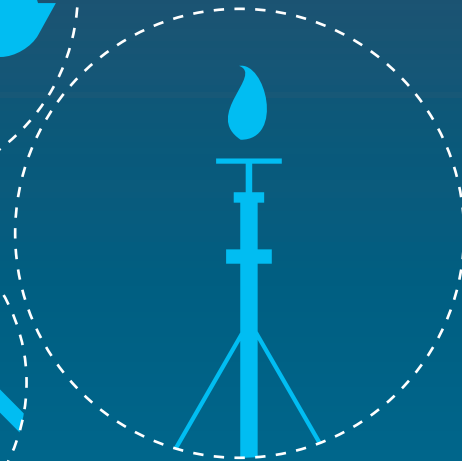
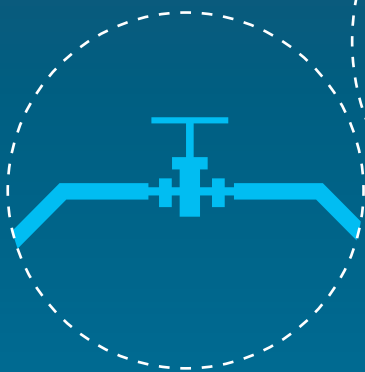




European  
Commission

# Quarterly report

## On European gas markets



Market Observatory for Energy  
DG Energy

Volume 16

(issue 3, covering third quarter of 2023)

Energy

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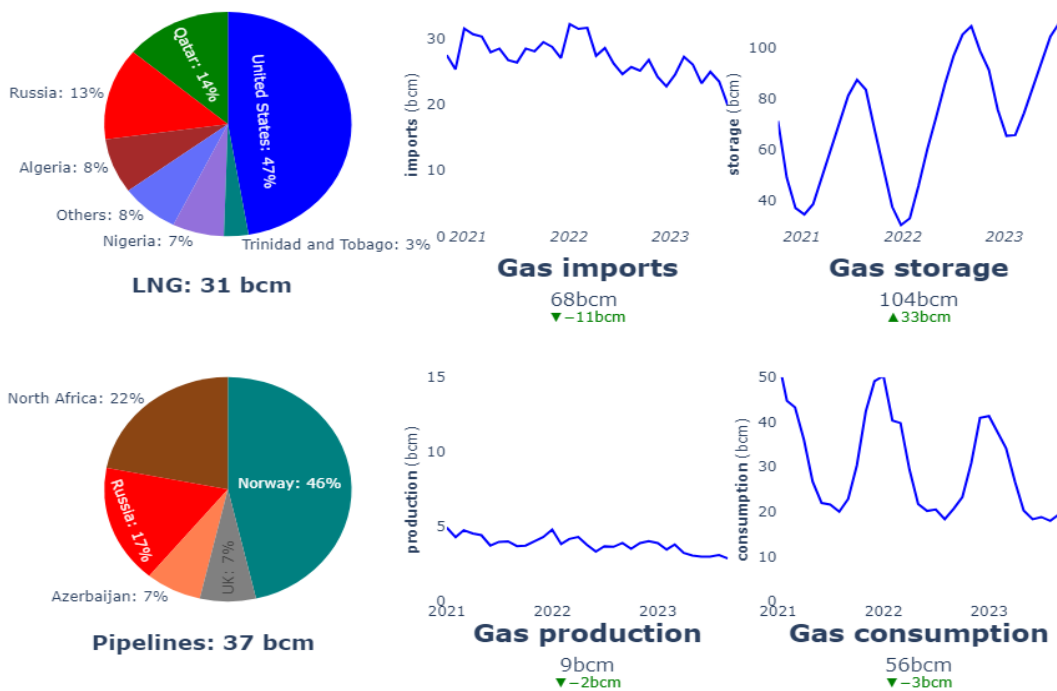
Directorate-General for Energy, Unit A.4, Chief Economist - Market Observatory for Energy, 2023

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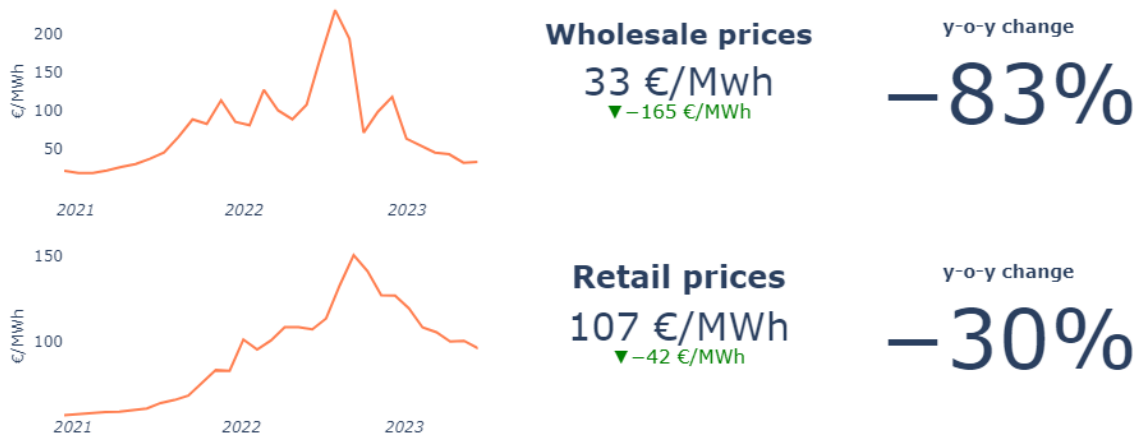
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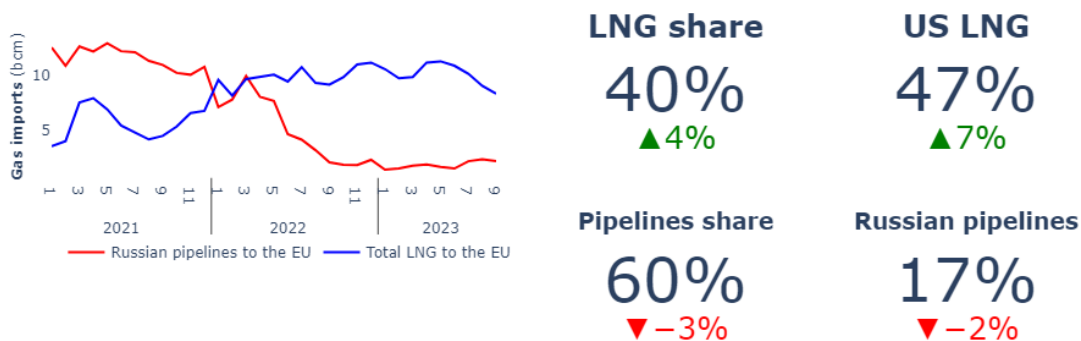
**KEY INSIGHTS:** Q3 2023 Gas Trends and Comparative Analysis with Q3 2022.



**PRICES:** Evaluating prices in Q3 2023 in comparison to Q3 2022



**Focus of the Quarter:** Imports of Russian Pipelines and of US LNG



## HIGHLIGHTS OF THE REPORT

### EU gas consumption, production and storage in Q3 2023

- **EU gas consumption continued to decline** and remained **below the consumption range of the last seven years** (2017-2023) in the third quarter of 2023. Total gas consumption was 56 bcm, a **decrease of 14% quarter-on-quarter** (-9 bcm) and **7% year-on-year** (-4 bcm). In addition to the usual seasonal decline in summer, structural changes and EU obligations to save gas have played a role in this decline.
- **EU domestic gas production continued its declining trend.** Total production was 9 bcm, **5% down from the previous quarter** (-0.5 bcm), and **18% less than in the same quarter of the previous year** (-2 bcm). The largest producer remained The Netherlands with a 2.5 bcm production.
- **EU gas storage levels have reached a record level of 96%** (1089 TWh, 111 bcm<sup>1</sup>) **at the end of September**, following filling rates of 93% (1055 TWh, 108 bcm) at the end of August and 86% (972 TWh, 99 bcm) at the end of July. The **average filling rate for the quarter was 88%** (1003 TWh, 103 bcm), 35% higher than in the previous quarter (65%, 741 TWh, 7 bcm) and 17% higher than in the same period of the previous year (75%, 855 TWh, 87.5 bcm). **Storage filling rates** at the end of the quarter **were over 90% in all Member States**, and **at record high levels compared to the previous years.**

### EU gas imports in Q3 2023

- **EU gas imports decreased by 13% quarter-on-quarter** and **by 17 % year-on-year.** Total gas imports amounted to 68 bcm, compared to 78 bcm in the second quarter of 2023 and 82 bcm in the third quarter of 2022.
- **EU pipeline imports decreased by 6%** (-2.5 bcm) **quarter-on-quarter** and **by 19%** (-9.4 bcm) **year-on-year** resulting from reduced pipeline flows from Norway amidst continued maintenance works on several production sites and less supply from the UK. **Pipeline imports from Russia slightly increased** (+1.6 bcm) **compared to the previous quarter but decreased compared to the previous year** (-2.6 bcm) while imports from Azerbaijan and North Africa remained stable compared to the previous quarter and year.
- **Total EU LNG imports decreased by 17%** to 27.5 bcm compared to the previous quarter and **by 6% year-on-year.** The **United States remained the EU's biggest LNG supplier** and **further increased its share to 47% (13 bcm)** from 45% in the previous quarter, followed by Qatar (14%, 3.8 bcm) and Russia (13%, 3.6 bcm).
- The **EU's biggest LNG importer remained France** (6 bcm, 21%), followed by Spain (5 bcm, 18%), and The Netherlands (4.9 bcm, 18%).
- **The EU remained the largest LNG importer in the world with 24% share in global LNG imports**, ahead of China (18%) and Japan (17%).
- **Russian gas represented 16%** (11 bcm) of **EU's total gas imports**, a small increase of 1.4% (+0,1 bcm) compared to the previous quarter and a decrease of 18% (-2.4 bcm) year-on-year. **Compared to the pre-crisis year of 2021**, total **Russian gas imports has been reduced by 70%** (25 bcm) in the quarter. Within the total Russian imports, the pipeline gas' share increased by 23% (+1.6 bcm) and that of LNG decreased by 29% (-1.5 bcm).

### EU wholesale gas prices and trade in organised markets in Q3 2023

- European wholesale gas prices displayed **high volatility** with several peaks and troughs throughout the third quarter confirming a trend that started already in June of the previous quarter. The **downward trend of prices** stopped in mid-June and then **prices in the third quarter fluctuated between 30 €/MWh and 40 €/MWh.** July's spot average price was 29 €/MWh. In August this has risen to 33 €/MWh and in September to 37 €/MWh. The quarterly **average spot price was 33 €/MWh, 5% lower than in the previous quarter** (35 €/MWh), and **83% lower than** in Q3 2022.
- In the third quarter of 2023, **European gas prices were on average 7% lower than Asian prices**, while Asia was 24% cheaper in the previous quarter and 51% cheaper a year earlier. In a year-on-year comparison, prices declined in all major global benchmarks by between 83% and 67% the biggest drop being registered in Europe and the smallest in the US.

### EU retail gas prices in Q3 2023

- **Average monthly gas retail price for household consumers continued to decline in the third quarter of 2023** although at slower pace than in the previous quarter. **The quarterly average retail gas price was 107 €/MWh, 6% lower than in the previous quarter and 30% lower year-on-year.** **Compared to the pre-crisis year** (2021 Q3), retail prices were **43% higher** and 61% higher compared to historic prices (2021's first half).

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<sup>1</sup> Values are rounded to the nearest decimal for the sake of easier reading unless two decimals are essential to reflect differences in the data.

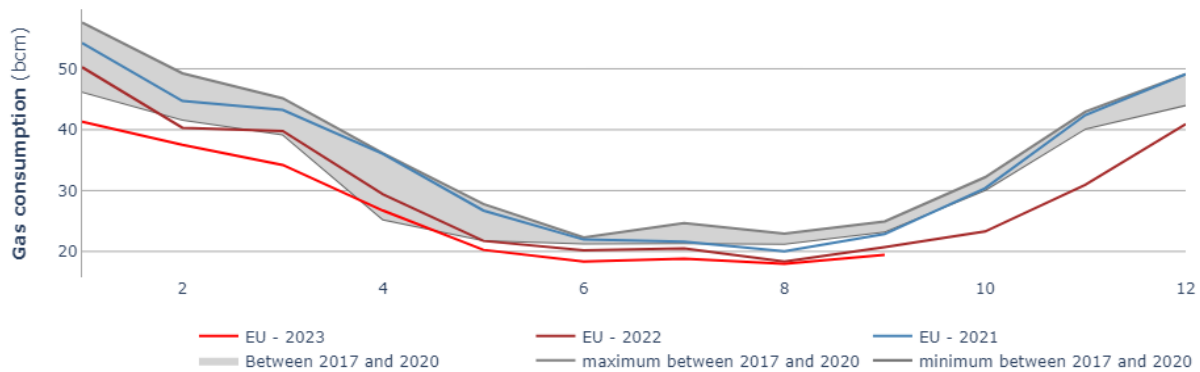
*Methodological Note: The rapid changes in gas and electricity markets happening through the energy transition as well as the significant restructuring of the EU's energy supply following the energy crisis, call for reviewing the Quarterly Reports of the European Electricity and Gas Markets so as to make them best fit for purpose. The aim is to ensure a timelier publication, modernise presentation, increase data transparency and an easier access to the data used to produce the reports. All this should increase usability for readers. The process of the review is planned to be carried out gradually attending the feedback we receive on it. As the Commission advances with its review, the quarterly reports will progressively reflect the methodological, technical, and editing changes as well as the comments received from stakeholders.*

# 1. Gas market fundamentals

## 1.1 Consumption

- EU gas consumption<sup>2</sup> in the third quarter of 2023 continued its declining trend and was below the consumption range of the previous seven years of 2017-2023. Gas consumption fell 6.7% year-on-year (compared to 60 bcm in Q3 2022) and 14% quarter-on-quarter (compared to 65 bcm in Q2 2023). The EU consumed a total of 56 bcm gas in the third quarter of 2023, 9 bcm less than in the previous quarter and 4 bcm less than a year earlier in the third quarter of 2022.

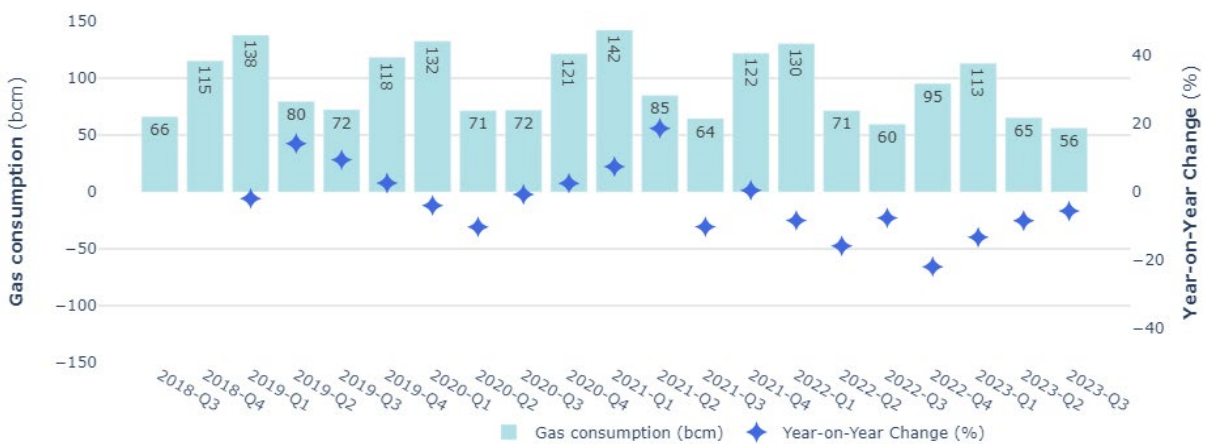
**Figure 1- EU gas consumption**



Source: Eurostat.

- Figure 2 shows the EU’s gas consumption and the year-on-year change in each quarter. Gas consumption declined in seventh consecutive quarters year-on-year and indeed through the last ten years (in the period of 2014-2023).
- Figure 3 highlights the quarter-on-quarter variations in the EU’s gas consumption. In the third quarter of 2023, the EU consumed 14% (-9 bcm) less natural gas than in the second quarter of 2023 reflecting the lack of heating demand during the hottest months of the year. Consumption also declined by 6.6% (-4 bcm) year-on-year indicating structural demand reduction and the effects of the EU’s gas saving obligation..

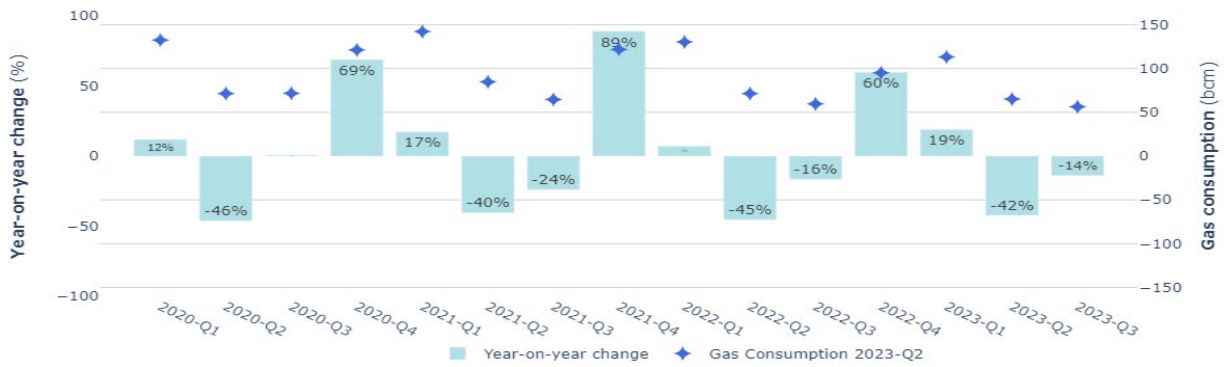
**Figure 2 – Gas consumption and year-on-year change per quarter in the EU**



Source: Eurostat.

**Figure 3: Quarter-on-quarter change in EU27 gas consumption in each quarter**

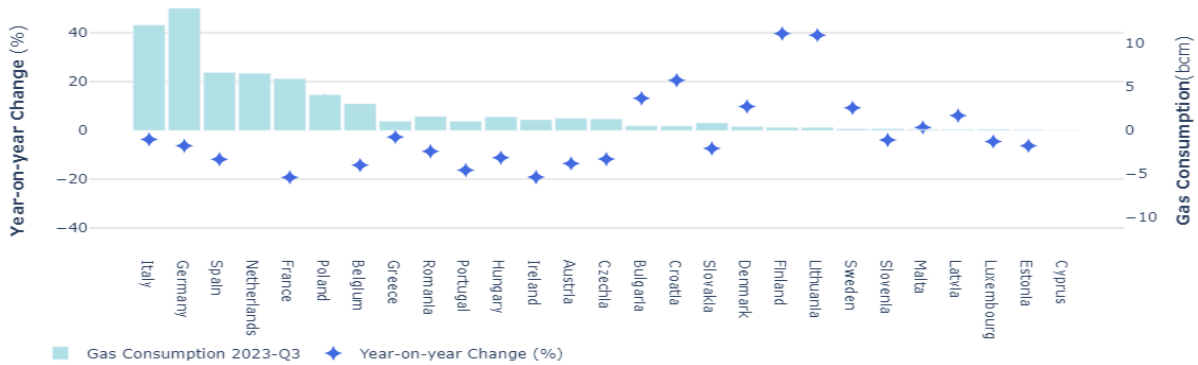
<sup>2</sup> EU aggregates, unless otherwise indicated, refer to EU-27, and in order to ensure comparability over time, values of earlier periods and year-on-year comparison indices also refer to EU aggregates without the United Kingdom. Therefore, in comparison to earlier editions, total EU aggregate numbers might differ in the current report.



Source: Eurostat.

- In a year-on-year comparison, gas consumption decreased in 16 Member State and increased in 10 Member States<sup>3</sup>. The largest decreases were recorded in France (-24%) and Ireland (-19%), followed by Portugal (-16%) and Austria (-14%). Belgium (-14%), Spain (-14%), Czechia (-14%) and Hungary (-12%), have shown double digit decrease compared to the same quarter in 2022. On the other hand, the largest increases were recorded in Finland (+40%) Lithuania (+39%) and Croatia (+39%), followed by also double digit growth in Denmark (+17%), Bulgaria (+13%) and Poland (+12%). Single digit consumption increases were observed in the Netherland (+9%), Sweden (+9%), Latvia (+7%) and Malta (+1%) in the third quarter of 2023.

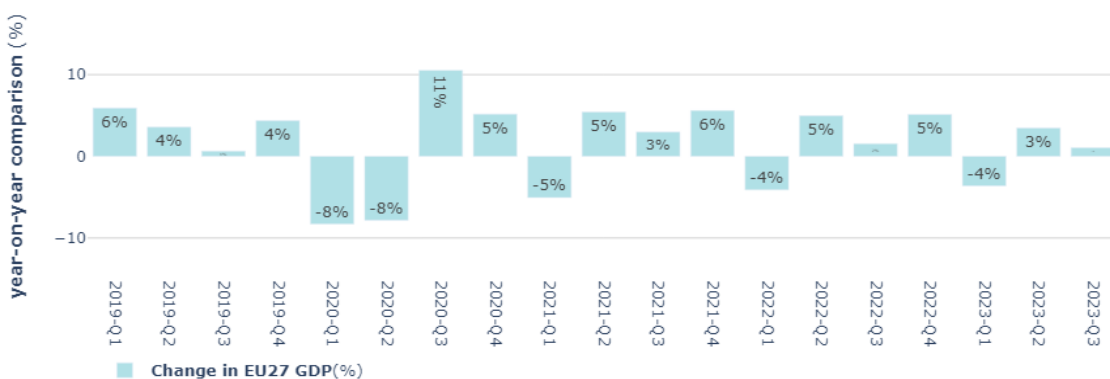
**Figure 4: Year-on-year change in Member States' gas consumption in the third quarter of 2023**



Source: Eurostat.

EU GDP has registered a moderate increase of 1.1% in the third quarter of 2023 compared to the previous quarter.

**Figure 5– Change in EU27 GDP in year-on-year comparison**



Source: Eurostat.

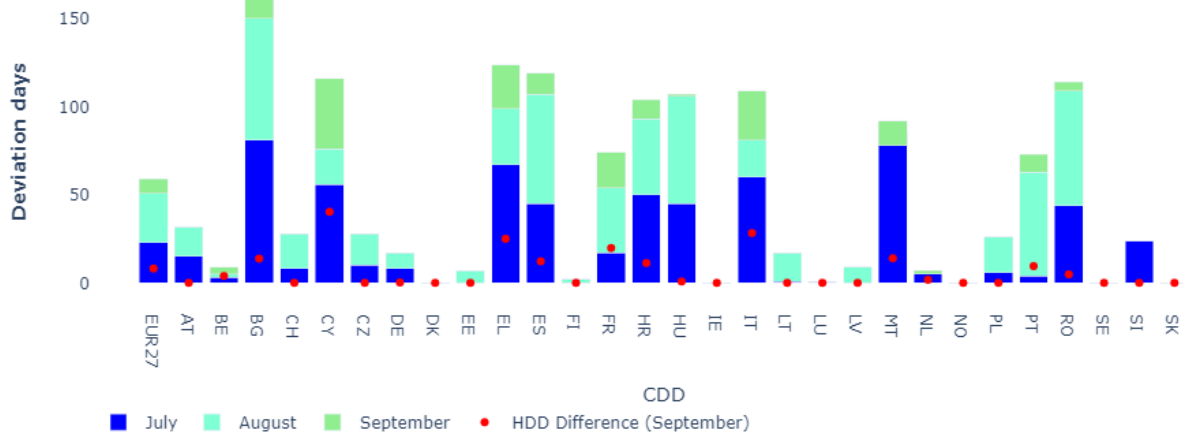
- Figure 6 illustrates the monthly deviation of actual Cooling Degree Days (CDDs) from the long-term average (a period between 1979 and the last calendar year completed) in the third quarter of 2023. In general, temperature during Q3 2023 where higher

<sup>3</sup> Cyprus currently does not have statistically reported gas consumption.



than usual continuing the prevailing trend of recent years. The deviation from the long-term average Heating Degree Days (HDDs) are also displayed for September.

**Figure 6 – Cooling Degree Days (CDD) in the months of Q3 2023 and deviation from long-term Heating Degree Day (HDD) average in September 2023**

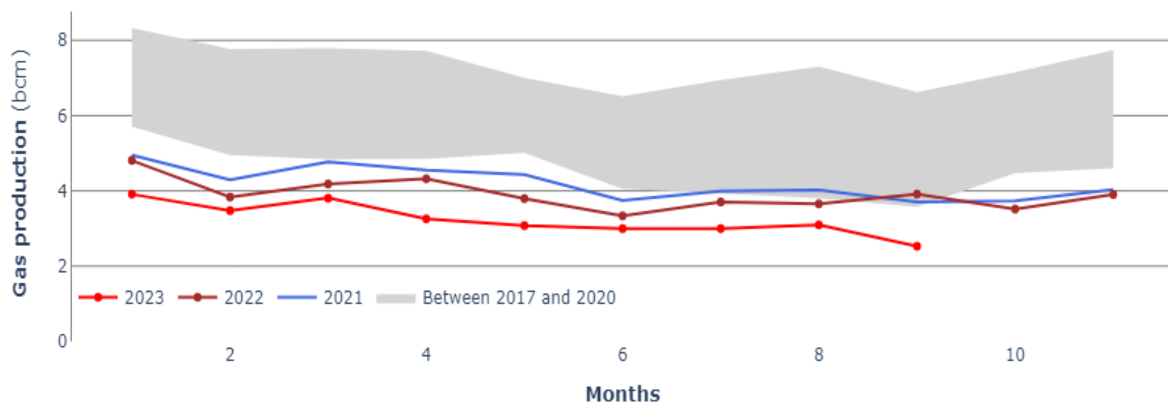


Source: JRC.

## 1.2 Production

- The EU's domestic gas production continued its downward trend in the third quarter of 2023. Total production was 9 bcm, a decrease of 5% compared to the previous quarter (9.5 bcm), and 18% reduction year-on-year (from 11 bcm). Average monthly production was 3 bcm, 5% decrease compared to the previous quarter (3 bcm), and 19% less than in the same quarter of 2022 (when the monthly average was 4 bcm). Since 2016, EU gas production more than halved (-54%, from 20 bcm in the third quarter of 2016).

**Figure 7 - Monthly domestic gas production in the EU**



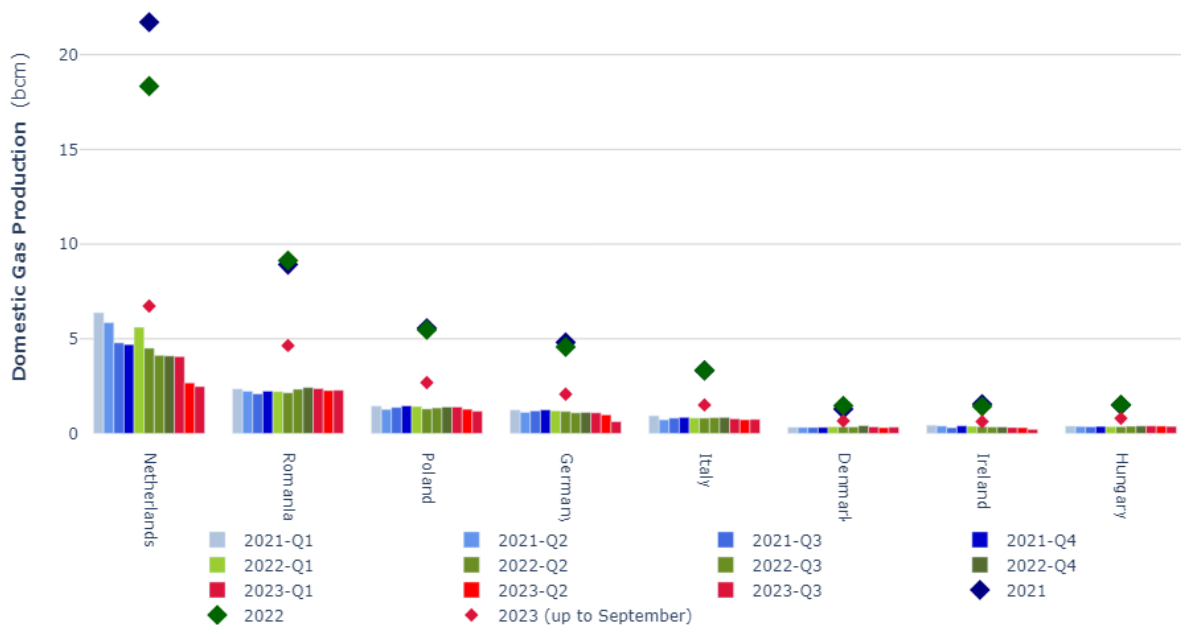
Source: Eurostat.

- In the EU, 18 Member States conduct domestic gas production, while nine Member States (Finland, Estonia, Latvia, Lithuania, Luxembourg, Malta, Portugal, Sweden, Cyprus<sup>4</sup>) do not produce gas in their territories.

<sup>4</sup> Cyprus' energy minister announced that the country can produce first natural gas as soon as 2026. Since exploration started in 2007, 17-18 trillion cubic feet gas reserves were discovered in Cyprus in five wells located in three exploration blocks. Currently, Cyprus is the only EU Member States that does not have statistically reported natural gas consumption (Reuters, 14 February 2024: Cyprus could produce first natural gas as soon as 2026, minister says (emm4u.eu).)

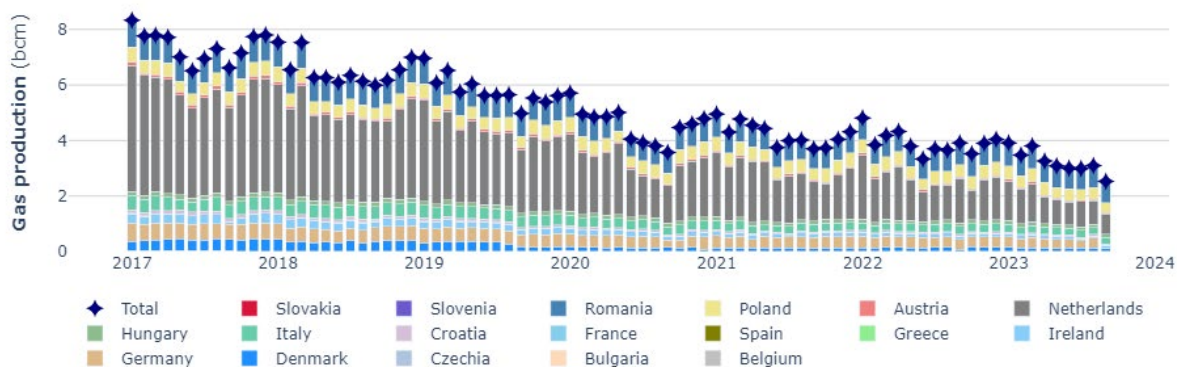
- The biggest EU gas producer in the third quarter of 2023 remained The Netherlands with a total quarterly production of 2.5 bcm, a decrease of 6% since the last quarter, and a decrease of 39% year-on-year compared to a 4.1 bcm production in the third quarter of 2022. Romania kept its second place (2.3 bcm), followed by Poland (1.2 bcm) and Germany (1.0 bcm). In a year-on-year comparison, production in all producing Member States fell with the exception of Denmark (+4%), Slovenia (+76%). Production grew compared to the previous quarter in six Member States (AT, BG DK, ES, IT, RO). The biggest increase (+75%) was recorded in Spain, although from a very small basis (from 3.7 mcm to 6.4 mcm). Bulgaria increased production by 13% and Denmark by 6%, followed by Austria (+4%) and Italy+2%). Romanian production remained stable (+0%).

**Figure 8: The ten biggest domestic gas producer Member States in the EU**



Source: Eurostat.

**Figure 9: Monthly gas production in the EU**



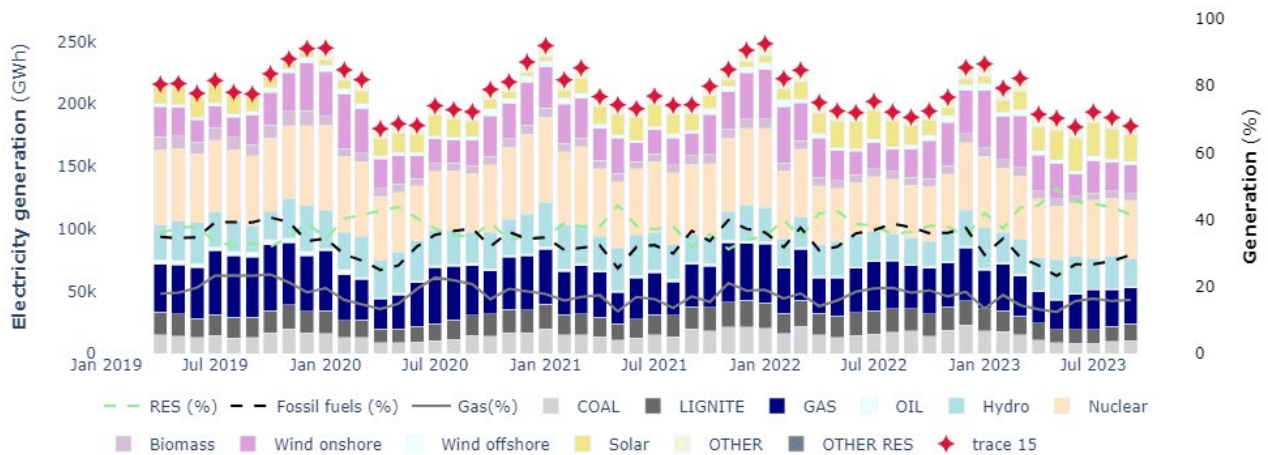
Source: Eurostat.

Electricity generation from natural gas amounted to 91 TWh in the third quarter of 2023, an increase of 18% compared to the previous quarter (77 TWh) and a reduction of 18% year-on-year (11 TWh)<sup>5</sup>. While gas-fired electricity generation constituted 16% of total electricity generation in the quarter, in terms of gas consumption around 25% of EU's total gas usage was dedicated to

<sup>5</sup> Data retrieved from ENTSO-E Transparency Platform, which may differ from Eurostat data. Indeed Eurostat monthly values are higher resulting in a total of 108.5 TWh EU gas fired power generation in Q3 and 95.6 TWh in Q2 of 2023.

power production<sup>6</sup>. This was 2 bcm more than in the previous quarter, while overall volume of gas for all end-use was significantly less (-14%, -9 bcm) resulting in a 7 %-point increase in the share of gas used for power generation in the total gas consumption compared to the previous quarter. Year-on-year gas consumption for power generation declined by 19% (-3 bcm). The share of gas fired power generation in total EU electricity production increased 2%-point quarter-on-quarter (from 12% to 14%) but declined 3%-point (from 19%) year-on-year.

**Figure 10: Monthly gas-fired power generation in the EU**

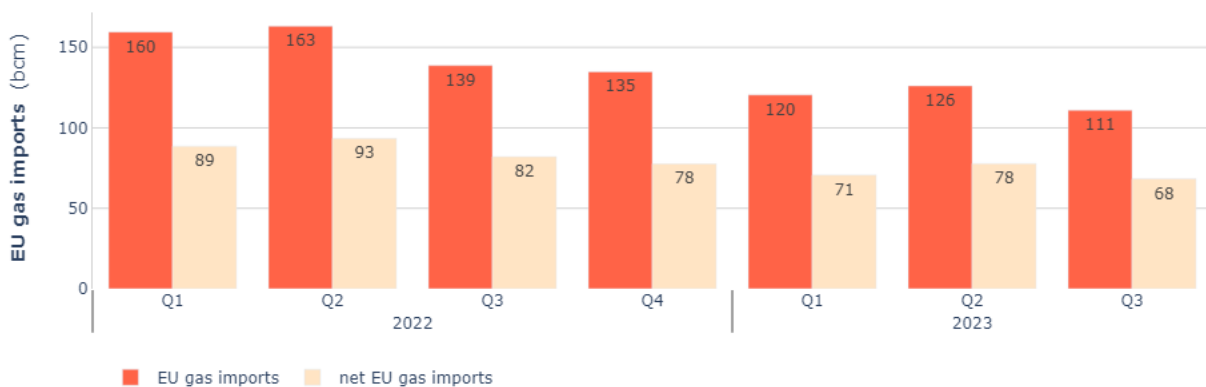


Source: ENTSO-E.

### 1.3 Imports

According to Eurostat, total gas import in the EU amounted to 111 bcm in the third quarter of 2023, a 12% (-15 bcm) decrease from the previous quarter and a 22% (-28 bcm) decrease year-on-year. Net imports<sup>7</sup> amounted to 68 bcm reflecting 43 bcm export. Net import decreased by 12% (-10 bcm) compared to the previous quarter and by 17% (-14 bcm) year-on-year. In addition to the EU gas saving obligation, high storage filling rates, the increase in the share of renewable electricity in final energy consumption combined with more electrification and the usual lower consumption during summer contributed to the historically low import level.

**Figure 11: EU gas imports (gross and net) by quarters**



Source: Eurostat.

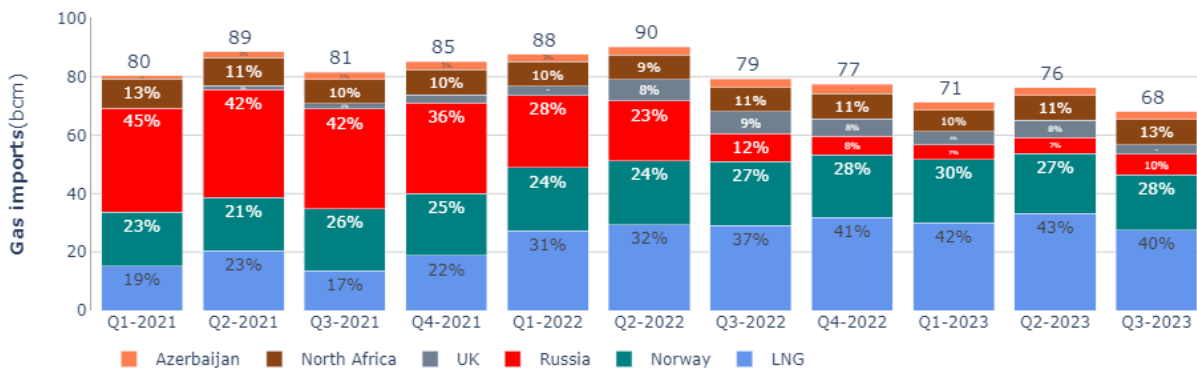
<sup>6</sup> Assuming an overall 50% generation efficiency of EU gas fired plants as an average.

<sup>7</sup> Net imports equal imports minus exports and do not account for stock changes.

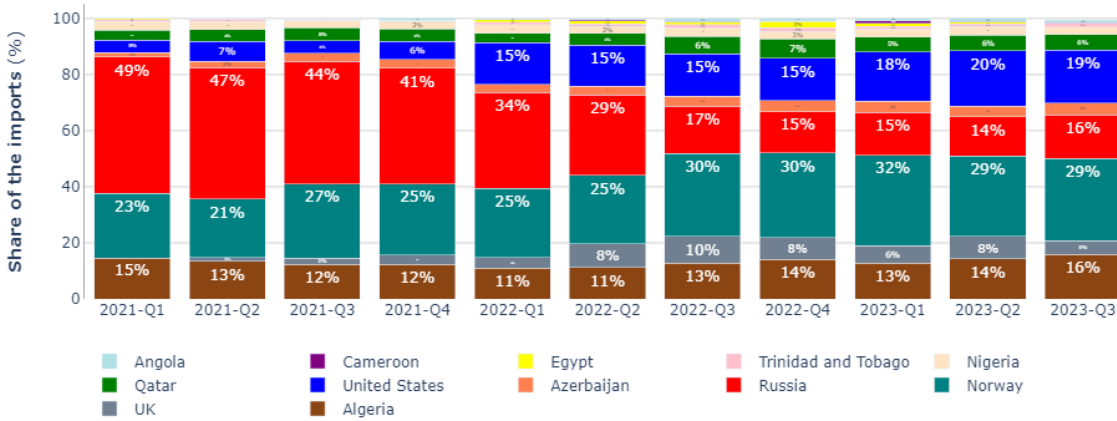
### 1.3.1. Total EU imports

- According to ENTSO-G, which tracks all flows in- and out of the EU, total gas imports by EU Member States amounted to 68 bcm in the third quarter of 2023 (-8 bcm compared to the second quarter of 2023), of which 60% arrived through pipelines and 40% through LNG cargoes.
- The share of LNG decreased by 3%-point to 40% compared to the previous quarter (when it was 43%) and increased 3%-point year-on-year (when it was 37%, i.e. in Q3 of 2022). The quarterly decrease in the LNG share was due to a 17.2% (6 bcm) decrease in overall EU LNG imports resulting from smaller LNG imports from the EU's main LNG suppliers. Imports from the United States were down by 14% (2 bcm), while Qatar (-6%, -0.5 bcm), Russia (-19 %, -1 bcm) Nigeria (-18%, -0.4 bcm), Algeria (-6.5%, -0.1 bcm) also exported less to the EU. The volume of pipeline imports also declined by 5.4% (-2 bcm) compared to the previous quarter, mainly due to a decrease in pipeline imports from Norway (-1,7 bcm, -8%) amidst continued maintenance operations in the main production fields and the United Kingdom (-2.7 bcm, -45%). The drop in Norway pipeline imports was fully compensated by the increase in pipeline imports from Russia (+1.6 bcm, +30%) and North-African (+0.1 bcm, +1%).

**Figure 12: EU imports of natural gas (share of pipeline imports by country and share of LNG)**



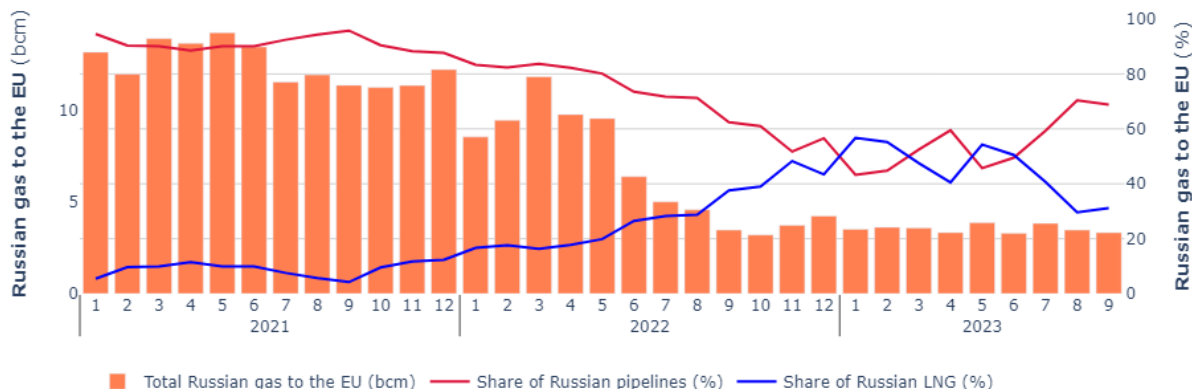
**Figure 13 – Quarterly share of gas imports within the total, combining both pipeline and LNG imports**



Source: Commission calculation based on ENTSO-G and Refinitiv.

- Total Russian gas export to the EU amounted to 10.6 bcm or 16% of total EU gas imports in the third quarter of 2023. This was a small increase of 1.4% (+0,1 bcm) compared to the previous quarter and a decrease of 18% (-2.3 bcm) year-on-year. Compared to the pre-crisis year of 2021, total Russian imports to the EU decreased by 70% (25.3 bcm). Within the overall Russian exports, the share of pipeline gas increased to 60%, 70% and 69% during July, August and September, respectively, reversing the trend of higher LNG shares during the Q2 of 2023 and reflecting a decline of 29% (-1.5 bcm) in Russian LNG imports during the third quarter, while pipeline exports increased by 23 % in the same period.

**Figure 14– Monthly pipeline and LNG imports from Russia**

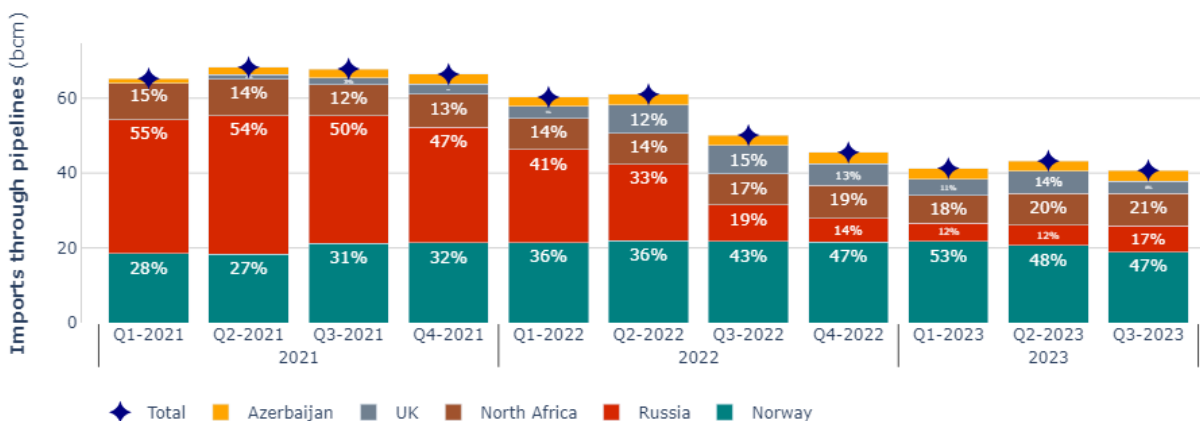


Source: Based on data Refinitiv and from the ENTSO-G Transparency Platform

### 1.3.2 Pipeline imports

- EU pipelines import was 41 bcm in the third quarter of 2023, a decrease of 6% compared to the previous quarter, and a 19% decline year-on-year.
- Norway remained the EU’s biggest pipeline gas exporter with a share of 47% (19 bcm), down from a 48 % in the previous quarter but up from 43 % a year earlier. The second largest exporter to the EU remained North-Africa with 21% export share (8.6 bcm), followed by Russia (17%, 7 bcm), who overtook the UK, which slipped to the fourth place with a share of 8% (3.3 bcm). Azerbaijan (6.5%, 2,8 bcm) kept its fifth position.
- Pipeline export volumes decreased from Norway (-1.7 bcm, -8.3%), while they increased from North Africa (+0.1 bcm, +1%) and Russia (+1.6 bcm, + 20 %). Gas exports from Azerbaijan remained stable (2.8 bcm).
- The 2023 Q3 pipeline imports displayed the lowest quarterly volumes ever, with September 2023 saw a historically record low pipeline gas imports (11 bcm).

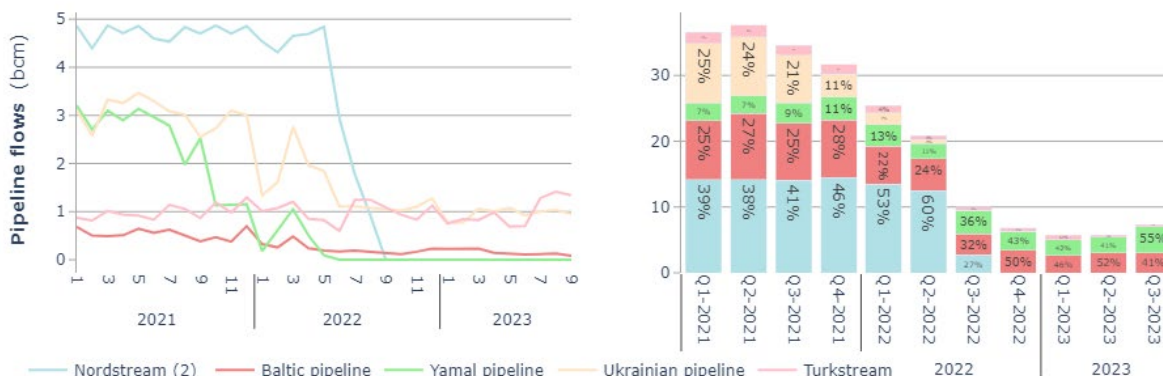
**Figure 15 – Quarterly EU imports of natural gas from pipelines**



Source: Based on data from the ENTSO-G Transparency Platform.

- In the third quarter of 2023, the two main remaining transit routes for Russian pipeline gas exports through Ukraine and Turkey transported 41% and 55% of the Russian gas volumes, respectively. The Turkish *Turkstream* pipeline took over the Ukraine route in terms of volumes shipped in the third quarter. Flows on other Russian pipelines coming to Europe (*Nordstream*, *Yamal* and *Baltic* pipelines) remained at zero.
- During the third quarter of 2023, the monthly amount of gas passing through Ukraine and *Turkstream* was relatively stable at around 2 bcm with slightly higher flows in the Turkish pipeline than in the Ukrainian pipeline.

**Figure 16 – Monthly and Quarterly EU imports of natural gas from Russia by supply route**

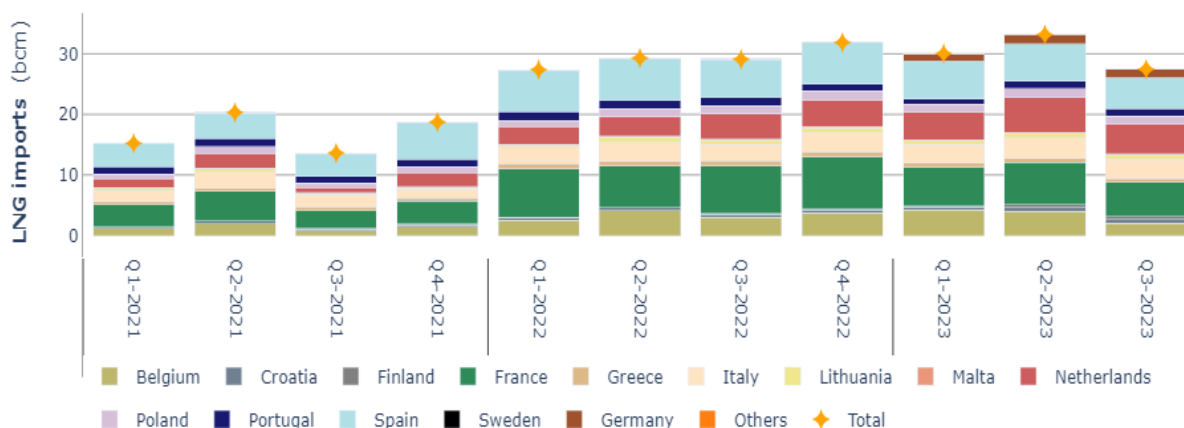


Source: Based on data from the ENTSO-G Transparency Platform

### 1.3.3 LNG imports

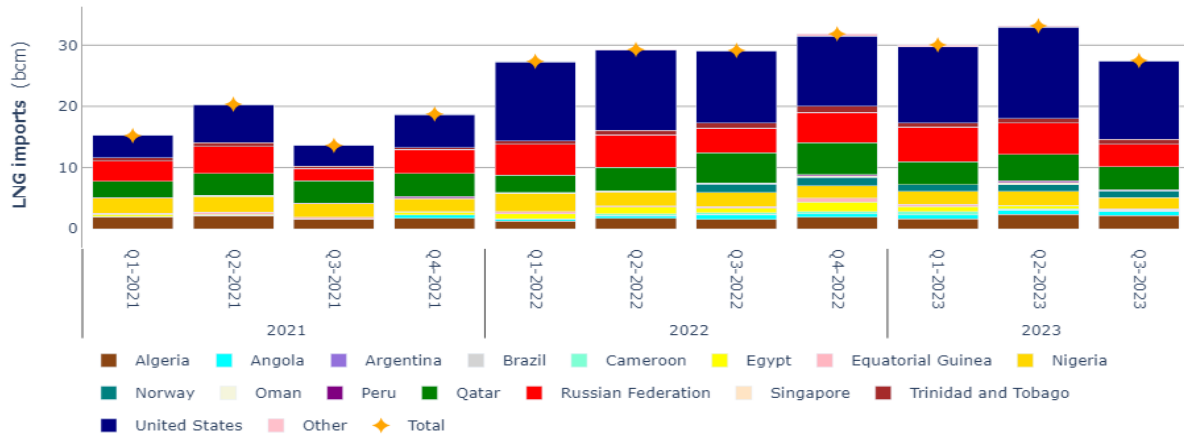
- Total gross EU LNG import was 27 bcm, a decrease of 17% (-6 bcm) compared to the previous quarter and 5% (-1.6 bcm) decrease year-on-year. However, compared to the pre-crisis year of 2021, the EU's LNG imports more than doubled (+102%, from 14 bcm). In the third quarter of 2023, the United States continued to be the EU's biggest LNG supplier with a 47% share (13 bcm), followed by Qatar (14%, 3 bcm) and Russia (13%, 3.6 bcm). The United States further increased its share in EU LNG imports by 2 percentage point, even if its LNG exports were 2 bcm less than in Q2 2023, due to a bigger decrease in the EU's overall LNG imports was (-5.7 bcm).
- The EU's biggest LNG importer remained France (6 bcm, 21%), followed by Spain (5 bcm, 18%), The Netherlands (5 bcm, 18%), Italy (3 bcm, 12%) and Belgium (2 bcm, 7%).

**Figure 17 - LNG imports to the EU by Member States**



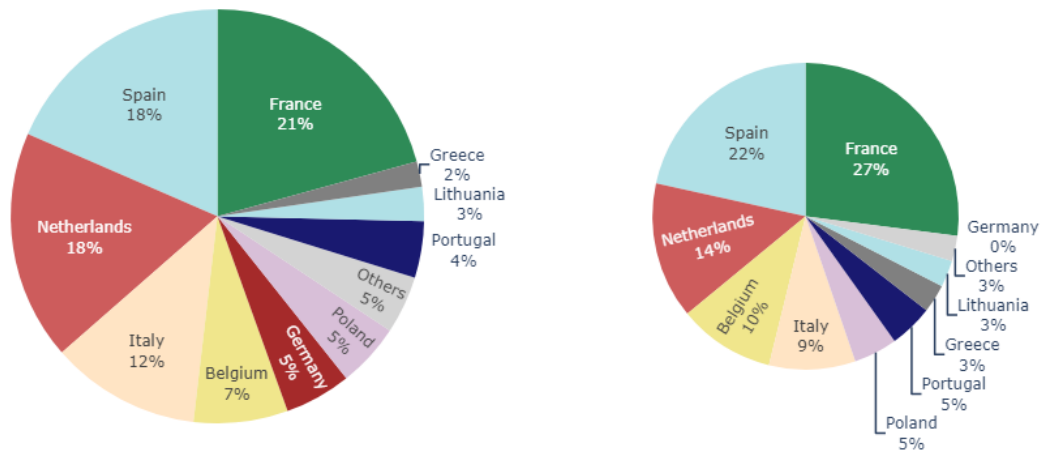
Source: European Commission calculation based on Refinitiv and ENTSO-G.

**Figure 18 - LNG imports to the EU by supplier countries**



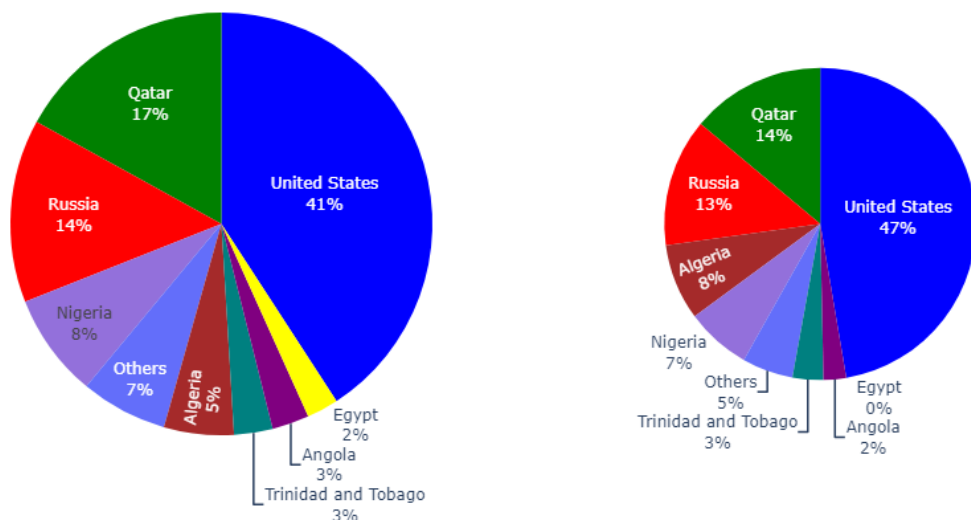
Source: European Commission calculation based on Refinitiv and ENTSO-G.

**Figure 19 – Share of Member States in EU LNG imports in Q3 2023 (left) and Q3 2022 (right)**



Source: Refinitiv, 'Others' includes Croatia, Finland, Malta and Sweden.

**Figure 20 – Share of exporters in EU LNG imports in Q3 2023 (right) and Q3 2022 (left)**

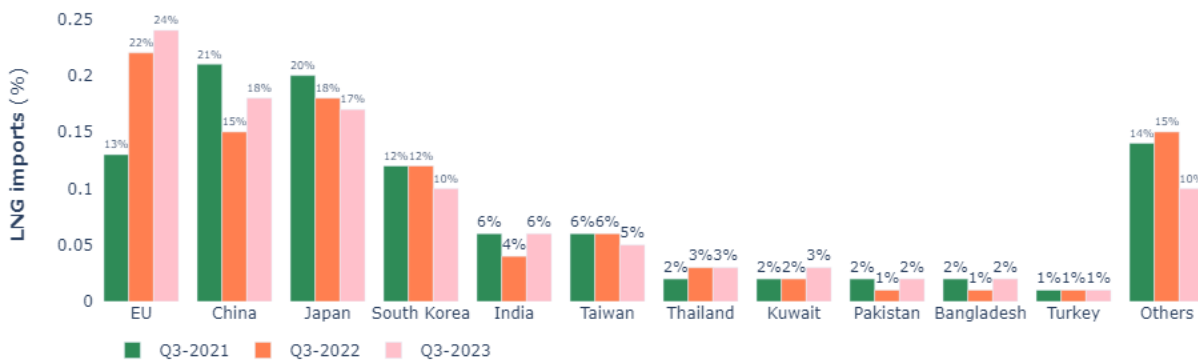


Source: Refinitiv.

## 2. Global LNG Trade

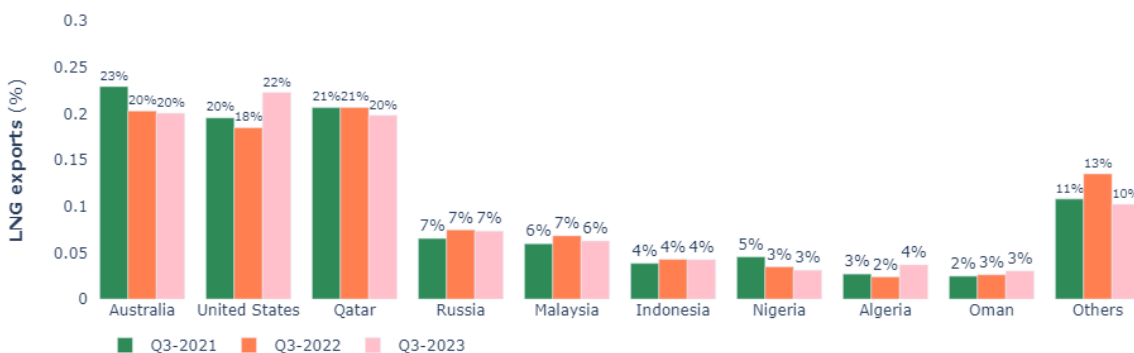
- In the third quarter of 2023, the EU continued to hold the number one position as the world's largest importer of LNG with a 24% share (32 bcm) in global imports<sup>8</sup>. China was the second largest LNG importer with a 18% share (24 bcm), followed by Japan with 17% (22 bcm). The EU kept its share in global imports compared to the previous year and increased it by 10 percentage point compared to the same period in 2021. Japan market share fell 2 percentage points to 17% from 19% in the previous year and 3 percentage points from 20% compared to 2021.
- In the third quarter of 2023, global LNG exports amounted to 133 bcm, a 3.5% decrease compared to Q2 2023 (-4.8 bcm) and nearly the same as in the third quarter of the previous year (-0.4% decrease year-on-year from 134 bcm in Q3 2022).
- The biggest LNG exporter remained the United States followed by Qatar and Australia. These three countries together supplied close to two thirds (62%) of the world's LNG demand. The United States kept its number one position with a 22% (29 bcm) share in global exports, closely followed by Qatar (20.5%, 27,3 bcm) and Australia (20%, 26.7 bcm).
- Far behind the leading trio, Russia (7%, 9.3 bcm), Malaysia (6%, 8.2 bcm) and Indonesia (4%, 5.8 bcm) secured the fourth, fifth and sixth position, respectively, in global LNG exports with single digit shares. Nigeria, Algeria, Oman, Trinidad and Tobago completed the ranks of the ten biggest LNG exporters.

**Figure 21– Main global LNG importers in Q3 2023**



Source: Refinitiv.

**Figure 22 – Main global LNG exporters in Q3 2023**

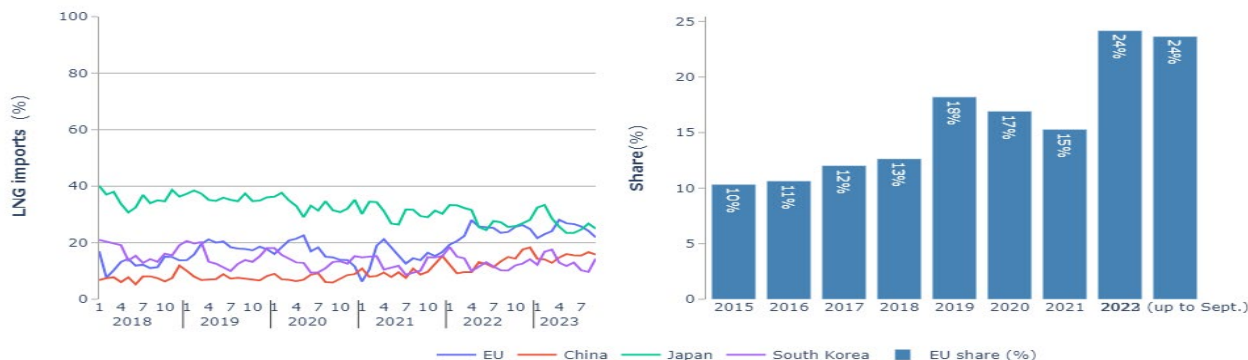


Source: Refinitiv.

<sup>8</sup> Gross imports.



**Figure 23 – The most important global LNG importers and evolution of the EU’s annual LNG imports share**



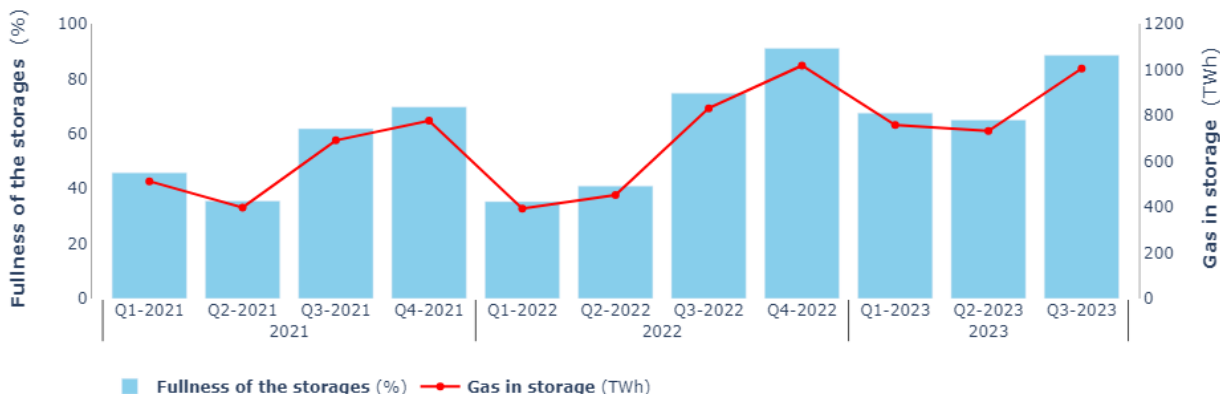
Source: Refinitiv.

### 3. Storage and LNG terminals

#### 3.1 Storage

- The EU’s operational gas storage capacity is 1140 TWh (117 bcm) corresponding to more than one third of the European Union’s total gas consumption in 2023.<sup>9</sup>
- Gas storage levels remained at record levels, well above historical values. EU gas filling rate stood at 96% (1089 TWh, 111 bcm) at the end of September 2023, following at the end of August’s filling rate of 93% (1055 TWh, 108 bcm) and at the end of July’s filling rate of 86% (972 TWh, 99 bcm). The average filling rate for the quarter was 89% (1004 TWh, 10 bcm), an increase of 36% from the 65% (741 TWh, 76 bcm) in the previous quarter reflecting preparations for the gas winter season and in compliance with the EU storage obligation. These filling rates were significantly higher (+21%) than the already high storage levels in the third quarter of 2022 (75%, 85 TWh, 88 bcm).
- All Member States but Belgium, Denmark, France and Portugal registered storage filling records in the third quarter of 2023 compared to the previous year and indeed compared to the three preceding years<sup>10</sup>.

**Figure 24 - Gas storage levels as quarterly average percentages of the EU’s maximum gas storage capacity**



Source: Gas Storage Europe AGSI+ Aggregated Gas Storage Inventory. See explanations on data coverage at <https://agsi.gie.eu/#/faq>.

<sup>9</sup> Gas Infrastructure Europe - AGSI (gie.eu), data published under the Storage Transparency Platform, 1139.8979 TWh of technical working capacity as of 28 November 2023. Technical storage capacity is equivalent of 36% of the EU’s 2023 annual consumption (327 bcm) and 33% of the EU’s 2022 consumption (357 bcm).

<sup>10</sup> Belgium and Portugal storage levels were around 100% in Q3 2022 and the lower levels in Q3 2023 were still exceptionally high. Denmark and France’s storage levels were also record high in Q3 2022 and Q3 2023.

**Figure 25 - Gas storage levels as percentage of maximum gas storage capacity at the end of September 2023**

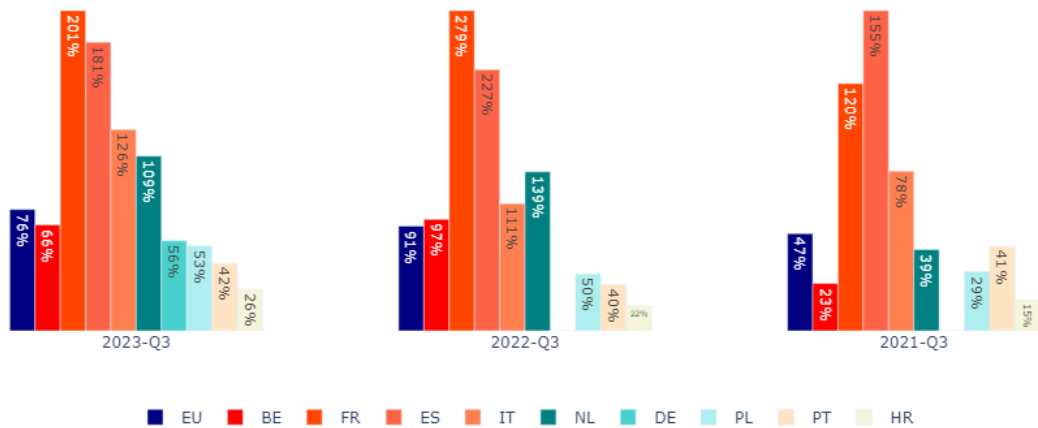


Source: Gas Storage Europe AGSI+ Aggregated Gas Storage Inventory. See explanations on data coverage at <https://agsi.gie.eu/#/faq>.

### 3.2 LNG Terminals

- LNG terminals' utilisations rates for regasification varied widely across Europe during the quarter. At the main EU LNG terminals in France, Spain, The Netherlands and Italy, utilisation rates were often well above full nameplate capacity (100%) during the third quarter of 2023. The recently deployed LNG terminals in Germany, as well as in those in Poland, Portugal, Croatia and other terminals in Europe had lower utilisation rates and operated at a fraction of full capacity.

**Figure 26: Regasification utilisation during the months of the third quarter of 2023**



Source: Refinitiv.

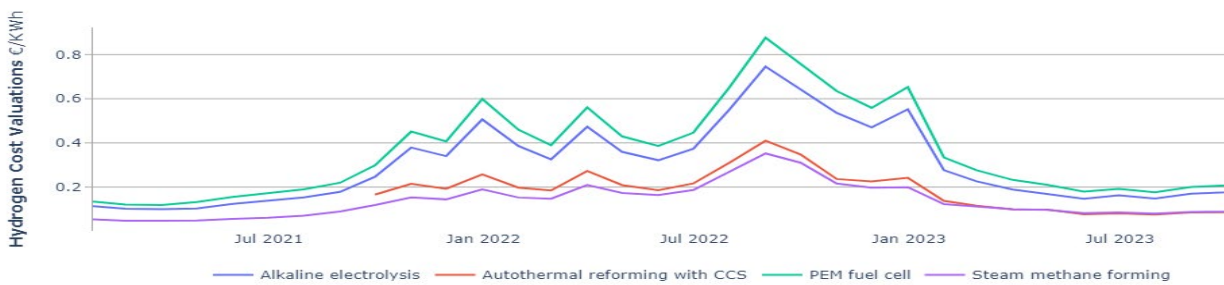
### 3.3 Hydrogen market developments

- The next chart shows the production cost-based estimated prices for hydrogen generated by four different technologies: alkaline water electrolysis (AWE), polymer electrolyte membrane (PEM), steam methane reforming (SMR), autothermal reforming (ATR).<sup>11</sup> For the SMR and ATR technology, the chart below also includes the costs of Carbon Capture and Storage (CCS).

<sup>11</sup> Alkaline water electrolysis (AWE) is a type of electrolyser characterised by the presence of two electrodes operating in a liquid alkaline electrolyte solution of potassium hydroxide or sodium hydroxide. A fuel cell is an electrochemical device that directly converts the chemical energy of reactants (a fuel and an oxidant) into electricity. electrolysis is the electrolysis of water in a cell equipped with a solid polymer electrolyte that is responsible for the conduction of protons, separation of product gases, and electrical insulation of the electrodes. Steam methane reforming (SMR) refers to a

- Whereas AWE and PEM electrolysis technology costs predominantly depend on the electricity price, the costs of SMR and ATR technology are driven by natural gas costs used for producing hydrogen. AWE and PEM are related to green power (hydrogen generation cost assessment is practically based on green power costs, adding EU wind guarantee of origin prices to wholesale electricity prices), whereas costs of SMR and ATR hydrogen generation is based on costs of natural gas (by adding CCS costs).
- In the third quarter of 2023, the price of ATR and SMR declined by 3% and 2%, respectively, in a quarter-on-quarter comparison, reflecting the declining price trend of natural gas. The cost of electricity-based production methods slightly increased by 3% in the case of AWE and by 0.4% in the case of PEM. Year-on-year, all technologies registered significant price decreases of between 72% and 77%. The price of ATR declined the most (-77%), followed by AWE (-75%) and PEM (-74%), while the lowest decline was observed for SMR (-72%).

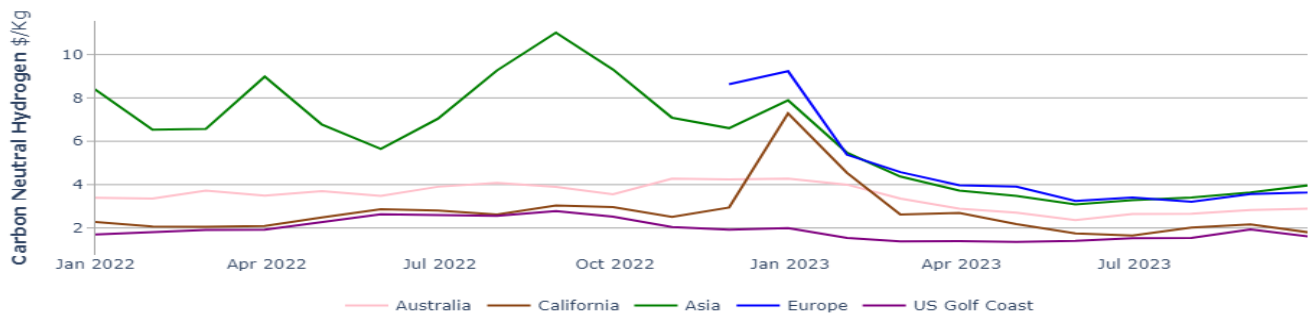
**Figure 27 –Production cost based hydrogen price assessment for different technologies (including CCS)**



Source: S&P Global (Platts).

- The next chart shows the price assessments for carbon-neutral hydrogen in different regions of the world: Australia, East Asia, Northwestern Europe, California and the US Gulf Coast. Quarter-on-quarter, all but Northwestern Europe shown price increases in the price of carbon-neutral hydrogen. The highest increase was registered for the US Gold Cost (+19%), followed by East Asia (+12%), Australia (+8.4%) and California (+7.5%). The price of carbon-neutral hydrogen in Northwestern Europe declined by 1% quarter-on-quarter.
- In year-on-year comparison, the price in all major producing regions declined. The biggest decline was registered in East Asia (-63%) and the smallest in Australia (-28%), while the price drops were 35% and 31% in US Gulf Coast and California, respectively. The price quotation of the European carbon neutral hydrogen was introduced recently in global price assessments and therefore did not yet have sufficient time series for an annual price comparison.
- The highest price region was East Asia (11\$/Kg), followed by Northwestern Europe (10\$/Kg), Australia (8\$/Kg), California (6\$/Kg) and the US Gulf Coast (5\$/Kg).

**Figure 28 –Carbon-neutral hydrogen prices in different regions of the world**



Source: S&P Global (Platts).

technology for producing hydrogen from natural gas. Autothermal reforming (ATR) combines steam reforming and partial oxidation processes. ATR creates a thermally neutral process by utilizing steam reforming to boost hydrogen production while using the partial oxidation to generate heat. This process does not require an external heat source for the reactor because this partial oxidation is exothermic. However, to provide pure oxygen to the reactor, it either needs an expensive and complicated oxygen separation device, or the resulting gas is diluted with nitrogen, necessitating gas separation and purification procedures.

## 4. Wholesale Gas Prices

### 4.1 Wholesale gas prices at the EU level

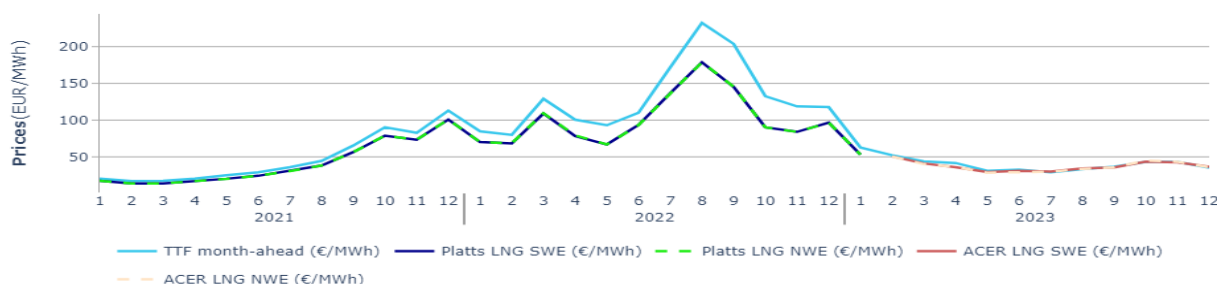
- In the third quarter of 2023, European spot prices (TTF day-ahead) displayed great volatility with several peaks and troughs. The downward trend of prices which reached the lowest point on 1 June with 23.4 €/MWh was disrupted by a short-lived peak of 40.5 €/MWh on 16 June, thereafter which prices returned to their downward movement and reached a second low of 24.6 €/MWh on 14 July. From that point on prices started to rise and reached a peak of 32.1 €/MWh on 25 July, a new peak of 43.2 €/MWh on 22 August and a higher peak of 44.7 €/MWh on 25 September 2023. The lows also settled at higher price points, i.e. 26.1 €/MWh on 1 August and 31.4 €/MWh on 6 September. The monthly averages reflected this rising trend with a July spot average of 28.9 €/MWh, an August average of 33.4 €/MWh and a September average of 36.8 €/MWh. The quarterly average spot price was 33.1 €/MWh, 5% lower than in the previous quarter (34.9 €/MWh), and 89% lower than in the height of the crisis in Q3 2022 (198.7 €/MWh).
- Forward contracts indicated higher prices ahead for the next two quarters by 36% and 58%, respectively. The 1 year ahead contract signalled a somewhat moderating increase and sold at a premium of 50% (+16 €/MWh, 49 €/MWh) over the Q3 2023 spot price on a quarterly average basis. The average quarter-ahead contract was 12 €/MWh above the spot price, while the two quarter-ahead contracts sold at a premium of 19 €/MWh.
- The LNG Northwestern Europe (NWE) and Southwestern Europe (SWE) or Mediterranean (MED)<sup>12</sup> benchmarks kept their prices close with NWE being slightly cheaper on average than the SWE/MED benchmark. Both SWE/MED and NWE sold gas contracts at a discount compared to Europe's main hub, the Dutch Title Transfer Facility (TTF). On a quarterly average basis the price differential started with a range of 2.4 €/MWh (MED) - 2.5 €/MWh (NWE) in July; in August it reduced to a range of 0.7 €/MWh (SWE/MED) and 0.8 €/MWh (NWE) and then rose again to a range of 2.4 €/MWh (SWE/MED) and 2.5 €/MWh (NWE) in September 2023. On average NWE and SWE/MED hubs were 5.6% cheaper than the TTF spot price.
- As of January 2023, the LNG NWE and LNG SWE/MED benchmarks are replaced by the new ACER Northwest Europe (NWE) and South Europe (SE/SWE) LNG benchmarks. In the third quarter of 2023, the change in benchmarks resulted in higher price assessments in July, and lower price assessments in August and September. The ACER NWE price assessment was on average 1.2 EUR/MWh cheaper than the LNG NWE benchmark and the ACER SE/SWE price assessment was 1 EUR/MWh cheaper than the LNG SWE/MED on a quarterly average basis.

**Figure 29 – TTF day-ahead (spot) prices compared with TTF quarter-ahead, two quarters-ahead and year-ahead prices**



Source: S&P Global (Platts).

**Figure 30 – LNG NWE and SWE<sup>13</sup> benchmarks compared with the Dutch TTF and ACER NWE and SWE benchmarks**



Sources: Global S&P (Platts), ACER.

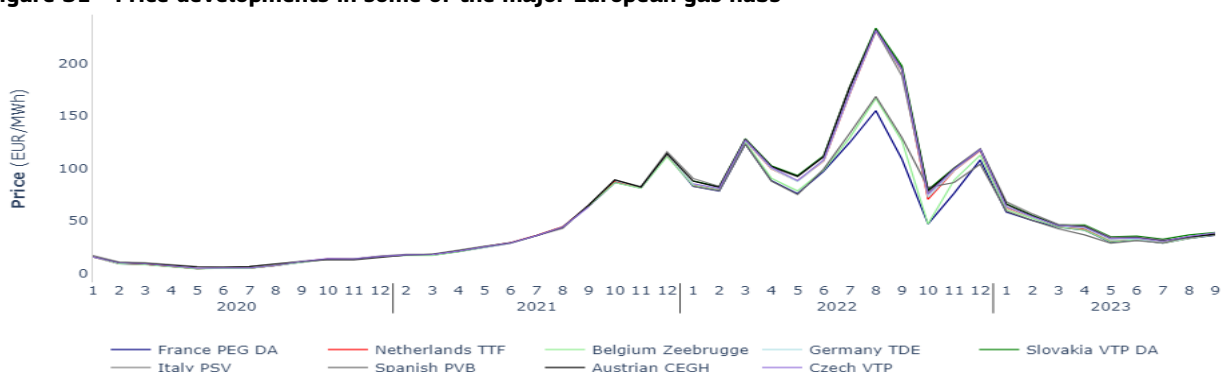
<sup>12</sup> As of September 2019, Platts renamed the Southwest European Marker (SWE) to Mediterranean Marker (MED). This change has been reflected in price quotation codes.

<sup>13</sup> Renamed MED in September 2019 by Platts.

## 4.2 European hubs

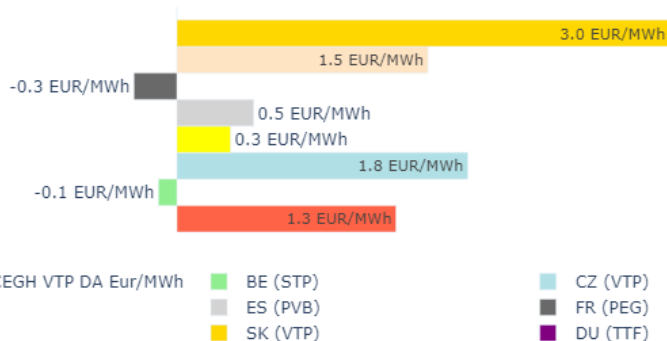
- In the third quarter of 2023, prices on a quarterly average basis decreased in most European hubs by between 3% (France PEG) and 7% (Austrian CEGH), and increased on the Spanish PVB by 4%. In year-on-year comparison, prices decreased in all hubs by between 75% (France PEG) and 83% (German THE, Italy PSV, Dutch TTF, Austrian CEGH, Czech VTP). The price differential between the hubs with the lowest and the highest price was 3.3€/MWh as a quarterly average. In monthly averages, the price difference was decreasing from 3.8 €/MWh in July, to 3.4 €/MWh in August and 2.7 €/MWh in September.
- The average price in the third quarter of 2023 ranged from the lowest 32.8 €/MWh (France) to the highest 36.8 €/MWh (Slovakia). Compared to the Dutch TTF, which serves as European benchmark, all EU hubs but France's PEG (-0.8%) and Belgium's ZTP (-0.3%) had higher prices in the third quarter of 2023. Traders paid 9,2% more in Slovakia's VTP, 5.4% more on the Czech VTP, 4.7% more on Italy's PSV, 4.1% more on Austria's VTP, 1.4% more on the Spanish PVB and 1% more on the German THE hub in the third quarter of 2023.

**Figure 31 - Price developments in some of the major European gas hubs**



Source: Global S&P (Platts).

**Figure 32 - Price differential of EU gas hubs compared to the benchmark Dutch TTF in the third quarter of 2023**



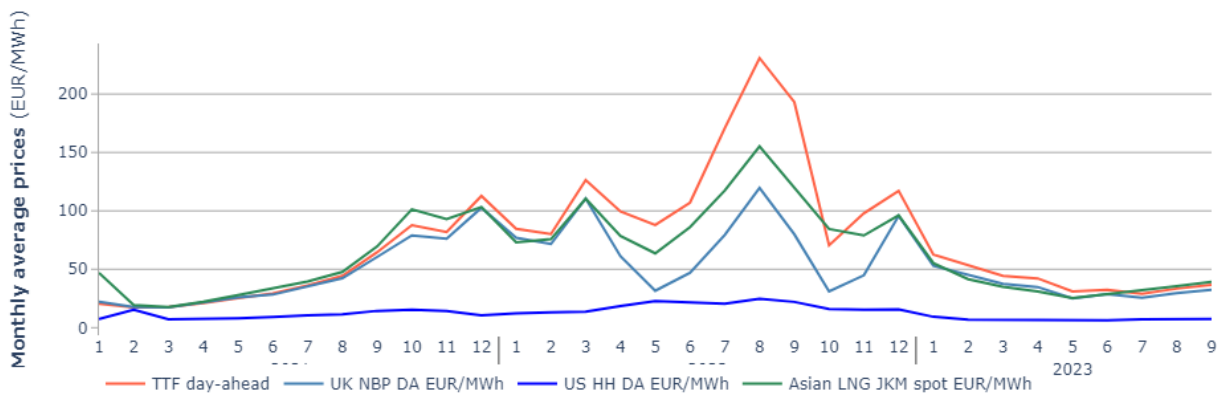
Source: S&P Global (Platts).

## 4.3 Wholesale gas prices at international level

- The movement of gas prices in the four major international gas hubs diverged in the third quarter of 2023. Prices declined on the Dutch Title Transfer Facility (TTF) and UK National Balancing Point (NBP) by 6%, while prices increased by 25% on the Asian Japan Korean Marker (JKM) benchmark and by 20% on the US Henri Hub (HH). In a year-on-year comparison, prices declined considerably in all major global benchmarks, the most on the Dutch TTF, where prices rose to the highest in the midst of Europe's energy crisis in the previous summer, and the least on the US Henri Hub, which - as a producers' hub - remained the cheapest by far throughout the entire period. The year-on-year decline on the Dutch TTF was 83%, while it was 73% on the Asian JKM benchmark and 72% on the UK NBP. Prices on the US Henri Hub declined 67% year-on-year.
- In the third quarter, Asian LNG prices were 7% higher than prices on the Dutch TTF, while they were 24% cheaper in the previous quarter and 51% cheaper in the same period of 2022. Compared to the UK NBP, gas contracts on the main EU TTF hub sold at an average price, which was 6% higher, but this was a considerably reduction compared to the 77% premium offered by the Dutch TTF compared to the UK NBP during the third quarter of 2022. The US Henri Hub remained by far the

cheapest gas market with prices more than 4.5 times lower than those on the European Dutch TTF in the third quarter and almost nine times lower than TTF prices during the height of Europe's energy crisis in the third quarter of 2022.

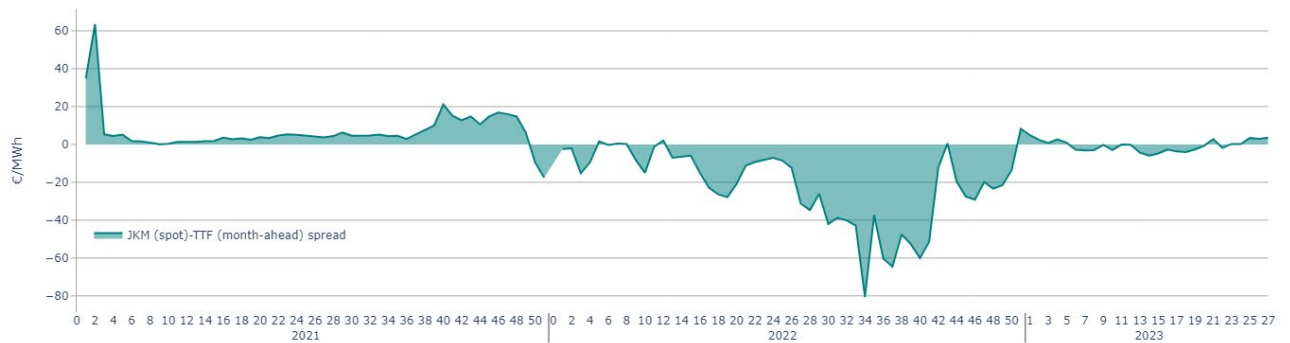
**Figure 31 – Comparison of monthly average prices on the Dutch TTF, UK NBP, the US Henry Hub and the Asian JKM**



Source: S&P Global (Platts).

- For most of the third quarter of 2023, Asia became the most attractive market displaying higher prices than Europe with the exception of a few short periods when Europe offered price premiums over Asian trading hubs.
- The difference between the Asian and European benchmarks continued to be mostly positive during the third quarter meaning that European prices were lower than those in Asia. Asian markets offered a premium of between 3.40 €/MWh and 6.80 €/MWh in July; 4.50 €/MWh-8 €/MWh in August; and 8 €/MWh-8,60 €/MWh in September. At the beginning of July, European markets returned briefly to an earlier trend of higher prices (established in the second quarter of 2022 and persisting throughout most of the period until the second quarter of 2023). In the second week of July, Europe offered a price premium of 3.6 €/MWh, and in the last week of July and the first week of August, the Dutch TTF premium over JKM was in the range of 5.20 €/MWh-5.80 €/MWh.

**Figure 33 – Prices differences between the JKM and the TTF (EUR/MWh)**



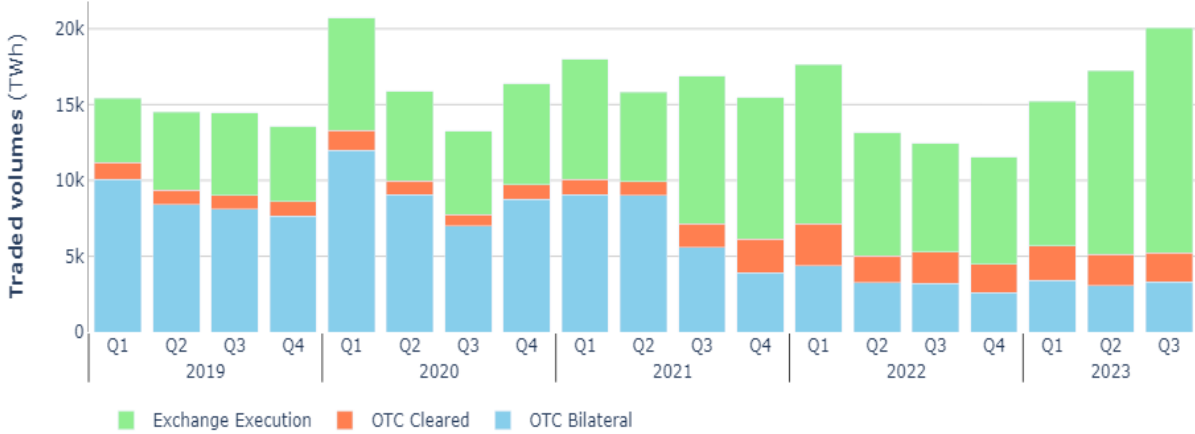
Source: S&P Global (Platts).

### 4.3 Gas trade on the EU hubs

- In the third quarter of 2023, total traded volumes increased by 2% quarter-on-quarter and by 50% year-on-year continuing a growth trend prevailing since the first quarter of 2023. Exchange executed trade constituted 80% of the transactions, a 14%-point increase from 66% in the second quarter showing a continued shift towards organised markets. The share of over-the-counter (OTC) bilateral transactions remained unchanged at 18%, while the share of OTC cleared trade declined to 10% from 12% in Q2 2023.
- Compared to the previous quarter, exchange executed trade grew by 23%, while OTC bilateral trade increased by 3% and OTC cleared trade decreased by 13%. Year-on-year, OTC exchange executed volumes more than doubled with an annual increase of 107%, while OTC bilateral trade increased by 4% and OTC bilateral trade declined by 9%.

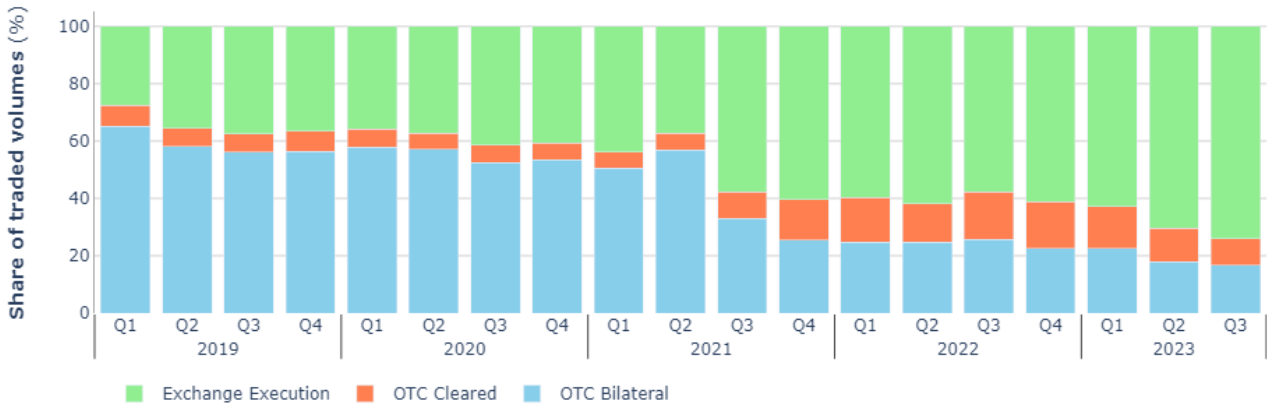
- The Dutch Title Transfer Facility (TTF) attracted 81% of the trading volumes increasing its lead over all other marketplace. The British National Balancing Point (NBP) kept its second place with 8%, followed by the German Trading Hub of Europe (THE), which kept its 5% share from the previous quarter. France’s PEG and Italy’s PSV followed with 2% and 1% shares, respectively.

**Figure 34 – Over the counter (OTC -bilateral and cleared) and exchange executed trade on European gas hubs**



Sources: Trayport Commodities Report, LEBA Monthly Energy Volume Report and Analysis.

**Figure 33 – Share of traded volumes in the main European gas hubs**



Sources: Trayport Commodities Report, LEBA Monthly Energy Volume Report and Analysis.

The chart covers the following trading hubs: Netherlands: TTF (Title Transfer Facility); Germany: THE (Trading Hub Europe); France: PEG (Point d’Exchange de Gas); Italy: PSV (Punto di Scambio Virtuale); Spain: PVB (Virtual Balancing Point); Austria: Virtual Trading Point (VTP); Belgium: ZTE (Zeebrugge Trading Point) (which fused with the Belgian Zeebrugge Beach Trading Point in June 2023). UK: NBP (National Balancing Point)  
Source: Trayport Commodities Report and LEBA Monthly Volumes and Energy Analysis reports.

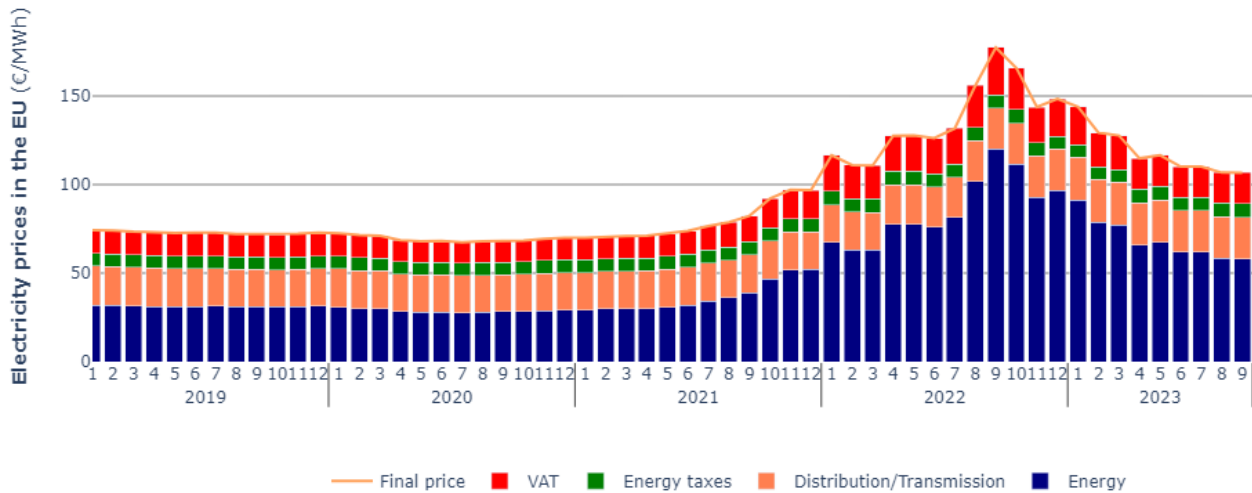
## 5. Retail gas prices

- In the third quarter of 2023, average quarterly gas retail price for household consumers fell by 6% to 107<sup>14</sup> €/MWh from 114 €/MWh in the previous quarter and by 30% from 153 €/MWh in the same quarter of the previous year. Despite the fall, the average EU retail price was 43% higher than in Q3 of 2021 and 61% higher than historical prices (first half of 2021).
- The energy component amounted to a quarterly average of 60 €/MWh, which was 56% of the price, a decrease from 59% (67 €/MWh) in the previous quarter, while network costs constituted 21% (22 €/MWh), energy taxes 9% (9 €/MWh) and value added tax (VAT) 15% (16 €/MWh) of the total end user price paid by the final retail consumers.

<sup>14</sup> Translated from 10.75 eurocents/kWh (with rounding) to make it comparable with the wholesale price. Retail prices quoted in this section are translated from eurocents/kWh and rounded for the sake of easier comparison with wholesale prices.

- The energy component fell the most, by 10% quarter-on-quarter and 41% year-on-year. This was somewhat offset by the rise in energy taxes, which increased by 1% compared to the previous quarter and 28% year-on-year. The network component remained stable compared to the previous quarter but increased by 6% year-on-year. On the other hand, the VAT component fell by 2% quarter-on-quarter and 23% year-on-year.

**Figure 36 – Monthly average gas price in the EU paid by typical household customers (in EUR/MWh)**

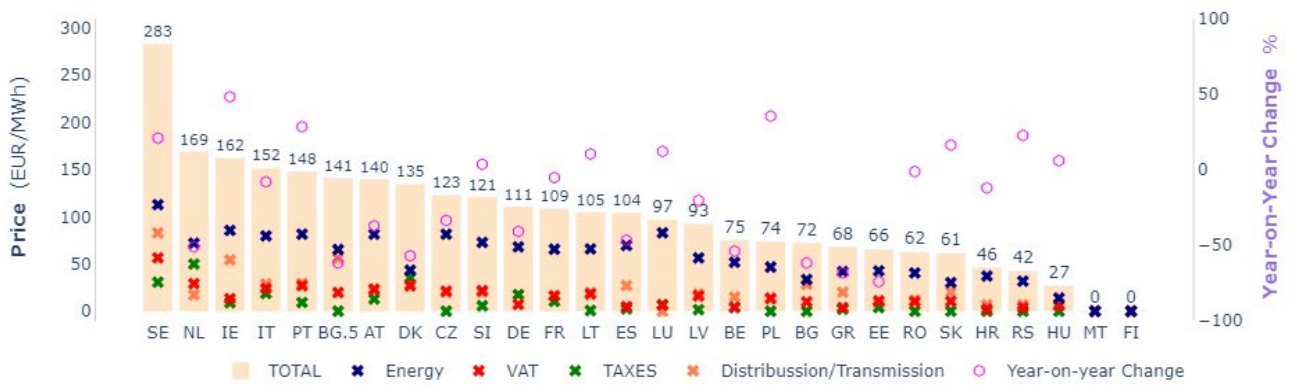


- Compared to the previous quarter, average quarterly retail prices declined in most Member States between 2% and 20%.<sup>15</sup> Prices stayed the same in five Member States (Croatia, Ireland, Romania and Slovakia) and increased in three Member States (Slovenia 7%, Poland 3%, Portugal 1%). The biggest price decline on a quarterly average basis was registered in Estonia (-20%), France (-18%) and Spain (-17%). Czechia (-13%), Greece (-13%) and Austria (-11%) also had double digit declines. Denmark (-6%), Germany (-6%), Italy (-6%), Bulgaria (-5%), Latvia (-5%), and Lithuania (-5%) had price decreases in a range of 5-6%. Smaller price drops were registered in Sweden (-3%), Belgium (-2%), The Netherlands (-5%) and Hungary (-5%).
- On a yearly comparison, very large year-on-year price drops were registered in ten Member States, led by Estonia (-75%), Greece (-68%) and Bulgaria (-61%). They were closely followed by Denmark (-57%), Belgium (-52%), The Netherlands (-52%), Spain (-49%), Germany (-41%), Austria (-39%) and Czechia (-34%) in terms of magnitude of price decrease. Smaller but still double digit price declines were observed in Latvia (-20%), France (-12%), Croatia (-12%) and Italy (-10%). In Romania the price decline was 1%. These price drops happened in comparison to historically record high prices in the third quarter of 2022 and were mainly characteristic of those Member States, where wholesale price levels' passe-through into retail prices was quick. On the other hand, nine Member States recorded price increases, reflecting more regulated type of retail price setting. The highest increases were experienced in Ireland (+48%), Poland (+36%), and Portugal (+29%). Double digit growth was also reported from Sweden (+20%), Slovakia (+16%) and Luxembourg (+12%). Prices increased moderately in Lithuania (+9%), Hungary (+5%) and Slovenia (+4%).
- Retail prices continued to diverge across the European Union. Amongst those Member States, where natural gas is an important part of the energy mix (e.g. widely used for heating and electricity production), the highest average quarterly price continued to be registered in The Netherlands (167 €/MWh), followed by Ireland (162 €/MWh, Portugal (148 €/MWh) and Italy (14 €/MWh). The lowest average quarterly gas retail price (27 €/MWh) continued to be reported in Hungary, followed by Croatia (46 €/MWh), Slovakia (61 €/MWh), Estonia (62 €/MWh) and Romania (62 €/MWh). A remarkably high price, which could be considered outlier in Europe (281 €/MWh) was reported from Sweden, where gas consumption for heating is limited amongst households.

<sup>15</sup> Cyprus, which does not have statistically reported retail gas consumption, is not included.

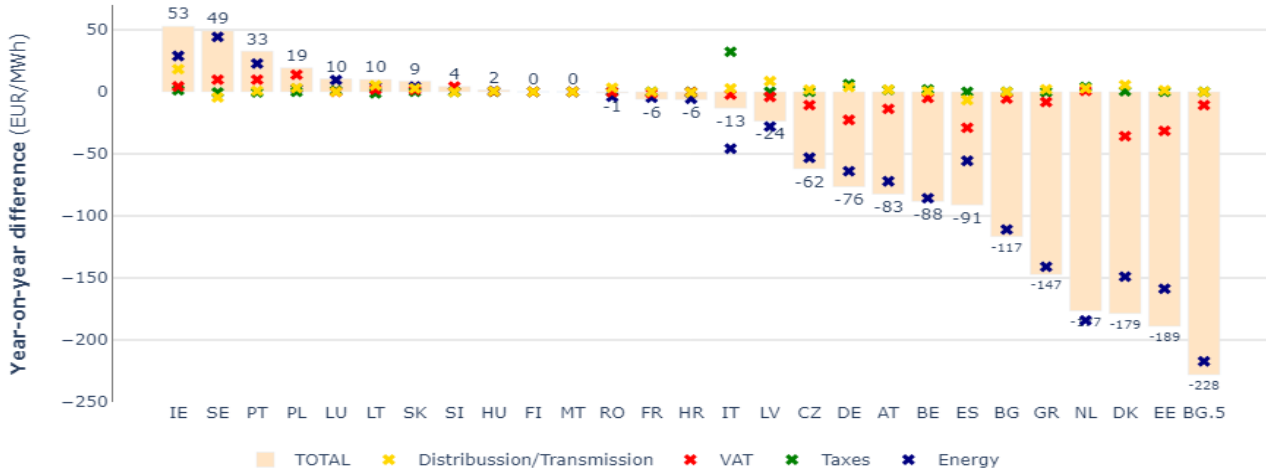


**Figure 37- Breakdown of gas price paid by households in European capitals and annual change in prices, Q3 – 2023**



Source: VaasaETT. EU-27 represents an aggregate average of the 27 capital cities.

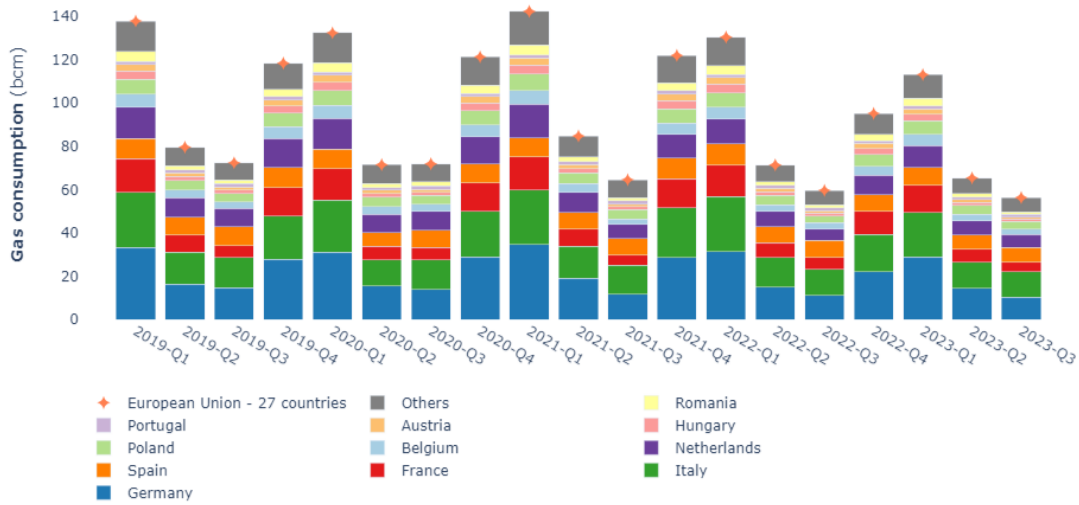
**Figure 38- Annual change in retail gas prices in Member States in Q3 2023**



Source: VaasaETT. EU-27 represents an aggregate average of the 27 capital cities.

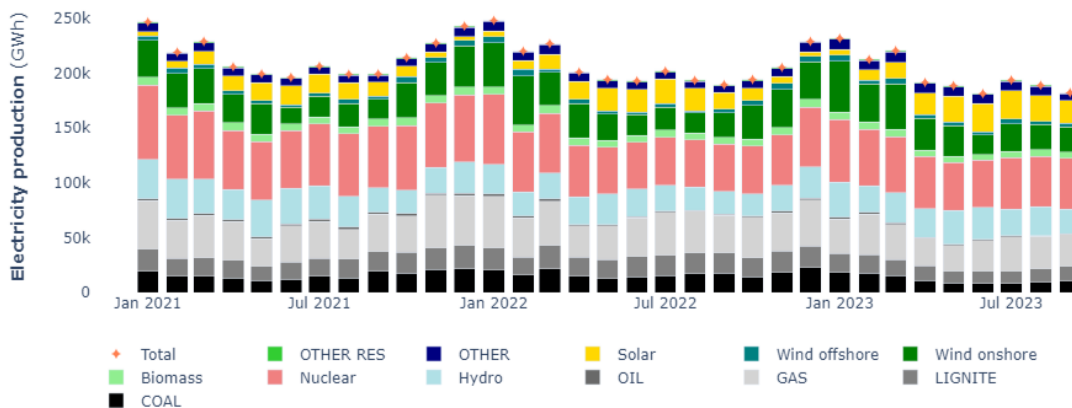
## 6. Appendix – charts providing further details on market developments

**Figure 1 – Quarterly gas consumption per Member States**



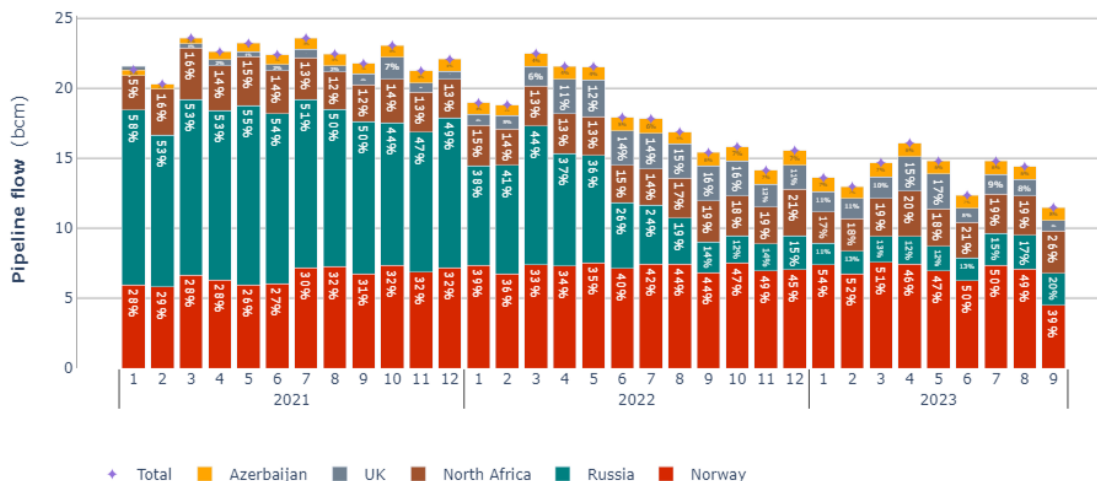
Source: Eurostat.

**Figure 2 – Monthly EU gas fired power generation**



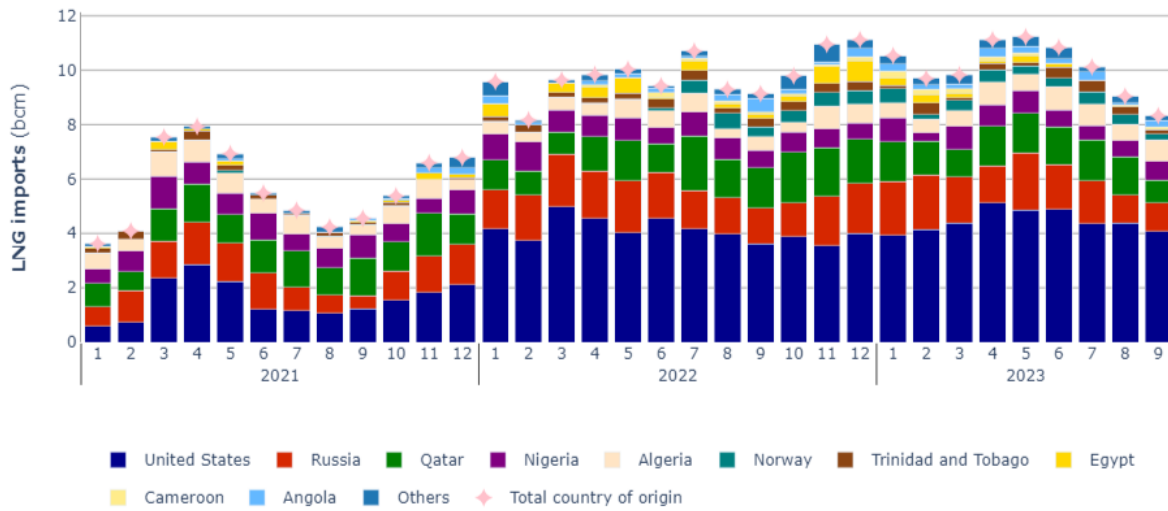
Source: ENTSO-E.

**Figure 3 – Monthly EU imports of natural gas from pipelines**



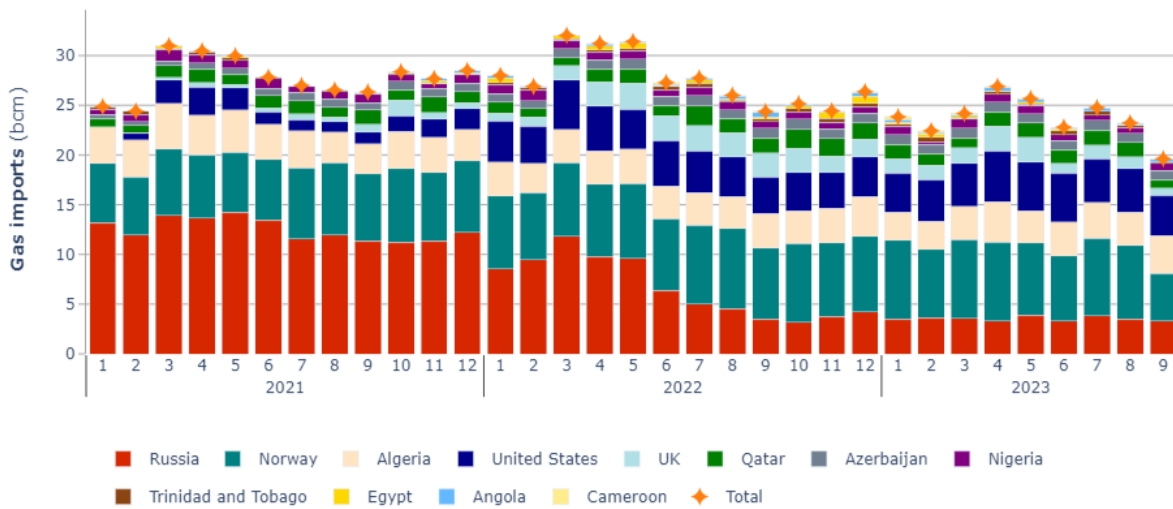
Source: European Commission calculation based on Refinitiv and ENTSO-G.

**Figure 4 – Monthly gross LNG imports to the EU per suppliers**



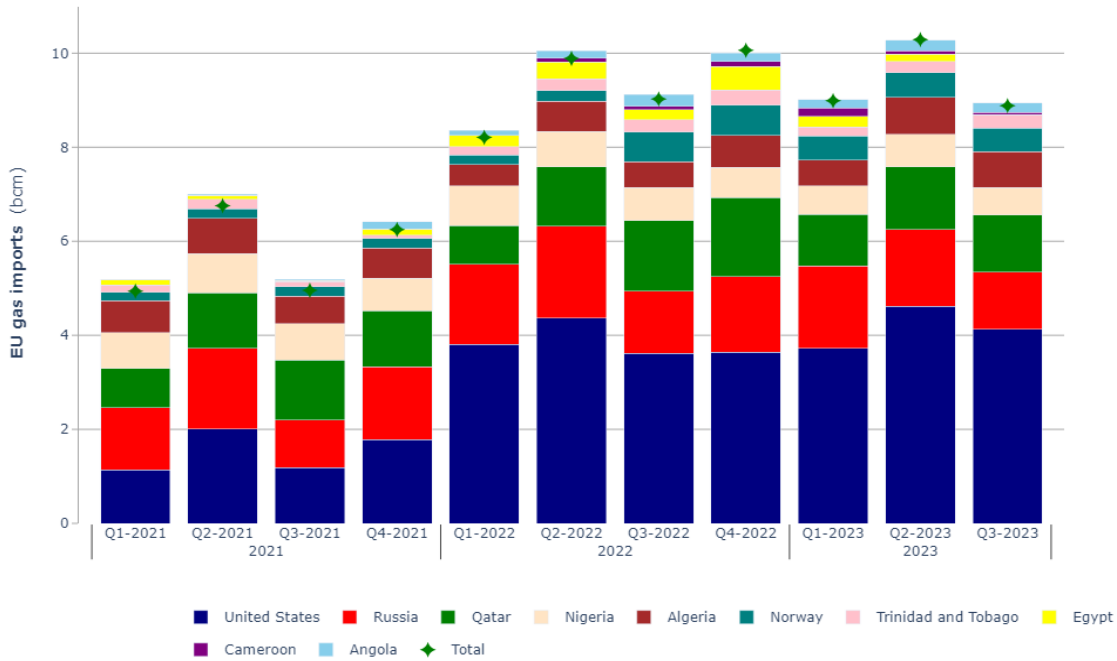
Source: European Commission calculation based on Refinitiv and ENTSO-G.

**Figure 5 – Monthly gas (pipe and/or LNG) imports to the EU per suppliers**



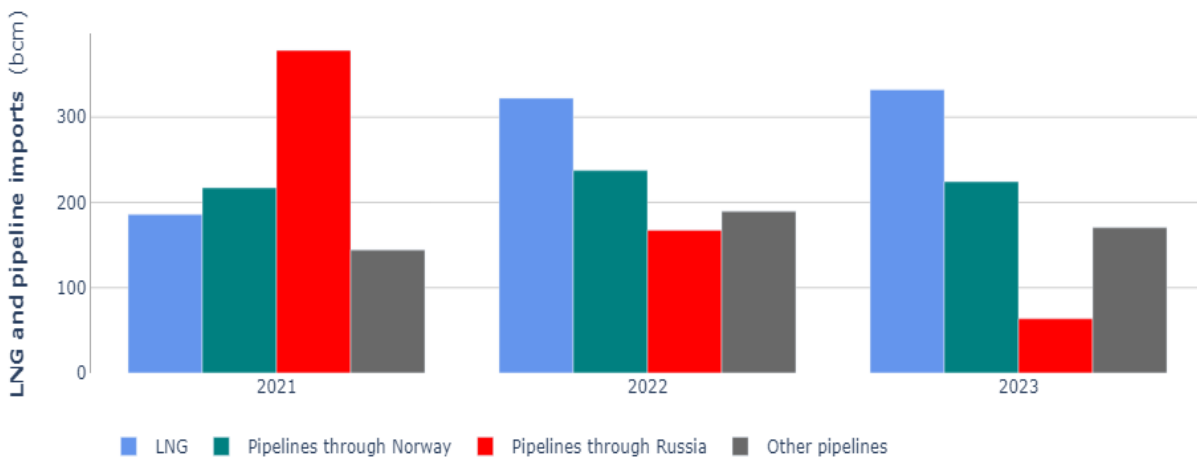
Source: European Commission calculation based on Refinitiv and ENTSO-G.

**Figure 6 – Quarterly EU gas imports (pipeline and LNG) per suppliers**



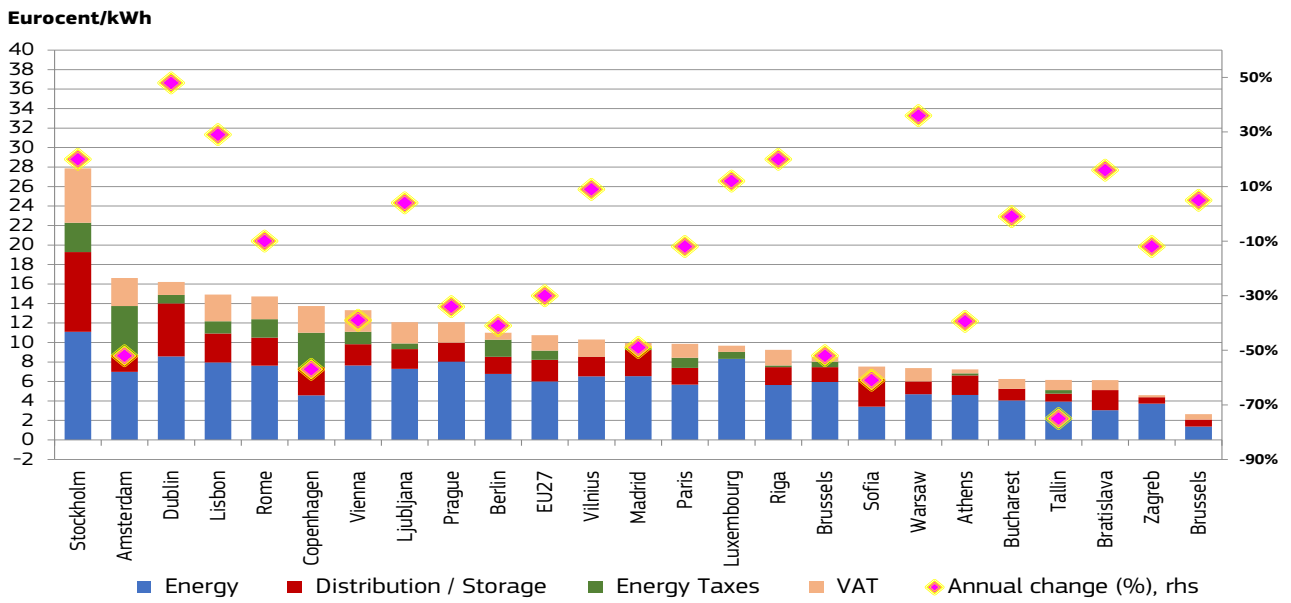
Source: Based on data from the ENTSO-G Transparency Platform.

**Figure 7 – Yearly pipeline and LNG imports from the EU main gas import sources**



Source: Based on data from the ENTSO-G Transparency Platform.

**Figure 8 - Breakdown of gas price paid by typical households in European capitals and annual change in prices, September 2023**



Source: VaasaETT