

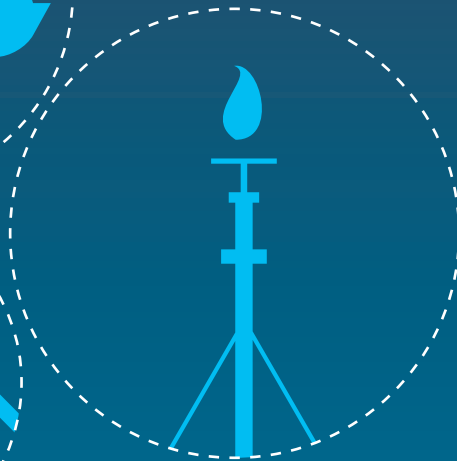
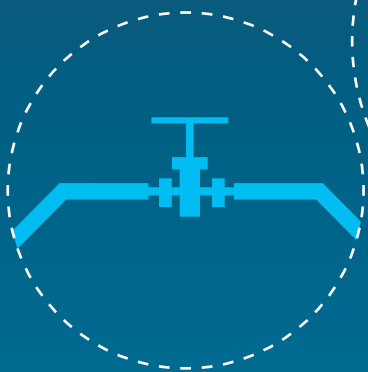


European  
Commission

# Quarterly report

## On European gas markets

with focus on annual overview  
for 2023



Market Observatory for Energy  
DG Energy

Volume 16

(issue 4, covering fourth quarter of 2023)

Energy

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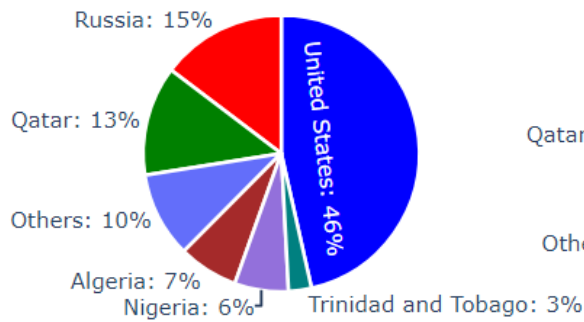
## Key Insights for 2023<sup>1</sup>:

### Russian gas imports in 2023 and 2022 compared to 2021

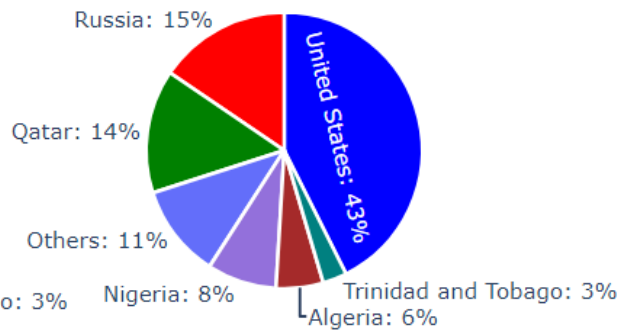


Source: ENTSO-G, LSEG (Refinitiv).

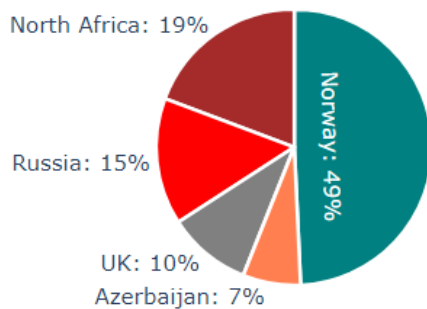
### LNG imports (2023)



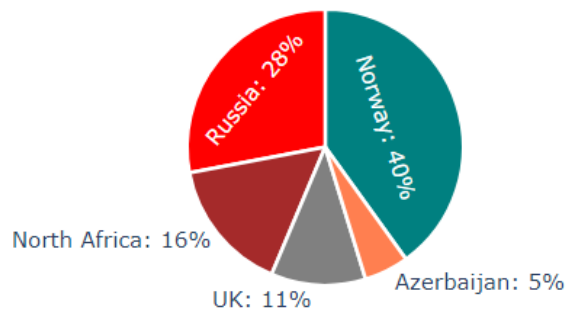
### LNG imports (2022)



### Pipeline imports (2023)



### Pipeline imports (2022)

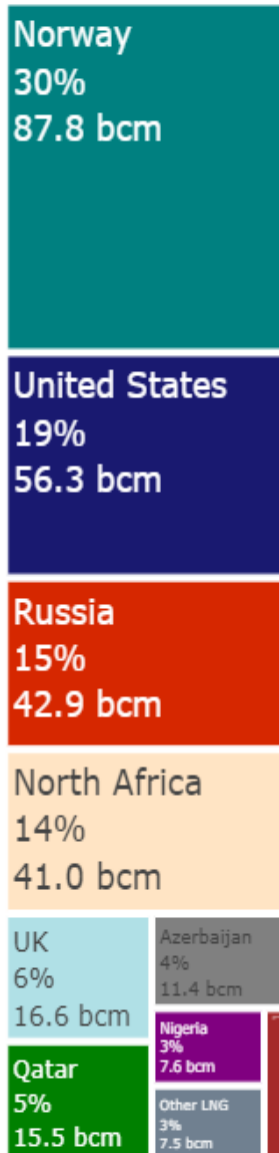


Source: ENTSO-G, LSEG (Refinitiv).

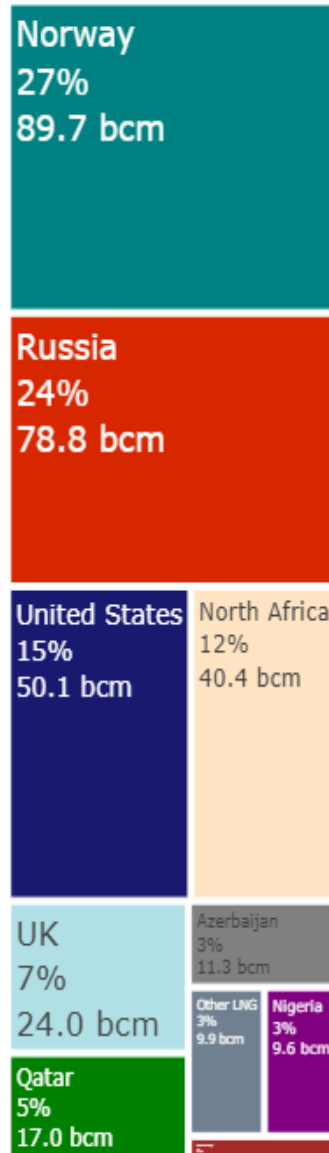
<sup>1</sup> Highlights are based on Eurostat (consumption, production), ENTSO-G and LSEG (Refinitiv) (imports, pipeline gas, LNG), S&P Platts (wholesale prices), VaasaETT (retail prices).

## Total EU gas imports (pipeline + LNG) by suppliers

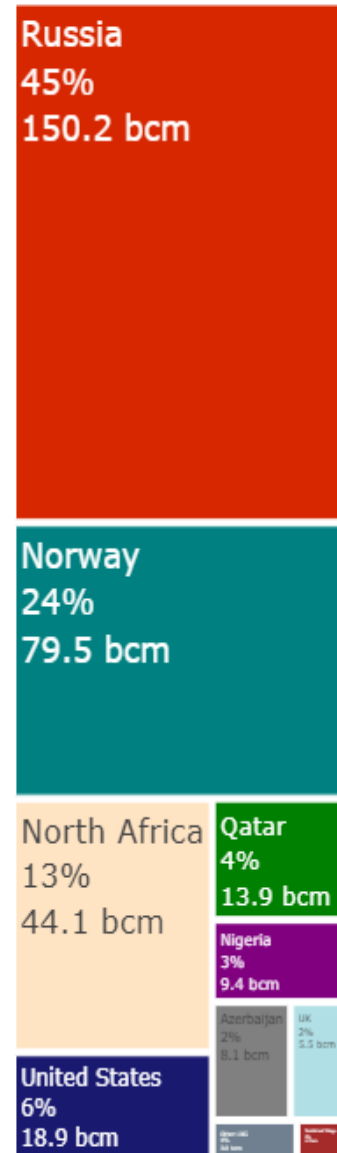
2023 - 289.9 bcm



2022 - 334.1 bcm



2021 - 334.3 bcm



Source: ENTSO-G, LSEG (Refinitiv).

## Gas wholesale prices in 2023, 2022 and 2021 and year-on-year comparison



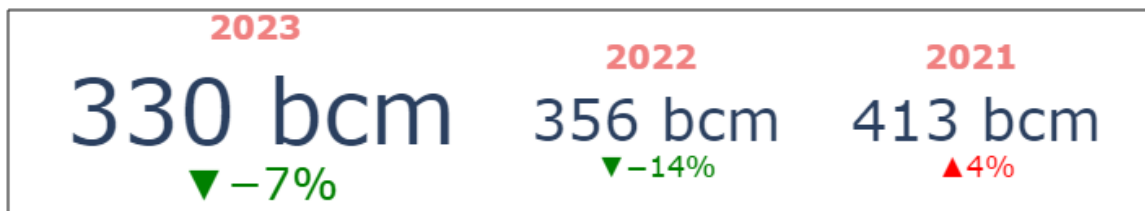
Source: S&P Global (Platts).

## Gas retail prices in 2023, 2022 and 2021 and year-on-year comparison



Source: VaasaETT.

## Gas consumption in 2023, 2022 and 2021 and year-on-year comparison



Source: Eurostat.

## Gas production in the EU



Source: Eurostat.

## Part of the EU gas consumption covered by domestic gas production



Source: Eurostat.

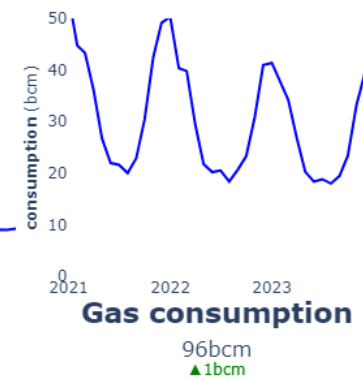
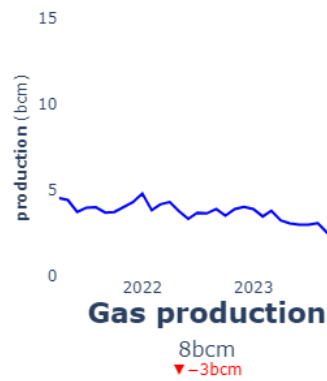
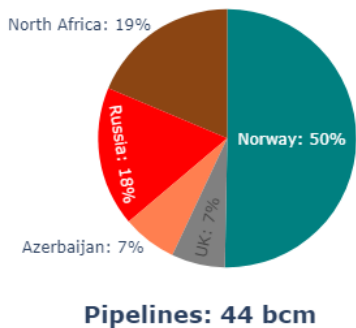
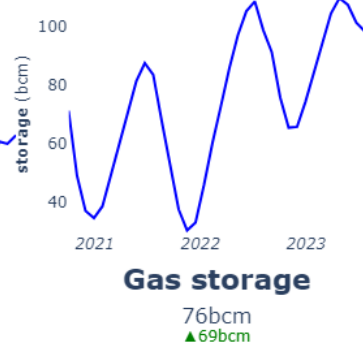
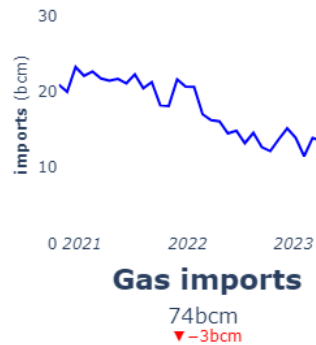
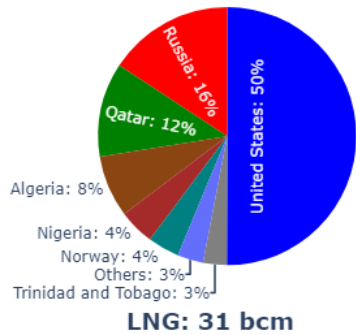
## TOP 3 Gas producers in the EU in 2023 compared to 2022



Source: Eurostat.

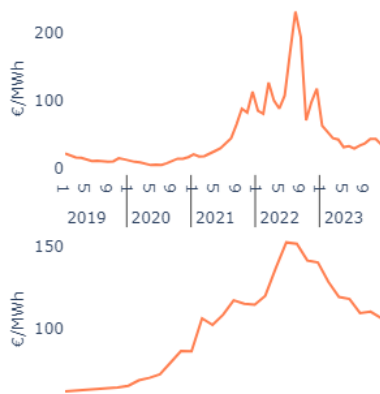
## Key Insights for 4th Quarter 2023<sup>2</sup>:

### KEY INSIGHTS: Q4 2023 Gas Trends and Comparative Analysis with Q3 2022.



Source: Eurostat, AGSI, LSEG (Refinitiv).

### PRICES: Evaluating prices in Q4 2023 and year-on-year comparison



**Wholesale prices**  
41 €/MWh  
▼-55 €/MWh

y-o-y change

**-57%**

**Retail prices**  
110 €/MWh  
▼-50 €/MWh

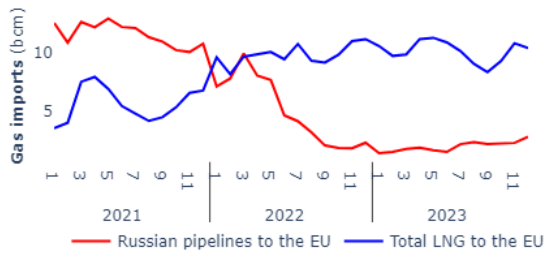
y-o-y change

**-31%**

Sources: S&P Global (Platts) and VaasaETT.

<sup>2</sup> Highlights are based on Eurostat (consumption, production), ENTSO-G and LSEG (Refinitiv) (imports, pipeline gas, LNG), S&P Platts (wholesale prices), VaasaETT (retail prices).

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



**LNG share**

**41%**

-

**US LNG**

**50%**

▲ 13%

**Pipelines share**

**59%**

-

**Russian pipelines**

**18%**

▲ 4%

Source: ENTSO-G, LSEG (Refinitiv).



## HIGHLIGHTS OF THE REPORT

### Highlights of the 4th quarter of 2023:

#### EU gas consumption, production and storage in Q4 2023

- **EU gas consumption** was **96 bcm**, an **increase of 1% year-on-year** and **71% increase quarter-on-quarter**, reflecting the usual higher winter demand and in line with long-term seasonal cyclicity<sup>3</sup>.
- **EU domestic gas production continued to decline**. It was **8 bcm**, **5% less than in the previous quarter** and **28% less than in Q4 2022**. **The Netherlands** remained the **largest producer** accounting for one-third (32%) of EU production (2.5 bcm), **followed by Romania** (2.4 bcm, 29%) and **Germany** (1 bcm, 13%).
- **EU gas storage levels reached new record highs**. Storage filling rate was **98% in October**, **99% in November** and **89% in December**. The **average filling rate for the quarter was 95%**, 8% higher than in the previous quarter and 5% higher compared to the fourth quarter of 2022.

#### EU gas imports in Q4 2023

- **EU gas imports** amounted to **74 bcm**, a **9% increase quarter-on-quarter** and **3% increase year-on-year**. **Pipeline gas** constituted **59% of imports** and **LNG** was **41%**
- **EU pipelines imports** amounted to **44 bcm**, an **increase of 7.3% compared to the previous quarter**, and **4.2% decline year-on-year**. **Norway** remained the **EU's biggest pipeline gas exporter** with a **share of 50%** (22 bcm), followed by **North-Africa** (19%), **Russia** (18%) and **Azerbaijan** (7%).
- **EU's total gross LNG import was 31 bcm**, an **increase of 11% quarter-on-quarter** and a **decrease of 7% year-on-year**. Compared to 2021, the EU's LNG imports was up 64%. **France** was the **largest EU importer** accounting for a quarter (25%) of total volumes, while **the Netherlands** (16%) held the **second** and **Spain** (16%) the **third position**.
- In the fourth quarter of 2023, the **United States** further increased its share to **50% of EU LNG imports** (from 47% in the previous quarter). **Russia was second** with 16% and **Qatar third** with 12%. **Algeria** (8%), **Nigeria** (4%), and **Norway** (4%) also exported **significant LNG volumes to EU**.
- **Russian gas** represented **17% of EU's total gas imports**, an increase of 16% in terms of volumes compared to the previous quarter and 19% increase year-on-year. Compared to 2021, total Russian gas imports decreased by 64%. Within the Russian imports, pipeline gas amounted to 7.7 bcm, a 9% increase quarter-on-quarter and 22% increase year-on-year. **The share of Russian pipeline gas in EU pipeline imports was 18%**, an increase of 1%-point compared to Q3 of 2023 and 4%-point increase compared to Q4 of 2022. **The share of Russian LNG imports was 16%** with a volume of 4.7 bcm, representing a quarter-on-quarter volumes' increase of 38% and a year-on-year volumes' increase of 7% from a low base.

#### EU wholesale gas prices and markets in Q4 2023

- European **wholesale gas prices continued the rise** that started in the 3<sup>rd</sup> quarter and **peaked at 55 €/MWh** in mid-October. Thereafter, **prices slowly declined during November and December** and reached the **lowest price point of 30€/MWh** on the last trading day of the year. Monthly average spot price was 43.3€/MWh in October, 43.26€/MWh in November and 35.22€/MWh in December 2023. The **quarterly average spot price was 41€/MWh**, **24% increase quarter-on-quarter** (from 33€/MWh) and **57% decline year-on-year** (from 95€/MWh).
- Asia continued to offer a price premium compared to **European gas prices**, which on average were **13% (5.4 €/MWh) lower than prices in Asia**, and were 18% cheaper in the previous quarter. This was a reversal compared to the fourth quarter of 2022, when EU prices were 17% higher than Asian prices. **Quarter-on-quarter, prices increased on all major global benchmarks by between 11% and 28%**, the biggest increase being registered in Europe and the smallest in the US. **Year-on-year global benchmarks declined by between 53% (Asian JKM) and 65% (Dutch TTF)**.

#### EU retail gas prices in Q4 2023

- The decline in **gas retail prices for household consumers** stopped and prices **started to rise in the 4<sup>th</sup> quarter of 2023**. The **quarterly average retail price was 110 €/MWh**, **2% higher** than in the 3<sup>rd</sup> quarter and **31% lower year-on-year**. Compared to the same quarter in 2021, retail prices were 18% higher; they were **64% higher compared to historic prices** (2021's first half). The **energy component** constituted **56%** of the price, while **network costs** amounted to **20%**, **energy taxes 9%** and **value added tax (VAT) 15%**, as EU average.
- **Retail prices continued to diverge** across the EU and **ranged between 26 €/MWh (Hungary) and 164 €/MWh (the Netherlands)** amongst those Member States, where natural gas is an important part of the energy mix for residential customers. The highest price (286 €/MWh) was registered in Sweden, where gas use at retail level is marginal.

<sup>3</sup> Values (volumes and percentages) are rounded to the nearest integer or, when needed for the purposes of clarity, to the nearest one or two decimals in the Highlights. Due to the rounding of partial amounts, their addition may result in totals that are higher or lower than 100%.

## Highlights of the year 2023:

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

- In 2023, the **EU's total gas consumption** amounted to **330 bcm**, a **7% decline compared to 2022** (356 bcm) and a **20% decline compared to 2021** (413 bcm).
- **At Member States level**, the quarter-on-quarter **change in gas consumption ranged from a decline of 20% to an increase of 24%**. In 2023, **gas consumption decreased in 21 Member States compared to 2022**, while in **five Member States** there was a **rebound following steep and sudden declines earlier**. Compared to 2021, almost **all Member States experienced significant declines in gas consumption ranging from 37% to 7%** with 5 Member States registering above 30% decline and 12 Member States above 20% decline.
- **EU gas production was 38 bcm** in 2023, a **decline of 20% compared to 2022** (47 bcm) and **26% less than in 2021** (51 bcm). **Domestic gas production covered 11% of domestic gas consumption in 2023**, 2%-points less than in 2022 (13%). The **number one producer** continued to be **the Netherlands** accounting for **close to one third (31%, 12 bcm) of EU domestic gas**. **Romania** kept its **second** position (9.3 bcm, 25%), while **Germany** moved to the **third** place (4 bcm, 11%).
- **In 2023, the average gas storage filling rate was 79%** (874 TWh, 90 bcm), **30% higher compared to 2022** (61%, 676 TWh or 69 bcm) and **49% higher** (53%, 595 TWh, 61 bcm) **compared to the level in 2021**.

### EU gas imports in 2023

- **Total EU gas imports** amounted to **290 bcm**, a **13% decrease** compared to **2022** (335 bcm) and **14% less than in 2021** (336 bcm). **Norway** provided **30%**, the **United States 19%**, **Russia 15%**, **North-Africa 14%**, **UK 6%**, **Qatar 5%**, **Azerbaijan 4%**, **Nigeria 3%**, **Trinidad & Tobago 1%**, and other LNG suppliers **3% of EU's total gas imports** in 2023.
- **The share of LNG in 2023 was 42%**, while **pipeline gas from Norway constituted 29%**, **pipeline gas from Russia 9%**, **from North-Africa (Algeria) 11%**, **from Azerbaijan 4%** and from the **UK 6% of total EU imports**.
- **The EU's total pipeline gas imports in 2023 was 169 bcm**, a **22% decrease compared to 2022** (216 bcm) and **37% decrease compared to 2021**.
- **In 2023, Norway was the largest pipeline gas supplier** of the EU with a market share of **49% sending 83 bcm to the EU**. Its market share increased from 40% (87 bcm) in 2022 and from 30% (79 bcm) in 2021. **North-Africa** was the **second largest source of pipeline gas** to the EU, with a market share of **19%** (33 bcm), which was an increase from 16% (34 bcm) in 2022 and 14% (37 bcm) in 2021. **Russia's import declined** to the third position with a **market share of 15%** (25 bcm) **in 2023**, a **large decrease from 28%** (61 bcm) **in 2022** and an even bigger fall **from 51%** (137 bcm) **in 2021**. **Azerbaijan** steadily **increased** its market share from 3% (8 bcm) in 2021 **to 5%** (11 bcm) in 2022 and **7%** (11 bcm) **in 2023**. The UK remained a balancing supplier exporting large volumes to the EU during the most critical period of the transitioning away from Russian gas by providing 10% (17 bcm) of EU imports in 2023, 11% (24 bcm) in 2022, and only 2% (5 bcm) in 2021.
- In 2023, **EU LNG imports** amounted to **121 bcm**, an **increase of 3%** (from 118 bcm) **in 2022** and **78%** (68 bcm) **more than in 2021**. The **largest LNG importer was France** (22%, 27 bcm) **in 2023**. **Spain** (18%, 23 bcm) and **the Netherlands** (17%, 21 bcm) occupied the **second** and **third positions**. On the supply side, the **largest LNG exporter to the EU was the United States** with a **46% (56 bcm) share**, followed by **Russia** (15%, 18 bcm) and **Qatar** (13%, 16 bcm) **on the second** and **third places**, respectively.
- **Total global LNG trade was 562 bcm**, an **increase of 1 % compared to 2022** (556 bcm), and **3.4% increase compared to 2021** (544 bcm).
- **In 2023, the world's largest LNG exporter was the United States** with a share of **22%**, followed by **Australia with 20%** and **Qatar with 19%**. **The next three biggest suppliers were Russia** (8%), **Malaysia** (6%) and **Nigeria** (3%). On the demand side, the **world's largest LNG importer was the European Union** with a share of **26%**, followed by **China** (17%) on the **second** and **Japan** (16%) on the **third place**.

### EU wholesale gas prices in 2023

- The **annual average gas wholesale price** was **41€/MWh**, a **decrease of 67% compared to 2022** (123€/MWh) and a **decrease of 13% compared to 2021** (47€/MWh).
- The **annual average gas retail price** was **116€/MWh**, a **decrease of 17% compared to 2022** (139€/MWh) and **55% higher than the price in 2021** (75€/MWh).

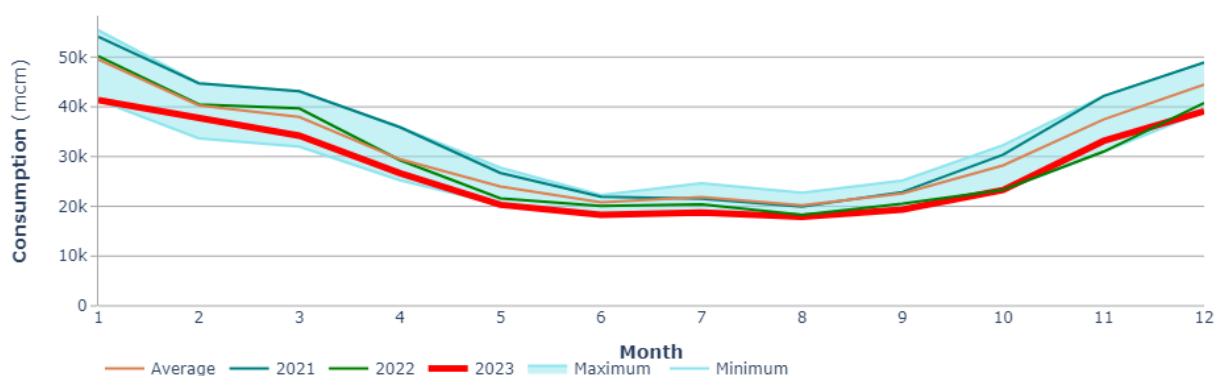
*Methodological Note: The rapid changes in gas and electricity markets happening through the energy transition as well as the significant restructuring of the EU's energy supply following the energy crisis, call for reviewing the Quarterly Reports of the European Electricity and Gas Markets so as to 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>4</sup> in the fourth quarter of 2023 was 96 bcm, an increase of 71% (+40 bcm) quarter-on-quarter reflecting the seasonal cyclicity of gas usage, as well as a rebound from historical low consumption levels in the 3<sup>rd</sup> quarter of 2023. Year-on-year, quarterly consumption shown a slight increase of 0.6% (+0.53 bcm) compared to the same quarter in 2022.

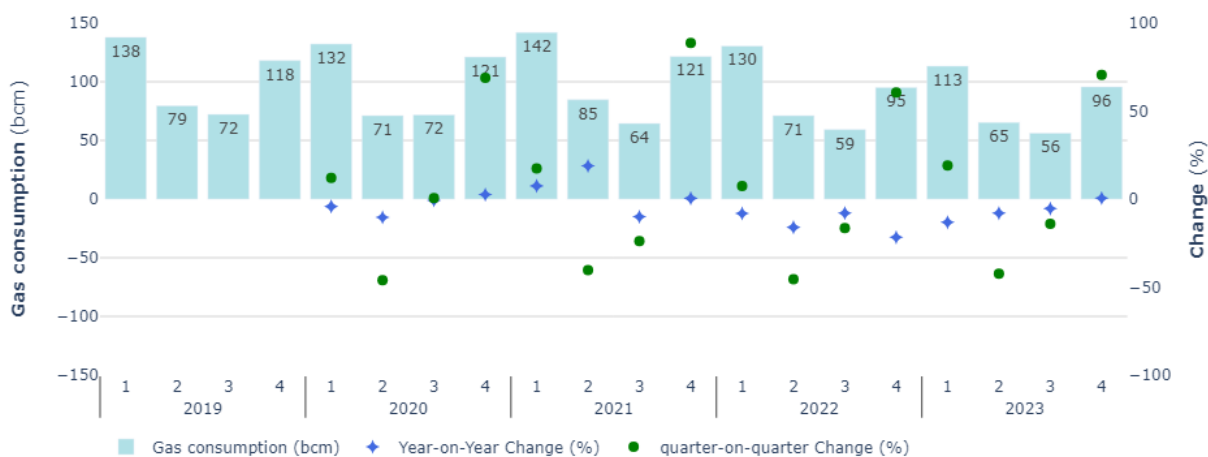
**Figure 1 - EU gas consumption**



Source: Eurostat.

- Figures 2 and 3 show the change in EU's gas consumption year-on-year in each quarter. In the fourth quarter, the continuous year-on-year decline in the consumption volumes of each quarter halted, and for the first time, there was a slight increase. This halt indicated a stabilisation at a low level after a steep fall compared to the consumption range in the last seven years. Thus, fourth quarter EU gas consumption reached a floor at around 95-96 bcm compared to a range around 120 bcm in the period of 2016-2022.
- Figure 4 highlights the quarter-on-quarter variations in the EU's gas consumption. In the fourth quarter of 2023, the EU consumed 71% (+40 bcm) more natural gas than in the third quarter of 2023 in line with the seasonally high demand during the winter heating period, when usually – and similarly to the first quarters of the year – gas demand reaches its peak. Consumption also increased year-on-year by 0.6% (+0.52 bcm)<sup>5</sup> indicating a possible halt in the fall of demand after steep and sudden decreases stemming from demand reduction efforts and demand destruction following the combined effects of the EU's gas saving obligation and historically still high gas prices.

**Figure 2 – Gas volumes and change (year-on-year, quarter-on-quarter) of EU gas consumption**

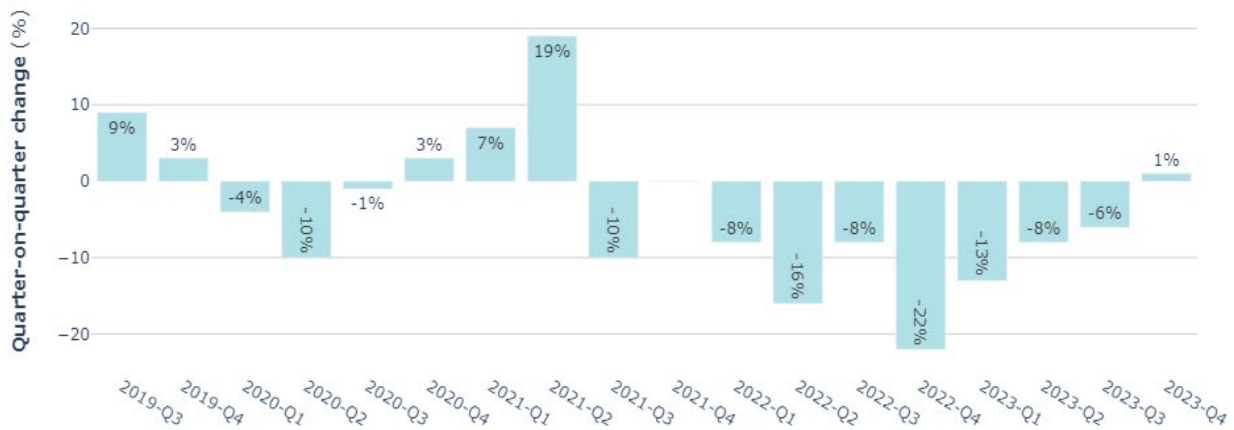


Source: Eurostat.

<sup>4</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.

<sup>5</sup> Rounded to 1% and 1 bcm in the related charts.

**Figure 3 - Year-on-year change (%) in EU's gas consumption per quarter**



Source: Eurostat.

**Figure 4 - Quarter-on-quarter change in EU27 gas consumption in each quarter**



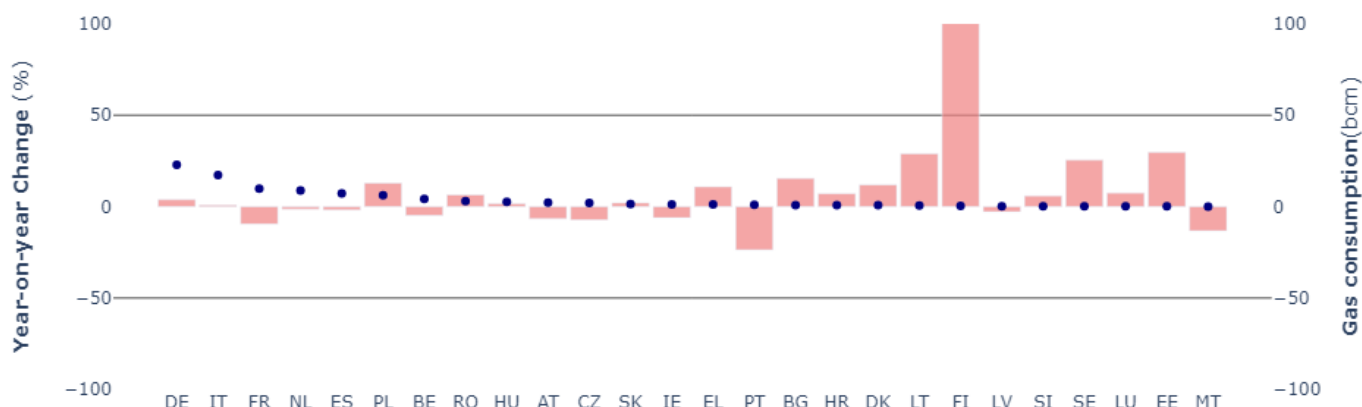
Source: Eurostat.

- In a year-on-year comparison, gas consumption increased in 16 Member State and decreased in 10 Member States<sup>6</sup>. The largest increase was recorded in Finland (+106%), where gas consumption more than doubled, although from a very low base (from 237 mcm in Q4 2022 to 489 bcm in Q4 2023). The other Nordic and Baltic States saw increases between 25% and 30%, i.e. Estonia +30%, Lithuania +29% and Sweden +25%. These were followed by Bulgaria (+15%), Poland (+13%), Denmark (+12%) and Greece (+11%). High single digit year-on-year growth was experienced in Luxembourg (+7%), Croatia (+7%), Romania (+6%) and Slovenia (+6%). A few percentage point annual increase was recorded in Germany (+4%), Slovakia (2%), Hungary

<sup>6</sup> Cyprus currently does not have statistically reported gas consumption.

+2%) and Italy (+1%). On the decrease side, the steepest annual decline occurred in Portugal (-24%), followed by Malta (-13%), France (-9%), Czechia (-7%), Austria (-7%), Ireland (-6%), Belgium (-5%), Latvia (-3%), Spain (-2%) and the Netherlands (-1%).

**Figure 5 - Year-on-year change in Member States' gas consumption in the fourth quarter of 2023**



Source: Eurostat.

- On a quarter-on-quarter comparison, most Member States recorded gas consumption increase due to the impact of the gas winter season. The largest quarterly increase was recorded in Estonia (+219%). Triple digit surge in gas consumption also occurred in Slovakia (+167%), Latvia (+164%), Romania (+145%), France (+139%), Hungary (+138%), Luxembourg (+136%), Czechia (+136%), Germany (+123%) and Austria (+122%). Double digit growth was recorded in Slovenia (+83%), Poland (+76%) and Denmark (-73%). Significant gas consumption increases were recorded also in Belgium (+69%), Lithuania (+61%), the Netherlands (+50%), Italy (+46%), Sweden (+46%), Croatia (+43%), Bulgaria (+42%) and Finland (+34%) following mild weather in the third quarter. The lowest increases were recorded in Ireland (+19%) and Spain (+6%). In Malta (-29%), Portugal (18%) and Greece (-10%) gas consumption declined in the quarter.

**Annual overview of EU gas consumption in 2023:**

**Gas consumption in the EU and year-on-year comparison**



Source: Eurostat.

- In 2023, the EU's total gas consumption amounted to 330 bcm. This was a 7% decline compared to 2022 ((356 bcm) and 20% decrease compared to 2021 (413 bcm).
- At Member States level, the change in gas consumption ranged from a decline of 20% (Portugal) to an increase of 24% (Finland). In 2023, gas consumption increased in five Member States (Finland, +24%, Sweden +8%, Malta +4%, Poland +4% and Croatia +1%) and decreased in 21 Member States. Portugal registered the biggest decline in annual consumption (-20%), followed by Austria (-15%), Czechia (-13%), France (-12%) and Hungary (-11%). Greece, Spain, Italy and Estonia had a 10% annual decline each, while the rest of the Member States have seen single digit fall in gas consumption.
- Compared to 2021, all Member States but Malta experienced significant declines in gas consumption. The decrease was above 30% in Sweden (=37%), Finland (-34%), Latvia (-34%) and Estonia (=33%), while it was above 20% in Czechia (-28%), Greece (-28%), Luxembourg (-27%), the Netherlands (-26%), Austria (-26%), Bulgaria (-25%), Hungary (-24%), Slovakia (-24%), Portugal (-23%), Denmark (-22%), Romania (-21%) and France (-20%). The remaining Member States registered above 10% decline with the exception of Ireland (-7%). Only Malta's gas consumption grew (+6%) in comparison with 2021 levels.
- EU GDP continued to recover from the energy price shock of the previous year on the back of decreasing energy prices and related moderating price inflation. On a non-adjusted market price basis, EU27 GDP growth recorded a 5% rise corresponding to a 0.2% quarter-on-quarter real growth on an adjusted market price basis.

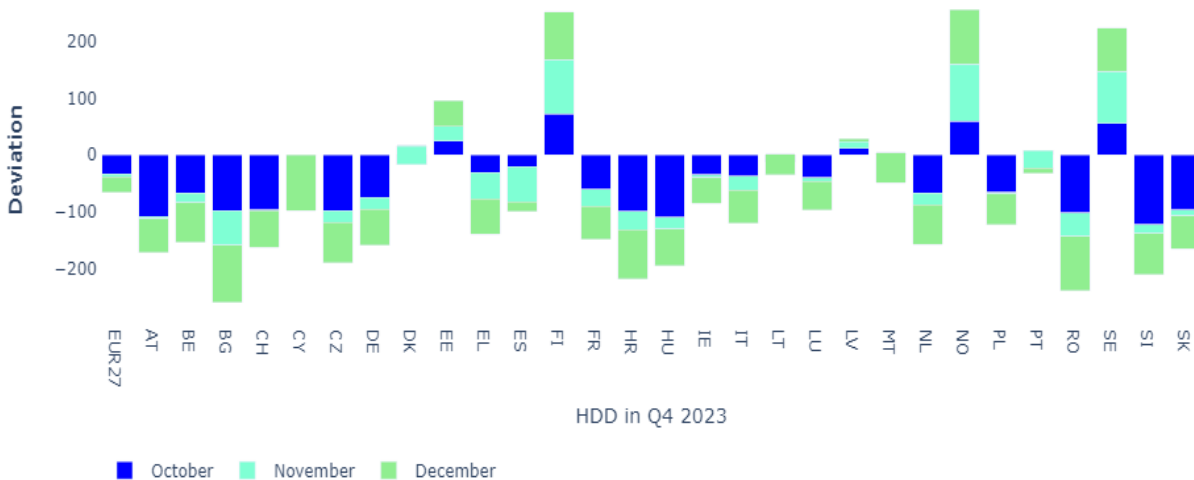
**Figure 6 – Change in EU27 real GDP in year-on-year comparison**



Source: Eurostat.

- Figure 6 illustrates the monthly deviation of actual Heating Degree Days (HDDs) from the long-term average (a period between 1979 and the last calendar year completed) in the fourth quarter of 2023. In most of Europe, milder than usual temperatures resulted in less HDDs during Q4 2023 continuing the prevailing trend of recent years.

**Figure 7 – Deviation of actual Heating Degree Day (HDD) from the long-term average in Q4 of 2023**



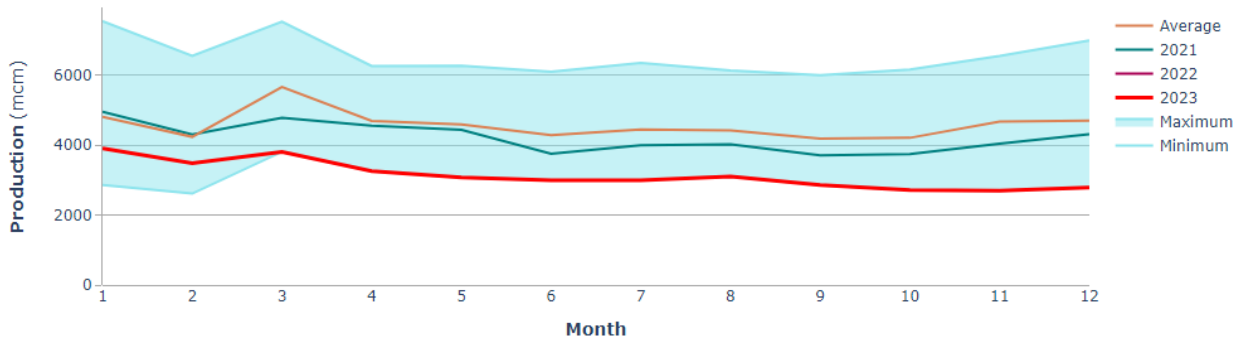
Source: JRC.

## 1.2 Production

- The EU's domestic gas production was 8.2 bcm, a decrease of 8% compared to the previous quarter (9 bcm) and a 28% decline year-on-year (from 11.4 bcm)<sup>7</sup>. Average monthly production was 2.8 bcm, 7.7% decrease compared to the previous quarter (3 bcm), and 28.4% less than in the same quarter of 2022 (when the monthly average was 3.8 bcm). Since 2014, EU Q4 gas production declined by 75% (-25 bcm), i.e. a decade ago overall EU domestic gas production was four times the volume produced in the Q4 of 2023 (33.5 bcm versus 8.2 bcm).

<sup>7</sup> Domestic gas production in Poland is not included in Eurostat statistics since September 2023.

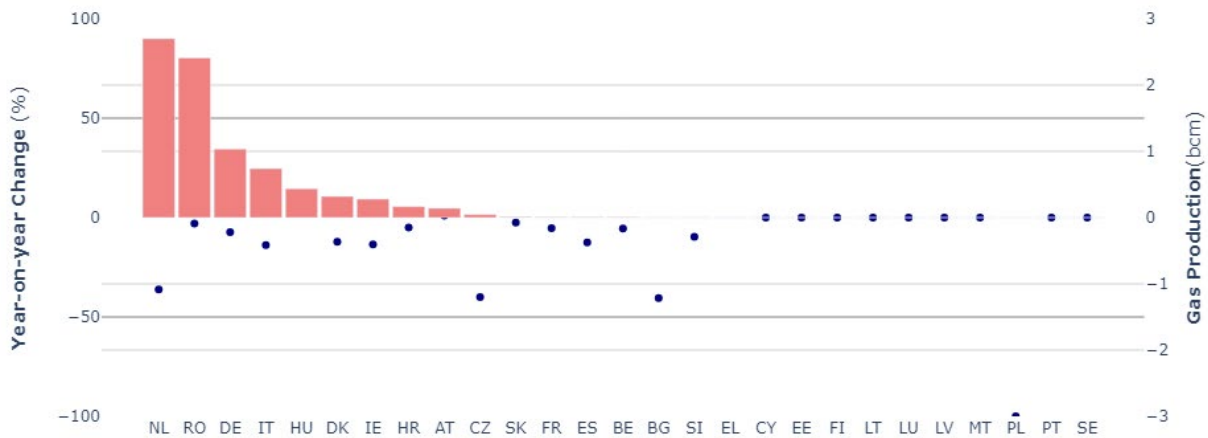
**Figure 8 - Monthly domestic gas production in the EU**



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) do not produce gas in their territories.
- The biggest EU gas producer in the fourth quarter of 2023 remained the Netherlands with a total quarterly production of 2.6 bcm, a increase of 5% since the last quarter and a decrease of 36% year-on-year, i.e., compared to a 4.1 bcm production in the fourth quarter of 2022. Romania kept its second place (2.4 bcm) followed by Germany (1.0 bcm).
- In a year-on-year comparison, production in all producing Member States fell with the exception of Hungary (+11%), Austria (+1%) and Greece (from zero in the statistics). Compared to the previous quarter, production grew in 12 Member States (BG, DK, DE, IE, GR, ES, FR, HR, HU, NL, AT, RO), while in four Member States (CZ, IT, SI, SK) there was a decline of between 1% and 3%. The biggest quarterly increase (+162%) was recorded in France, where volume returned to historic levels after a dip in Q3 2023. Spain increased production by 36%, while Ireland increased it by 34%, Hungary by 16% and Bulgaria by 10%. The rest of the increases remained below 10%.

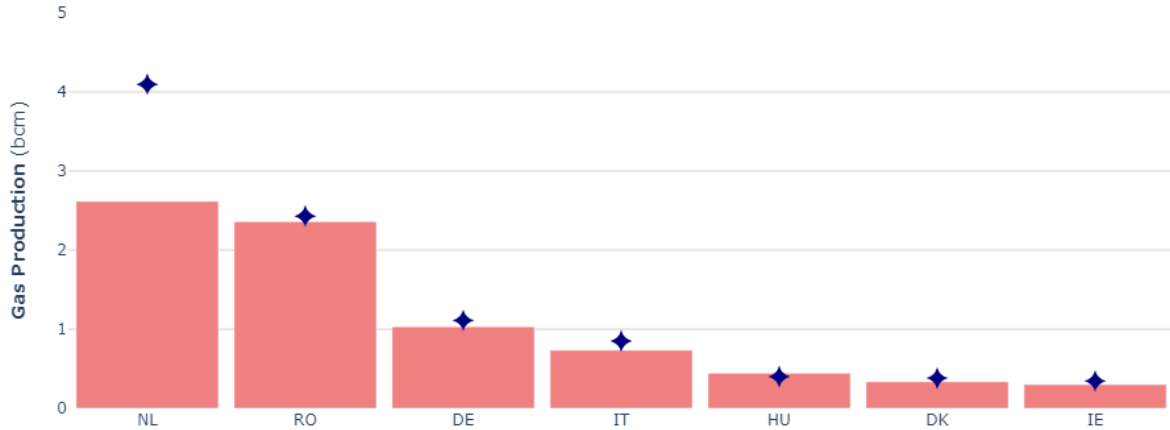
**Figure 9 - Quarterly gas production in EU Member States in Q4 of 2023**



Source: Eurostat.

- The top three gas producers in the fourth quarter of 2023 were the Netherlands (2.6 bcm, 32%), Romania (2.4 bcm, 29%) and Germany (1 bcm, 13%). These top three producers provided 73% (6 bcm) of the EU's domestic gas supply. The first five producers (NL, RO, DE, IT, HU) accounted for 88% (7.2 bcm) of EU gas production.

**Figure 10 - The ten biggest domestic gas producer Member States in the EU in Q4 of 2023**



Source: Eurostat.

**Annual overview of domestic gas production for 2023:**

**Gas production in the EU**



Source: Eurostat.

**Part of the EU gas consumption covered by domestic gas production**



Source: Eurostat.

**TOP 3 Gas producers in the EU in 2023 compared to 2022**



Source: Eurostat.

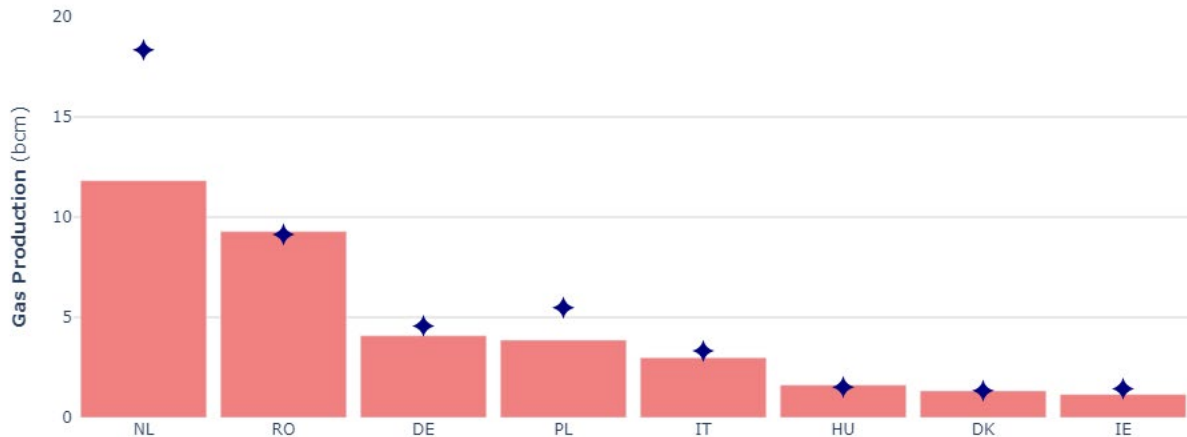
- On annual basis, the EU 2023 gas production amounted to 38 bcm covering 11% of the EU's gas consumption in 2023. This was 2%-point less than in 2022, when the EU's domestic production covered 13% of EU consumption, and 1%-point less than in 2021, when it covered 12% of consumption. The declining coverage reflected declining production. EU gas production declined by 20% compared to 2022 (47 bcm) and by 26% compared to 2021 (51 bcm). Over the last ten years, EU domestic gas production displayed an uninterrupted series of decline: -20% in 2023, -7% in 2022, -7% in 2021, -22% in 2020 and so on back to 2014, when the EU produced almost 4 times (115 bcm) the volumes than the volumes it produced in 2023 (38 bcm).
- On an annual basis, the number one producer continued to be the Netherlands accounting for close to one third (31%, 12 bcm) of EU domestic gas. Romania kept its second position (9.3 bcm, 25%), while Germany moved to the third place (4 bcm, 11%), replacing Poland, which came in on the fourth



position (3.9 bcm, 10%)<sup>8</sup>. The fifth and sixth places were occupied by Italy (3 bcm, 8%) and Hungary (1.62 bcm, 4%) in 2023. They were followed by Denmark (1.32 bcm, 3%), Ireland (1.15 bcm, 3%), Croatia (0.7 bcm, 2%) and Austria (0.56 bcm, 1%). The remaining eight Member States supplied less than one percent each, and together they constituted 0.8% of the EU domestic gas production in 2023.

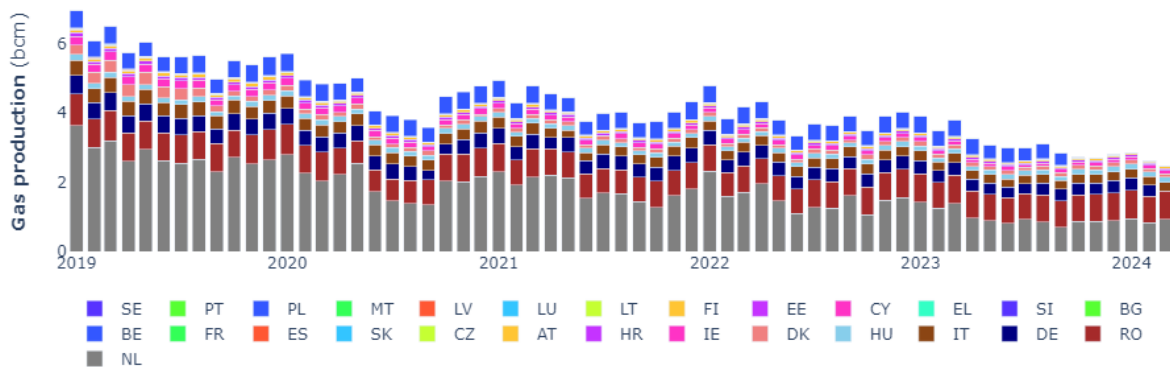
- In 2022 and 2021, the annual ranking was similar to that of 2023 with the difference that Poland was the third largest producers instead of Germany. It is noteworthy that while the Netherlands kept its first position, the volumes it supplied decreased steadily from 21.7 bcm (41%) in 2021 to 18.3 bcm (39%) in 2022 and to 11.8 bcm (30%) in 2023. The list of the ten biggest EU producers also was the same in 2021-2022, but Hungary, Denmark and Ireland alternated on the sixth, seventh and eighth position depending on the year.

**Figure 11 - The ten biggest domestic gas producer Member States in the EU in 2023**



Source: Eurostat.

**Figure 12 - Monthly gas production in the EU**



Source: Eurostat.

- Electricity generation from natural gas amounted to 87.6 TWh in the fourth quarter of 2023, a decrease of 2.1% compared to the previous quarter (89.5 TWh) and a reduction of 21.5% year-on-year (111.5 TWh)<sup>9</sup>. While gas-fired electricity generation constituted 16%<sup>10</sup> of total electricity generation in the quarter, in terms of gas consumption around 18% of the EU's total gas usage was dedicated to power production<sup>11</sup>. This was around 1.12 bcm less than in the previous quarter, while the overall volume of gas for all end-use was significantly more (+71%, +40 bcm) resulting in a 15%-point decrease in the share of gas usage for power generation in the total gas consumption compared to the previous quarter. Year-on-year gas consumption

<sup>8</sup> Poland's domestic gas production is no longer reported in EU statistics as of September 2023. The annual volume of 3.9 bcm ((3862 mcm) thus is the sum of the production of the period January-September and does not include October, November, December, i.e., Q4 of 2023. There is therefore no production volume for Poland in Q4 of 2023. This is reflected in Figure 12, where Poland is no longer present starting in October 2023.

<sup>9</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 106 TWh EU gas fired power generation in Q4 2023 and 108 TWh in Q3 of 2023.

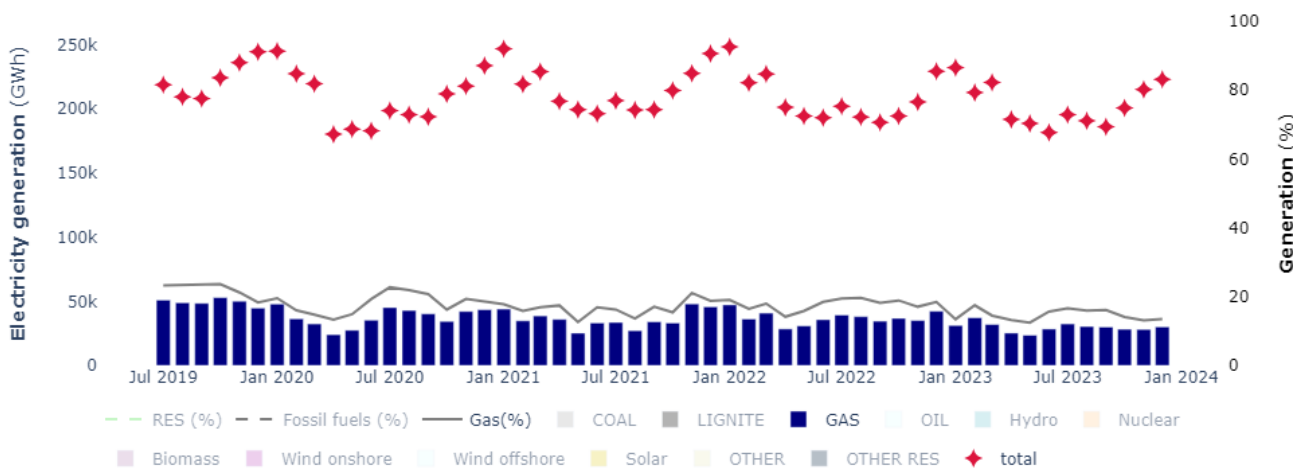
<sup>10</sup> The share of gas-fired power generation in total EU power generation is based on Eurostat data (see nrg\_cb\_pem; Net electricity generation by type of fuel - monthly data). ENTSO-E data indicates lower shares for gas-fired power generation in total power generation: around 14% for Q4 2023, 16% for Q3 2023 and 18% for Q4 2022.

<sup>11</sup> Assuming an overall 50% generation efficiency of EU gas fired plants as an average.

for power generation declined by 25% (-5.54 bcm). The share of gas fired power generation in total EU electricity production decreased by 2%-point quarter-on-quarter (from 18% to 16%) and declined 4%-point (from 20%) year-on-year.

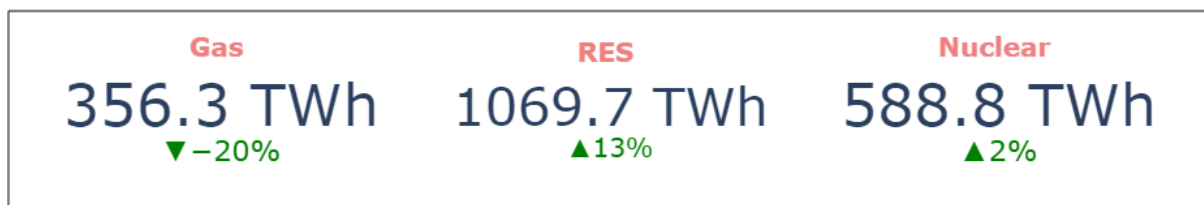
- On an annual basis, the total gas-fired power generation amounted to 436.5 TWh, a 16% decline compared to 2022 (518,2 TWh). The share of gas-fired power generation in 2023 was 17% of the EU's total net power production (2574 TWh), 3%-point less than in 2022, when the share was 20%. In seven Member States, the volume of power generation from gas declined, while it increased in eighteen Member States. The biggest increases were recorded in Poland (+45%), Latvia (+16%), Sweden (+14%), Lithuania (+12%) and Croatia (+11%), while the biggest decreases occurred in Portugal (-39%), Finland (-38%), Austria (-32%), France (-29%), Spain (-28%), Luxembourg (-21%) and Belgium (-20%).
- The biggest share of gas-fired power generation in total power generation were recorded in Malta (86%), Ireland (47%), Italy (46%), the Netherlands (38%) and Greece (33%). On the other end of the spectrum, the smallest gas-fired power shares were reported from Sweden (0.1%), Finland (1%), Slovenia (2%), Denmark (3%) and Luxembourg (4%).

**Figure 13 - Monthly gas-fired power generation in the EU**



Source: ENTSO-E.

### Electricity generation from gas, RES and nuclear in the EU in 2023



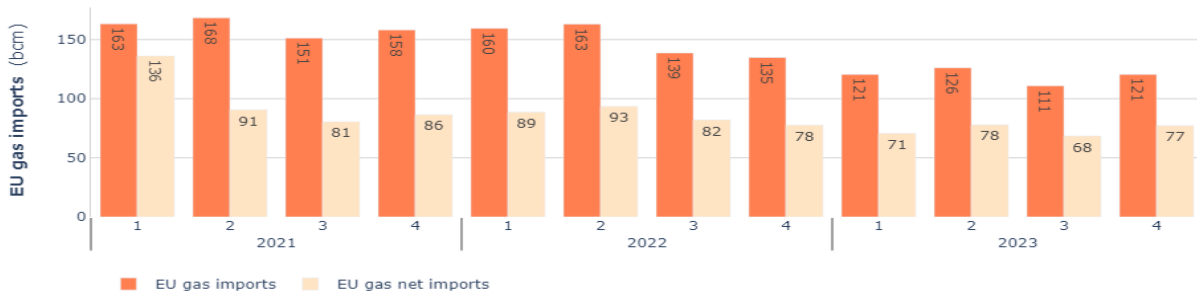
Source: ENTSO-E.

### 1.3 Imports

- According to Eurostat, total gas import in the EU amounted to 121 bcm in the fourth quarter of 2023, a 9% (+10 bcm) increase compared to the previous quarter and a 11% (-14 bcm) decrease year-on-year. Net imports<sup>12</sup> amounted to 77 bcm reflecting 43 bcm export. Net import increased by 13% (+9 bcm) compared to the previous quarter and decreased by 1% (-1 bcm) year-on-year. The continued annual decrease confirmed the structural changes in the EU energy sector as 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 exercised their effect, while the quarterly increase stemmed from the seasonally greater winter consumption of gas.
- On an annual basis, the EU's total net import amounted to 294 bcm in 2023, a decrease of 14% or 47 bcm compared to 2022.

<sup>12</sup> Net imports equal imports minus exports and do not account for stock changes.

**Figure 14 - EU gas imports (gross and net) by quarters**

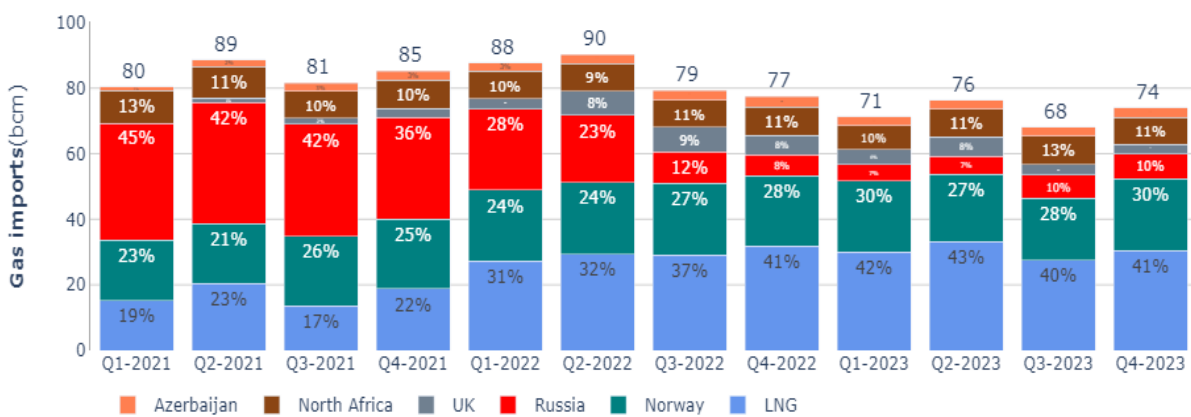


Source: Eurostat.

### 1.3.1. Total EU imports

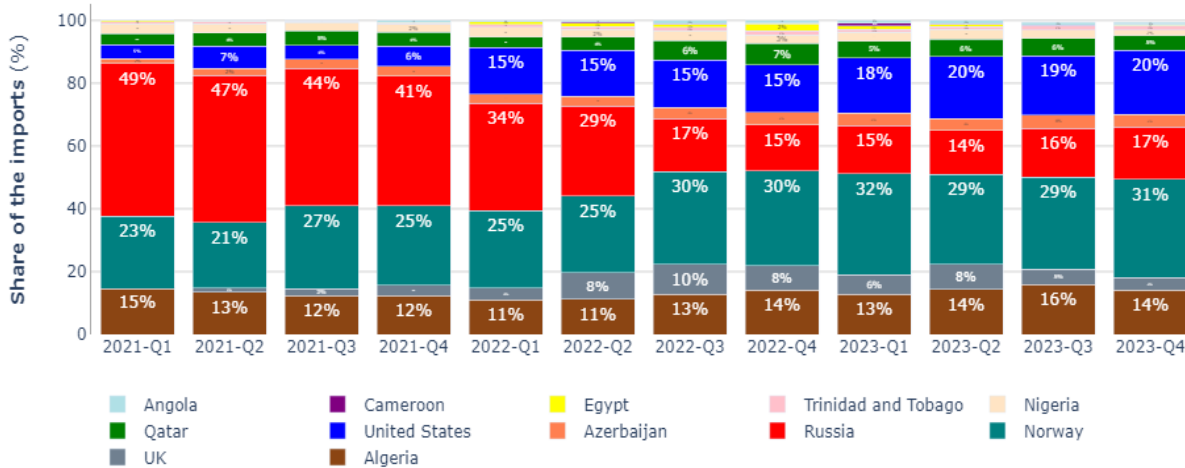
- According to ENTSO-G, which tracks all flows in- and out of the EU, total gas imports by EU Member States amounted to 74 bcm in the fourth quarter of 2023, an increase of 8.8% (+6 bcm) compared to the third quarter of 2023 and a 2.6% (+2 bcm) increase year-on-year. Of the total imports, 59% arrived through pipelines and 41% through LNG cargoes. The share of LNG increased by 1%-point to 41% compared to the previous quarter and remained the same year-on-year (i.e., 41%, i.e. in Q4 of 2022). The quarterly increase in the LNG share was due to a 10.6% (2.9 bcm) increase in overall EU LNG imports resulting from larger imports from some of the EU's main LNG suppliers. LNG flows from the United States were up by 16.2% (2.1 bcm), while Russia (+40.6 %, +1.4 bcm), Algeria (+7.5%, +0.16 bcm), and Norway (+6.4%, +0.07 bcm) also exported more LNG to the EU. The volume of pipeline imports also increased by 7.3% (+2.9 bcm) compared to the previous quarter, mainly due to an increase in the pipeline imports from Norway (+3 bcm, +16%), and smaller increases in the pipeline imports from Russia (+9%, 0.6 bcm) and Azerbaijan (+6%, -0.17 bcm).
- In a year-on-year comparison, total EU gas import in the fourth quarter declined by 4.4% (-3.4 bcm) due mainly to decrease in the pipeline gas flow from the UK (-50%, -2.9 bcm), North Africa (-7.8%, -0,7 bcm) and Azerbaijan (-2.2%, -0.1 bcm), combined with a 4.6% (-1.5 bcm) decrease in EU LNG imports.
- Looking at the entire year, total EU gas imports combining pipeline and LNG were 290 bcm, a 13% decrease compared to 2022 (335 bcm) and 14% decrease compared to 2021 (336 bcm), the last year before the Ukraine crisis started.

**Figure 15 - EU imports of natural gas (share of pipeline imports by country and share of LNG)**



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

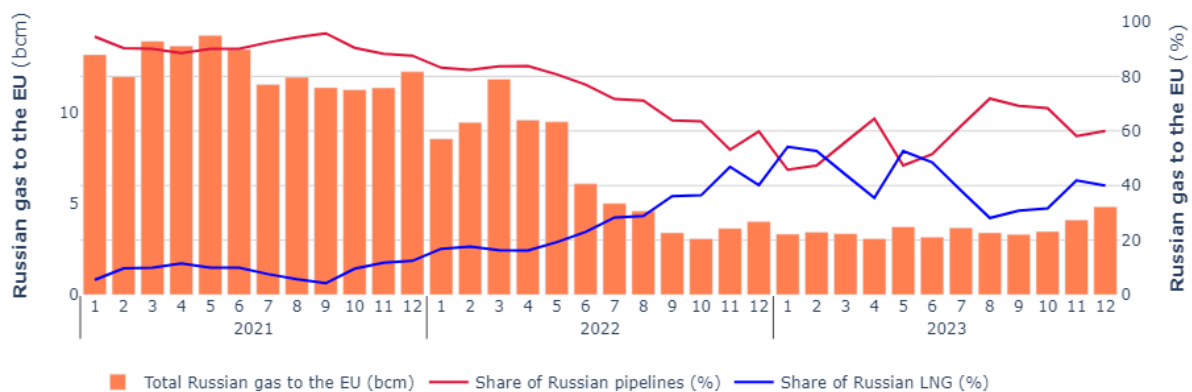
**Figure 16 – Quarterly share of gas imports within the total, combining both pipeline and LNG imports**



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

- In the fourth quarter of 2023, total Russian pipeline gas export to the EU amounted to 7.7 bcm or 10% of total EU gas imports. This was an increase of 9% (+0,64 bcm) compared to the previous quarter, but did not change the share of Russian gas, which was 10% also in the third quarter of 2023. Year-on-year, the Russian pipeline volume increased by 21.8% (+1.4 bcm) in the fourth quarter, and its share in total EU imports increased by 2 percentage points (from 8% in Q4 of 2022). Compared 2021, Russian pipeline imports to the EU decreased by 75% (-23.3 bcm) and its share in total EU imports fell by 16 percentage points (from 36%).
- Total Russian gas exports, combining pipeline and LNG imports, was 12.4 bcm in the fourth quarter of 2023, a 19% increase compared to the previous quarter (+2 bcm) and 16% increase (+1,7 bcm) year-on-year. Compared to the fourth quarter of 2021, total Russian gas exports were down by 64% (-22.5 bcm).
- Within the overall Russian exports, the share of pipeline gas was 62% on a quarterly basis, a decrease of 5 percentage points from 67% in the previous quarter, but 3 percentage points higher than a year earlier (when it was 59%). Despite fluctuations, the importance of LNG in overall Russian exports has increased compared to the historic Russian gas export structure to the EU.

**Figure 17 – Monthly pipeline and LNG imports from Russia**

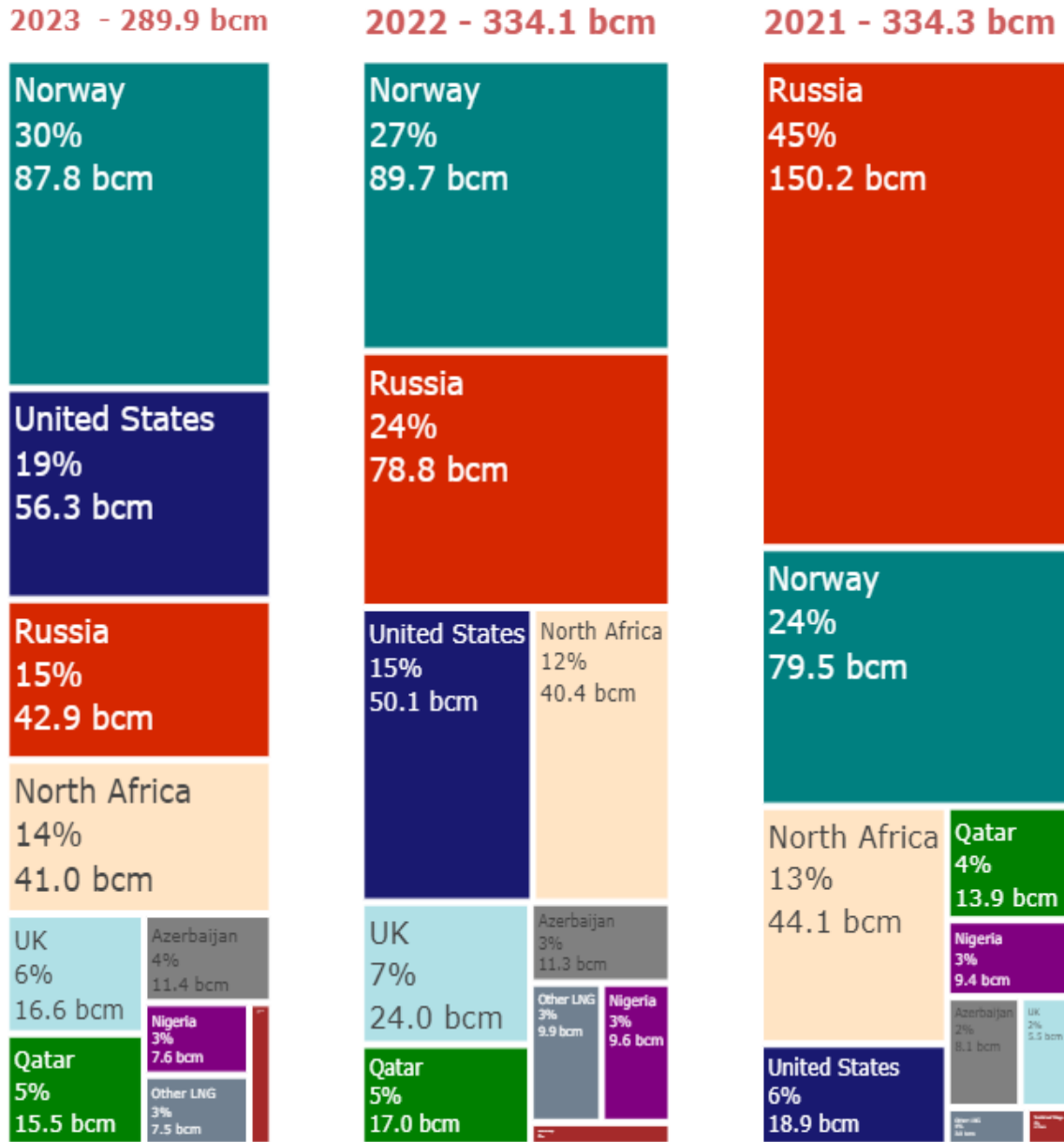


Source: Based on data from LSEG (Refinitiv) and from the ENTSO-G Transparency Platform

**Annual overview of the EU's total gas imports in 2023:**

- Total EU gas imports amounted to 290 bcm, a 13% decrease compared to 2022 (335 bcm) and 14% less than in 2021 (336 bcm). Norway provided 30%, the United States 19%, Russia 15%, North-Africa 14%, UK 6%, Qatar 5%, Azerbaijan 4%, Nigeria 3%, Trinidad & Tobago 1% and other LNG suppliers 3% of EU's total gas imports in 2023.

**Highlight - Total EU gas imports (pipeline + LNG) by suppliers**



Source: ENTSO-G, LSEG (Refinitiv).

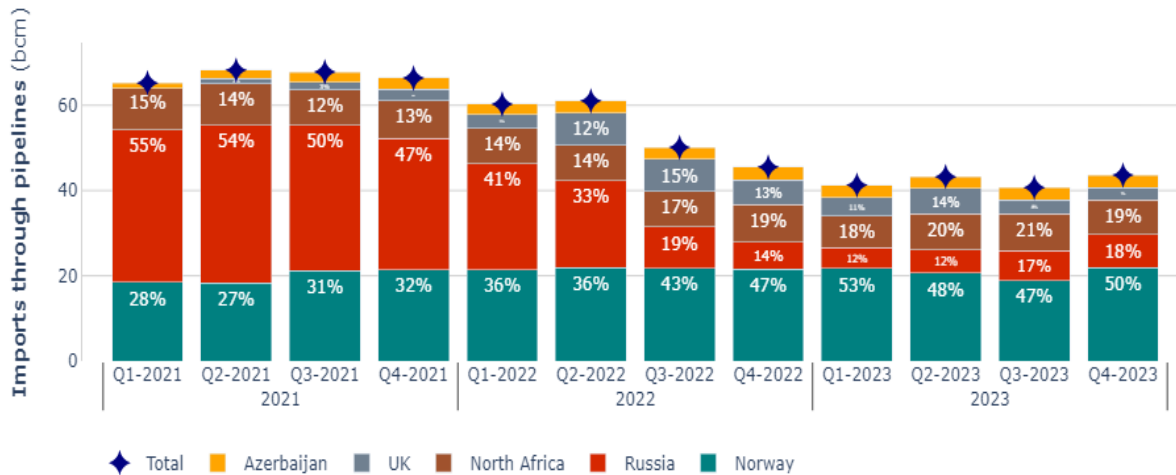
**1.3.2 Pipeline imports**

- EU pipelines import was 43.6 bcm in the fourth quarter of 2023, an increase of 7.3% compared to the previous quarter, an a 4.2% decline year-on-year.
- Norway remained the EU's biggest pipeline gas exporter with a share of 50% (22 bcm), up from a 47 % in the previous quarter. The second largest exporter to the EU remained North-Africa with a 19% export share (8 bcm), followed by Russia (18%, 8 bcm) and Azerbaijan (7%, 3 bcm). The UK fell to

the fifth position (6.7%, 2.9 bcm). The increase in the Q4 2023 pipeline volumes was the result of a 3 bcm increase in imports from Norway, a 0.6 bcm increase from Russia and a 0.4 bcm increase from Azerbaijan.

- Comparing import shares, Norway's share increased 3 percentage points both on a quarter-on-quarter and year-on-year basis, while North-Africa lost 2 percentage points (from 21%) compared to the previous quarter and kept steady compared to a year ago (19%). Azerbaijan's exports to the EU were stable around 3 bcm each quarter amounting to a 7% share in Q4 2023, Q3 2023 and Q4 2022. Russia's market share increased by 1 percentage point quarter-on-quarter (from 17%) and 4 percentage points year-on-year (14%). The UK lost market share, which fell to 7%, down 1 percentage point from 8% in the previous quarter and down 6 percentage points from 13% in Q4 of 2022.

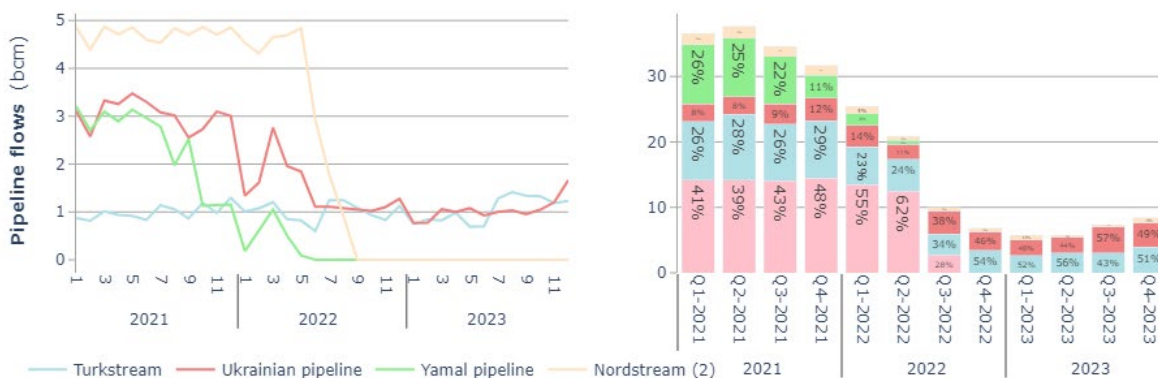
**Figure 18 – Quarterly EU imports of natural gas from pipelines**



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

- In the fourth quarter of 2023, the two main remaining transit routes for Russian pipeline gas exports through Ukraine and Turkey transported 47% and 45% of the Russian gas volumes, respectively. This reversed the ranking of the flows from the previous quarter where the Turkish *Turkstream* pipeline carried the larger volumes, 55%, while the Ukraine route carried 41%. Flows on the other main Russian pipeline routes coming to Europe (*Nordstream*, and *Yamal*) remained at zero, the Baltic line carried 9% in the quarter, a slight increase from 5% in the previous quarter.
- During the fourth quarter of 2023, the monthly amount of gas passing through the Turkstream route was relatively stable at around 1.2 bcm per month, while flows on the Ukraine pipeline increased to 1.7 bcm in December from a 1 bcm in October and 1.2 bcm in November 2023.

**Figure 19 – Monthly and Quarterly EU imports of natural gas from Russia by supply route**



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

**Annual overview of the EU's pipeline imports in 2023:**

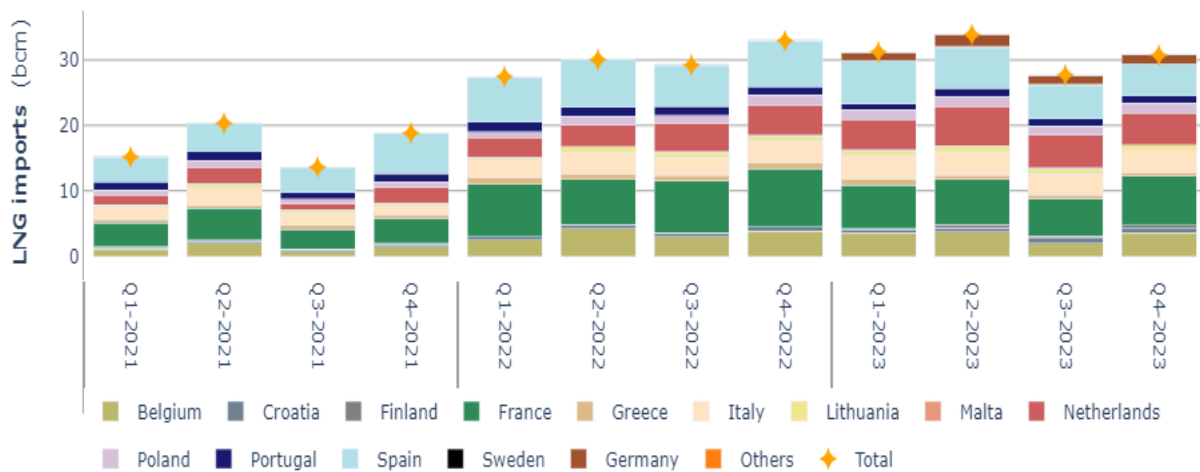
- The EU's total pipeline gas imports in 2023 was 169 bcm, a 22% decrease compared to 2022 (216 bcm) and 37% decrease compared to 2021.
- In 2023, Norway was the largest pipeline gas supplier of the EU with a market share of 49% sending 83 bcm to the EU. Its market share increased from 40% (87 bcm) in 2022 and from 30% (79 bcm) in 2021. North-Africa was the second largest source of pipeline gas to the EU, with a market share of 19% (33 bcm), which was an increase from 16% (34 bcm) in 2022 and 14% (37 bcm) in 2021. Russia's import declined to the third position with a

market share of 15% (25 bcm) in 2023, a large decrease from 28% (61 bcm) in 2022 and an even bigger fall from a 51% (137 bcm) market share in 2021. Azerbaijan steadily increased its market share from 3% (8 bcm) in 2021 to 5% (11 bcm) in 2022 and 7% (11 bcm) in 2023. The UK was a balancing supplier exporting large volumes to the EU during the most critical period of the transition away from Russian gas by providing 10% (17 bcm) of EU imports in 2023, 11% (24 bcm) in 2022, while only 2% (5 bcm) in 2021.

### 1.3.3 LNG imports

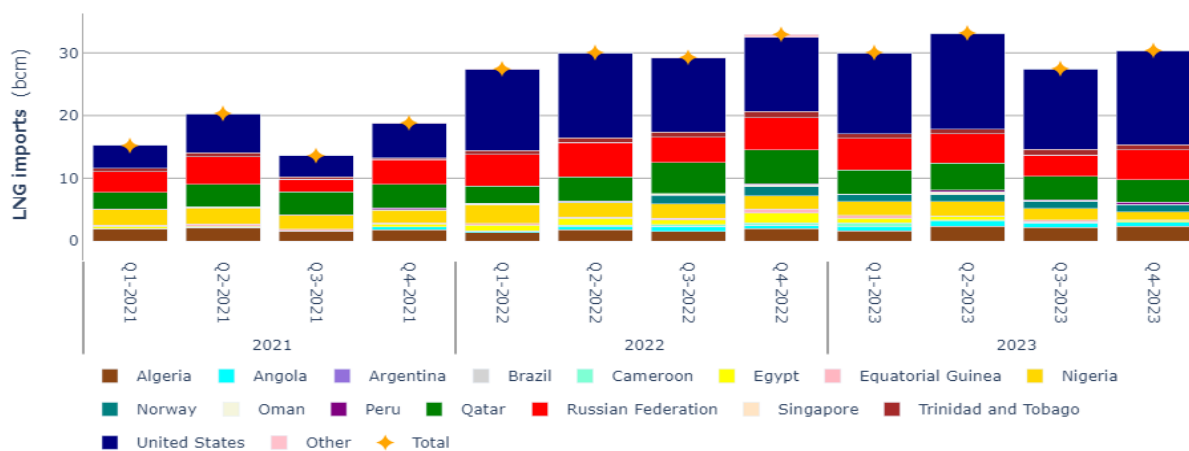
- In the fourth quarter of 2023, total gross EU LNG import was 30.8 bcm, an increase of 11% (+3 bcm) compared to the previous quarter and a decrease of 7% (-2.15 bcm) year-on-year. However, compared to 2021, the EU's LNG imports was up 64% (+12 bcm).
- France kept and strengthened its number one position by importing a quarter (25%, 7.6 bcm) of the EU's LNG. The Netherlands took the second position (16% (4.9 bcm), while Spain became the third largest importer (16%, 4.8 bcm). Belgium (12%, 3.6 bcm) and Italy (12%, 3.6 bcm). remained in the top five LNG importers in Europe with almost identical import volumes and shares, followed remotely by Poland (5%, 1.5 bcm) and Germany (4.5%, 1.4 bcm).
- In the fourth quarter of 2023, the United States further increased its share in EU LNG imports by a share of 50% (15 bcm), an increase from 47% share (13 bcm) in the previous quarter. Russia took the second position from Qatar by increasing its share to 16% (4.8 bcm) from 12% (3,4 bcm) in the third quarter. Qatar was the third largest LNG exporter, but its share decreased to 12% (3.6 bcm) from 14% (3.8 bcm) in Q3 2023 and from 17% (5.4 bcm) in the same quarter a year earlier. In the fourth position, Algeria had 8% (2.3 bcm) share in LNG exports to the EU. Nigeria (4%, 1.6 bcm) and Norway (4%, 1.4 bcm) also provided significant LNG volumes to EU.

**Figure 20 - LNG imports to the EU by Member States**



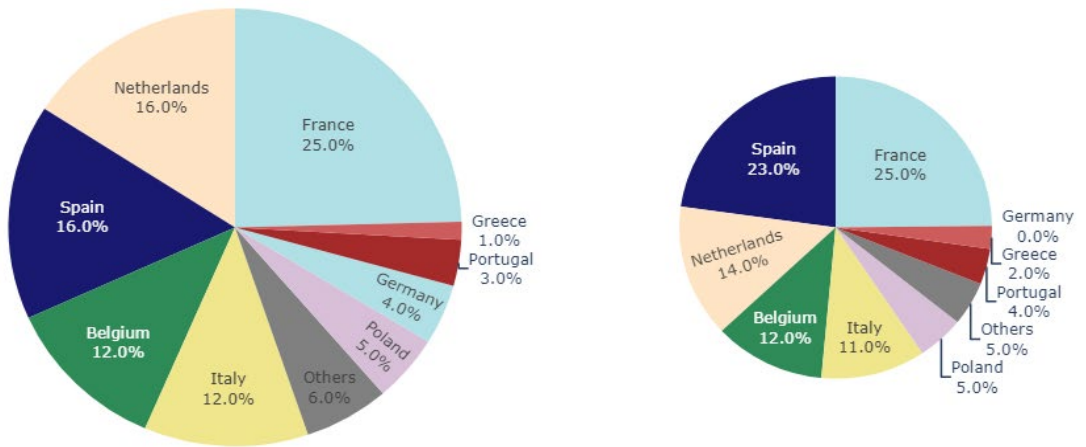
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 21 - LNG imports to the EU by supplier countries**



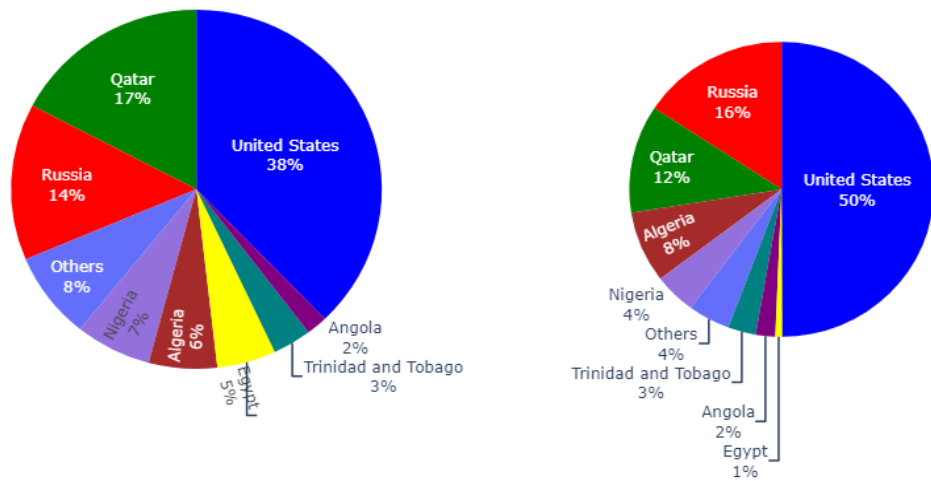
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 22 – Share of Member States in EU LNG imports in Q4 2023 (right) and Q4 2022 (left)**



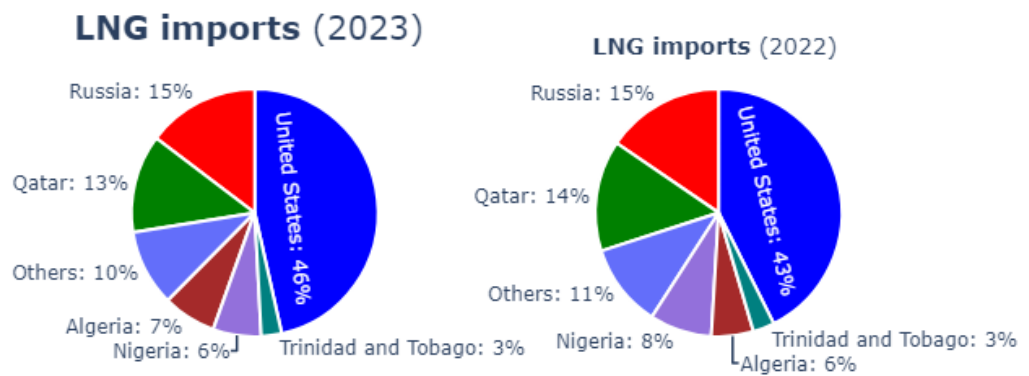
Source: LSEG (Refinitiv), 'Others' includes Croatia, Finland, Malta and Sweden.

**Figure 23 – Share of exporters in EU LNG imports in Q4 2023 (right) and Q4 2022 (left)**



Source: LSEG (Refinitiv).

**Annual overview of EU LNG imports for 2023:**





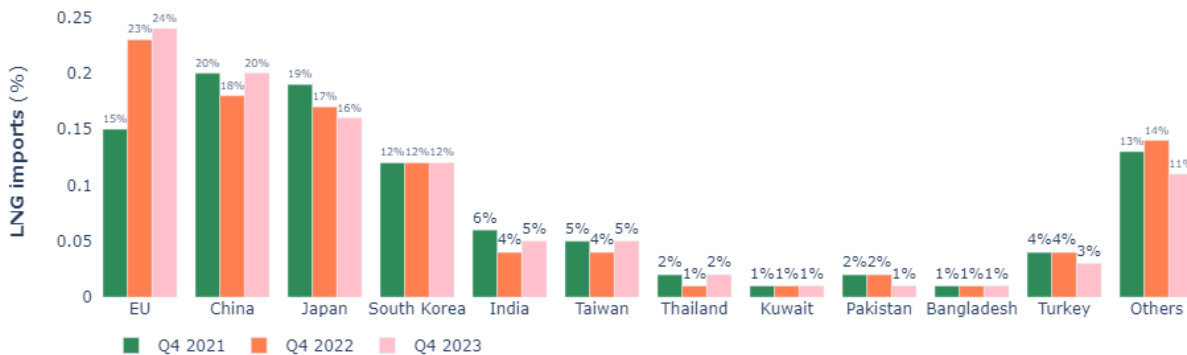
Source: LSEG (Refinitiv).

- In 2023, EU LNG imports amounted to 121.1 bcm, an increase of 3% (from 117.6 bcm) in 2022 and 78% (67.9 bcm) more than in 2021. The largest LNG importer was France (22%, 26.7 bcm) in 2023. Spain (18%, 22.8 bcm) and the Netherlands (17%, 20.7 bcm) occupied the second and third position. They were followed by Italy (11%, 14 bcm) and Belgium (10%, 12.8 bcm) on the fourth and fifth largest LNG importer position. On the supply side, the largest LNG exporter to the EU was the US with a 46% (56.3 bcm) share, followed by Russia (15%, 17.8 bcm) and Qatar (13%, 15.5 bcm) on the second and third place, respectively. Algeria (7%, 8.5 bcm), Nigeria (6%, 7.6 bcm) and Norway (4%, 4.6 bcm) were also significant LNG exporters to the EU occupying the fourth, fifth and sixth market shares, respectively.

## 2. Global LNG Trade

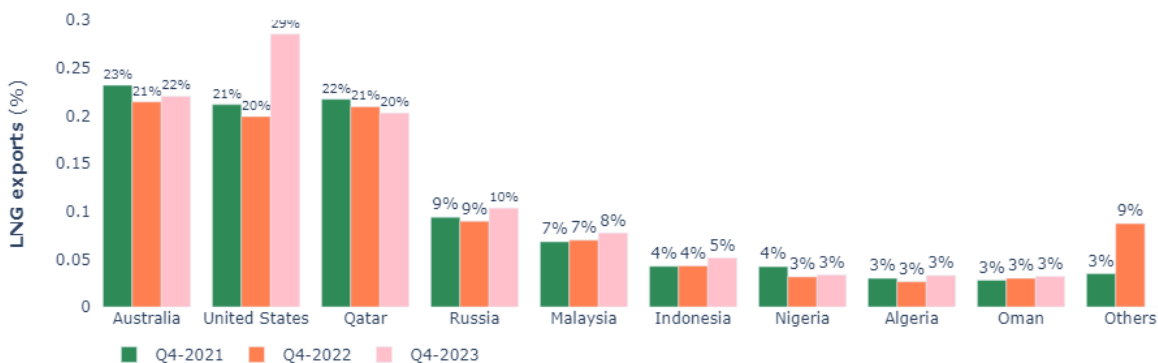
- In the fourth quarter of 2023, the EU continued to hold the number one position as the world's largest importer of LNG with a 24% share in global imports. China was the second largest LNG importer with a 20% share, followed by Japan with 16%, South-Korea (12%) and India (5%). The EU increased its import share by 1 percentage point, while China increased it by 2 percentage points compared to the same period in 2022. Japan market share fell to 16% from 17% in the previous year and from 19% in 2021.
- In the fourth quarter of 2023, global LNG exports amounted to 147 bcm, a 11% (+14 bcm) increase compared to the previous quarter and 3% (+4.4 bcm) year-on-year.
- The biggest LNG exporter remained the United States by 29%, followed by Australia (22%) and Qatar (20%). These three countries together supplied close to three-quarters (71%) of the world's LNG demand.
- Far behind the leading trio, Russia (10%, 9.3), Malaysia (8%) and Indonesia (5%) secured the fourth, fifth and sixth position, respectively, in global LNG exports with single digit shares. Nigeria, Algeria were also important exporters with significant individual market shares in global LNG trade.

Figure 24 – Main global LNG importers in Q4 2023



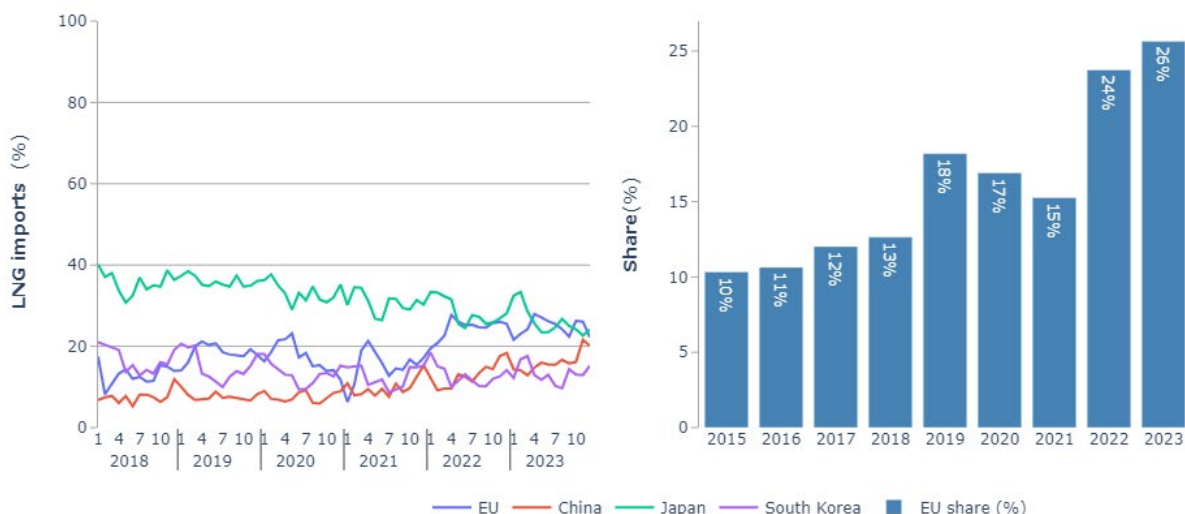
Source: LSEG (Refinitiv).

Figure 25 – Main global LNG exporters in Q4 2023



Source: LSEG (Refinitiv).

**Figure 26 – The most important global LNG importers and evolution of the EU's annual LNG imports share**



Source: LSEG (Refinitiv).

**Annual overview of global LNG trade in 2023:**

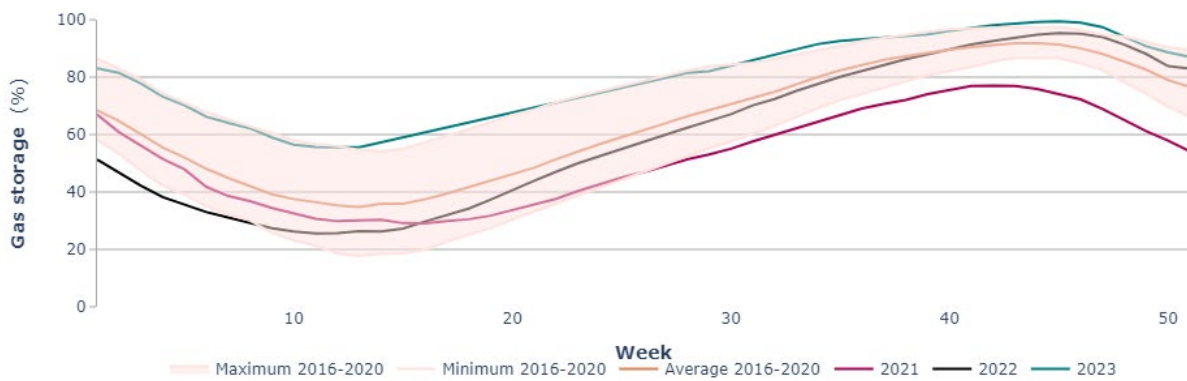
- Total global LNG trade was 562 bcm, an increase of 1.2% compared to 2022 (556 bcm), and 3.4% increase compared to 2021 (544 bcm).
- In 2023, the largest LNG exporter was the United States with a share of 21.7%, followed by Australia with 19.6% and Qatar with 19%. The next three biggest suppliers were Russia (7.6%), Malaysia (6.4%) and Nigeria (3.2%). The main LNG suppliers decreased the volumes of their exports with the exception of the US that increased those by 13.5%. Nigeria's export decreased by 8.6%, while Russia's annual exports fell by 4.8%, Malaysia's exports by 3.1% and that of Qatar by 1.5%. Australia's export was unchanged compared to 2022.
- On the importers side, the EU kept its number one position as the world's largest LNG buyer, a position it acquired in 2022, when the EU replaced the bulk of its Russian pipeline imports with LNG purchased on global gas markets. The EU's share in global LNG imports was 24%, the same as in 2022. China took the second position with 17%, and increase of 1%-point compared to 2022, and thus replacing Japan, which moved to the third place with 16%, which was a decrease of 2%-points compared to 2022. South-Korea and India occupied the fourth and fifth place with 11% and 5%, respectively, with South-Korea losing 1%-point in its share of global LNG imports, while India's share remained unchanged.
- Compared to 2022, the EU increased its LNG imports by 2.5%, while China increased its imports by 11.5% and India by 10.4%. The imports of Japan and South-Korea on the other hand decreased by 9.1% and 3.9%, respectively.

### 3. Storage and LNG terminals

#### 3.1 Storage

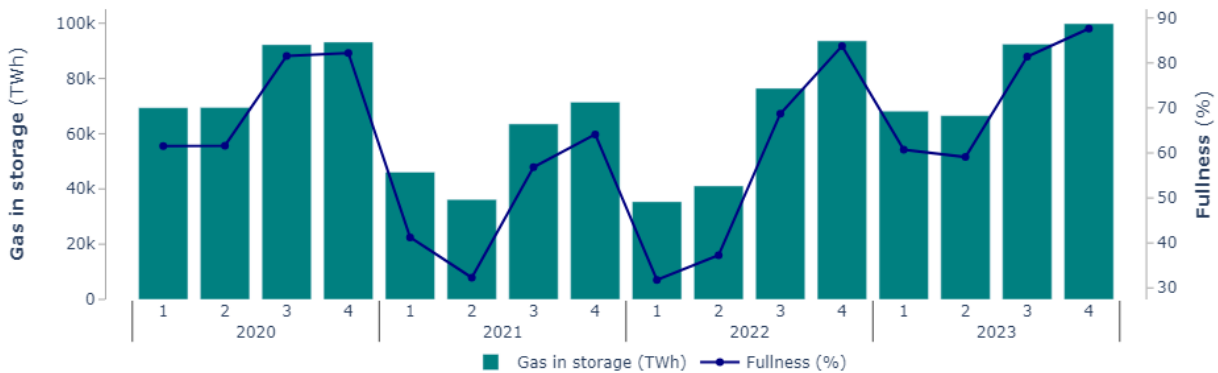
- The EU's maximum technical gas storage capacity is 1133 TWh (116 bcm) corresponding to more than one third of the European Union's total gas consumption in 2023.<sup>13</sup>
- Gas storage levels reached new record highs in the fourth quarter of 2023, and stood well above historical level in all three months of the quarter. EU gas filling rate was 98% as a monthly average in October; it was 99% in November and 89% in December 2023. The average filling rate for the quarter stood at 95% (1000 TWh, 102 bcm), 8% higher than in the previous quarter and 5% higher compared to the fourth quarter of 2022.

**Figure 27 - Gas storage levels**



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

**Figure 28 - Gas storage levels**



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

**Annual overview for 2023:**

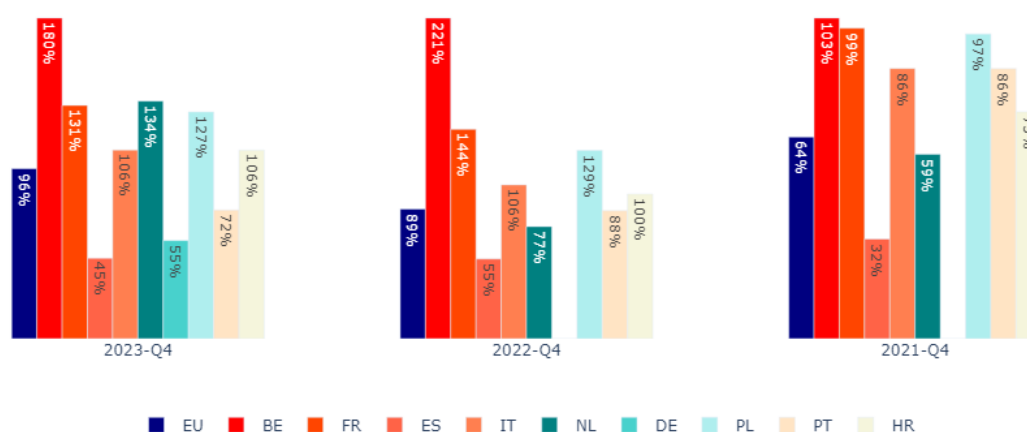
- in 2023, the average storage filling rate was 79% (874 TWh, 89.5 bcm), 30% higher compared to 2022 (61%, 676 TWh or 69 bcm) and 49% higher (53%, 595 TWh, 61 bcm) than in 2021.

<sup>13</sup> Gas Infrastructure Europe - AGSI (gie.eu) - data published under the Storage Transparency Platform, shows 1133 TWh (116 bcm) of technical working capacity as of 28 May 2024. This technical storage capacity is equivalent with 35% of the EU's 2023 annual consumption (330 bcm) and 32.5% of the EU's 2022 consumption (357 bcm).

### 3.2 LNG Terminals

- LNG terminals' utilisations rates for regasification varied considerably across Europe during the quarter. Belgium displayed the highest utilisation rate (180%), similarly to the previous quarter (168%), as well as like in the fourth quarter of the previous year (221%). The second highest utilisation rate was recorded in the Netherlands (134%), followed by France (131%), Poland (127%), Italy (106%) and Croatia (106%).
- Most LNG terminals in the EU's main LNG importers, e.g., France, the Netherlands, Belgium and Italy, operated above nameplate capacity with the exception of Spain, which had one of the lowest utilisation rates (45%) in the quarter, likely reversely correlating with the magnitude of its available regasification capacity, currently the largest in Europe, almost twice as large as the second largest capacity in Europe, that of France. In Germany, LNG terminals started operating only in 2023 and the aggregate utilisation rate of the country was 55% in the fourth quarter of 2023. Regasification capacity utilisation rates were below nameplate capacity in Lithuania (84%), Portugal (72%), Malta (64%), Germany (55%), Sweden (54%), Spain (45%), Greece (45%) and Finland (42%).
- Quarter-on-quarter, utilisation rates increased in all LNG importing Member States with the exception of Greece. The largest increase occurred in Finland (390%) from a very low base (9% in Q3 2023), followed by Malta (64%), Germany (38%), Portugal (36%) and the Netherlands (33%). In the other Member States, utilisation rates increased by between 1% (Italy) and 12% (Croatia), while in Greece there was a decrease of 19%.
- Year-on-year, utilisation rates decreased in seven (i.e., half) of the LNG importing Member States by between 2% and 20%: namely in Lithuania (-20%), Belgium (-18%), Portugal (-18%), Spain (-18%), Greece (-16%), France (-9%), Poland (-2%). Utilisation rates increased in six Member States: namely in Finland (589%), Sweden (215%), the Netherlands (73%), Malta (64%), Croatia (6%) and Italy (0.1%). (Germany did not have LNG regasification capacity operating in 2022).

**Figure 29 - Regasification capacity utilisation rates in Q4 2023, 2022 and 2021**



Source: LSEG (Refinitiv).

### 3.3 Hydrogen market developments

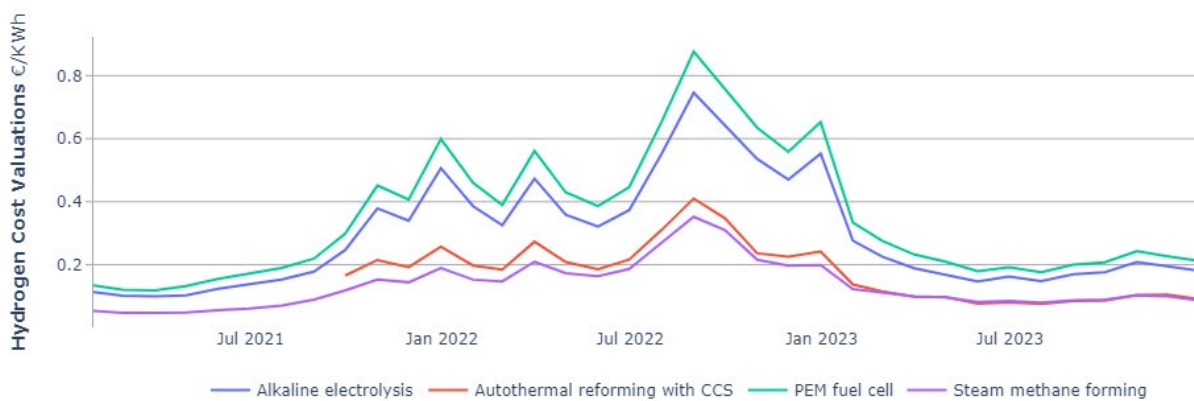
- In the fourth quarter of 2023, a major milestone was reached in the development of a liquid market for renewable hydrogen with the launch of the first EU-wide auction for the production of renewable hydrogen on 23 November 2023 (closing date: 8 February 2024). With this auction, the European Hydrogen Bank, a financial instrument with €3 billion for green hydrogen production was officially initiated and allocated an initial €800 million for EU projects dedicated to the production of green hydrogen within a five-year timeframe. The Bank aims to encourage the development of renewable hydrogen in Europe by offering a fixed premium for each kilogram of hydrogen generated. The auction allows eligible producers to submit offers based on proposed premium prices, with a maximum limit of €4.5/kg. Selected projects will receive grants and market revenues for up to 10 years, with a requirement to start production within five years.
- The next chart shows the production cost-based estimated prices for hydrogen generated by the four main technologies used to produce green hydrogen. These technologies take either water or methane as the main feedstock from which to generate hydrogen. The water-based technologies are alkaline water electrolysis (AWE) and polymer electrolyte membrane (PEM). For these to produce renewable hydrogen, EU regulation requires the use of renewable electricity, the production of which must be time- and geo-correlated with the hydrogen production. The gas based technologies are steam methane reforming (SMR) and autothermal reforming (ATR).<sup>14</sup> The gas-based production paths should use renewable gas or/and be

<sup>14</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

combined with carbon capture and storage (CCS) so as to result in green hydrogen. Current international price assessments for carbon-neutral hydrogen incorporate many elements of the criteria defined by EU legislation for renewable hydrogen in a market based, practice oriented approach. For the ATR technology, the chart below includes the costs of Carbon Capture and Storage (CCS), while SMR without CCS is included in the chart for the sake of comparison. Nevertheless, analysis of the price assessments for SMR with CCS are also provided in this chapter.

- 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 renewable power, whereas costs of SMR and ATR hydrogen generation is based on costs of natural gas. CCS costs is added to the ATR production cost and to low-carbon hydrogen produced from SMR with CCS.
- In the fourth quarter of 2023, the price of all technologies increased compared to the previous quarter. The cost of ATR increased the most, by 20%, while the cost of AWE increased by 18% and that of PEM and SMR by 17% and 12%, respectively. This reflected the temporary upward trend in prices of both natural gas and electricity. In a year-on-year comparison, however, the costs of all technologies were significantly lower in 2023 than in 2022, although the price discount narrowed in the fourth quarter compared to the third quarter of 2023. The price of electricity-based technologies was down 63% year-on-year, while the cost of gas-based ATR declined 58%, that of SMR without CCS by 53% and that of SMR with CCS by 65%.
- PEM fetched the highest average price in Q4 2023 with 227 €/MWh. PEM was closely followed by the other electricity-based technology, AWE, which was assessed at 194 €/MWh. The gas price-based ATR costs were significantly less, 99 €/MWh on average, while the costs of SMR without CCS were assessed at 96 €/MWh on average and those of SMR with CCS cost at 75 €/MWh.

**Figure 30 – Production cost based hydrogen price assessment for different technologies (including CCS)**



Source: S&P Global (Platts).

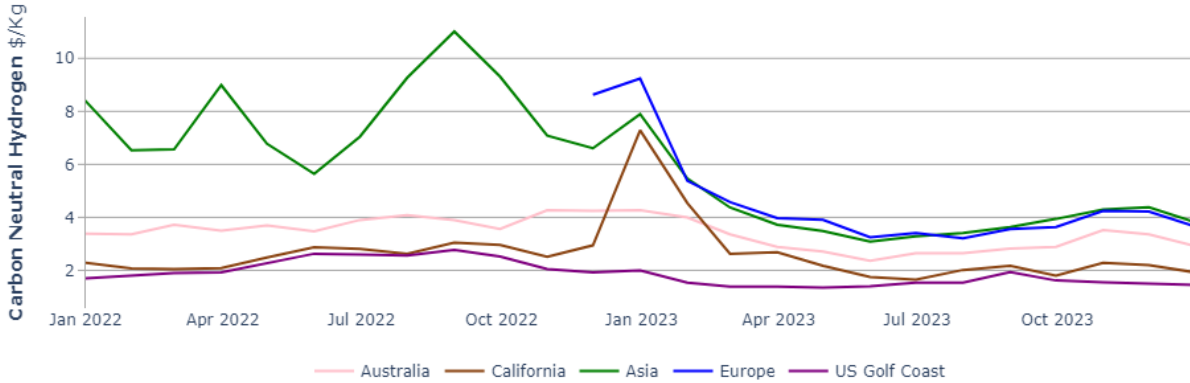
- The next chart shows the price assessments for carbon-neutral hydrogen<sup>15</sup> in different regions of the world: Australia, Far East Asia, Northwestern Europe, California, and the US Gulf Coast. Quarter-on-quarter, all but the US Gulf Coast prices increased. The highest increase was registered in Australia (+17%), followed by Northwestern Europe (+16%), Far East Asia (+14%), and California (+7%). The price of carbon-neutral hydrogen in the US Gulf Coast declined by 12% quarter-on-quarter.
- In a year-on-year comparison, the price in all major producing regions declined. The biggest decline was registered in Northwestern Europe (-55%), followed by California (-50%) and Far East Asia (-42%). The price declined by 24% in both the US Gulf Cost and California.

(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 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.

<sup>15</sup> The definition of carbon neutral hydrogen by Platts is significantly broader than the definition of renewable hydrogen under the EU Renewable Energy Directive (RED). Platts' definition covers but is not limited to renewable hydrogen as defined under the RED, which – for hydrogen produced via electrolysis – requires the use of renewable electricity off-grid (dedicated renewable power production for the electrolysis) or, if on-grid, to meet certain criteria regarding origin of electricity combined with temporal and geographical correlations of the electricity production with the electrolysis. Platts definition reflects “the value of hydrogen as it leaves the production facility” and includes the following factors: “the market value of hydrogen in which emissions have been, in order of priority: avoided where possible through the use of low emissions generation, removed through the use of carbon capture and storage, and offset through the use of carbon credits or equivalent instruments. In addition to spot market activity, power-purchase agreements and hydrogen offtake agreements may be considered for assessment purposes, but normalised for terms, periods, and other factors. Platts also considers cost of production factors, which provide baseline inputs in the absence of market activity. These costs incorporate renewable power prices and carbon capture and storage costs with any remaining accounted emissions offset using relevant carbon instruments.”

- The highest price region remained Far East Asia (4.16\$/Kg), followed by Northwestern Europe (4\$/Kg), Australia (3.26\$/Kg) and California (2.13\$/Kg). The cheapest sourcing region for carbon-neutral hydrogen remained the US Gulf Coast (1.5\$/Kg).

**Figure 31 – Carbon-neutral hydrogen prices in different regions of the world**



Source: S&P Global (Platts).

**Annual overview of hydrogen market developments for 2023:**

- In 2023, production costs came down significantly from the highs of 2022, when energy prices skyrocketed due to the supply crisis in the aftermath of Russia’s invasion of Ukraine. In 2023, annual average costs more than halved for all technologies. ATR costs declined by 62%, while AWG and PEM fell by 61% and by 60%, respectively. The costs of SMR without CCS declined by 56%, while the cost of SMR with CCS declined by 68%.
- Compared to 2021, all technologies but SMR without CCS, displayed decreases in the costs of production, reflecting the maturation of green hydrogen technologies and the resulting improvement in their commercial viability. ATR costs decreased the most, by 54%, followed by SMR with CCS, which fell 12%. The costs of electricity-based hydrogen production technologies fell by 10% for PEM and 9% for AWE. The costs of SMR without CCS increased by 6%.
- The average costs of PEM in 2023 was 224\$/kg, while that of AWG was 187\$/kg. The gas-based ATR and SMR products were cheaper, with ATR average costs in 2023 assessed at 96\$/kg, while SMR cost without CCS was assessed at 95\$/kg and that with CCS at 71\$/kg.

**4. Wholesale Gas Prices**

**4.1. Wholesale gas prices at the EU level**

- In the fourth quarter of 2023, the rise of European spot prices (TTF day-ahead) that already started in July from levels in the low 20s €/MWh continued in August with prices in the low 30s €/MWh and reached a peak of 44.7€/MWh on 25 September. The rise in the spot price continued in October and reached a monthly peak in 55.3 €/MWh on 13 October. Prices remained in the high 40s €/MWh most of October and started to descend in November, but still oscillating mostly in the range of 44-46€/MWh and peaking at 47€/MWh on 24 November 2023. From that point on, the spot price started to decline and reached the lowest point, 30€/MWh on the last trading day of the year, 29 December 2023. Average TTF day-ahead price was 43.3€/MWh in October, 43.26€/MWh in November and 35.22€/MWh in December 2023. The quarterly average price was 41€/MWh, 24% higher than in the previous quarter (33€/MWh), and 57% lower than in Q4 of 2022 (95€/MWh), where prices were at historically unprecedented levels. The TTF month-ahead prices moved closely together with the day-ahead prices, while year-ahead prices anticipated higher prices ahead, which did not materialise in the quarter.

- Forward contracts indicated higher prices ahead but moderating over time with quarter-ahead price being 12% higher (46 €/MWh) and the two quarter-ahead price just 8% (45€/MWh) higher than the spot price (41€/MWh). The premium for the 1 year ahead contract narrowed to +3% (42€/MWh) compared to the spot price, while the price of the 2 years-ahead contracts offered a 6% premium (43€/MWh). On the longer term, market anticipated lower prices as the 3 years ahead contracts sold at a 5% lower (38€/MWh) than the spot price.
- The LNG Northwestern Europe (NWE) and Southwestern Europe (SWE)/Mediterranean (MED)<sup>16</sup> benchmarks kept their prices closely together. In a quarterly average basis, there was no real price difference between LNG NWE and LNG MED. Both MED and NWE sold gas contracts at a small premium of 0.8€/MWh compared to Europe's main hub, the Dutch Title Transfer Facility (TTF) day-ahead contract but around 1.5€/MWh cheaper than TTF month-ahead contract.
- As of January 2023, the LNG NWE and LNG SWE/MED benchmarks were replaced by the new ACER Northwest Europe (NWE) and South Europe (SE/SWE) LNG benchmarks<sup>17</sup>. On a quarterly basis, ACER NWE price assessment was on average 0.3 EUR/MWh cheaper than the LNG NWE benchmark and the ACER SE/SWE price assessment was 0.9 EUR/MWh cheaper than the LNG SWE/MED. The ACER assessed EU benchmark price was 0.7€/MWh lower than the LNG NWE and MED price assessments; it was 0.4€/MWh cheaper than the ACER NWE price and 0.2€/MWh higher than the ACER SE price. The spread between these benchmarks was narrow throughout the fourth quarter of 2023.

**Figure 32 – TTF day-ahead prices compared with TTF quarter-ahead, two quarters-ahead and year-ahead prices**



Source: S&P Global (Platts).

**Figure 33 – Comparison of TTF month-ahead, day-ahead and year-ahead prices (daily values)**

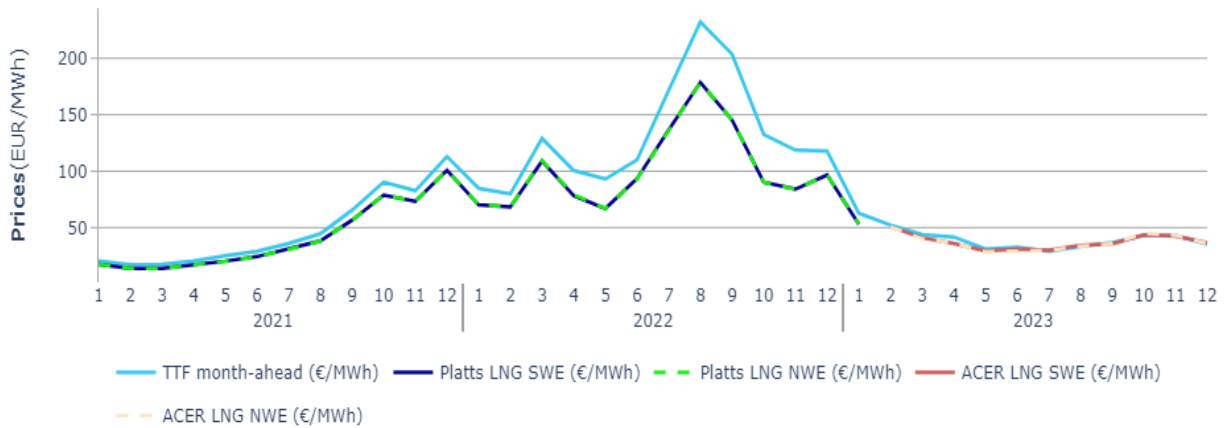


Source: S&P Global (Platts).

<sup>16</sup> As of September 2019, Platts renamed the Southwest European Marker (SWE) to Mediterranean Marker (MED). This change has been reflected in the price quotation codes.

<sup>17</sup> ACER South-Europe (SE) is marked as ACER SWE on the charts to facilitate comparison with Platts LNG SWE; Platts LNG SWE marking is kept for the same reason.

**Figure 34 – LNG NWE and SWE benchmarks compared with the Dutch TTF and ACER NWE and SWE (SE) benchmarks (monthly values)**



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

**Figure 35 – LNG NWE and SWE benchmarks compared with the Dutch TTF and ACER NWE and SWE (SE) benchmarks (daily values)**



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

**Annual overview of gas wholesale prices for 2023:**

**Gas wholesale prices in 2023, 2022 and 2021 and year-on-year comparison**



Source: S&P Global (Platts).

- The annual average of the gas wholesale price was 41€/MWh<sup>18</sup>, a decrease of 67% compared to 2022 (123€/MWh) and a decrease of 13% compared to 2021 (47€/MWh).<sup>19</sup>

<sup>18</sup> The annual average was calculated on the basis of the Dutch TTF day-ahead prices.

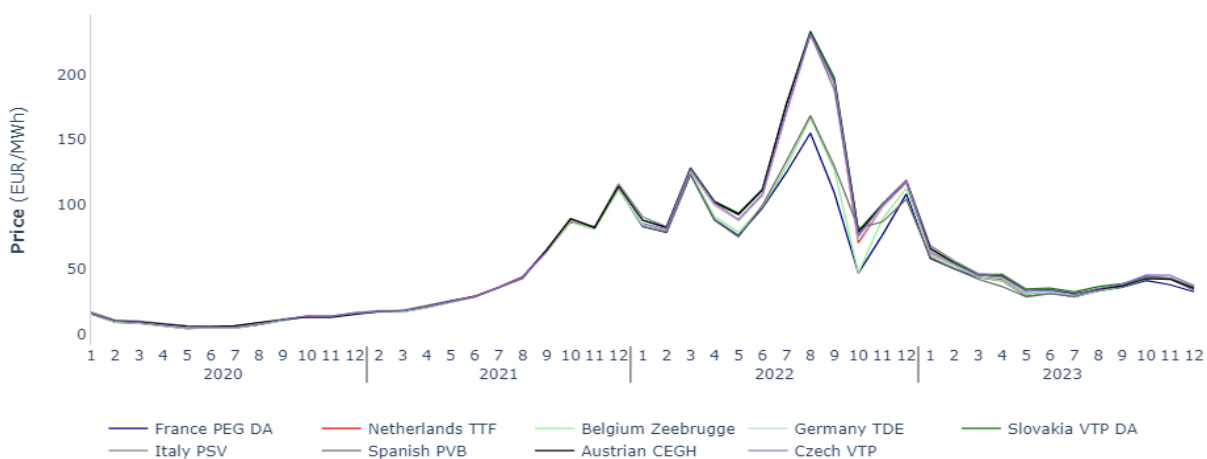
<sup>19</sup> Please note that in the infographic text box, the comparison is between a year and its previous year, while in the text the average wholesale price of 2023 is compared with the price of 2022 and 2021.



## 4.2 European hubs

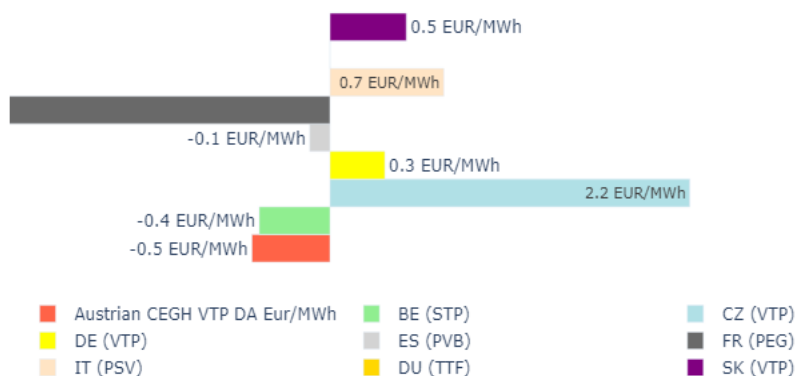
- In the fourth quarter of 2023, prices increased mainly due to a big rise in October from lower price levels in September. The increase was by between +13% and +22% month-on-month and resulted in monthly average hub prices reaching a range of 41-46€/MWh in October, while they were around 36-39€/MWh in September. In November, prices started to decrease in all hubs except for Germany's THE and Belgium's ZTP. The decrease was between -8% (France PEG) and -0.1% (Dutch TTF), while the increase was between +0.6% (German THE) and +1.2% (Belgium ZTP). In December, the decrease in prices accelerated and affected all hubs, ranging between -14% (France PEG) and -21% (Spain PVB). These monthly price movements added up to a quarterly average price increase of between 15% (France PEG, Slovakia VTP) and 24% (Czech VTP, Dutch TTF). Year-on-year, prices were down by between 51% (France PEG, Belgium ZTP) and 59% (Austria CEGH) compared to the historic highs in the fourth quarter of 2022. The largest year-on-year decrease was recorded in Austria (CEGH, -59%), followed by Italy (PSV, -58%), Slovakia (VTP, -58%), the Netherlands (TTF, -57%) and Germany (THE, -57%). The smallest decrease occurred in France PEG (-51%) and Belgium ZTP (-51%).
- The price differential between the lowest and the highest hub price was 5.5€/MWh as a quarterly average, a significant increase (+66%) compared to the difference in the previous quarter (3.3€/MWh). In monthly averages, the price difference increased to 4.1€/MWh in October (from 2.7€/MWh in September) and to 7.3€/MWh in November, and decreased to 4.8 €/MWh in December.
- The average price in the third quarter of 2023 ranged from the lowest 37.6 €/MWh (France) to the highest 43.1 €/MWh (Czechia). Compared to the Dutch TTF, which serves as European benchmark, half the EU hubs were more expensive and half were less expensive. Traders paid 5% more on the Czech VTP (+2.2€/MWh), 2% more on the Italian PSV (+0.7€/MWh), 1.2% more on the Slovak VTP (+0.5€/MWh), and 0.8% more on the German THE (+0.3MWh). On the other hand, France PEG offered 8% lower price (-3.2€/MWh), while the Austrian CEGH was 1.2% (-0.5€/MWh) cheaper, the Belgian ZTP was 1.1% (-0.4€/MWh) less expensive and Spain PVB was lower priced by 0.3% (-0.1€/MWh) than the Dutch TTF.

**Figure 36 - Price developments in some of the major European gas hubs**



Source: Global S&P (Platts).

**Figure 37 - Price differentials of EU gas hubs compared to the benchmark Dutch TTF in the fourth quarter of 2023**

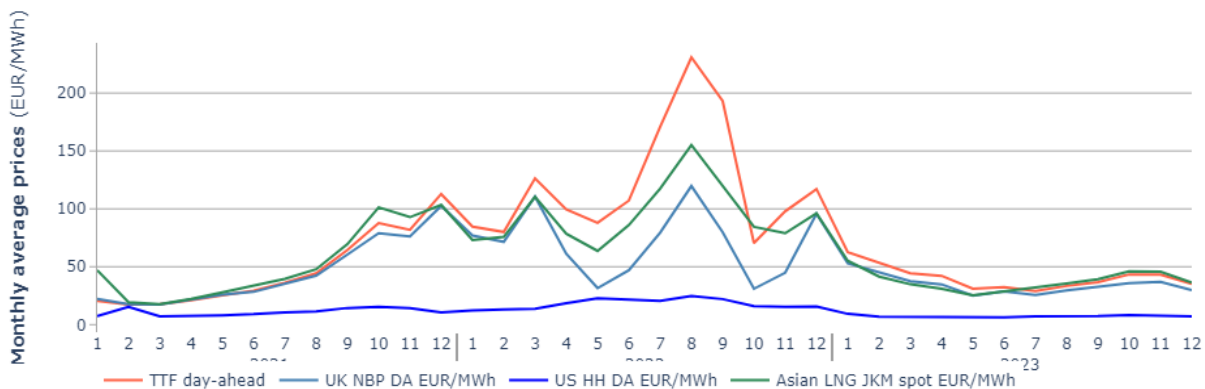


Source: S&P Global (Platts).

### 4.3. Wholesale gas prices at international level

- In the fourth quarter 2023, prices increased in all international hubs compared to the previous quarter by between 11% and 28%. Prices increased the most, 28%, on the Dutch Title Transfer Facility (TTF), followed closely by a 27% increase on the UK National Balancing Point (NBP). On the Asian Japan Korean Marker (JKM) benchmark prices went up by 22% and on the US Henry Hub (HH) by 11%.
- In a year-on-year comparison, prices displayed a considerable decline in all global benchmarks. The largest decline occurred on the Dutch TTF, where prices fell by 65%; however, similar large declines occurred on the other international hubs. Prices on the UK NBP dropped by 60%, while prices on HH declined by 54% and on JKM by 53%.
- In the fourth quarter, Asian LNG prices were the highest, 13% higher than those on the Dutch TTF and 14% higher than prices on the UK NBP. The cheapest hub by far remained the US Henry Hub, which was 77% less expensive than the Dutch TTF and the UK NBP in Europe, and 80% cheaper than the Asian JKM. In the fourth quarter of 2023, prices on the Dutch TTF and UK NBP displayed close price convergence in Q4 of 2023 (just as in Q3 of 2023), the UK hub being slightly cheaper, by 0.5€/MWh as a quarterly average, than the Dutch TTF.

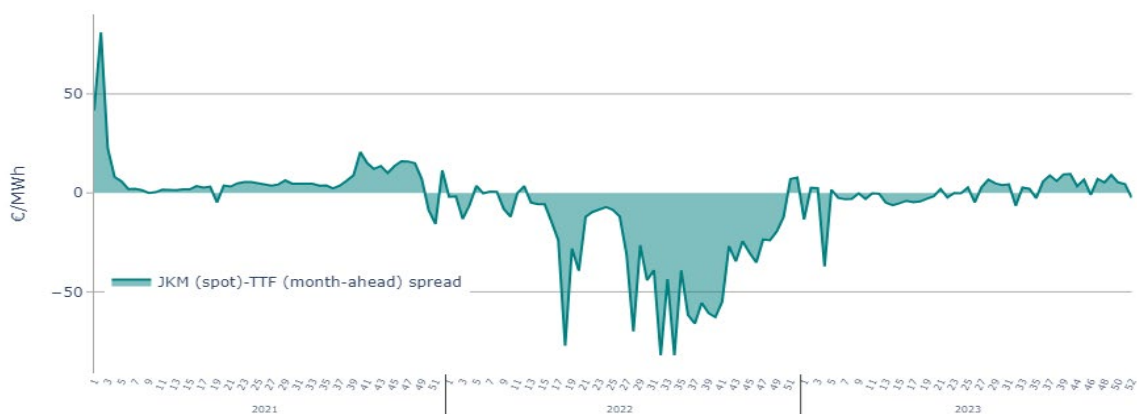
**Figure 38 – Comparison of monthly average prices on the Dutch TTF, UK NBP, the US Henry Hub and the Asian JKM**



Source: S&P Global (Platts).

- In the fourth quarter of 2023, Asia displayed higher prices than Europe on average and was the most attractive market for LNG cargoes. The higher Asian prices are depicted as positive price differentials between the European TTF benchmark and the Asian JKM benchmark in the chart below.
- On a quarterly average basis, the Asian price premium amounted to 5.4 €/MWh. On a monthly basis, the Asian mark-up was 5.9€/MWh in October, 5.6€/MWh in November and 4.5€/MWh in December 2023.
- In brief periods, such as in the middle of November (week 46.) and at the very end of December 2023 (week 52.), the price differentials turned negative, meaning prices on the Dutch TTF in Europe were higher than those on the Asian JKM. The mark-up was limited to 0.9€/MWh in November and was 2.5€/MWh in the last week of December.

**Figure 39 – Prices differences between the Asian JKM and the Dutch TTF (EUR/MWh) benchmarks**

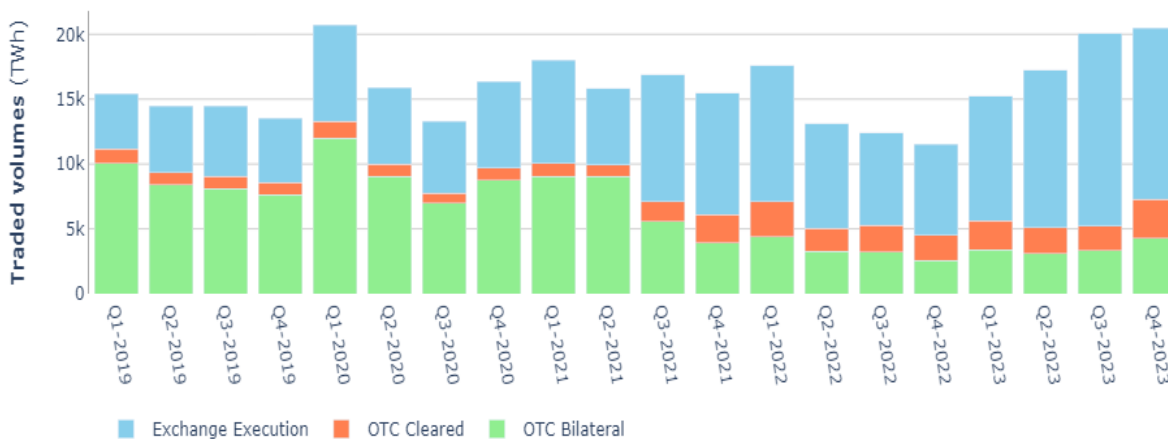


Source: S&P Global (Platts).

#### 4.4 Gas trade on the EU hubs

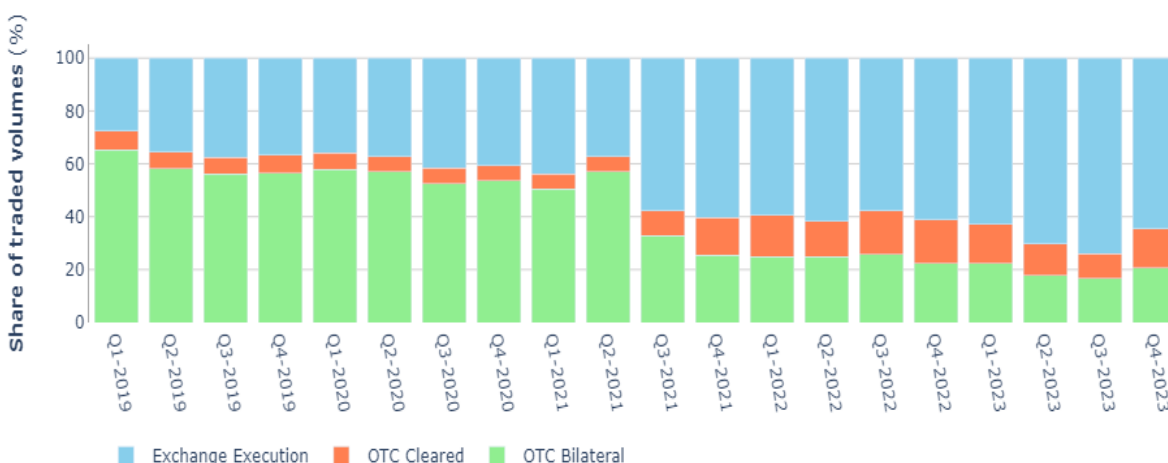
- In the fourth quarter of 2023, total traded volumes increased by 9% quarter-on-quarter and by 75% year-on-year continuing an overall growth trend prevailing since the first quarter of 2023. Exchange executed trade constituted 64% of the transactions, a 16%-point decrease from 80% in the third quarter halting the continued shift towards exchange trade experienced since the fourth quarter of 2022. The share of the over-the-counter (OTC) bilateral transactions increased to 21% from 18% in the previous quarter, and the share of OTC cleared trade also jumped to 15% from 10% in Q3 2023.
- Compared to the previous quarter, exchange executed trade decreased by 11%, while OTC bilateral trade increased by 27% and OTC jumped by 61%. Year-on-year, however, OTC exchange executed volumes almost doubled showing an annual increase of 87%, while OTC bilateral trade increased by 64% and OTC cleared trade also increased by 59%.
- The Dutch Title Transfer Facility (TTF) kept its leading market share by attracting 80% (16435 TWh) of the trading volumes and the British National Balancing Point (NBP) also maintained its second place with 9% (1754 TWh). Almost half of the remaining 11% trades was conducted on the German Trading Hub of Europe (THE) (47% or 1080 TWh out of the 11% representing 2292 TWh) share, followed by France's PEG (21% or 482 TWh) and Italy's PSV (14% or 381 TWh). Austria ZTP (8% of 2292 TWh) and the Belgium ZTP (6% of 2292 TWh) also conducted trade in gas volumes, although at a much smaller scale than the leading TTF trade hub.

**Figure 40 – 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 41 – Share of OTC and exchange executed trade on European gas hubs**



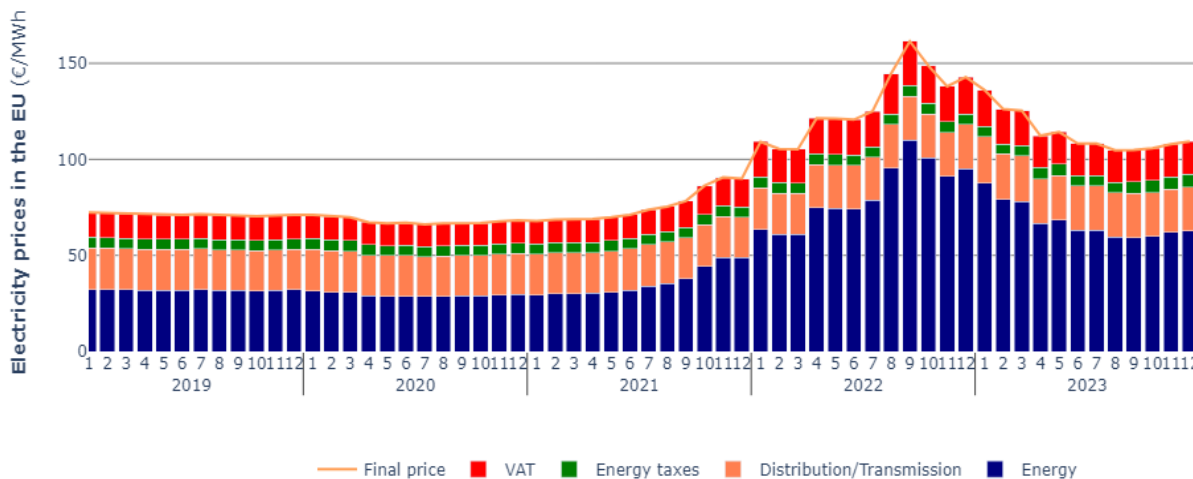
Sources: Trayport Commodities Report, LEBA Monthly Energy Volume Report and Analysis.

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)

## 5. Retail gas prices

- In the fourth quarter of 2023, average quarterly gas retail price for household consumers increased by 2% to 110<sup>20</sup> €/MWh from 107.5 €/MWh in the previous quarter marking a reversal in the downward trend prevailing since prices peaked in October 2022. Retail prices started to rise already in September, but the fourth quarter of 2023 is the first such quarter that registered an increase since the fourth quarter of 2022, when prices started to fall. The average EU retail price was 18% higher than in Q4 of 2021 and 61% higher than historical prices (first half of 2021).
- The energy component amounted to 62 €/MWh a quarterly average and constituted 56% of the price, the same as in the previous quarter, but significantly lower than in Q4 2022, when it was 69%. Network costs constituted 20% (22 €/MWh) of the total end user price paid by the retail consumer, while energy taxes 9% (9.5 €/MWh), and value added tax (VAT) 15% (16 €/MWh).
- The price of the energy component increased by 3% quarter-on-quarter, but decreased 44% year-on-year. Despite this significant fall, the energy price component was still 122% higher in Q4 2023 in the first half of 2021, which can be considered as historic benchmark. The tax and VAT component increased both by 2% quarter-on-quarter; year-on-year VAT was down by 25%, while energy taxes move up by 25%. The network component decreased 1% quarter-on-quarter and increased 3% year-on-year.

**Figure 42 – Monthly average gas price in the EU paid by typical household customers (in EUR/MWh)**



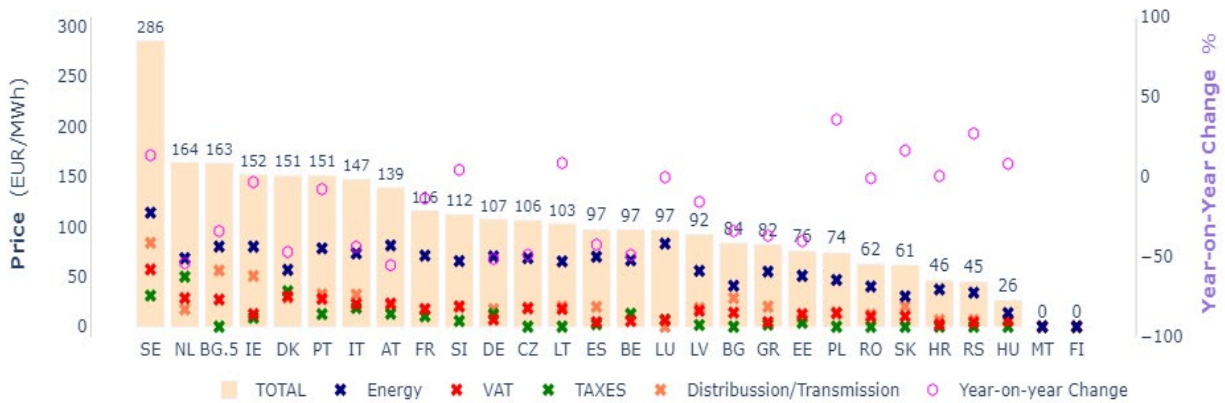
Source: VaasaETT. EU-27 represents an aggregate average of the 27 capital cities.

- Compared to the previous quarter, average quarterly retail prices increased in 9 Member States, remained unchanged in 8 Member States and decreased in 7 Member States<sup>21</sup>. Between 2% and 21% increases were recorded in Estonia (+21%), Greece (+18%), Belgium (+16%), France (+15%), Bulgaria (+13%), Denmark (+12%), Austria (+3%), Portugal (+2%) and Sweden (+2%). In Croatia, Lithuania, Slovakia, Luxembourg, Italy, Romania and Hungary the quarterly average retail price remained the same implying below 0.5% change or identical prices in the last six months. In Czechia (-13%), Slovenia (-7%), Ireland (-6%), Spain (-3%), Germany (-2%), the Netherlands (-2%), Latvia (-1%) and Poland (-1%) prices decreased between 1% and 13%. As a net result, the average EU retail gas price increased for the first time since the start of 2023.
- Year-on-year, price drops were registered in 16 Member States. Out of which in 11 Member States, the price drops were significant, between -55% and 34%, led by Austria (-55%), the Netherlands (-54%), Germany (-51%), Belgium (-49%), Czechia (-49%), Denmark (-47%), Italy (-44%), Spain (-43%), Estonia (-40%), Greece (-37%) and Bulgaria (-34%). In Latvia (-16%) and France (-14%), the year-on-year decline was above 10%, while in Portugal (-8%), Ireland (-3%) and Romania (-1%), the drop was single digit.
- 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 in the residential and commercial sectors, and electricity production), the highest average quarterly price continued to be registered in The Netherlands (164 €/MWh), followed by Ireland (152 €/MWh), Portugal (151 €/MWh) and Italy (147 €/MWh). The lowest average quarterly gas retail price (26 €/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 (286 €/MWh) continued to characterise Sweden, where residential gas consumption is limited. The ranking of the Member States from the highest priced to the lowest priced in terms of retail gas remained largely unchanged.

<sup>20</sup> Translated from 11 eurocents/kWh 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.

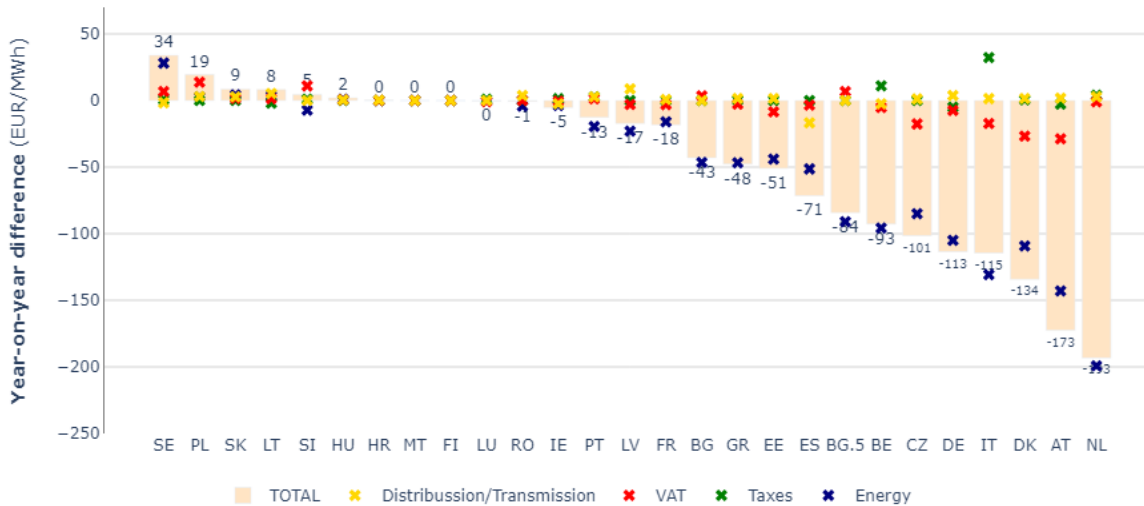
<sup>21</sup> In addition to Cyprus, where gas is not used, retail price quotations are also not covered in Malta and Finland in the VaasaETT data set.

**Figure 43- Breakdown of gas price paid by households in European capitals and annual change in prices, Q4 2023**



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

**Figure 44 - Annual change in retail gas prices in Member States in Q4 2023**



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

**Annual overview of retail price developments in 2023:**

**Gas retail prices in 2023, 2022 and 2021**

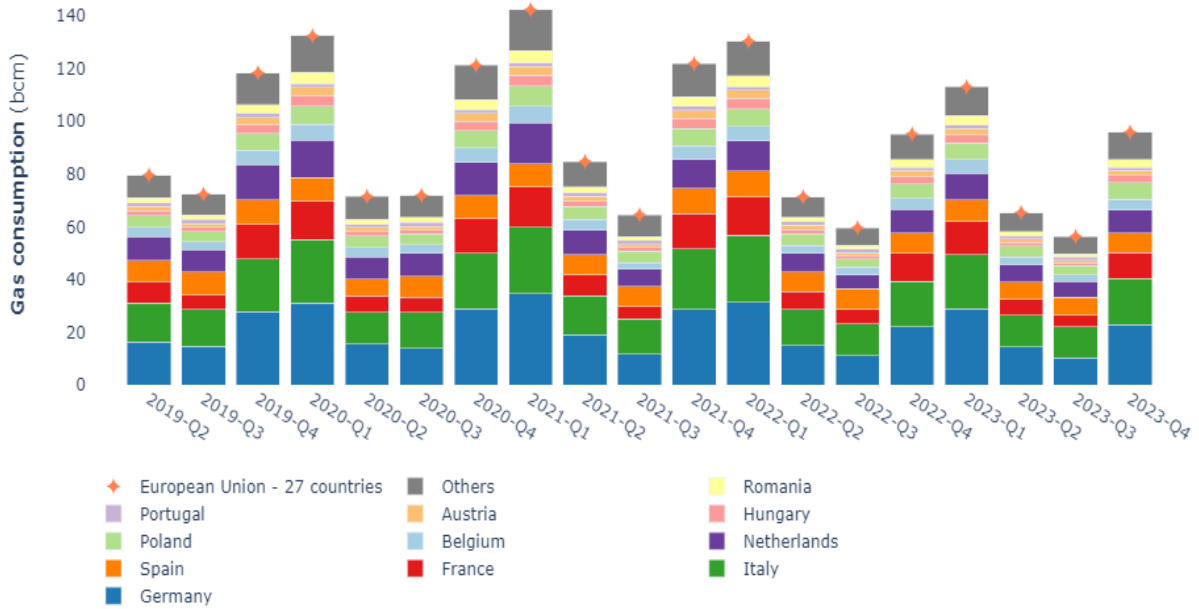


Source: VaasaETT.

- The annual average gas retail price was 115€/MWh, a decrease of 16% compared to 2022 (137€/MWh) and 53% higher than the price in 2021 (75€/MWh).

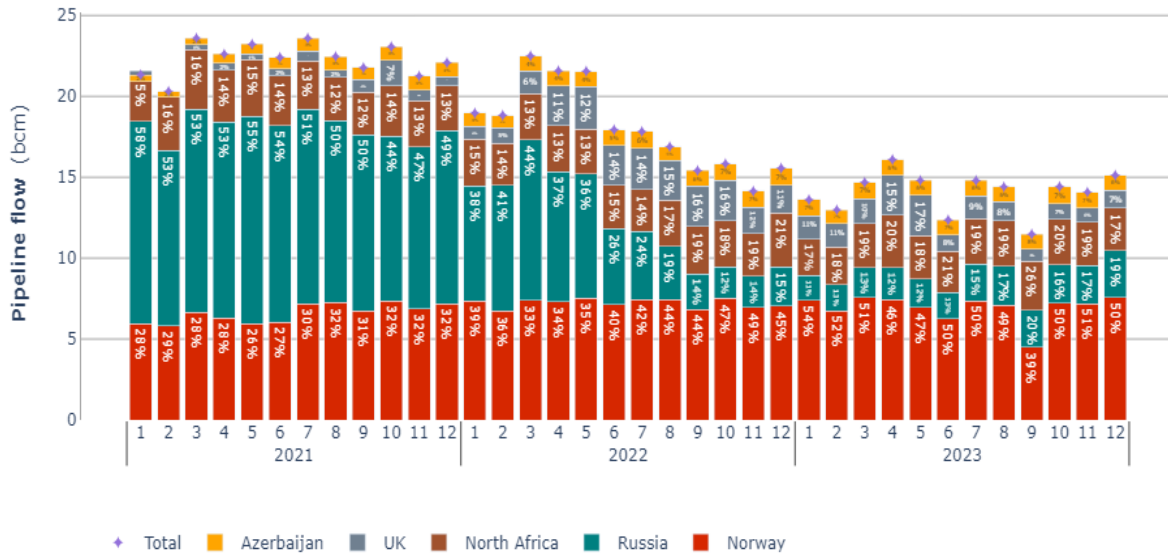
## 6. Appendix – charts providing further details on market developments

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



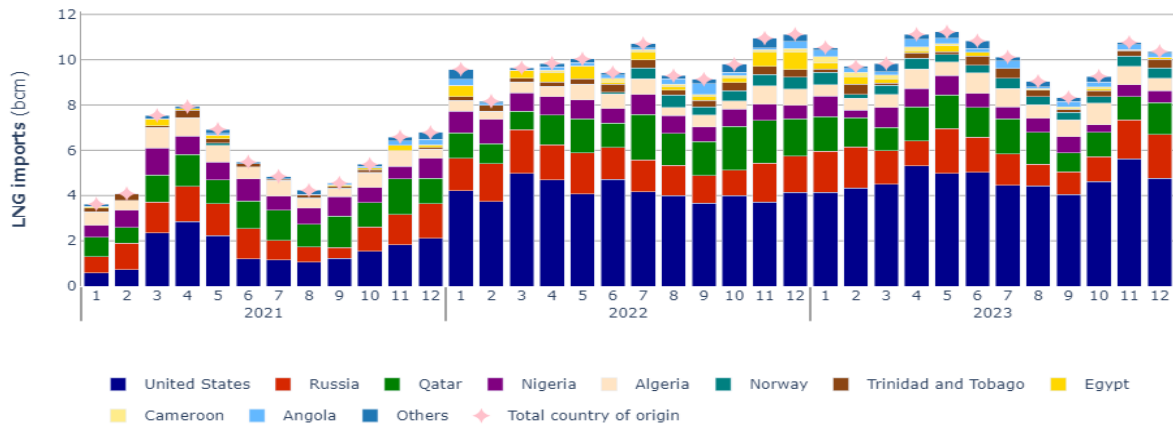
Source: Eurostat.

**Figure 2 – Monthly EU imports of natural gas from pipelines**



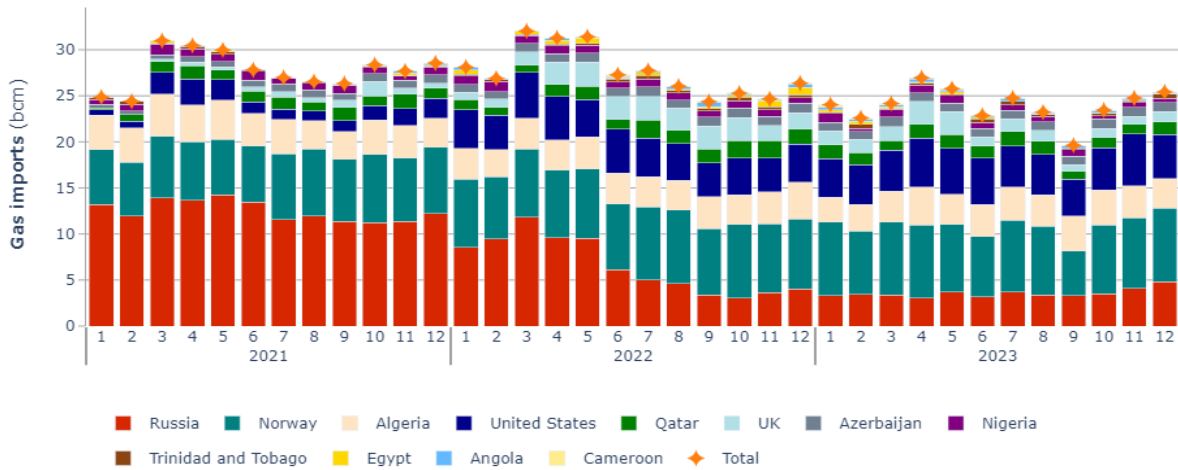
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 3 – Monthly gross LNG imports to the EU per suppliers**



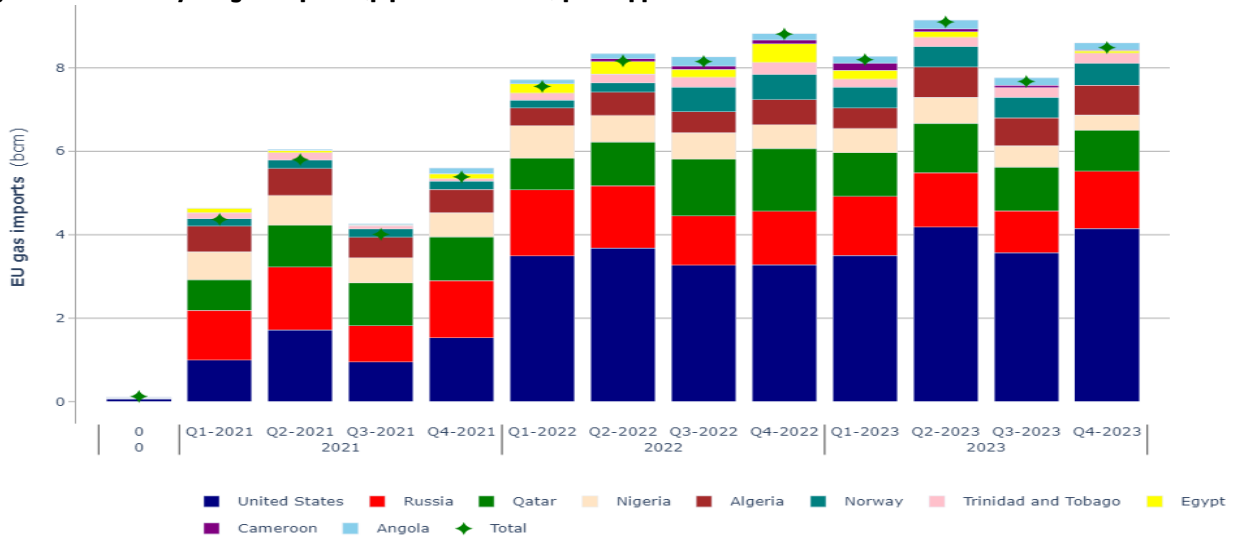
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 4 – Monthly gas (pipe and/or LNG) imports to the EU per suppliers**



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

**Figure 5 – Quarterly EU gas imports (pipeline and LNG) per suppliers**



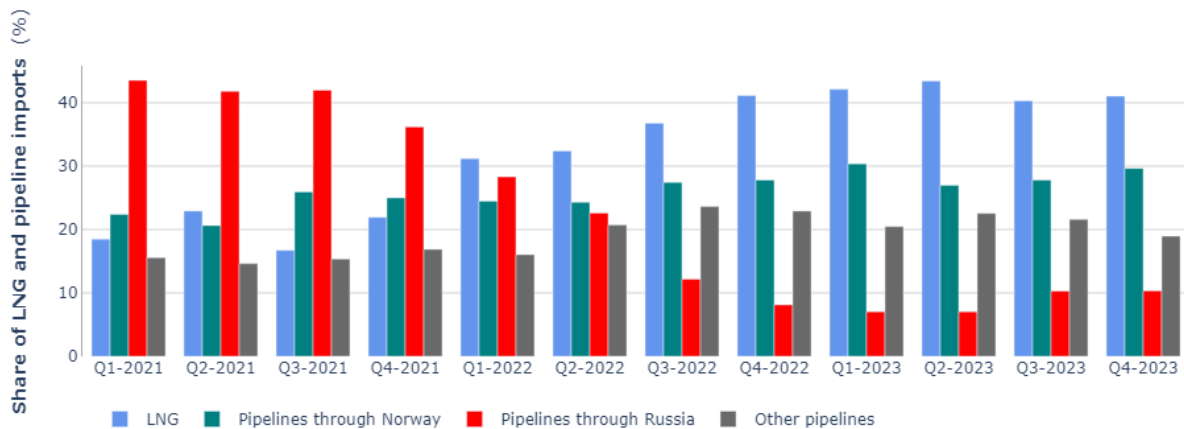
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 6 – Monthly EU imports of natural gas from Russia by pipeline route**



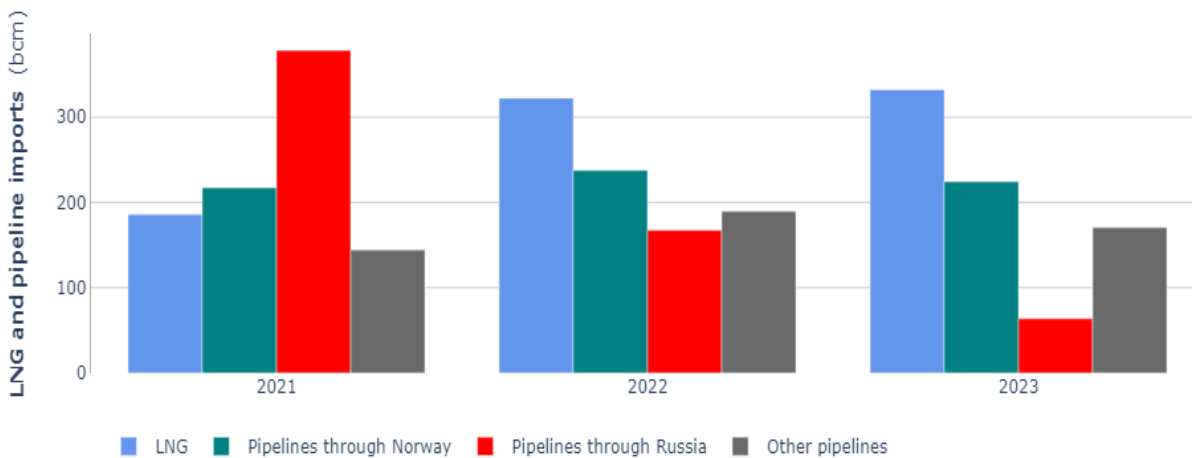
Source: European Commission calculation based on LSEG (Refinitiv) and ENTSO-G.

**Figure 7 – Pipeline and LNG shares in the EU gas imports by quarters**



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

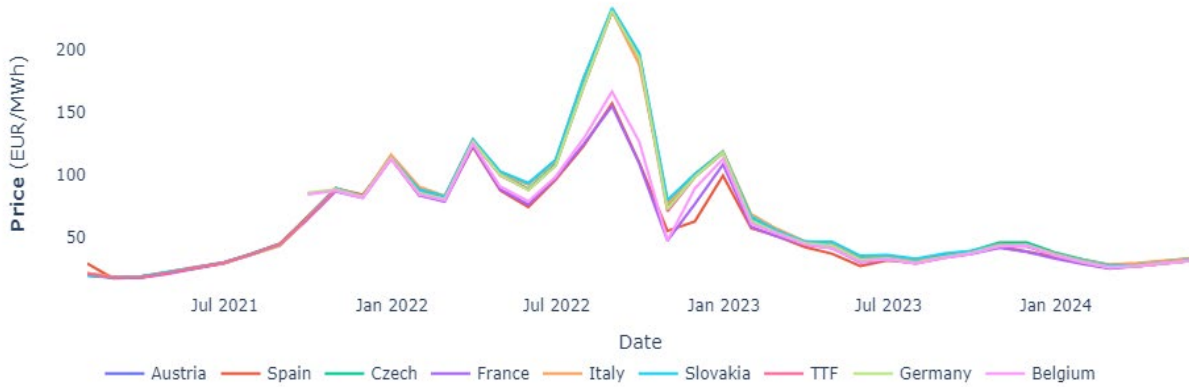
**Figure 8 – Yearly pipeline and LNG imports from the EU main gas import sources**



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

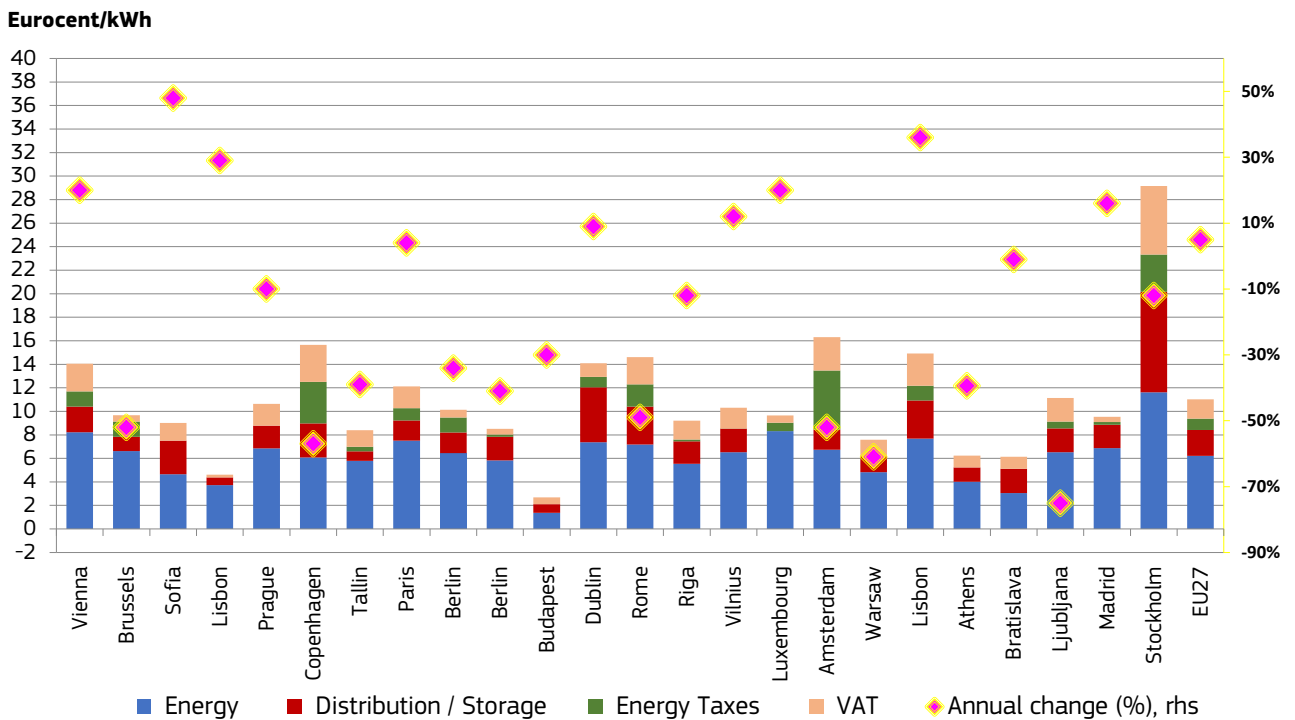


**Figure 9 – Price development in some of the major EU gas hubs (monthly averages)**



Source: S&P Global (Platts).

**Figure 10 - Breakdown of gas price paid by typical households in European capitals and annual change in prices, December 2023**



Source: VaasaETT.

**Figure 11 – Monthly gas-fired power generation**

