entsog

european network
of transmission system operators
for gas

Winter Review 2017/2018

OCTOBER 2018

Contents

Winter Review 2017/2018

Executive Summary

ENTSOG has completed the review of the European gas supply and demand for Winter 2017/2018 (October to March). The Seasonal Reviews aim to provide a deeper understanding 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 to ensure consistency and continuous improvement in every ENTSOG report. The main findings of this Winter Review are:

- **During the last week of February and the first week of March some countries in Europe declared an early warning situation but the gas sector managed to cope with this last cold spell showing robustness and flexibility, also providing the power system with a secure energy source.**
- **Seasonal gas demand in Europe was 3% higher (+90 TWh) than in the previous winter and the peak day consumption reached 27,905 GWh/d, increasing (+2,385 GWh/d) around 9%.**
- **The share of gas in the generation of electricity has decreased slightly in the last season, from 20% to 19%.**
- **UGS utilisation was significantly higher than the one from previous winters. The level at the end of season was the lowest of the last 6 years (18%).**
- **LNG terminals' send-out and LNG tanks capacities also performed their role concerning demand modulation in some countries, especially to those located in the south of Europe.**
- **The supplies from Norway and Algeria were higher than in the previous winter but the Russian share remained at 36% of the total supplies and went up to 47% of the imports.**
- **Supplies from Libya dropped (-2%) and LNG showed the sharpest decline (-14%).**
- **National Production decreased in the EU compared to Winter 2016/2017, and more specifically, the L-Gas from the Netherlands.**

Detailed data for the cross-border flows are available on the Transparency Platform[1].

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.

[1] Transparency Platform: https://transparency.entsog.eu/

1. Introduction

This review, as part of the ENTSOG Annual Work Program 2018, is published on a voluntary basis and aims at providing an overview of the demand and supply balance during Winter 2017/2018. The report brings transparency to 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.

During Winter 2017/2018, the gas sector contended well with an extreme cold spell. Consequently, a dedicated section of this report analyses the different events which occurred and also provides information about the measures taken and lessons learned.

More generally, 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.

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 highlights specific events, which occurred during the period between October 2017 and March 2018, that caused fluctuations in the supply and demand balance. The major gas related topics were:

OCTOBER

- Pipeline gas flows into Europe nudge towards record highs at the end of October.
- Supplies from Russia, Norway and Africa all climbed higher. The firm pipeline flows supported further storage injections.
- For Italy and Spain, North African flows increased up to 1.3 bcm.

NOVEMBER

- Russian flows to Europe highest since January (11.5 bcm) via the three main routes.
- Nord Stream and Yamal flows were close to max capacity.
- In the United Kingdom, Norway's exports soared to 3.6 bcm.

DECEMBER

- European pipeline gas imports increased year on year despite some outages.
- December reached a total of 25 bcm imports, the highest in 11 months.
- Norwegian pipeline exports came back above 10 bcm in the United Kingdom.

JANUARY

- Russian flows to EU dipped 18% in January to 9.6 bcm through the three main corridors and slumped to three-year low through Ukraine.
- In Italy, imports via Passo Gries reached very high levels and Algerian deliveries got close to 70 mcm/d.

FEBRUARY

- European gas hub tested to limit on cold snap and prices reached multi-year highs.
- Total stocks in the United Kingdom, The Netherlands, Belgium, France and Germany combined stood below 10 bcm at the end of February. LNG stocks also fell sharply.
- Italy and Denmark declared an early warning situation at the end of February.

MARCH

- United Kingdom, Sweden and Ukraine announced different gas deficit early warnings.
- Russian flows to Europe ascend to 14 months record high monthly supply in March.
- In the Netherlands, the TTF average day ahead price was completely de-coupled from the oil indexed range due to the weather gas price spike.

Note detailed early warnings during the February/March cold snap:

- **On 23rd February**, Italy declared an early warning situation due to the situation on the TENP pipeline that threatened the flexibility of the Italian gas system.

- **On 27th February**, Denmark declared the crisis level early warning resulting of a tight supply situation together with an increasing negative system imbalance.

- **On 1st March**, United Kingdom informed of a tight situation because of the reduction of the supplies from the North Sea and from the Netherlands together with a significant increase of the demand. Also, on 1st March, Sweden declared an early warning situation due to a significant imbalance in the Swedish transmission network.

- **On 2nd March**, Ukraine informed of a tough situation due to problems with deliveries from Russia and the reduction of the pressure at the entry point in the gas transmission system.

The level of storages at the end of winter 2017/2018 was the lowest (190 TWh) of the 8 last years with a very high extra use of storages at the end of the season but without any significant demand curtailment.

2. Gas Prices and Quantities at European hubs

The following graphs show the evolution of gas prices in Europe during the Winter 2017/2018:

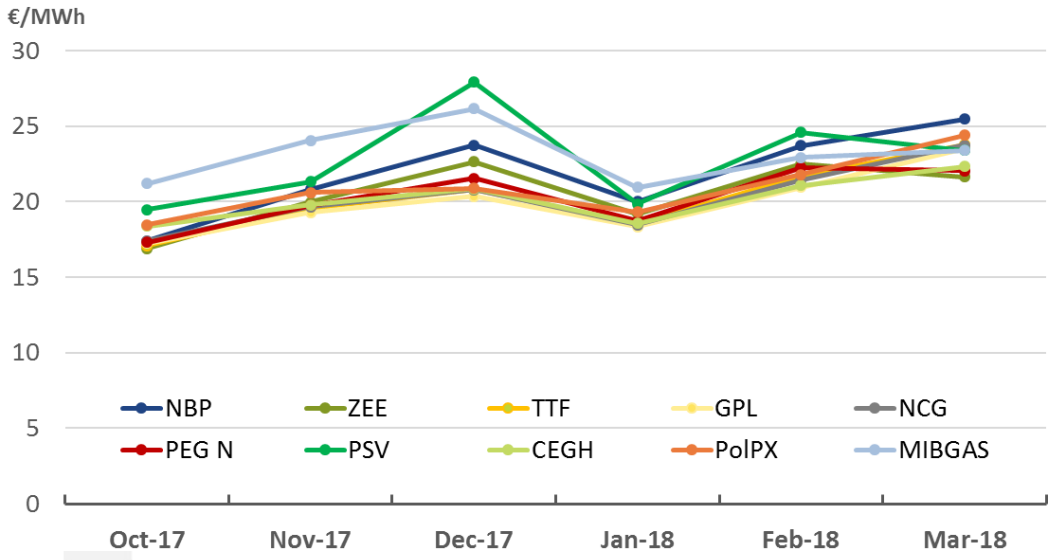

Figure 1 - Day-ahead average prices at European hubs in €/MWh (Source: Bloomberg and MIBGAS)

Figure 1 shows the evolution of the day-ahead winter average prices at different European gas hubs. As in the previous winter review, price convergence between the different European hubs continued, with the Italian PSV and Iberian MIBGAS above the other hubs at the beginning of the season. From January all European hubs showed generally a similar trend.

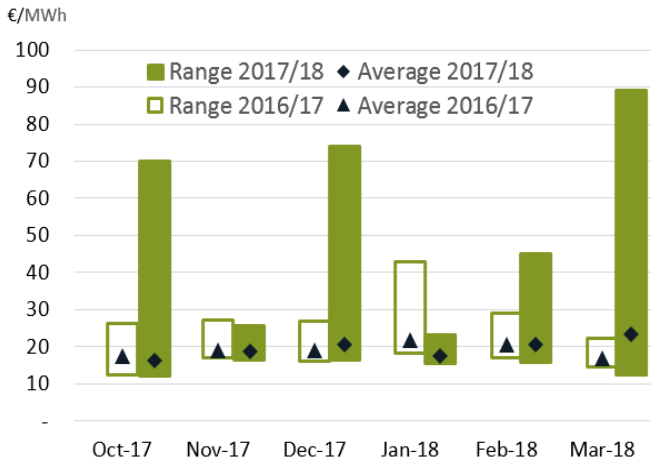

Figure 2 displays the maximum range and average of the day-ahead winter price for the last two years over all the European hubs. The average price started the winter season very close to the previous winter, around 20 €/MWh. However, it is also important to mention several price spikes that raised NCG to 71 €/MWh in October, PSV to 75 €/MWh in December and finally TTF to 76 €/MWh and NBP, even higher, close to 90 €/MWh in March 2018. This situation caused very high maximum price ranges in winter 2017/2018.

Figure 2 - Ranges and averages of the day-ahead hub prices at European hubs in €/MWh (Source: Bloomberg)

3. Demand

3.1. European seasonal gas demand

The gas demand in Winter 2017/2018 was higher (3,377 TWh) compared to the previous winter (3,286 TWh). All months except January, the maximum and minimum values and the average daily demand was higher, especially in February and March. **Figure 3** shows the range and the daily monthly average for total demand in EU and a comparison with the previous winter.

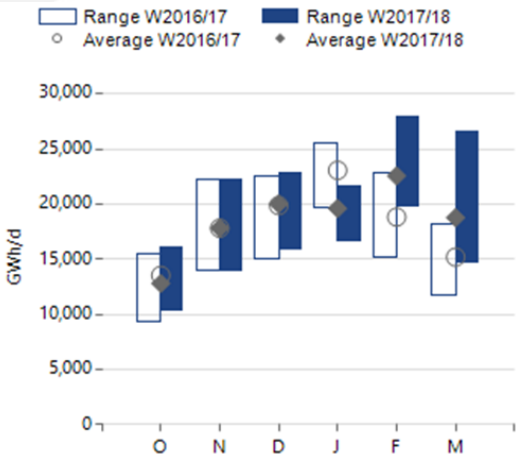

Figure 3 - Total gas demand. Winter 2016/2017 vs Winter 2017/2018

Figures 4 and 5 show the demand range and monthly average when split into Final Demand (Residential, Commercial and Industrial) or Power Generation sectors, for the countries where the demand breakdown is available. Residential, Commercial and Industrial sector represents more than 80% of the total demand.

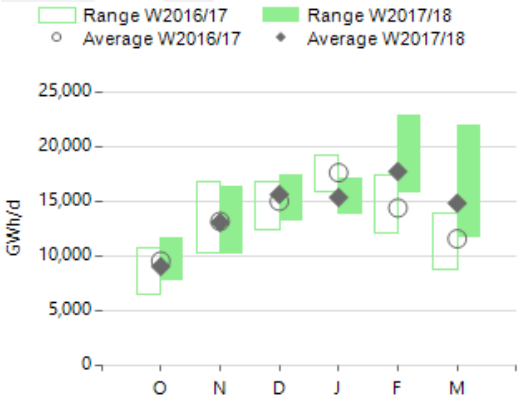

Figure 4 - Final gas demand *

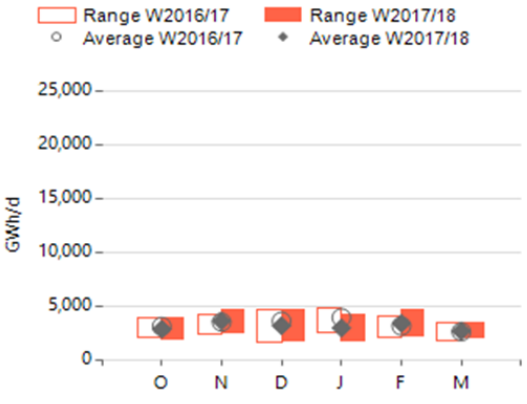

Figure 5 - Power generation gas demand *

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

3.2. Electricity power generation from gas

In Winter 2017/2018 the power generation from gas has stopped growing. Compared to the previous winter, the power generated with gas in 2017/2018 decreased -1.7% as shown in **Figure 6**. This generation has been increasing for many years, whereas coal and other sources were reduced in general terms.

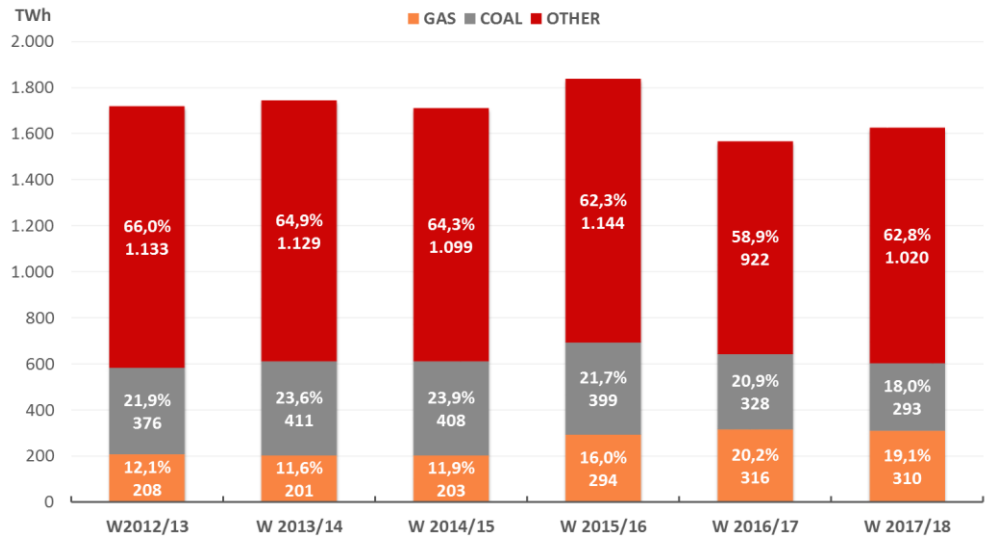

Figure 6 - Gas, coal and other sources in the electricity mix. Winters 2012-18. (Source: own elaboration based on data from ENTSO-E)

Figure 7 shows the evolution of the minimum and maximum month ahead clean spark spread[2] (gas) and clean dark spread[3] (coal) of the previous winters[4]. Until 2014, market conditions for power generation from coal and gas were quite divergent, showing stable high maximums and minimum spreads at around zero for coal. In contrast, since 2014, both maximum and minimum spreads for gas showed an upward trend reaching the spread range of coal. This convergence was almost achieved in Winter 2016/2017 and maintained in 2017/2018, were the range of clean spark spread and clean dark spread are quite similar. Generally, these spreads are driven by the respective input prices for gas and coal, the price of CO_2 allowances and the power prices in the different countries.

[2] 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. The formula applied is:

*Clean Spark Spread = Price of Electricity - [(Price of Gas) * (Heat Rate)] – Carbon Price*

[3] The clean dark spread follows the same methodology as the clean spark spread but applies to coal rather than gas.

[4] This graph represents data for the following countries: Germany, United Kingdom, 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.

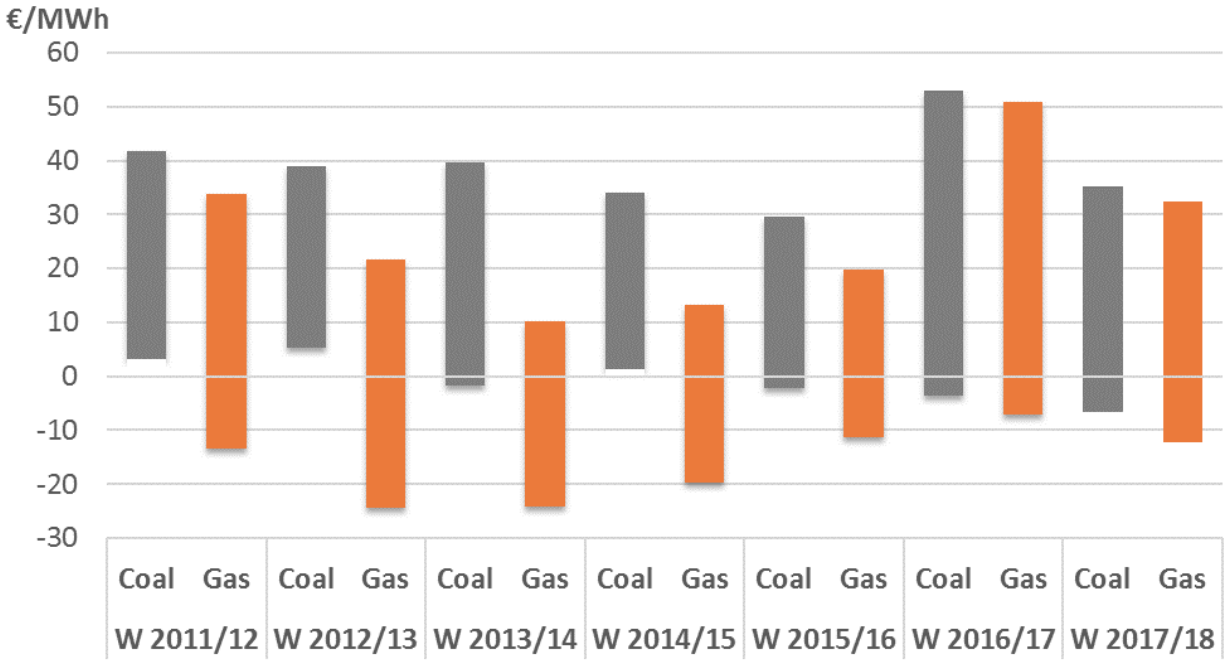

Figure 7 - Range of clean dark vs. clean spark spread over the season in €/MWh. Winters 2011-18. (Source: own elaboration based on data provided by Bloomberg)

In absolute terms, the electricity produced from gas was 316 TWh_e in Winter 2017/2018, representing 19% of the generation mix with a decrement of 1%. Coal and lignite show a reduction of 3% together when compared to the previous winter. Non-fossil fuels do not show large variations from the previous year, except for wind generation that increased (+3%).

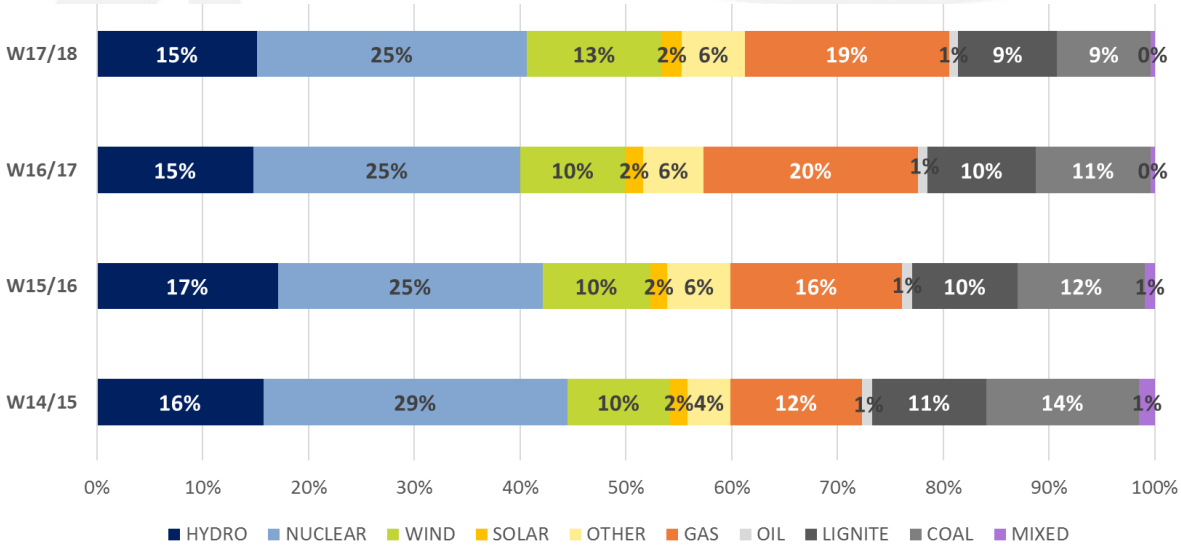

Figure 8 - *Electricity generation mix. Source: own elaboration based on data from ENTSO-E in 2017/2018*

3.3. Winter demand evolution 2013-2018

The demand for the winter 2017-2018 was higher than in Winter 2016/2017. The growth was significant (+2.8%), meaning it was the third consecutive increase in the total demand and achieved similar heights to those seen in winter 2012/2013 (3,317 TWh not shown in the graph).

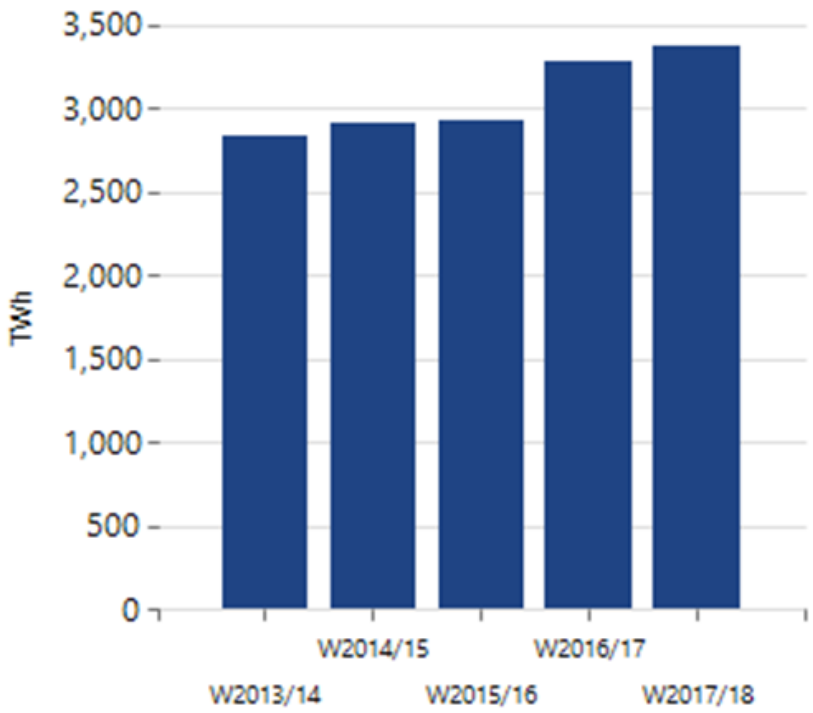

Figure 9 - Total consumption of natural gas. Winters 2013-2018

Figure 11 in the next page shows the daily average demand for each month in every winter since 2013. The largest daily average demand occurred in January 2017 (23,077 GWh/d), and this winter achieved a similar value (22,574 GWh/d), due to the cold spell that EU faced during February 2018.

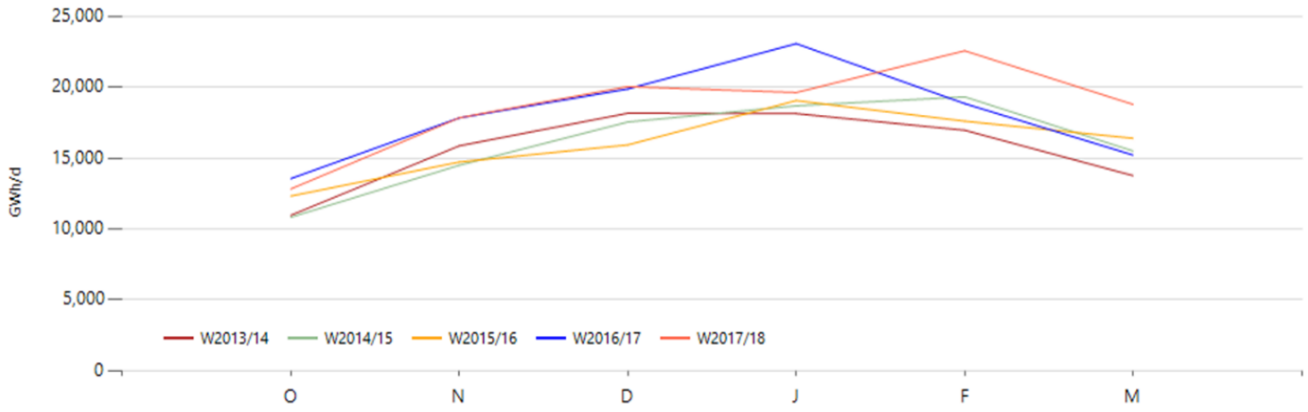

Figure 17 - Demand Monthly Average

Figure 10 - Daily average of monthly gas demand. Winter 2013/2018

As shown in the graphs below, for the countries where the demand breakdown is available, demand for power generation slightly decreased for the first time after increasing for the last four winters.

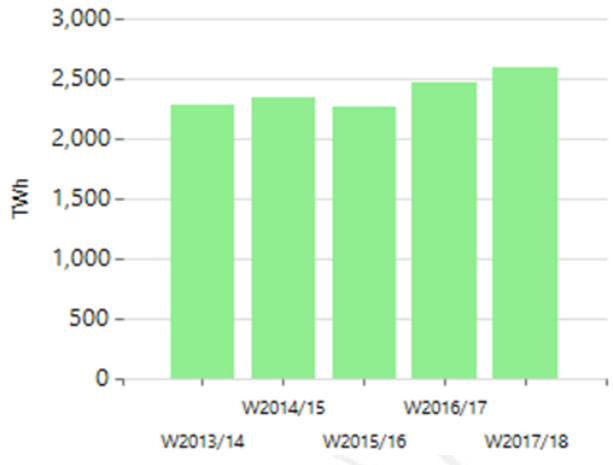

Figure 11 - Final gas consumption (residential, commercial and industrial). Winters 2013-2018 *

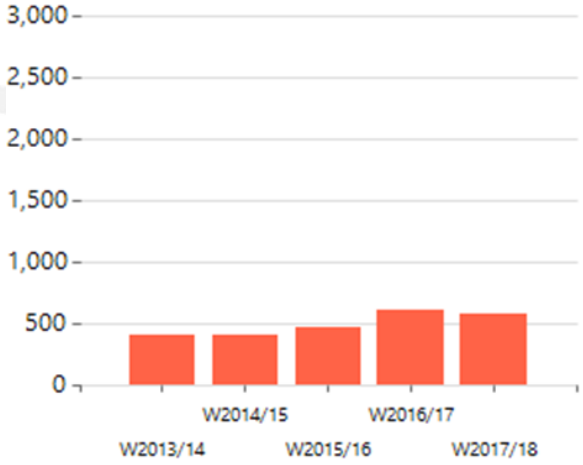

Figure 12 - Gas consumption for power generation. Winters 2013-2018 *

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

As in Winter 2017/2018, Germany Spain and Poland had significant positive variances compared to the previous winter.

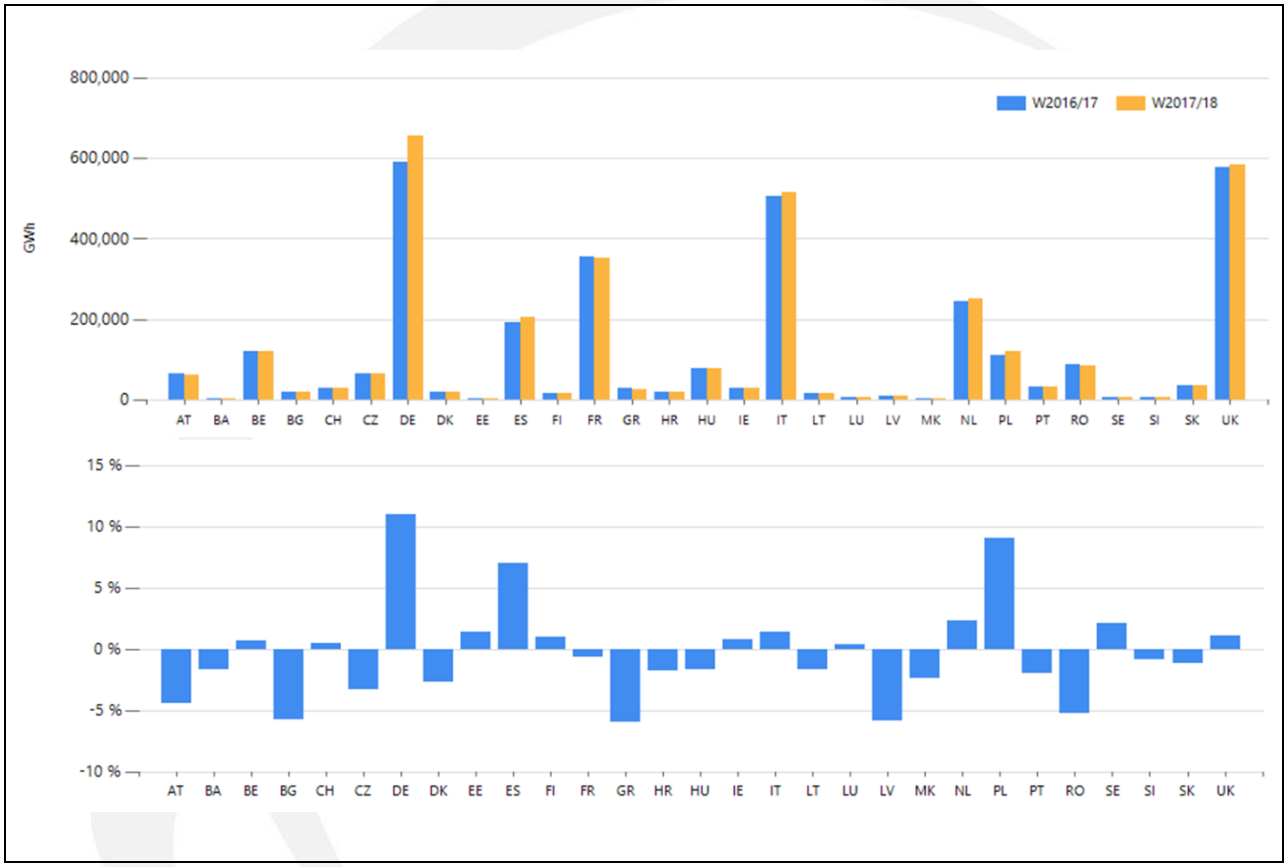

Figure 14 – Total winter demand and variation. Country detail. Winter 2017/2018 vs. Winter 2016/2017

It is also interesting to highlight the high decrease in demand (around 5%) on Austria, Bulgaria, Greece, Latvia and Romania.

3.4. Peak demand 2017/2018

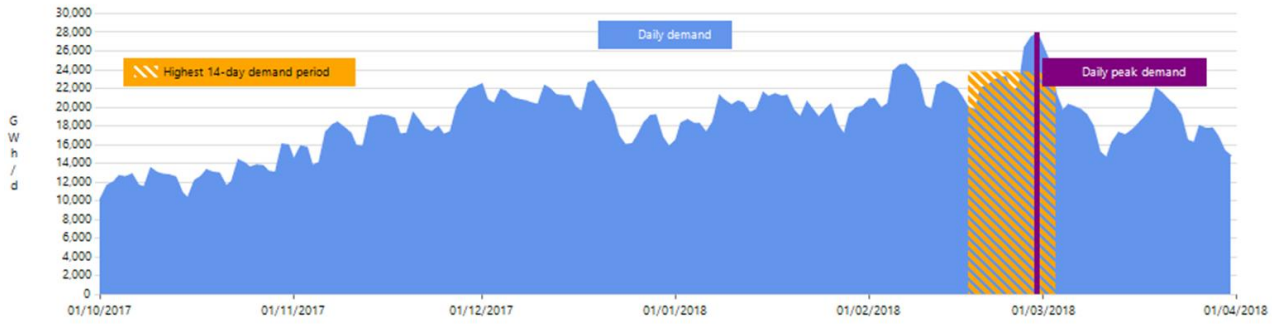

Figure 13 - Total demand daily profile. Winter 2017/2018.

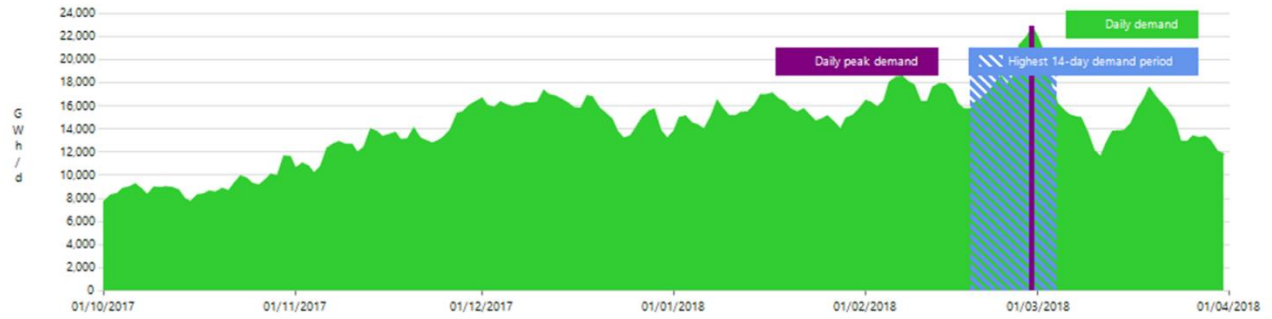

Figure 14 – Final demand (residential, commercial and industrial) daily profile. Winter 2017/2018 *

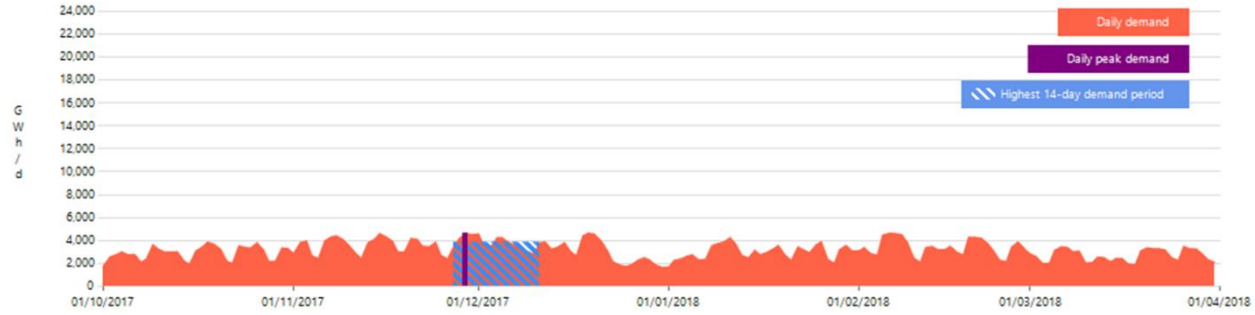

Figure 15 - Power generation demand daily profile. Winter 2017/2018 *

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

14- day peak period	Feb. 18th to Mar. 03rd 2018	**Peak day**	28/02/2018
Average 14-day demand	23,726 GWh/d	**Peak demand**	27,906 GWh/d

Peak demand was reached at the end of February 2018 during the cold spell, in the heart of the 14-day period. Likewise, the peak and 14-day period for final demand was reached during the cold spell in February 2018. In the case of power generation consumption, both peak and two-week high demand cases happened at the end of November, several months earlier and away from the cold spell.

3.5. Peak demand evolution 2012-2018

Both 14-days and peak day demand behaved differently last winter. In the first case, peak increased reaching 9% more compared to last year but the two-week high demand case was reduced by 1% versus the previous winter.

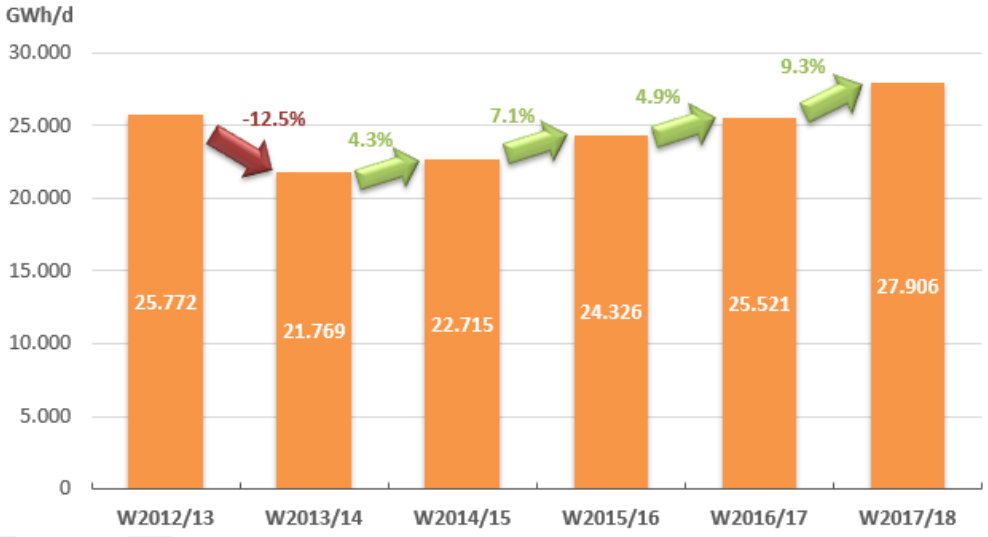

Figure 16 - Daily peak demand. Winters 2012-2018

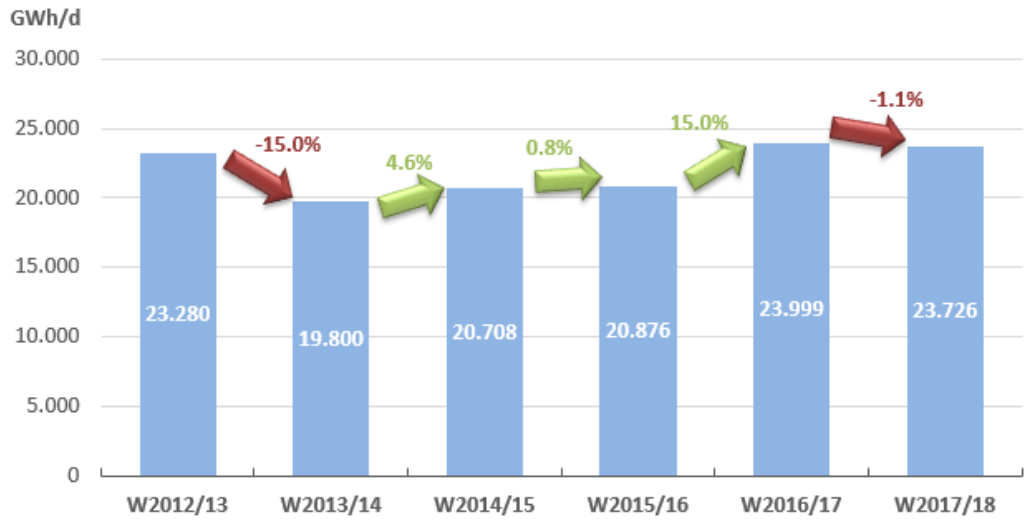

Figure 17 - Average daily demand for highest 14-day demand period. Winters 2012-2018

The charts below show a comparison between the high demand periods for the last two winters where a greater level of detail is available on the split between gas demand for power generation and for residential, commercial and industrial. It is important to mention that the total value of these graphs is lower than the previous figures because the information of the split is not available for all the countries.

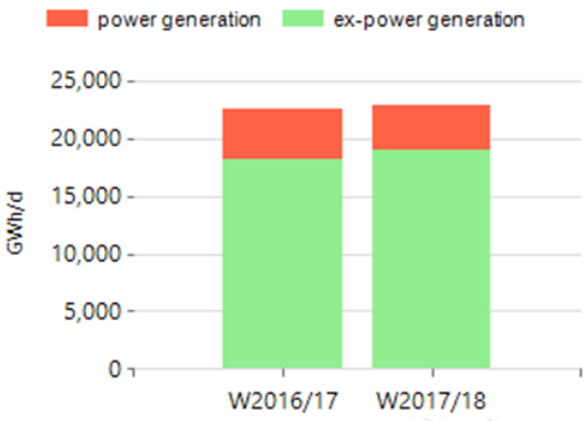

Figure 18 - Average daily demand for highest 14-day demand period split *

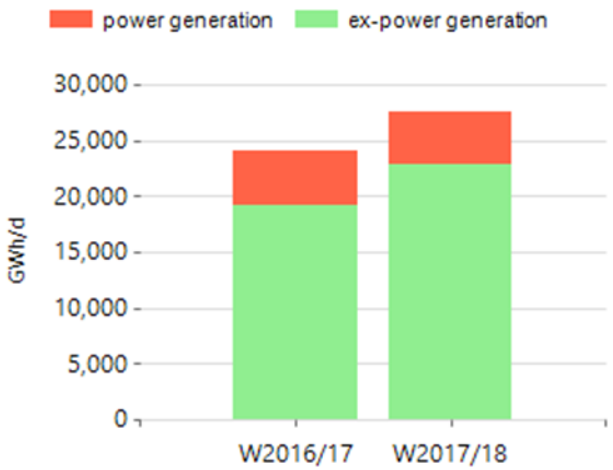

Figure 19 - Daily peak demand split *

** These graphs refer to the countries for which demand breakdown is available (Belgium, Czech Republic, Germany, Denmark, Estonia, Croatia, Finland, France, Greece, Hungary, Ireland, Italy, Lithuania, Luxembourg, FYROM, Netherlands, Portugal, 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 during the winter.

The graph below shows the deviation of the monthly average demand from the winter average for each of the last five winters. In this graph, February 2018 shows a high figure in comparison to all the winter average, only surpassed by the cold spell during January 2017.

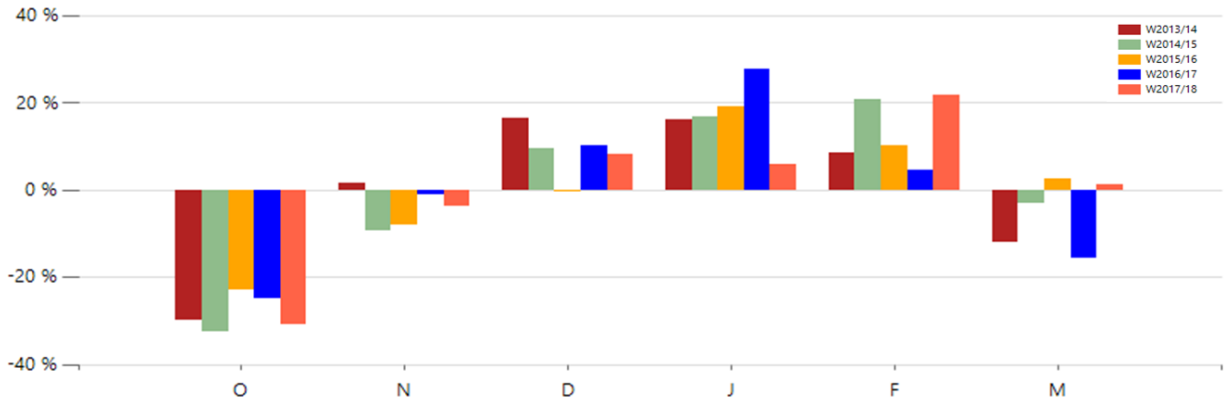

Figure 20 - Winter modulation 2013-2018

Figure 22 shows the monthly variation between the maximum and minimum daily demand and also the average daily demand for each month of the winters. When comparing Winter 2017/18 with the previous winters, the ranges and average shown in February and March are higher than usual.

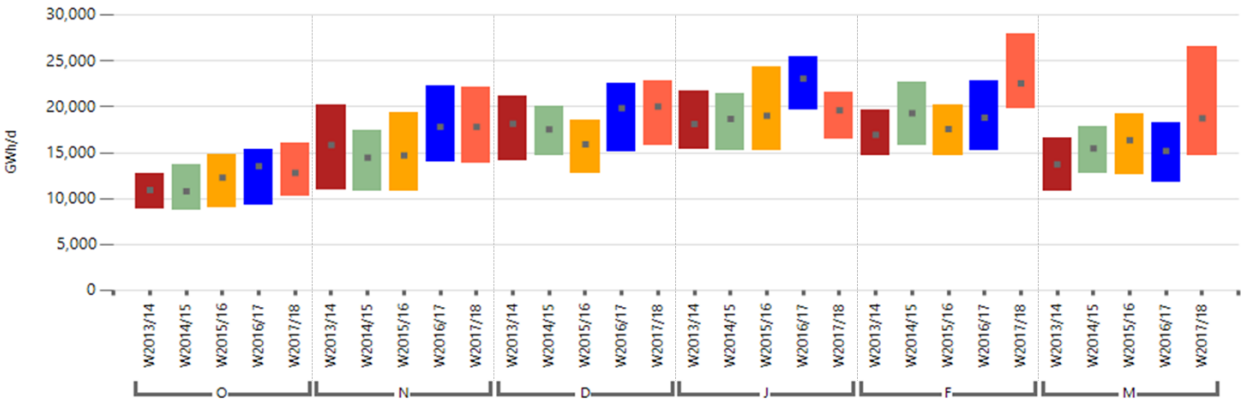

Figure 21 - Monthly demand ranges and average daily demand for each month. Winters 2013-2018

> Country detail

In the same way that the seasonal demand increased across Europe in Winter 2017/18, only Germany experienced a variation over 20% in the peak consumption. Other countries that reached around 10% more are Estonia, Spain, Finland, Poland and UK.

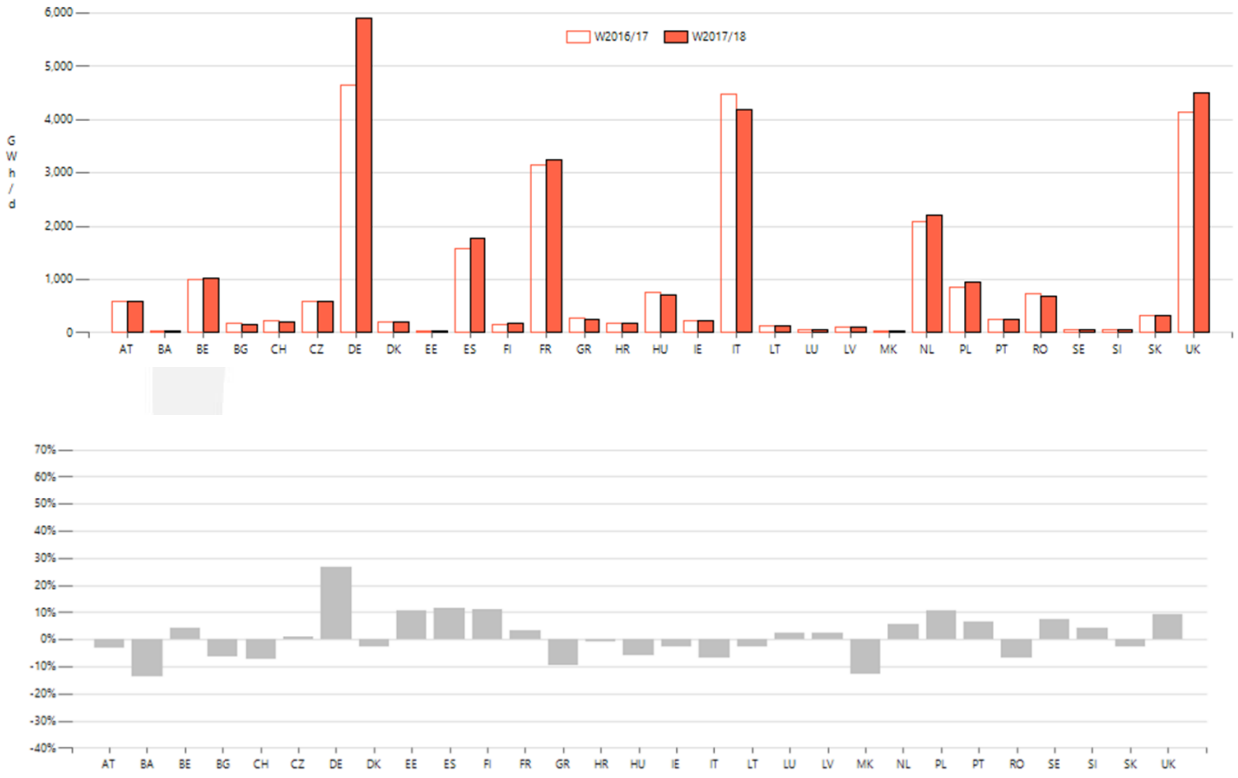

Figure 22 - Daily peak demand and variation. Winter 2017/2018 vs. 2016/2017

On the other hand, there were some countries where the peak consumption this winter was rounding a 10% lower than in the previous one: Bosnia & Herzegovina, Greece and FYROM.

As presented in **Figure 24**, many countries show a decrease of the 14-day high demand compared to last winter. As shown in these graphs, the same countries that reduced their peak consumption (shown in the previous graphs) behaved similarly in this two-week case.

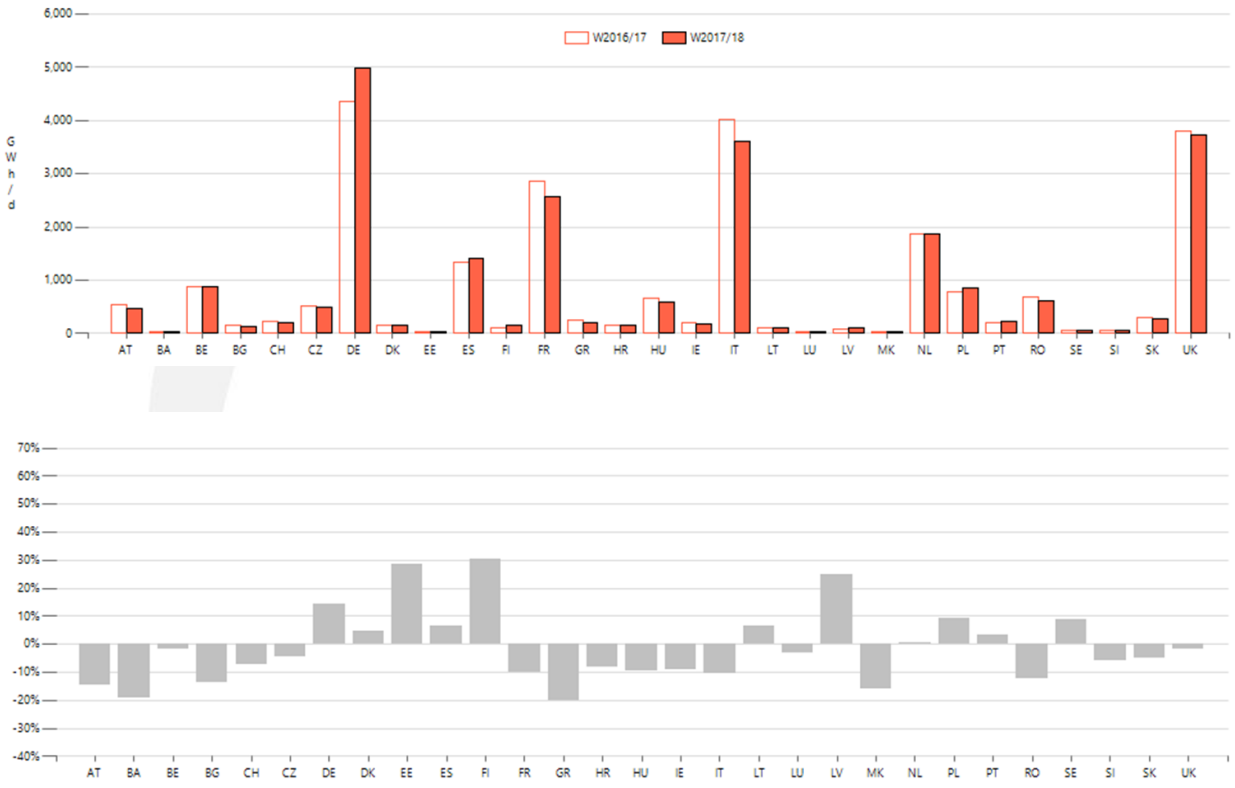

Figure 23 - Average 14-d demand and variation. Winter 2017/2018 vs. 2016/2017

Alternatively, Estonia and Finland experienced a high positive variance for the 14-day demand, round 30%, and also Latvia which increased above 20%.

The following graphs show the minimum, maximum and average daily demand during Winter 2017/18, as well as the daily maximum and minimum demand of the last five winters per country:

Figure 24 - Winter maximum, minimum and average demand

In these graphs we can observe the countries where the highest daily demand in W17/18 has been higher than the maximum demand over the five previous winters, those are Germany, Poland and UK.

Almost all the countries show a higher minimum than the one observed during the last five years.

> Simultaneity

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 simultaneity of an individual country in the European peak day (CPS)
    - CPS = Country demand on the European peak day/Country peak demand (%)

So defined, the European peak simultaneity during the peak day on 28th February 2018, was 97%, only 1% above the average of 96% considering this last 5 winters.

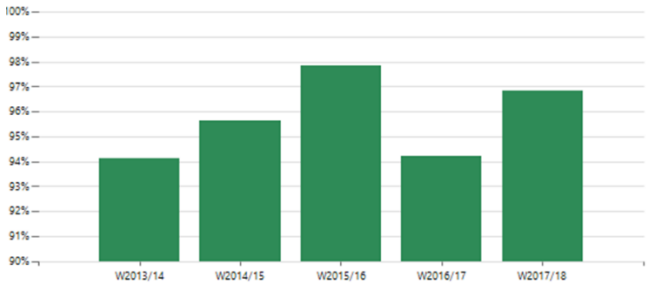

Figure 25 - European peak simultaneity

Winter	Day	Peak Demand (GWh/d)	EU Peak Simultaneity (%)
W2013/14	30/01/2014	21.769	94%
W2014/15	05/02/2015	22.715	96%
W2015/16	19/01/2016	24.326	98%
W2016/17	18/01/2017	25.521	94%
W2017/18	28/02/2018	27.906	97%

Table 1 - Peak demand and European peak simultaneity. Winters 2013-2018

Figure 26- Simultaneity of the highest single day between last 2 winters

4. Supply

4.1. European seasonal gas supply

The graph below shows the evolution of the aggregated gas supply in Europe during the last winter season 2017/2018.

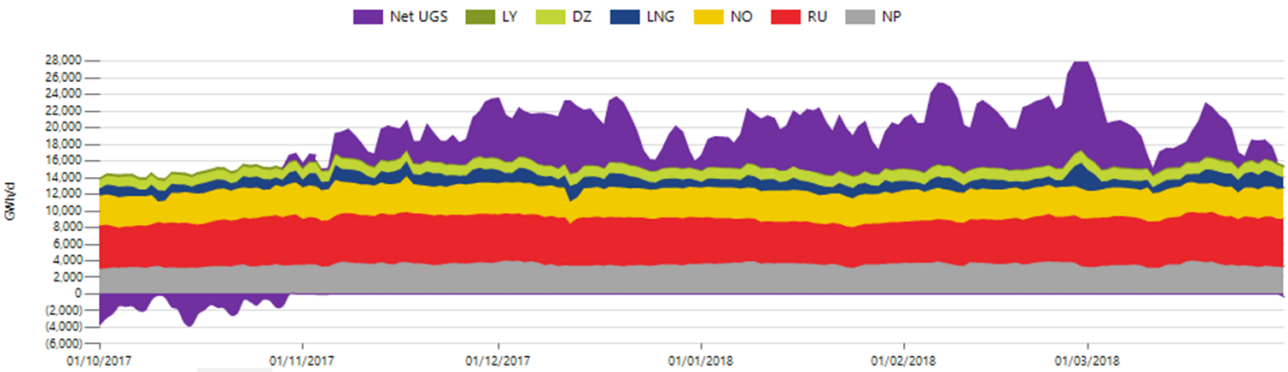

Figure 27 - Supply profile. Winter 2017/2018

The next graphs give an overview of Imports and National production supply shares during Winters 2017/2018 and 2016/2017 in both absolute and relative terms.

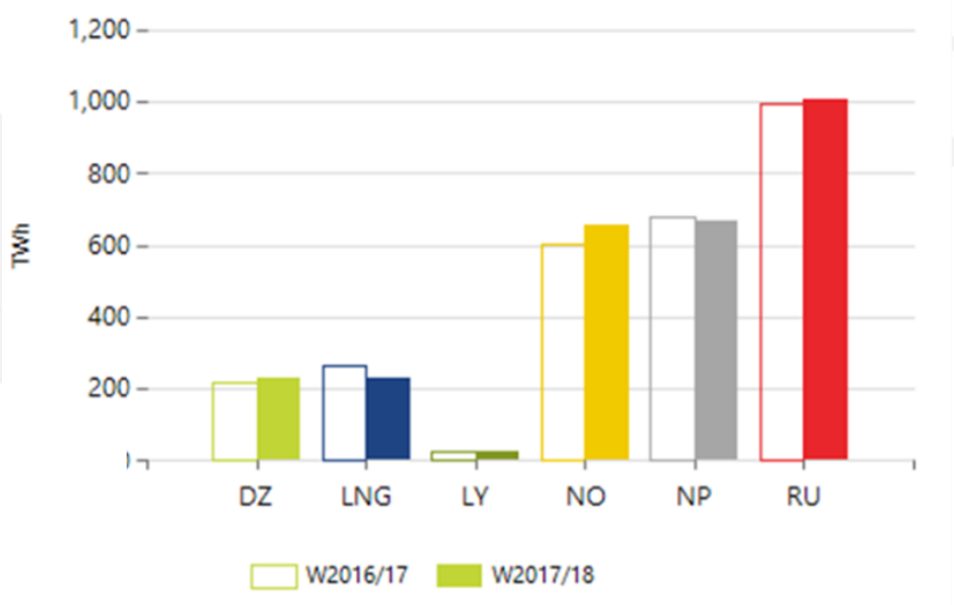

Figure 28 - Total supply by source

Figure 29 shows the seasonal supplies by source for the last two winters in absolute figures. The total gas supply has been very similar this winter compared to the previous one, but the behaviour of the different supply sources hasn't been so homogeneous.

There were significant increases from Algeria (+4%), and Norway (+8%) while Russia (+1%) remained constant as the main supplier. Libya and National Production were more or less stable compared to the previous winter, only decreasing slightly (-2%), and in the case of LNG, this supply declined notably from 266 to 228 TWh (-14%).

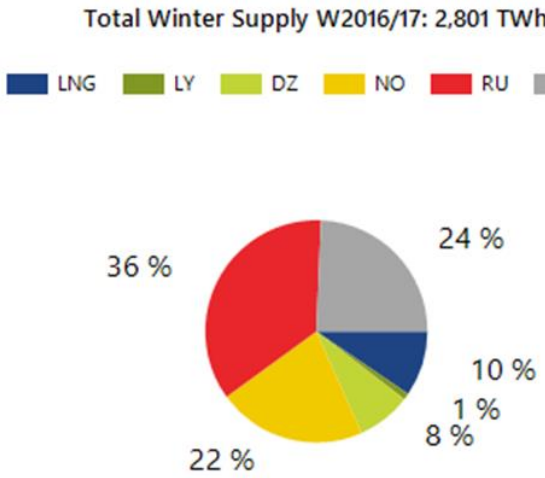

Figure 29 - Supply Mix. Winter 2016/2017

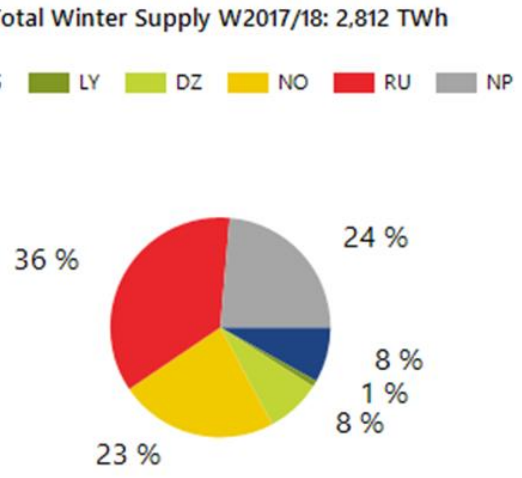

Figure 30 - Supply Mix. Winter 2017/2018

The total supply (without UGS) has been very similar in Winter 2017/2018, 2,812 TWh means a very slight increase when compared to the last winter (2,801 TWh).

4.2. Supply Modulation

The following graphs illustrate for national production and each import supply source, the average flow and the monthly range (between the lowest and highest daily flow of each month during the whole winter).

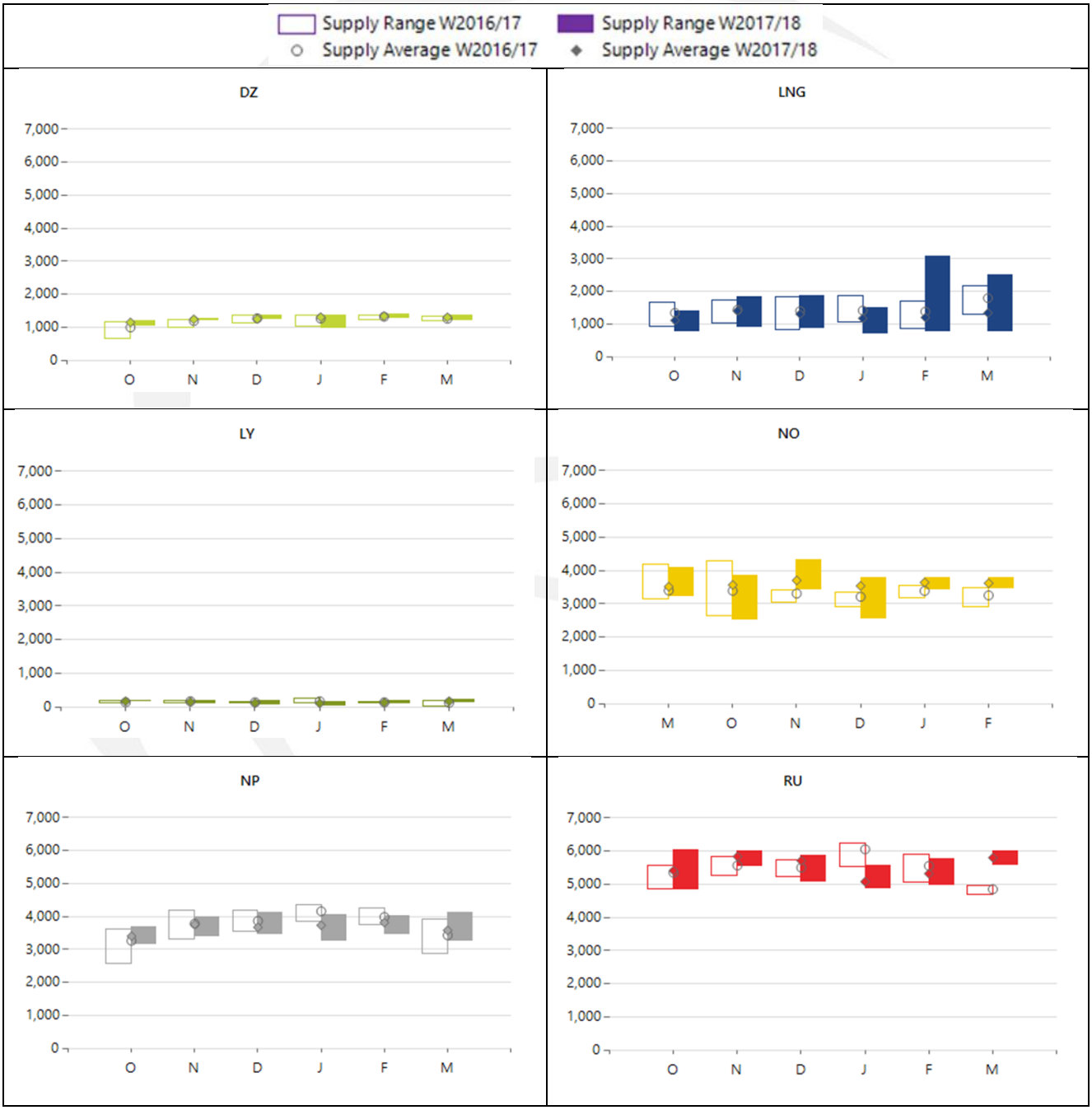

Figure 31 - Supply daily range (GWh/d)

4.3. 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 use of UGS this winter has been driven by its use as an alternative to other supply sources that saw reductions from the previous winter.

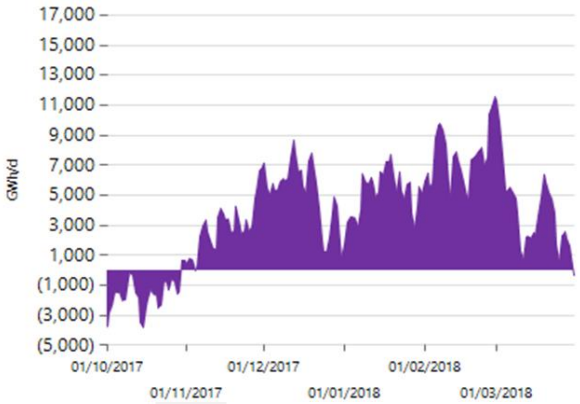

Figure 32 - UGS injection/withdraw profile. Winter 2017/2018

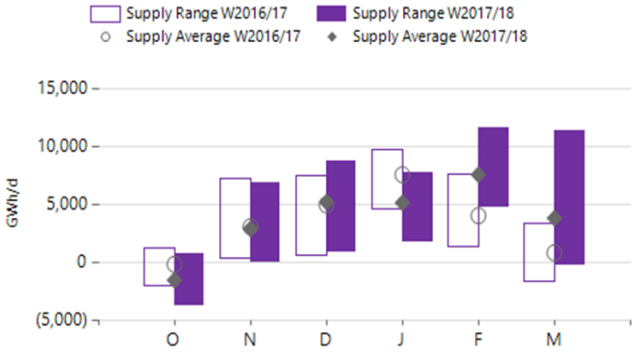

Figure 33 - UGS daily range of withdrawal and injection. Winter 2017/2018 vs. Winter 2016/2017

The peak deliverability of UGS was 12,215 GWh/d, meaning a 30% increase from the previous year (9,272 GWh/d). **Figure 34** shows the high utilisation from February both in range and average.

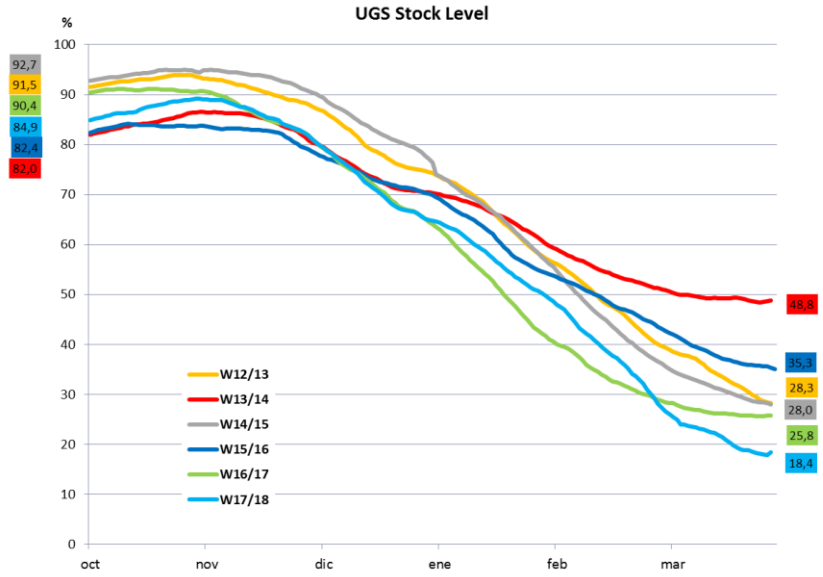

Figure 34 - Evolution of UGS stock level. Winters 2012-2018 (Source: AGSI)

Winter	UGS Utilisation (% WGV)
W12/13	66
W13/14	38
W14/15	67
W15/16	49
W16/17	66
W17/18	71

Table 2 - UGS Utilisation (% WGV) Winter 2012-2018. (Source: AGSI)

Figure 35 compares the stock level evolution curve of the last 6 winters. The stock level for the Winter 2017/2018 started from a level of 84.9%, 5 points lower than in the previous winter. The injection period was short and the maximum stock level (89.2%) was reached on 29th October. At the end of this winter the level reached 18.4%, the lowest seen in last six winters.

In the same way, the curve of stock level in the UGS had a larger slope than last six winters, especially from February to March. The resulting UGS utilisation was higher than the previous winter (71% vs. 66%), and it has been also the highest when compared to the previous 5 years.

4.4. 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 LNG, and especially underground storages are the main source of flexibility in high demand situations.

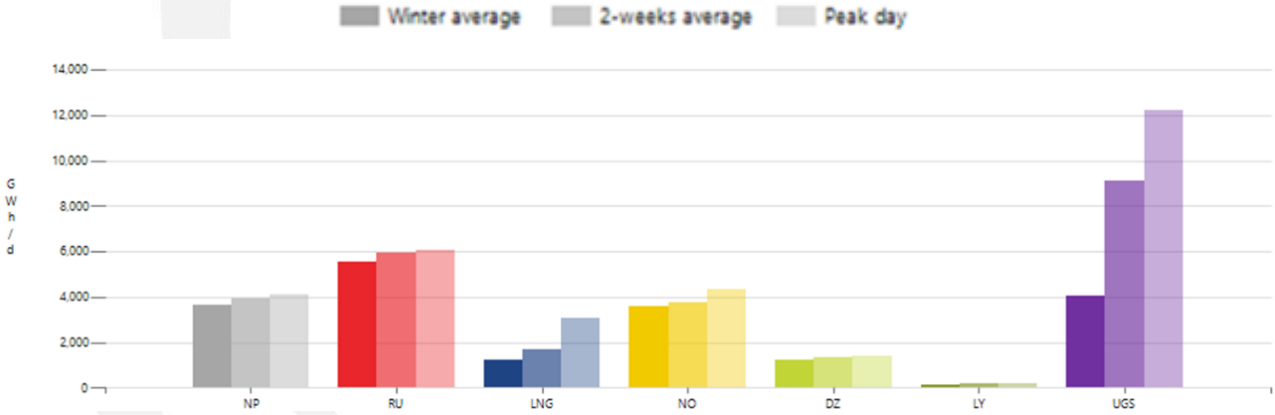

Figure 35 - Daily average supply / Average daily supply for highest 14-day demand period / Supply for peak day demand. Winter 2017/2018

4.5. Winter supply evolution 2013-2018

The following graph show the evolution of the different supply sources during the last five winters. When comparing the last five winters, National Production is decreasing year by year and for the last season, the UGS bar shows a very high use, close to Russian imports which are in the same high level than in the previous winter.

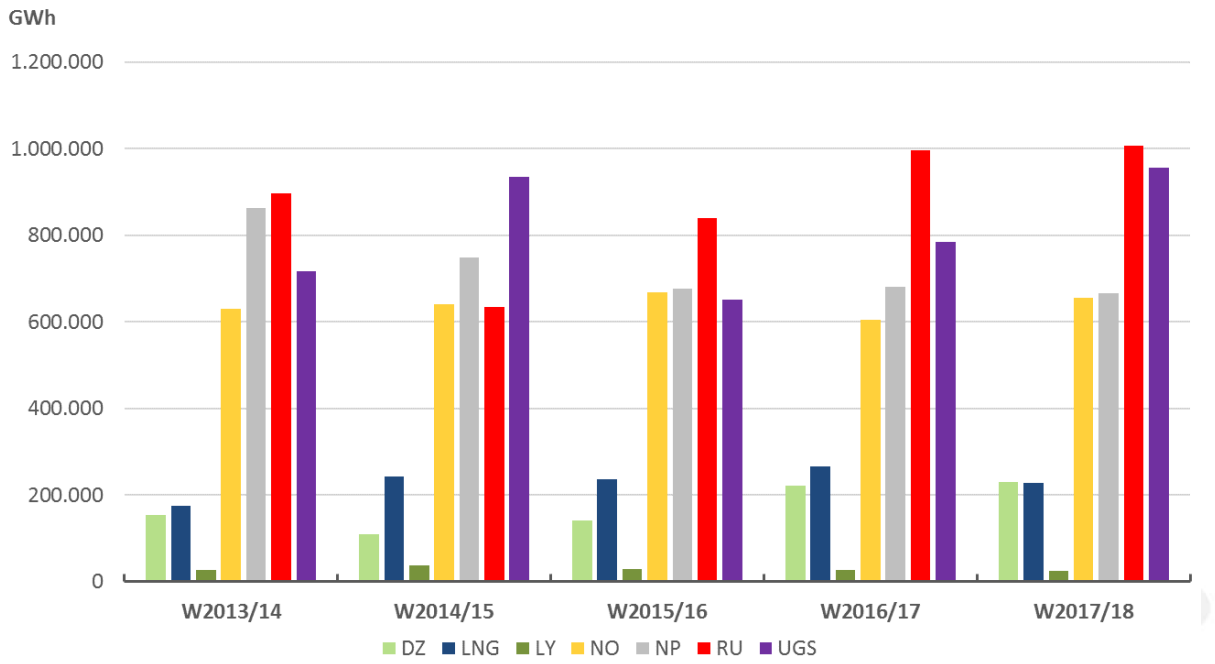

Figure 36 - Evolution of winter gas supplies 2013-2018

ENTSOG AISBL

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

info@entsog.eu
www.entsog.eu