

Diversity of supply for oil and oil products in OECD countries in 2019

Introduction and summary

Countries meet their oil needs through a combination of indigenous production and trade. This article is a comparative assessment of how OECD countries manage their crude oil and transport fuel demand using data from the IEA database¹. The aim is to determine how the UK compares with other OECD countries in terms of how it secures oil supplies.

Within the OECD, the same three countries as the previous year were the only net exporters of crude oil in 2019: Canada, Norway, and Mexico. All other OECD countries met their demand at least partially through imports, with 10 countries not producing any crude oil indigenously. Of these other countries the UK had the highest self-sufficiency, producing over 90 per cent of its crude oil demand.

Sixteen of the OECD countries met their petrol demand through indigenous production, with much of Western Europe being net exporters. Subsequently petrol achieved the highest average security of supply score but also had the second lowest average diversity index above jet fuel.

Eleven of the OECD countries were self-sufficient in kerosene production. The self-sufficiency average was greatly increased by the high contributions notably from Lithuania (meeting 7.7 times the demand) and Korea (meeting 3.2 times the demand).

Thirteen of the OECD countries were self-sufficient in diesel production; Greece, Korea, the Netherlands, and Finland were the top four. Greece remained the most self-sufficient OECD country for diesel, producing almost two and a half times the amount it consumed.

The UK could have met more than 90 per cent of its demand for crude through indigenous production and ranked in the top four for security of supply. The UK was able to more than meet demand for petrol through indigenous production. For jet fuel, the UK was in the lower half of the OECD in terms of indigenous production scores, even though consumption was the second highest. However, with a diversity score of 0.72 the UK remained in the top 50 per cent in terms of security of supply. On diesel, the UK produced just over half of demand and was fourth highest for diversity but fell just into the lower half of OECD countries for security of supply.

Charting oil self-sufficiency and diversity of supply

Bubble charts

The bubble charts demonstrate the relationship between demand, indigenous production, diversity of gross imports and the political stability of import sources. This year we have continued to group the OECD countries in Asia, the Middle East and the EU, using the average scores. See Appendix 1 for a list of the countries included in each of these categories. 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 score of 1 indicates a country produces as much oil as it uses, a score of 0 indicates that no demand was met with own production.
- A diversity score: the diversity and political stability – defined via the World Bank's governance indicators - of a country's gross imports is shown on the horizontal axis (see Appendix 3 for a methodological note).
- Consumption: is represented by the circle or bubble, the area of which indicates the level of consumption for 2019 for each OECD country.

¹ <http://data.iea.org/>

Special feature – Supply of oil and oil products

Bar charts

The bar charts provide a means of comparing OECD countries by self-sufficiency and diversity of imports. These profiles combine the proportion of demand that could be met through indigenous production with the diversity and political stability of import origins. The sum of these two components is used as a simplified metric for security of supply, and thus does not represent a full description of security of supply beyond import diversity, stability, and self-sufficiency. Appendix 2 shows the underlying data.

Choropleth map

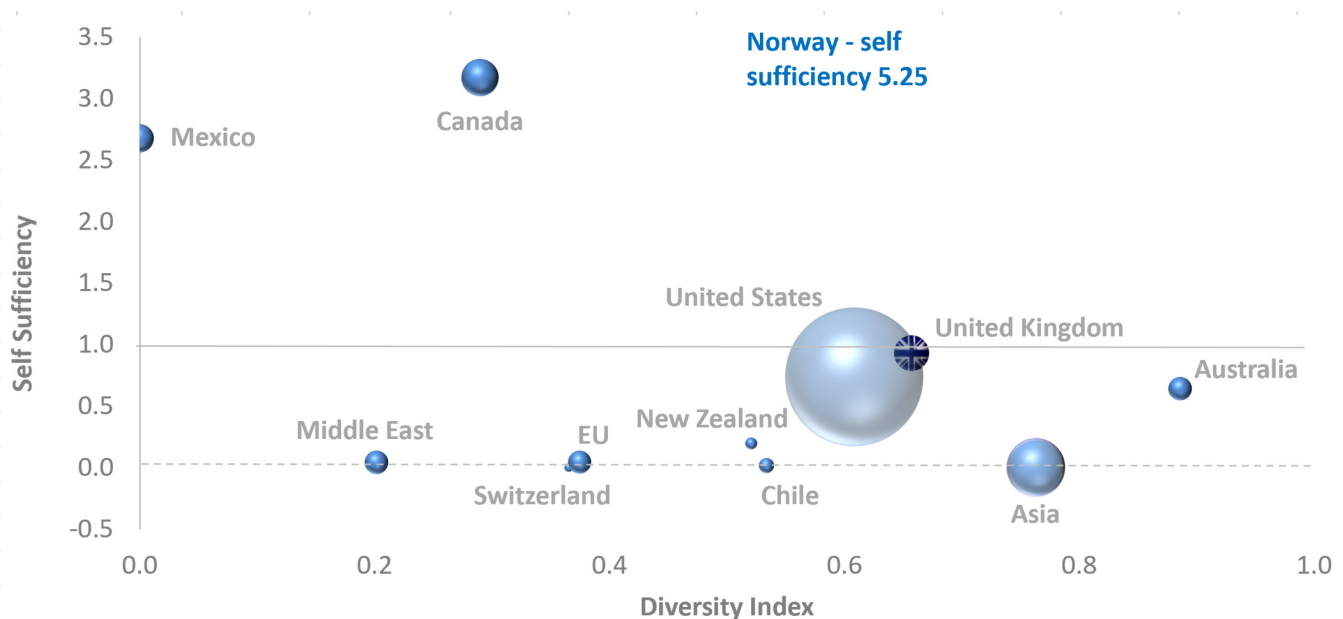
These maps indicate a visual representation of the source countries and quantities of exports for each product. A darker shade represents that a high proportion of the world's exports originated from that country, whereas lighter shades indicate that fewer exports originated in that country.

Results

Crude oil

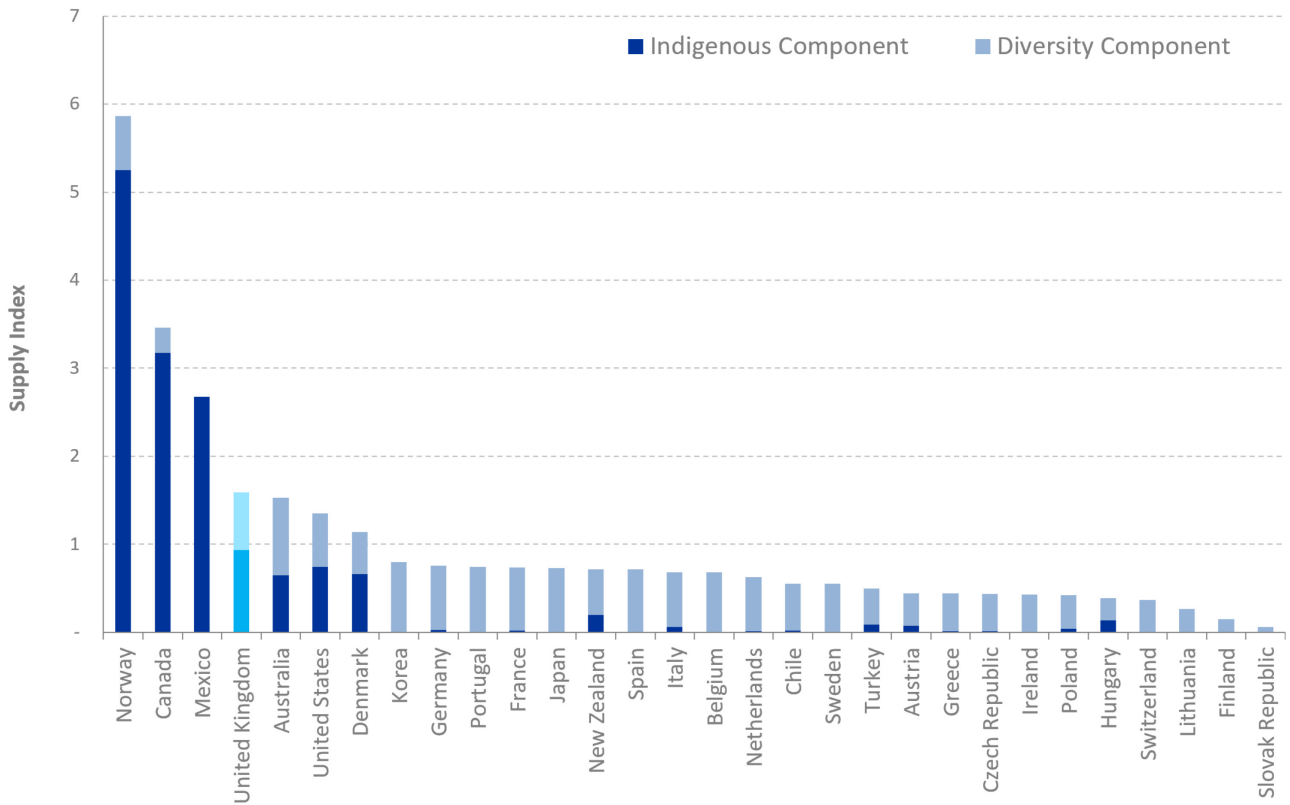
Only three OECD countries were self-sufficient for crude oil again in 2019 (Chart 1). Norway had by far the highest self-sufficiency score, producing nearly five and a half times its own consumption. With a self-sufficiency score of 0.93, the UK was above the OECD average of 0.41 and this marks a marginal increase in self-sufficiency for the UK compared to 2018. Similarly, the UK's diversity score of 0.66 was above the average score of 0.42.

Chart 1: Diversity and self-sufficiency of crude oil for OECD countries, 2019



Most OECD countries showed diversity and political stability scores that reflect a strong trading element, with a relatively small contribution from indigenous production (Chart 2). Chart 2 shows that the UK placed highly in the ranking of OECD countries being one of only a few countries with substantial oil production.

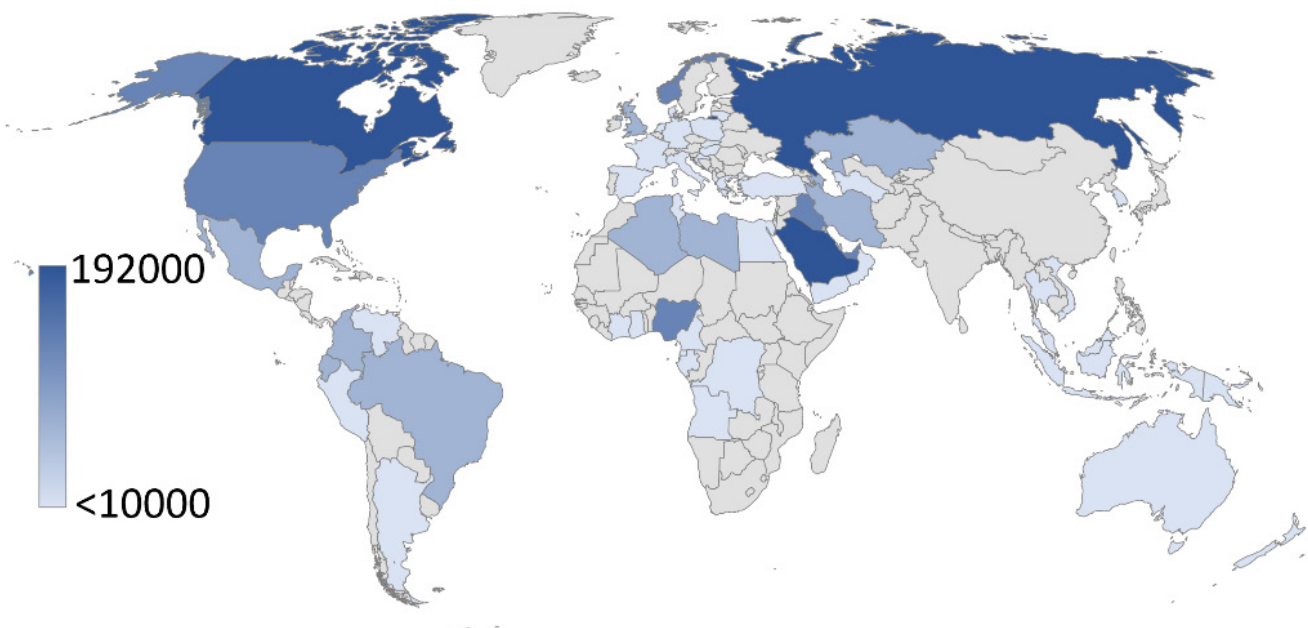
Chart 2: Security of supply of crude oil for OECD countries, 2019



Note: No data was available for Estonia, Iceland, Israel, Latvia, Luxembourg or Slovenia.

Map 1 is an illustration of where crude oil exports originated in 2019. Canada, Russia and Saudi Arabia are the biggest exporters of crude in the world, with the US increasing their share, up almost 35kt compared to 2018. Within the OECD, the UK was the sixth largest exporter.

Map 1: Worldwide crude oil exports (thousand tonnes), 2019



Petrol

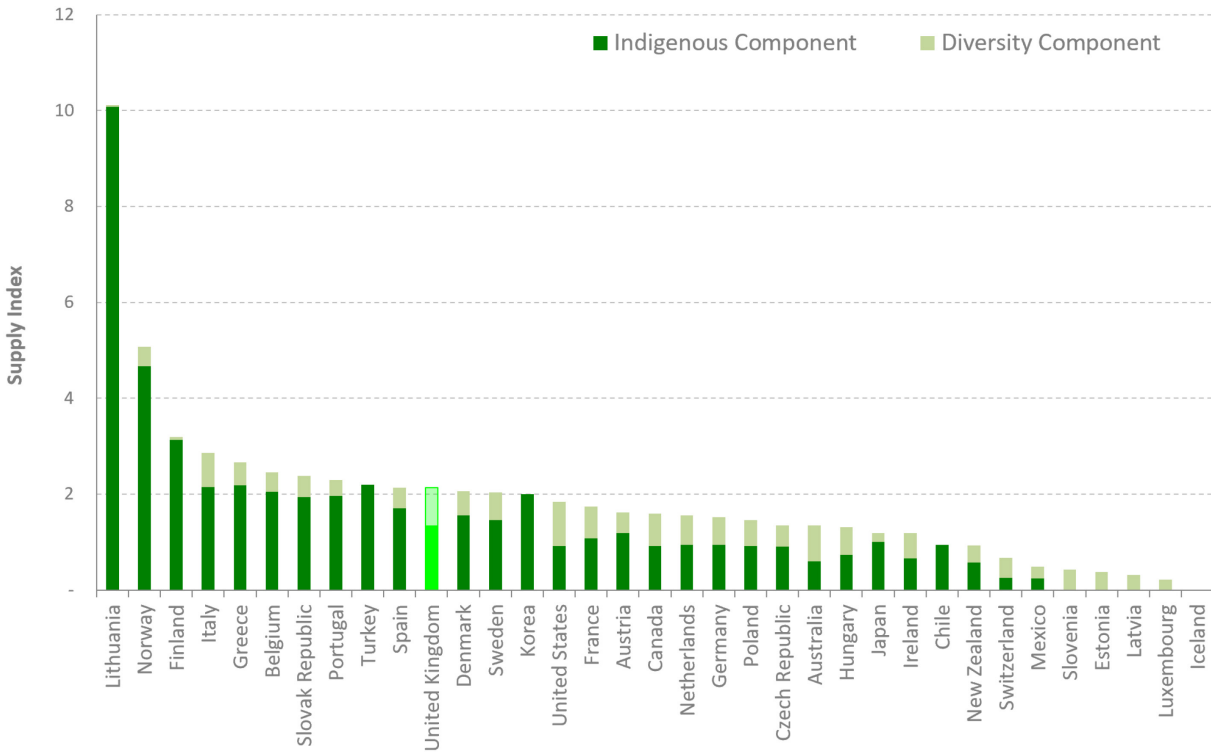
The profiles for petrol are different to that of crude. Sixteen of the 36 OECD countries were self-sufficient in 2019 (Chart 3). Lithuania (combined in the EU average and who only joined the OECD in 2018) had a self-sufficiency score of 10.08, making it by far the highest ranking in this regard. The OECD average self-sufficiency score was 1.42, down from 1.53 (revised figure) in 2018. This is largely due to production being down with stable demand in Lithuania, Norway, Sweden and Portugal. Consumption in the US dwarfs that of other OECD countries, equal to nearly 64 per cent of the OECD total. The UK had a self-sufficiency score of 1.34 and would be more than able to meet demand for petrol in 2019 using indigenous supply only. The UK's diversity score of 0.80 was much higher than the OECD average of 0.40 and was second only to the US with 0.92.

Chart 3: Diversity and self-sufficiency of petrol for OECD countries, 2019



Our simplified security of supply index (Chart 4) shows how most countries produce enough petrol to meet their needs and the amount of petrol trade amongst the OECD countries. The UK ranks 11th out of the 36 OECD countries for security of supply of petrol.

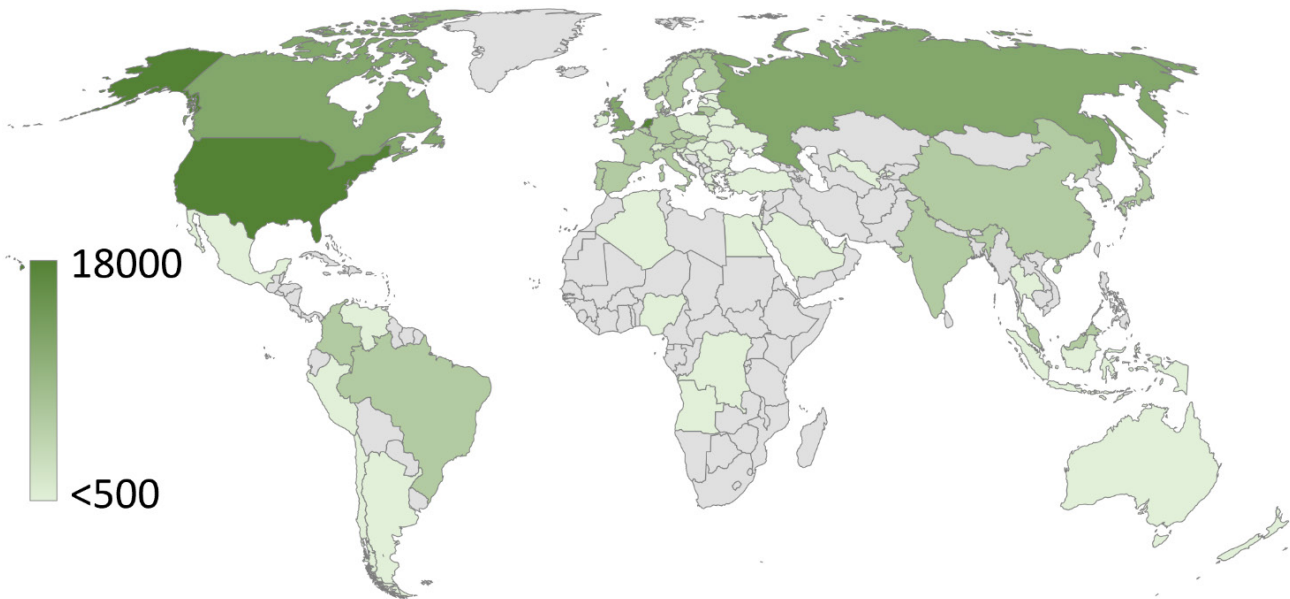
Chart 4: Security of supply of petrol for OECD countries, 2019



Note: No data was available for Israel

The main exporter of petrol around the world is North America, exporting more than twice the amount of Canada, the third biggest exporter. Europe is also shown on the map to be a significant exporter of petrol to the rest of the world, notably including the United Kingdom, Belgium and specifically the Netherlands; the second biggest exporter, exporting 2/3 the amount exported by the United States. Many large economies such as Australia, Japan and China export comparatively low quantities of petrol.

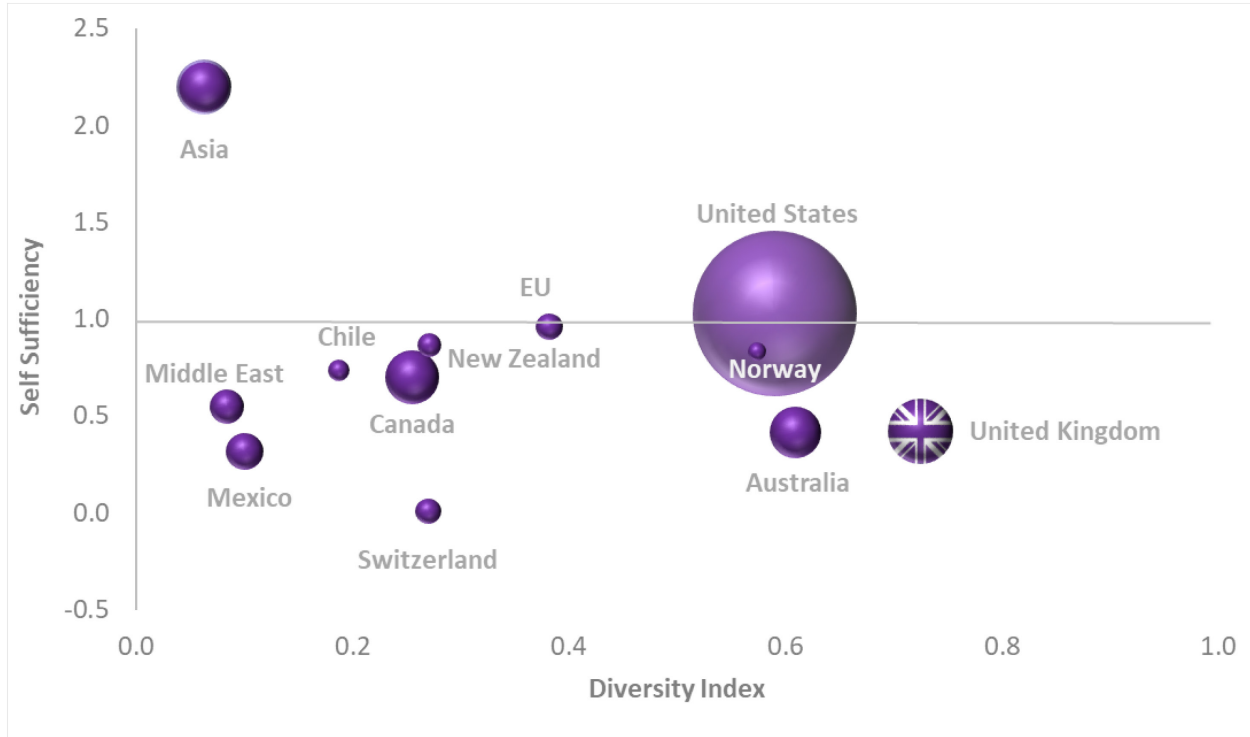
Map 2: Worldwide petrol exports (thousand tonnes), 2019



Jet fuel

Chart 5 shows that the UK, with a score of 0.42, was below both the self-sufficiency threshold of 1 and the OECD average 0.91 for jet fuel. However, the UK's import diversity score of 0.72 was far higher than the average for all OECD countries of 0.35.

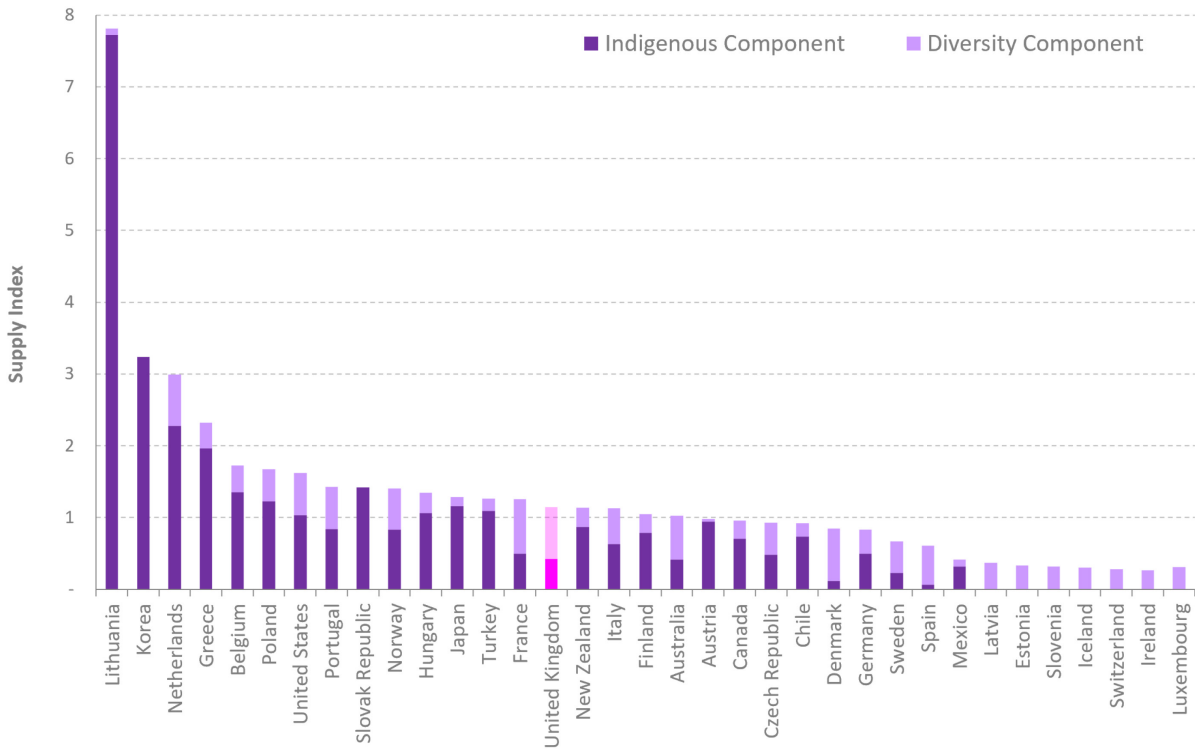
Chart 5: Diversity and self-sufficiency of jet fuel for OECD countries, 2019



Many OECD countries have significant production capacity of jet fuel. For instance, with a refining capacity of approximately 10 million tonnes a year² and a relatively low demand, Lithuania produced more than seven times its consumption and Korea more than three times. The UK's low capacity to meet demand through indigenous production is of the largest deficits in the OECD, significantly lower than the OECD and EU average. However, Heathrow (being the busiest airport in Europe), causes the UK to have the second highest demand for jet fuel, behind only the United States.

² www.orlenlietuva.lt/EN/Company/OL/Pages/Refinery.aspx

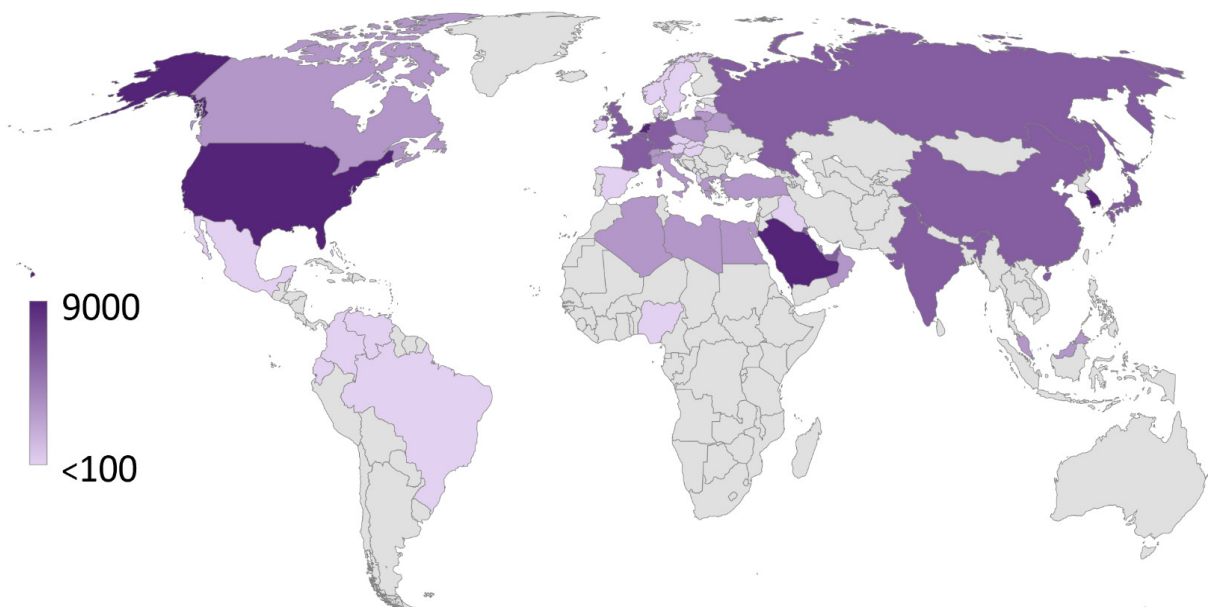
Chart 6: Security of supply of jet fuel for OECD countries, 2019



Note: No data was available for Israel

Jet fuel is only exported in significant quantities in a few countries around the world with Korea, the Netherlands, the United States, Saudi Arabia and the United Arab Emirates exporting the most. The Netherlands is a trading hub for many oil products, with large amounts of imports ‘re-exported’ and not used for the country’s own consumption. Europe exports relatively small amounts of jet fuel (excluding the Netherlands), as does Canada and North Africa.

Map 3: Worldwide jet fuel exports (thousand tonnes), 2019



Road diesel

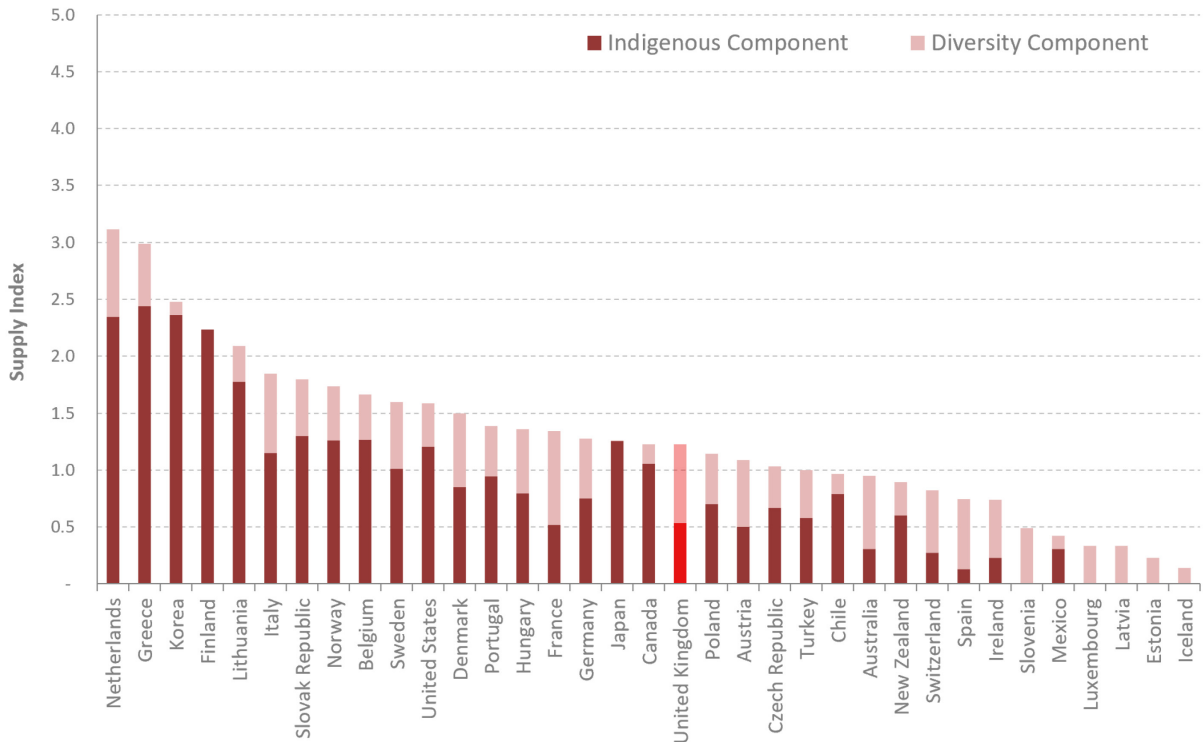
Compared to 2018, the OECD average self-sufficiency has decreased to 0.84 from 0.87 (revised figure). This is largely due to production being down with demand stable in Denmark, Sweden and most notably Greece who saw a 1.52 decrease in their self-sufficiency score to 2.44. At 0.54 on the self-sufficiency axis the UK was below the average OECD self-sufficiency score, producing only just over half the amount of diesel it consumed. However, the UK was in a favourable position in terms of diversity and political stability of imports. The UK's diversity score, at 0.69, was substantially above the OECD average of 0.41, making it the fourth highest only surpassed by Italy, the Netherlands and France, with the largest diversity score of 0.83 (Chart 7).

Chart 7: Diversity and self-sufficiency of diesel for OECD countries, 2019



Most countries either met demand through indigenous production or by a combination of production and diverse imports. The profile shows that although the UK's self-sufficiency score is reasonably low it has ranked in the middle of OECD countries for security of supply owing to its high diversity component (Chart 8).

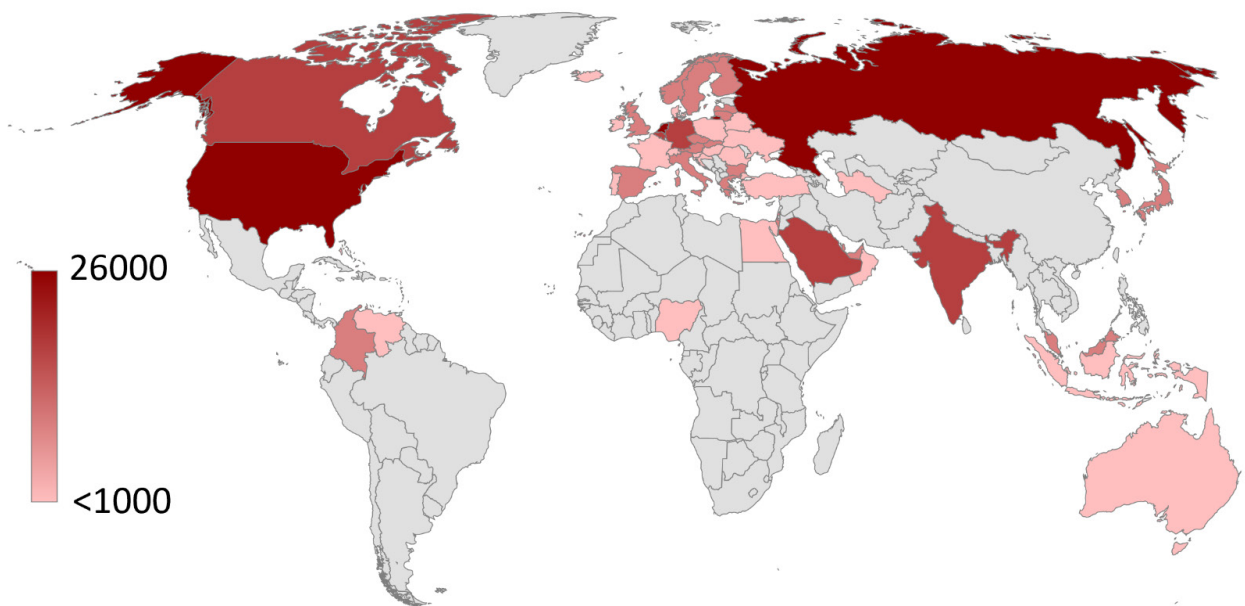
Chart 8: Security of supply of diesel for OECD countries, 2019



Note: No data was available for Israel

Map 4 shows that Russia and the United States are the most significant exporters of diesel. There are limited quantities of exports from Asia and South America, with Europe and Canada exporting diesel in moderate quantities. The UK was the 13th largest exporter out of the 36 OECD countries in 2019, compared to the fourth largest in 2018.

Map 4: Worldwide diesel exports (thousand tonnes), 2019



Summary

Self-Sufficiency and Import Diversity of OECD countries in 2019

The overall picture reflects a higher security of supply for products than for crude oil. This pattern is driven by higher levels of refinery production compared to crude extraction, leading to increased self-sufficiency for transport fuels. However, the scores for transport fuels are dependent on refining crude oil, and as such cannot be decoupled easily from crude oil security of supply. With an average self-sufficiency score of 0.41, OECD countries are very much dependent on imports of crude oil to meet refinery demand, although in 2019 we have seen average self-sufficiency scores remain stable for crude at 41 per cent, with an average diversity score of 0.42.

Total petrol production was almost one and a half times the average consumption in OECD countries. However, only 16 of the 36 OECD countries were self-sufficient; particularly notable were Lithuania, Norway, and Finland, with Lithuania producing more than ten times its demand. With a self-sufficiency score of 1.42 the OECD is well-placed to meet demand for petrol.

For diesel, half of the OECD countries were self-sufficient in 2019, with Greece notably producing nearly two and a half times the amount it consumed. However, Greece's self-sufficiency score has fallen compared to 2018 due to a decrease in production by about a third. On average OECD countries could have met 84 per cent of demand for diesel with own production.

Jet fuel imports amongst OECD countries have led to an average diversity score of 0.35, in part because a few countries such as Saudi Arabia, United Arab Emirates and the US are the key suppliers of jet fuel to the global market. Jet has the lowest diversity score after petrol, but OECD countries on average met 91 per cent of demand with own production. The UK, along with several north-western European countries, scored much higher than average on the diversity index, which offsets the relatively low production and suggests that a number of countries have taken steps to maximise the security of jet fuel supply.

Self-Sufficiency and Import Diversity of the UK in 2019

The UK compares well with other OECD countries for both self-sufficiency and diversity, with strong diversity scores for all oil types. The UK scored 0.66 on the diversity score for crude compared to the 0.42 OECD average, and could have met more than 90 per cent of crude consumption by indigenous production. The UK ranks strongly amongst OECD countries for self-sufficiency. On petrol, the UK more than meets its needs from indigenous production. Conversely, the UK relies on imports to meet its requirements for jet fuel and road diesel because its refineries do not produce sufficient volumes to meet increasing demand. However, with scores of 0.72 and 0.69 the UK compares favourably with the OECD averages of 0.35 and 0.41, respectively.

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Appendix 1 – List of OECD countries in category averages

Asia

Japan
Korea

EU (excluding UK)

Austria
Belgium
Czech Republic
Denmark
Estonia
Finland
France
Germany

Greece
Hungary
Iceland
Ireland
Italy
Latvia
Lithuania
Luxembourg

Netherlands
Poland
Portugal
Slovak Republic
Slovenia
Spain
Sweden

Middle East

Israel
Turkey

Special feature – Supply of oil and oil products

Appendix 2 – Provisional data for 2019

	CRUDE			PETROL			JET FUEL			DIESEL		
	DI	S-S	Demand	DI	S-S	Demand	DI	S-S	Demand	DI	S-S	Demand
Australia	0.89	0.64	22,414	0.75	0.60	13,707	0.61	0.41	7,531	0.64	0.31	24,555
Austria	0.37	0.07	9,124	0.43	1.19	1,681	0.04	0.94	955	0.59	0.50	7,031
Belgium	0.68	-	34,525	0.41	2.05	2,081	0.37	1.35	1,624	0.39	1.27	6,423
Canada	0.29	3.17	59,501	0.67	0.92	35,501	0.26	0.70	8,357	0.17	1.06	29,112
Chile	0.53	0.02	9,286	-	0.95	3,484	0.19	0.74	1,189	0.18	0.79	4,637
Czech Rep.	0.43	0.01	7,823	0.44	0.90	1,616	0.44	0.48	448	0.37	0.67	4,929
Denmark	0.48	0.66	7,644	0.50	1.56	1,433	0.73	0.11	1,049	0.65	0.85	2,698
Estonia	-	-	-	0.38	-	279	0.33	-	89	0.23	-	502
Finland	0.14	-	11,937	0.06	3.13	1,418	0.26	0.79	953	-	2.23	2,520
France	0.72	0.01	49,188	0.66	1.07	8,707	0.76	0.49	7,862	0.83	0.52	33,386
Germany	0.73	0.02	87,389	0.58	0.95	21,416	0.33	0.50	10,233	0.53	0.75	37,512
Greece	0.43	0.01	23,026	0.48	2.19	2,307	0.36	1.96	1,436	0.55	2.44	2,449
Hungary	0.26	0.13	6,823	0.57	0.74	1,487	0.28	1.06	282	0.56	0.79	3,447
Iceland	-	-	-	0.01	-	122	0.30	-	229	0.14	-	334
Ireland	0.42	-	2,530	0.52	0.66	772	0.26	-	1,062	0.51	0.23	3,079
Israel	-	-	12,307	-	-	3,051	-	-	1,151	-	-	-
Italy	0.62	0.06	66,867	0.71	2.14	7,581	0.50	0.63	4,882	0.70	1.15	21,122
Japan	0.73	0.00	145,425	0.19	1.00	36,037	0.13	1.16	10,548	0.00	1.25	21,037
Korea	0.80	0.00	144,780	-	2.00	9,924	-	3.24	6,632	0.12	2.36	19,239
Latvia	-	-	-	0.31	-	186	0.37	-	153	0.33	-	681
Lithuania	0.26	0.00	9,514	0.04	10.08	245	0.09	7.72	129	0.32	1.77	1,754
Luxembourg	-	-	-	0.21	-	370	0.31	-	566	0.34	-	1,792
Mexico	-	2.68	33,047	0.25	0.25	33,572	0.10	0.32	3,987	0.11	0.31	14,158
Netherlands	0.61	0.01	55,909	0.62	0.94	4,261	0.71	2.27	3,852	0.77	2.35	6,656
N. Zealand	0.52	0.20	5,472	0.36	0.57	2,415	0.27	0.87	1,527	0.29	0.60	3,156
Norway	0.61	5.25	13,307	0.40	4.67	782	0.57	0.83	906	0.47	1.26	2,458
Poland	0.39	0.04	27,186	0.55	0.92	4,706	0.44	1.23	1,076	0.44	0.70	17,378
Portugal	0.74	-	11,288	0.33	1.96	1,073	0.58	0.84	1,601	0.44	0.95	4,668
Slovak Rep.	0.06	0.00	5,110	0.45	1.93	583	-	1.42	55	0.50	1.30	1,959
Slovenia	-	-	-	0.42	-	402	0.32	-	26	0.49	-	1,510
Spain	0.71	0.00	65,648	0.43	1.71	5,325	0.54	0.07	6,920	0.62	0.13	23,456
Sweden	0.55	-	16,796	0.59	1.46	2,547	0.44	0.23	1,048	0.59	1.01	4,536
Switzerland	0.37	-	2,723	0.41	0.26	2,337	0.27	0.01	1,874	0.55	0.27	2,863
Turkey	0.40	0.09	33,615	-	2.19	2,415	0.17	1.09	5,462	0.42	0.58	23,050
UK	0.66	0.93	52,300	0.80	1.34	12,312	0.72	0.42	12,389	0.69	0.54	24,780
USA	0.61	0.74	816,933	0.92	0.92	397,853	0.59	1.03	80,380	0.38	1.20	188,720
OECD - Asia	0.76	0.00	145,103	0.09	1.50	22,981	0.06	2.20	8,590	0.06	1.81	20,138
OECD - EU	0.37	0.04	21,666	0.42	1.55	3,069	0.38	0.96	2,023	0.47	0.85	8,253
OECD - Middle East	0.35	0.30	25,647	-	1.10	2,733	0.08	0.55	3,307	0.21	0.29	11,525
OECD ave.	0.42	0.41	51,373	0.40	1.42	17,333	0.35	0.91	5,235	0.41	0.84	15,211

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

DI = Diversity Index

S-S = Self-sufficiency

Demand is in thousand tonnes (kt)

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

Appendix 3 – Methodology

Data for crude oil and transport fuel self-sufficiency

Data for crude oil, petrol and jet fuel were extracted from the IEA database. For diesel, data were provided on request from the IEA. Self-sufficiency was determined from data on indigenous production and consumption (production (kt) ÷ consumption (kt)).

Crude oil and transport fuel 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 fuel 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 2 represents a country with a wide range of import sources. The minimum value of zero denotes a country that has one imported fuel source or relies entirely on indigenous production.

A previous comparative study on import diversities in Energy Trends March 2011 used the Herfindahl Index as the basic diversity index. Although both of these indices have their advantages, the Shannon-Wiener was chosen here as this represents the data with less skew, as well as placing more weight on the diversity of contributions from smaller countries and lessening 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 for each petroleum product between 0 and 1, 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 product, 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.