ORG Explains #3: UK Energy Security and Climate Change

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Subject

This primer explains the UK's current energy mix, with a focus on how import dependency might affect energy security in the context of rising geopolitical tensions and a changing climate.

Context

Climate change poses a number of risks to the UK's national security, both direct and indirect. One of the indirect risks highlighted by the scientific community is that to the UK's energy security, due to increasing dependence on imports. Achieving self-sufficiency in energy production potentially could deliver significant security benefits by addressing the risks that stem from import dependency, quite apart from the wider importance of transitioning to a zero-carbon economy as the UK's contribution to limiting the warming of the planet. Such benefits might include proofing the UK against sharp and unplanned reductions of supply from specific countries and regions, either due to instability or attempts at political coercion, and more generally insulating the UK from price shocks in the global energy market. This may also yield dividends in terms of resilience. At the same time, decarbonisation has the potential to increase political instability in certain regions, not least the Middle East and North Africa, depending on how effectively major hydrocarbon exporters are able to adapt. This also has direct and indirect implications for the UK's energy security.

Key Points

- Having been a net energy exporter for most of the period 1981 to 2004, the UK currently relies on imports to meet over 35% of its energy requirements.
- The dominant energy exporter to the UK is Norway, although the OPEC states are also an important source of both primary oils and Liquified Natural Gas (LNG). Russia is overall not a critical energy supplier to the UK.
- A changing climate poses significant risks to both maritime transport of energy suppliers and centralised domestic energy infrastructure such as electricity generation plants.
- Climate change and efforts at decarbonisation pose potentially significant political risks to the OPEC states if they are not able to diversify their economies.
- Risks associated with a revived UK nuclear energy sector would tend to increase with climate change. Geopolitical risks related to financing, technology are also significant.
- Transitioning to a zero-carbon and distributed renewable energy and transport infrastructure will reduce British exposure to such risks.

What are the key sources of the UK's energy, and where do they come from?

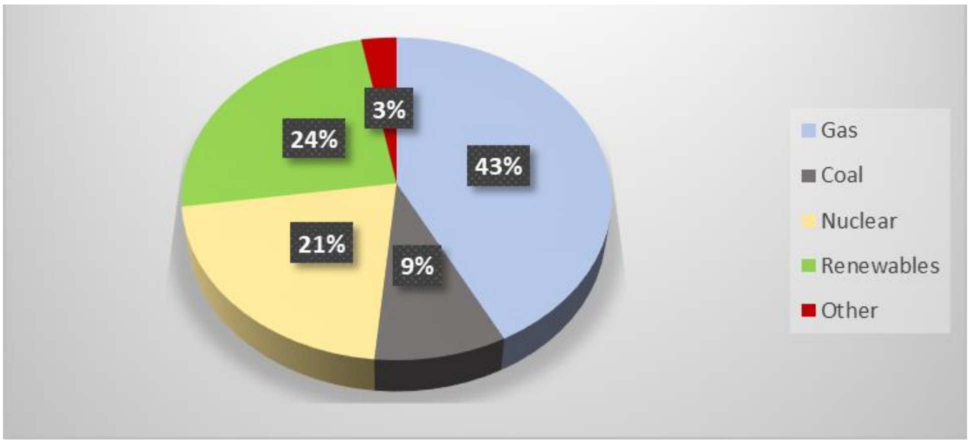
For most of the period 1981–2004 the UK was a net exporter of energy owing to the exploitation of the North Sea oil reserves. The decline in domestic oil production has meant that, after 2004, UK dependence on imports to fulfil its energy requirements has resumed and steadily increased. By 2016, the UK relied on imports for 35.6% of its total energy demand (unless otherwise stated, all statistics are taken from the UK Government's Digest of Energy Statistics).

Broadly speaking, UK energy consumption can be divided into two components.

- The first is electricity generation which powers UK homes, business and services; crudely speaking anything connected to the national grid or which plugs into a socket.
- The second comprises primary oils and petrochemical products which comprise, *inter alia*, fuels for almost all road vehicles, ships and aircraft.

A breakdown of the key sources of the UK's electricity generation in 2016 is depicted in Chart 1 (below). Domestic low carbon sources, incorporating both nuclear and renewables, accounted for 45% of the total.

Chart 1. UK Electricity Generation by Source, 2016



Sources where the UK is not self-sufficient include natural gas, on which the UK relies for 43% of electricity generation, and coal. The latter still provides 9% of the UK's electricity, despite significant reductions in recent years.

In 2016 the UK relied on imports to meet just over 47% of its coal requirements and just over 46% of natural gas demand. The countries of origin for these imports are depicted in Charts 3 and 4 below.

Chart 2: Percentage of Natural Gas Imports by Country of Origin, 2016

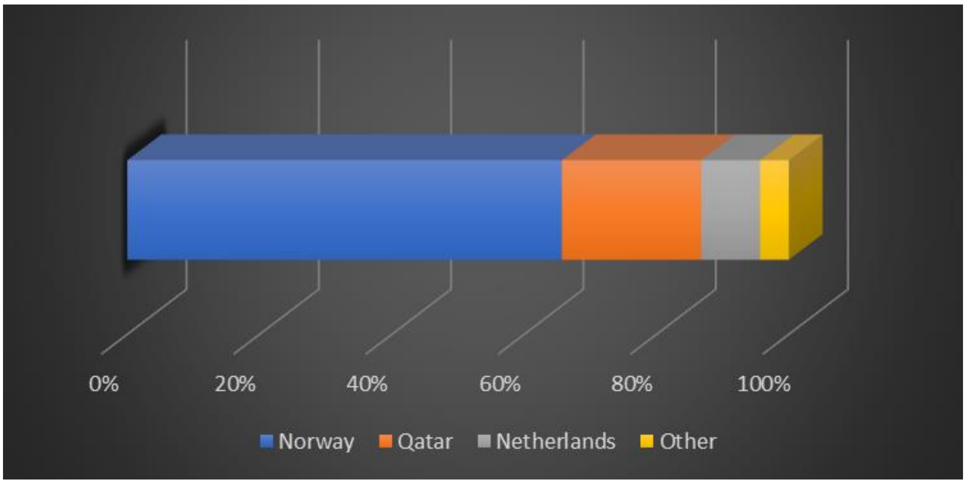
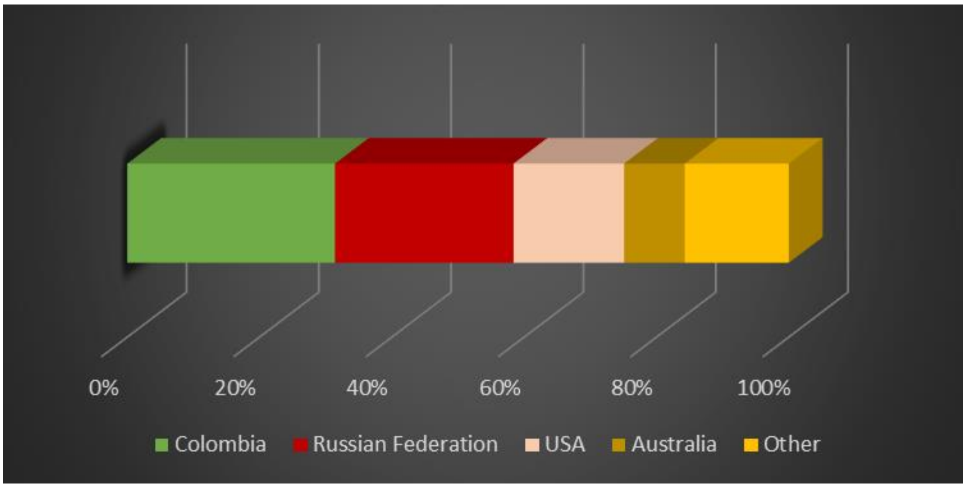


Chart 3: Percentage of Coal Imports by Country of Origin, 2016



Accounting for 65% of natural gas imports, Norway was by far the most important supplier to the UK in 2016, with Qatar the next most significant player at 21%. The UK's coal imports are supplied by a slightly more diverse group of countries, the most important of which were Colombia and the Russian Federation, accounting for 31% and 26% of coal supplies respectively.

The UK retains both significant domestic production of primary oils and the capacity to refine these oils into finished petroleum products, but still requires imports of both. In 2016 the UK imported 28.9% of its primary oils and 14.8% of its petroleum products. The countries of origin for these imports are depicted in Charts 4 and 5 below.

Chart 4: Percentage of Primary Oil Imports by Country of Origin, 2016

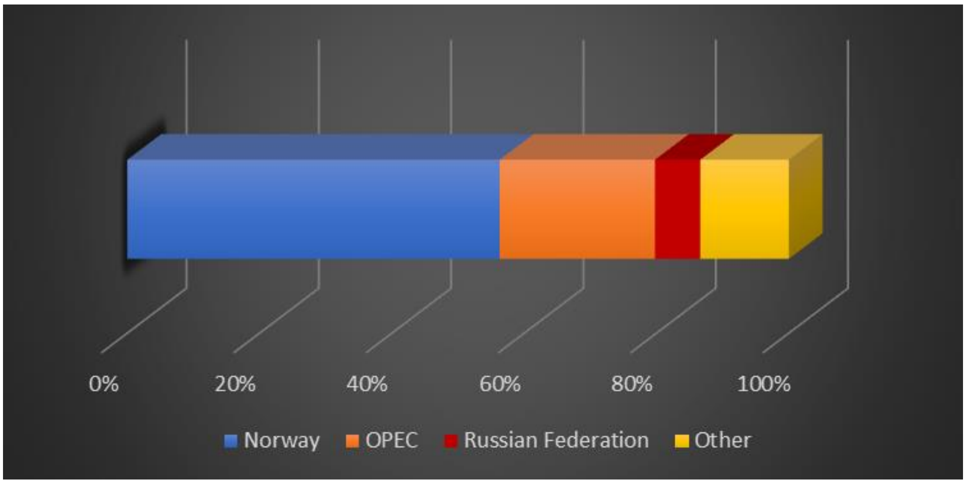
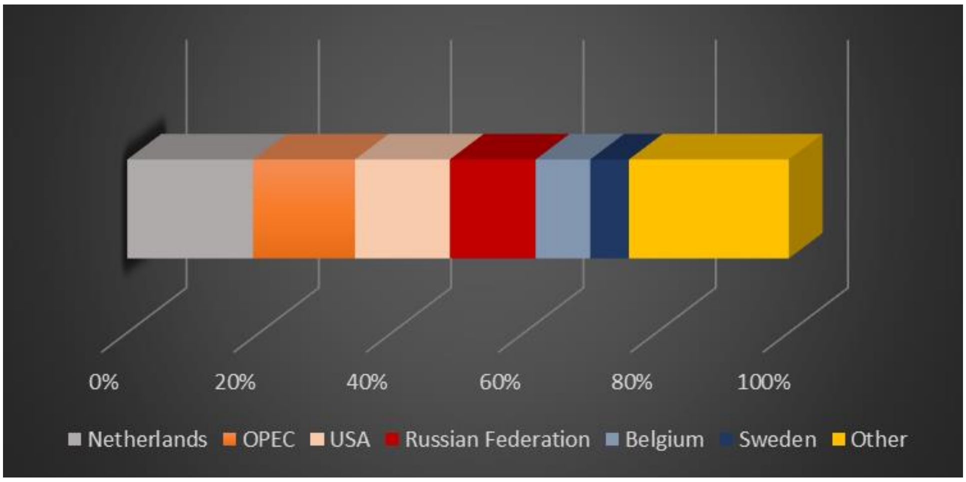


Chart 5: Percentage of Petroleum Product Imports by Country of Origin, 2016



Norway was again the UK's most important supplier for Primary Oils, accounting for 56% of imports. The majority of the other supplies came from either OPEC countries (23%) or the Russian Federation (6%). Petroleum products were imported from a more numerous and diverse pool of countries; while the Netherlands (19%), the OPEC countries (15%), the United States (14%) and the Russian Federation (12%) accounted for significant proportions of these imports, there is no obvious dominant player in this category. The "Other" segment of the bar chart represents nearly a quarter of all imports, which came from a total of 39 countries.

How are UK energy imports likely to change in the future?

There are a number of factors that will influence how the proportion of imports that make up the UK's energy supply changes in the coming years. The main factor is UK domestic policy, which has two crude strands. The first concerns how UK energy consumption overall changes. Energy saving measures, such as higher energy efficiency standards and investments in public transport, have the potential to significantly reduce UK energy requirements. On the other hand, decarbonisation measures such as the implementation of Carbon Capture and Storage (CCC) technologies are energy-intensive but absolutely necessary if the UK is to achieve its carbon targets. The second strand involves the speed with which the UK shifts to low carbon energy self-sufficiency, through increasing the share of nuclear and/or renewables in electricity generation, and the universal use of ultra-low carbon powered surface transport.

Beyond this central question of domestic policy, UK oil production will continue to decline as North Sea oil reserves are exhausted, potentially increasing reliance on imports as long as surface transport is powered by petroleum products. Dependency on natural gas imports might be reduced if large scale fracking is implemented in the UK. However, this may not prove to be politically viable and recent research suggests that it may not be economical even if the concerns of local communities and environmentalists can be assuaged. A likely scenario is that UK dependence on imports will increase marginally in the near term, before declining significantly as low carbon domestic energy production increases, energy efficiency improves and the transition to an ultra-low carbon surface transport infrastructure proceeds apace.

What are the geopolitical risks of dependence on energy imports?

The dominant supplier of UK energy imports is Norway, a long-standing NATO ally to which the UK maintains a substantial military commitment. In view of the number and diversity of other sources of energy, the risk that a hostile power could threaten to withhold supplies as a form of strategic coercion is low. The one import sector where, for example, Russia is an important supplier is coal, which is likely to continue to shrink in its importance as a source of the UK's electricity.

The possibility of a "rerun" of the embargo of 1973-74, when OPEC cut production and banned petroleum exports to the US and allied countries, both as a punitive step for re-supplying Israel in the Yom Kippur war and to gain leverage in the subsequent peace negotiations, is also unlikely. Political deadlock within the cartel between Iran and the Gulf States also makes any collective initiative to hike oil prices unlikely.

The recent global transition to natural gas as an energy supply, including the massive increase in hydraulic fracturing of shale gas ("Fracking") in the United States, and ongoing decarbonisation efforts mean that downward pressure on oil prices is likely to remain the key trend in this area for the foreseeable future. This is more of a risk to oil exporting states, although instability at source could have supply and price consequences for importer states.

A more likely risk thus emerges from the systemic vulnerability of the UK to price spikes in global markets, caused by such phenomena as natural disasters and political unrest. This risk is underlined by the wider European context: other EU countries are generally significantly more dependent on imports than the UK. In 2015, according to Eurostat, the average proportion of energy demand across the EU 28 met through imports stood at 50%, 60% in the case of Germany, 73% for Spain and 77% for Italy. These countries are also more likely to import their energy from higher risk suppliers like Russia, North Africa and the Middle east. This higher level of import dependence across Europe makes the overall energy supply system inherently more fragile and therefore more volatile, with significant interruptions likely to lead to sharper price spikes, and therefore a more serious impact on the UK. Isolated incidents would be unlikely to cause significant problems for the UK. However, the global energy supply chain could be seriously disrupted by multiple incidents and risk cascades. A changing climate makes such a pattern of disruption more likely.

What might be the direct impacts of climate change on UK energy security?

The UK receives energy imports through two primary mechanisms. Oil, petroleum products, coal, and Liquified Natural Gas (LNG) are transported by ship. “Dry” natural gas, which accounts for nearly 80% of all gas imports, is transported via the Langeled pipeline from Norway and the Interconnector pipeline from continental Europe via Belgium. The pipelines are substantially more resilient to potential climate impacts than shipping. A changing climate will result in more regular extreme weather events of greater severity, which poses significant risks to shipping, port infrastructure and key maritime “choke points” discussed by Chatham House, including the Dover and Gibraltar Straits, as well as the Suez Canal, and the Straits of Bab al-Mandab and Hormuz in the case of LNG supplies from Qatar.

This is compounded by risks to UK domestic infrastructure. The Committee on Climate Change, in its 2017 Risk Assessment, highlighted the fact that “41%, 6% and 18% of all power stations in England are at risk of river and coastal flooding, surface water, and groundwater flooding respectively.” The same report emphasised that, even in conservative warming scenarios, flooding is expected to increase over the coming decades. Conversely, projected future droughts in the UK will reduce freshwater availability for power plant cooling. Currently, four million UK citizens in the Thames catchment area at significant risk of losing access to electricity in the event of a 1-in-1000-year flood event. Finally, it is important to remember that flood defences themselves, including gates and pumping stations, are themselves reliant on electricity to function. In the aggregate, a changing climate significantly increases the risk that UK energy security will be disrupted through price spikes and the interruption of supply, with implications for the individual welfare of millions of UK citizens.

What might be the indirect impacts of climate change on UK energy security?

The UK’s most important source of energy imports is Norway, which is an allied country with high adaptability potential to climate change impacts and high political stability. However, the UK is somewhat reliant on the OPEC countries for natural gas (particularly Qatar) and primary oil imports. In a context of a changing climate, these states are caught in a vice. On the one hand they are all among the most vulnerable to the impacts of climate change, while at the same time being the most economically dependent on the production and export of hydrocarbons. As the planet decarbonises, the OPEC states may face a major curtailment of their national revenues, unless they diversify their economies sufficiently to meet this challenge. Significant political destabilisation is therefore a non-trivial probability over the coming decades, depending on whether this diversification can be secured.

The direct risk such political instability might pose to the UK’s energy security is directly related to how quickly the UK continues to decarbonise its electricity generation and transport infrastructure. Of central importance is the transition to electric vehicles. Another important issue in this context is that declining North Sea oil production will, all other things being equal, probably increase the UK’s reliance on OPEC for oil imports. Serious political instability in the Gulf or North Africa will also have implications for the UK and global security.

What might be the consequences of increasing nuclear energy production for UK security?

In terms of domestic energy production, a zero-carbon and self-sufficient energy infrastructure would appear to require a mix of two options: renewables and nuclear power. However, critics of nuclear power cite four concerns.

The first is that the UK has to import all of the uranium it uses, meaning it would remain dependent on external supplies of uranium, sourced mainly from Australia. The second is that building both nuclear power stations and the supporting infrastructure, including shelters to store spent fuel, is very expensive and still cannot be achieved without substantial state subsidies. The third is that nuclear power plants represent a far higher resilience risk than highly distributed renewable networks. It is not necessary to contemplate an extreme "Fukushima" scenario in the UK to note that nuclear reactors concentrate a substantial amount of electricity generation in a small geographical area that, in the event of an extreme weather event, would be potentially vulnerable to disruption. Because of the specific nature and complications surrounding nuclear power, repair of such facilities is likely to be expensive and time consuming. Finally, nuclear power requires significant amounts of fresh water for cooling purposes.

The manner in which the UK Government is financing new nuclear plants, including Hinkley C, is an additional security concern as it involves substantial investment from the Chinese state-backed firm. This geopolitical implications of the Chinese state's involvement in Critical National Infrastructure has been noted as a concern by the UK's Joint Committee on the National Security Strategy.

What alternatives might increase energy security?

A highly distributed energy grid arguably represents both the cheapest and most resilient option for the UK. At the heart of distributed energy system is the microgrid, with a very high number of geographically dispersed generators linked by DC transmission lines, increasing energy efficiency by reducing the reliance on long-distance AC lines and associated power leakage. Such a system would be more flexible and upgradable, as it is a cheaper exercise to replace and upgrade small installations. Such a system would be far more resilient because the chance of a significant portion of the overall power supply being disrupted by an extreme weather event would be far smaller, and repairs easier to carry out. This would also apply to non-climate-related risks like terrorism. There has been some interest in the UK in investing in small modular nuclear reactors (SMRs) for use in this kind of network. Public acceptance of a mini-nuclear reactor in every town is, however, a dubious proposition, as is the economic viability of such an approach. It seems likely that small, highly dispersed renewable installations will be the key to making distributed energy networks a reality.

As regards oil consumption, the faster electric vehicles are introduced and renewable electricity generation brought online, the quicker the UK will reduce its exposure to disruptions in seaborne supplies of primary oil products from extreme weather events, and potential political instability risks in exporting countries. Additional investments in the rail and bus networks would constitute a more efficient path to a zero-hydrocarbon transport infrastructure. This represents the remaining "low hanging fruit" in the sector. It is likely hydrocarbons will be necessary to provide fuels for aircraft and ships for some time to come, although tentative research and development investments in electric planes and ships are beginning to come online.

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