

## Diversity and security of gas supply in the EU, 2017

### Introduction

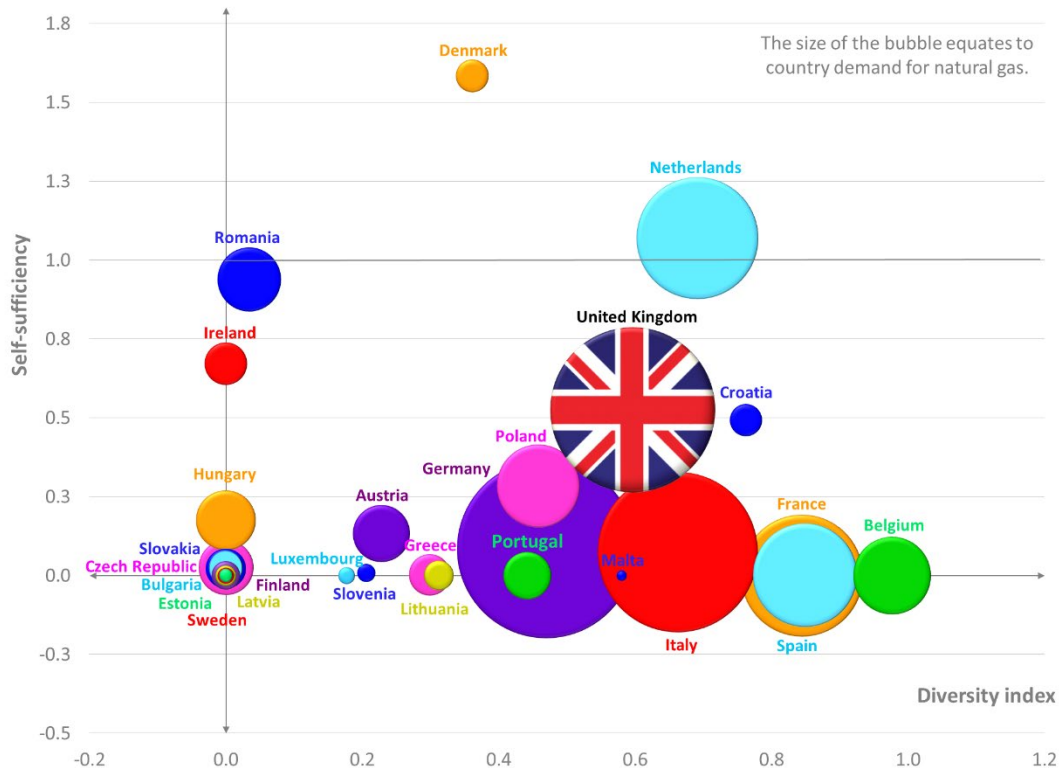
Countries meet their natural gas needs through a combination of indigenous production and trade through pipeline and Liquefied Natural Gas (LNG)<sup>1</sup>. This article is a comparative assessment of how EU countries met their natural gas demand in 2017, using International Energy Agency Statistics<sup>2</sup>. The aim is to determine how the UK's resilience of supply compared to other EU countries.

Total EU indigenous gas production was 132 billion cubic metres (bcm) in 2017. The UK's indigenous production contributed nearly a third to overall EU production, second only to the Netherlands who contributed 35 per cent. Total EU gas demand was 485 bcm in 2017 and Germany was the largest consumer at nearly one-fifth of this, with the UK ranked second at 17 per cent. Demand in the EU is relatively high compared to production (just over one-fifth of demand could currently be met by production), meaning that the EU imports gas to meet the shortfall. These imports arrive predominantly via the European gas pipeline network (around 90 per cent of imports arrive this way), as well as from a wider diversity of sources of shipped LNG.

### Diversity and security of gas supply in the EU, 2017

Two methods have been used in this article to assess the diversity and security of EU gas supply; self-sufficiency and an index of diversity, which considers both the number of import sources and the political stability of these sources<sup>3</sup>. Chart 1 shows the relationship between a country's demand, indigenous production, diversity of its gross imports and the political stability of the countries of import to gauge the UK's position relative to other EU countries.

**Chart 1: Diversity and security of gas supply in EU Countries, 2017**



<sup>1</sup> LNG is a natural gas that has been cooled to a liquefied state for ease of transportation (usually by ship)

<sup>2</sup> [www.iea.org/statistics/monthly/](http://www.iea.org/statistics/monthly/)

<sup>3</sup> Appendix 2 shows further detail on the methodology

A score of one for self-sufficiency indicates that a country produced as much gas as it used, and the size of each bubble indicates that country’s level of demand. A diversity score has been calculated using the number and political stability (using World Bank governance indicators) of a country’s import sources (see Appendix 1 for scores and Appendix 2 for method).

### Self-sufficiency

The UK had a self-sufficiency rating of 0.53 (Chart 1), meaning it could have met more than half its demand through indigenous production in 2017, comparing favourably with the EU average of 0.22<sup>4</sup>.

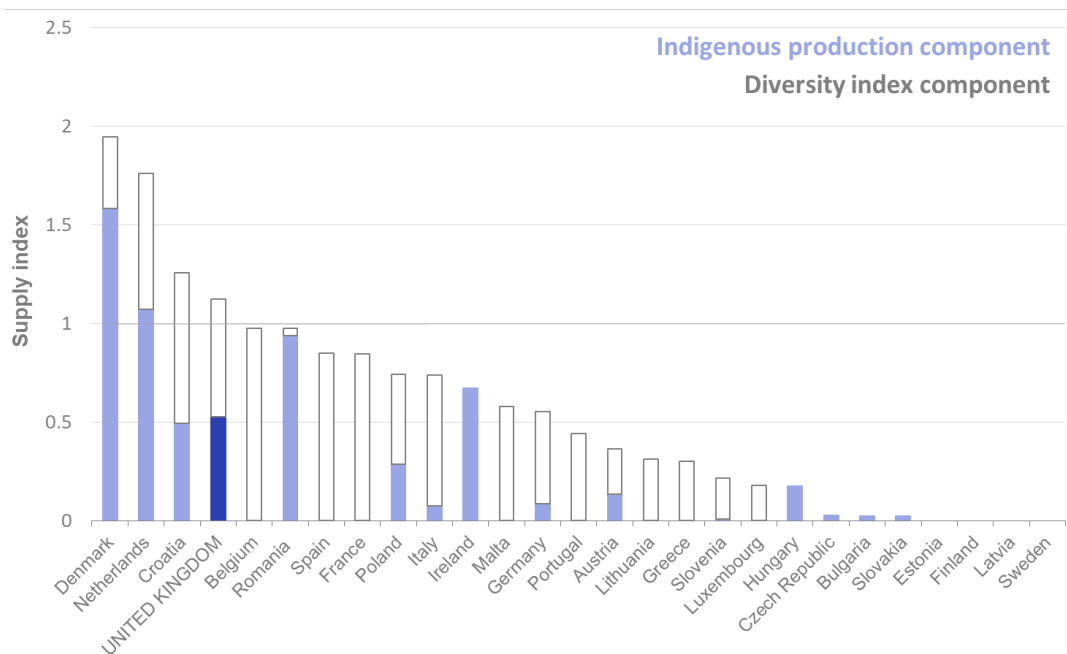
Within the EU only Denmark (who consumed less than two thirds of their indigenous production) and the Netherlands were net exporters of gas in 2017. Both countries send exports (via pipeline) predominantly to nearby Western European countries. All other EU countries met demand through imports, with ten countries producing no natural gas indigenously. Cyprus was the only country in the EU to have no gas consumption in 2017 and thus had no need to import gas despite no indigenous production.

### Diversity of supply

The UK placed highly in the ranking of EU countries for diversity of supply, with a diversity index twice that of the EU average at 0.6 compared to the EU average of 0.3. The UK imported gas from 11 countries in 2017 and ranked fourth overall for security of supply in the EU (Chart 2). Norway is the predominant supplier of gas to the UK, meeting 40 per cent of supply (and three-quarters of total imports). Both Denmark and the Netherlands ranked highest because they were self-sufficient.

Chart 2 compares EU countries by self-sufficiency and diversity of imports, combined to show the relative contribution of production, and import diversity and security, to give a simple indication of the overall security of supply score. Appendix 1 shows the underlying data.

**Chart 2: Security of supply of gas for EU countries, 2017**



Cyprus has been excluded because it has zero consumption of gas

<sup>4</sup> Self-Sufficiency is calculated through indigenous production divided by inland consumption (calculated) using IEA statistics. There are 6 countries in the EU which are not OECD countries and therefore calculated data is not available for them in the IEA database. For these countries inland consumption (observed) has been used.

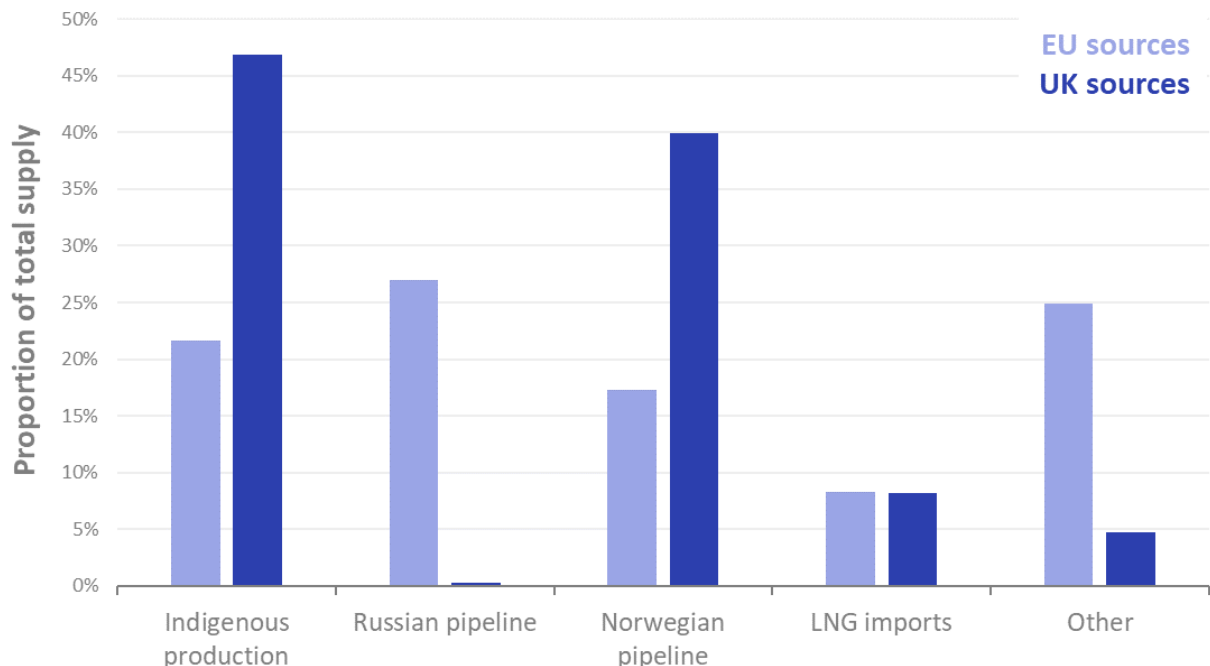
There are five countries with an overall supply index of zero (Cyprus, Estonia, Finland, Latvia and Sweden). A score of zero indicates that the country has no indigenous production and receives gas from a single import source. For Estonia, Finland and Latvia this single import source was Russia, whilst Sweden only imported from Denmark. Cyprus receives a default diversity index of 0 but as described they also did not have any consumption.

### Sources of EU and UK gas

The EU met on average just over a fifth of its supply through indigenous production (Chart 3). EU countries benefit from an established gas pipeline infrastructure, enabling countries to meet most of their consumption through imports via pipeline with around eight per cent of demand being met through LNG shipments. LNG is natural gas that has been cooled to a liquified state to make it easier for it to be stored and transported by ship before being regasified and transferred to the natural gas pipeline system.

The EU typically receives around a quarter of its supply from Russia through pipelines (Chart 3). There are no direct pipeline connections between the UK and Russia; the only gas to arrive this way comes via the Netherlands (~0.3 per cent of supply, see Appendix 2). The current legacy pipeline infrastructure (built during the USSR) means that Central and Eastern European countries receive almost all their supply from Russia. Most Eastern European countries are taking steps to increase their diversity of supply, including through access to LNG terminals or expansion of existing pipeline networks. It should also be noted that the origin of all this gas is not necessarily Russian, since Russia acts as a transit country for gas from Kazakhstan and Turkmenistan to reach European markets. Eighteen EU countries imported gas from Russia and for seven EU countries, Russia was their sole import origin.

**Chart 3: Sources of all EU and UK gas as a proportion of supply, 2017**



The second largest source of gas for the EU is Norway, principally via pipeline, which makes up nearly one-fifth of EU supply. In comparison the UK received 40 per cent of total supply from Norway, who do not have pipeline connections to Russia. The reason is largely because of the UK's proximity to Norway, resulting in some shared infrastructure in the North Sea. Norwegian flows arrive in the UK predominantly via the major pipelines Langeled, Flaga and Vesterled.

**Chart 4: Sources of EU and UK gas, 2017**

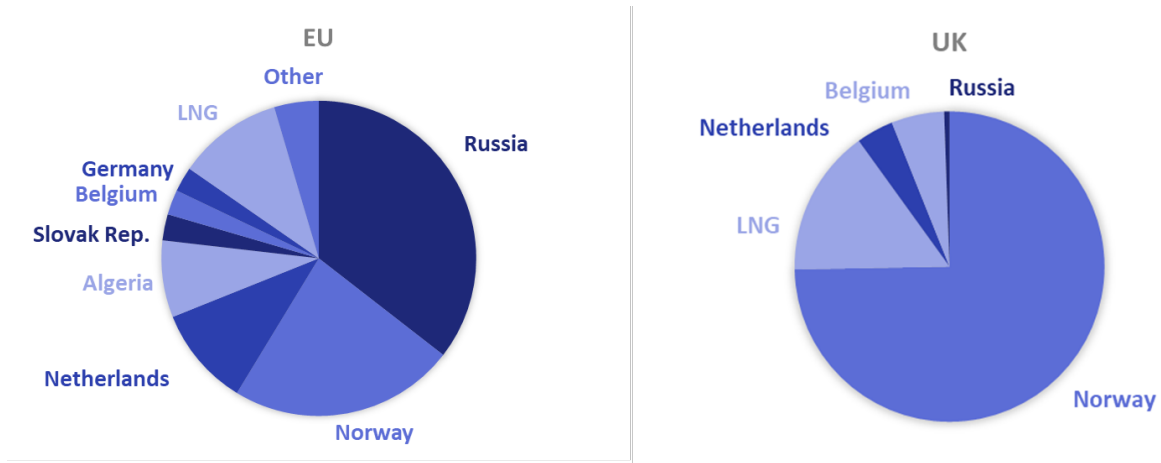


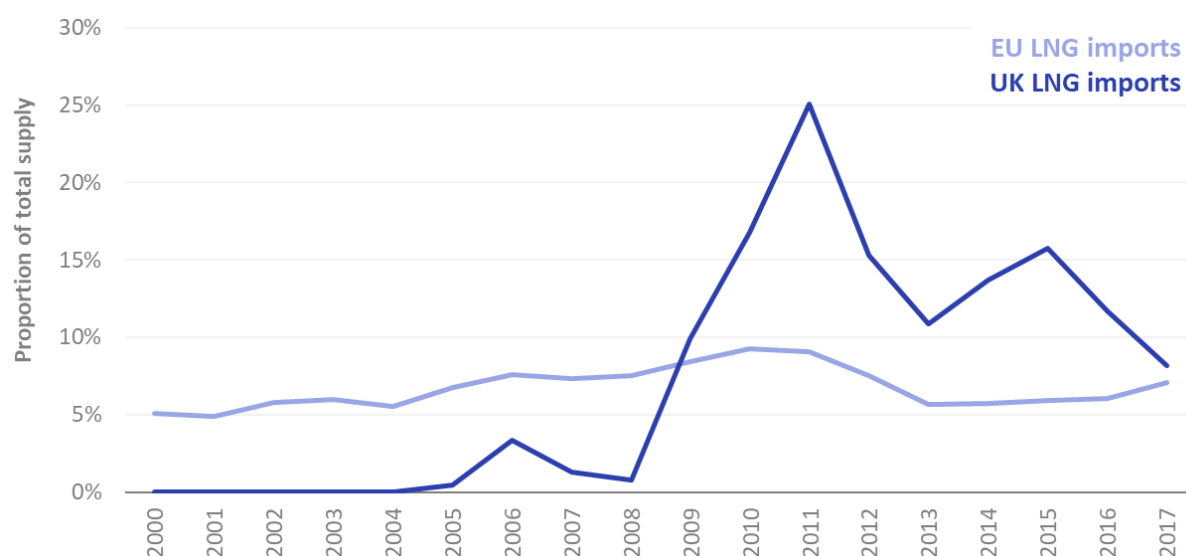
Chart 4 shows the source of EU and UK gas as a proportion of total imports. The EU sourced 37 per cent of its total imports from Russia in 2017, and at 23 per cent Norway was the second largest supplier to the EU. Roughly 10 per cent of EU imports are sourced through the Maghreb–Europe, Medgaz, Trans-Mediterranean, Galsi and Greenstream Pipelines from Northern Africa. The EU then imports smaller quantities from an array of sources with 13 countries<sup>5</sup> being included in “other” clearly displaying the diversity of EU sources, of which the majority is transported through pipelines.

### Liquefied Natural Gas (LNG)

Global LNG markets play a vital role in responding to disruptions. Uncontracted volumes of LNG play a role in providing volumes to those countries that need it. In the event of a supply shock in Europe, additional supply would typically come from Qatar. However, were supply from Qatar to be disrupted then other flexible supply sources could be used to meet demand. The US is one example, with recent start-ups of LNG projects exporting volumes that will be mostly traded on the short-term/spot market. Other sources would also be available, for instance Nigeria, which has proven to be flexible during the Fukushima accident. Demand for LNG has grown since the turn of the century, since when new start-ups have made more supply globally available.

Prior to 2000 (from the earliest data available in the series), the only countries in the EU to import LNG were Belgium, France, Italy and Spain. This had increased to 11 countries by 2017, including the UK. Spain was predominantly the highest importer of LNG in the EU between 2000 and 2017, reaching a peak of 30 bcm in 2008 (the highest of any EU country to date).

<sup>5</sup> United Kingdom, Libya, Austria, Denmark, France, Hungary, Nigeria, Turkey, Slovenia, Croatia, Czech Republic, Spain, Portugal (listed in order of volume imported.)

**Chart 5: EU and UK annual LNG imports as a proportion of total supply**

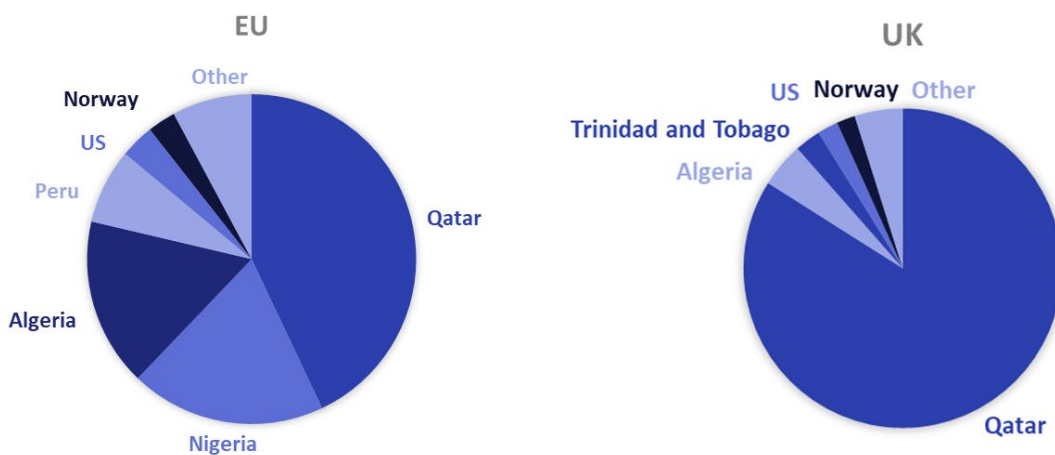
Average LNG imports to the EU have fluctuated between five and ten per cent of supply since 2000. The UK first imported LNG in 2005, when it made up less than 0.5 per cent of total supply (Chart 5), before reaching a peak of 25 per cent in 2011 (and nearly half of UK imports). The top four importers of LNG in the EU - France, Italy, Spain and the UK - all reached a peak between 2008 and 2011, with falling supply since then likely related to reductions in investment around the late 2000's and increased prices due to strong demand from Asia.

This downward trend continued so that in 2017 UK LNG imports had fallen to eight per cent of supply, the lowest level since 2008 and only marginally higher than the EU average of seven per cent. However, more recently, rising oil prices and demand from rapidly growing economies such as China and India have resulted in renewed investment and a subsequent diversification of supply sources as new projects have come online globally, including in the US and Russia. This increase to the variety of LNG sources provides additional resilience by increasing the diversity of the UK's and EU's supply portfolio.

This recent renewed investment has been reflected in a recent rise as volumes of LNG to France, Italy and Spain began increasing in 2016 and 2017, and from a more diverse range of sources (Chart 6). While it falls outside the scope of this article, LNG supply also increased to the UK in 2018 – please see Chapter 4 of Energy Trends (March 2019) and Energy Trends Table 4.4 for further information on 2018 UK data.

The UK received a similar proportion of gas imports from LNG as the EU average in 2017 (15 per cent and 12 per cent respectively). Chart 6 compares sources of UK LNG in 2017 to the EU. Compared to 2011 when 97 per cent of LNG was received from Qatar, Chart 6 demonstrates the increased diversity of LNG supply sources to the UK in 2017.

**Chart 6: Sources of EU and UK LNG imports, 2017**



(‘EU Other’ includes Angola, Egypt, Russia, Netherlands, Equatorial Guinea, Belgium transshipments and non-specified imports. ‘UK Other’ includes imports from Peru, Nigeria, Russia and non-specified imports.)

A significant portion (more than 40 per cent) of EU LNG was imported from Qatar in 2017, which was the world’s third largest net exporter of gas (of which 102,000mcm was LNG). For the UK this figure was 82 per cent, which was the lowest level in recent years as the UK has diversified its LNG portfolio, thereby benefiting the resilience of supply.

### Summary of findings

The EU could on average have met just over a fifth of demand through indigenous production in 2017 and this supply was supplemented with imports from pipelines (70 per cent of supply) and LNG imports (8.4 per cent of supply) to meet remaining demand. This varies on a country-by-country basis, but most countries in the EU have a diverse range of import sources, overall receiving pipeline gas from 18 countries and LNG imports from 12 countries.

In contrast, with a self-sufficiency score of 0.53, the UK could have met just over half of demand through indigenous production, which is substantially higher than the EU average and creates the foundation for a strong security of supply rating. In terms of the supply portfolio, the UK imported just under half its gas via pipeline with a further 8.3 per cent from imports of LNG from a range of sources in 2017. This resulted in the UK being placed fourth overall in EU countries for security of supply, with two of the three countries with higher scores benefitting from complete self-sufficiency. Continued increases to the range of supply sources (for example further diversifying sources of LNG imports) will continue to improve the UK’s resilience of supply.

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## Appendices

## Appendix 1: Natural Gas data, 2017

	Self-Sufficiency	Diversity x Political Stability	Demand (mcm)
Austria	0.13	0.23	9,488
Belgium	0.00	0.98	17,634
Bulgaria	0.02	0.00	3,313
Croatia	0.49	0.76	3,008
Cyprus	0.00	0.00	-
Czech Republic	0.03	0.00	8,727
Denmark	<b>1.58</b>	0.36	3,052
Estonia	0.00	0.00	493
Finland	0.00	0.00	2,327
France	0.00	0.84	43,517
Germany	0.08	0.47	93,351
Greece	0.00	0.30	4,953
Hungary	0.18	0.00	10,367
Ireland	0.67	0.00	5,235
Italy	0.07	0.66	75,151
Latvia	0.00	0.00	1,210
Lithuania	0.00	0.31	2,487
Luxembourg	0.00	0.18	791
Malta	0.00	0.58	286
Netherlands	<b>1.07</b>	0.69	43,329
Poland	0.28	0.46	20,097
Portugal	0.00	0.44	6,514
Romania	0.94	0.03	11,902
Slovakia	0.02	0.00	4,679
Slovenia	0.01	0.21	907
Spain	0.00	0.85	31,349
Sweden	0.00	0.00	753
United Kingdom	0.53	0.60	80,065
<b>EU Average</b>	<b>0.22</b>	<b>0.32</b>	<b>17,321</b>

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

Items in **bold** highlight those countries where indigenous production exceeded domestic consumption.

## 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 consumption (indigenous production (mcm) ÷ consumption (mcm)).

### Diversity indices

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. The Shannon-Wiener index is of the form:

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

Where x is the proportion of total natural gas supply represented by the *i*<sup>th</sup> 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 as 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>)

Once Shannon-Wiener and political stability indices were determined, these 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 5:1:1:1:1:1). 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. Where the source IEA data did not specify the origin country for a gas import, we used Border Point Data which is publicly available at [www.iea.org/gtf/](http://www.iea.org/gtf/). This data is collected by the IEA and shows gas flows in Europe on a monthly basis.

The UK sourced 4 per cent of its natural gas imports through pipeline from the Netherlands in 2017. However, the Netherlands sourced a substantial amount through pipeline from Russia, meaning for transparency purposes the proportion of Netherlands’ imports from Russia was applied to UK imports from the Netherlands as an estimate of the volume of pipeline gas that the UK imports from Russia.