

# European gas demand fundamentals

Q3 2023 review, October 2023 first glance,  
and winter 2023/2024 outlook

## Key messages

- European gas demand was down by almost 10 per cent year-on-year in the first ten months of 2023. Demand remains well below pre-crisis levels, raising questions as to whether some demand losses may be permanent. However, a closer analysis highlights remarkable differences between the beginning and the end of the year. Over half of the demand reduction occurred in Q1 as the mild winter continued, while reduced gas-fired power demand took over as the driver for reduced consumption in Q2 and Q3.
- Gas use in the industrial sector and by small businesses showed signs of recovery in Q3. These trends were confirmed by the preliminary data for October 2023. But in this sector, expectations of a rebound may be short lived considering the general worsening of the economic outlook in Europe. The demand for end-products rather than gas prices may be the key driver over the next six to nine months and may place a cap on any industrial demand recovery.
- In the power sector, improved renewables availability and French nuclear production in line with EDF's target suggest an overall weaker gas demand this winter compared to last year, although days with low wind availability will undoubtedly mark a short-term spike in gas use.
- The largest uncertainty regarding gas consumption this winter comes from the residential and commercial sector, even assuming consumer demand restraint continues to some degree in a context of lower gas prices. The correlation between temperatures and gas consumption will not return to pre-crisis levels, but rough estimates show that up to 20-30 bcm could be added if winter 2023/24 is much colder than winter 2022/23.

## Executive summary

Gas demand in Europe (EU27 + UK) collapsed in 2022 by 13 per cent or 61 bcm to 427 bcm on the back of warm temperatures, demand response to record-high prices and additional energy savings due to consumer behavioural change. This trend has largely continued in 2023, with gas consumption down by almost 10 per cent or 32 bcm year-on-year in the first ten months. Gas demand remains well below pre-crisis levels, raising questions as to whether some demand losses may be permanent. However, a closer analysis highlights remarkable differences between the beginning and the end of the year, as well as on the factors driving gas consumption this year, as illustrated in Table 1.

The extent of the decline narrowed from 12 per cent year-on-year in Q1, to 9 per cent in Q2 and 8 per cent in Q3. Preliminary data for October 2023 indicate an even more limited decline of about 1 per cent only. The sectoral analysis presented in this Insight highlights some of the key factors behind these changes.

Over half of the demand reduction so far this year occurred in Q1 on the back of unseasonably mild weather across most of Europe in January and March, limited industrial recovery and muted electricity demand combined with higher availability of renewables (hydro, wind and solar). This represented a loss of over 18 bcm year-on-year.

After March, when space heating demand generally reduces quickly to near zero, Q2 and Q3 continued the downward trend, but this time primarily driven by non-weather-related factors. The use of gas in the power sector continued to fall throughout the year following the progressive return of the French nuclear fleet and strong renewable availability. As a result, the power sector has emerged as the most important driver behind gas demand reduction this year.

The most interesting evolution happened in the industrial sector, with gas demand well below 2022 levels at the beginning of the year (-15 per cent in Q1). Gas use progressively climbed back to last year's levels in Q3, and preliminary data for October 2023 even show a 14 per cent growth year-on-year.

The residential and commercial sector also started to recover from Q2, most likely due to growing gas demand from small businesses.

**Table 1: Changes in gas demand in Europe from 2021 to October 2023 (per cent, year-on-year change)**

	2022 vs 2021	Jan-Oct 23 vs 22	Q1 23 vs Q1 22	Q2 23 vs Q2 22	Q3 23 vs Q3 22
Power	2.7	-19.2	-16.5	-18.9	-21.0
Industry	-18.4	-6.5	-14.7	-8.3	1.2
Residential and Commercial	-22.0	0.0	-8.3	6.3	33.1
Total	-12.7	-9.6	-12.0	-8.8	-8.3

Source: Data from author's calculations. Table by the author

It is probably too soon to speak of a strong recovery as the fundamentals point toward limited growth for the coming months unless the winter turns out to be much colder than last year.

In the power sector, total electricity demand is not expected to increase dramatically this winter, aside from its usual seasonal fluctuations as energy efficiency improvements and an economic slowdown should continue to curtail demand. The outlook for nuclear availability this winter is positive, with French production so far in line with EDF's target, eroding concerns of a repeat of last winter's low nuclear availability in France. Hydro stocks are up compared to last year in most of Europe, allowing more flexibility to raise hydropower generation this winter and reducing the need for gas (and coal) plants.

The continued deployment of renewables will also have increased the availability of wind and solar. Lastly, even if coal-fired plants have started to regain competitiveness against gas-fired plants from mid-October 2023, the relatively limited need for coal and/or gas in the mix this year means that any competition between coal and gas plants in the merit order this winter will probably only have a marginal impact on gas burn in the power sector. In conclusion, the fundamentals suggest an overall weaker gas demand for power generation this winter compared to last year, although days with low wind availability will undoubtedly mark a short-term spike in gas use.

In the industrial sector, expectations of a rapid rebound in gas consumption in 2023 following a sharp drop in gas prices year-on-year have clearly not materialized. Without underestimating any probable demand destruction, it is likely that roughly 75 per cent of the 2022 decline has been from demand reduction measures, but the impact of lower gas prices has been counter balanced by several factors that often prevented firms from quickly switching back to gas and/or re-starting idle production capacity. Overall gas use by industry was still down by -6.5 per cent year-on-year from January to October, but it has also been trending higher from Q3. After a consecutive 20-month year-on-year decline, preliminary data indicate a timid recovery - at least on a yearly basis - from August 2023; and the whole third quarter was just about 1 per cent above 2022 levels. Gas demand continued to increase in the petroleum sector while other sectors also started to recover, even if the picture was not uniform across Europe. Initial data for October show even stronger growth, with industrial gas demand about 14 per cent higher year-on-year. It seems to have been driven primarily by the petroleum sector but also by other sectors such as chemicals, food and metals. This time of year is traditionally marked by higher fertilizer demand in Europe when stocks are being rebuilt for autumn application, which may partly explain the October result. Despite this development, it is probably too soon to expect a strong rebound considering the general worsening of the economic situation in Europe, as shown in recent Winter Economic Outlooks and the Euro Area Manufacturing Purchasing Managers Index (PMI). Weak economic growth momentum is anticipated to extend into 2024. In other words, the demand for end-products (chemicals, steel, glass and nonferrous metals) rather than gas prices may well become the most important driver over the next six to nine months and place a cap on any industrial demand recovery.

In the residential and commercial sector, a cold winter would boost Europe's space heating demand in the coming months, even assuming consumer demand restraint continues to some degree. Because gas is the largest single source of energy used for heating in the residential sector in Europe, continued participation of small consumers in demand saving measures is going to be essential to keep gas demand under control, and especially to limit a sudden surge in gas use during the coldest days. However, after the warm temperatures in 2022 and at the beginning of 2023, consumers' willingness to continue reducing their energy use may erode if (or when) cold temperatures finally hit Europe, especially in a context of a lower gas prices. Because of its size and relative unpredictability, this sector presents the largest uncertainty for the level of gas demand this winter. The correlation between weather and gas consumption will not return to pre-crisis levels, but rough estimates show that up to 20-30 bcm could be added if winter 2023/24 is much colder than winter 2022/23.

A key lesson from the past two years is that *short-term* demand response to changes in gas prices is *not* straightforward. But considering all these factors that impact gas use in Europe, gas demand is expected to decline by about -8% in 2023, driven by the power sector and taking into account the possibility of a few days of colder weather in November and/or December which may trigger higher demand for heating. In 2024, there are many moving pieces to the puzzle, but continued lower use of gas in power is expected to be counterbalanced by higher gas use in other sectors and could drive gas demand marginally up over the year.

## Introduction

This Energy Insight examines how the gas crisis continues to impact gas demand in Europe. It provides an update on what happened in the third quarter of 2023, looks at preliminary data for the month of October and highlights the main trends for this winter.<sup>1</sup>

The first chapter sets the scene with an overview of monthly gas demand in Europe, interestingly showing the premise of a recovery in Q3 and in October. The following chapter highlights the main drivers behind this evolution with a cursory sector-focused analysis. The following three sections dive into more detail about drivers in each of the three main sectors of gas demand, starting with the power sector, the most important driver behind the reduction of gas consumption in 2023. The industrial sector, in all its complexity, comes next; before turning to the residential and commercial sector, the largest source of uncertainty for this winter. The final chapter draws some conclusions about 2023 and highlights some important factors for this winter.

A word on methodology and definition: gas demand is driven by a combination of factors, and it is difficult to disentangle all the different drivers that influence it, including variations that may happen specifically as a result of price fluctuation, let alone access timely, detailed and consistent data to allow for accurate and up-to-date analysis. In addition, when data is available, differences in methodologies and definitions complicate a comparison between sectors and national markets. As a result, the charts and most of the data presented in this Insight are this author's own estimates, which are based on publicly available statistics and this author's calculations to complete the missing statistics and to allow for comparison between various sets of data.<sup>2</sup> Because of the lack of granularity in gas demand statistics, additional data - for instance on temperatures, industrial production, and electricity generation - are used to provide a better picture of the recent trends and key factors by sector. The regional conclusions and outlook presented here are based on the author's analysis of this data using a bottom-up methodology. In addition, although daily changes are important for security of supply and may have an important impact on prices, especially in such a tight gas market, the analysis in this Insight focuses on monthly variations in order to highlight the main trends in gas use and mute the noise that may come out from daily variations. Lastly, unless otherwise specified, 'Europe' includes 28 countries comprising EU27 plus the UK.<sup>3</sup>

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<sup>1</sup> For more information about gas demand fundamentals in the first half of 2023, see Honoré, A. (2023). 'European gas demand fundamentals – H1 2023 review and short-term outlook'. <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2023/07/Insight-134-European-gas-demand-fundamentals.pdf>

For a focus on gas demand fundamentals during the period from early 2022 to March 2023, see Honoré, A. (2023). 'European gas demand fundamentals: 2022 & Q1 2023 review and short-term outlook'. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2023/04/Insight-127-European-gas-demand-fundamentals.pdf>

More information about gas demand fundamentals in 2021 can be found in Honoré, A. (2022). 'Demand response to high gas prices in Europe in 2021 and early 2022'. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2022/06/Insight-117-Demand-response-to-high-gas-prices-in-Europe-in-2021-and-early-2022.pdf>

Details on European gas demand in 2020 can be found in Honoré, A. (2020). 'Natural gas demand in Europe: The impacts of COVID-19 and other influences in 2020'. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2020/06/Natural-gas-demand-in-Europe-the-impacts-of-COVID-19-and-other-influences-in-2020.pdf>

<sup>2</sup> Harmonized data that allow for an easy comparison of gas demand between sectors and countries at a regional level are only made available with a time lag of several months (and even up to 18 months from international entities). National data generally provided by transmission system operators (TSOs) -whether directly or via the ENTSO-G transparency platform- show much more up-to-date gas demand data, and some even provide a split for gas uses by various groups of consumers. These data are the main sources used as raw statistics by this author. However, the different (and often unclear) definitions and methodologies make it very difficult, and at times almost impossible, to compare the evolution in 28 countries and in various sectors based on these data alone without additional steps/calculations to harmonize the data. This explains why most of the sources indicate 'calculations by the author' in addition to the original sources. For clarity, sources are not added within the text but are indicated in footnotes and below each figure.

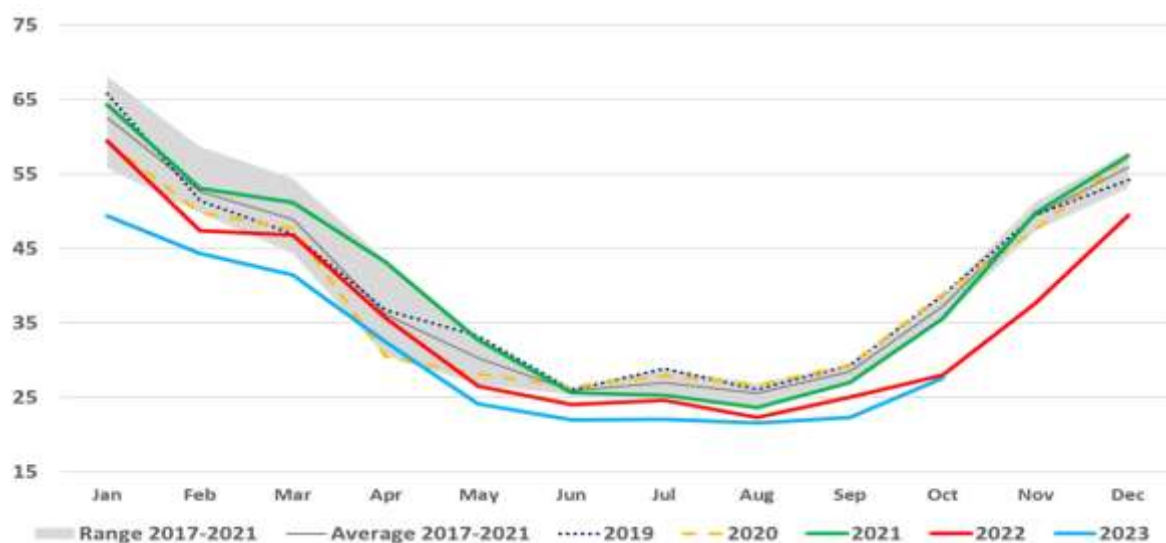
<sup>3</sup> Gas demand data does not include storage filling. Because this is a bottom analysis, data corresponds to 'observed' demand. The terms 'demand' and 'consumption' are used interchangeably in this Insight.

Finally, in this fast-changing world, it is important to date the research: the text and statistical calculations were finalized in early November 2023, from data available in the public domain at the time covering 2019 (the last pre-COVID year) up to October 2023. Any discussion on supply, gas balances and impact on gas prices this winter is not covered in this Insight and can be found in the latest OIES Quarterly Gas Review published on 30 October 2023.<sup>4</sup>

## 1. European gas demand still down in the first ten months of 2023, but timid signs of recovery have emerged since Q3

Gas demand in Europe declined by 13 per cent year-on-year in 2022, on the back of warm temperatures, demand response to high gas prices and changes in consumer behavior to save energy. This trend has largely continued in 2023 as shown in Figure 1 and in Table 2, with overall gas consumption down by 9.6 per cent in the first ten months of the year (about 32 bcm) despite the improved supply outlook and lower prices since the middle of 2022.<sup>5</sup>

**Figure 1: Monthly gas demand in Europe, 2019-2023 (bcm)**



Source: Data from author's assumptions and calculations based on various sources, including IEA, Eurostat, Entso-g, GRTgaz, Terega, THE, SNAM, Enagás and NGT. Graph by the author

Overall gas demand remains well below pre-crisis levels,<sup>6</sup> raising questions as to whether some demand losses may be permanent. However, a closer look at the evolution throughout the year highlights a stronger decline in Q1 (-12 per cent) on the back of unseasonably mild weather across most of Europe in January and March, limited industrial recovery and muted electricity demand combined with a higher availability of renewables (hydro, wind and solar). In effect, about 57 per cent of the demand reduction in the first 10 months occurred in Q1 only (representing 18.5 bcm).

<sup>4</sup> <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2023/10/Quarterly-Gas-Review-Issue-23.pdf>

<sup>5</sup> See Annex 1

<sup>6</sup> With the exception of April 2020, gas (and general energy) use was down due to extensive lockdowns around Europe because of the COVID pandemic. Details on European gas demand in 2020 can be found in Honoré, A. (2020). 'Natural gas demand in Europe: The impacts of COVID-19 and other influences in 2020'. <https://a9w7k6g9.stackpathcdn.com/wpcms/wp-content/uploads/2020/06/Natural-gas-demand-in-Europe-the-impacts-of-COVID-19-and-other-influences-in-2020.pdf>

From April, space heating demand generally reduces quickly and declines close to zero, therefore the decline in Q2 and Q3 (-8.8 and -8.3 per cent respectively) must have been primarily driven by non-weather-related factors. As seen in the subsequent chapter, the use of gas in the power sector continued to fall throughout the year, while industrial gas demand showed timid signs of recovery in Q3.<sup>7</sup> These trends were confirmed by the preliminary data for October 2023.

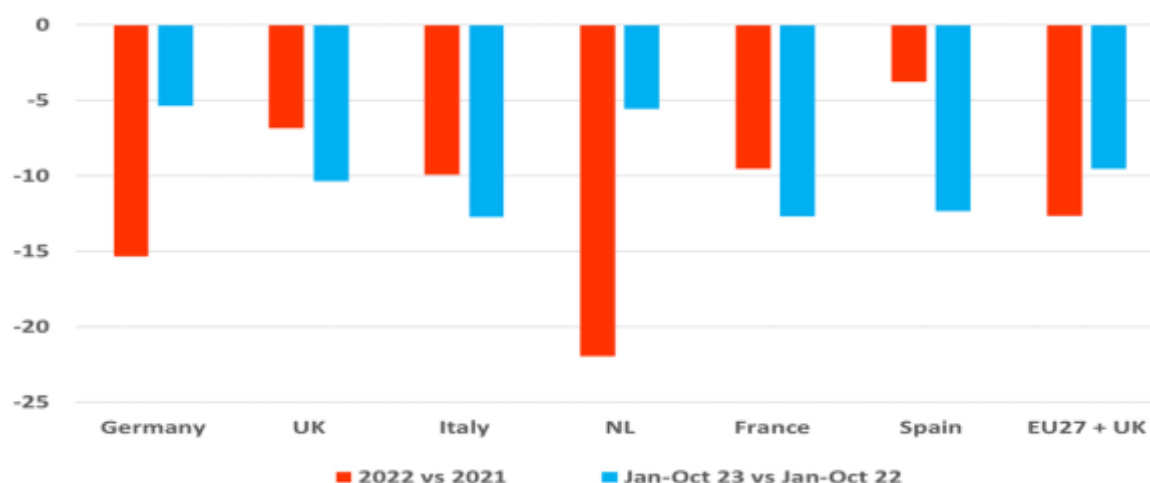
**Table 2: Variations of gas demand in Europe in 2022 and 2023 (per cent and bcm)**

	%	bcm
Year 2022 vs year 2021	-12.7	-61.9
Jan-Sept 23 vs Jan-Sept 22	-10.3	-32.1
Jan-Oct 23 vs Jan-Oct 22 (estimates)	-9.6	-32.5
Q1 23 vs Q1 22	-12.0	-18.5
Q2 23 vs Q2 22	-8.8	-7.6
Q3 23 vs Q3 22	-8.3	-5.9

Source: Data from author's assumptions and calculations based on various sources, including IEA, Eurostat, Entso, GRTgaz, Terega, THE, SNAM, Enagas and NGT. Table by the author

Before turning to a sectoral analysis, it is worth noting that this Energy Insight provides an overview of gas demand at the regional level. However, gas use varies significantly between countries as shown in Figure 2 (and in Annex 2), as gas consumption is influenced by various country-specific factors such as the role of gas in the energy mix, access to alternative fuels, and more recently, the levels and extent of the support measures from governments to shield their national consumers from the worst impacts of high energy and gas prices. In other words, the regional overview presented in this Insight may show different trends from the ones experienced at national level and the picture of gas demand changes is not necessarily - or even traditionally - uniform across Europe.

**Figure 2: Changes in gas demand in the largest gas markets in 2022 and 2023 (per cent, year-on-year)**



Source: Data from author's assumptions and calculations based on various sources, including IEA, Eurostat, Entso, GRTgaz, Terega, THE, SNAM, Enagas and NGT. Graph by the author

<sup>7</sup> At least short-term recovery as unabated gas demand in the industrial sector is expected to decline further to 2030 to meet the environmental targets described in the Fit-for-55 package and in the REPowerEU documents.

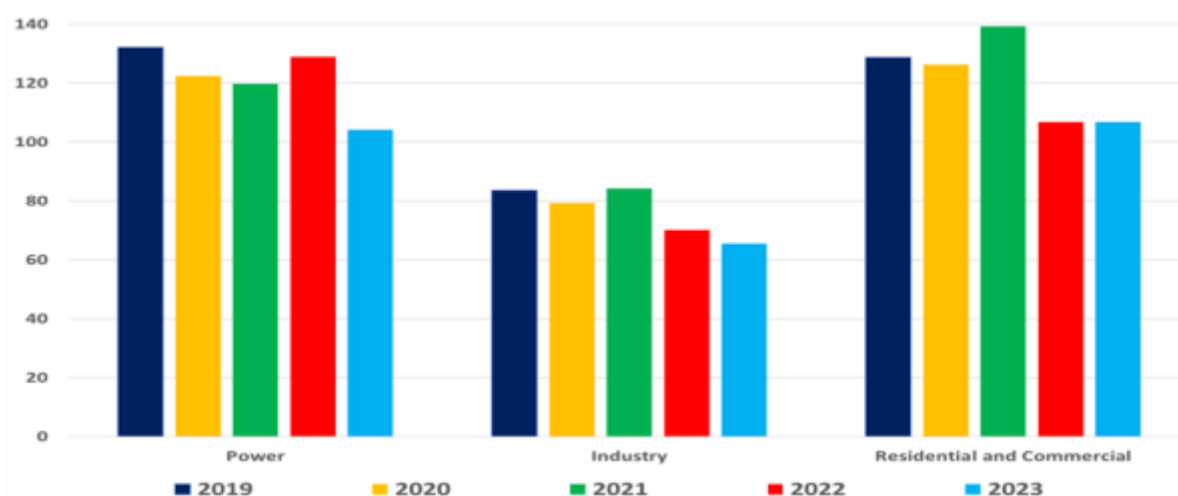
## 2. Drivers of gas demand reduction in 2023 very different to 2022

Natural gas in Europe is used in three main sectors: the power sector, essentially for electricity generation, the industrial sector,<sup>8</sup> and the residential and commercial sector (mainly for residential space heating).<sup>9</sup> Together, they typically represent about 90 per cent of total gas demand. All three sectors contributed to high levels of demand in 2021, with an especially sharp increase in the residential and commercial sector due to colder and longer than normal winters at the beginning and the end of the year.<sup>10</sup>

Conversely, most of the demand reduction in 2022 was concentrated in the residential and commercial sector due to warm temperatures and, to a lesser extent, in the industrial sector as high gas prices<sup>11</sup> induced a demand-side response from many sub-sectors (by switching to other fuels or by reducing their activity). On the contrary, gas use for electricity generation was marginally up last year, a surprising trend considering that the level of gas prices should have pushed the fuel to the back of the merit order and favoured other sources.<sup>12</sup>

In 2023, this author's estimates of European gas consumption by sector show large disparities as illustrated in Figure 3 (January to October), Table 3 (quarterly changes), and Figure 4 (monthly evolution).

**Figure 3: Gas demand in the three main sectors in Europe, from January to October in 2019-2023 (bcm)**



Source: Data from author's calculations. Graph by the author

<sup>8</sup> For more details on gas in industrial sector, see Honoré, A. (2019). <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2019/05/Decarbonization-and-industrial-demand-for-gas-in-Europe-NG-146.pdf>

<sup>9</sup> For more details on gas in the heating sector, see Honoré, A. (2018). 'Decarbonisation of heat in Europe: implications for natural gas demand'. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2018/05/Decarbonisation-of-heat-in-Europe-implications-for-natural-gas-demand-NG130.pdf>

<sup>10</sup> More information about gas demand fundamentals in 2021 can be found in Honoré, A. (2022). 'Demand response to high gas prices in Europe in 2021 and early 2022'. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2022/06/Insight-117-Demand-response-to-high-gas-prices-in-Europe-in-2021-and-early-2022.pdf>

<sup>11</sup> See Annex 1

<sup>12</sup> For additional information on gas demand fundamentals during the period from early 2022 to March 2023, see Honoré, A. (2023), 'European gas demand fundamentals: 2022 & Q1 2023 review and short-term outlook', <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2023/04/Insight-127-European-gas-demand-fundamentals.pdf>

Lower use of gas in the power sector turned out to be the main driver this year, accounting for over 70 per cent of Europe’s total gas demand decline in the first 10 months of 2023. Gas consumed by power generators was down by 16.5 per cent year-on-year in Q1, gradually declining to about -21 per cent in Q3 as French nuclear generation returned closer to long-term average levels (albeit still well below their historical average, as seen in chapter 3).

**Table 3: Changes in gas demand by sector in Europe from 2021 to October 2023 (per cent, year-on-year change)**

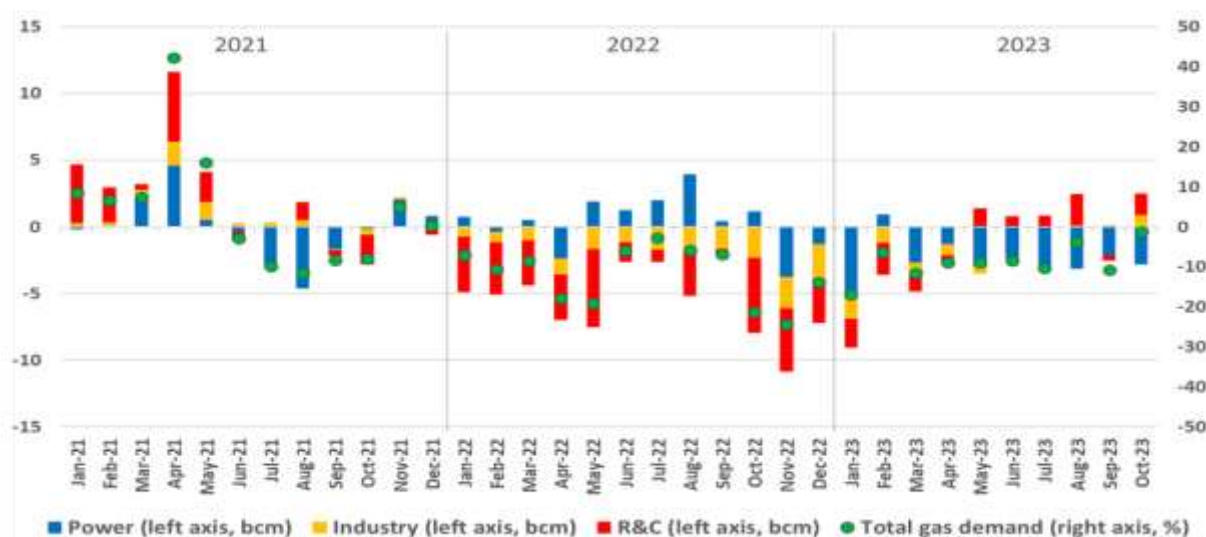
	2022 vs 2021	Jan-Oct 23 vs 22	Q1 23 vs Q1 22	Q2 23 vs Q2 22	Q3 23 vs Q3 22
Power	2.7	-19.2	-16.5	-18.9	-21.0
Industry	-18.4	-6.5	-14.7	-8.3	1.2
Residential and Commercial	-22.0	0.0	-8.3	6.3	33.1

Source: Data from author’s calculations. Table by the author

Another important factor was the evolution of gas use in the industrial sector, which was still down by about 6.5 per cent year-on-year from January to October. However, the pace of demand reduction moderated between Q1 and Q2 and even registered a marginal increase in Q3 (+1.2 per cent year-on-year). Preliminary data for October indicate an even stronger growth at the beginning of the winter period. It is probably too soon to speak of a recovery, as gas demand remains well below pre-crisis levels and especially considering the ongoing economic difficulties across Europe (as explained in chapter 4). But it may indicate that industrial gas use may have finally reached a floor, at least until measures to reach the 2030/2050 targets start to dramatically reduce unabated gas use in Europe.

Additional gas consumption in the residential and commercial sector over Q2 and Q3 is likely to indicate demand recovery from small businesses.

**Figure 4: Monthly changes in gas demand in the three main sectors in Europe, year-on-year from January 2021 to October 2023 (bcm and per cent)**



Source: Data from author’s calculations. Graph by the author

The evolution of gas demand will continue to be a complex puzzle with many moving pieces. The following chapters take a closer look at each of the three sectors, explaining recent developments in 2023 and highlighting the main drivers and uncertainties for the next few months.

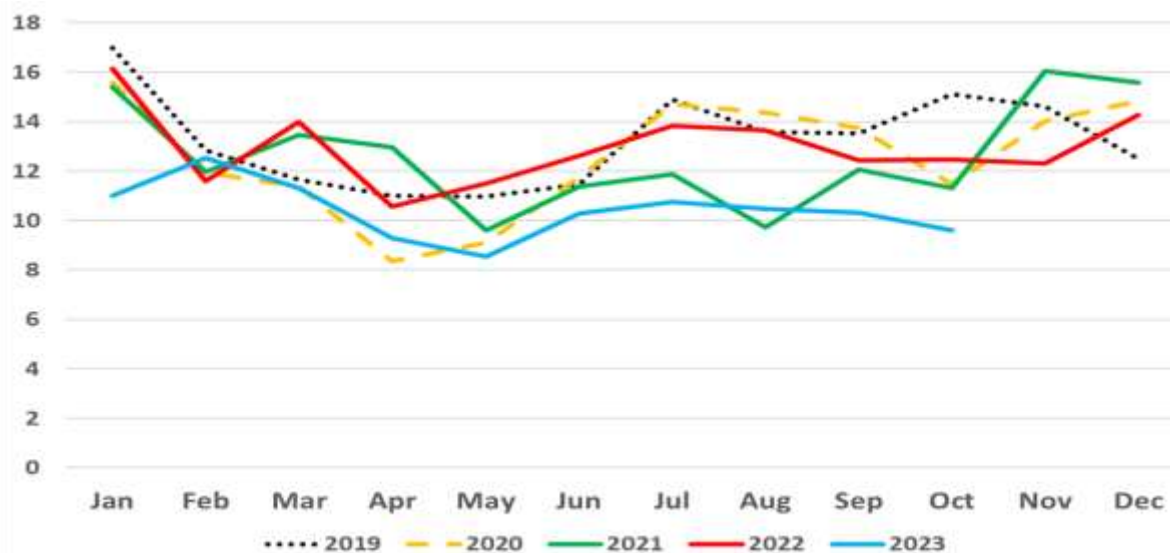


### 3. Power sector key driver behind gas demand reduction in 2023

Gas used in the power sector typically represents around 30 per cent of gas demand in Europe, with gas covering about 20 per cent of electricity generation last year.

In 2023, the steep decline in gas burn in the power sector has been the main driver of gas demand reduction, with an even sharper drop in Q2 and Q3, as illustrated in Figure 5.

**Figure 5: Gas demand in the power sector in Europe, 2019-2023 (bcm)**



Source: Data from author's calculations. Graph by the author

Gas prices influence the place of gas-fired plants in the merit order, which stacks available generation capacity to supply power over a certain period from the cheapest to the most expensive source. However, gas prices are not the only determining factor for gas burn in the power sector, as clearly shown over the past two years. Determining which plants are used at any moment in time is a complex puzzle, but a broad overview is given by looking at the level of total electricity demand and at the availability of various sources. Essentially, plants with low marginal costs, like most renewables, and nuclear, that need to run on baseload, will be dispatched first. The remaining gap will then be covered by dispatchable plants using fossil fuels. Gas prices therefore influence the use of gas-fired power plants versus coal plants in Europe. At times of high electricity demand and/or low availability of renewables and/or nuclear, gas plants may be called into the mix even at times of very high gas prices, as happened in 2022.

Before turning to 2023, it is useful to start with a quick overview of the circumstances in 2022 to frame the challenges for this winter. Gas used for electricity generation increased by almost 3 per cent in 2022 (+4 bcm) despite record-high gas prices and European objectives to reduce gas consumption. Three main elements influenced the need to use more gas in the generation mix:

- First, there was continued high electricity demand in the first eight months of the year, before energy saving measures and the economic slowdown finally started to have an impact from September onwards, as illustrated in Figure 6. Exceptionally mild temperatures in Q4 2022 also helped to limit the need for electricity demand.
- The second reason was low availability of nuclear power. Nuclear generation was down by 116 TWh in 2022 (minus 16 per cent year-on-year), with most of the decrease concentrated in May-November as seen in Figure 7. About 69 per cent of the decline (80 TWh) originated from France alone. The second half of 2022 saw French nuclear generation fall to historic lows as the utility EDF faced a wave of repairs caused by stress corrosion plus delays to its scheduled

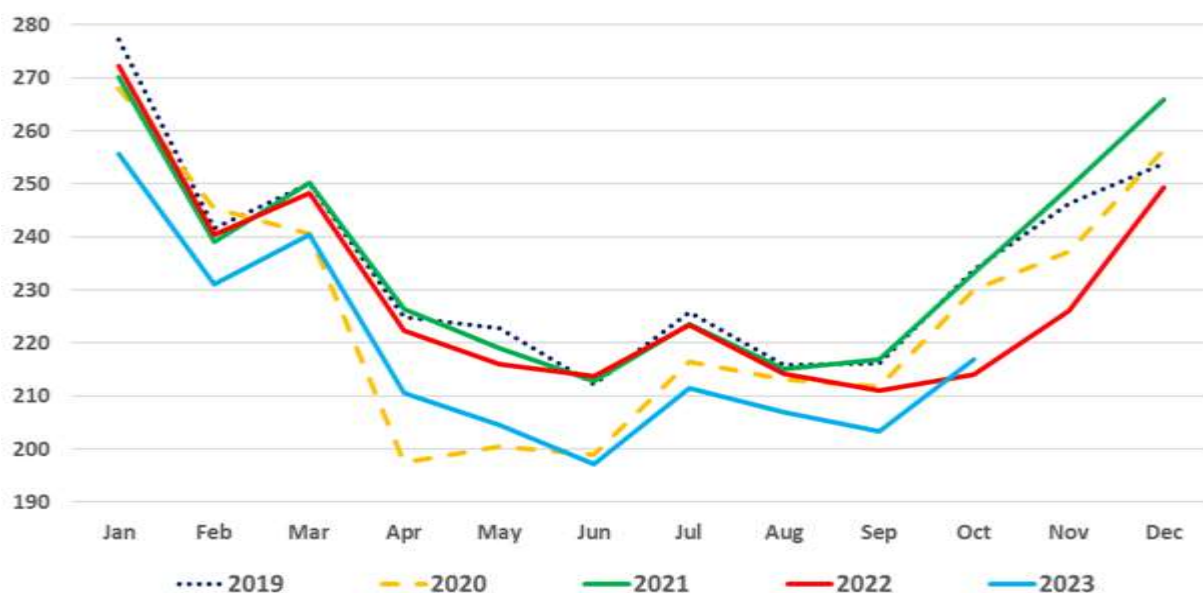
ten-year maintenance plan due to the COVID pandemic (as well as strikes in France in October 2022), which forced a record number of reactors offline for most of the year. As a result, French nuclear generation was down by 23 per cent in 2022, lifting thermal power generation in the country and in neighbouring markets.

Another important factor was the closure of three reactors in Germany at the end of 2021 as part of the country's phase-out process, which limited nuclear generation to 33 TWh in 2022 compared to 65 TWh in 2021 (this accounted for about 28 per cent of the total decline in nuclear generation in Europe last year).

- Thirdly, the severe drought across Europe, especially in the south, depleted hydro stocks last year. Hydropower generation fell by 53 TWh (15 per cent), with the bulk of the year-on-year decline concentrated in the first nine months, although this result is also explained by existing low levels of hydro generation in Q4 2021.

In 2022, the sharp fall in both nuclear and hydro generation were responsible for the loss of almost 180 TWh. This was partly covered by lower electricity demand (70 TWh), higher generation from renewables, helped by additional installed capacity (wind 39 TWh and solar with an impressive growth of 32 TWh), and finally by higher electricity generation from coal (23 TWh) and, as a last resort, gas (14 TWh).<sup>13</sup>

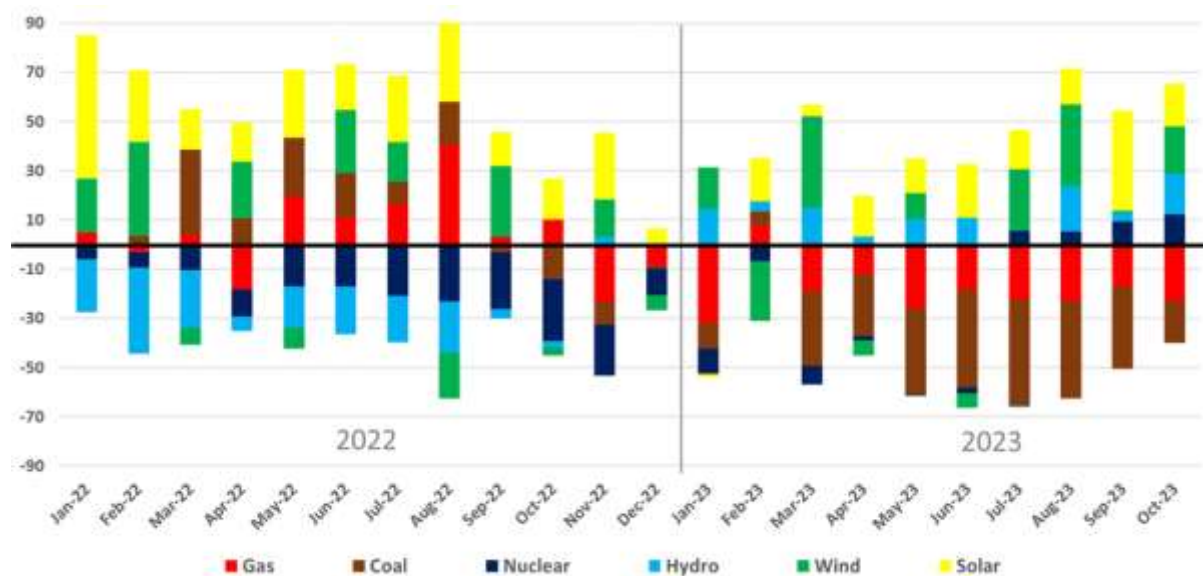
**Figure 6: Monthly (total) electricity demand in the EU27 + UK (TWh)**



Source: Data from author's calculations, Entsoe and Gridwatch. Graph by the author

<sup>13</sup> Smaller sources are not mentioned in this section.

**Figure 7: Monthly changes in electricity generation in Europe by source, from January 2022 to October 2023 (per cent, year-on-year)**



Source: Data from author's calculations, Entsoe and Gridwatch. Graph by the author

In 2023, total electricity demand continued on the same trend (-4 per cent year-on-year in January-October) driven by lower production in energy-intensive industries, continued improvements in energy efficiency and changes in consumer behaviour to save energy. However, the electricity generation mix is dramatically different from last year as illustrated in Figure 7. There was much stronger renewable output (thanks to the continued roll-out of wind and solar and to a somewhat improved availability of hydropower) and the progressive return of nuclear, reducing the call on gas and coal plants this year.

Figure 8 provides a clear overview of electricity generation from the six main sources, allowing for an easy comparison in levels and evolution over the past few months.

- The most impressive chart is probably the one illustrating nuclear generation. It highlights the huge drop in Q2 and Q3 2022 but also the progressive return since Q4 2022. In the early months of 2023, uncertainties persisted regarding nuclear supply availability, especially after further reactor cracks were discovered in France in March 2023. However, availability has gradually improved over the course of the year and even accelerated in Q3 2023.

This recovery is all down to the return of the French nuclear fleet which, in normal years, typically covers about 15 per cent of European electricity needs.<sup>14</sup> The French utility EDF raced against the clock last year to put as many reactors as possible back into service as quickly as possible. Nonetheless, actual production in 2022 reached 279 TWh, its lowest level in over thirty years,<sup>15</sup> and well below the twenty-year average of over 400 TWh. The availability of the French nuclear fleet significantly improved in 2023 as several reactors were reconnected to the grid after safety checks were concluded. In the first ten months, nuclear generation in France stood at 261 TWh, 31.8 TWh higher than that of the same period in 2022 or almost 14 per cent higher year-on-year, as illustrated in Figure 9.

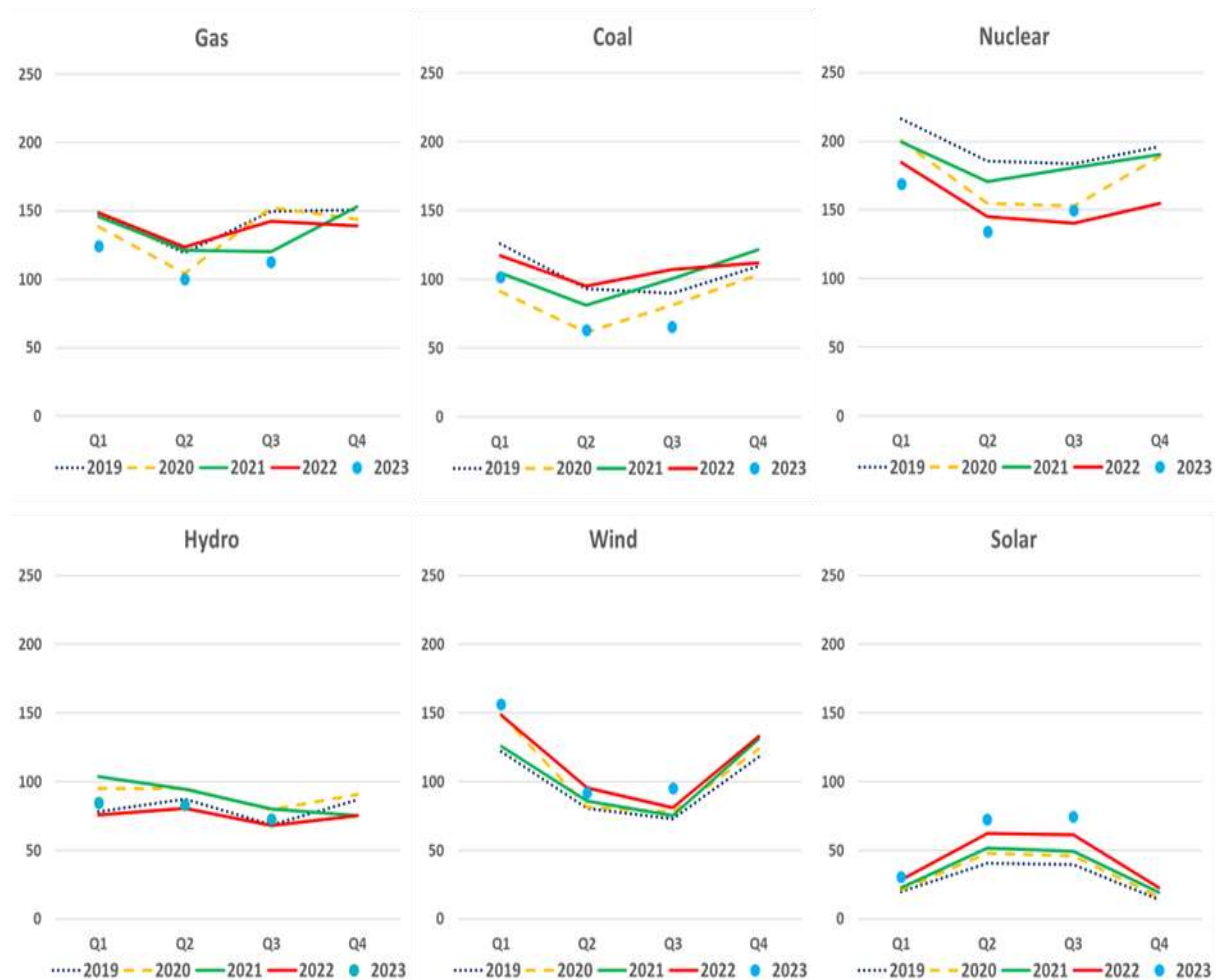
- The charts showing the impressive drop in gas and coal generation this year are also remarkable. Electricity generation from gas was down by -19 per cent year-on-year in the first

<sup>14</sup> Author's calculations from Entsoe data

<sup>15</sup> Data from the French utility EDF

ten months of 2023 while coal was down by -27 per cent. As a result of this evolution, over 67 per cent of the electricity generated so far this year has come from renewables and nuclear, in other words, from low or zero-emission sources (44 per cent from wind, solar and hydro, up from 39 per cent at the same time in 2022), while fossil fuels were down to 33 per cent (39 per cent in 2022), with natural gas alone at 17 per cent (down from 20 per cent).<sup>16</sup>

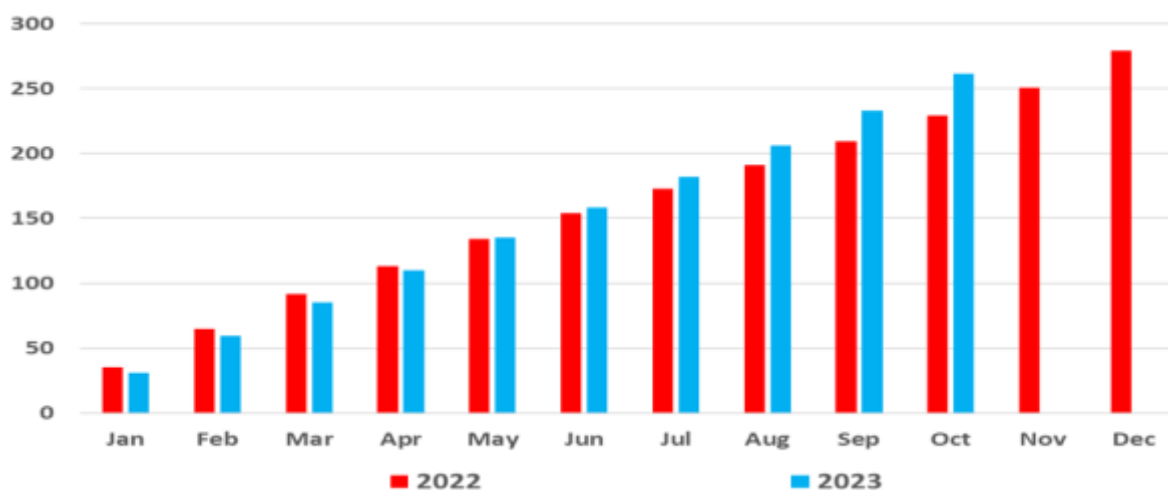
**Figure 8: Quarterly electricity generation in the EU27 + UK (TWh)**



Source: Data from author's calculations, Entsoe and Gridwatch. Graph by the author

<sup>16</sup> Calculations by the author from data from Entsoe and Gridwatch

**Figure 9: Electricity generation from nuclear in France in 2022 and 2023 (TWh)**



Source: Data from EDF. Graph by the author

The key drivers for this winter include the level of electricity demand, the pace and extent of the French nuclear recovery, and finally, the availability of renewables.

- Europe's power demand is not expected to increase dramatically this winter, aside from its usual seasonal fluctuations as energy efficiency improvements and an economic slowdown should continue to curtail demand (even if the EU voluntary reduction target has not been renewed for this winter). However, a cold winter and/or some industrial recovery could still push demand up, as seen in October 2023 (Figure 6) when cold temperatures in the second half of the month are likely to have triggered an increase in heating demand, while an industrial recovery is also likely to have taken place (see chapter 4).
- The outlook for nuclear availability this winter is positive. EDF has so far confirmed its expectations for 300-330 TWh of nuclear generation for 2023 after submitting a revised inspections plan for the 16 reactors most at risk from stress corrosion (most of which have already been repaired at the time of writing).<sup>17</sup> This would still be relatively low by historical standards<sup>18</sup> but nonetheless 8 to 18 per cent above 2022. Production so far has been in line with EDF's target, reducing concerns of a repeat of last winter's low nuclear availability in France. All in all, French nuclear availability in 2023, combined with the higher capacity in Finland,<sup>19</sup> is expected to mitigate the impact of the plant closures that happened in Germany, Belgium and the UK in 2022 and early 2023.<sup>20</sup> EDF expects to produce 315-45 TWh in 2024.
- By October 2023, the level of hydropower reservoirs across Europe was generally higher year-on-year, including in the Nordic countries, France and Switzerland and southern Europe, but with the notable exception of Austria. Hydro generation availability this winter will also depend on how much precipitation Europe gets until the end of the year (which is becoming increasingly

<sup>17</sup> <https://www.reuters.com/business/energy/resurgent-nuclear-calms-french-winter-power-market-2023-09-06/>

<sup>18</sup> The average generation over the last 20 years is about 402 TWh. Data from French transmission system operator RTE

<sup>19</sup> The 1.6GW Olkiluoto 3 nuclear reactor finally began full commercial operations on 1 May 2023

<sup>20</sup> Germany's last three nuclear plants (1.4GW Isar 2, 1.34GW Emsland A and 1.3GW Neckarwestheim 2 units) closed in mid-April 2023

Belgium decommissioned the Doel 3 and Tihange 2 plants in September 2022 and February 2023 (2GW in total) as planned as part of the previous policy to phase out nuclear by 2025

In the UK, the 1GW Hunterston B was closed in January 2022 and the 1GW Hinkley Point B closed in August 2022

unpredictable and an important source of uncertainty). Nonetheless, hydro stocks are up compared to last year in most of Europe, allowing more flexibility to raise hydropower generation this winter and reduce the need for gas (and coal) plants.

- The continued deployment of renewables has increased the availability of wind and solar.<sup>21</sup> & <sup>22</sup> This winter, wind generation is expected to rise year-on-year due to capacity additions, but the level of wind availability remains hard to predict, and at times of low wind generation, gas plants are expected to help fill the gap. This is more discernible on a daily basis (see Annex 3) but could also clearly be seen in the monthly statistics for February 2023 and for summer 2022 (Figure 7).
- Lastly, the extent of coal/gas switching this winter will also influence the use of gas for power, although probably only marginally in most of Europe. The tendency has been towards coal to gas switching for most of 2023: the clean spark spreads was generally well above the clean dark spreads in most continental European countries from mid-February 2023, and even from mid-January in the UK, as gas prices fell faster than coal while the price of carbon emission allowance remained firm (see Annex 4). The deteriorating competitiveness of coal-fired plants was illustrated by a steeper decline in coal-based generation than for gas in the first ten months of 2023. Coal-fired plants started to regain competitiveness against gas-fired plants from mid-October 2023 as clean spark spreads and clean dark spreads seemed to have already started to converge. This is expected to continue until the end of the year and in Q1 2024 but may only have a small impact on gas demand, unless there are sudden supply disruptions or a significant increase in the region's power demand, which could happen when there are cold snaps.
- In conclusion, these factors suggest an overall weaker gas demand from the power sector this winter compared to last year, although days with low wind availability will also undoubtedly mark a short-term spike in gas use.

#### 4. Industrial gas demand in 2023: the premise of a -timid- recovery

The industrial sector traditionally covers just over 20 per cent of gas demand in Europe.<sup>23</sup> The decline in industrial gas demand over the past two years was largely price-driven as many firms struggled under the strain of high energy prices. However, one important conclusion from the recent crisis is that the extent to which gas use for industrial production can be affected by higher gas prices is not necessarily straightforward and depends on various factors such as contractual arrangements, access to alternative supply and the ability to pass increased costs to consumers.<sup>24</sup>

After an impressive post-COVID recovery in 2021,<sup>25</sup> gas consumption in the energy-intensive industrial sector decreased by 18 per cent in 2022 (-19 bcm),<sup>26</sup> with an even stronger slowdown in the second

<sup>21</sup> After an impressive growth in 2022, the solar sector is set to continue its positive trend in 2023 with 53 GW of new installations after 41 GW in 2022 according to SolarPower Europe. EU Market Outlook for Solar Power 2022-2026 - SolarPower Europe

<sup>22</sup> <https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2022-statistics-and-the-outlook-for-2023-2027/>

<sup>23</sup> Average share during 2015-2021. Calculated from Eurostat data

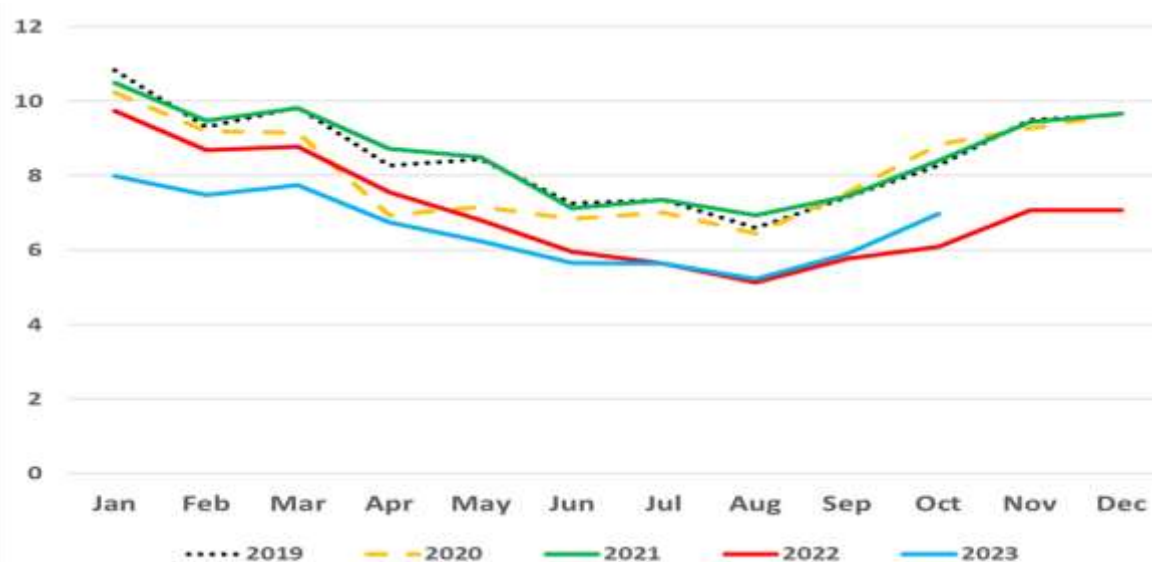
<sup>24</sup> Some companies may be less exposed to fluctuations on the spot market, depending on their contractual agreements with suppliers and/or their forward hedging arrangements. Whether or not they have access to alternative sources of supply is another factor, while some complex industrial processes cannot be switched on and off easily or rapidly, for instance due to staff requirements. Production commitments and the supply chains' own time-lag or inertia could also play a role. Finally, whether companies are in direct competition with similar companies located in regions with lower (and/or subsidised) prices or whether they have the ability to pass on their rising costs to their consumers will also determine their demand response to high gas prices. Access to, and the extent of, government support was also important last year.

<sup>25</sup> An important factor explaining strong gas demand in 2021 was the economic recovery across Europe after the COVID pandemic and several lockdowns (from the second half of 2020). Despite rising prices from September 2021 onward, this author estimates that industrial gas demand increased by 5 per cent year-on-year in 2021.

<sup>26</sup> Author's calculations

half of the year, as illustrated in Figure 10. If the 2022 decline was largely due to a simple price-demand response, then a strong rebound in gas consumption could have been expected in 2023, stimulated by the fall in energy prices.<sup>27</sup> Earlier this year, these expectations even raised questions over how the region would cope if industrial consumption were to bounce back rapidly, especially in what was (is) still a tight gas market. This scenario did not materialize and gas demand in the industrial sector in Europe was still down by -6.5 per cent year-on-year in the period from January to October. However, the evolution has not been regular, with large differences between the beginning and the end of the year, and an overall upward trend.

**Figure 10: Gas demand in the industrial sector in Europe, 2019-2023 (bcm)**



Source: Data from author's calculations. Graph by the author

- Q1 2023: Despite important year-on-year industrial gas consumption decline (-16 per cent), the rate of yearly contraction slowed from February and gradual gas demand recovery seemed to be on the way across several industrial sub-sectors, both in sectors that were likely to have switched to other fuels (like the refinery sector with oil products<sup>28</sup>) and to a much lesser extent in sectors where curtailment of production and/or closures of plants happened in 2022 (as in the chemical sector). For instance, while gas-fed production of ammonia had been largely uncompetitive since mid-2022, improved economics triggered a return of plants back online both in December 2022 and in Q1 2023, although it was only a brief return for a short period.<sup>29</sup>

<sup>27</sup> The International Energy Agency (IEA) estimated that about half of the decline in industrial gas demand in the EU27 in 2022 came from production curtailment and about 30 per cent from fuel switching, and the rest was from efficiency gains, import substitutions, and the effect of the weather. <https://iea.blob.core.windows.net/assets/227fc286-a3a7-41ef-9843-1352a1b0c979/Naturalgasupply-demandbalanceoftheEuropeanUnionin2023.pdf>

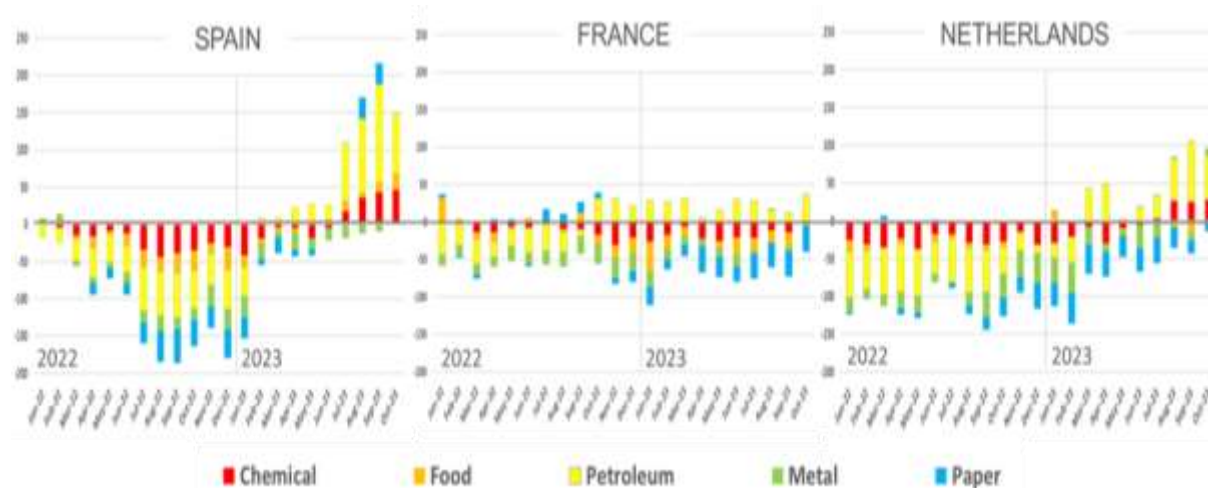
In other words, based on this estimate, about 80 per cent of the demand fall last year was due to price-demand response. Therefore, these volumes were expected to come back with lower gas prices. And we saw this happening in October 2022 when gas prices reached their lowest levels in months and fertilizer producers restarted production in Europe (fertilizers may tend to be more responsive to changes in gas prices than manufacturers of finished products), and this is also what we started to see in Q1 2023.

<sup>28</sup> Firms that switched to renewables are unlikely to switch back to gas.

<sup>29</sup> Europe's largest ammonia producer, Yara, decided to curtail its production and took its Ferrara plant offline in April, just three weeks after bringing it back online (after nine months of being idled). <https://direct.argusmedia.com/newsandanalysis/article/2468836>

- Q2 2023: The picture was more mixed during the following months. Gas consumption was closer to 2022 levels than in Q1 (-9 per cent year-on-year), but at the same time, the pace of recovery seemed to have slowed or even stopped, with the notable exception of the petroleum sector, where lower gas prices allowed for year-on-year recovery thanks to plants switching back to gas.
- Q3 2023: After a consecutive 20-month year-on-year decline, preliminary data indicate a timid recovery - at least on a year-on-year basis - from August 2023, albeit marginal as the whole third quarter was just about 1 per cent above 2022 levels. This was the result of continued gas demand growth in the petroleum sector, while other sectors also started to recover. However, the picture was not uniform across Europe. For instance, the chemical sector was up in Spain and in the Netherlands, while it continued its year-on-year decline in France as shown in Figure 11. This was also most likely the case in Germany where chemical producer BASF mentioned a 'renewed rise in gas prices' and therefore lower demand, as one of the reasons<sup>30</sup> it cited to explain its lower year-on-year production in Q3 2023.<sup>31</sup>
- Preliminary data for October show even stronger growth, with industrial gas demand about 14 per cent higher year-on-year, which seems to have been driven primarily by the petroleum sector but also by other sectors such as chemicals, food and metals. This time of year is traditionally marked by higher fertilizer demand in Europe when stocks are being rebuilt for autumn application,<sup>32</sup> and may partly explain the October data.

**Figure 11: Changes in industrial gas demand in selected sub-sectors in Spain, the Netherlands, and France. January 2022 to October 2023 (per cent, year-on-year)**



Note 1: Sectoral definitions vary between countries. Groups have been simplified to allow a comparison.

Source: Data from author's calculations, Enagas, GRTGaz, CBS, GTS. Graph by the author

Reduced industrial gas demand in 2022 and 2023 helped Europe cut the need for gas imports, and free up gas to fill storage to record levels at the beginning of winter, which helped improve the gas security outlook for this winter, but the region has paid a high price in terms of reduced manufacturing activity.

<sup>30</sup> High inflation and high interest rates were also mentioned as causes for lower demand. <https://direct.argusmedia.com/newsandanalysis/article/2504549>

<sup>31</sup> The company had already announced last year that it will permanently close its most gas-intensive plants in Europe by 2026 as a result of high gas prices. <https://direct.argusmedia.com/newsandanalysis/article/2423384>

<sup>32</sup> It also usually happens in February for spring application.



Looking at industrial production, especially manufacturing output, gives *some* indication regarding recent industrial gas demand trends and expectations for the winter. The reason to focus on the manufacturing sector is because it typically covers over 90 per cent of industrial gas demand in Europe,<sup>33</sup> & <sup>34</sup> with the main consumers being the chemical sector; the food, beverages and tobacco sector; and the non-metallic minerals sector (that includes glass and cement for instance) as seen in Annex 5.

It appears that the EU27<sup>35</sup> has maintained high volumes of manufactured goods production in 2021 and 2022, as illustrated in Figure 12. In other words, the remarkable reduction in industrial gas demand did not seem to correlate with the decline in the *total* manufacturing output. The logical explanation for this finding is that, facing increased prices and insecure supply, many sectors have been able to reduce gas demand without reducing (much of) their production by switching to alternative fuels - with some firms opting to use fuel oil or other liquids to replace gas during record high prices and refiners opting to use LPG for instance - and/or by improving their operational efficiency. However, a closer look shows important disparities between the industrial sub-sectors. The chemical sector (represented by both the dark and the light blue lines in Figure 12), the iron and steel sector, the pulp and paper sector and (to a lesser extent) the non-metallic mineral products (which is represented by both the dark and the light pink lines) have been clear exceptions. Objectively, the level of output in these four sectors, which represent over two thirds of industrial gas demand in Europe, was more affected than the other sectors by rising energy costs and ensuing deteriorating business competitiveness last year, as many of these gas users struggled to pass on the rise in energy costs to their own customers.

In 2023, the picture was significantly different. Not only was the *total* manufacturing output down,<sup>36</sup> it also appeared to be on a declining trend. Production has also been low across some key gas-intensive sectors this year, although rather interestingly, some large users of gas have been experiencing some recovery since May (refined petroleum products), June (iron and steel) and July (fertilizers). This evolution is likely to be linked to the timid recovery in industrial gas demand mentioned earlier. Nonetheless, output in these three sectors was still well down in 2023 compared to 2022,<sup>37</sup> hinting at limited upside for manufacturing output and, as a collateral, industrial gas demand in the short term.

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<sup>33</sup> Average share during 2015-2020. Calculated from IEA data.

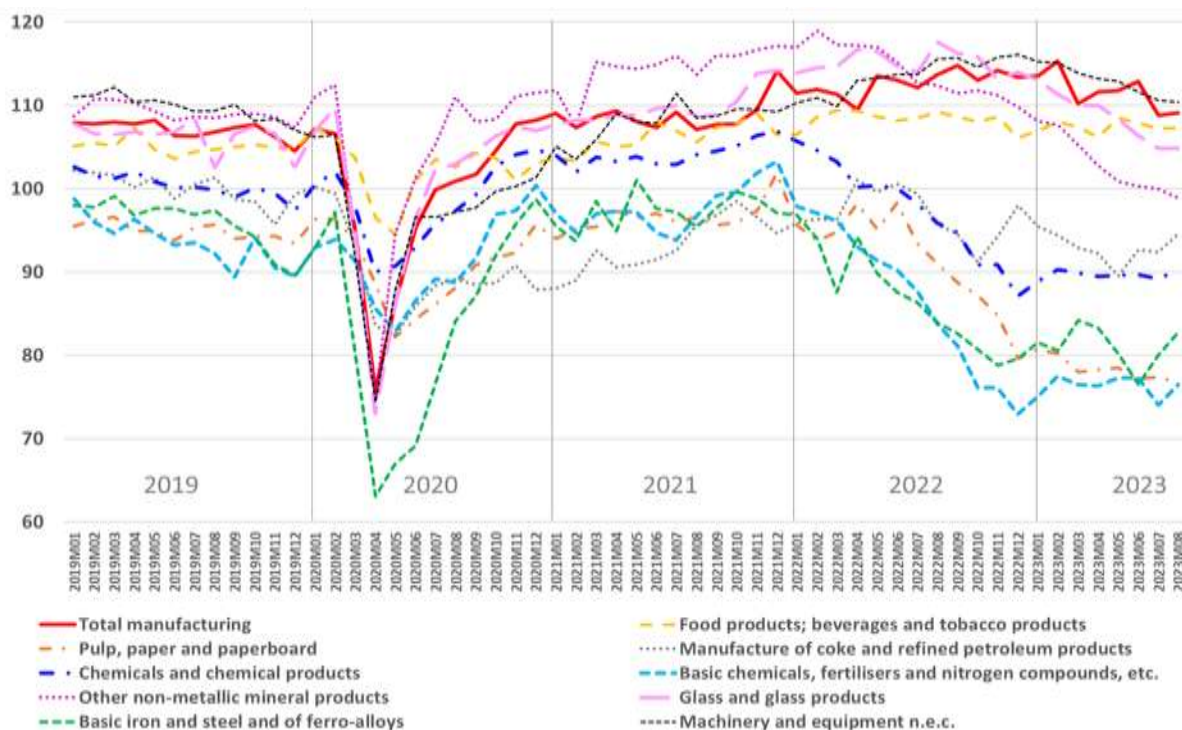
<sup>34</sup> In the manufacturing sector, most of the gas is used for energy use (85 per cent), with the remainder as non-energy use (all in the chemical and petrochemical sector). Gas volumes used to generate process heat could, in theory, be replaced more easily/rapidly by other fuels although available options depend on access to alternative fuels, existing adequate equipment, and the level of temperatures (because not all technologies and fuels are capable of achieving very high temperatures, especially those associated with traditional renewables). See Honoré, A. (2019). 'Decarbonization and industrial demand for gas in Europe', *Chapter IV*. <https://a9w7k6q9.stackpathcdn.com/wpcms/wp-content/uploads/2019/05/Decarbonization-and-industrial-demand-for-gas-in-Europe-NG-146.pdf>

<sup>35</sup> Eurostat stopped publishing data covering the UK in 2020, when the country left the EU. Therefore, data on manufacturing output in this section only cover the EU27.

<sup>36</sup> Only by -0.4 per cent year-on-year between January and August, which was the latest available data from Eurostat for the EU27 at the time of writing.

<sup>37</sup> -5 per cent in the refined petroleum products, -10 per cent in iron and steel and -17 per cent for the fertilizers over the first 8 months of 2023, the latest available data at the time of writing. Author's calculations from Eurostat data.

**Figure 12: Volume index of monthly production for manufacturing in EU27 from January 2019 to August 2023 (2015 = 100)**



Source: Data from Eurostat. Seasonally and calendar adjusted data. Graph by the author

Demand reduction or demand destruction? The potential for industrial demand to rebound quickly depends on the extent to which gas demand has been permanently cut or only temporarily reduced. Unfortunately, gas demand data granularity does not allow for an extensive and in-depth analysis of the evolution of gas uses by industrial sub-sectors in 2022 and 2023 at the European level. It is not yet possible to find hard data to differentiate between what has been demand reduction (fuel switching to oil products or curtailment of production) and demand destruction (improved operational efficiency, switching to renewables and heat pumps, and relocation outside Europe).

Notwithstanding this difficulty and without underestimating any probable demand destruction, it is likely that roughly 75 per cent of the decline has been from demand reduction measures. So why only a limited recovery in 2023? It seems that the impact of low gas prices this year compared to 2022<sup>38</sup> has been counter balanced by several factors that often prevented firms from switching back to gas and/or re-starting idle production capacity quickly, including uncertainties on gas supply and demand fundamentals (and therefore a lack of visibility), continuous tightness of the market (and consequently high gas price volatility) and expectations regarding security of supply especially at the beginning of the year.<sup>39</sup>

<sup>38</sup> Gas prices are still relatively high compared to pre-crisis levels, and volatility is also much higher. For more information, see the OIES Quarterly Gas Review series: <https://www.oxfordenergy.org/publicationtopic/quarterly-gas-review/>

<sup>39</sup> Source: author's interviews and press articles. An analysis of the German situation can be found in Seeliger A. (2023). 'German Industrial Gas: Crisis Averted, For Now'. <https://www.oxfordenergy.org/wpcms/wp-content/uploads/2023/11/Insight-137-German-industrial-gas.pdf>

Note that security of supply may also still be an issue in case of shortage during the winter. The industrial sector will be the main source of flexibility to balance supply and demand in case of a tight European market with potential gas rationing in order to divert supply to protected users if need be. Last year, mild temperatures, voluntary demand reduction and demand response were

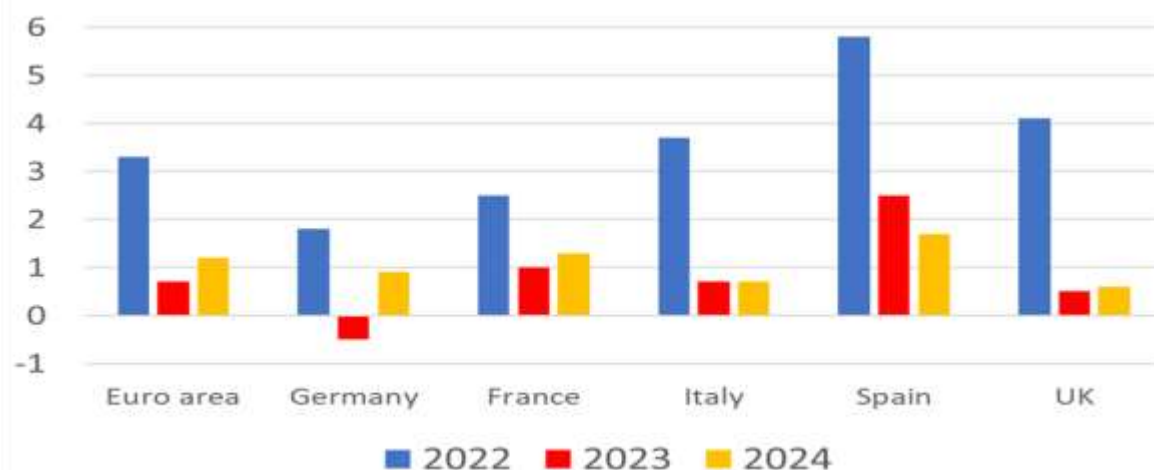
There has, however, been an upward trend in industrial gas demand since Q3. The European gas market remains tight, but additional LNG import capacity, full storage and muted gas demand may have contributed to eroding the impact of some of these factors since the summer. Investments in new LPG systems in various subsectors, enabling industrial users to switch between gas and LPG, also increased last year,<sup>40</sup> potentially making industrial gas demand more flexible and price responsive. For instance, Germany's industrial demand for LPG, including the chemical sector, grew by almost 25 per cent in 2022, most likely as a result of gas to LPG switching.<sup>41</sup> The extent of this phenomenon and what impact it may have on industrial gas demand this winter remains unclear (especially as logistical bottlenecks may limit any significant increase in LPG demand), but it is an interesting development that could help the sector manage security of supply fears, lack of visibility in the gas market, and more importantly, any spike in prices and/or demand.

However, the level of gas prices alone may not be the most important driver for gas use in industry over the next six to nine months as a general economic slowdown raises doubts about the level of demand for end-products, especially impacting sub-sectors such as chemicals, steel, glass and nonferrous metals. In other words, slow economic growth, or even recession in some countries, could mute any rebound in gas demand from industry this winter.

Winter economic forecasts for Europe have been revised down since the summer as inflation remains high and financing conditions are expected to tighten further. The latest World Economic Outlook published in October 2023 by the International Monetary Fund (IMF)<sup>42</sup> showed GDP growth in the Euro area well below 1 per cent in 2023, down from over 3 per cent in 2022, as seen in Figure 13. Weak growth momentum is also anticipated to extend into 2024.

In Germany, the largest economy, the largest gas market and the biggest consumer of gas in the industrial sector in Europe, GDP was expected to contract in 2023 and should recover more slowly from its recession than previously anticipated, finally achieving lower growth in 2024.

**Figure 13: Economic forecast, October 2023, GDP growth (per cent)**



Source: IMF, World Economic Outlook, October 2023

sufficient, but had there been a need for it, the industrial sector would have been first in line. This, in turn, would have caused widespread disruption to manufacturing production, though exactly which industries would have been targeted first remained largely unclear.

<sup>40</sup> As reported by Argus media: "Sales of systems which convert liquefied petroleum gas (LPG) into synthetic natural gas (SNG) have increased by 10 times in the past year as more customers fear disruptions to gas supply, Algas-SDI sales director for gas systems, Sean Guichon." <https://direct.argusmedia.com/newsandanalysis/article/2478595>

<sup>41</sup> [https://www.dvfg.de/fileadmin/user\\_upload/downloads/jahresberichte/DVFG-22-Jahresbericht\\_2022\\_ES\\_online.pdf](https://www.dvfg.de/fileadmin/user_upload/downloads/jahresberichte/DVFG-22-Jahresbericht_2022_ES_online.pdf)

<sup>42</sup> <https://www.imf.org/en/Publications/WEO/Issues/2023/10/10/world-economic-outlook-october-2023>

Another pessimistic signal concerning short term expectations for the region's manufacturing sector is shown in the Eurozone Manufacturing PMI,<sup>43</sup> which has been below 50 (the level that separates growth from contraction) since July 2022 as shown in Figure 14. PMI stood at 43.1 for the Euro area and even 40.8 for Germany in October 2023, indicative of another worsening of the manufacturing economy.<sup>44</sup> The survey showed 'steep and accelerated contractions' in new orders, purchasing activity and backlogs, despite a fall in input prices for an eight successive month.<sup>45</sup> The UK manufacturing sector also contracted with a PMI at 44.8.<sup>46</sup>

In early November, the European Commission proposed extending temporary state aid rules to 31 March 2024, as some countries also contemplated prolonging or increasing their support (Germany debated subsidies for the electricity used by heavy industry in order to improve competitiveness).<sup>47</sup> Whether these measures will support industrial output and consequently industrial gas demand this winter is uncertain. Another factor that may keep industrial gas demand down over the winter is lower production costs abroad, which may weigh on output in various sectors (steel, fertilizers) as companies turn to imports instead of production in Europe.<sup>48</sup>

**Figure 14: Manufacturing PMI in the EU over the past five years (September 2019 to September 2023) (Index)**



Source: Data from Trading Economics, retrieved on 7 November 2023

<sup>43</sup> PMI = Purchasing Managers Index is a measure of the prevailing direction of economic trends in manufacturing. The HCOB Eurozone Manufacturing PMI is compiled by S&P Global from responses to monthly questionnaires sent to survey panels of manufacturers in Germany, France, Italy, Spain, the Netherlands, Austria, Ireland and Greece, totalling around 3,000 private sector companies. The headline figure is the Purchasing Managers' Index (PMI), which is a weighted average of the following five indices: New Orders (30%), Output (25%), Employment (20%), Suppliers' Delivery Times (15%) and Stocks of Purchases (10%). For the PMI calculation the Suppliers' Delivery Times Index is inverted so that it moves in a comparable direction to the other indices. The index varies between 0 and 100, with a reading above 50 indicating an overall increase compared to the previous month, and below 50 an overall decrease. <https://tradingeconomics.com/euro-area/manufacturing-pmi>

<sup>44</sup> <https://tradingeconomics.com/euro-area/manufacturing-pmi>

<sup>45</sup> <https://tradingeconomics.com/euro-area/manufacturing-pmi>

<sup>46</sup> <https://direct.argusmedia.com/newsandanalysis/Article/2505298>

<sup>47</sup> <https://www.cleanenergywire.org/factsheets/geared-germany-enters-second-winter-without-russian-gas>

<sup>48</sup> Example of Yara in this article: <https://direct.argusmedia.com/newsandanalysis/article/2504433>

In conclusion, fundamentals indicate a fairly limited scope for industrial gas use to rebound in Q4 and probably for the rest of the winter, even if gas prices remain around €50/MWh.<sup>49</sup> For instance, in the chemical sector, which accounts for about 40 per cent of total gas demand in the industrial sector, the European Chemistry Industry Council (CEFIC) anticipates a decline of approximately 8 per cent in the EU27 chemical production year-on-year in 2023 as demand for chemicals continues to fall.<sup>50</sup>

Incidentally, the longer the recovery takes to materialize, the higher the risk of gas demand destruction (rather than simple price-driven reduction) in Europe. Indeed, as difficulties linked to high gas prices and uncertain supply continue, firms are likely to consider measures to shield themselves from further difficulties and make them more resilient to future shocks by investing in energy-efficiency measures, switching to alternative sources of energy such as renewables or even by relocating outside Europe.<sup>51</sup> Permanent closures of industries (and relocations) have, so far, not materialized significantly (with the exception of the BASF announcement in October 2022),<sup>52</sup> but some smaller firms have been forced into bankruptcy, which will contribute to demand destruction in Europe.

## 5. Biggest uncertainty this winter is residential and commercial demand

Gas used in residential and commercial (primarily for space heating) represents 35-40 per cent of annual gas demand in Europe and is typically the most important driver of annual fluctuations.<sup>53</sup> There can easily be a difference of +/- 20 to 25 bcm year-on-year between a mild and a cold winter, as illustrated over the past couple of years.

Before turning to 2023, it is useful to start with a quick overview of the circumstances in 2021 and 2022 to frame the challenges for this winter. Temperatures in 2021 were much colder than in 2022 as shown

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<sup>49</sup> See Annex 1

<sup>50</sup> <https://cefic.org/media-corner/newsroom/#:~:text=18%20July%202023%20%E2%80%93%20EU27%20chemical,consumer%20chemicals%20are%20more%20resilient>

<sup>51</sup> The general context for the industrial sector in Europe is not conducive of a strong gas demand recovery, for three main reasons.

First, although the length and the extent of the crisis will be a crucial factor, so is the general context in Europe as firms need to reduce their GHG emissions in line with the EU 2030 and 2050 environmental targets. Measures include efficiency measures (such as waste heat recovery, self-generation, and electrification), switching away from fossil fuels to low carbon sources such as renewables (when possible) and hydrogen (when low carbon hydrogen becomes available and at scale), or by relocating outside Europe. All these options will impact the level of gas demand in the industrial sector and may be taken sooner rather than later in view of continued gas uncertainties.

Second, and in addition to having to meet emissions reduction targets, another incentive for companies to invest in energy-efficiency measures or to switch to renewables will be to make them more resilient to future shocks, and therefore, lowering their gas consumption faster than previously envisaged. Industries that use gas as feedstock (non-energy use) may not be able to implement efficiencies to the same degree as other sectors, but the risks remain to see a decline in investments traditionally done to maintain production over the years. If this happens, production will decline faster than previously anticipated.

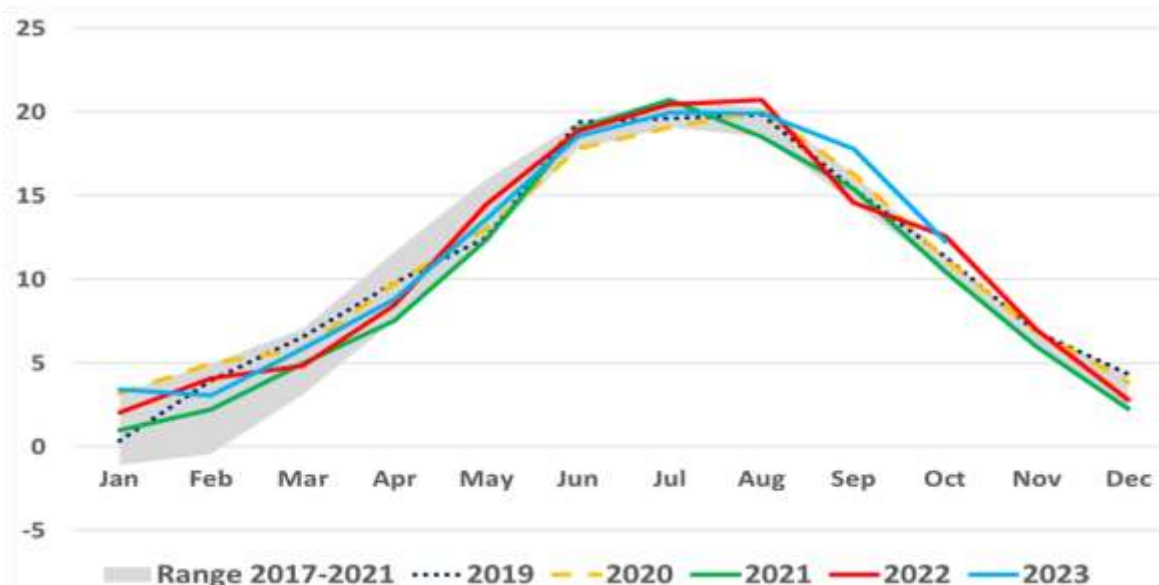
The third risk is to see this production stop in Europe and be relocated outside its borders where gas and energy prices are lower, security of supply perceived as better and/or where environmental regulation is lighter. The erosion of competitiveness was one of the main factors (along with industry regulation in the EU) given by BASF, one of world's largest chemical companies, when it announced in October 2022 that it would 'permanently' downsize in Europe, closing one of two ammonia plants and associated fertilizer facilities in Ludwigshafen in 2026 (<https://www.ft.com/content/f6d2fe70-16fb-4d81-a26a-3afb93e0bf57>). Another example came in Yara's July 2023 result statement, when Europe's largest ammonia producer warned that competitive supply from the US to Europe could lead to reduced lifespan or impairments of European ammonia and fertilizer production assets (Platts S&P Global, European Gas Daily, 20 July 2023). Despite all these uncertainties, permanent closures of industries (and relocations) have, so far, not materialized significantly, although some smaller firms have been forced into bankruptcy, which will also contribute to demand destruction in Europe.

<sup>52</sup> <https://www.ft.com/content/f6d2fe70-16fb-4d81-a26a-3afb93e0bf57>

<sup>53</sup> See Annex 6

in Figure 15.<sup>54</sup> The influence of warmer temperatures alone is likely to have contributed to about half of the gas demand reduction in the residential and commercial sector last year (the equivalent of about 30 per cent of the entire decline in gas demand in Europe in 2022, or just over 20 bcm). In other words, this drop in demand would have happened even without the gas crisis and the record-breaking prices.

**Figure 15: Average monthly temperatures in Europe in 2019-2023 (degrees Celsius)**



Note: Malta not included

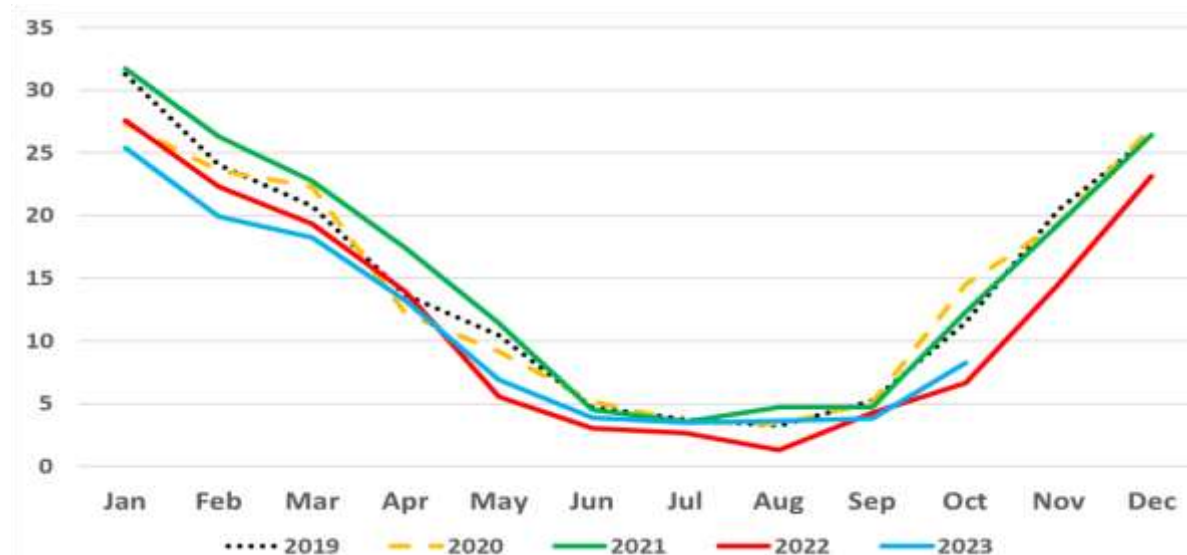
Source: Data from author's calculations, EU Copernicus programme. Graph by the author

In the first ten months of 2023, gas use by small consumers from the residential and commercial sector remained flat year-on-year, but with an important contraction in Q1 due to an unseasonably mild weather in January and March, which kept the need for gas in heating well below historical levels. Preliminary data indicate gas demand rose strongly in Q3, most likely driven by a recovery in the commercial and service sectors. Finally, colder temperatures in the second half of October<sup>55</sup> are likely to have triggered the start of the heating season in gas demand as illustrated in Figure 16.

<sup>54</sup> 2021 was a really cold year as the first four months and also the last one were much colder than the same periods in 2020, which contributed to a boost in demand for heating. On the contrary, the average temperatures in January, February, and April 2022 were warmer than the previous year, and March was relatively similar at a regional level, implying a lower need for heating in the residential and commercial sector. Warm temperatures in October and November then pushed the beginning of the heating season towards late November/early December.

<sup>55</sup> Average temperature in October 2023 is similar to October 2022, but daily temperatures indicate that in 2022 temperatures had a much flatter profile than in 2023, when the first half was relatively mild before temperatures dropped in the second half, probably boosting the use of heating. Source: Observation based on daily temperature data from Copernicus.

**Figure 16: Gas demand in the residential and commercial sector in Europe, 2019-2023 (bcm)**



Source: Data from author's calculations. Graph by the author

The impact of temperatures on gas demand for the rest of the winter will not be as straightforward to understand as it used to be. Last year, on top of the 'direct' impact of mild temperatures on gas use, the combination of warmer weather, rising affordability issues and communications campaigns<sup>56</sup> to incentivize energy savings facilitated an important demand response from small consumers. This was an interesting evolution in what is usually a rather inelastic sector in the short term.<sup>57 & 58</sup>

Demand response took various forms, including lower production and fuel switching in small businesses, gas-saving measures in public buildings and lower energy use in the residential sector. The latter is likely to have predominantly come from behavioural changes with customers turning their thermostat down or switching their heating off earlier in the season, but we should not discard some demand destruction with fuel-switching to renewables, the deployment of heat pumps<sup>59</sup> and efficiency gains via building renovation and improved insulation.

<sup>56</sup> Incentivizing customers to turn down their heating, especially during the coldest days, while at the same time providing financial support to shield them, at least partially, from soaring prices was a tricky balancing act in 2022.

<sup>57</sup> Despite high gas prices in the second half of 2021, there was no strong evidence that gas demand was not in line with levels to be expected at various temperature levels, although there seem to have been signs of some initial demand response in December as seen in Figure 17. For some details, see Honoré, A. (2022). 'Demand response to high gas prices in Europe in 2021 and early 2022'. <https://www.oxfordenergy.org/publications/demand-response-to-high-gas-prices-in-europe-in-2021-and-early-2022/>

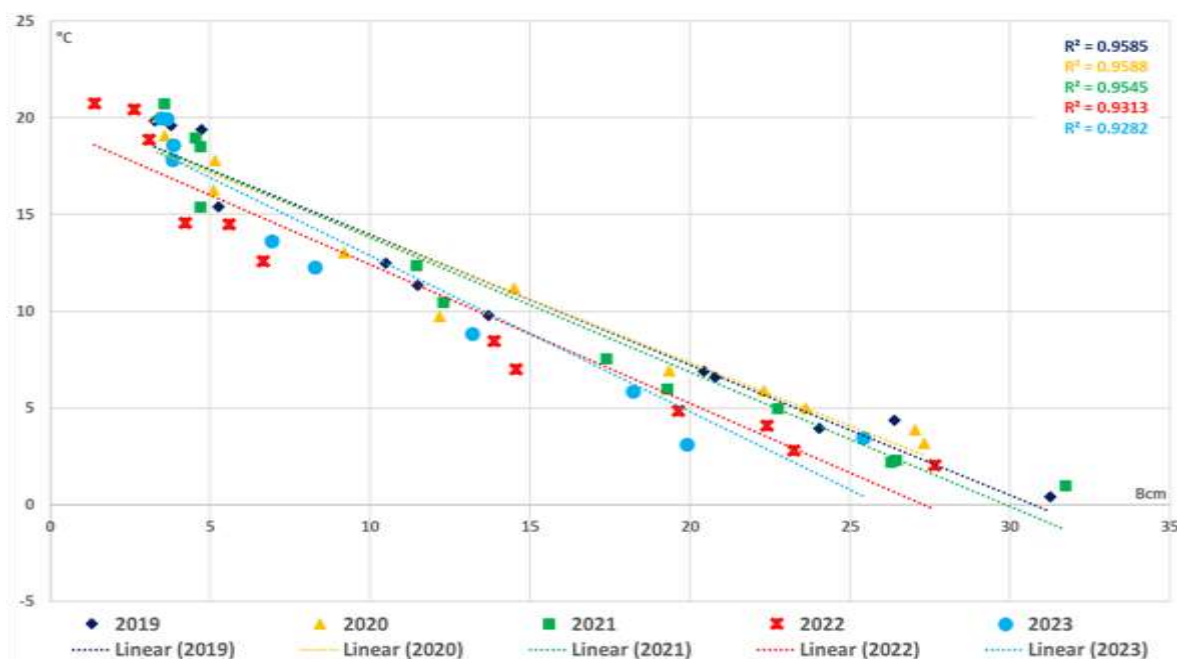
<sup>58</sup> Space heating in buildings covers energy use in the residential sector (the largest segment), the commercial sector and the industrial sector. This demand is very responsive to fluctuations in temperatures, but short-term price elasticity is relatively non-existent or, at best, fairly limited due to a combination of factors. First, consumers do not have easy access to alternative options for heating. Second, in addition to these physical limitations, the degree to which end-use consumers would be affected by higher gas prices also depends on the type of contracts they have with their suppliers: contracts based on fixed tariffs would not reflect fluctuations of wholesale prices quickly. It is also possible that even for contracts with variable rates, gas suppliers had not adapted their rates to reflect higher procurement costs by December 2021 (therefore not impacting the level of gas demand in the last months of 2021), though they probably had done so by the first months of 2022. Finally, the share of the energy bill relative to the customers' income would also play a role in this, nonetheless, rather inelastic price demand and this varies considerably across Europe.

<sup>59</sup> According to the European Heat Pump Association, the European heat pump market broke a new record in 2022 with around 3 million units sold in 21 markets, which represents a growth of 39 per cent, even more than the previous year's unprecedented rise of 34 per cent in annual sales. <https://www.ehpa.org/market-data/>

This non-weather-related demand response drove gas demand down in the sector by an estimated 10 per cent in 2022 (Figure 17), although this was not a linear decline: the colder the temperature, the smaller the difference in gas demand compared to historical levels.

All in all, changes in consumer behaviour helped reduce gas use in the residential and commercial sector probably by about 10-15 bcm in 2022 (equivalent to more or less 30 per cent of the total reduction in this sector).<sup>60</sup> A major source of uncertainty for this winter concerns consumers' willingness (or ability) to continue adapting their behaviour and carry on energy saving measures, especially in a context of lower energy bills.<sup>61</sup> Prices are expected to be lower this winter even for small consumers, but by how much is not always clear. The sharp fall in wholesale gas prices at the beginning of 2023 was not necessarily reflected (rapidly) in prices paid by household consumers as illustrated by Figure 18 (unfortunately the data was only available up to H1 2023).

**Figure 17: Monthly gas demand in residential and commercial vs temperature variations in Europe in 2019 – 2023 (bcm and degrees Celsius)**



Source: Author's calculations. Gas demand data from author's estimates and temperature data from EU Copernicus programme. Graph by the author

The roll-out of heat pumps in Europe will contribute to reducing gas demand in the future, but the impact on gas use for heating this winter compared to last winter is expected to be marginal, probably about 2-3 bcm, if heat pumps have replaced gas boilers (instead of installations in new buildings, which would not reduce the amount gas consumed for heating). Therefore, despite the impressive growth in 2022, so far, the effect is expected to be much less than that of weather and prices.

<sup>60</sup> The REPowerEU document published on 8 March 2022 by the European Commission mentioned that turning 'down the thermostat for buildings' heating by 1°C [would save] 10bcm' (p.6). [https://eur-lex.europa.eu/resource.html?uri=cellar:71767319-9f0a-11ec-83e1-01aa75ed71a1.0001.02/DOC\\_1&format=PDF](https://eur-lex.europa.eu/resource.html?uri=cellar:71767319-9f0a-11ec-83e1-01aa75ed71a1.0001.02/DOC_1&format=PDF)

The IEA also mentioned the measure in its 10-point plan to reduce the European Union's reliance on Russia natural (9<sup>th</sup> point): gas. <https://iea.blob.core.windows.net/assets/2db624be-ccda-4bc7-80a8-9bd3787efcd9/10PointPlanToReduceTheEuropeanUnionsRelianceOnRussiaNaturalGasInfographic.pdf>

Individual countries are also counting on customers' participation, for instance in the Netherlands. <https://www.rferl.org/a/dutch-reduce-russian-gas-campaign/31782700.html>

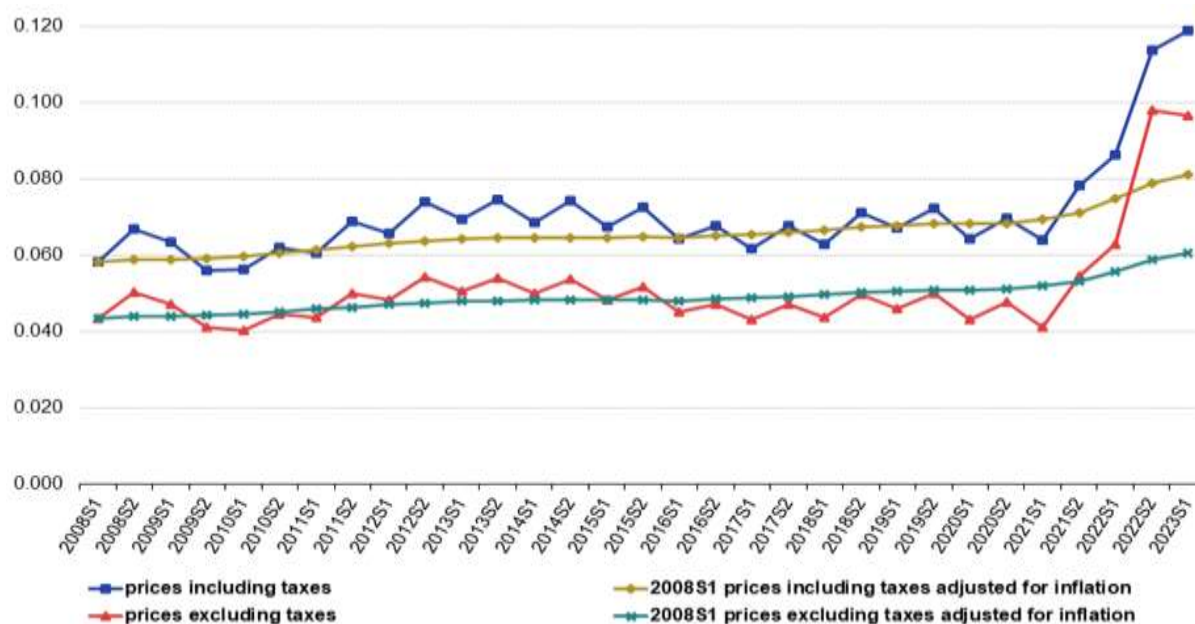
<sup>61</sup> An example in Germany: <https://www.verivox.de/presse/start-in-die-heizsaison-2023-gaspreise-fast-halbiert-heizoelkosten-ein-viertel-niedriger-1120441/>



Cold weather would boost Europe’s space heating demand this winter, even assuming consumer demand restraint continues, although the correlation between weather and gas consumption will not return to pre-crisis levels. At the time of writing, the latest expectations by Copernicus regarding winter 2023/24 were warmer than average temperatures over most of Europe, and above-average precipitations were also favoured in many parts of the region.<sup>62</sup> However, the site also mentions that ‘uncertainty in the forecast for winter in Europe is large, with the level of agreement between individual-model forecasts being low.’ These predictions are therefore linked to high uncertainties and Europe should still get ready for episodes of cold temperatures this winter, just in case.

Because gas is the largest single source of energy used for heating in the residential sector in Europe (37 per cent in 2021,<sup>63</sup> not counting electricity used for space heating that is generated from gas<sup>64</sup>) continued participation of small consumers in demand saving measures is going to be essential for this winter to keep gas consumption under control, and especially to limit a sudden surge in gas demand during the coldest days.

**Figure 18: Natural gas prices for household consumers in EU27 (Euro per KWh, 2008- H1 2023)**



Note: Household consumers in the EU are defined as medium-sized consumers with an annual consumption between 20 Gigajoules (GJ) and 200 GJ

Source: Eurostat<sup>65</sup>

<sup>62</sup> ‘Uncertainty in the forecast for winter in Europe is large, with the level of agreement between individual-model forecasts being low.’ 10 October 2023, <https://climate.copernicus.eu/seasonal-forecasts>

<sup>63</sup> This regional picture on the role of gas in residential heating hides wide disparities around Europe: from over 60 per cent in the Netherlands and the UK to less than 5 per cent in Estonia and Bulgaria. Data from Eurostat for 2021 (except for the UK: data for 2020).

<sup>64</sup> Around a quarter of energy used for heating in the residential sector in Europe comes from electricity, and in turn, gas covers about 20 per cent of Europe’s electricity needs.

<sup>65</sup> [https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:F2Development\\_of\\_natural\\_gas\\_prices\\_for\\_household\\_consumers.png](https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:F2Development_of_natural_gas_prices_for_household_consumers.png)

## 6. Conclusions and outlook for winter 2023/2024

Gas demand in Europe fell by 13 per cent in 2022 on the back of warm temperatures, demand response to record-high prices and additional energy savings due to consumer behavioural change. This trend has largely continued in 2023, with gas consumption down by almost 10 per cent year-on-year in the first ten months (-32 bcm). Gas demand remained well below pre-crisis levels, raising questions as to whether some demand losses may have been permanent. However, a closer analysis highlights remarkable differences between the beginning and the end of the year, as well as on the factors driving gas consumption this year.

The extent of the decline narrowed from 12 per cent year-on-year in Q1, to 9 per cent in Q2 and 8 per cent in Q3. Preliminary data for October 2023 indicate an even more limited decline of about 1 per cent only. A sectoral analysis highlights some of the key factors behind these changes.

Over half of the demand reduction so far this year occurred in Q1 on the back of unseasonably mild weather across most of Europe in January and then in March, limited industrial recovery and muted electricity demand combined with higher availability of renewables (hydro, wind and solar). This represented a loss of over 18 bcm year-on-year.

After March, when space heating demand generally reduces quickly and heads close to zero, Q2 and Q3 continued the falling trend, but this time primarily driven by non-weather-related factors. The use of gas in the power sector continued to fall throughout the year following the progressive return of the French nuclear fleet and strong renewable availability. The most interesting evolution happened in the industrial sector, with gas demand well below 2022 levels at the beginning of the year (-15 per cent in Q1). Gas use progressively climbed back to 2022 levels in Q3, and preliminary data for October 2023 shows a 14 per cent growth year-on-year. The residential and commercial sector also started to recover from Q2, most likely due to growing gas demand from small businesses.

It is probably too soon to speak of a recovery as the fundamentals point toward limited growth for the coming months unless the winter turns to be a very cold one in Europe.

In the power sector, total electricity demand is not expected to increase dramatically this winter, aside from its usual seasonal fluctuations as energy efficiency improvements and an economic slowdown should continue to curtail demand. The outlook for nuclear availability this winter is positive, with French production so far in line with EDF's target, eroding concerns of a repeat of last winter's low nuclear availability in France. Hydro stocks are up compared to last year in most of Europe, allowing more flexibility to raise hydropower generation this winter and reducing the need for gas (and coal) plants. The continued deployment of renewables will also have increased the availability of wind and solar. Lastly, even if coal-fired plants have started to regain competitiveness against gas-fired plants from mid-October 2023, the relatively limited need for coal and/or gas in the mix this year means that any competition between coal and gas plants in the merit order this winter will probably only have a marginal impact on gas burn in the power sector. In conclusion, the fundamentals suggest an overall weaker gas demand from the power sector this winter compared to last year, although days with low wind availability will undoubtedly mark a short-term spike in gas use.

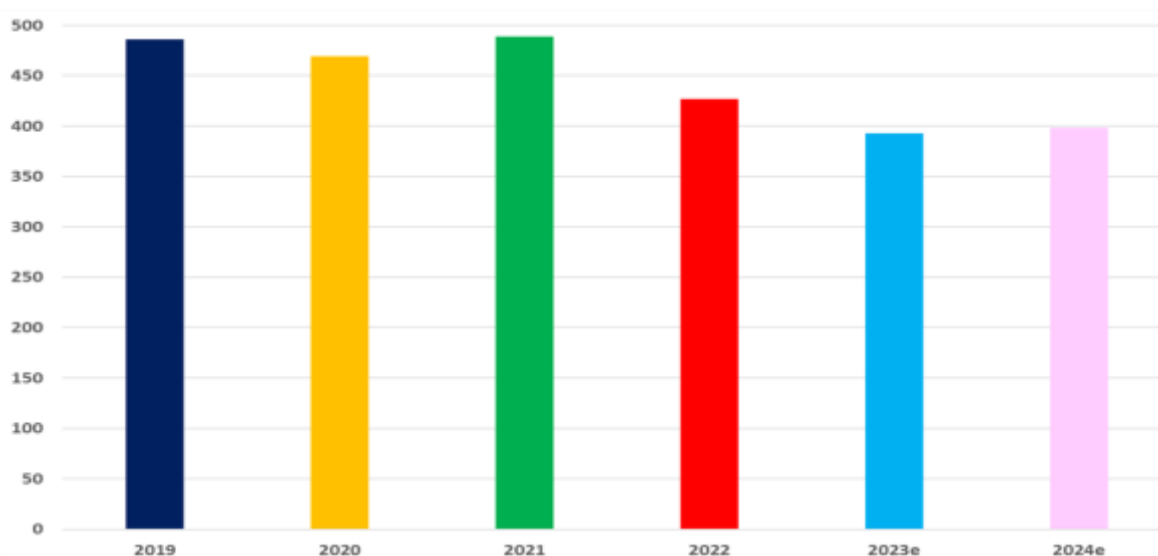
In the industrial sector, expectations of a rapid rebound in gas consumption in 2023 following a sharp drop in gas prices year-on-year have not clearly materialised. Without underestimating any probable demand destruction, it is likely that roughly 75 per cent of the 2022 decline has been from demand reduction measures, but the impact of lower gas prices has been counter balanced by several factors that have often prevented firms from quickly switching back to gas and/or re-starting idle production capacity. Overall gas use by industry was still down by -6.5 per cent year-on-year from January to October, but it has also been trending higher from Q3. After a consecutive 20-month year-on-year decline, preliminary data indicate a timid recovery - at least on a yearly basis - from August 2023; and the whole third quarter was just about 1 per cent above 2022 levels. Gas demand continued to increase in the petroleum sector while other sectors also started to recover, even if the picture was not uniform across Europe. Initial data for October show an even stronger growth, with industrial gas demand about

14 per cent higher year-on-year. It seems to have been driven primarily by the petroleum sector but also by other sectors such as chemicals, food and metal. This time of year is traditionally marked by higher fertilizer demand in Europe when stocks are being rebuilt for autumn application, which may partly explain the October result. Despite this development, it is probably too soon to expect a strong rebound considering the general worsening of the economic situation in Europe, as shown in recent Winter Economic Outlooks and the Euro Area Manufacturing PMI. Weak economic growth momentum is even anticipated to extend into 2024. In other words, the demand for end-products (chemicals, steel, glass and nonferrous metals) rather than gas prices may well become the most important driver over the next six to nine months and place a cap on any industrial demand recovery.

In the residential and commercial sector, a cold winter would boost Europe's space heating demand in the coming months, even assuming consumer demand restraint continues to some degree. Because gas is the largest single source of energy used for heating in the residential sector in Europe, continued participation of small consumers in demand saving measures is going to be essential to keep gas demand under control, and especially to limit a sudden surge in gas use during the coldest days. However, after warm temperatures in 2022 and at the beginning of 2023, consumers' willingness to continue reducing their energy use may erode if (or when) cold temperatures finally hit Europe, especially in the context of lower gas prices. Because of its size and relative unpredictability, this sector presents the largest uncertainty for the level of gas demand this winter. The correlation between weather and gas consumption will not return to pre-crisis levels, but rough estimates show that up to 20-30 bcm of demand could be added if winter 2023/24 is much colder than winter 2022/23.

A key lesson from the past two years is that the *short-term* demand response to changes in gas prices is *not* straightforward. But considering all factors that impact gas use in Europe, gas demand is expected to decline by about -8% in 2023, driven by the power sector and taking into account the possibility of a few days of colder weather in November and/or December which may trigger higher demand for heating. In 2024, there are many moving pieces to the puzzle, but continued lower use of gas in power generation is expected to be counterbalanced by higher gas use in the other sectors and could drive gas demand marginally up over the year (Figure 19).

**Figure 19: Annual gas demand in Europe, 2019-2024 (bcm)**



Source: Data from author's calculations. Graph by the author

A word on the EU and the 15 per cent demand reduction target. In July 2022, the EU published the Save Gas for Safe Winter proposal,<sup>66</sup> which included a European Gas Demand Reduction Plan to reduce gas use in Europe by 15 per cent between 1 August 2022 and 31 March 2023 compared to the five-year average (equivalent to 45 bcm). The region reached and exceeded this target, with overall EU27 gas demand down by 18 per cent (equivalent to 54 bcm) compared to the previous five years.

The new regulation for this winter sets a voluntary target for member states to reduce their natural gas consumption by 15 per cent between 1 April 2023 and 31 March 2024, compared to the average consumption in the period between 1 April 2017 and 31 March 2022.<sup>67</sup> The average gas demand over this five-year period was about 400 bcm. A reduction of 15 per cent sets the target at 341 bcm for the period April 2023 to March 2024. The EU has used about 144 bcm between April 2023 and October 2023, leaving 197 bcm for this winter (November 2023 to March 2024). The average gas consumption over the winter in 2017-2022 was 225 bcm, well above the expected consumption for this winter. A positive note is that the EU consumed only 185 bcm of gas last winter, signalling that it is possible to reach this new target. However, as explained in this Insight, Europe was lucky last winter with warm temperatures and consumer participation in energy saving. The new target allows for about 12 bcm more this winter compared to last winter, which looks do-able even if the winter is mildly colder (ie not a beast from the east episode as in 2021), as long as consumers continue to change behaviour and commit to saving energy.

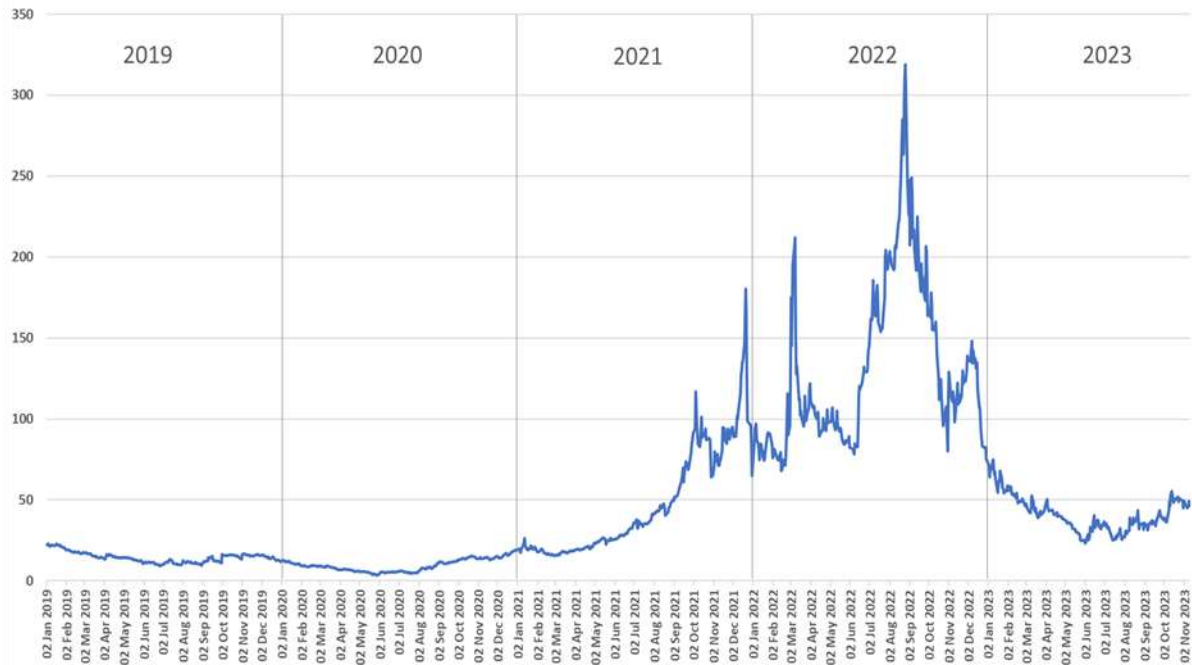
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<sup>66</sup> [https://ec.europa.eu/commission/presscorner/detail/en/ip\\_22\\_4608](https://ec.europa.eu/commission/presscorner/detail/en/ip_22_4608)

<sup>67</sup> <https://www.consilium.europa.eu/en/press/press-releases/2023/03/30/council-formally-adopts-15-gas-demand-reduction-target/>



## Annex 1: TTF front month gas prices from 01 January 2019 to 10 November 2023 (midpoint, Euro/MWh)



Source: Data from Argus. Graph by the author

Gas prices have been on a rollercoaster since mid-2021 in Europe and the regional gas market is expected to remain tight this winter. Price fluctuations have been analysed in great detail by the OIES and more in-depth information is available in various OIES papers and in our regular OIES Quarterly Gas Review series.<sup>68</sup>

<sup>68</sup> OIES Gas Programme publications. <https://www.oxfordenergy.org/publication-category/gas-programme/>  
OIES Quarterly Gas Review. <https://www.oxfordenergy.org/publicationtopic/quarterly-gas-review/>

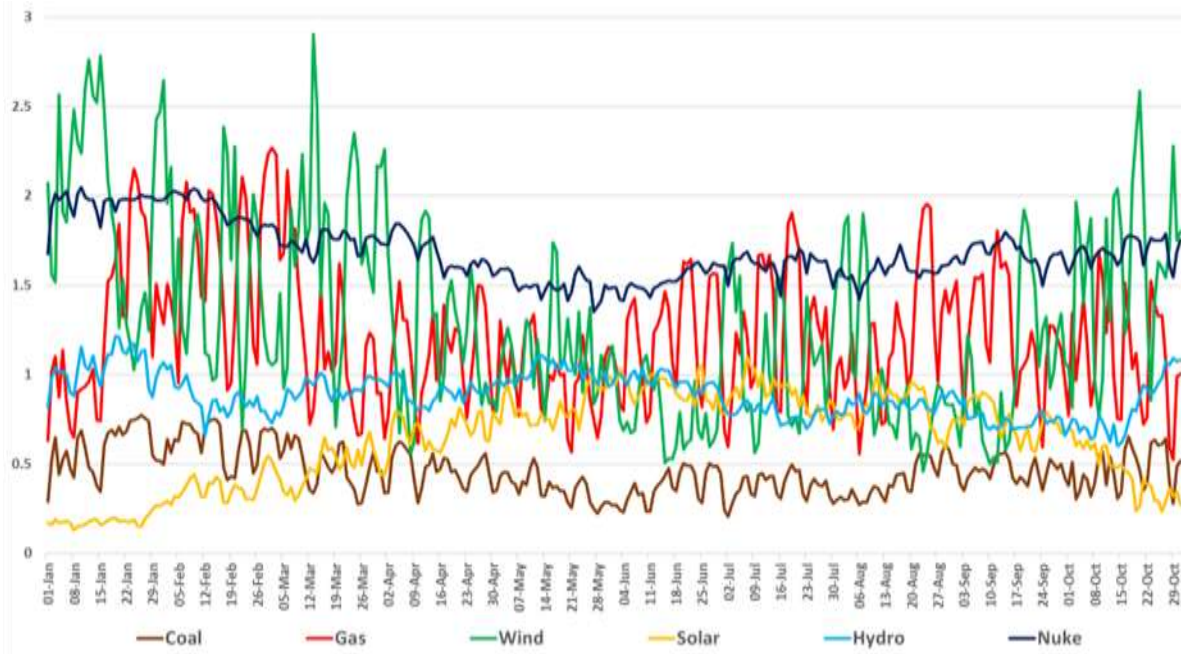
## Annex 2: Evolution of gas demand in European countries in 2022 and in the first three quarters of 2023 (per cent)

	2022 vs 2021	Jan-Sep 23 vs 22	Q1 23 vs Q1 22	Q2 23 vs Q2 22	Q3 23 vs Q3 22
Austria	-13	-24	-23	-11	-46
Belgium	-14	-7	-5	-4	-13
Bulgaria	-20	-14	-26	-13	13
Croatia	-14	-2	-17	9	21
Czechia	-17	-15	-19	-8	-12
Denmark	-20	-5	-10	-8	10
Estonia	-26	-24	-29	-22	-6
<b>Europe</b>	<b>-13</b>	<b>-10</b>	<b>-12</b>	<b>-9</b>	<b>-8</b>
Finland	-47	8	-17	13	48
France	-10	-13	-10	-13	-20
Germany	-15	-6	-9	-2	-5
Greece	-20	-15	-34	-3	-2
Hungary	-15	-16	-23	-6	-4
Ireland	1	-9	0	-7	-19
Italy	-10	-14	-19	-12	-5
Latvia	-30	-6	-6	-16	8
Lithuania	-29	-16	-31	-24	34
Luxembourg	-22	-12	-16	-7	-5
Malta	2	10	17	16	1
Netherlands	-22	-6	-12	-8	9
Poland	-17	0	-3	-5	12
Portugal	-5	-19	-18	-22	-16
Romania	-16	-11	-12	-12	-8
Slovakia	-19	-10	-14	-1	-8
Slovenia	-12	-7	-14	3	-4
Spain	-4	-12	-16	-9	-12
Sweden	-43	2	-5	9	9
United Kingdom	-7	-12	-6	-14	-19

Source: Data from Eurostat, THE, NGT and author's assumptions. Table by the author

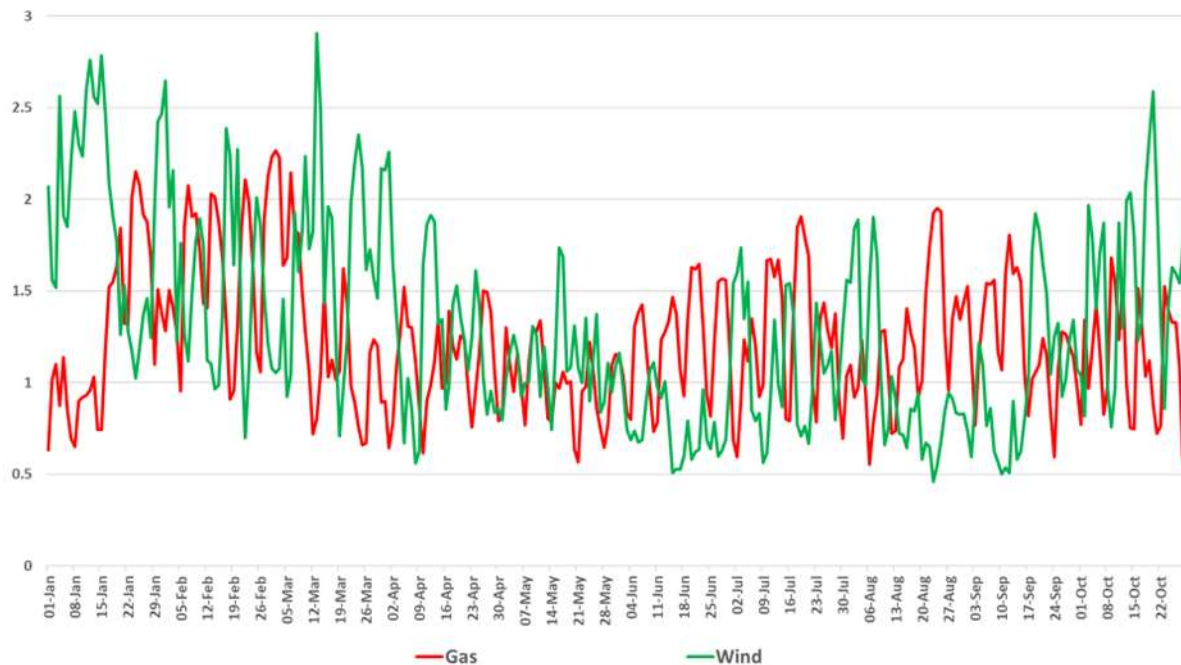


### Annex 3: Daily electricity generation by fuel source in Europe, January to October 2023 (TWh/day)



Source: Data from author's calculations, Entsoe and Gridwatch. Graph by the author

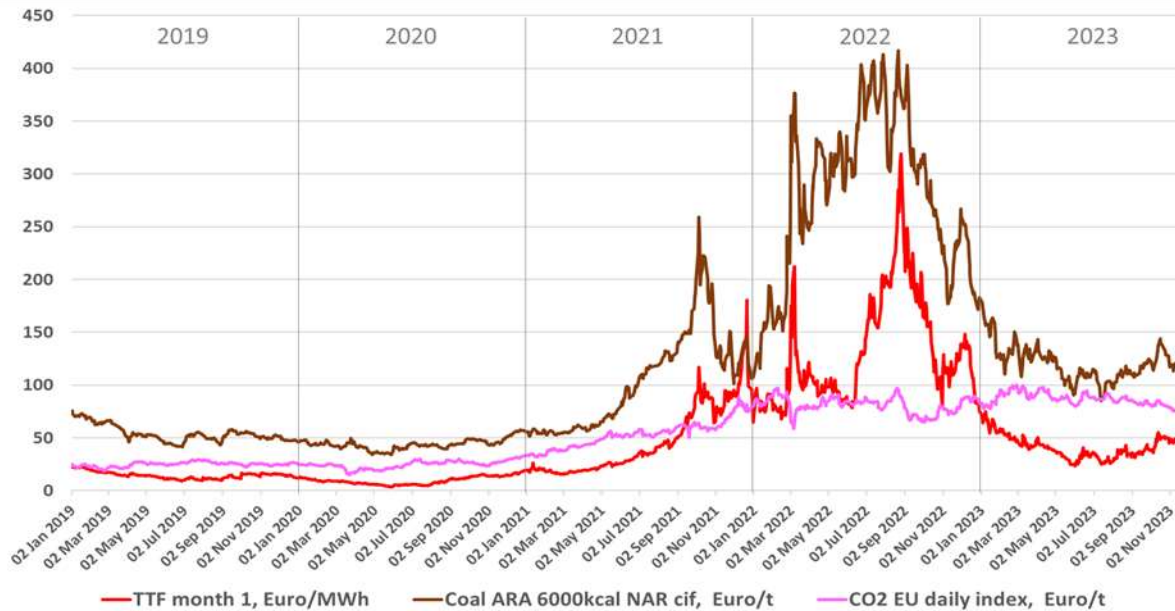
Extracting the wind and gas generation only:



Source: Data from author's calculations, Entsoe and Gridwatch. Graph by the author

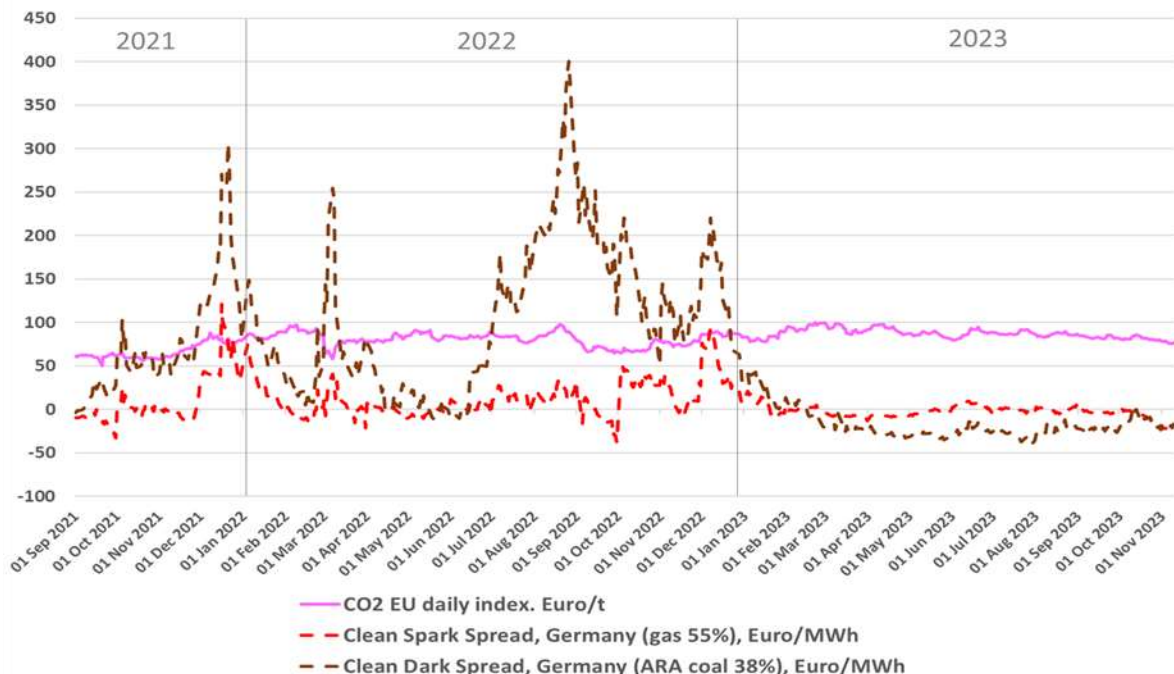
## Annex 4: Prices for gas, coal, ETS allowances, clean and dark spreads

Prices for gas, coal and EU ETS allowances from January 2019 to November 2023:



Source: Data from Argus. Graph by the author

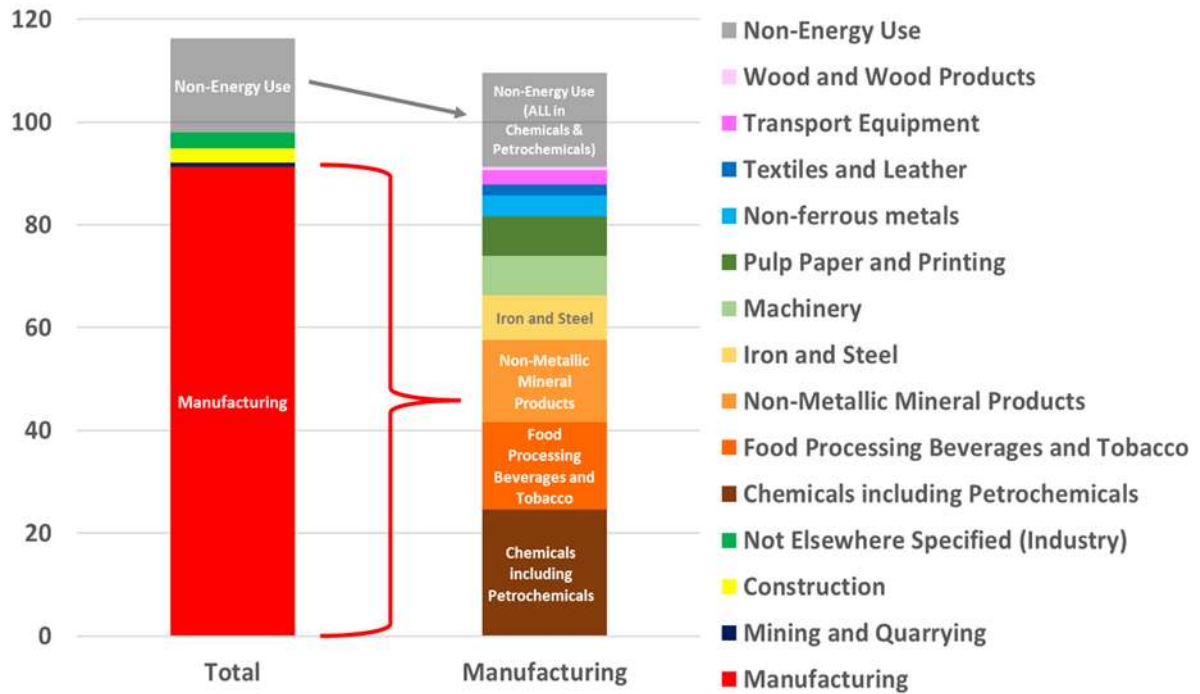
Prices for EU ETS allowances, plus clean spark and dark spreads in Germany from September 2021 to November 2023:



Source: Data from Argus. Graph by the author

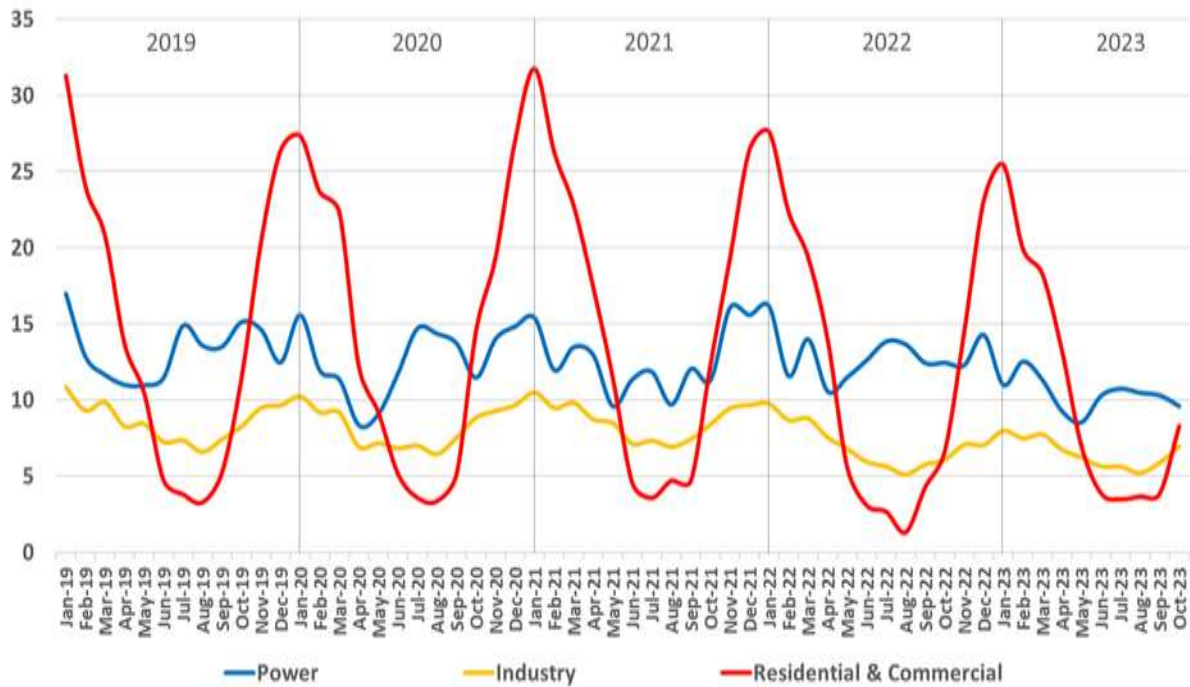


## Annex 5: Gas demand in Europe in the main industrial sub-sectors, 2020 (bcm)



Source: Data from the IEA, Annual report gas information. Graph by the author

## Annex 6: Monthly gas demand in the 3 main sectors in the EU27 + UK from January 2019 to October 2023, bcm



Source: Data from author's calculations. Graph by the author