

# Diversity of supply of natural gas in Europe, 2023

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## Key headlines

The Russia-Ukraine conflict caused shifts in European gas supply and demand which continued into 2023.

Like 2022, liquefied natural gas (LNG) continued to play a role as many countries moved away from Russian gas. LNG imports to Europe increased a further 7 per cent in 2023 on 2022 highs. Relatedly, European demand continued to fall, down 8 per cent in part due to policies designed to reduce consumption as well as the effects of warm temperatures and high prices.

UK exports of gas to Europe fell but remained substantial, imports returned to typical levels with exports facilitated by low UK demand rather than increased imports like 2022. This resulted in fewer import sources for the UK in 2023 and subsequently lower diversity and supply indexes. However whilst production continued to fall, down 10 per cent in 2023 compared with 2022, lower demand meant self-sufficiency remained stable.

## Background

Europe, including the UK, use natural gas for electricity generation, domestic (or household) heating and cooking, and other purposes such as industrial processes. This article sets out how countries in Europe meet their natural gas demand via production and imports.

This article uses Energy Trends and International Energy Agency (IEA) data. European IEA member states reflect the majority of Europe but excludes Andorra, Kosovo, Liechtenstein, Monaco, San Marino, and Vatican City which are not included in the article. Cyprus, Iceland, and Montenegro did not produce or consume natural gas so are also not included in the article.

## Methods

Three indicators have been used to undertake this analysis.

### Self-sufficiency

Production is the process of extracting natural gas from the earth. Self-sufficiency is a measure of a country's ability to meet its demand through production. This is calculated as production divided by demand where:

- Self-sufficiency equals 0, there was no natural gas production.
- Self-sufficiency is between 0 and 1, production met some demand.
- Self-sufficiency equals 1, production equalled demand.
- Self-sufficiency greater than 1, production exceeded demand.

Generally higher self-sufficiency means more secure natural gas supply.

### Diversity index

The diversity index is a measure of the number of import sources, weighted by the country of origin's political stability<sup>1</sup>. This means that a country with many import sources of high political stability will have a high diversity index. Conversely, a country with few import sources of low political stability will have a low diversity

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<sup>1</sup> Data sourced from World Bank governance indicators. See Appendix 1 for underlying data and Appendix 2 for method.

index. In general, a diverse source of imports means gas supply is more secure. This is further improved if the source countries are politically stable.

## **Supply index**

The supply index is the sum of self-sufficiency and diversity index. A higher supply index can be indicative of higher security in terms of a country's sources of gas. A supply index of 0 indicates that a country has no production and only one import source.

## Chart 1: Self-sufficiency and diversity index for European countries, 2023

Norway has been excluded from the graph because its self-sufficiency is substantially larger than other countries (25). See Appendix 1 for underlying data.

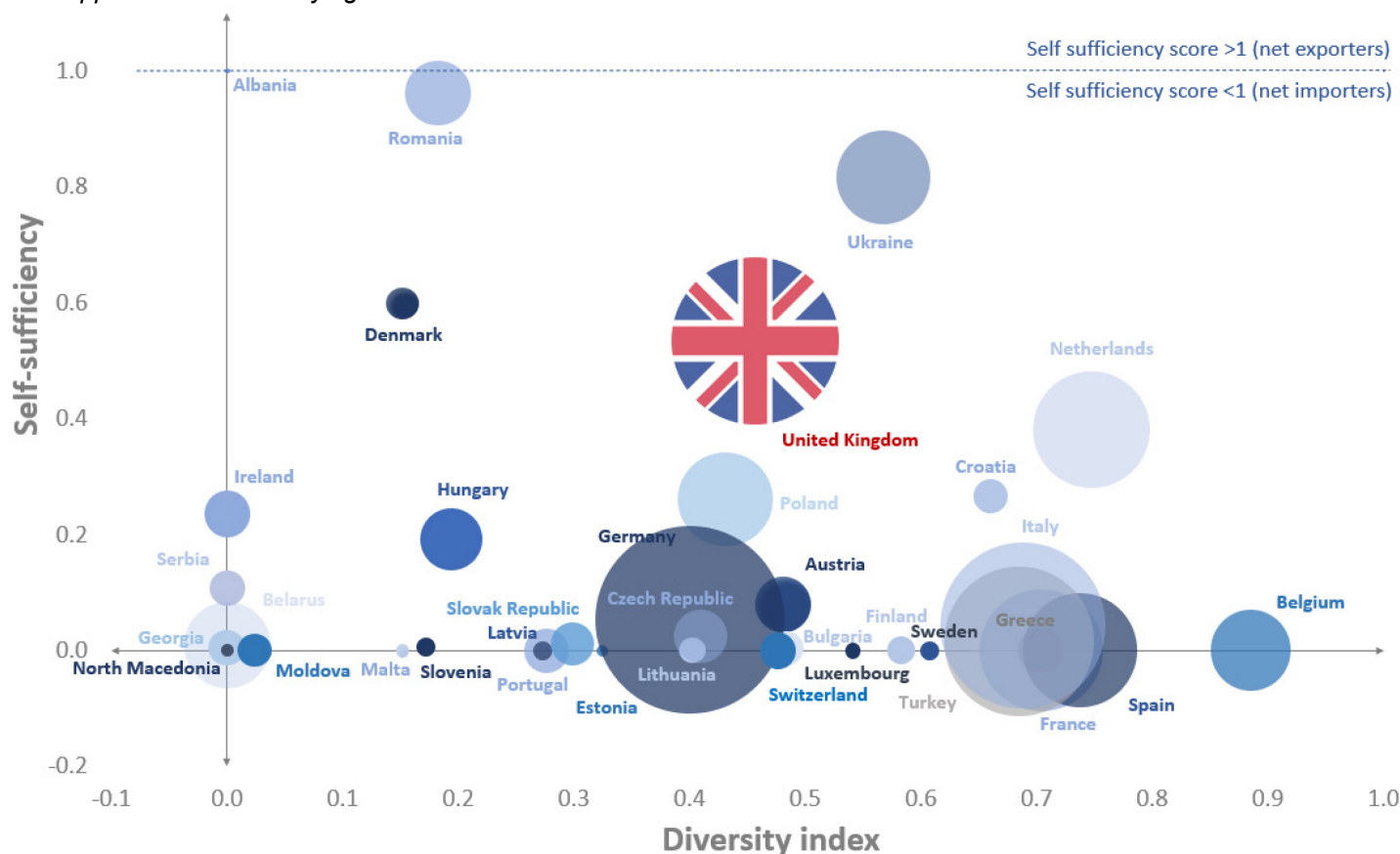


Chart 1 shows the relationship between self-sufficiency and diversity index. The size of each bubble represents natural gas demand in each country.

### Self-sufficiency

Norway met their demand for natural gas with production alone, making them self-sufficient. Norway is the largest producer of natural gas in Europe, and in the top 10 globally; in 2023, Norway produced more than 25 times the natural gas it consumed, accounting for 57 per cent of total European natural gas production. Other European countries are not large producers of natural gas which is reflected by an average self-sufficiency score of 0.15 for European countries (excluding Norway). This means on average 15 per cent of gas demand could be met by production.

Albania also continued to be self-sufficient in 2023, producing the same amount of gas that it used. Of the European countries who use natural gas, Albania's demand is the smallest.

The UK had a self-sufficiency score of 0.54 meaning more than half of gas demand could have been met by production in 2023. In the UK, production has been equivalent to around half of demand for over a decade reaching 54 per cent in 2023 due to notably low demand. UK production of natural gas fell in 2023, down 10 per cent compared to 2022 as North Sea output declines. Production remained just above the 2021 record low caused by extensive maintenance.

Of the 39 countries included in this analysis, 12 had a self-sufficiency score of 0 meaning they didn't produce any gas and were reliant on imports to meet supply.

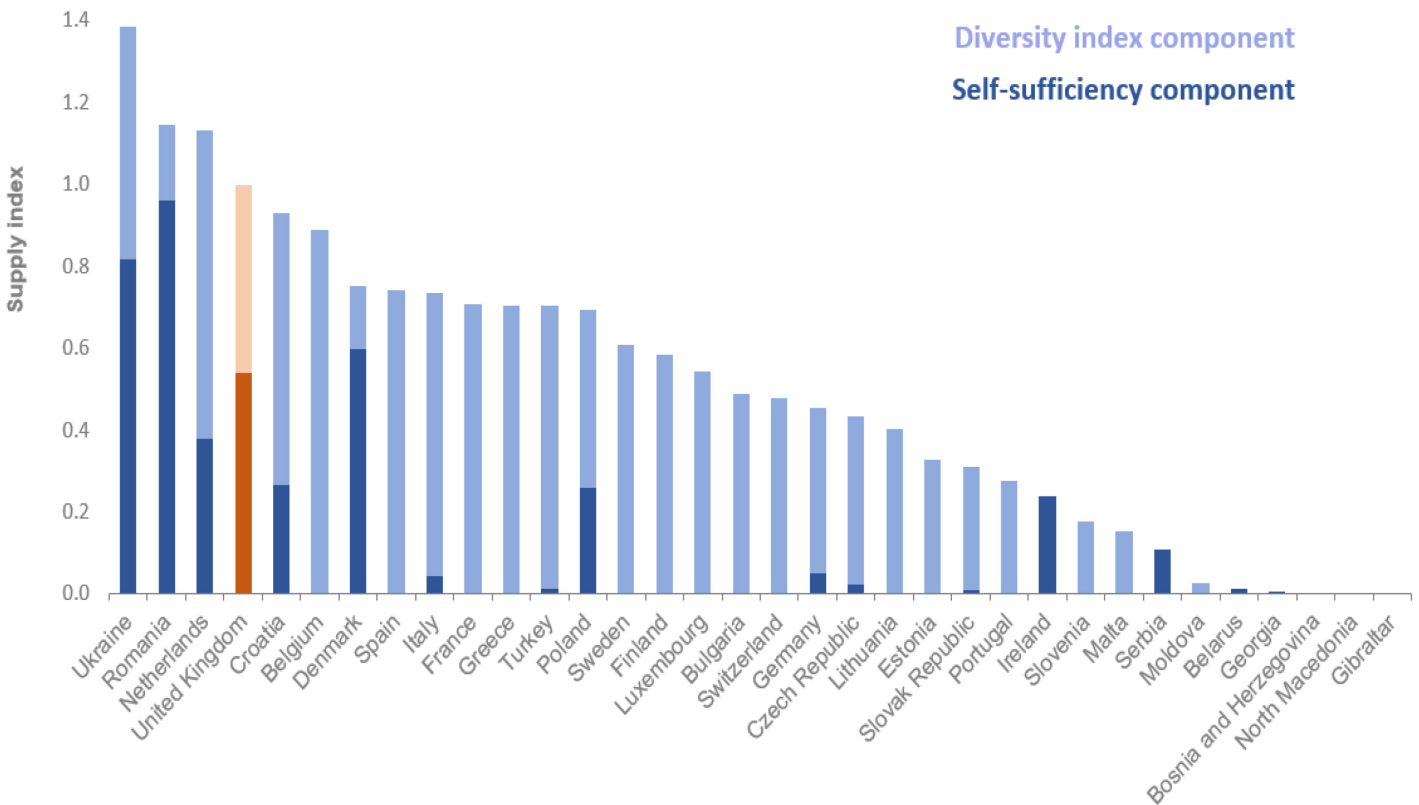
## Diversity

Most countries use imports to meet demand. In 2023, the average diversity index of European countries was 0.37. The proximity of Western European countries to the sea facilitates shipments of liquified natural gas (LNG) from a wider range of countries than would be possible with pipelines alone, which contributes to their tendency to have higher diversity indexes. In 2023, the UK's diversity score was 0.46, above the European average, reflecting a large number of import sources, some of which were rated as very politically stable.

## Demand

Germany remained the largest natural gas consumer in Europe (80 bcm), followed by the UK, Italy and Turkey; these four countries accounted for over half of total European natural gas demand in 2023. Overall European demand for natural gas continued to decline, down 8 per cent on 2022. Declines were seen in the majority of European countries as a result of warmer temperatures and higher gas and other prices. Additionally, EU countries saw ongoing effects of policies designed to reduce gas consumption in light of the Russia-Ukraine conflict. UK gas demand decreased by 11 per cent in 2023 compared with 2022, due to a substantial decline in gas demand for electricity generation and reduced demand from final consumers due to warm temperatures and high costs.

**Chart 2: Supply index for European countries, 2023**



Norway has been excluded from the graph because its self-sufficiency is substantially larger than other countries (25), see Appendix 1 for underlying data.

Chart 2 shows the supply index for European countries in 2023. The self-sufficiency score and diversity index have been stacked, indicating the relative contribution of these components to the index.

## Ukraine

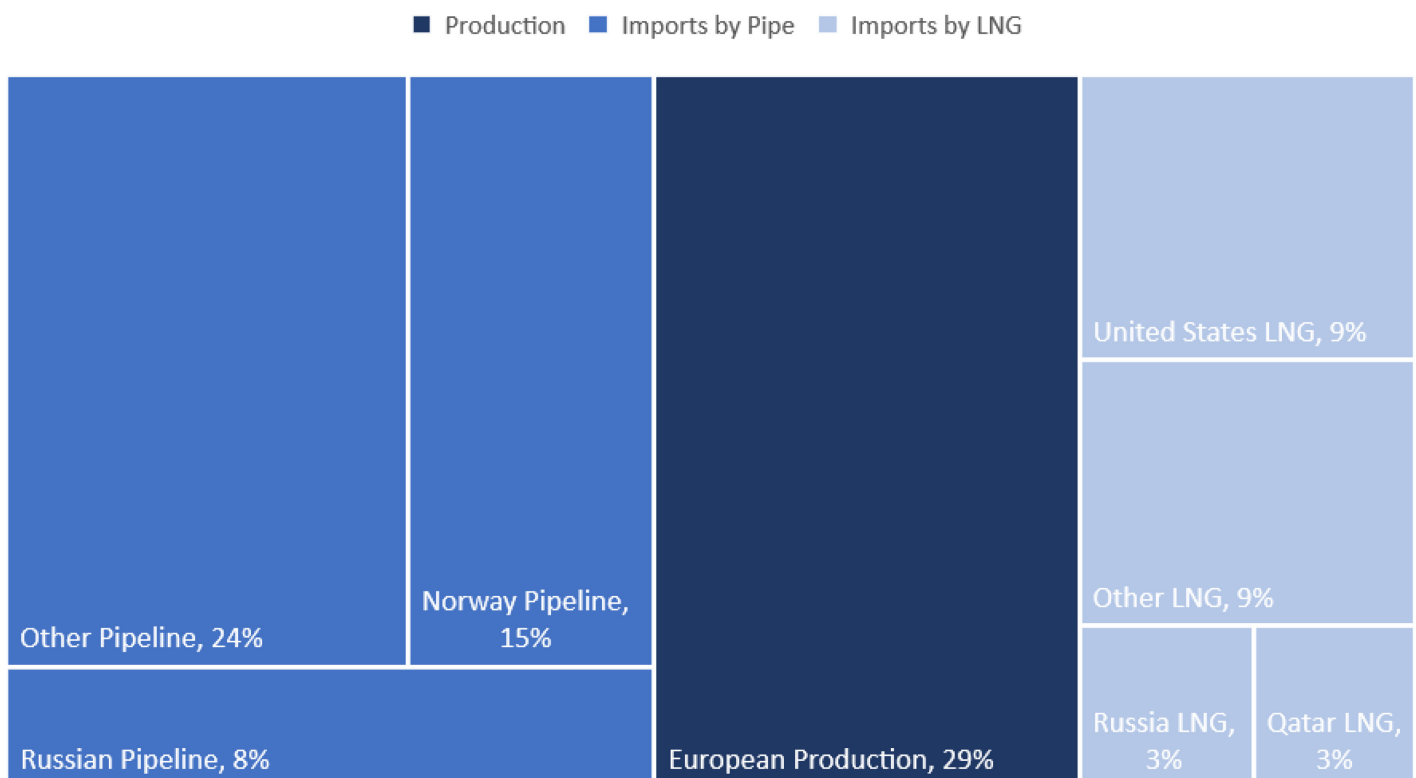
In 2023, the self-sufficiency and diversity index of Ukraine increased substantially resulting in the second highest supply index. Ukraine's self-sufficiency increased due to a notable drop in demand (meaning less production met a greater proportion of demand). Ukraine's diversity index increased due to a larger number of import sources compared to previous years. This analysis does not consider other factors which could be considered when evaluating supply.

## Supply index

In 2023, Norway had the highest supply index of European countries at 25.8. This is significantly higher than the median score of 0.49 due to substantial production. The average European supply index was 1.16 which falls to 0.51 when excluding Norway, reflecting most countries' reliance on imports to meet demand. Twelve countries produced no natural gas, so their supply index equalled their diversity index. Of these countries, Bosnia and Herzegovina, Gibraltar, and North Macedonia had only one import source, resulting in a supply index of zero.

With a supply index of 1.00, the UK had the sixth highest European supply index, behind Norway, Ukraine, Romania, the Netherlands, and Albania. This was down from 1.15 in 2022. The UK is Europe's second largest producer of natural gas; however it is substantially smaller than Norway, producing 72 per cent less gas than Norway in 2023.

## Chart 3: Sources of European gross gas supply, 2023

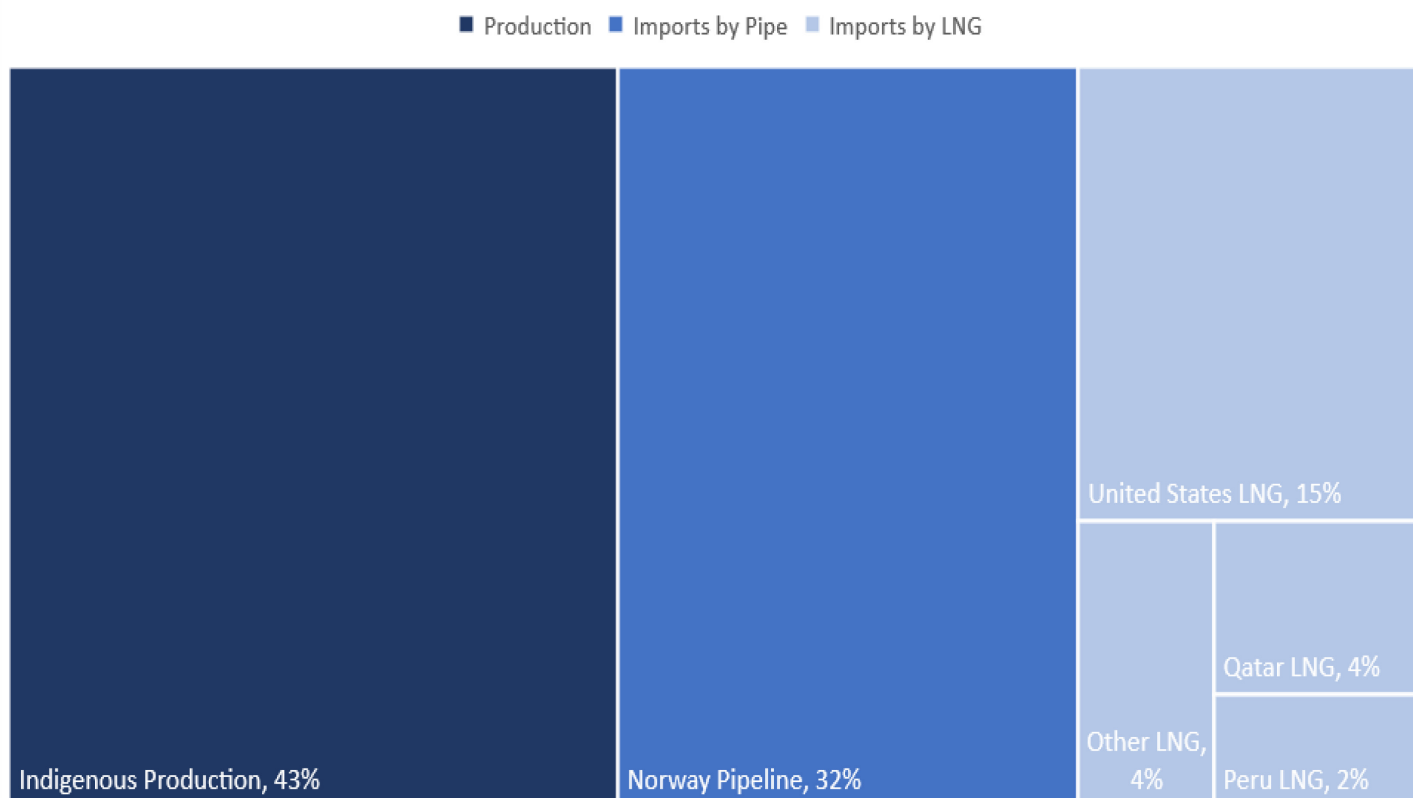


The majority of European natural gas imports arrive via pipeline for which infrastructure is well-established. In 2023, imports by pipeline made up 66 and 57 per cent of total imports to Europe and the UK respectively. Pipeline infrastructure means it is often convenient to import gas from neighbouring countries. Countries can also import natural gas as shipments of LNG which is gas that has been cooled to a liquefied state, making it easier to store and transport. It can then be regasified at import terminals, before being transferred to the

pipeline system. The UK has the second largest LNG regasification infrastructure in Europe, behind Spain, with three import terminals - Dragon, the Isle of Grain and South Hook.

Chart 3 shows European gas supply sources in 2023, see Appendix 1 for a breakdown of other. The top import sources for European countries have remained relatively unchanged since 2021, with 13 countries ranking within the top 15 sources each year from 2021 to 2023. Of these, Norway, Russia, Algeria, and the United States have consistently ranked within the top five sources of European imports although the proportion of European supply met by Russian gas has fallen sharply since 2021 when Russian imports comprised 24 per cent of gross supply. European pipeline imports from Russia<sup>2</sup> fell by almost 50 per cent in 2023 compared to 2022 as many European countries moved away from Russian gas following the invasion of Ukraine. Despite this Russia remained the second largest pipeline import source to Europe behind Norway, down from the largest in 2022 and accounting for 8 per cent of gross supply. Imports of Russian LNG increased slightly in the same period. Unlike 2022, the shortfall was met with reduced demand and increased LNG imports rather than pipeline imports. LNG imports increased by 7 per cent in 2023 compared to 2022, with imports of LNG from the US making up 9 per cent of gross supply. Imports of gas to Europe from the UK decreased by 14 per cent in 2023 compared to record highs in 2022 but remained higher than pre-conflict averages.

**Chart 4: Sources of UK gross gas supply, 2023**



Similar to Chart 3, Chart 4 shows gas supply sources for the UK in 2023. In 2022 UK trade patterns shifted following Russia’s invasion of Ukraine reaching record highs for both imports and exports as the UK facilitated gas trade into mainland Europe. Following this, in 2023, imports and exports were down compared to those record highs. Imports returned to more typical levels and higher than normal exports were facilitated by low UK demand. Norway remained the UK’s largest import source, accounting for 32 per cent of gross supply. Norway accounted for almost 100 per cent of all pipeline imports to the UK in 2023 as Belgian and Dutch interconnectors were mainly used for exports.

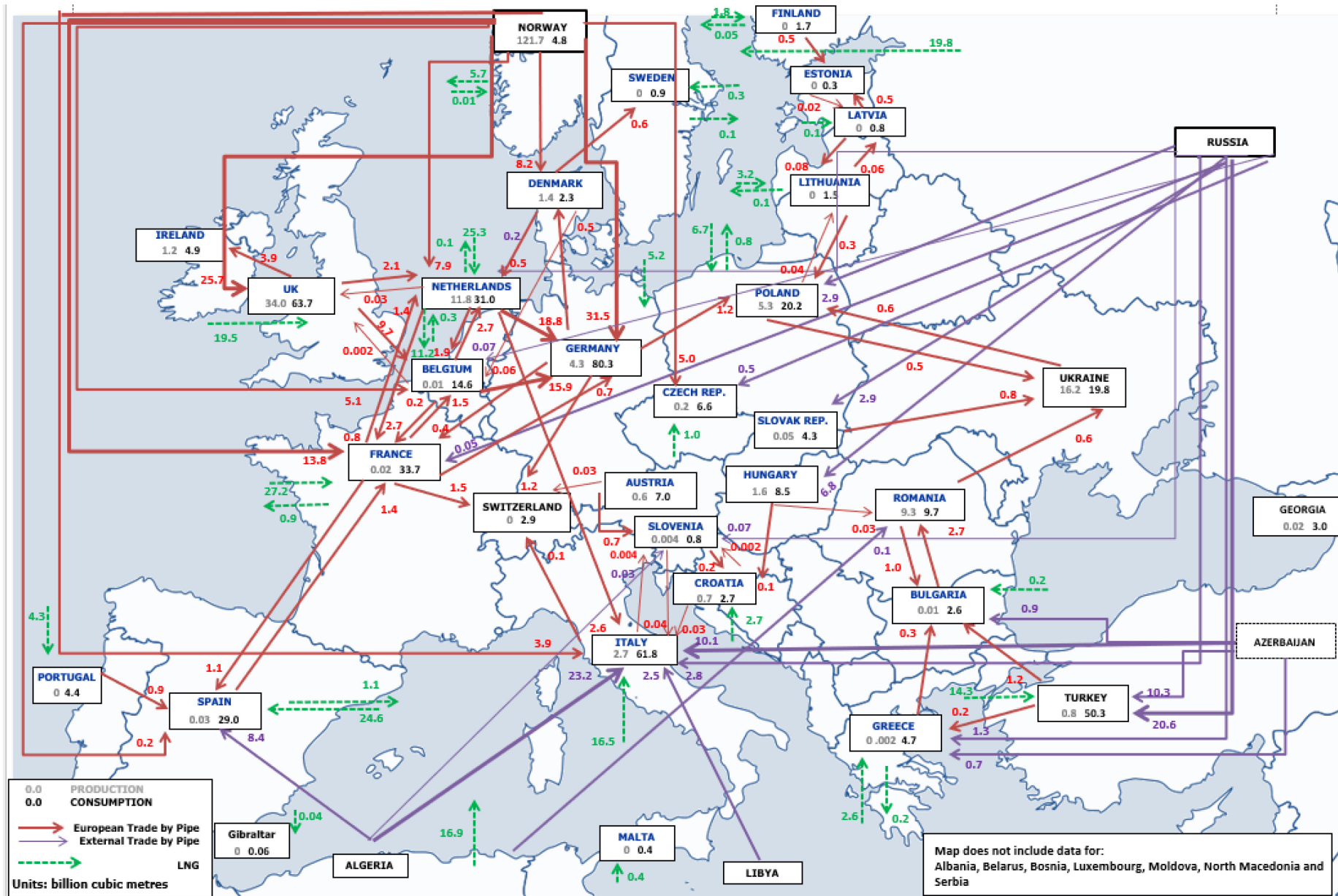
<sup>2</sup> Russia acts as a transit country for gas from Kazakhstan and Turkmenistan, so it should be noted that the origin of this gas is not necessarily all Russian.

Imports of LNG from the US accounted for 61 per cent of total UK LNG imports in 2023, up from 50 per cent in 2022 and 26 per cent in 2021. It remained the largest source of LNG to the UK, having overtaken Qatar in 2022. LNG from the US has increased considerably; recent provisional data up to October 2024 indicates that so far in 2024, US LNG imports have accounted for almost 70 per cent of total LNG imports (see [Energy Trends Table 4.3](#) for further information). Qatari LNG imports accounted for 14 per cent of total LNG imports and despite being the second largest source, this was the lowest proportion seen in over a decade. LNG imports from Qatar fell by 64 per cent in 2023 compared to 2022. In total, the UK sourced LNG from 10 different countries in 2023, down from 13 in 2022.

Following sanction announcements and industry self-sanctioning, the last cargo of Russian LNG imported to the UK was received in March 2022.

# Map 1:

Map 1 illustrates the diversity of import supply, as well as the complexities of inter-EU gas trade.





## Appendix 1: Underlying data for charts

**Table 1: Underlying data for Chart 1 and Chart 2**

Country	Self-sufficiency	Diversity index	Supply index	Demand (mcm)
Albania	1.00	0.00	1.00	48
Austria	0.08	0.48	0.56	7,004
Belarus	0.01	0.00	0.01	16,532
Belgium	0.00	0.89	0.89	14,619
Bosnia and Herzegovina	0.00	0.00	0.00	247
Bulgaria	0.00	0.48	0.49	2,552
Croatia	0.27	0.66	0.93	2,719
Czech Republic	0.02	0.41	0.43	6,568
Denmark	0.60	0.15	0.75	2,336
Estonia	0.00	0.32	0.32	336
Finland	0.00	0.58	0.58	1,719
France	0.00	0.70	0.70	33,691
Georgia	0.01	0.00	0.01	3,017
Germany	0.05	0.40	0.45	80,305
Gibraltar	0.00	0.00	0.00	60
Greece	0.00	0.70	0.70	4,658
Hungary	0.19	0.19	0.39	8,519
Ireland	0.24	0.00	0.24	4,874
Italy	0.04	0.69	0.73	61,842
Latvia	0.00	0.27	0.27	801
Lithuania	0.00	0.40	0.40	1,487
Luxembourg	0.00	0.54	0.54	556
Malta	0.00	0.15	0.15	401
Netherlands	0.38	0.75	1.13	30,983
Norway	25.29	0.55	25.84	4,811
Poland	0.26	0.43	0.69	20,194
Portugal	0.00	0.28	0.28	4,437
Republic of Moldova	0.00	0.02	0.02	2,503
Republic of North Macedonia	0.00	0.00	0.00	350
Turkey	0.02	0.69	0.70	50,291
Romania	0.96	0.18	1.14	9,686
Serbia	0.11	0.00	0.11	2,906
Slovak Republic	0.01	0.30	0.31	4,274
Slovenia	0.01	0.17	0.18	810
Spain	0.00	0.74	0.74	29,015
Sweden	0.00	0.61	0.61	856
Switzerland	0.00	0.48	0.48	2,910
Ukraine	0.82	0.57	1.38	19,799
United Kingdom	0.54	0.46	1.00	63,731
<b>Average</b>	<b>0.79</b>	<b>0.37</b>	<b>1.16</b>	<b>12,883</b>

Source: IEA (<http://data.iea.org/>)

**Countries included in 'Other Pipeline' in Chart 3:** Algeria, Azerbaijan, Netherlands, Belgium, Germany, Slovak Republic, United Kingdom, Iran, France, Libya, Ukraine, Bulgaria, Spain, Denmark, Czech Republic, Italy, Lithuania, Switzerland, Austria, Greece, Estonia, Hungary, Portugal, Slovenia, Latvia, Turkey, Croatia, Moldova, Finland, Romania.

**Countries included in 'Other LNG' in Chart 3:** Algeria, Nigeria, Egypt, Angola, Trinidad and Tobago, Norway, Peru, Equatorial Guinea, Cameroon, Oman, Spain, France, Australia, Indonesia, Lithuania, China, Chile, Mozambique, Netherlands, Gibraltar, Belgium, South Korea, Jamaica, Finland, Malaysia, Sweden, Estonia, Germany, Hungary, Italy.

**Countries included in 'Other LNG' in Chart 4:** Angola, Algeria, Nigeria, Russia, Norway, Trinidad and Tobago, Egypt, Spain, Chile, Oman.

## Appendix 2: Methodology

### Self-sufficiency

Data for natural gas was extracted from the IEA database. Self-sufficiency was determined from data on production and demand (production (mcm) ÷ demand (mcm)).

### Diversity index

The diversity index used here is a product of a standard diversity index and an index for political stability. As a basic index for measuring diversity, we used the Shannon-Wiener diversity index:

$$\sum_{i=1}^n -x_i \ln(x_i)$$

Where  $x$  is the proportion of total natural gas supply represented by the  $i^{\text{th}}$  source country and  $n$  represents the final source country. A value below 1 signifies a country that is dependent on a small range of import sources, a value above 1 represents a country with a wider range of import sources. The minimum value of zero denotes a country that has one imported fuel source or relies entirely on production (or a country with no imports). The Shannon-Wiener was chosen here because it places weight on the diversity of contributions from smaller countries and reduces the impact of larger nations.

Political stability was determined using data from the World Bank worldwide governance indicators. Specifically, the index reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically motivated violence and terrorism. These data were standardised between 0 and 1.

Source: World Bank <http://info.worldbank.org/governance/wgi/index.aspx#home>

Shannon-Wiener and political stability indices were multiplied and summed:

$$\sum_{i=1}^n -x_i \ln(x_i) b_i$$

Where  $b$  is an index of political stability of producing country. This is called the SWNI (Shannon-Weiner-Neumann index), in line with previous work. Each SWNI index was normalised between 0 and 1, in order to have a standardised index. This was done by working out a maximum diversity score, by assuming maximum diversity was equivalent to importing products in line with proportional contributions of exporting countries (e.g. if a single country were responsible for exporting 50 per cent of all natural gas, and five other countries were responsible for 10 per cent each, we assumed maximum import diversity at a ratio of 5:1:1:1:1). This maximum diversity score then acted as our upper score of 1, with all other scores divided by this maximum to standardise the data.

### Other sources of gas

Sometimes, due to a variety of reasons, countries may report an import of natural gas from a “Non-Specified/Other” source country. Border Point Data was used to reallocate imports for Austria, Hungary, Poland, Republic of Moldova, Slovak Republic, and Ukraine, which is available at <https://www.iea.org/data-and-statistics/data-product/gas-trade-flows#gas-trade-flows>. This data is collected by the IEA and shows monthly gas flows in Europe.



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