entsog
european network
of transmission system operators
for gas

ENTSOG
WINTER SUPPLY REVIEW

2022/2023

Table of Contents

Executive Summary

ENTSOG has completed the review of the European gas picture for the winter of 2022/23, September to April. ENTSOG's 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.

Winter Supply Reviews help to build experience and a solid background for the assumptions considered in the Winter Supply Outlook. Such knowledge is also factored in the recurrent TYNDP process in order to ensure a consistent improvement over ENTSOG reports.

The key findings of this review are:

- Comparing with winter 2021/22 the total gas demand values dropped in the EU by 18.6% as a result of policy expectations from European Commission and Member States as well as Russia's invasion of Ukraine and record temperatures. Those had the most significant impact on the supply mix, gas prices and gas demand in Europe. Small increases in the demand values for Ireland and United Kingdom – 3% and 1.3% respectively – for the Winter 2022/23 period due to low nuclear and hydro power production.
- Pipeline gas supplied by Russia dropped by around 80% in comparison with the Winter 2021/22. LNG experienced the most notable increase from all supply sources to Europe and accounted for 30% of increase. National Production have decreased slightly for around 6 TWh.
- Storage levels during Winter 2022/23 increased its stockage till late November after which it followed pre-crisis trend of Winter 2019.
- The sum of all the import flows to Europe together with the National Production dropped by around 14.4%.
- The price in the European hubs started the season in different levels but followed a similar trend by reacting in the same direction.

Detailed data for the cross-border flows is available on the ENTSOG 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 infrastructure. Comments would serve as a basis for the R&D plan and be beneficial to the quality of future reports.

Disclaimer: the source of data if not indicated otherwise is ENTSOG members.

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

Introduction

This review, as part of the ENTSOG Annual Work Program 2023, is published on a voluntary basis and aims at providing an overview of the demand and supply balance during the Winter 2022/23. The report brings transparency on the internal analysis carried out by ENTSOG for the purpose of developing the seasonal Supply Outlooks as well as the Union-wide TYNDP.

The report aims to provide an overview of European trends that cannot be captured at national or regional 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 in view of actual past trends.

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.

Seasonal and Market Overview

Different events on the European gas market caused fluctuations in the supply and demand balance from October 2022 till end of March 2023. The major ones were:

- Russian pipeline exports to Europe during Winter were supplied via the remaining supply routes, TurkStream and the Ukrainian network.
- Lower Russian deliveries to Europe pushed European gas prices to record levels in 2022.
- The Dutch TTF, used as a European benchmark, reached a 116 €/MWh average in December 2022, increasing a 20% on the month as heating demand raised in Europe.
- Russian contract prices became less competitive versus European hub prices in January 2023 as spot prices plunged.

However, new infrastructure was commissioned that might have helped to mitigate the listed supply issues:

Table 1 - Newly commissioned infrastructure 2022

Newly commissioned infrastructure in 2022			
Country	**Project Name**	**Start date**	**Capacity**
Germany	Wilhelmshaven LNG	December 2022	7.5 bcm/y
Finland	Hamind LNG	October 2022	150 Mcm/y
Lithuania/Latvia	Capacity increase	October 2022	7.9 bcm/y
Poland/Slovakia	New interconnector Poland/Slovakia	End 2022	PL to SK : 4.7 bcm/y SK to PL : 5.7 bcm/y
Greece/Bulgaria	IGCB	October 2022	3 bcm/y
Romania/Hungary	Capacity increase	October 2022	2.4 bcm/y
Denmark/Poland	Baltic Pipe	October 2022	NO to DK/PL: 10 bcm/y PL to DK: 3 bcm/y

In 2022 there were also some improvements done with the existing infrastructure between Spain and France and between France and Germany providing enhanced capacity under certain conditions of 40 GWh/d (from Spain to France) and 100 GWh/d respectively.

Source: Bloomberg, Platts

Gas Prices at European hubs

The following graphs show the evolution of gas prices in Europe during Winter 2022/23.

Figure 1 displays the evolution of the day-ahead average prices for the different European gas hubs. The graph shows how the majority of the European hubs started the season in different levels but followed a similar trend by reacting in the same direction.

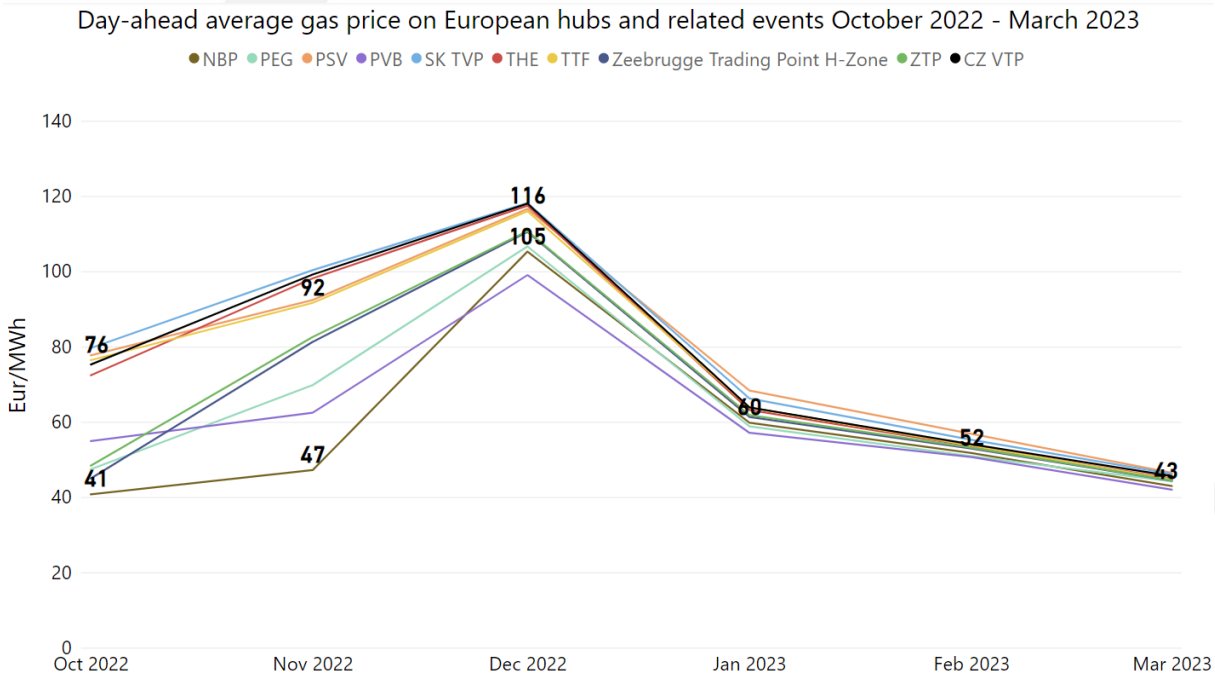

Figure 1 - Day-ahead average gas price at EU Hubs[2]

European wholesale gas prices fluctuated between 41 €/MWh and 116 €/MWh over the September 2022 – April 2023 period.

[2] Source: Platts, Bloomberg

Demand

Total gas demand values reduced by around 18.6% (2652 TWh vs. 2157 TWh) in the EU and 15.77% (3135 TWh vs. 2641 TWh) in Europe in general in Winter 2022/23 vs Winter 2021/22. The reduction is mainly the consequence of policy expectations from European Commission and Member States as well as Russia's invasion of Ukraine that triggered record-high gas prices as well as the consequent demand decrease from the industrial sector amongst others. The top 3 countries with the highest demand decrease percentage were Finland, Lithuania and Estonia. On the other hand Ireland and UK due to increased consumption for power generation driven by historically low availability of nuclear and hydro power, gas demand has increased by 3% and 1.3% respectively. **Figure 2** below represents the total demand change in the Winter 2022/23 for the European countries. The accompanying **Table 2** shows the values of demand per country and the sum of total demand with and without considering the UK's demand values. **Figure 3** shows gas demand for power by country. **Figure 4** shows the comparison of historical gas demand values in Europe between winter 2019 and 2022.

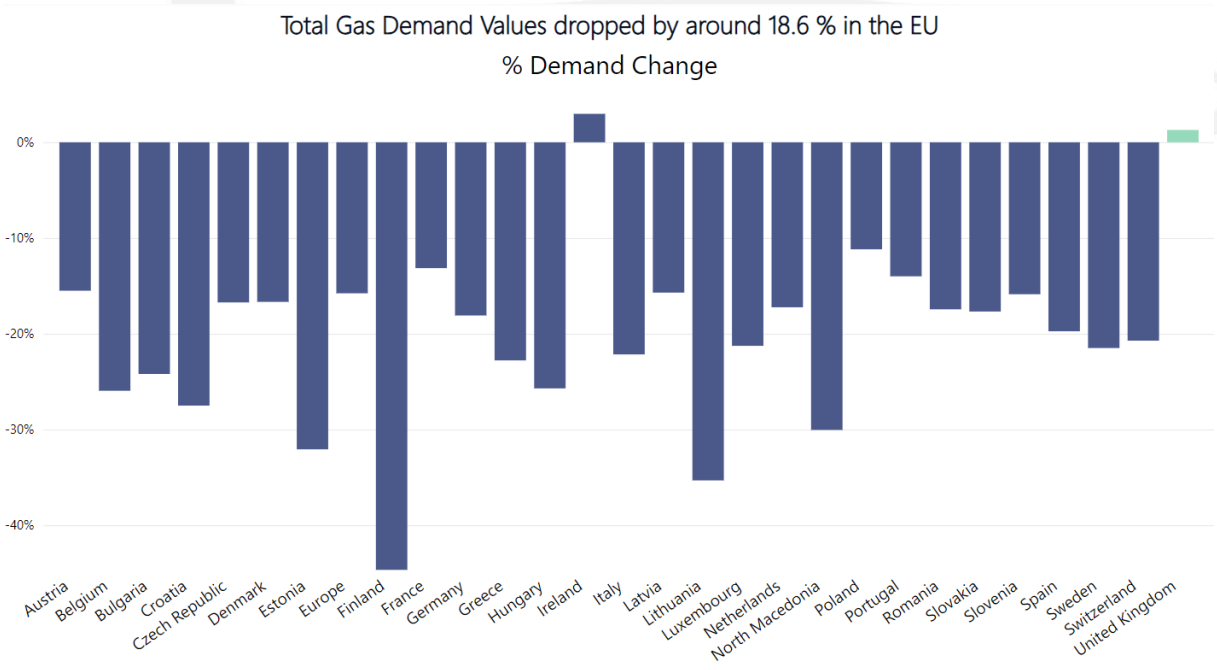

Figure 2 - Total gas demand by country Winter 22/23 vs Winter 21/22

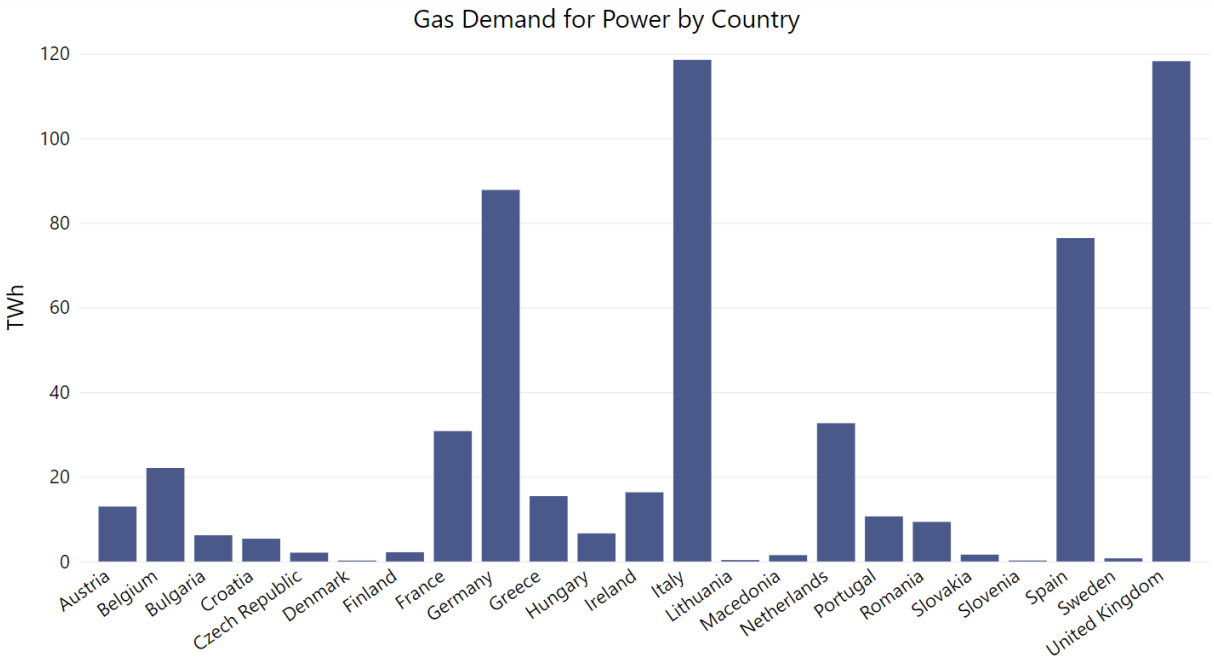

Figure 3 - Gas demand for power by country

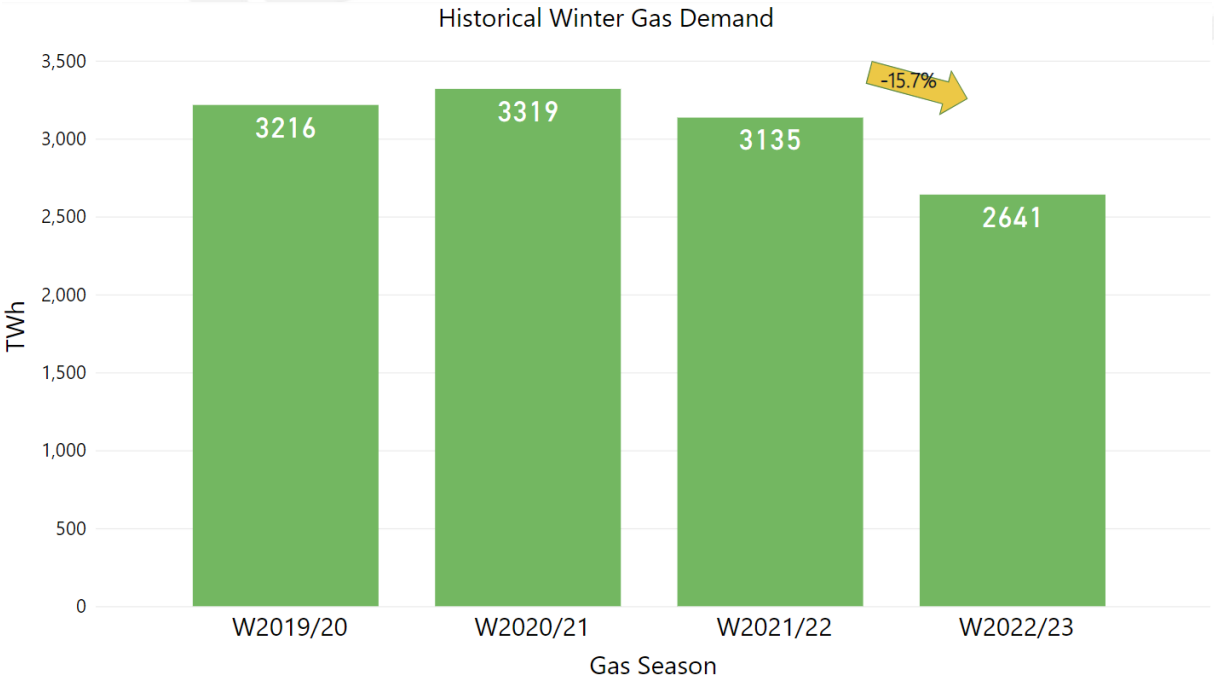

Figure 4 - Historical gas demand

Table 2 – Demand per country Winter 2021/22 vs 2022/23*

Country	Demand W2021/22 (TWh)	Demand W2022/23 (TWh)	Difference
Austria	64.442	52.425	-15.50%
Belgium	110.263	81.6	-25.95%
Bulgaria	19.708	14.94	-24.20%
Croatia	19.938	14.455	-27.50%
Czech Republic	61.838	51.497	-16.72%
Denmark	15.528	12.94	-16.67%
Estonia	3.207	2.178	-32.07%
Finland	10.704	5.924	-44.66%
France	318.459	276.604	-13.14%
Germany	648.5	531.2	-18.09%
Greece	36.24	27.985	-22.78%
Hungary	82.033	60.947	-25.70%
Ireland	28.719	29.572	2.97%
Italy	507.124	394.777	-22.15%
Latvia	7.495	6.318	-15.70%
Lithuania	10.729	6.94	-35.31%
Luxembourg	5.311	4.182	-21.26%
Netherlands	205.786	170.325	-17.23%
Poland	119.4	106.054	-11.18%
Portugal	30.831	26.516	-14.00%
Romania	78.334	64.669	-17.44%
Slovakia	37.406	30.795	-17.67%
Slovenia	6.307	5.306	-15.87%
Spain	219.17	175.911	-19.74%
Sweden	4.596	3.608	-21.49%
EU	**2652.068**	**2157.668**	**-18.60%**
Switzerland	26.084	20.68	-20.72%
North Macedonia	2.79	1.952	-30.04%
United Kingdom	454.944	460.803	1.29%
Europe	**3135.886**	**2641.098**	**-15.77%**

*Demand data was not adjusted for temperature corrections.

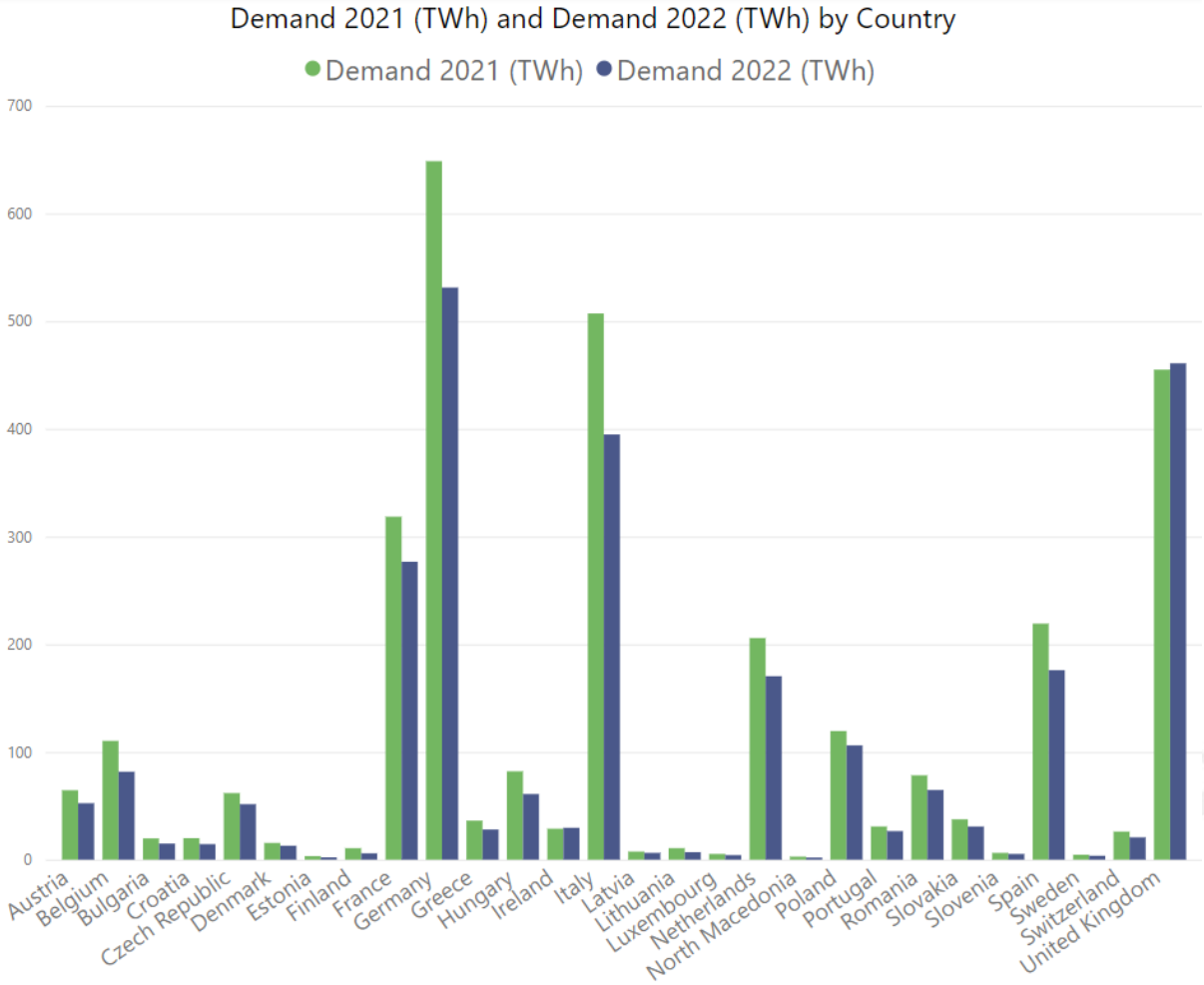

Figure 5 - Demand Winter comparison

Peak gas demand 2022/23

The peak for total demand was reached on the 13th December 2022. The highest 14-day demand period was noted in December 2022, as shown in **Table 3**.

Table 3 – Peak demand and 14 day Peak demand.

14-day peak period	05/12/2022 to 18/12/2022	**Peak day period**	13/12/2022
14-day Peak Demand	20,033 GWh/d	**Peak Demand**	22,420 GWh/d

Peak demand evolution

Figures 5 and 6 show the daily peak demand and the average daily demand for the highest 14-day demand period. Peak demand, in the same way as the seasonal demand, decreased across Europe

in winter 2022/23. The daily peak demand and the average daily demand for the highest 14-day demand period were reduced by 7.4% and 9.9% respectively compared to the previous winter.

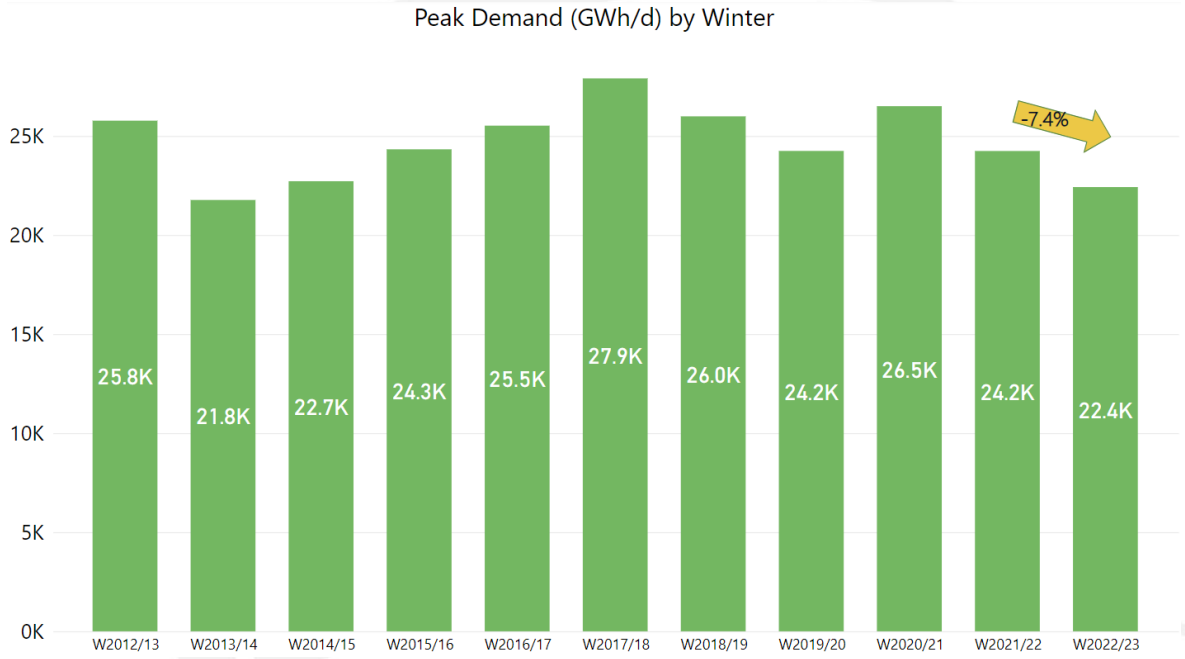

Figure 6 - Peak Demand (GWh/day) by winter

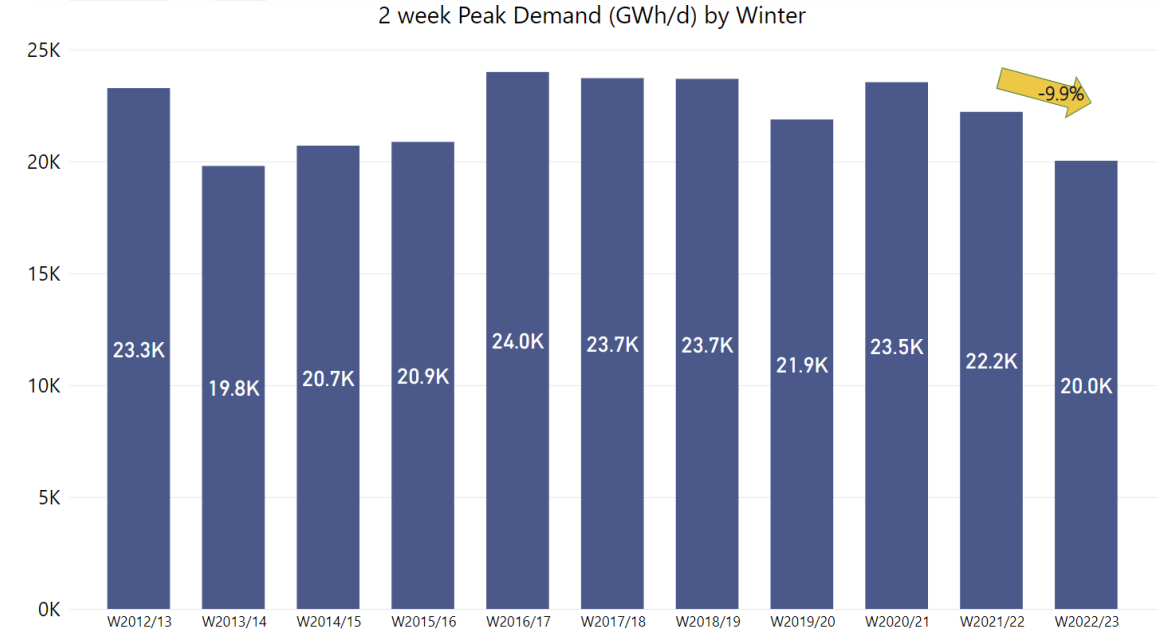

Figure 7 - 14 day peak demand evolution

Country detail

The evolution of gas peak demand at country level shows a decreasing trend in almost all the countries as compared with the previous winter season except UK, France, Ireland and Denmark.

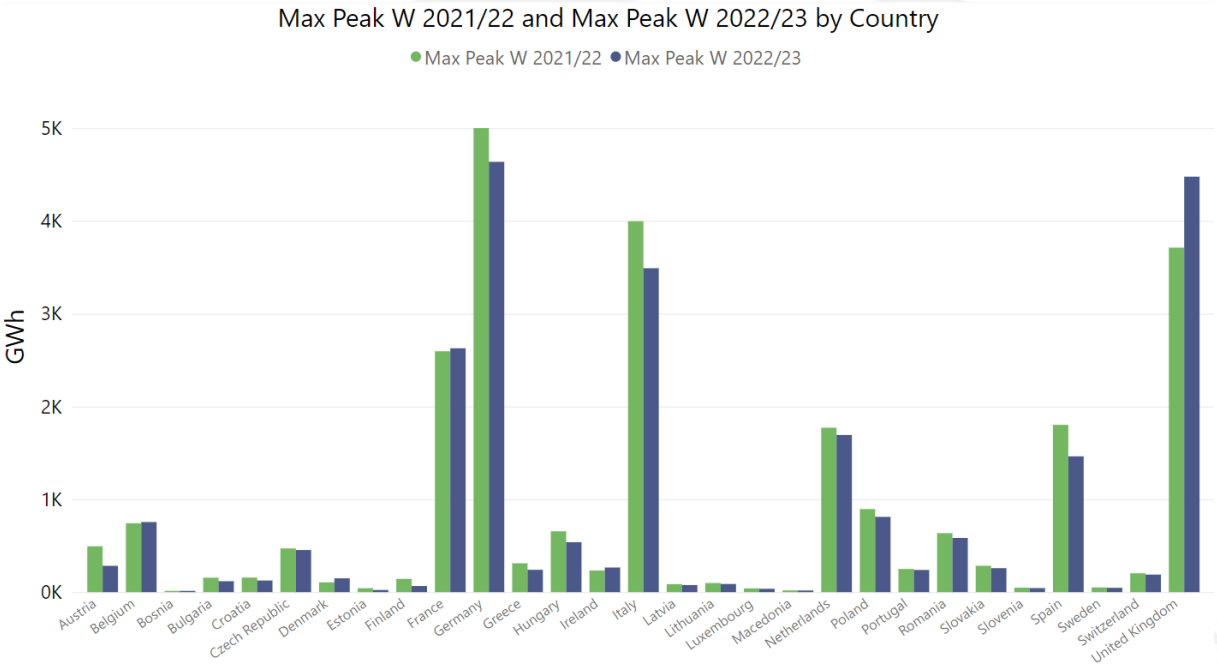

Figure 8 - Max Peak Winter 2021/22 vs 2022/23

Similarly to the daily peak demand, **Figure 8** shows that, for most countries, their 14-day high demand level went down as compared to the winter season 2020/21 except UK, Netherlands, Belgium and Denmark.

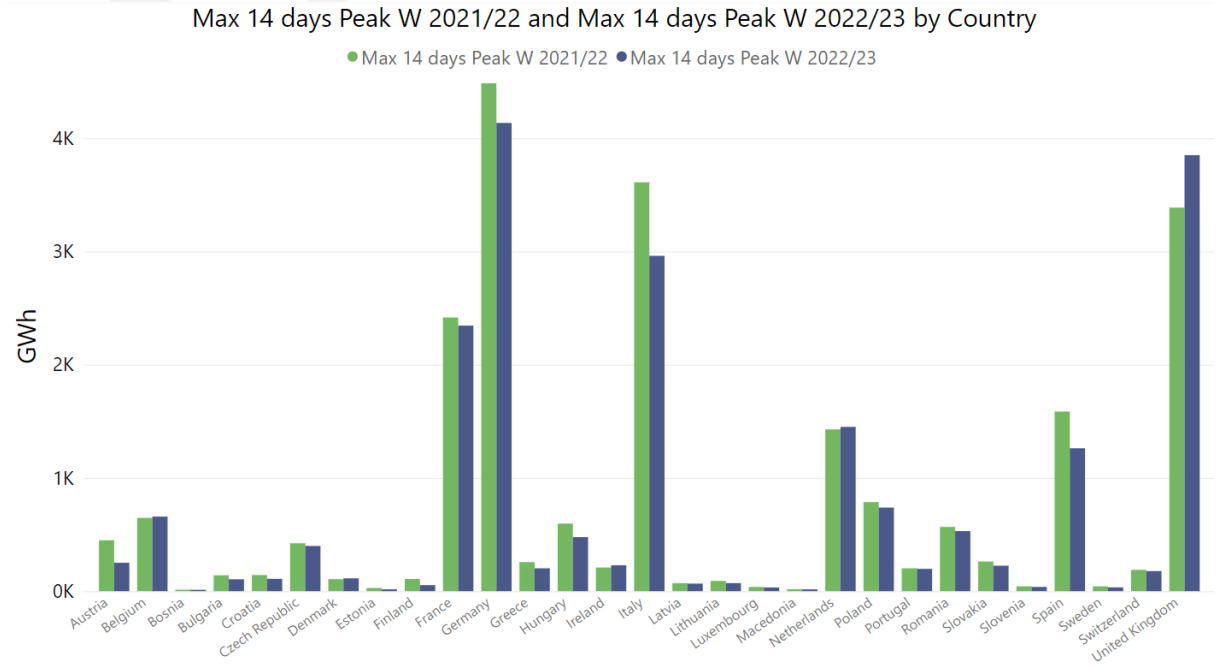

Figure 9 - Max 14 days Peak Winter 2021/22 vs Winter 2022/23

Simultaneity

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:

- 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 (%)

The European peak simultaneity during the peak day on 13 December 2022 was 94%.

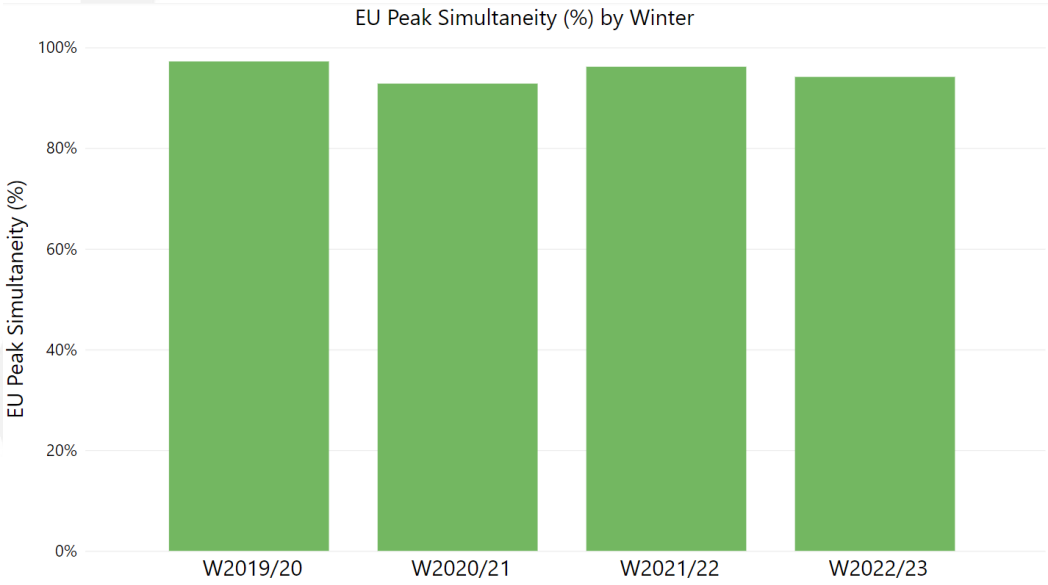

Figure 10 - The European peak simultaneity

Table 4 - Peak demand and the European peak simultaneity.

Winter	Day	Peak Demand (GWh/d)	EU Peak Simultaneity (%)
W2019/20	22/01/2020	24,245	97%
W2020/21	12/02/2021	26,503	93%
W2021/22	25/01/2022	24,242	96%
W2022/23	13/12/2022	22,420	94%

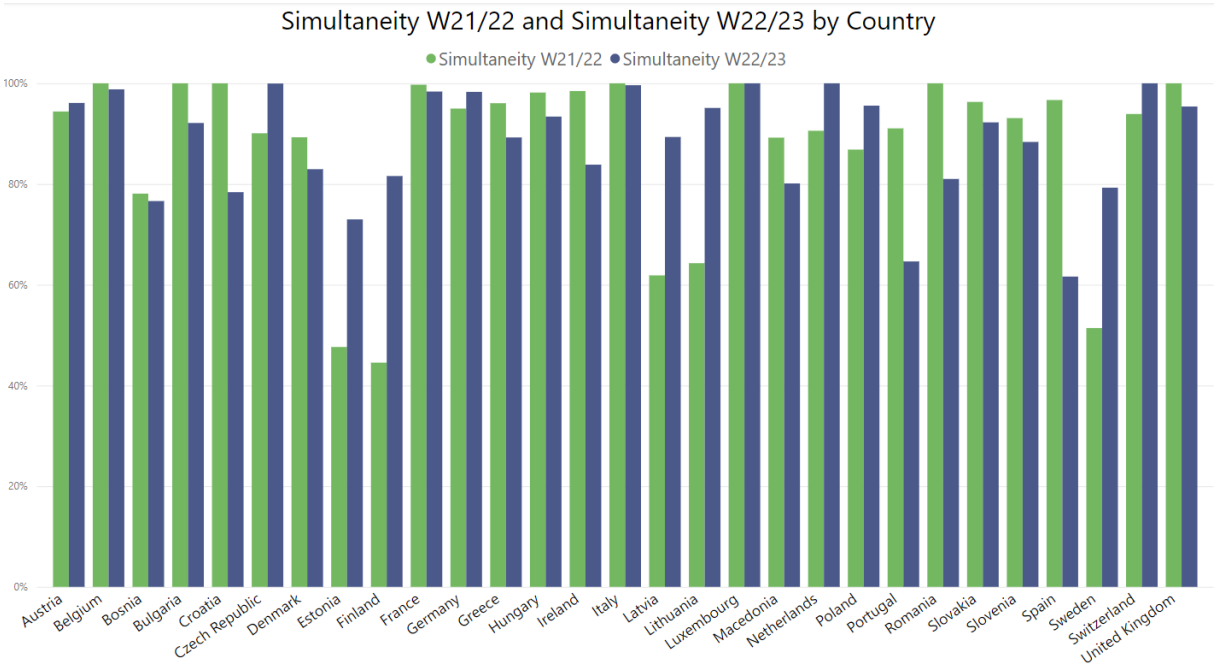

Figure 11 - Simultaneity of the highest single day between last 2 winters

> Seasonal electricity power generation (TWh_e)[3]

Total electricity demand during Winter 2022/23 was 1524 TWh_e which is 6.3 % lower than Winter 2021/22 according to combined ENTSO-E Transparency Platform (EU data) and National Grid ESO data (UK data).

Compared to Winter 2021/22, power generation from natural gas has decreased by 42 TWh_e due to Russian invasion of Ukraine and Warm Winter. Generation from hard coal and lignite generation decreased by 24 TWh_e and other fossil and oil usage for electricity production decreased by 65 TWh_e (for EU plus UK).[4]

[3] Source: ENTSOG elaboration based on ENTSO-E Transparency Platform data and National Grid ESO data.

[4] The natural gas demand to achieve this electricity production is higher in thermal terms due to the gas-fired power plants' efficiency factor.

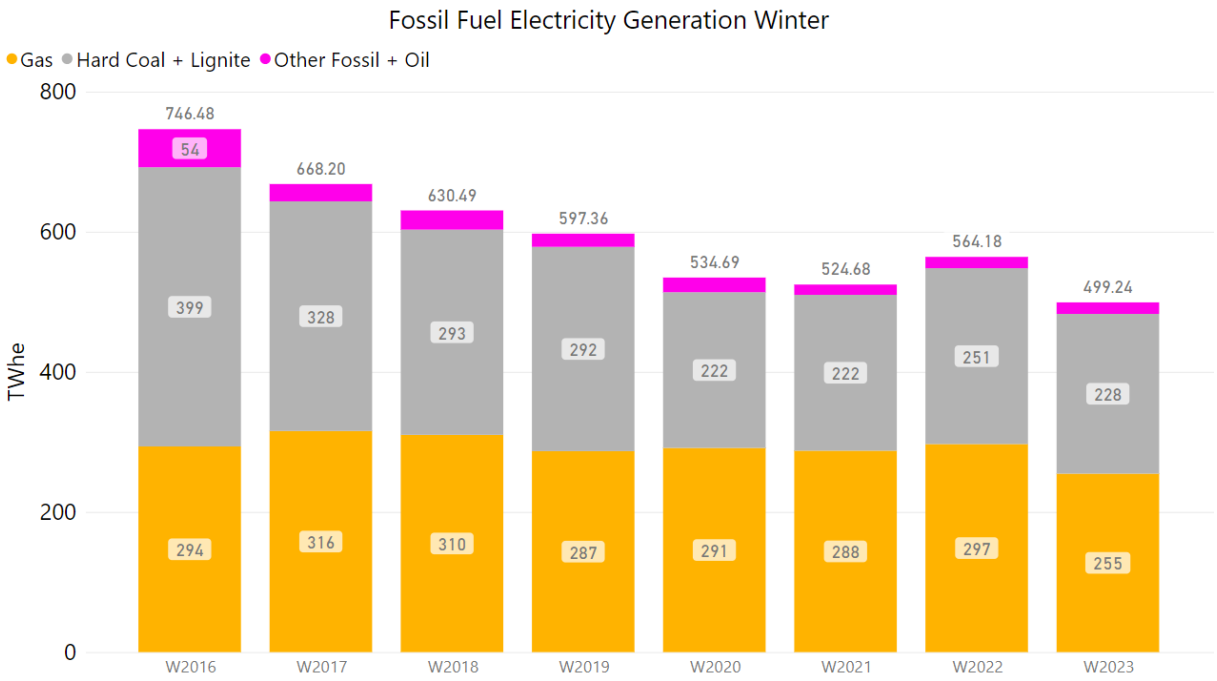

Figure 12 - Historical electricity power generation Winter 2022/23 in Europe.

Figure 13 below shows the electricity generation mix in the Winter 2022/23 and Winter 2021/22. The share of natural gas in the electricity mix decreased by 1.55 % in Winter 2022/23.

What is more it can be noted the high contribution of renewable sources in the total mix for electricity generation in 2022/23: Hydro, wind and solar energy contributed to the 2022 mix around 39% of the total generation in Europe which around 3.5% higher in comparison with the previous year.

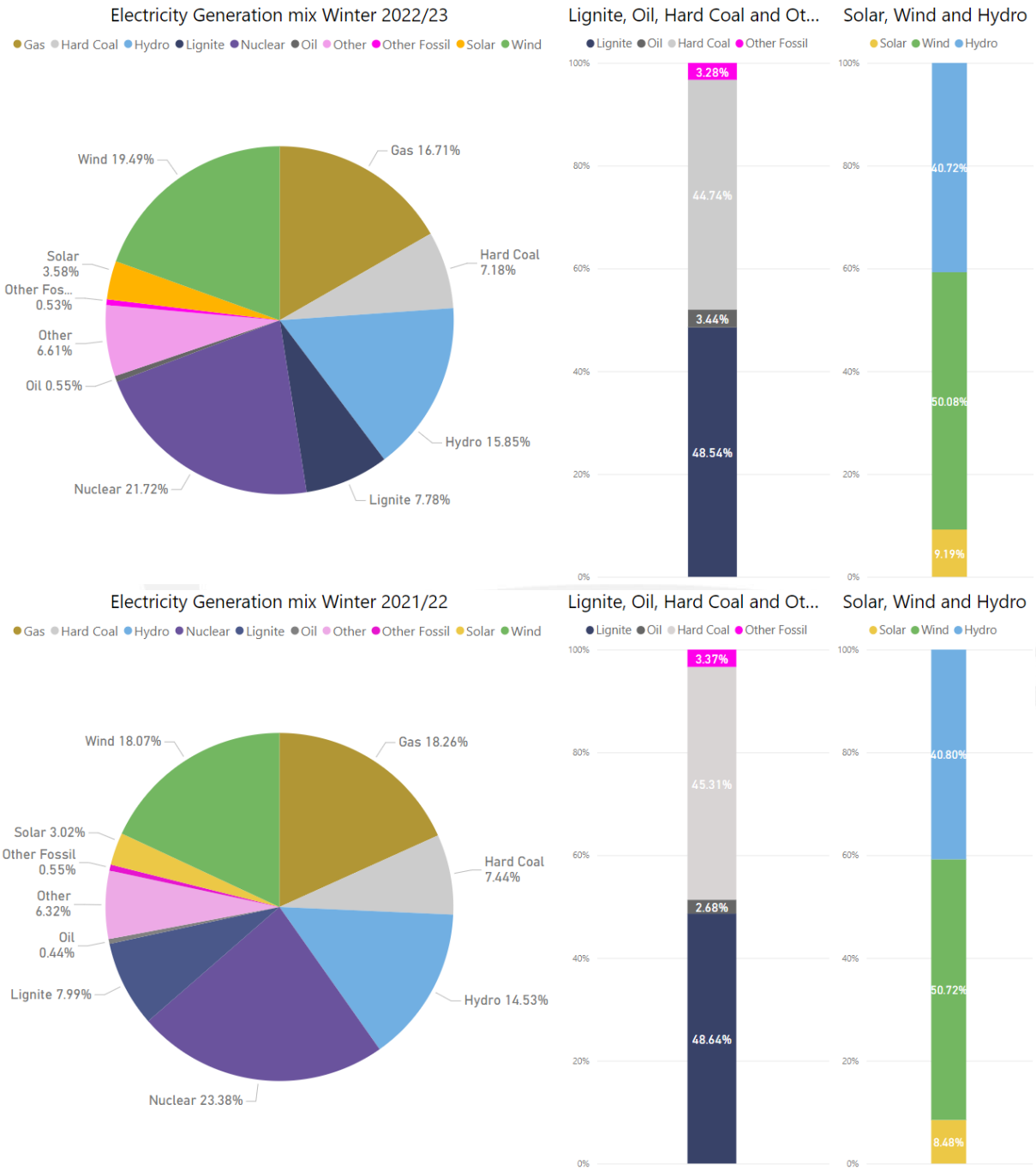

Figure 13 - Winter 2022/23 and Winter 2021/22 electricity power generation mix.[3]

Figure 14 below shows the historical Electricity Generation mix between 2016 and 2022 for the EU and the UK.

From these figures it can be noted for 2023 an increase in Wind and Hydro generation but lower nuclear and gas generation in comparison with 2022 data.

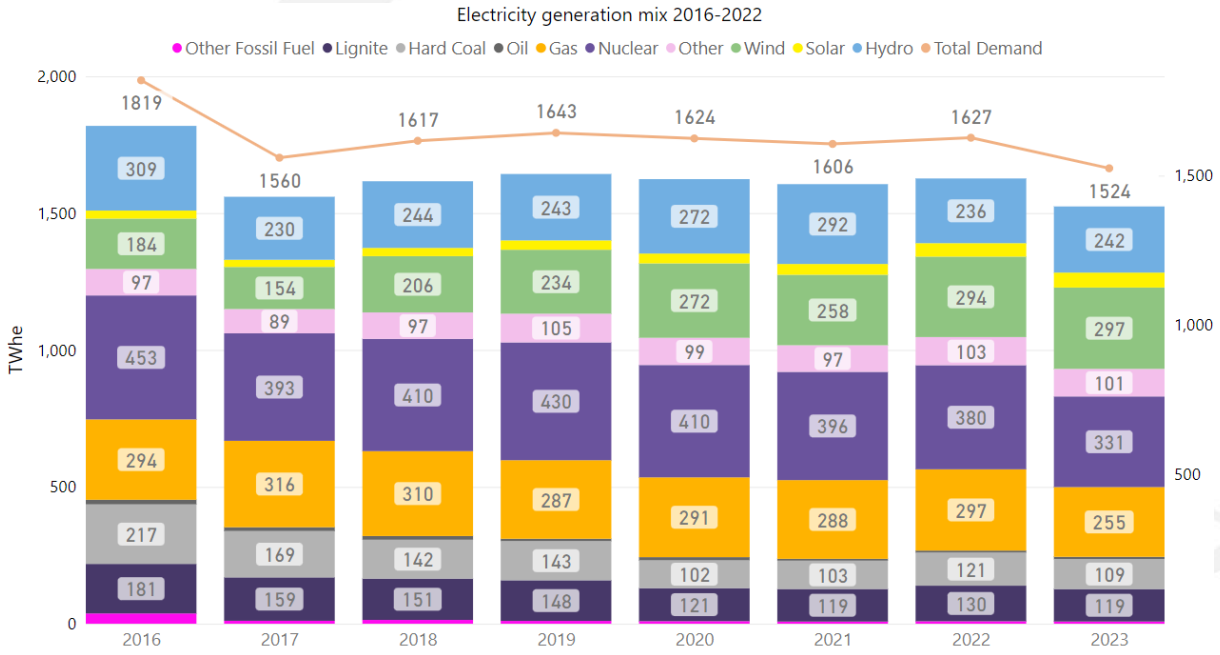

Figure 14 - Historical Electricity Generation mix 2022/23[3]

Supply

> European seasonal gas supply

Figure 15 is a representation of the aggregated gas supply in Europe during Winter 2022/23, i.e., October to April. In the beginning of the Winter, net injection till November 14th due to warm winter was followed by a long net withdrawal period till end of March with short time-frames of storages being filled in January and end of March. Most importantly, Russian's pipeline supply decreased by over 80% season to season (665 TWh vs 140 TWh).

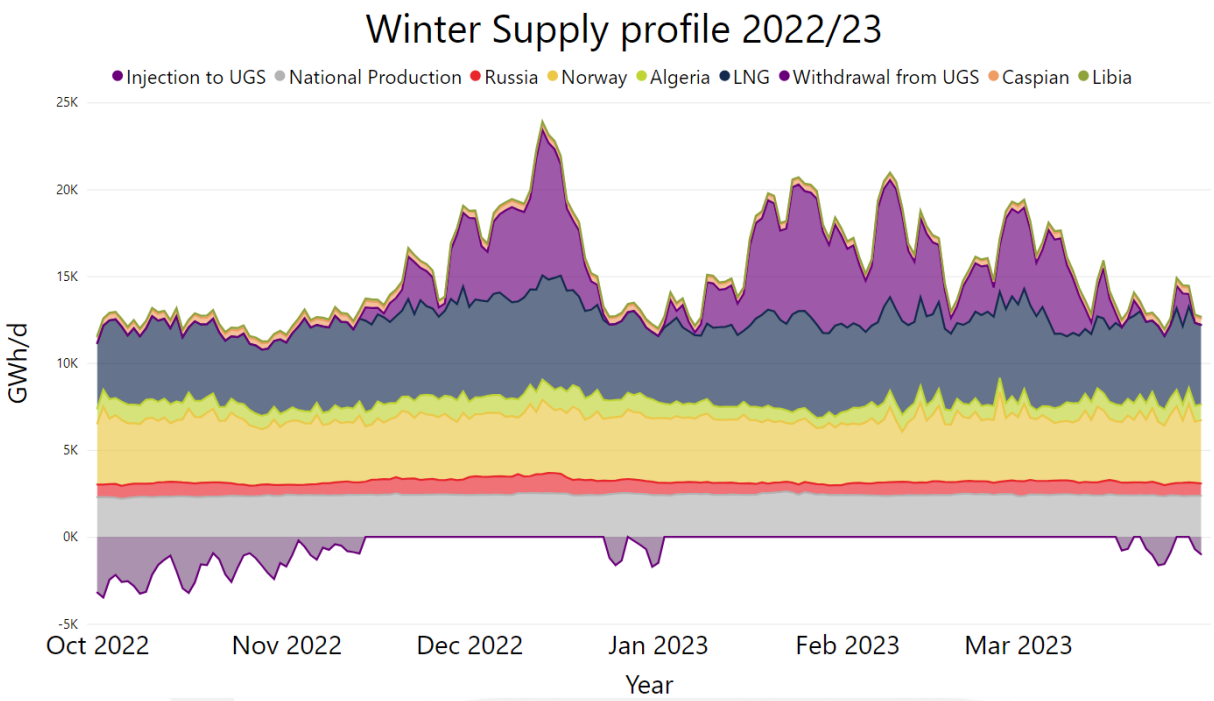

Figure 15 - Winter 2022/23 supply profile

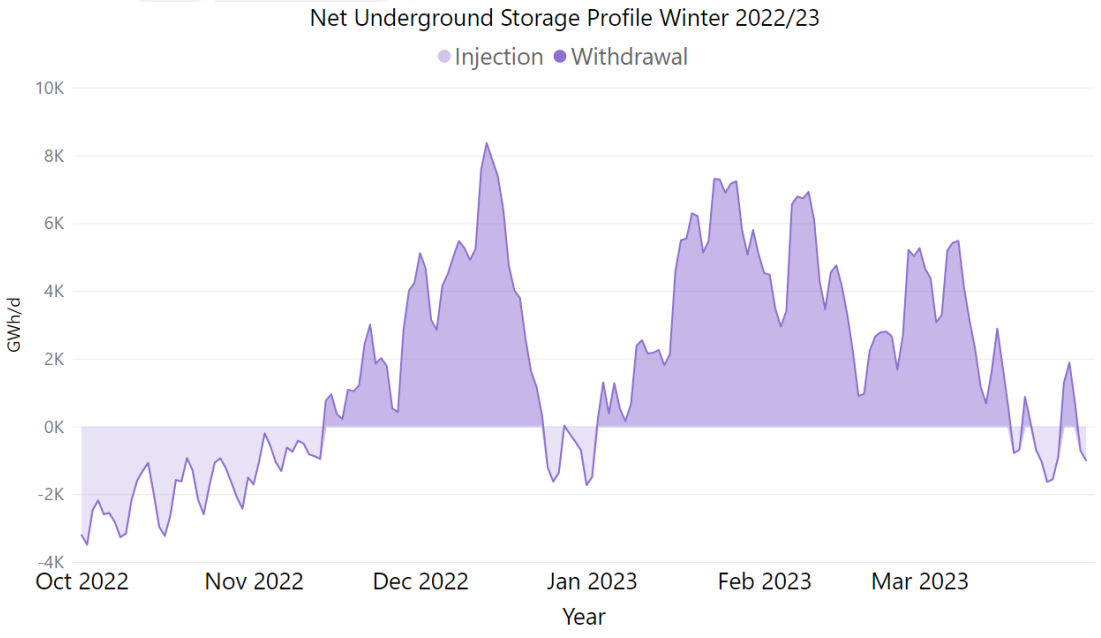

Figure 16 - Net underground gas storage profile for Winter 2022/23

Figure 17 brings more light into the Russian gas supply over time. Over 80% decrease in comparison with previous year's Winter in Russia's Pipeline Gas Supply.

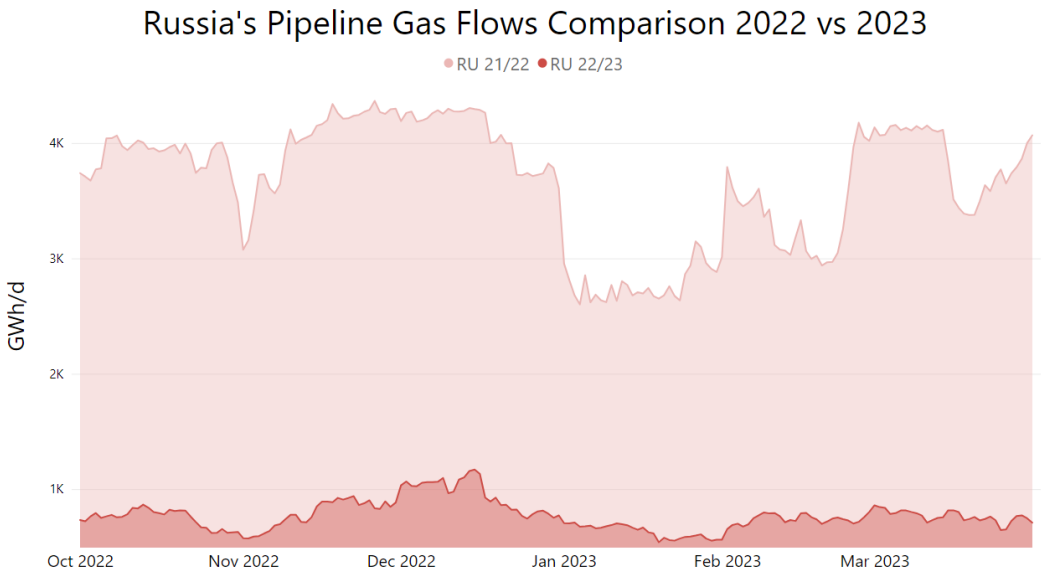

Figure 17 - Russian supply Winter 2022/23

Figure 18 shows the total LNG import into European countries. Total LNG imports increased by almost 30% in Europe in comparison with Winter 2021/22. The most notable changes of almost 200% increase of LNG imports was observed in Lithuania and over 100 % in Belgium.

Total LNG Imports increased by almost 30 %

LNG Import per country (TWh)

Country	LNG Import 2021	LNG Import 2022	Increase
Belgium	34,056.62	70,371.47	106.63%
Croatia	10,703.27	14,373.26	34.29%
Finland	0.00	855.37	100.00%
France	140,379.38	173,681.05	23.72%
Germany	0.00	38,047.11	100.00%
Greece	15,212.06	20,475.62	34.60%
Italy	50,636.23	85,774.69	69.39%
Lithuania	6,246.58	18,293.50	192.86%
Netherlands	62,256.56	104,423.66	67.73%
Poland	22,378.38	35,523.04	58.74%
Portugal	32,069.94	23,326.76	-27.26%
Spain	143,624.51	116,870.03	-18.63%
United Kingdom	121,092.04	175,576.03	44.99%

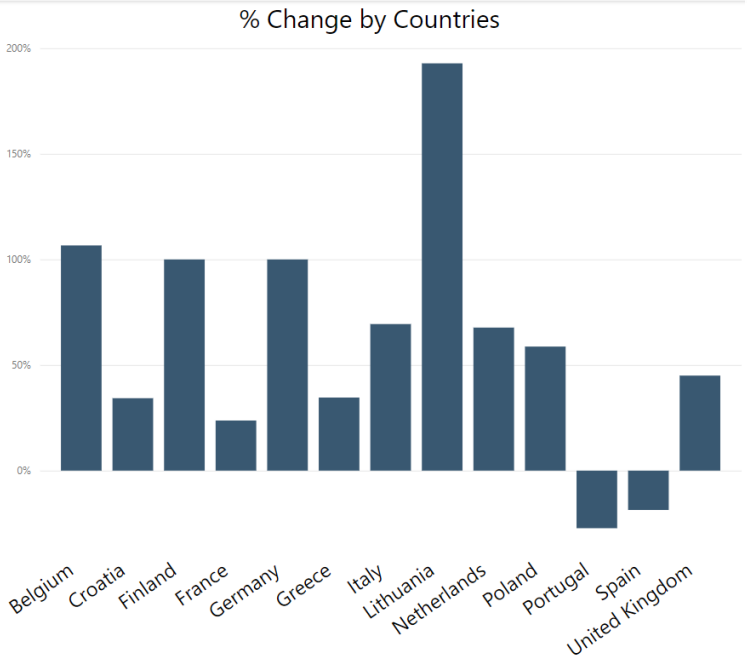

Figure 18 - Winter 2022/23 LNG supply comparison with Winter 2021/22 per country

Figure 19 presents total seasonal supply per import source in Winter 2021/22 and Winter 2022/23. Russia's pipeline imports decreased by around 80%. LNG imports increased by 30%

in comparison with 2021/22. Norwegian imports and National Production has decreased slightly.

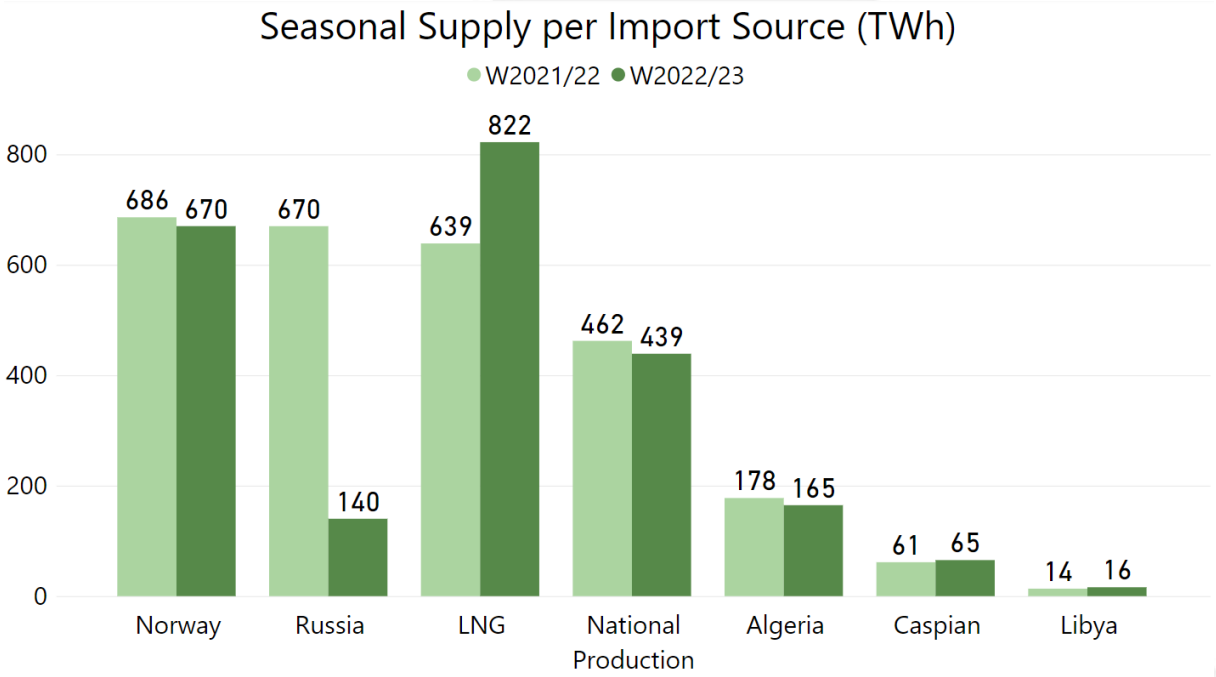

Figure 19 - Supply sources in Winter 2022/23 in comparison with Winter 2021/22

Figure 20 presents the Winter supply mix in 2022/23 and 2021/22. The total imports in 2022/23 declined (2320 TWh in 2022/23 vs. 2710 TWh in 2021/22). Supply sources' contributions in the Winter 2022/23 were however drastically different than in the Winter 2021/22. The highest share of 35.4% of LNG, supply from Norway (28%) and national production (18.9%) were followed by only 7.1% of Algerian Supply and 6% of Russian pipeline supply. Imports from Norway were partially delivered to the UK and the EU (183 TWh vs. 487 TWh) as can be seen in **Figure 21**. The Winter 2021/22 supply mix is displayed in **Figure 22**.

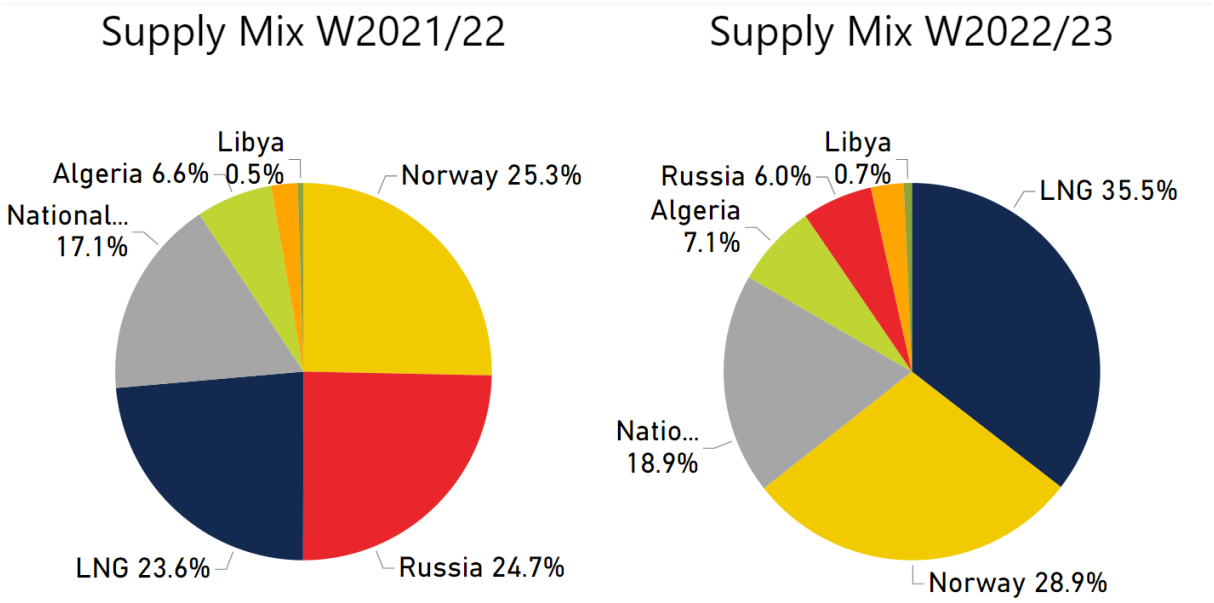

Figure 20 – Winter supply mix 2021/22 and 2022/23 comparison

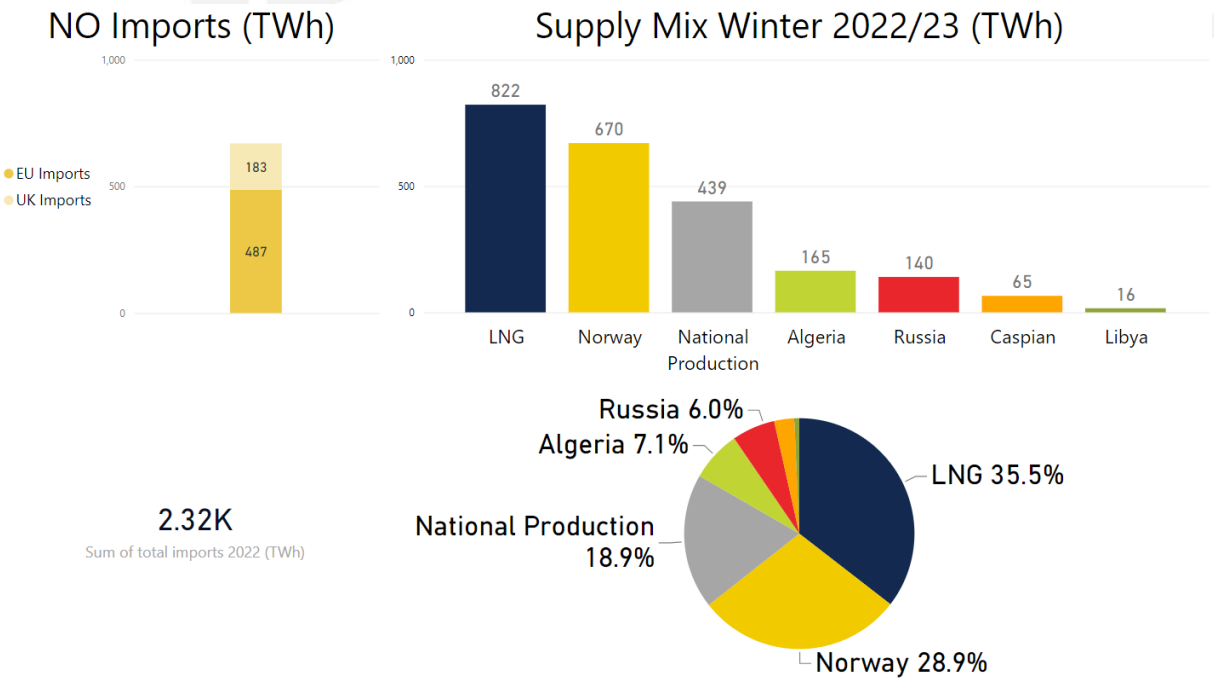

Figure 21 – Winter 2022/23 supply mix

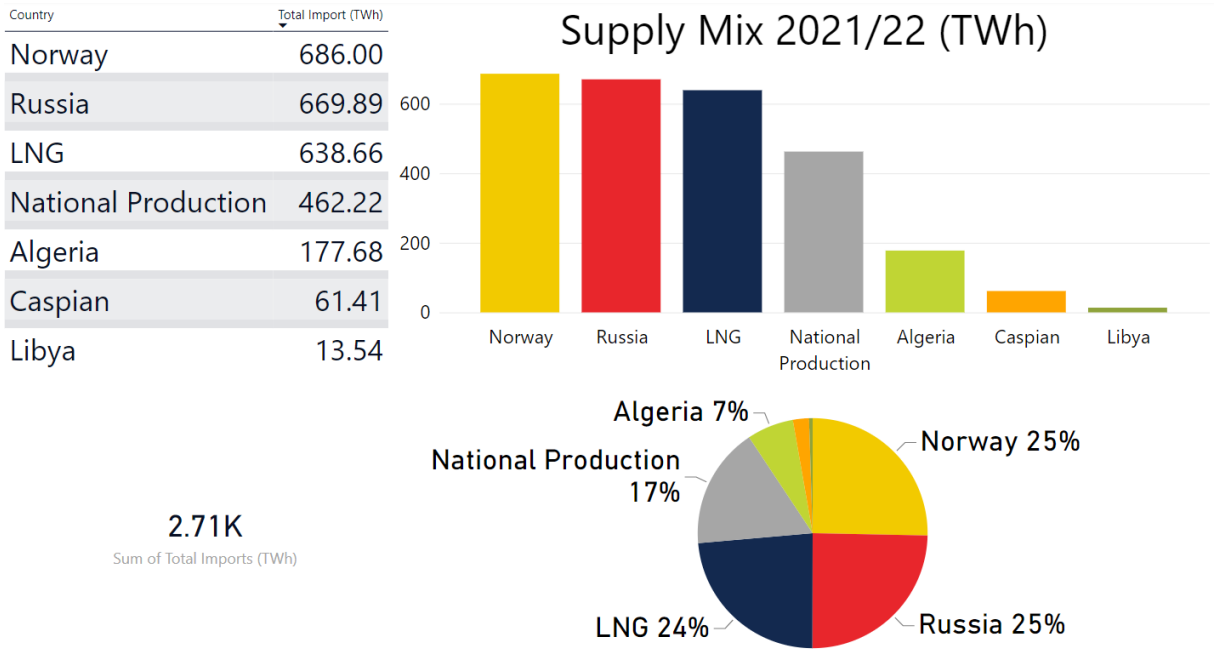

Figure 22 – Winter supply mix 2021

Supply	Total Import 2022/23 (TWh)	Total Import 2021/22 (TWh)	Difference
National Production	438.94	462.22	-4%
Norway	670	686	-2%
Caspian	65.288	61.415	6%
Algeria	164.690	177.679	-7%
Libya	16.103	13.536	19%
Russia	140.147	669.890	-79%
LNG	822.052	638.656	29%

Table 5 - Supply 2022/23 vs Supply 2021/22

Figure 23 shows the historical trends of all the supply sources. Most notable changes in the trends:

- After 15% increase between Winter 2019/20 and Winter 2020/21 the Supply from Norway decreased by around 5% and 2.5% in the Winter 2021/22 and Winter 2022/23 respectively.
- The decrease of Russian pipeline supply by 23% in the Winter 2021/22 followed by the decreased of around 80% in the following winter 2022/23.
- National Production experienced downward trend and decreased by 7%, 2% and 4% between 2019/20 - 2021/22 and 2022/23 respectively.
- LNG supply decreased by 33% between Winter 2019/20 and Winter 2020/21 after which it increased by 54% and around 30% during the next two winter seasons.
- Algerian supply increased by 80% between Winter 2019/20 and Winter 2020/21 after which it decreased by around 11% between Winter 2020/21 and Winter 2021/22 and between the next winter seasons it decreased further by 7%.
- Caspian supply increased by over 300% and 267% between Winter 2019/20 and Winter 2020/21 respectively after which it increased by 6% between the Winter 2021/22 and Winter 2022/23.

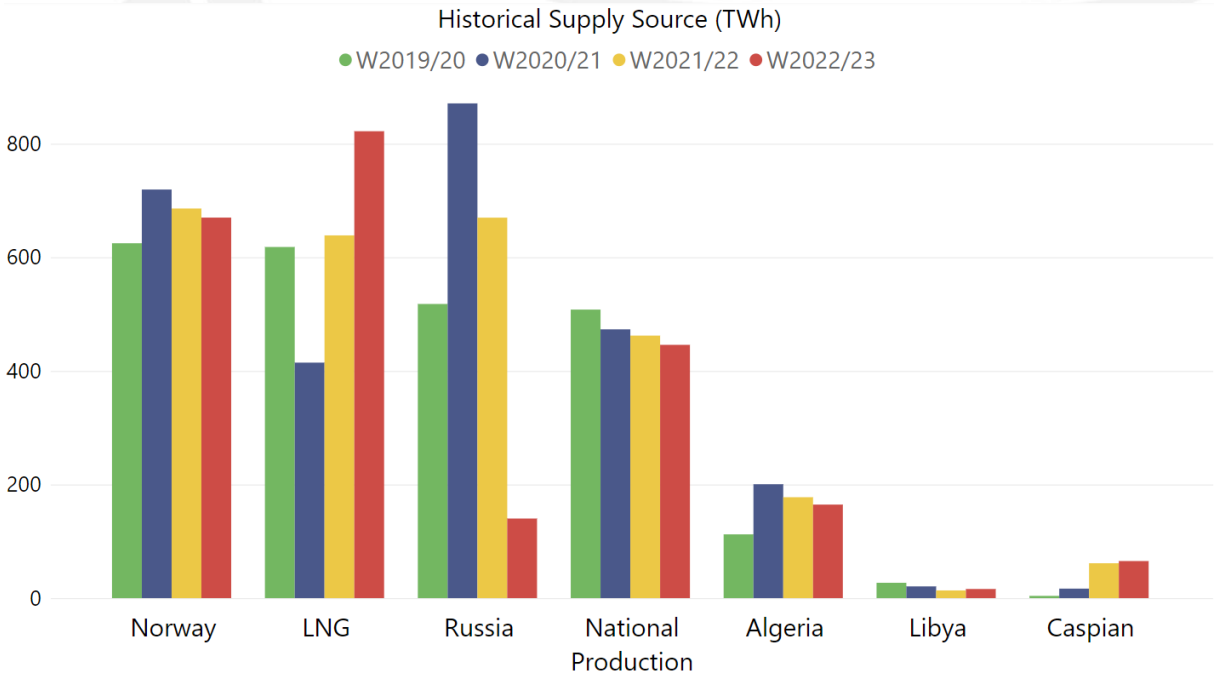

Figure 23 - Historical gas supply sources

Figure 24 shows exports from the EU. The total exports to Serbia was 44 TWh, to Ukraine 15.9 TWh, to Russia it was 13.49, Morocco 3.45 and around 1 TWh to Moldova.

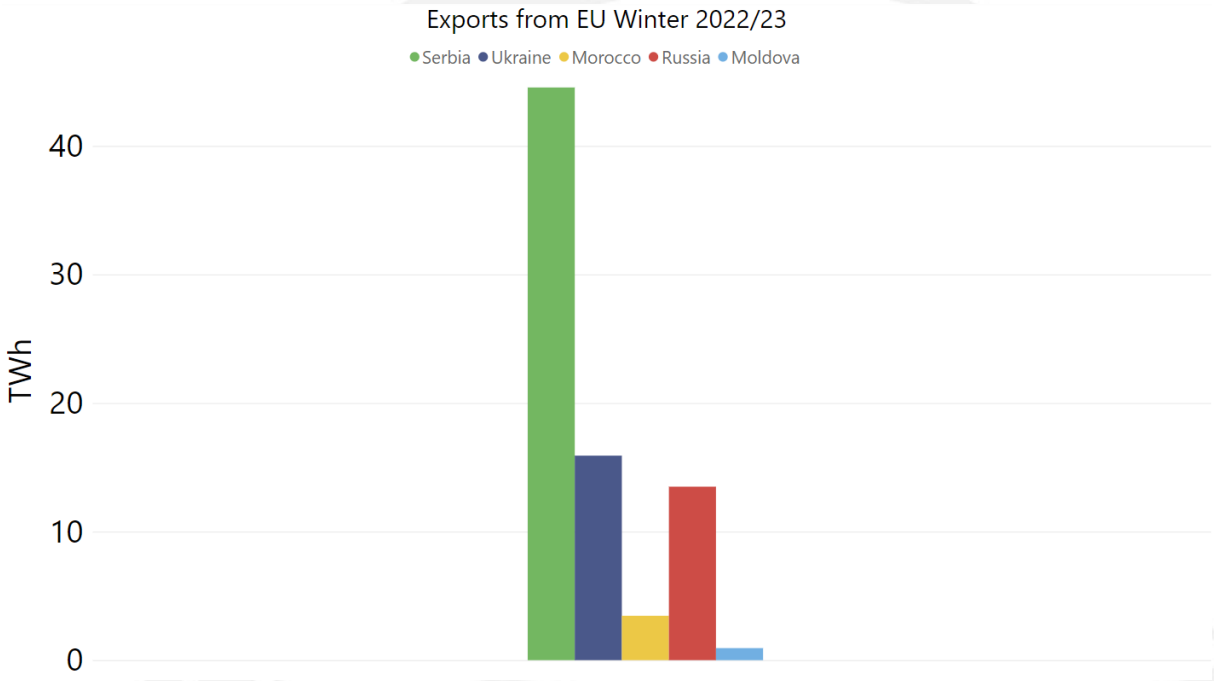

Figure 24 – Winter 2022/23 exports

Underground Storages

The evolution of the injection season depends on many factors, in particular the willingness of shippers (or other entities designated by Member States) to inject gas, and the actual amount of gas available for injection. The factors are linked to price signals such as summer/winter spread, EU and national laws stipulating mandatory injections, climatic effects on temperature-driven consumption, and economic considerations of end users.

Figure 25 provides the average net injection / withdrawal and the daily distribution ranges between the lowest and highest injection in GWh/d for the whole Europe except Bosnia and Serbia for each consecutive month of the winter periods of 2022/23 and 2021/22.

The most notable months with comparatively different storage distribution in Europe were October, November and February.

The box plots October, November and February show differences that were further investigated. October 2022/23 shows there was no net withdrawal. In November 2021/22 there was no net injection whereas November 2022/23 was a period with some days of injections. February on the other hand shows the withdrawal range was much wider than the previous winter. This February 2023 box plot is comparatively taller than for February 2022. Higher withdrawal values in February 2023 were noted.

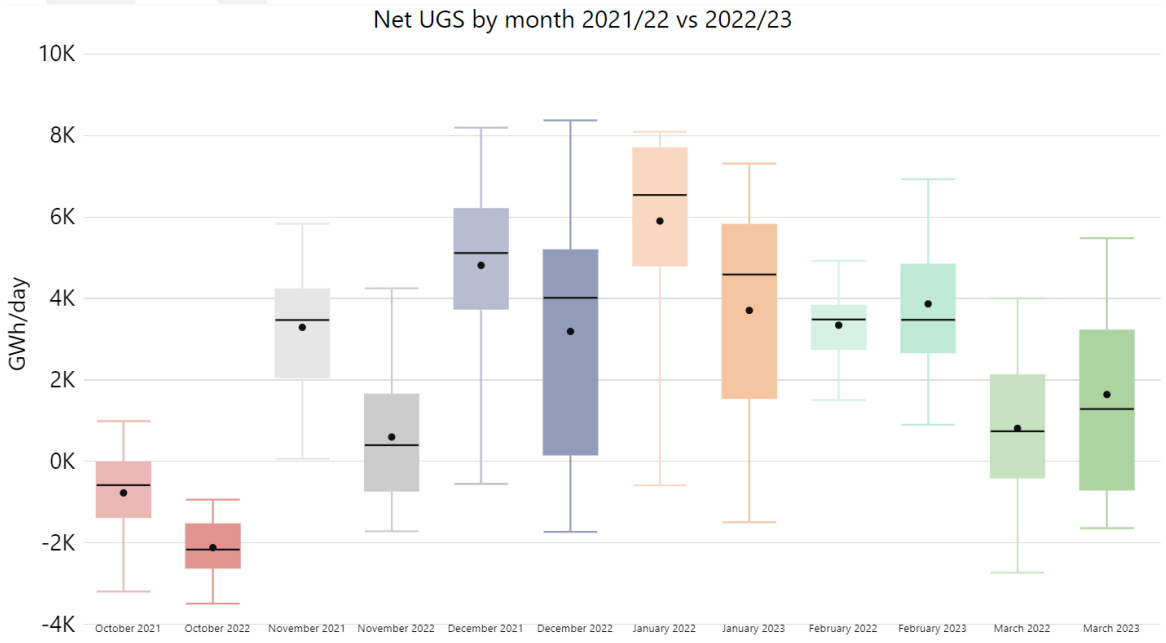

Figure 25 - Net UGS 2021/22 vs. 2022/23 per month

Figure 26 shows that storage levels during Winter 2022/23 increased its filling level till late November after which it followed pre-crisis trend of Winter 2019.Historical UGS utilization is shown in the Table 6.

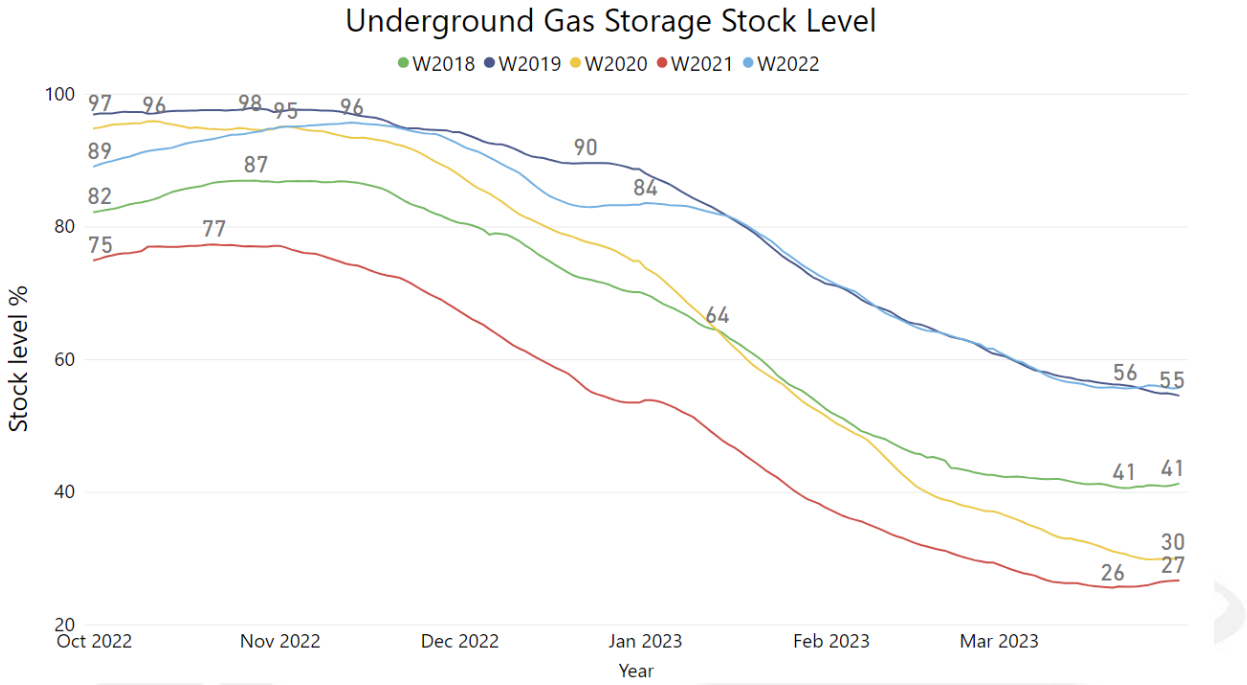

Figure 26 - Stock level over winters 2018 - 2022[4]

Table 6 - UGS Utilisation (TWh). Winter 2011/12 – 2021/22. (Source: AGSI+)

	1-Oct (TWh)	31- Mar (TWh)	UGS Utilisation (TWh)
W11-12	601.7	331.3	270.5
W12-13	716.2	222.8	493.5
W13-14	724.1	433.4	290.7
W14-15	867.4	274.6	592.9
W15-16	838.6	364.1	474.5
W16-17	972.9	278.1	694.8
W17-18	903.8	191.1	712.7
W18-19	898.8	441.4	457.4
W19-20	1063.2	598.4	464.8
W20-21	1053.3	336.1	717.2
W21-22	832.2	291.3	540.9
W22-23	991.0	627.8	363.2

[4] Source: AGSI

Publisher ENTSOG AISBL
Avenue de Cortenbergh 100
1000 Brussels, Belgium

Co-Authors Thilo von der Grün, Kacper Zeromski, Arturo de Onis, Diana Fathelbajanova, Hubert Bolesta

Cover picture Courtesy of Elering

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

info@entsog.eu | www.entsog.eu