

## Physical gas flows across Europe and security and diversity of gas supply in 2011

### Background

This article focusses on the upstream supply of gas to the EU. The map published within this article was prepared by DECC statisticians to illustrate physical gas flows at the European level using 2011 data published by the International Energy Agency (IEA)<sup>1</sup>, and aims to improve gas data transparency and quality. The first part of this article highlights patterns in European gas production and consumption, and examines how European demand was met in 2011. The second part of this article covers a diversity of supply index developed by DECC statisticians using the same data published by the IEA. This builds on previously published work on oil diversity of supply published in the December 2011 issue of Energy Trends<sup>2</sup>.

### European Gas Flows

#### European Gas Production

Total EU-27 gas production in 2011 was 182 billion cubic metres (bcm) with the Netherlands and the UK accounting for 44 per cent and 26 per cent of this total respectively, down 9 per cent on 2010. In the rest of the EU-27, production generally decreased or remained constant, with only the Netherlands and Denmark producing more gas than they consumed.

#### European Gas Consumption

The greatest demand among EU-27 countries came from Germany, the United Kingdom and Italy. These countries together accounted for over 50 per cent of consumption. Germany remained the largest net importer in Europe in 2011 at 90 bcm, followed by Italy at 62 bcm and the UK at 28 bcm.

Natural gas consumption in the EU-27 decreased by over 10 per cent in 2011 compared to 2010, from 545 bcm to 489 bcm. In particular, countries in North-Western Europe such as Belgium, France, Germany, the Netherlands and the UK have seen a reduction in gas demand. This reflects warmer temperatures in northwest Europe in 2011 and a shift in electricity generation from natural gas to coal.

#### Sources of Gas

Just over 37 per cent of EU-27 consumption in 2011 was met by indigenous production, with production from Netherlands and UK respectively meeting 16 and 10 per cent of total EU demand.

The Russian Federation remained the largest single supplier of gas to the EU-27, delivering around 119 bcm, or 24 per cent, of total EU-27 gas demand in 2011. The European pipeline infrastructure means that Central and Eastern European countries receive almost all of their natural gas supply from Russia. It should be noted that not all of this gas is Russian, since Russia acts as a transit country for gas from Kazakhstan and Turkmenistan to reach European markets.

Norwegian exports to the EU-27 decreased slightly between 2010 and 2011, at around 93 bcm or 19 per cent of total EU-27 gas consumption; 21 per cent of Norwegian exports were directed to the UK in 2011, similar to that in 2010.

North African pipelines via Spain and Italy provided 35 bcm, or 7.2 per cent, of EU-27 demand. Algerian gas, coming direct from Algeria and also via Morocco and Tunisia, accounted for over 93 per cent of North African gas delivered to the EU-27, with Libya supplying the remainder.

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<sup>1</sup> Please note that the analysis shows some differences with IEA data in order to provide a coherent view of gas flows. The supply for some countries may appear unbalanced as stock changes are not shown. Data were calculated primarily from 2011 monthly pipeline gas flows, with 2011 annual imports, exports, production and consumption used for quality assurance amendments.

<sup>2</sup> [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/65816/3928-physical-gas-flows-europe-2010.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65816/3928-physical-gas-flows-europe-2010.pdf)



EU-27 imports of LNG remained high in 2011 at 83.3 bcm (see below for more details), as energy companies sought to take advantage of price differentials across the world. LNG met 17 per cent of EU-27 demand and, in particular, 70 per cent of Spanish gas consumption. The largest suppliers of LNG to the EU-27 were Qatar, Algeria and Nigeria.

**UK imports of LNG in 2011**

UK imports of LNG increased by over a third to 24.8 bcm in 2011. The data suggest the UK was the largest importer of LNG in 2011. LNG imports from Qatar increased by 45%, whilst imports from elsewhere decreased; 85% of UK imports of LNG came from Qatar in 2011, up from 78% in 2010.

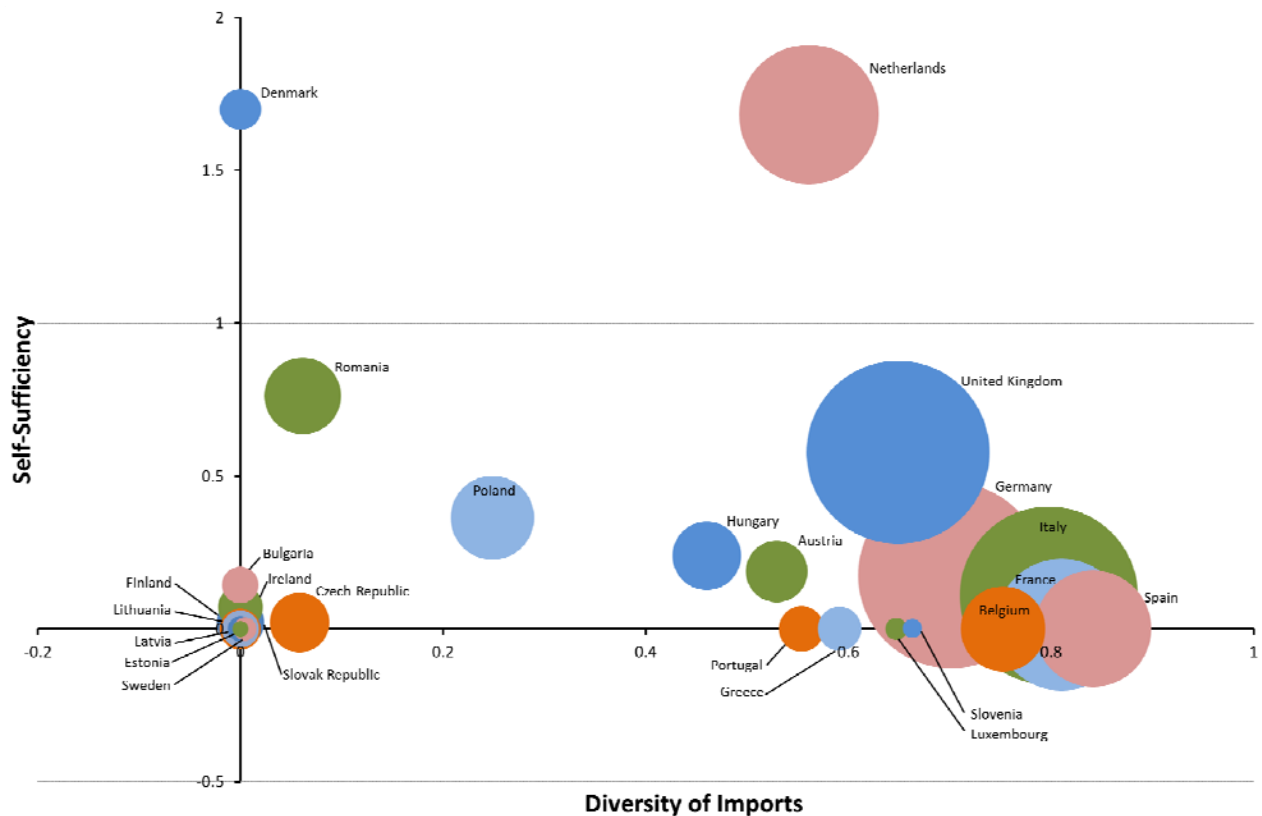
**Further data**

For readers wanting a greater level of detail, the IEA have made available an interactive gas map, based on entry and exit points throughout Europe. This map is available free of charge at: [www.iea.org/gtf/index.asp](http://www.iea.org/gtf/index.asp)

**Self-sufficiency and diversity of gas supply in 2011**

Indigenous production and/or diversification of imports by country of origin are key elements of the security of supply for each EU member state. Indigenous production is a function of recoverable natural resources, available technologies and/or the cost of extraction. Among the EU-27, Denmark and the Netherlands are the only two self-sufficient countries, producing enough gas to meet their own demand and exporting the surplus. In the rest of the EU, only Romania (76 per cent) and the UK (58 per cent) produced half or more of their own consumption. Of the EU-27 countries, 22 member states meet less than 25 per cent of their own gas consumption via indigenous production.

**Chart 1: Self-sufficiency and diversity of supply, EU-27\* countries in 2011**



Source: DECC analysis of IEA data. \*No data available for Cyprus and Malta

## *Special feature – European gas flows*

Chart 1 demonstrates the relationship between demand, indigenous production and the diversity of gross imports for the EU-27 countries.

The profiles show:

- Self-sufficiency: the proportion of a country's demand that could be met through indigenous production is shown on the vertical axis.
- A diversity score: the diversity of a country's gross imports is shown on the horizontal axis, using an index ranging between 0 and 1. Higher values equate to more diverse imports. It is derived from the Herfindahl index using share of imports by countries of origin.
- Consumption is represented by a circle, the area of which indicates the relative level of consumption.

The chart shows that the Netherlands, on the top right corner, has a strong security of supply position, being self-sufficient as well as importing from a range of other countries, leading to a good diversity score for imports. Denmark is also self-sufficient but imports small volumes of gas from Germany only, leading to a score of 0 on the diversity index.

Countries in the bottom right corner of Chart 1 have little or no indigenous production but a diverse source of imports. The majority of these countries are in Western Europe, many of which import gas both via pipelines and as LNG (see Table 1).

Countries in the bottom left corner of Chart 1 have little or no indigenous production and only one source of imports. The majority of these countries are in Scandinavia and Eastern Europe, who import from Norway (Scandinavia) and Russia (Eastern Europe) only. However, the impact of a supply disruption would vary widely according to demand. Sweden's small gas demand accounted for only 2.3 per cent of its primary energy mix (Table 1) and as a result a cut in supply would have less impact than in a country such as Lithuania, which met 36 per cent of its primary energy demand from gas.

In terms of the UK's import diversity, chart 1 illustrates that the UK has a slightly lower diversity index than other countries such as Italy or France which also import LNG; this is because over 80 per cent of UK gas imports came from just two countries, Norway and Qatar.

### **Gas security and diversity index in 2011**

Chart 2 shows the security of supply index for gas in each of the EU-27 countries, ranked according to their score.

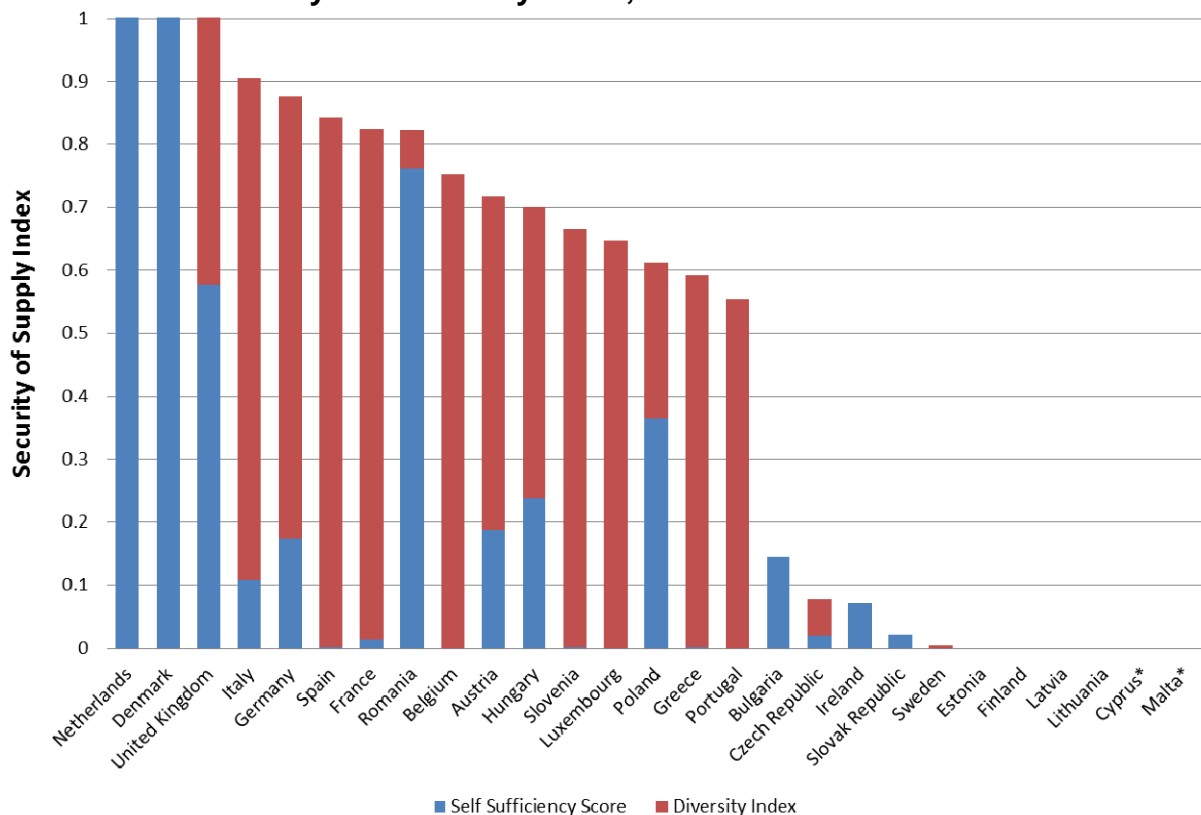
The overall index is derived from the self-sufficiency score of Chart 1 and the diversity score of each country's imports. Self-sufficient countries are shown on the left hand side with a score of one. Countries with no indigenous production and low diversity scores are on the right hand side.

Chart 2 shows that UK had the third highest score in EU-27 after the Netherlands and Denmark, both of whom were self-sufficient. Germany and Italy both show high scores of approximately 0.9, having both a diverse supply of imports and some indigenous natural gas production. Romania had the third highest self-sufficiency score, but scored lower than many Western European countries due to a low diversity index, importing almost all its gas from Russia.

Countries scoring zero on the index include Finland and the Baltic countries. In all cases, these countries have no indigenous production and are entirely dependent on imports from

Russia. The Republic of Ireland also had a low security of supply index, having only small production capabilities and importing from the United Kingdom only.

**Chart 2: Gas security and diversity index, EU-27\* countries in 2011**



Source: DECC analysis of IEA data. \*No data available for Cyprus and Malta

It should be noted that the diversity index and the security of supply index make no distinction as to the relative reliability of supplies between LNG and pipelines, or between supplies entering at multiple points rather than one or only a few. Sources of LNG imports can, for example, change very rapidly, in contrast to pipeline supplies.

Stocks are also a key factor affecting security of supply. Stocks do not feed into DECC's current self-sufficiency and diversity index as this article focusses on the upstream supply of gas to the EU, rather than downstream intra-country security of supply. Further, IEA data are not currently available on maximum daily consumption by EU member states, and as such we cannot calculate whether daily peak withdrawal rates at storage sites are able to meet consumption.

Although maximum storage capacities are available for most of the EU-27 countries, we do not have data on actual volumes held and how storage volumes vary on an annual basis. As such, security of supply calculations based on storage volumes are not currently available.

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**Table 1: Key data for gas use in the EU-27\* countries, 2011**

EU MS	billion cubic metres					Self Sufficiency Score	Diversity Index	Gas as Proportion of Primary Energy Mix
	Imports	(of which LNG)	Exports	Production	Consumption			
Austria	13.4	-	3.6	1.8	9.4	0.19	0.53	0.24
Belgium	21.9	2.8	4.1	0.0	17.7	0.00	0.75	0.26
Bulgaria	2.8	-	-	0.5	3.3	0.14	0.00	0.13
Cyprus*	-	-	-	0.0	0	-	-	-
Czech Republic	9.3	-	0.2	0.2	8.8	0.02	0.06	0.17
Denmark	0.4	-	3.1	7.1	4.2	1.70	0.00	0.21
Estonia	0.6	-	-	0.0	0.6	0.00	0.00	0.09
Finland	4.1	-	-	0.0	4.1	0.00	0.00	0.10
France	48.3	12.7	3.9	0.6	43	0.01	0.81	0.14
Germany	89.6	-	17.6	14.8	84.8	0.17	0.70	0.21
Greece	4.8	1.2	-	0.0	4.8	0.00	0.59	0.14
Hungary	8.0	-	0.6	2.8	11.6	0.24	0.46	0.37
Ireland	4.5	-	-	0.3	4.8	0.07	0.00	0.30
Italy	70.4	8.9	0.1	8.4	77.9	0.11	0.80	0.39
Latvia	1.7	-	-	0.0	1.6	0.00	0.00	0.33
Lithuania	3.5	-	-	0.0	3.4	0.00	0.00	0.36
Luxembourg	1.2	-	-	0.0	1.2	0.00	0.65	0.25
Malta*	-	-	-	0.0	0	-	-	-
Netherlands	23	-	55.9	80.6	47.9	1.68	0.56	0.44
Poland	11.8	-	-	6.2	17.2	0.36	0.25	0.13
Portugal	5.0	2.9	0.0	0.0	5.1	0.00	0.55	0.19
Romania	3.1	-	-	11.0	14.4	0.76	0.06	0.31
Slovak Republic	5.9	-	0.0	0.1	5.6	0.02	0.00	0.27
Slovenia	0.9	-	-	0.0	0.9	0.00	0.66	0.10
Spain	35.5	23.6	1.2	0.1	33.3	0.00	0.84	0.23
Sweden	1.3	-	-	0.0	1.3	0.00	0.00	0.02
United Kingdom	52.8	24.8	16.0	47.7	82.5	0.58	0.65	0.37

Source: DECC analysis of IEA data. \*No data available for Cyprus and Malta