

Diversity and security of gas supply in Europe, 2022

Amelia Wyatt

07714 171 175

amelia.wyatt@energysecurity.gov.uk

Key headlines

The Russian invasion of Ukraine and subsequent sanctions announcements saw significant shifts in European gas trade patterns in 2022. This included a substantial increase in European imports of Liquefied Natural Gas (LNG) which made up 22 per cent of gross supply in 2022 compared to 13 per cent in 2021.

Imports of LNG from the US to Europe and the UK tripled with imports of LNG over double those of the second largest source, Qatar. Increased imports of LNG to the UK saw regasification infrastructure utilised to support European efforts to move away from Russian gas. As a result, the UK saw record high imports and exports in 2022.

Demand for natural gas fell as a result of warm temperatures, high costs and policies targeted at reducing natural gas consumption in light of Russia-Ukraine. Demand in the UK fell less than on the continent, down 8 per cent compared to 12 per cent for Europe, the result of record high temperatures, costs and record renewable output.

Indigenous production of natural gas in Norway fell on 2021 but remained substantial as Norway continues to be one of the largest producers of gas globally and the largest producer of natural gas in Europe. Indigenous production in the UK was up in 2022 compared to 2021 which saw record lows due to maintenance.

Background

In Europe and the UK, demand for natural gas is met through indigenous production and imports. In 2022, indigenous production was equivalent to 43 and 54 per cent of demand in Europe and the UK respectively. The remainder was met through imports, which arrive via pipeline or as shipments of Liquefied Natural Gas (LNG).

This article assesses the diversity and security of gas supply in Europe and the UK. Data for Europe used in this article were sourced from the International Energy Agency (IEA), and as such only reflect IEA member states. Whilst this includes the majority of Europe, Andorra, Kosovo, Liechtenstein, Monaco, San Marino, and Vatican City are not included. Cyprus, Iceland, and Montenegro are not included as they did not produce or consume natural gas in 2022. In this analysis Russia is not considered part of Europe.

Methods

This article uses three indicators to analyse the diversity and security of natural gas supply.

Self-sufficiency reflects a country's ability to meet natural gas demand through indigenous production alone. This is calculated by dividing the volume of indigenous production by demand. Countries with a self-sufficiency score of 0 did not produce natural gas; countries with a score greater than 0 and less than 1 meet some demand through imports; countries with a score of 1 produced as much gas as was used; and countries with a score greater than 1 produced more gas than was used. A high self-sufficiency score means natural gas supply is likely to be more secure.

Diversity index measures the number of import sources for a given country, weighted by each source country's reported political stability¹. 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

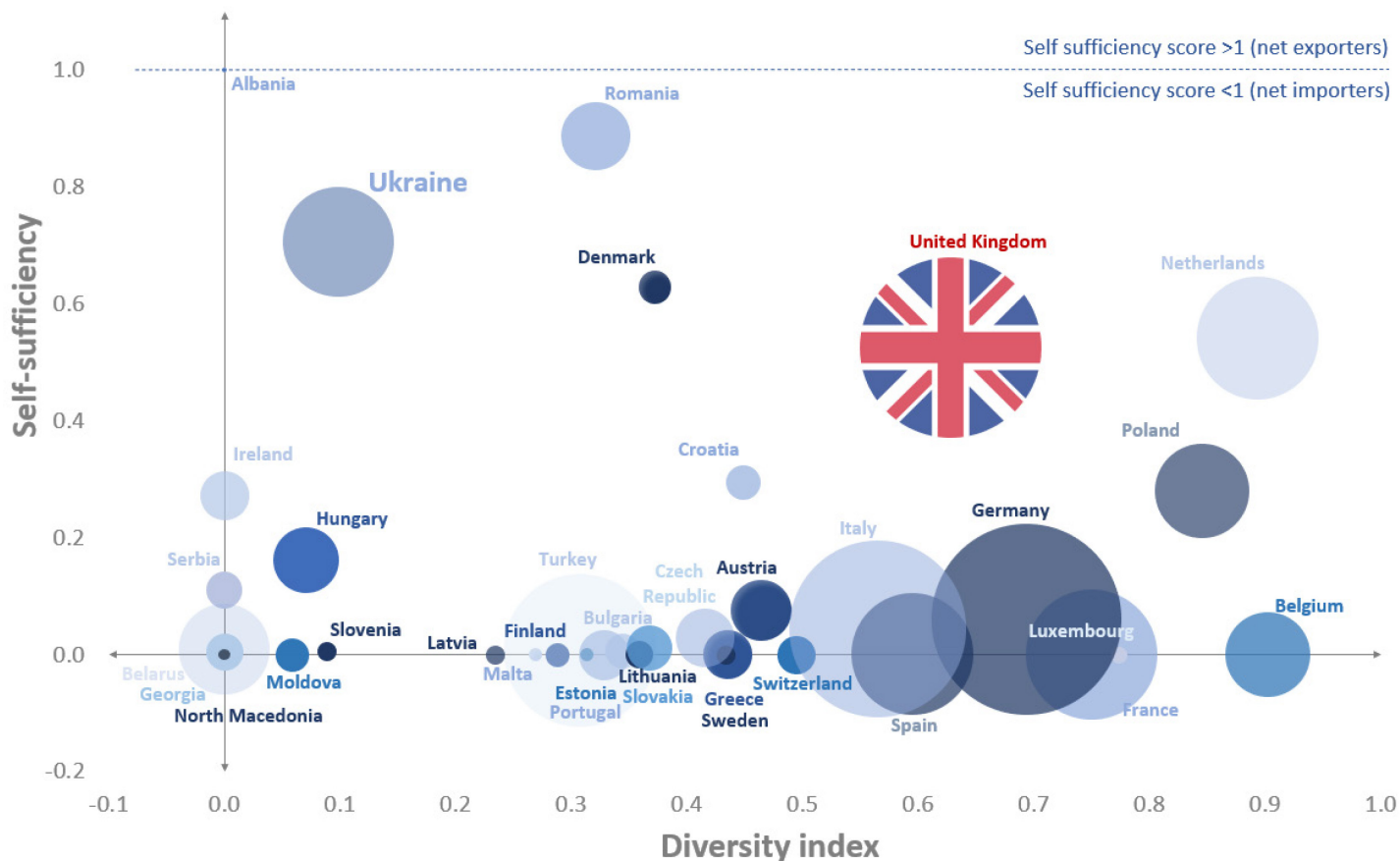
¹ Data sourced from World Bank governance indicators. See Appendix 1 for underlying data and Appendix 2 for method.

will have a low diversity 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 calculates the sum of a country's self-sufficiency score and diversity index score. This is a simple indication of security of supply. A supply index of 0 indicates that a country has no indigenous production and only one import source.

Security and diversity of gas supply in UK and Europe

Chart 1: Self-sufficiency and diversity index for European countries, 2022



Norway has a diversity index of 0.54 and a self-sufficiency of 18.34 so has been excluded from the graph as it is substantially larger than the other countries, see Appendix 1 for underlying data

Chart 1 shows the relationship between a country's self-sufficiency score and diversity index. The size of each bubble equates to the natural gas demand in each European country.

Self-sufficiency

Norway and Albania met their demand for natural gas with indigenous production alone in 2022, making them self-sufficient. Norway is the largest producer of natural gas in Europe, and in the top 10 globally; in 2022, Norway produced more than 18 times more natural gas than it consumed, accounting for 55 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 just 15 per cent of gas demand is met by indigenous production. Of European countries who consume natural gas Albania is the smallest, producing the same amount that it consumed in 2022.

The UK had a self-sufficiency score of 0.54 meaning it produced the equivalent to just over half the gas it consumed in 2022. In the UK, indigenous production has been equivalent to around half of demand for over a decade, reaching 54 per cent in 2022 due to notably low demand, and up on 2021 when production reached a record low due to planned maintenance of North Sea infrastructure including the Forties Pipeline System (FPS).

Of the 39 countries included in this analysis, 13 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 2022, the average diversity index of European countries was 0.35. The proximity of Western European countries to the sea facilitates shipments of 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 contrast, Poland rose from seventh to fourth place in 2022 as a result of importing record high volumes of LNG in response to Russia's invasion of Ukraine; the US accounted for the majority of these imports, but Poland also imported from an additional 8 countries in 2022 compared with 2021.

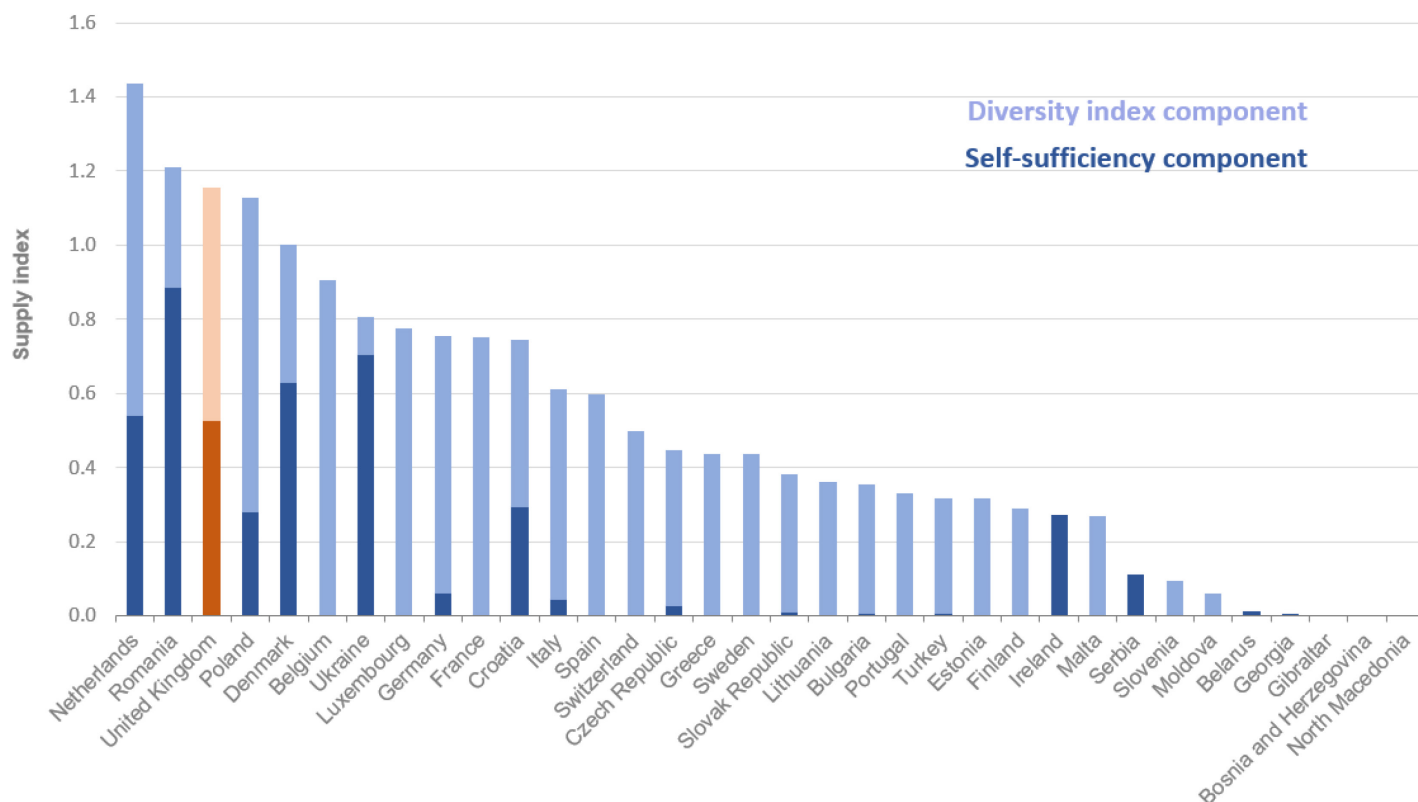
In 2022, the UK's diversity score was 0.63 reflecting a large number of import sources some of which are very politically stable.

Demand

Germany was the largest consumer of natural gas in Europe, consuming 80 bcm in 2022. This was followed by the UK (72 bcm), Italy (69 bcm) and Turkey (51 bcm). In 2022, these four countries accounted for half of total European natural gas demand. Demand for natural gas decreased throughout Europe in 2022, down 12 per cent on 2021. Declines were seen in 85 per cent of European countries as a result of warmer temperatures but also higher gas and other prices and new policies aimed at reducing gas consumption in light of Russia-Ukraine. UK gas demand decreased by 7.9 per cent in 2022 compared with 2021, due to the warmest year on record, higher prices impacting consumer behaviour, and record renewable output.

Some large consumers of natural gas sit in the bottom right quadrant of Chart 1 reflecting a high diversity index but low self-sufficiency relative to demand.

Chart 2: Supply index for European countries, 2022



Norway has a supply index of 18.9 so has been excluded from this graph as it is substantially larger than the other countries, see Appendix 1 for underlying data

Chart 2 shows the supply index for European countries in 2022. The self-sufficiency score and diversity index have been stacked, indicating the relative contribution of these components to the security of supply ranking.

Supply index

In 2022, Norway had the highest supply index of European countries at 18.9. This is significantly higher than the median score of 0.43 due significant indigenous production. The average European supply index is 0.97 which falls to 0.50 when excluding Norway, reflecting most countries' reliance on imports to meet demand. Thirteen 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 1.15, the UK had the fourth highest European supply index, behind Norway, the Netherlands and Romania. The UK is Europe's second largest producer of natural gas; however it is substantially smaller than Norway, producing 71 per cent less gas than Norway in 2022.

European gas supply

The majority of European natural gas imports arrive via pipeline as infrastructure is well-established. In 2022, imports by pipeline made up 69 and 55 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 re-gasified 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 Hook².

Chart 3: Sources of European gross gas supply, 2022

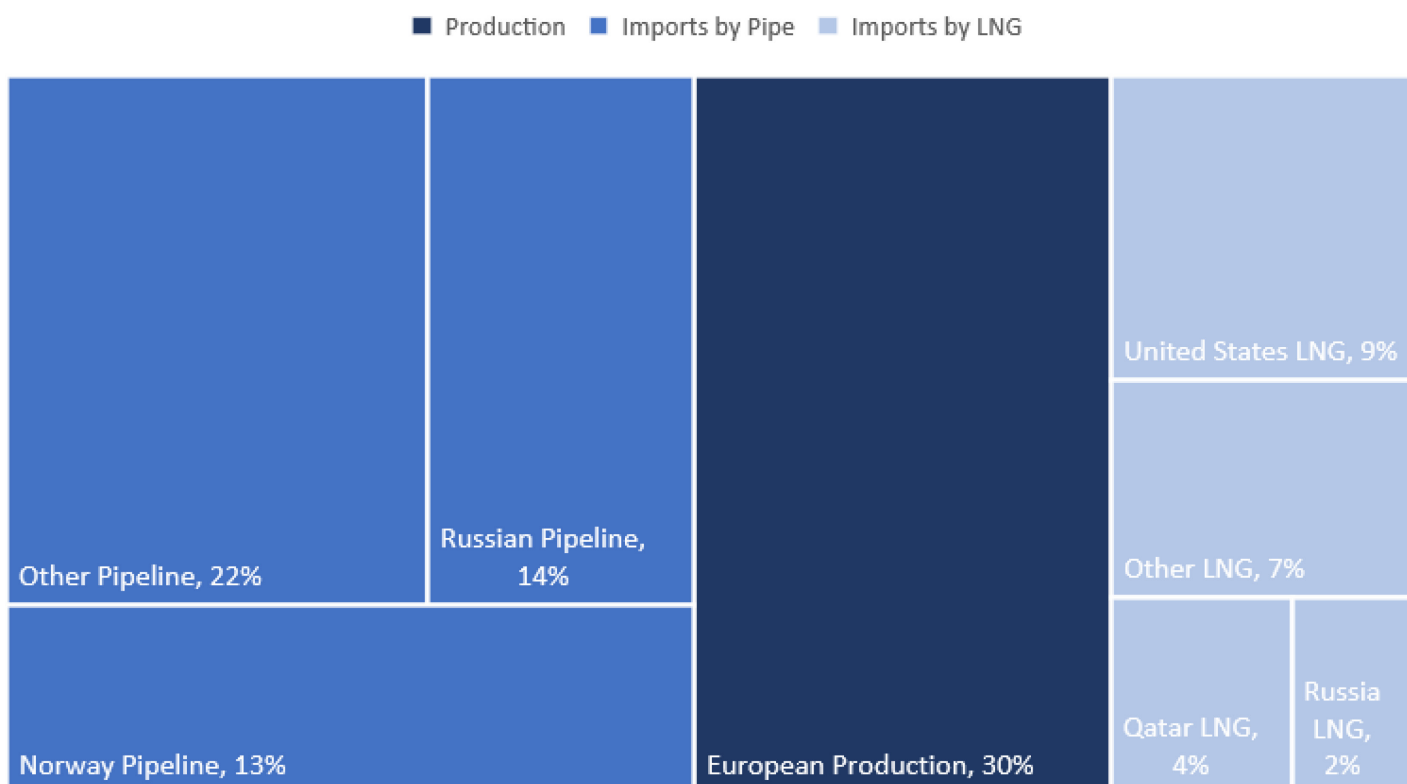


Chart 3 shows European gas supply sources in 2022, see Appendix 1 for a breakdown of other.

Following the Russian invasion of Ukraine in February 2022, many countries including all EU countries and the UK sanctioned Russian imports of natural gas. Whilst these sanctions did not come into effect until the end of

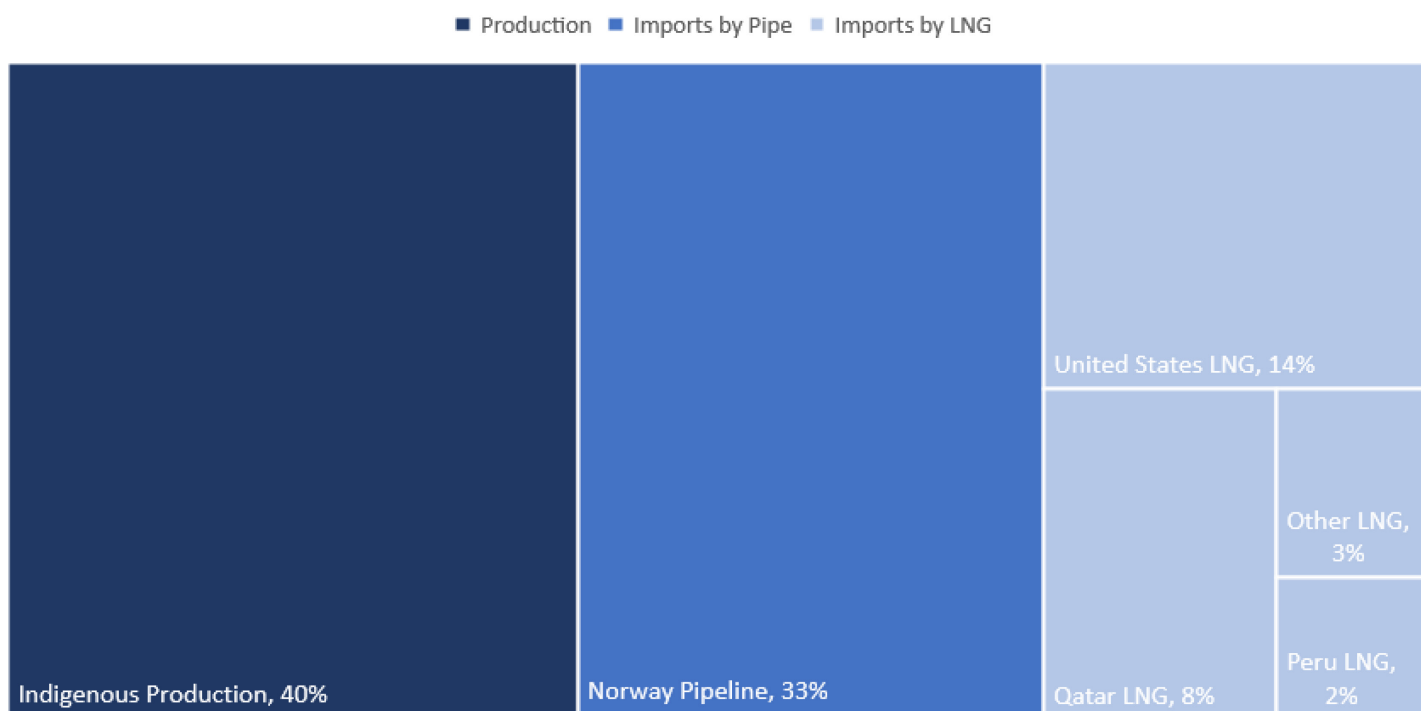
² For more information on LNG please see [Supply of Liquefied Natural Gas in the UK](#), this will be updated with data for 2023 in March 2024

the year, shifting trade patterns and industry self-sanctioning was observed from the Spring. Despite this, pipeline imports from Russia³ remained the largest import source to European countries accounting for 14 per cent of gross supply, down from 24 per cent in 2021. The shortfall was made up by increased pipeline imports which increased by 20 per cent in 2022 compared to 2021; and increased imports of LNG which made up 22 per cent of gross supply in 2022 compared to 13 per cent in 2021.

In 2022, the US was the largest source of LNG imports to Europe making up 42 per cent of total LNG imports, compared to 27 per cent in 2021. Qatar was the second largest source of LNG, making up 16 per cent of the total, down from 23 per cent in 2021. This follows increased liquification capacity in the US and Qatar primarily focusing on long-term supplies to the Asian market. In total, European countries imported LNG from 34 different countries in 2022. Egypt, Angola and Norway joined the top ten LNG exporters to Europe in 2022.

Pipeline imports to Europe from the UK more than tripled in 2022 compared to 2021. UK LNG regasification infrastructure was utilised to support European efforts to move away from Russian gas, with imports of LNG to the UK increasing by 74 per cent in 2022. Once re-gasified, pipeline infrastructure meant these imports could be exported to the mainland allowing the UK to operate as a 'land bridge' for imports of LNG. 2022 also saw a large increase in pipeline imports from Azerbaijan to Europe, rising from the eighth largest pipeline import source to the fourth.

Chart 4: Sources of UK gross gas supply, 2022



Similar to Chart 3, Chart 4 shows gas supply sources for the UK in 2022.

In 2022, indigenous production in the UK increased by 16 per cent following record lows in 2021. Production was just below pre-pandemic levels, down 17 per cent compared to 2019.

The UK saw substantial shifts in trade patterns following Russia's illegal invasion of Ukraine. Exports tripled in 2022 compared to 2021, reaching a record high. Imports also reached a record high, up 10 per cent, and driven by a significant increase in imports of LNG, up 74 per cent in the same period. Norway remained the UK's largest import source, accounting for 33 per cent of gross supply. Norway accounted for more than 99 per cent of all pipeline imports to the UK in 2022 as Belgian and Dutch interconnectors were mainly used for exports.

³ 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 tripled in 2022, accounting for 50 per cent of total LNG imports and making it the largest source of LNG to the UK for the first time, overtaking Qatar. LNG from the US has been increasing considerably since the first import in 2017. Recent provisional data up to October 2023 indicates that so far in 2023, US LNG imports have accounted for almost 60 per cent of total LNG imports (see [Energy Trends Table 4.4](#) for further information). In 2022, Qatari LNG imports accounted for 30 per cent of total LNG imports and despite being the second largest source, this was the lowest proportion seen in over a decade. In total, the UK sourced LNG from 13 different countries in 2022, up from 8 in 2021.

Following sanction announcements and industry self-sanctioning, the last cargo of Russian LNG imported to the UK was received in March 2022, which made up 1.2 per cent of gross supply.

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	49
Austria	0.08	0.46	0.54	8,175
Belarus	0.01	0.00	0.01	18,272
Belgium	0.00	0.90	0.90	15,539
Bosnia and Herzegovina	0.00	0.00	0.00	244
Bulgaria	0.01	0.34	0.35	2,747
Croatia	0.29	0.45	0.74	2,531
Czech Republic	0.03	0.42	0.44	7,604
Denmark	0.63	0.37	1.00	2,388
Estonia	0.00	0.31	0.31	353
Finland	0.00	0.29	0.29	1,294
France	0.00	0.75	0.75	37,578
Georgia	0.00	0.00	0.00	3,038
Germany	0.06	0.69	0.75	79,540
Gibraltar	0.00	0.00	0.00	82
Greece	0.00	0.44	0.44	5,171
Hungary	0.16	0.07	0.23	9,575
Ireland	0.27	0.00	0.27	5,286
Italy	0.05	0.57	0.61	68,737
Latvia	0.00	0.23	0.23	843
Lithuania	0.00	0.36	0.36	1,598
Luxembourg	0.00	0.77	0.77	593
Malta	0.00	0.27	0.27	384
Netherlands	0.54	0.89	1.44	32,929
Norway	18.34	0.54	18.88	6,984
Poland	0.28	0.85	1.13	19,569
Portugal	0.00	0.33	0.33	5,580
Republic of Moldova	0.00	0.06	0.06	2,482
Republic of North Macedonia	0.00	0.00	0.00	276
Turkey	0.01	0.31	0.31	51,041
Romania	0.89	0.32	1.21	10,353
Serbia	0.11	0.00	0.11	2,960
Slovak Republic	0.01	0.37	0.38	4,548
Slovenia	0.01	0.09	0.09	840
Spain	0.00	0.59	0.60	32,583
Sweden	0.00	0.43	0.43	775
Switzerland	0.00	0.49	0.49	3,134
Ukraine	0.71	0.10	0.81	26,662
United Kingdom	0.53	0.63	1.15	71,785
Average	0.62	0.35	0.97	13,952

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 indigenous production and demand (indigenous 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^{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 indigenous 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, Czech Republic, France, Ireland and Slovak Republic, which is available at www.iea.org/gtf/. This data is collected by the IEA and shows monthly gas flows in Europe.



© Crown copyright 2023

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3 or write to the Information Policy Team, The National Archives, Kew, London TW9 4DU, or email: psi@nationalarchives.gsi.gov.uk.

Where we have identified any third-party copyright information you will need to obtain permission from the copyright holders concerned.

This publication is available from: <https://www.gov.uk/government/collections/energy-trends>

If you need a version of this document in a more accessible format, please email energy.stats@energysecurity.gov.uk

Please tell us what format you need. It will help us if you say what assistive technology you use.