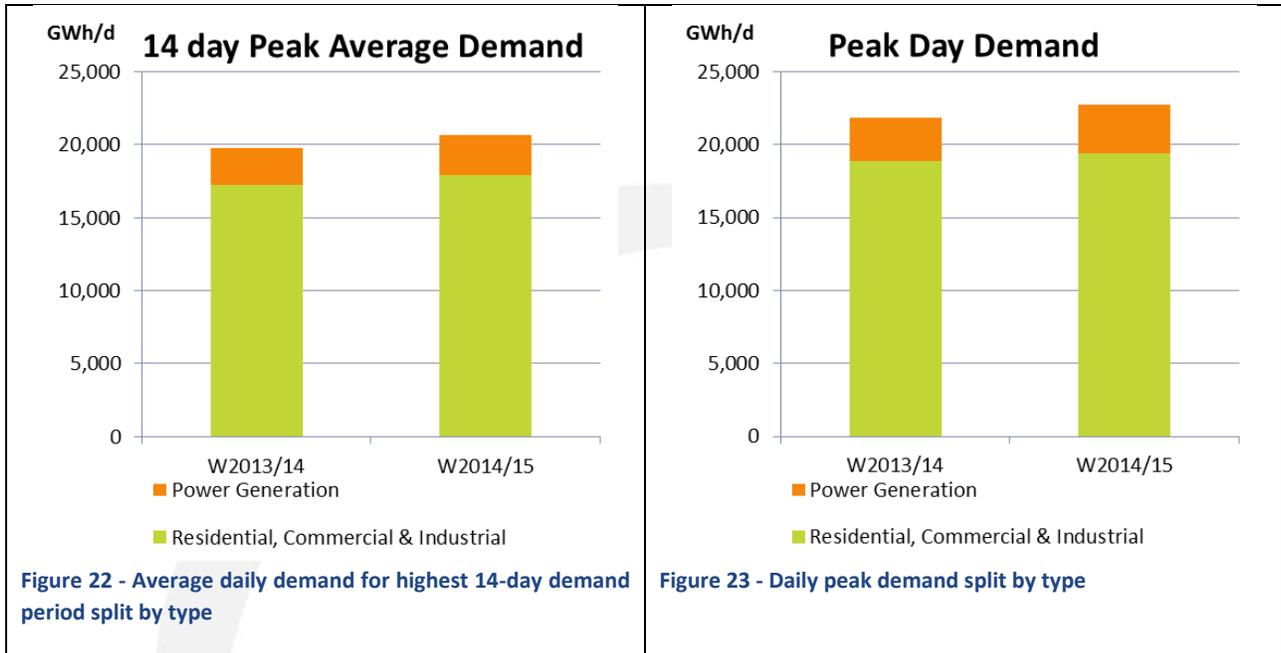
(*) These graphs refer to the countries for which demand breakdown is available (Belgium, Croatia, Czech Republic, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom)

▪ **Peak demand evolution 2009-2015**

Although both the peak day and 14-day peak average increased from last year, but due to the absence of extreme cold during Winter 2014/15 lead to peak demand levels being lower than average seen over the last 6 Winters (Peak 14 Day: 23.5 TWh, Peak: 25.8 TWh)



The charts below show a comparison between the peak demand periods, the 14 day average and peak day, for the two last winters where a greater level of detail is available on the split between gas demand for Power Generation and for Residential, Commercial and Industrial



(* These graphs refer to the countries for which demand breakdown is available (Belgium, Croatia, Czech Republic, Finland, France, FYROM, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, Netherlands, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom)

▪ **Seasonal modulation**

The pattern followed by winter demand is strongly linked to the climatic conditions, like the presence of cold snaps or particularly mild conditions in one or several months along the winter. The graph below shows the deviation of the monthly average demand from the winter average for each of the last five winters.

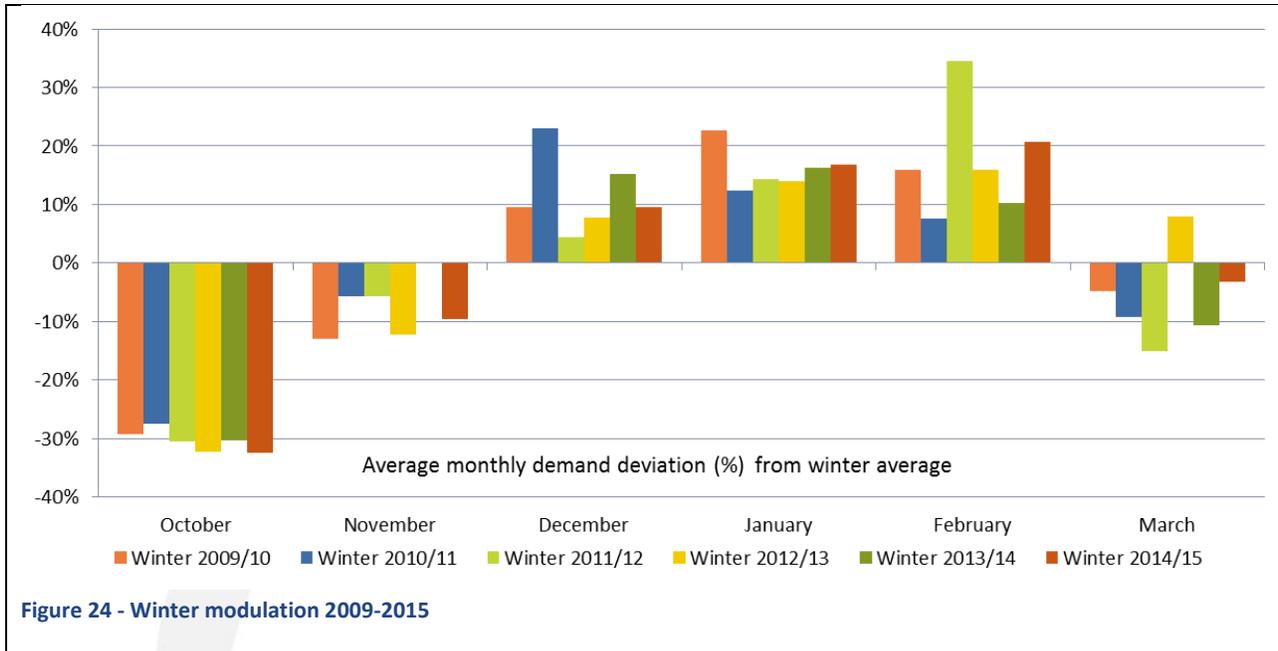


Figure 24 - Winter modulation 2009-2015

Figure 25 shows the monthly variation between the maximum and minimum daily demand. When comparing Winter 2014/15 with previous winters, the ranges seen are very narrow

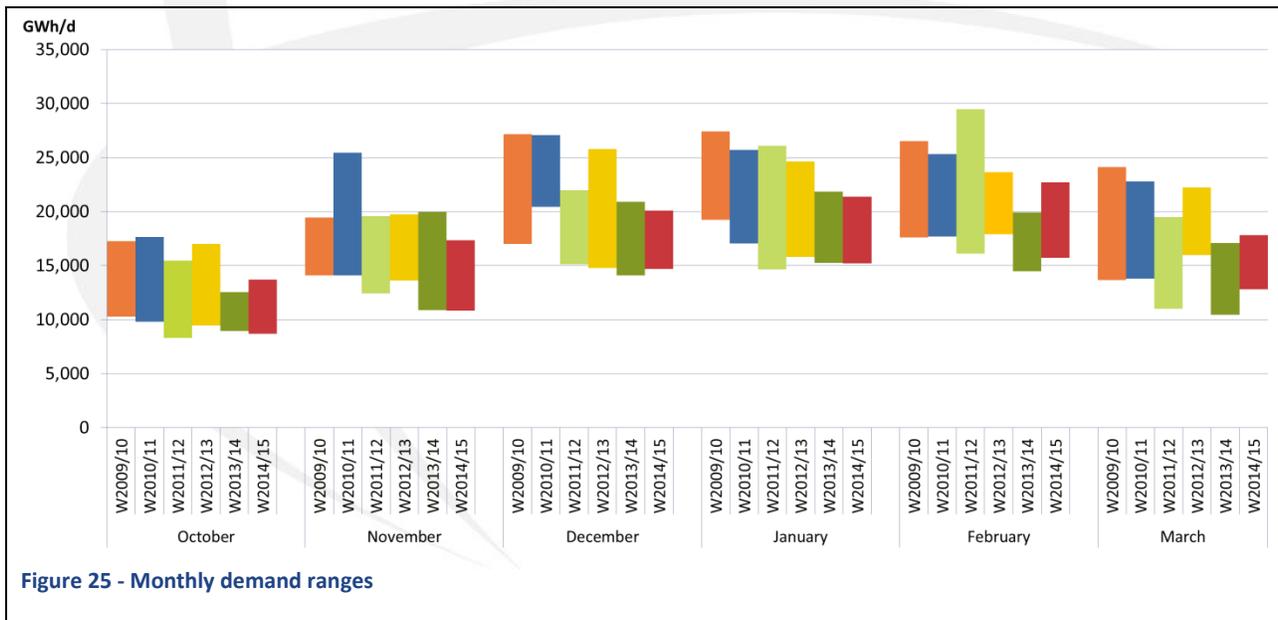
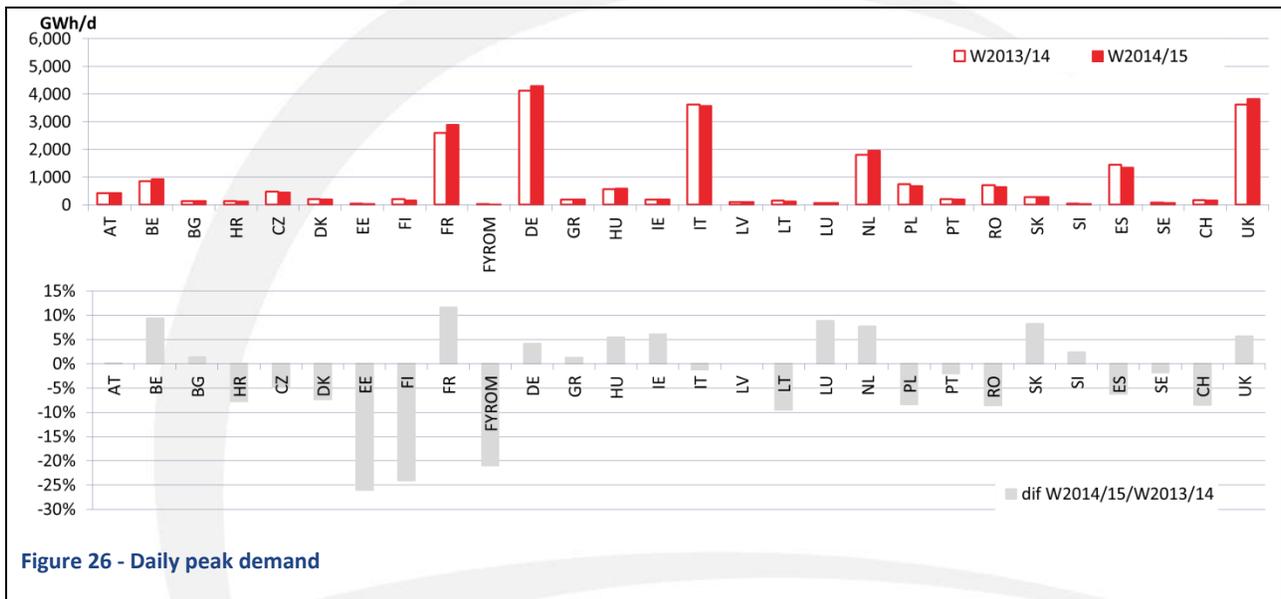


Figure 25 - Monthly demand ranges

▪ **Country detail**

While the increase of seasonal demand was generalized across Europe in Winter 2014/15, several countries experienced a decrease in the peak consumption. The majority of these were less than 10%, but Estonia (-26%), Finland (-24%) and FYROM (-21%) saw decreases greater than this.



As shown in Figure 27, there were a number of countries that saw a decrease of the 14-day peak demand compared to last winter, however increases were seen for the France, Germany, Netherlands and the UK who comprise a large share of the total European demand.

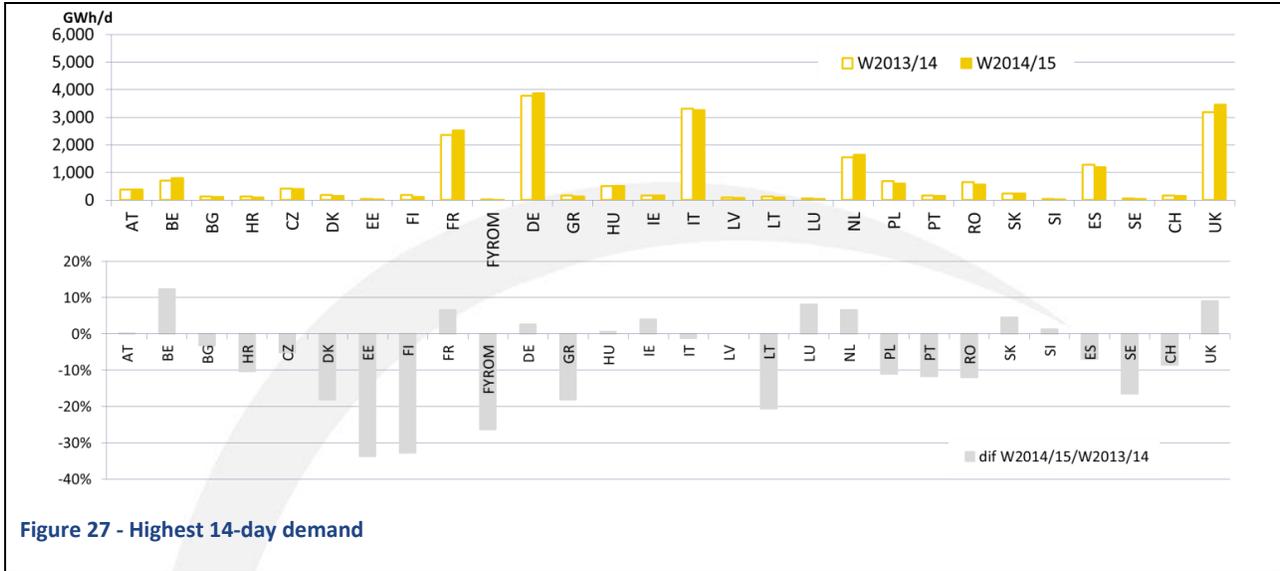


Figure 27 - Highest 14-day demand

The following graph shows the minimum, maximum and average daily demand during Winter 2014/15, as well as the daily maximum and minimum of the last four winters per countries:

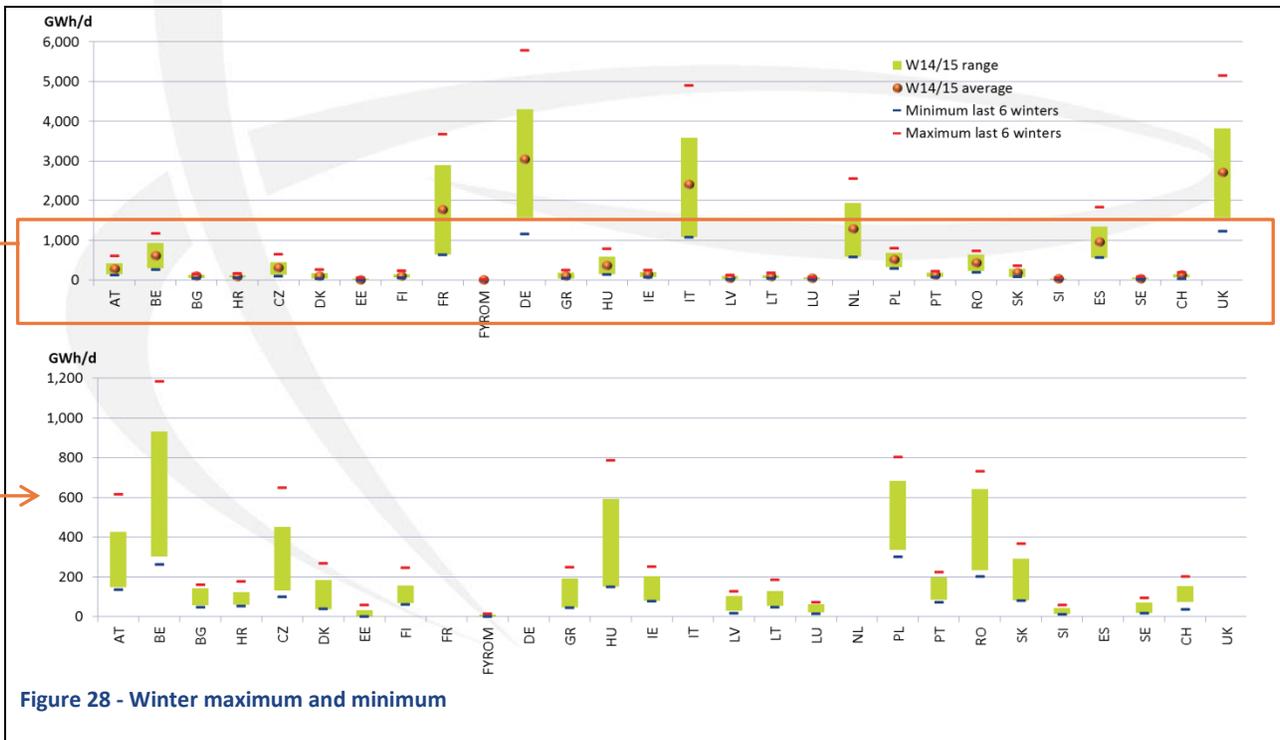


Figure 28 - Winter maximum and minimum

▪ Simultaneity

In order to measure the simultaneity between the peak days in different countries, the “Unsimultaneous 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)
 - $EPS = \text{European Peak Demand} / \text{Un-simultaneous Peak} (\%)$
- The simultaneity of an individual country in the European peak day (CPS)
 - $CPS = \text{Country demand on the European peak day} / \text{Country peak demand} (\%)$

So defined, the European peak simultaneity during the peak day on 5 February 2015, was 96%, a value slightly above the average of 95% seen over the previous 5 winters.

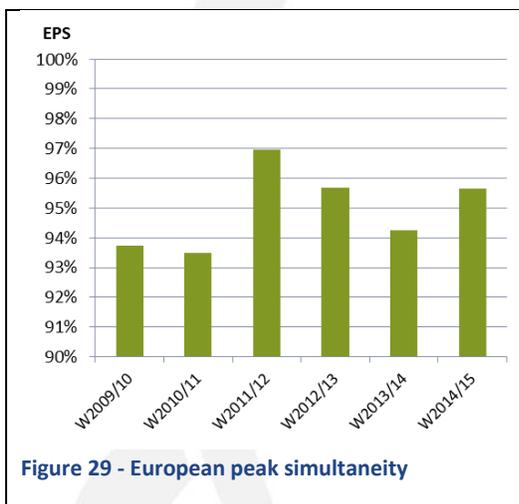


Figure 29 - European peak simultaneity

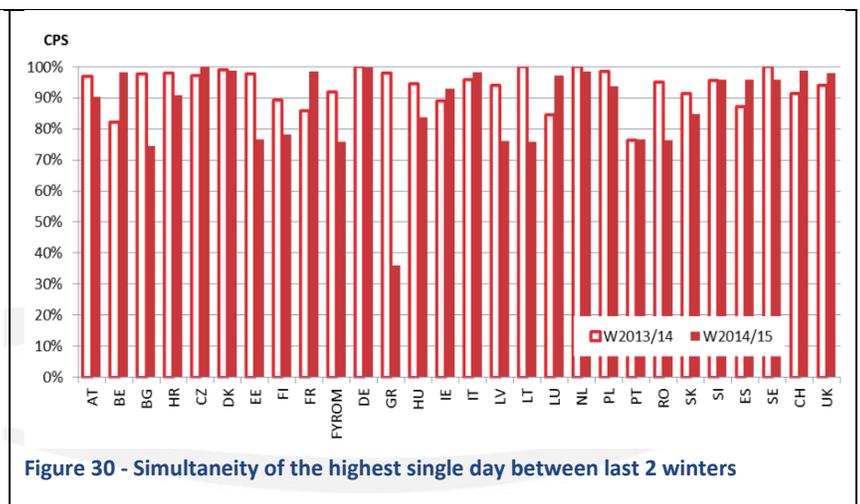


Figure 30 - Simultaneity of the highest single day between last 2 winters

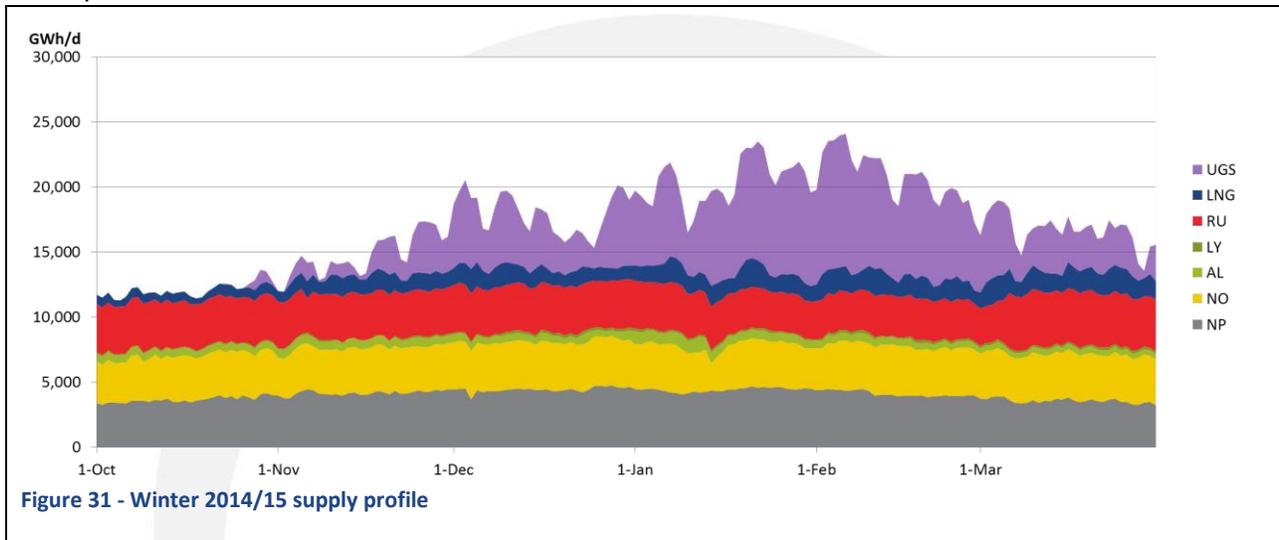
Winter	Day	Peak demand (GWh/d)	EU simultaneity (%)
W09/10	26/01/2010	27,431	94%
W10/11	17/12/2010	27,091	93%
W11/12	7/02/2012	29,460	97%
W12/13	12/12/2012	25,775	96%
W13/14	29/01/2014	21,842	94%
W14/15	05/02/2015	22,711	96%

Table 1 - 2009-2015: Peak demands and their simultaneity

Supply

> European seasonal gas supply

The graph below shows the evolution of the aggregated gas supply in Europe during winter 2014/15.



The next graphs give an overview of Imports, National production and UGS supply shares during Winters 2014/15 and 2013/14 in both absolute and relative terms:

Total winter supply: 3,092 TWh

Figure 32 shows the seasonal supplies by source for the last two winters in absolute figures.

The average increase of total gas supply was 5%, but it was not homogeneous between the different supply sources.

There were significant reductions from National production, Russian and Algerian imports (-11.5, -23% and -32% respectively).

This was countered by the increase in LNG (34%), Norwegian (9%), and Libyan (45%) imports.

However, the most significant increase in the use of supply sources was UGS (103%).

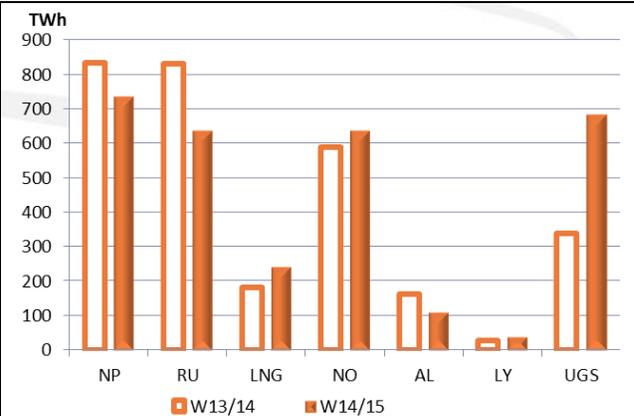
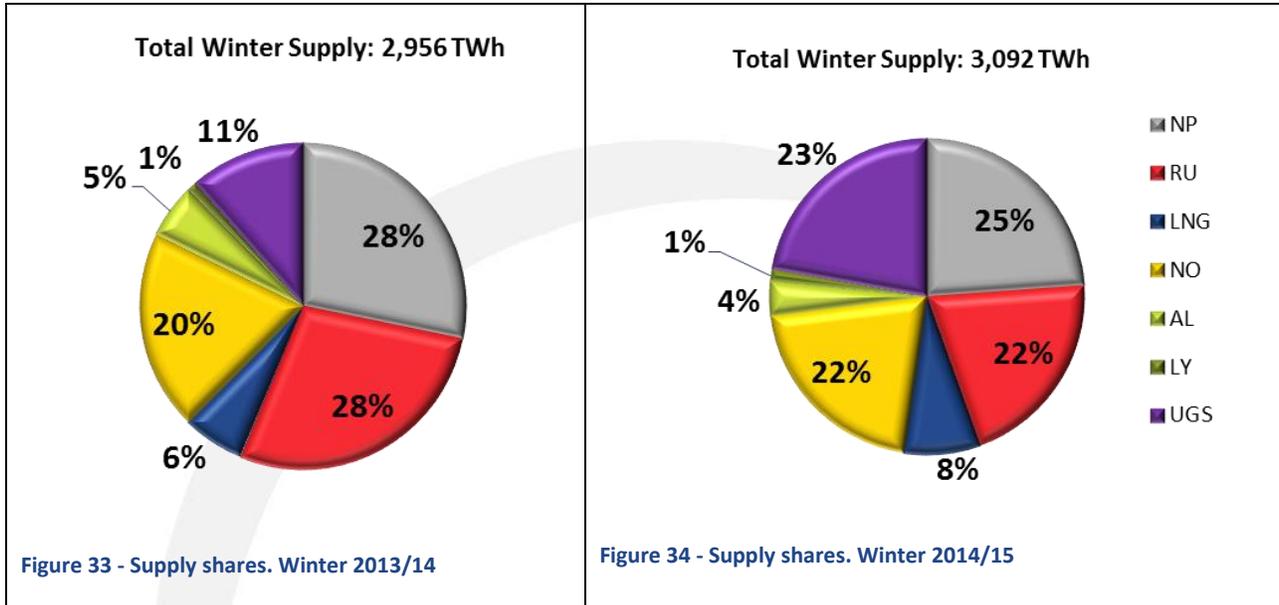


Figure 32 - Seasonal supply

These variations implied a significant change in the supply shares.

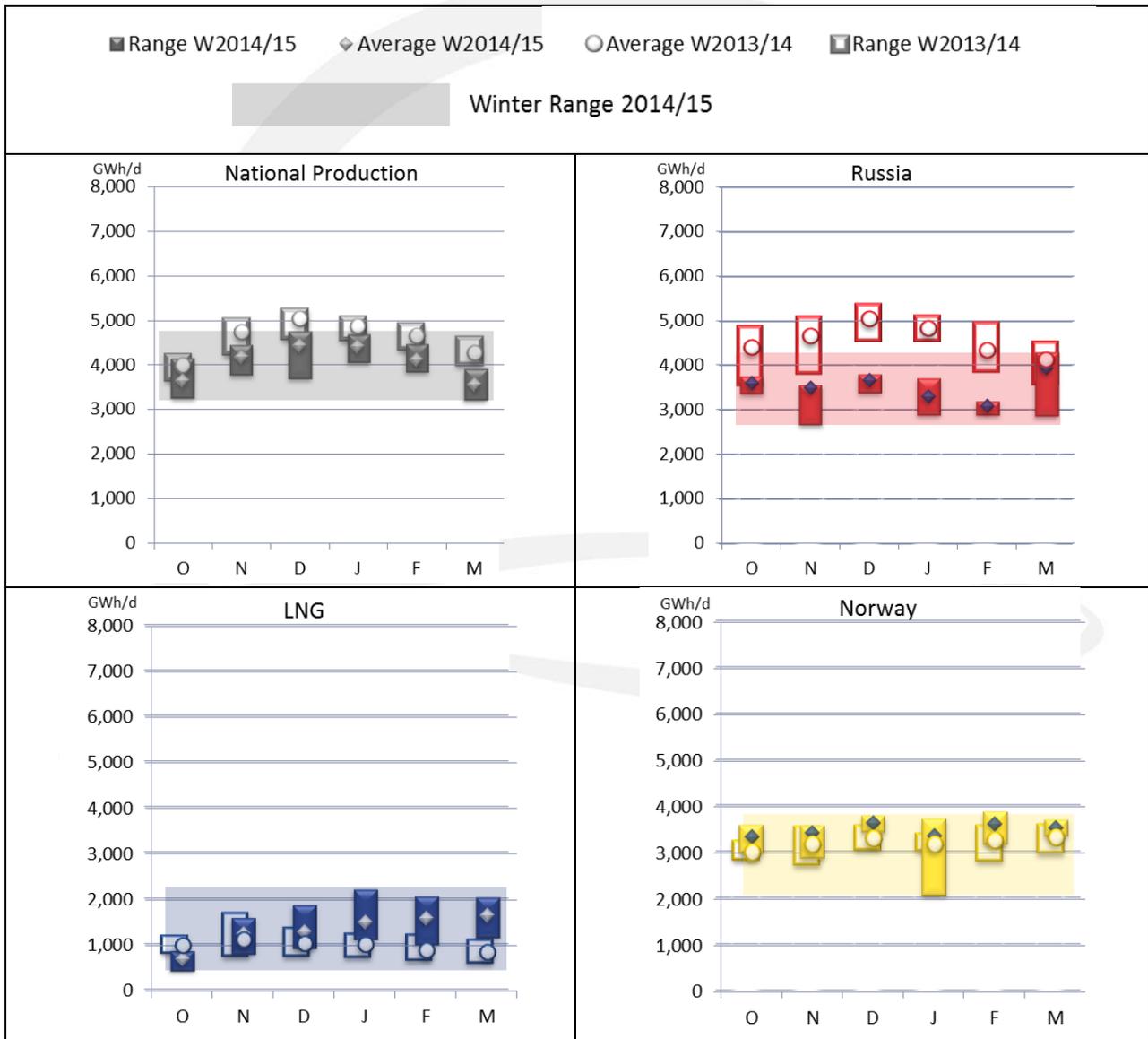


LNG supply increased following the reduction in price spread between the European and Asian markets, potentially driven by an increase in global LNG production and lower than anticipated demand in Asia.

There is a significant decrease in supplies from Russia, potentially due to market strategies where the optimisation of oil index linked contracts was exercised, with the continued fall of oil prices were expected across the period and into Q2 and Q3. A substantial reaction was seen from UGS which started the winter with reasonably high stocks and due to the relatively low demand across the season, had the capability to respond.

▪ **Supply Modulation**

The following graphs illustrate for national production and each import supply source per 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).



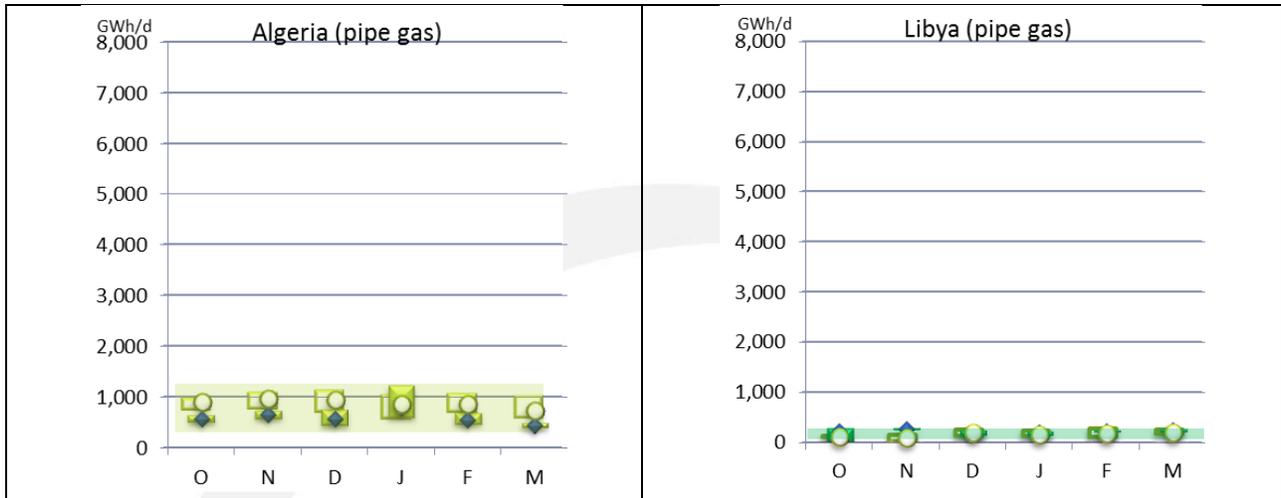
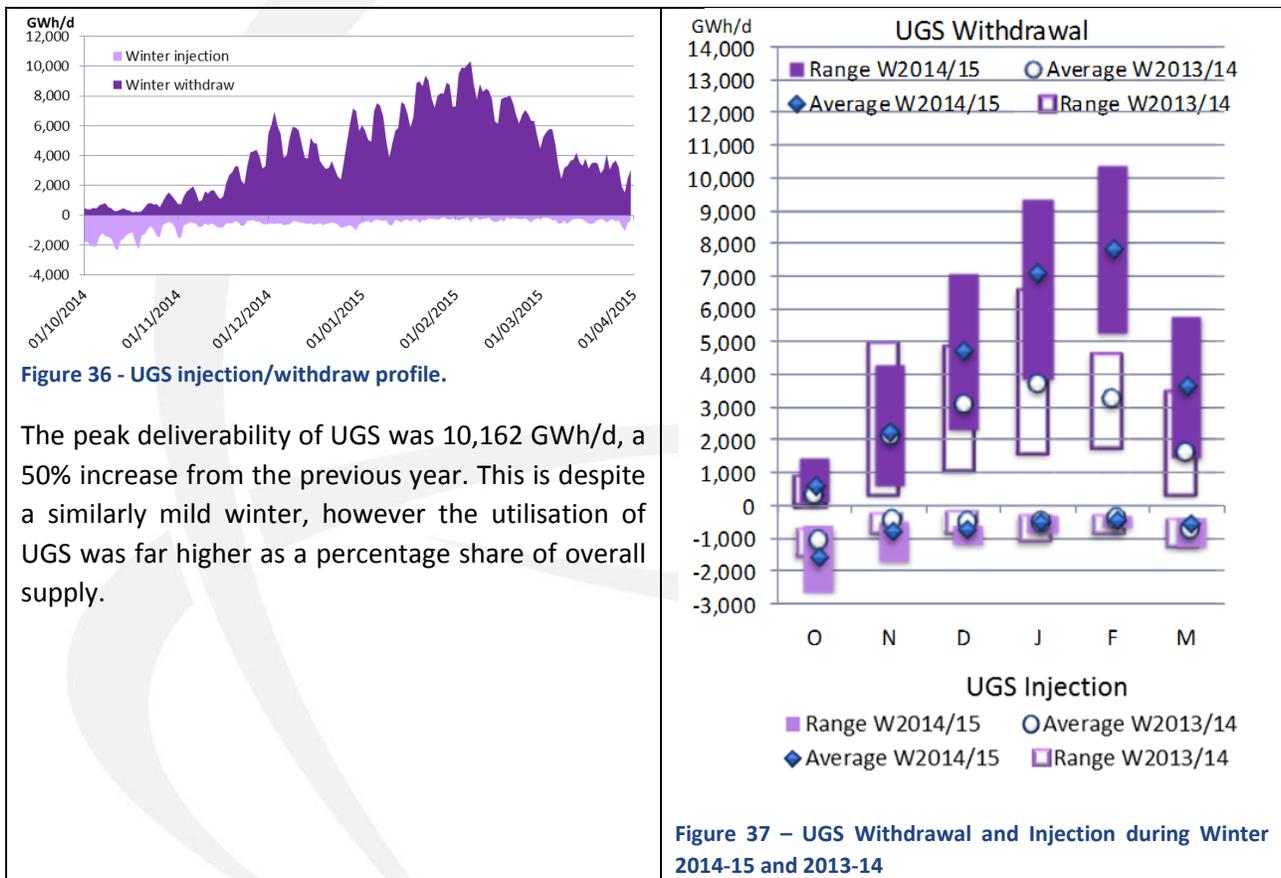


Figure 35- Supply modulation

▪ **Underground Storages**

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

As previously mentioned in this report, the high use of UGS this winter despite low overall demand has been driven by its use as an alternative to other supply sources that saw reductions from the previous winter. This was facilitated by the high stock level, although it is comparable to previous winters.



The peak deliverability of UGS was 10,162 GWh/d, a 50% increase from the previous year. This is despite a similarly mild winter, however the utilisation of UGS was far higher as a percentage share of overall supply.

Figure 38 compares the stock level evolution curve of the last four winters. The stock level for the winter 14/15 started from a significantly high level (91%) as a consequence of the high stocks at the end of the previous warm winter. Despite this, the injection period continued and the maximum stock level (94%) was reached towards the end of October. By the end of the winter, the stock level was 26%, following the highest UGS utilisation value of the last five years.

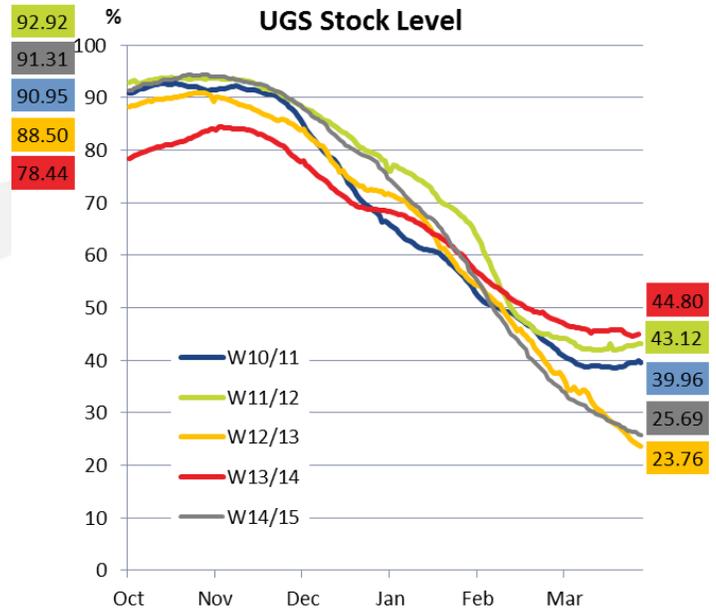


Figure 38 - Evolution of stock level. Winters 2010-2015 (Source AGSI)

Winter	UGS utilisation (% WGV)
W2010/11	54%
W2011/12	52%
W2012/13	67%
W2013/14	40%
W2014/15	68%

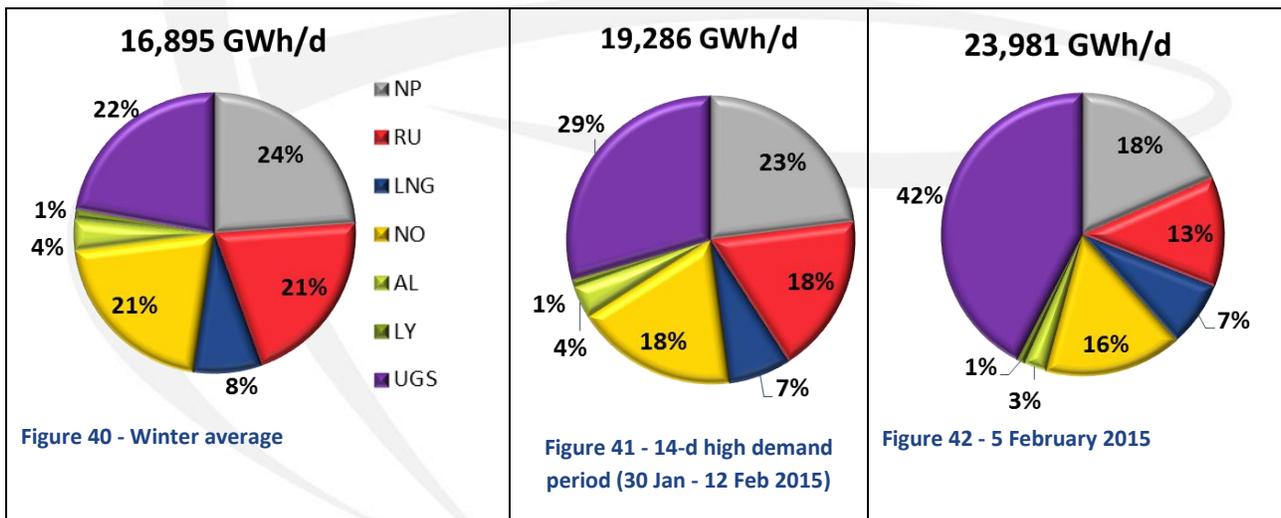
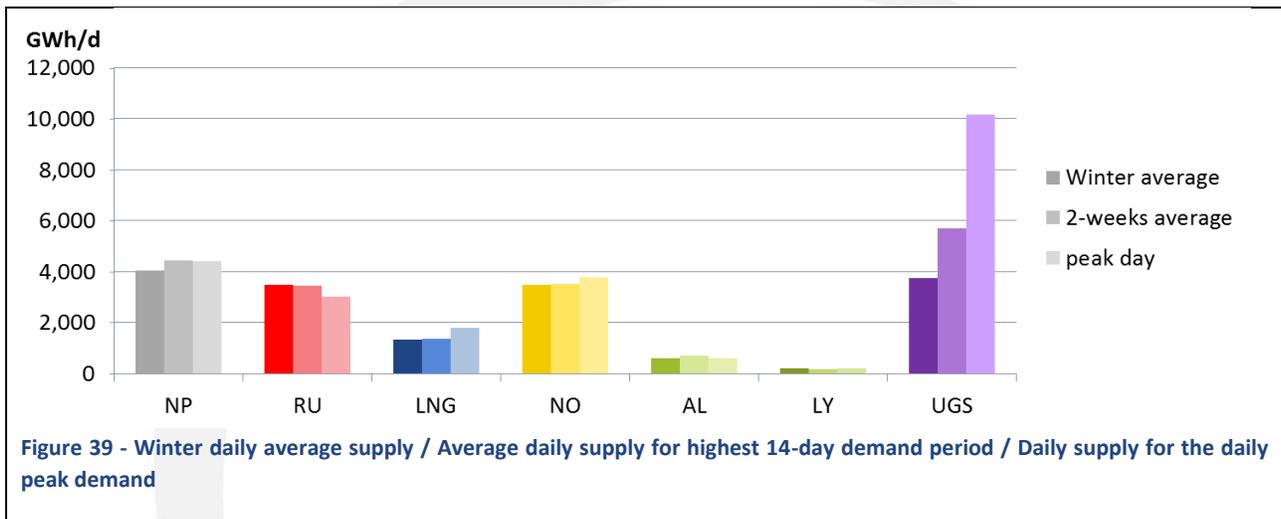
Table 2 - UGS winter use

Table 2 shows the variation between the maximum and the minimum stock level reached during the winter season.

Data source: AGSI

▪ **Supply coverage of high daily demands**

Due to the different ability of the different supply sources to increase or decrease the supply levels in response to demand, the supply mix varies significantly depending on the demand level. The following graphs compare the supply level of the different sources under different demand conditions. It shows that underground storages are the main source of flexibility in high demand situations.



▪ **Winter supply evolution 2009-2015**

The following graphs show the evolution of the different supply sources both in absolute and relative terms during the last six winters.

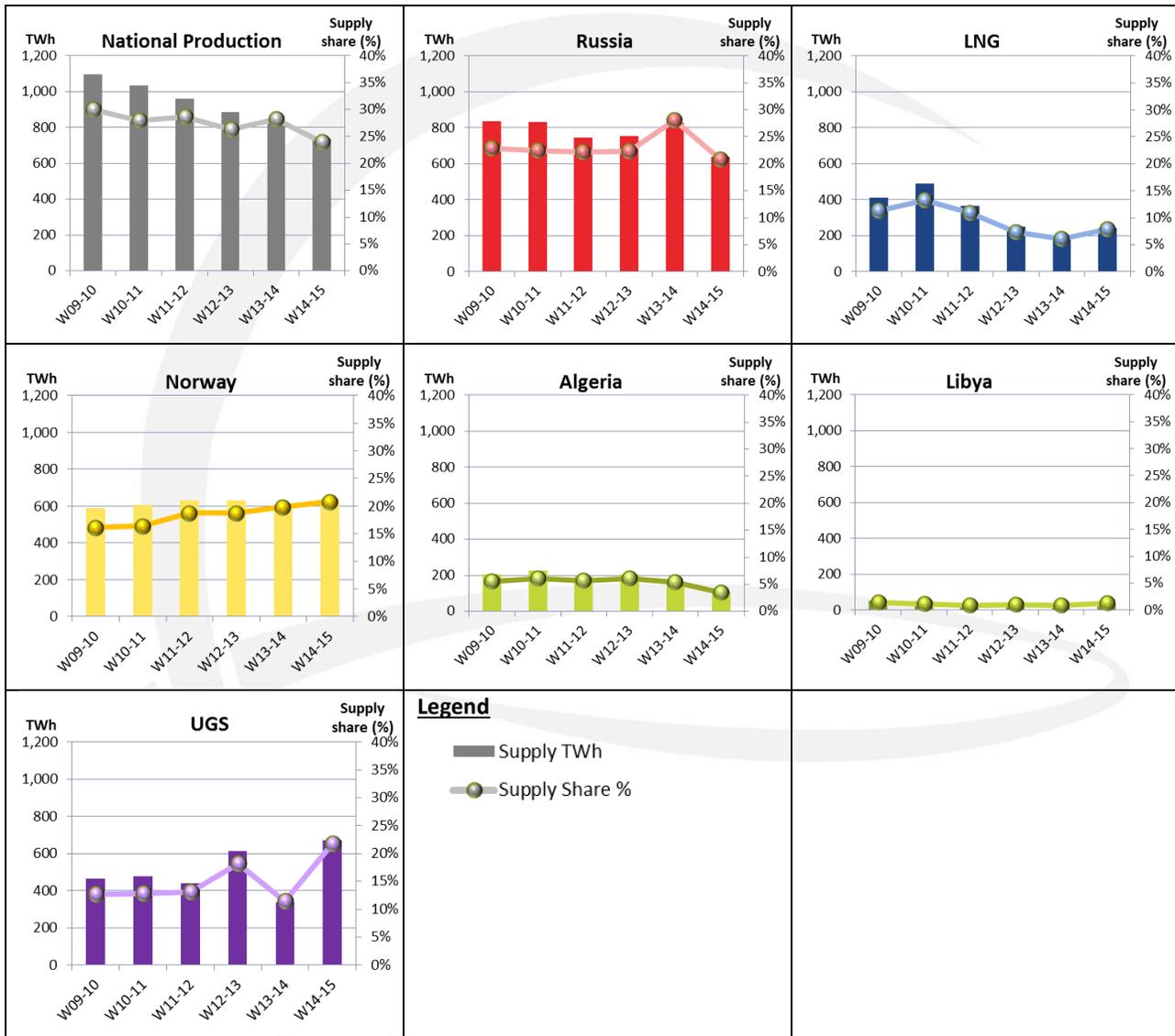


Figure 43 - Evolution of winter gas supplies 2009-2015.