

Diversity of supply for oil and oil products in OECD countries

Introduction and summary

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

Within the OECD, only four countries were net exporters of crude oil: Norway, Mexico, Canada and Denmark. The UK would be able to meet 63 per cent of its demand via indigenous production, and was the sixth most self-sufficient country. The UK also had above-average diversity in terms of where it imported products from and these factors added together means that it ranked sixth in our simplified ranking of overall security of supply (deemed as the combination of indigenous production and import diversity) for crude oil.

The majority of OECD countries met their motor gasoline (petrol) demand through indigenous production, with the UK and most of Western Europe being net exporters. Despite motor gasoline having the lowest average diversity index, it achieved the highest average security of supply score of the four products due to high levels of indigenous production in the OECD.

For jet fuel, the position is markedly different with only a third of OECD countries self-sufficient. Although the UK was not self-sufficient, it had the third most diverse source of imports after Sweden and France. The UK ranked middle of all OECD countries when indigenous production and diversity of imports are combined into a single index.

Most OECD countries were not able to support their diesel consumption by indigenous production alone. The UK was positioned below the average OECD score for self-sufficiency but this was offset by a diverse range of import sources which put the UK in the top half of OECD countries in terms when production and diversity were combined.

Charting oil self-sufficiency and diversity of supply

Bubble Charts

The bubble charts demonstrate the relationship between a country's demand, its indigenous production, diversity of its gross imports and the political stability of the countries of import. 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 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 2 for a methodological note).
- Consumption: is represented by the circle or bubble, the area of which indicates the relative level of consumption for 2012 for each OECD country.

Bar Charts

The bars charts provide a means of comparing OECD countries by self-sufficiency and diversity of imports. These profiles combine the proportion of demand that is met through indigenous production (shown in blue) with the diversity and political stability of import origins (shown in white). The sum of these two components is used as a simplified metric for security of supply. This is a

¹ <http://wds.iea.org/WDS/Common/Login/login.aspx>

Special feature – Supply of oil and oil products

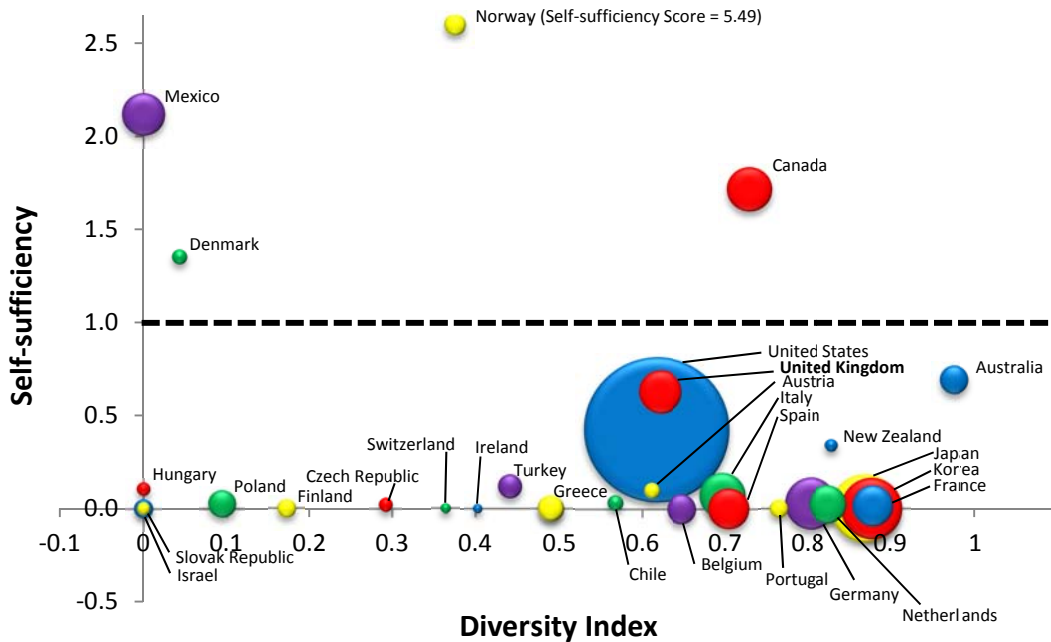
simplified metric, and does not represent a full description of security of supply beyond import diversity, stability and self-sufficiency. Appendix 1 shows the underlying data.

Results

Crude

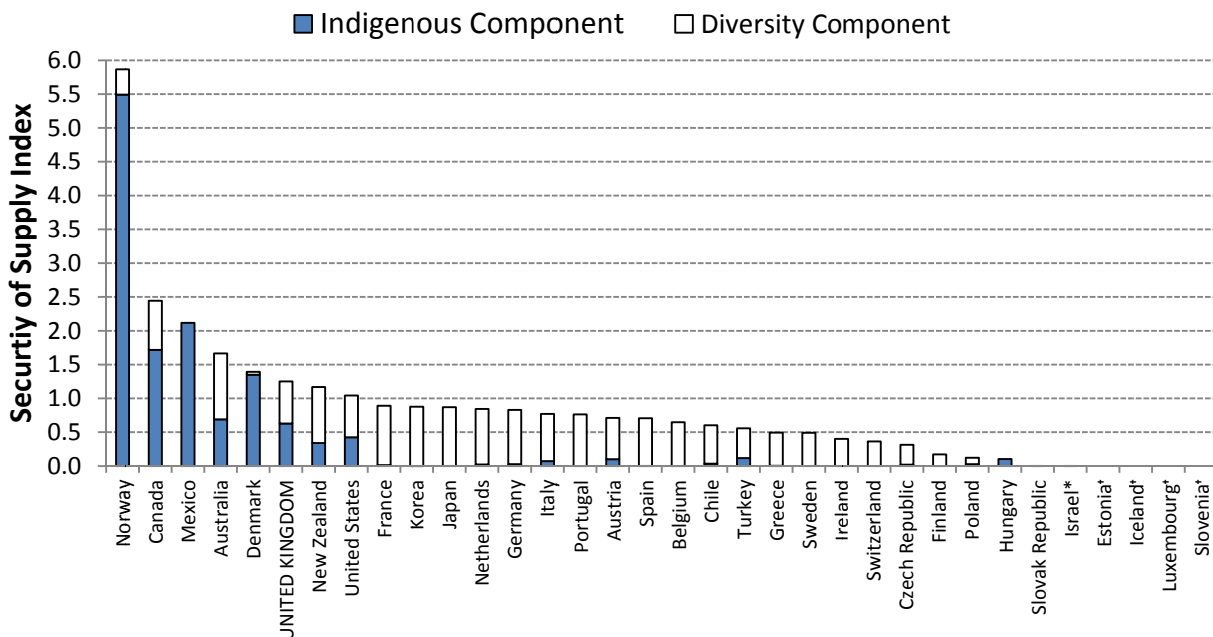
Only four OECD countries were self-sufficient for crude oil in 2012 (Chart 1). Norway had by far the highest self-sufficiency score, producing over 5 times its own consumption of crude oil. With a self-sufficiency score of 0.63, the UK was above the OECD average of 0.44 (or 0.27 with the exclusion of Norway). Similarly, the UK's diversity score of 0.62 was above the average score of 0.52.

Chart 1: Diversity and self-sufficiency of crude oil for OECD countries 2012



The majority of OECD countries showed 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 the few countries with significant oil production.

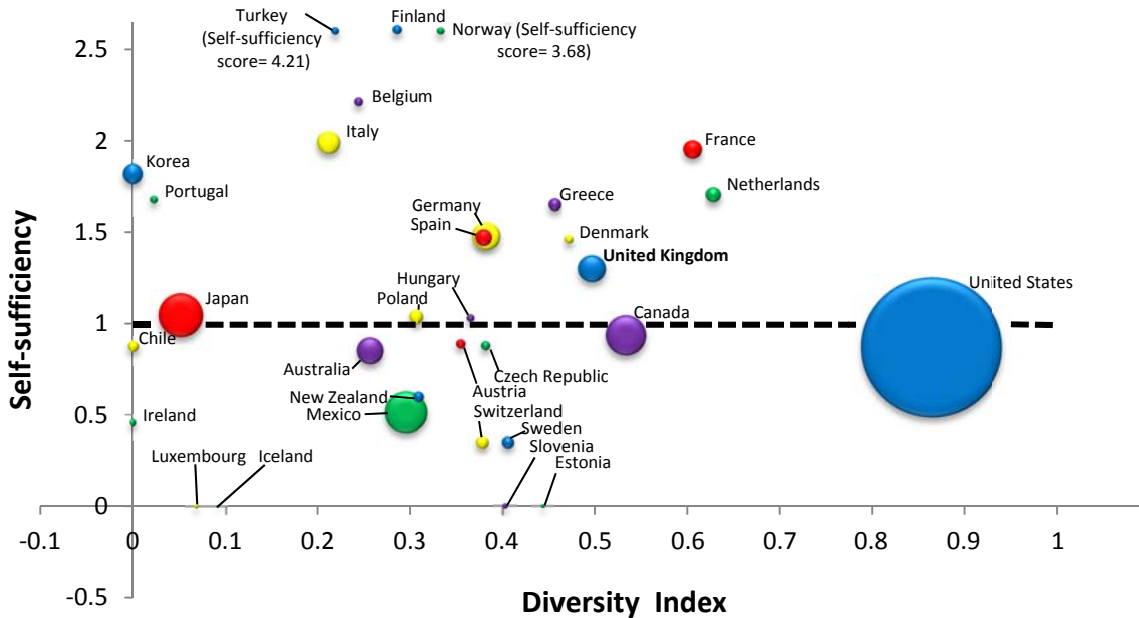
Chart 2: Security of supply of crude oil for OECD countries 2012



Motor Gasoline

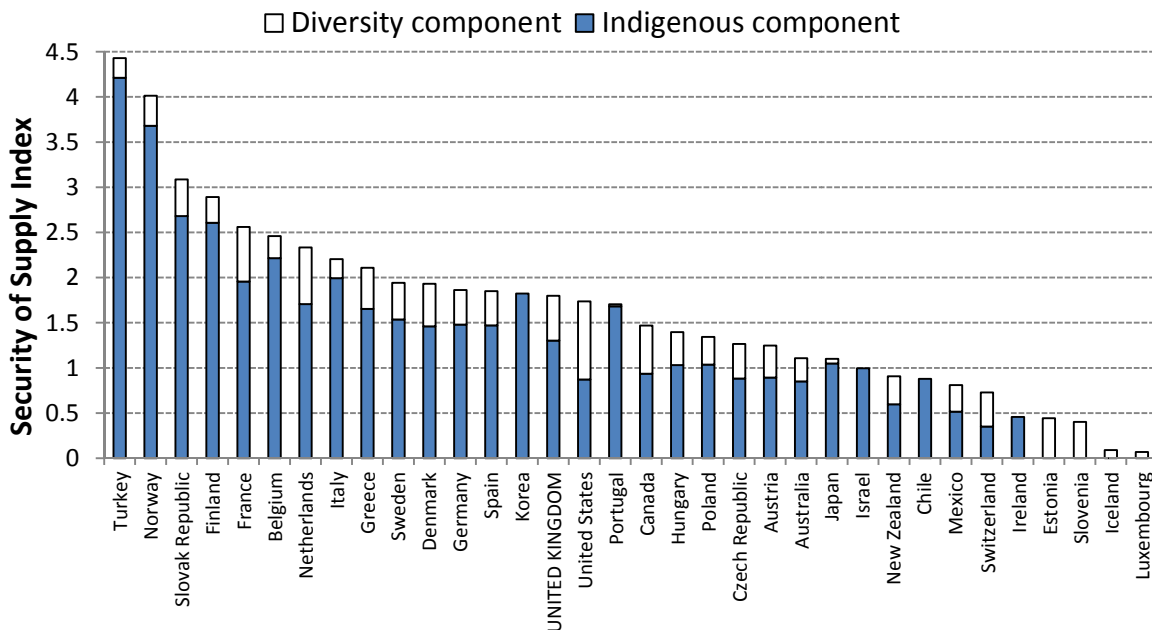
The profiles for motor gasoline are considerably different to that of crude. Nearly 60 per cent of OECD countries were self-sufficient in 2012 (Chart 3). The UK had a self-sufficiency score of 1.30, which was in line with the average across all OECD countries. The UK's diversity score of 0.50 was higher than the average of 0.31.

Chart 3: Diversity and self-sufficiency of motor gasoline for OECD countries 2012



Our simplified security of supply index (Chart 4) shows how the vast majority of countries produce enough petrol to meet their needs and how much trade there is in motor gasoline amongst the OECD countries. The UK ranks approximately middle out of all OECD countries.

Chart 4: Security of supply of motor gasoline for OECD countries 2012

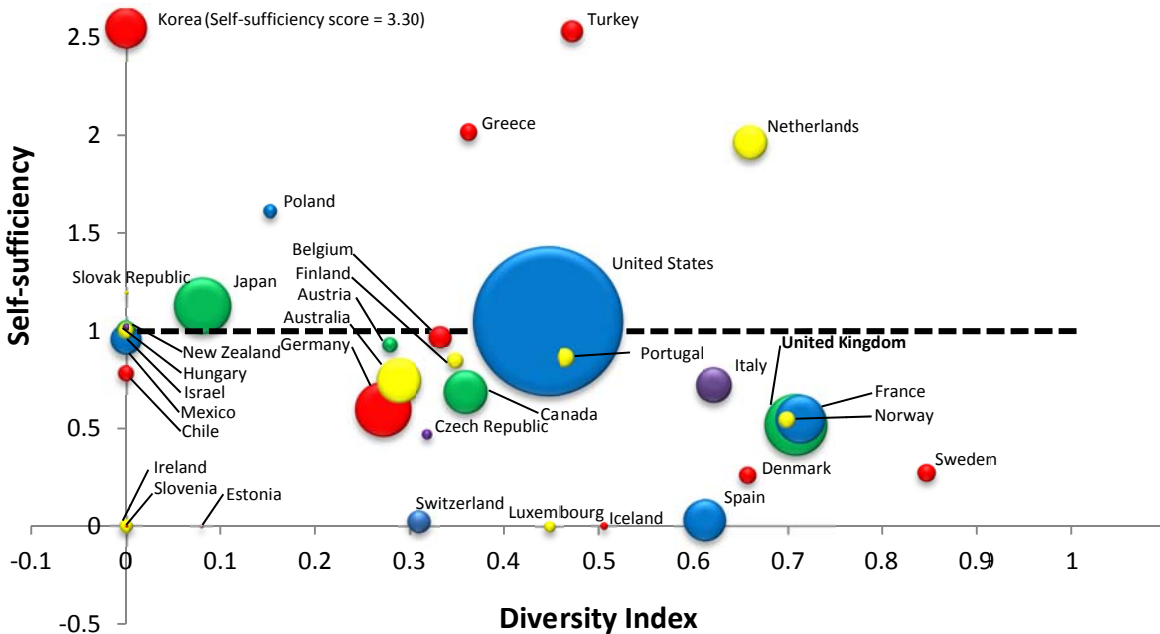


Special feature – Supply of oil and oil products

Jet Fuel

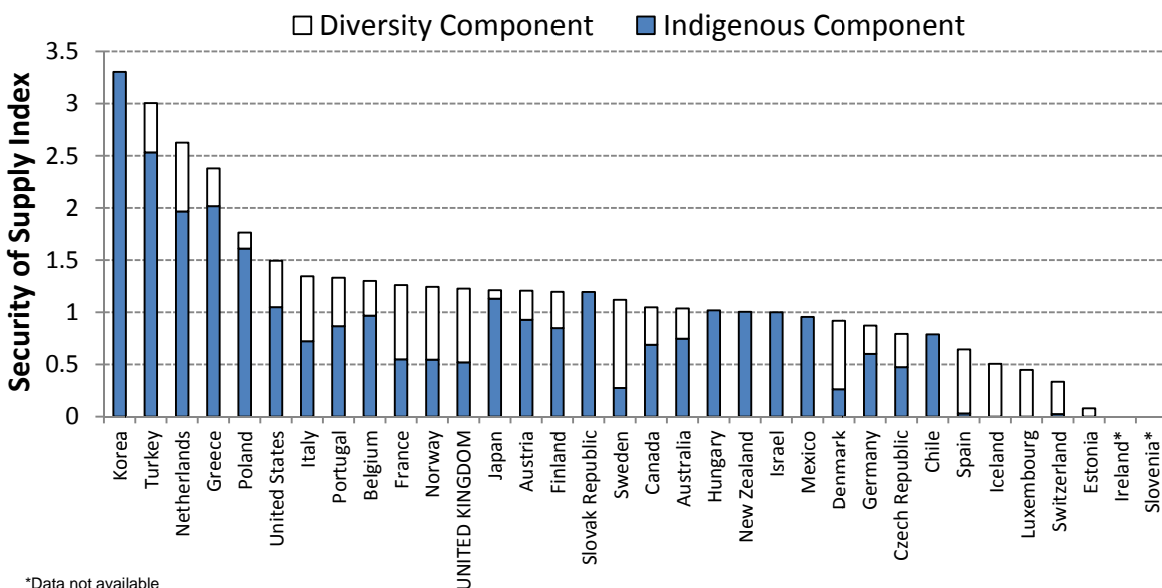
Chart 5 shows that, with a self-sufficiency score of 0.52, the UK was below both the self-sufficient threshold of 1 and the OECD average 0.89 for jet fuel. However, the UK's import diversity score of 0.71 was more than double the average for all OECD countries (0.32) and third highest of all OECD countries.

Chart 5: Diversity and self-sufficiency of jet fuel for OECD countries 2012



Many OECD countries have significant production capacity of jet fuel. Korea is particularly strong, and produces some three times its demand and requires no imports. The UK's capacity to meet its demand through indigenous production is low: in 2012 the UK met only around half its demand, which is one of the largest deficits in the OECD. However, this was compensated by having one of the most diverse and stable import sources within the OECD.

Chart 6: Security of supply of jet fuel for OECD countries 2012

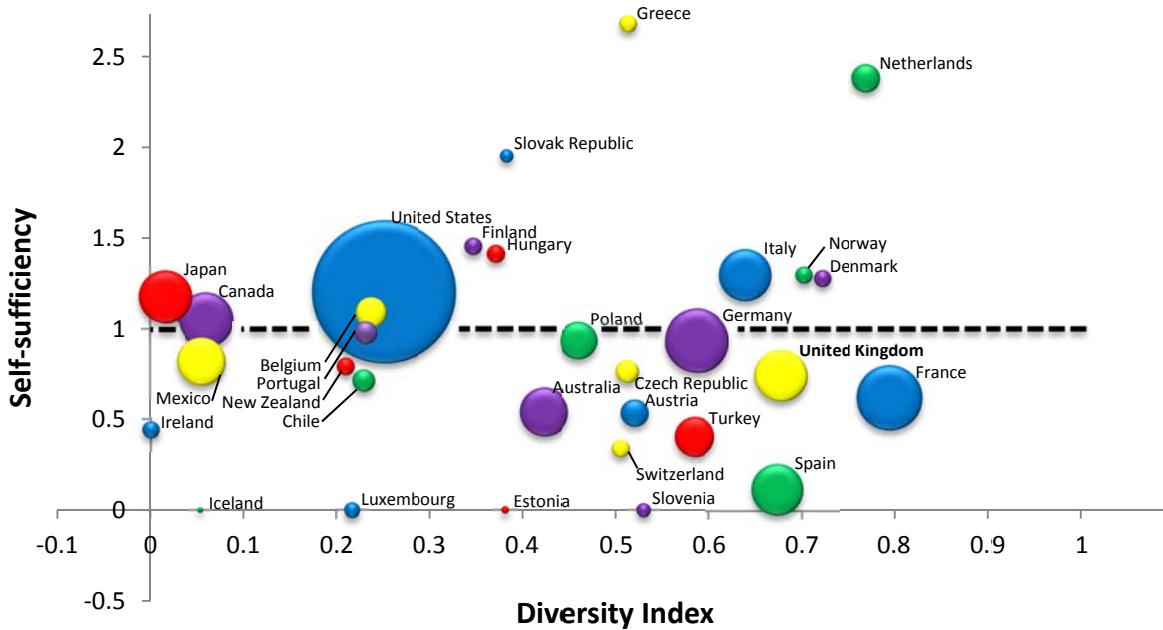


*Data not available

Diesel Road Fuel

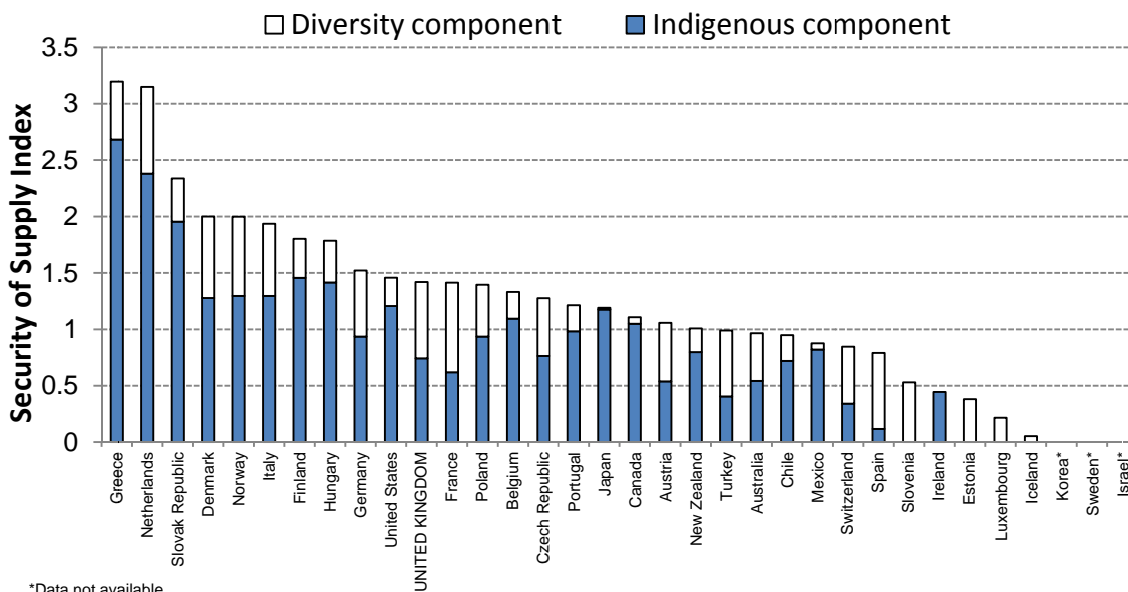
At 0.74 on the self-sufficiency axis, the UK produces around ¾ of the diesel it consumes. The UK was below the average OECD self-sufficiency score of 0.9 in 2012. However, the UK is in a favourable position in terms of diversity and political stability of imports; the UK's diversity score of 0.68 was markedly higher than the OECD average of 0.41 (Chart 7).

Chart 7: Diversity and self-sufficiency of diesel for OECD countries 2012



The majority of countries either met demand through indigenous production or by a combination of production and diverse imports. The profile depicts how the UK was in the top half of OECD countries (Chart 8).

Chart 8: Security of supply of diesel for OECD countries 2012



*Data not available

Summary

Self-Sufficiency and Import Diversity of OECD Countries

The overall picture of diversity of supply for oil and oil products reflects a higher security of supply for oil products than for crude oil, primarily driven by higher levels of indigenous production for products than for crude itself. With an average self-sufficiency score (excluding Norway) of just over one quarter of consumption (0.27), OECD countries are highly dependent on imports of crude oil to meet refinery demand, compared to average scores of 1.32, 0.89 and 0.90 for motor gasoline, jet fuel and diesel respectively. However, although average self-sufficiency scores for transport fuels were much higher, these scores are dependent on refining crude oil, and as such indigenous production of productions cannot be decoupled easily from crude oil security of supply.

Motor gasoline production across the OECD was a particular strength, because the refining profile has historically been biased towards petrol production. With the increasing shift to dieselisation of passenger road transport, the majority of OECD countries more than met their consumption needs. This high self-sufficiency is reflected through the lower diversity of imports compared to crude.

In contrast to motor gasoline, many countries did not produce enough jet fuel or diesel domestically to meet their demand. Although diesel imports scored the highest average diversity index of approximately 0.4, jet fuel imports had an average score similar to that of motor gasoline, at approximately 0.3. This relatively low diversity score, combined with a low self-sufficiency score put jet fuel as the lowest scoring oil product in our simplified security of supply index. However the UK, along with a number of north-western European countries, scored much higher than average on the diversity index, at around 0.7. This suggests a number of countries have taken steps to maximise the diversity and political stability of jet fuel imports.

Self-Sufficiency and Import Diversity of the UK

The UK compares well with other OECD countries for both self-sufficiency and diversity, always being in the top half of rankings for both crude oil and oil. The UK met around two thirds of its crude oil consumption via indigenous production, putting it sixth out of all the OECD countries. The UK meets its needs for motor gasoline from indigenous production, depending on its offshore fields for some of the crude oil and the production profiles of its refineries. Conversely, the UK relies on imports to meet its requirements for jet fuel and diesel road fuel as its refineries do not meet demand from increasing air movements and the shift towards diesel cars. The closure of Coryton refinery in mid-2012 and maintenance of other refineries late in 2012 also saw production of petroleum products fall by around 8 per cent from July onwards. At least some of this will pick up for 2013.

The data show that the UK is supplementing its indigenous capacity with a diverse trading position where its indigenous capacity does not meet current demand. For both jet fuel and diesel, the UK scored highly on the diversity index, indicating a diverse range of imports from politically stable countries.

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Appendix 1 – Provisional Data for 2012

	Crude Oil			Motor Spirit			Jet Fuel			Diesel Road Fuel		
	Diversity plus Political Stability	Self-sufficiency	Demand (KT)	Diversity plus Political Stability	Self-sufficiency	Demand (KT)	Diversity plus Political Stability	Self-sufficiency	Demand (KT)	Diversity plus Political Stability	Self-sufficiency	Demand (KT)
Australia	0.98	0.69	28,669	0.26	0.85	13,516	0.29	0.75	5,820	0.42	0.54	19,093
Austria	0.61	0.10	8,347	0.35	0.89	1,714	0.28	0.93	666	0.52	0.54	6,090
Belgium	0.65	0.00	31,777	0.24	2.21	1,358	0.33	0.97	1,499	0.24	1.09	7,187
Canada	0.73	1.72	69,477	0.53	0.94	31,414	0.36	0.69	5,469	0.06	1.05	23,778
Chile	0.57	0.03	8,502	0.00	0.88	2,660	0	0.79	781	0.23	0.72	3,963
Czech Republic	0.29	0.02	7,247	0.38	0.88	1,676	0.32	0.47	302	0.51	0.76	4,166
Denmark	0.04	1.35	7,628	0.47	1.46	1,385	0.66	0.26	853	0.72	1.28	2,386
Estonia	0	-	0	0.44	0.00	292	0.08	0.00	49	0.38	0.00	430
Finland	0.17	0.00	10,756	0.29	2.61	1,600	0.35	0.85	729	0.35	1.46	2,428
France	0.88	0.01	56,799	0.61	1.96	6,113	0.71	0.55	6,954	0.79	0.62	33,531
Germany	0.80	0.03	94,937	0.53	1.48	14,108	0.27	0.60	8,684	0.59	0.94	33,680
Greece	0.49	0.00	20,479	0.46	1.65	3,004	0.36	2.02	825	0.51	2.68	2,149
Hungary	0	0.10	6,192	0.37	1.03	1,149	0	1.02	166	0.37	1.42	2,560
Iceland	0	-	0	0.09	0.00	139	0.51	0.00	149	0.054	0.00	239
Ireland	0.40	0.00	3,064	0.00	0.46	1,204	0	0.00	557	0.00	0.44	2,147
Israel	0	0.002	12,058	0.00	1.00	2,713	0	1.00	772	0.00	-	1,450
Italy	0.70	0.07	73,987	0.21	1.99	9,275	0.62	0.72	3,717	0.64	1.30	21,652
Japan	0.87	0.00	158,910	0.05	1.05	37,349	0.08	1.13	9,204	0.02	1.18	22,053
Korea	0.88	0.00	128,549	0.00	1.82	8,409	0	3.30	4,960	0.00	-	13,660
Luxembourg	0	-	0	0.069	0.00	354	0.45	0.00	348	0.22	0.00	1,833
Mexico	0	2.12	62,365	0.30	0.51	34,035	0	0.96	2,712	0.05	0.82	18,048
Netherlands	0.82	0.02	50,251	0.63	1.71	4,139	0.66	1.97	3,327	0.21	2.38	6,124
New Zealand	0.83	0.34	5,440	0.31	0.60	2,268	0	1.00	1,042	0.77	0.80	2,450
Norway	0.37	5.49	14,277	0.33	3.68	997	0.70	0.55	810	0.70	1.30	2,399
Poland	0.09	0.03	25,151	0.31	1.04	3,867	0.15	1.61	542	0.46	0.93	11,465
Portugal	0.76	0.00	11,234	0.023	1.68	1,129	0.46	0.87	1,037	0.23	0.98	4,221
Slovak Republic	0	0.00	5,406	0.41	2.68	514	0	1.20	41	0.38	1.95	1,436
Slovenia	0	-	0	0.40	0.00	506	0	0.00	26	0.53	0.00	1,482
Spain	0.70	0.00	59,123	0.38	1.47	4,916	0.61	0.03	5,225	0.67	0.12	21,147
Sweden	0.49	0.00	20,815	0.40	1.54	2,861	0.85	0.27	888	0.00	-	4,425
Switzerland	0.36	0.00	3,395	0.38	0.35	2,930	0.31	0.02	1,557	0.51	0.34	2,516
Turkey	0.44	0.12	19,844	0.22	4.21	1,786	0.47	2.53	1,294	0.58	0.41	13,077
<u>United Kingdom</u>	<u>0.62</u>	<u>0.63</u>	<u>66,812</u>	<u>0.501</u>	<u>1.30</u>	<u>13,849</u>	<u>0.71</u>	<u>0.52</u>	<u>11,116</u>	<u>0.68</u>	<u>0.74</u>	<u>22,232</u>
United States	0.62	0.43	742,915	0.86	0.87	385,265	0.45	1.05	64,786	0.25	1.21	162,381

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

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

Appendix 2 – Methodology

Crude oil and transport fuel self-sufficiency

Data for crude oil, motor gasoline 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 ith 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. 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, 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 product, and five other countries were responsible for 10 per cent each, we assumed maximum import diversity at a ratio of 5:1:1:1:1:1). This maximum diversity score then acted as our upper score of 1, with all other scores divided by this maximum to standardise the data.