Research Paper

Paul Stevens
Energy, Environment and Resources Department | August 2019

# The Geopolitical Implications of Future Oil Demand


CHATHAM HOUSE
The Royal Institute of International Affairs

# Contents

# Summary

The global energy economy is undergoing a rapid transition from 'hydrocarbon molecules to electrons': in other words, from fossil fuels to renewables and low-carbon electricity. Leading energy industry players and analysts – the energy-forecasting 'establishment' – are seriously underestimating the speed and depth of this transition. This in part reflects the vested interests that dominate that establishment. By contrast, the financial sector – which has little or no vested interest in fossil fuels – understands what is going on and is taking the transition on board.

The history of past energy transitions – including the US's shift from wood to coal in the late 19th and early 20th centuries, and the French adoption of nuclear power on a wide scale in the 1980s – provides useful context for analysis of this trend. Such transitions have been triggered by factors ranging from market upheaval to technological change, with the technological element typically reinforcing the transition.

A similar dynamic, involving triggers and reinforcing factors, is in evidence today. The current transition in the global energy system has been triggered, in the first instance, by concerns over climate change and recognition of the imperative of shifting to a lower-carbon economy. In some places, growing concerns over urban air quality have overtaken climate change as a driver of government policy in support of the transition. The reinforcing factors include the falling costs of renewables and the rapid market penetration of electric vehicles (EVs). To these factors can be added ongoing uncertainty over the possibility of another oil price shock; and rises in oil product prices that are independent of movements in crude oil prices – a phenomenon sometimes known as 'OECD disease'.

If the transition to renewables and low-carbon electricity happens faster than the energy establishment anticipates, the implications for exporters of oil and for the geopolitics of oil will be very serious. For example, the failure of many oil-exporting countries to reduce their dependence on hydrocarbon revenues and diversify their economies will leave them extremely vulnerable to reduced oil and gas demand in their main markets. The countries of the Middle East and North Africa (MENA) region will be particularly exposed, with the possible consequences including an increase in the incidence of state failure in a region already suffering the fallout from having signally failed to address the causes of the Arab uprisings since 2011. Increased political and economic turbulence in the MENA region would also have the potential to create serious migration problems for Europe.

The geopolitics of oil over the past 120 years have played a central role in international relations. Indeed some would argue that geopolitical rivalry over access to, and control of, oil supplies has been the source of much of the conflict witnessed in the 20th century (Yergin, 1991). The rise of renewables implicit in the current energy transition could well change this status quo. Renewables are widely used and widely produced. Currently, their availability is constrained neither by the agendas of dominant fuel suppliers nor by the threat of physical disruption to the strategic transit routes along which traded resources are typically shipped. There are certainly supply constraints associated with some minerals required for renewable energy technologies, but these hardly compare with the conflicts around oil supply, and most such constraints, in any case, are easily managed. Thus, as this energy transition proceeds, oil geopolitics will begin to fade away as an issue of concern.

# 1. Introduction

The world economy is undergoing an energy transition from 'hydrocarbon molecules to electrons' – that is, from the use of fossil fuels to greater reliance on low-carbon electricity produced increasingly by renewables. Past experience and an abundance of analysis of earlier energy transitions suggest a number of questions, all of which need to be addressed if we are to understand what is going on in the energy economy now, and what the future implications of this transition might be. These questions are potentially very large, and many do not have obvious or clear answers. The purposes of this research paper are to summarize some of the key issues arising from these questions, to explore in particular how they link together, and to generate debate.

## What are the triggers and reinforcing factors that drive this transition?

Specific triggers have caused previous energy transitions. Reinforcing factors, usually revolving around changes in technology affecting relative prices, have then supported each transition once it has been triggered. The current transition was started by environmental concerns – initially, over climate change and carbon emissions – which ultimately led to the Paris Agreement reached at the 21st Conference of the Parties (COP21) in late 2015. More recently, there has been growing concern over local air pollution.[1]

In this author's view, the need to reduce air pollution is likely to be a much stronger global driver of policy than activism over climate change, because the effects of poor air quality are so immediate and apparent at a local level. The issue exemplifies the dictum that 'all politics are local', as one need only walk down a street in some cities (or let one's children walk to school) for the relevance of air quality to be immediately obvious.

Meanwhile, the reinforcing factors for this energy transition are likely to include the following: the falling costs of renewable-generated electricity; the rise of electric vehicles (EVs); a variety of other technological changes affecting energy demand, such as LED lighting, artificial intelligence, big data and blockchain computing; the possibility of another oil price shock; and rises in oil product prices that are occurring independently of movements in crude oil prices – a phenomenon sometimes known as 'OECD disease'.

[1] Obviously this differs with the geography. For example, in the UK climate change has been paramount, while in China and India air pollution is the predominant concern.

## What is the speed and depth of the transition?

This author's view is that the speed and depth of the current transition are being significantly underestimated by leading industry players and analysts (referred to in this paper as the 'energy establishment'). Their forecasts seem to persist with a 'business as usual' view of future demand for hydrocarbons. Yet there is much evidence that the energy establishment has consistently *underestimated* the rate of deployment of renewables.

## Is the long-term demand for oil being overstated?

Putting all the above factors together, this research paper argues that many forecasters who are central to the energy establishment are overstating long-term demand for oil.[2]

## Why is the energy establishment underestimating the speed and depth of the transition?

Several factors can explain the consensus among many forecasters in understating, or ignoring the nature of, the transition. These include 'group think' and a safety-in-numbers mentality; the institutional culture of the International Energy Agency (IEA); and the need for the international oil companies (IOCs) to maintain the confidence of their shareholders. By contrast, the financial community is far more aware of the transition, as evidenced both by the global campaign in support of divestment from fossil fuels and by other moves to persuade companies to reduce hydrocarbon use.

## What policy options are available to countries that will face the negative consequences of the transition?

The energy transition presents serious challenges to countries that are heavily dependent upon exporting oil and oil products (a number of such countries are identified in this paper).[3] The obvious solution lies in diversifying their economies. Yet while much lip service is paid to this imperative, for many countries it is already too late to effect the changes required. There are serious barriers to economic diversification, largely derived from political constraints that are unlikely to go away. Without meaningful restructuring of their energy sectors and economies, a number of oil-producing countries – especially in the Middle East and North Africa (MENA) region – will face serious consequences in the coming years. The resulting economic, social and political upheaval could potentially result in armed conflict and the emergence of failed states.

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[2] The current energy transition has clear implications for all fossil fuels. However, in this paper the focus is on the impact on oil markets, if only because the geopolitical impacts associated with oil are far greater than those for other fossil fuels.
[3] These challenges apply to all countries exporting hydrocarbons in any form, but the focus of this paper is on oil to keep the analysis manageable.

## What are the geopolitical implications of the current energy transition as it unfolds?

The geopolitics of energy has developed into a huge area of study, analysis and indeed contention. The contention arises because hydrocarbon energy resources are a result of geography, and are unevenly distributed between nations. Some producers enjoy a surplus, which offers the possibility of exporting hydrocarbon resources. Some consumers have a shortage of domestic hydrocarbon resources and must rely wholly or partially on imports. These structural imbalances in natural endowments (and hence in supply) are fundamental to the geopolitics of energy, which are informed by the dynamics of energy trade, developments in energy markets, and the potential of such markets to be controlled and managed.

Geopolitical calculus also involves considering energy transit routes, the risks pertaining to particular routes, and conflict over access and security issues. By contrast, renewable electricity can be deployed at a variety of scales: at large centralized facilities, such as offshore wind or gigawatt (GW)-scale solar arrays; or at a smaller scale, in a highly decentralized way and without the deployment of large-scale grids.[4] Thus many of the constraints that underpin the geopolitics of energy in the context of traditional hydrocarbon trade disappear where renewables are involved. This potentially means that as this energy transition proceeds, conflicts over energy are likely to be diluted – although the change may not be immediately apparent given the likely lingering impacts from geopolitical manoeuvring over hydrocarbons.

[4] As will be developed, this might be rather more complex than this simple statement suggests.

# 2. Energy Transitions in History

## A brief history of energy transitions

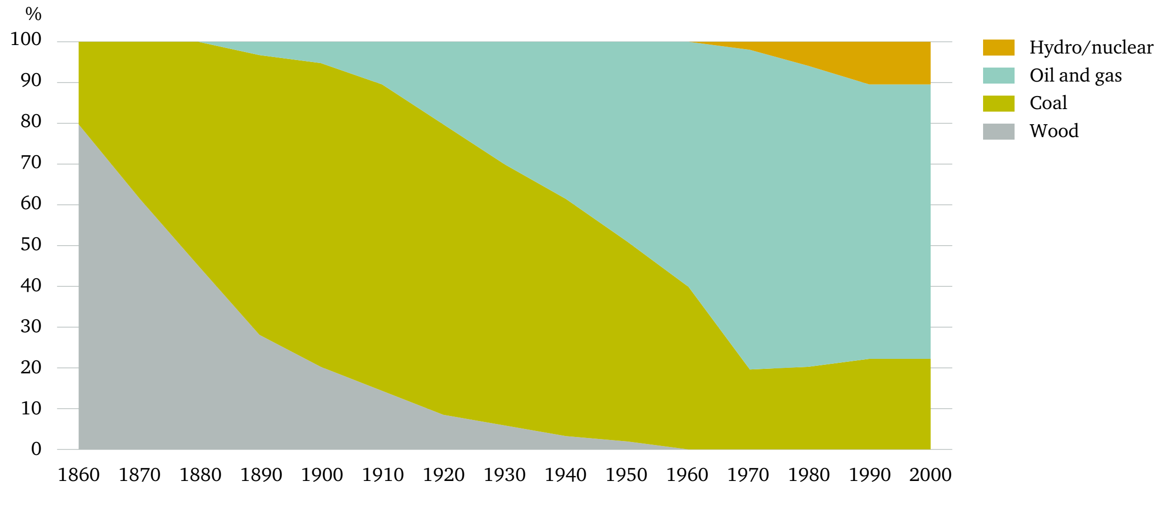
An energy transition occurs when an economy switches from one main source of energy to another.[5] There are many examples in history, and the phenomenon has been much studied (Fouquet, 2010; Smil, 2010; Sovacool, 2016; Cherif, Hasanov and Pande, 2017). In the past, energy transitions have tended to be largely national or occasionally regional developments. However, in today's globalized world, the latest energy transition may well affect numerous nations simultaneously.

### Two case studies

Two examples illustrate the essential elements of energy transitions: that seen in the US between 1865 and 1900, and the transition in France between 1973 and 1987.

*United States, 1865–1900*

**Figure 1: Primary energy consumption by fuel/generation source in the US, 1860–2000**




Source: Darmstader, Teitelbaum and Polach, 1971; BP, 2018a.

At the end of the American civil war in 1865, wood accounted for 80 per cent of primary energy consumption in the US and coal for 20 per cent. By 1900, coal accounted for 75 per cent and wood for around 20 per cent. The trigger for this change was a growing shortage of commercial wood[6] as a result of the dramatic increase in demand. This was driven by rapid economic development –

[5] In the literature, the definitions of an energy transition are much more complicated and sophisticated. For example, for a discussion of definitions in the academic literature, see Sovacool, 2016. However, for the purposes of this paper – to stimulate discussion on the views of the 'energy establishment' – a simple definition will suffice.
[6] Wood is a high-volume, low-value commodity. Therefore there are strict geographic limitations on the distances over which wood can be transported commercially.

described by one source as 'the greatest economic expansion in history' – whereby 'abundant wood was substituted for scarce labor' (Maurice and Smithson, 1984: p. 47). In particular, rapid growth in wood use was due to the expansion of the railway system – from the 1870s to 1900, the US railways consumed as much as a quarter of timber production: 'everything except the rails, spikes, car wheels and locomotives were made of wood' (ibid.: p. 50).

The shift to coal began to produce many technological changes, designed in part to reduce wood use (through greater energy efficiency and wood preservation measures) and also to lower the cost of producing coal.

As the price of wood rose to reflect the growing shortages,[7] consumers looked for alternatives, and in terms of an energy source, coal was the obvious choice. The shift to coal began to produce many technological changes, designed in part to reduce wood use (through greater energy efficiency and wood preservation measures) and also to lower the cost of producing coal. Thus the relative prices of wood and coal changed, with coal increasingly becoming the preferred option. Even as this change was happening, the pace of transition started to accelerate. The process was almost entirely driven by allowing market forces to operate with minimal interference from government.[8]

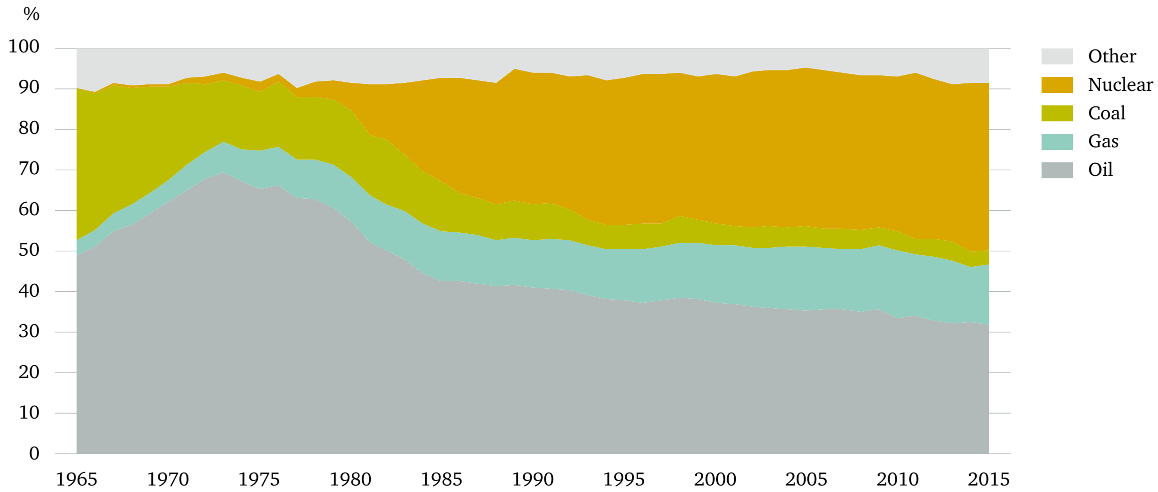
As Figure 1 illustrates, there was a second energy transition in the US from the early 1900s to 1970, when coal was gradually replaced by oil as the main source of primary energy. This was triggered by changes in vehicle manufacturing, specifically the development of the assembly line process pioneered by Henry Ford and his Model T.

### *France, 1973–87*

The French transition is illustrated in Figure 2. We can see that the first oil shock of 1973–74 generated huge concerns in France about the security of energy supply. In response, the government made a strategic decision to increase the use of nuclear power in electricity generation, at the expense of oil,[9] and to increase the role of electricity across society (leading to the increased use of electricity for heating). The emphasis was on developing a standard reactor design in an effort to lower the costs of building and operating nuclear plants.[10]

[7] Between 1896 and 1907, the price of *crosstie stumpage* ('railway sleepers' in English) increased by between 500 and 800 per cent (Maurice and Smithson, 1984).
[8] Interestingly, the US Forest Service did provide advice that often was unhelpful since it only advocated supply-side solutions, i.e. increased planting and growing. It was left to the private users of wood, notably the railway companies, to try to develop wood-preserving techniques and improved designs that used less wood (Maurice and Smithson, 1984).
[9] In the period leading up to the first oil shock, oil had been the fuel of choice for power generation, not least because as the 1960s proceeded oil prices were falling in real terms and were expected to continue to do so.
[10] It has been suggested to the author that the reason the French were enthusiastic about nuclear power was because of the role that Marie Curie – a French national – played in researching radioactivity.

Figure 2: France's primary energy consumption, 1965–2015




Source: BP, 2018a.

The result was that oil was increasingly superseded by nuclear as a source of power, a process entirely driven by government intervention.

## The lessons from history

From these case studies, and indeed many others, certain lessons can be learnt that are relevant to the current energy transition.

The first is that any transition has triggers. Once the trigger has been activated, various reinforcing factors come into play. These may be the result of markets working through adjustments in relative prices, government intervention, or a combination of the two. The process, once triggered, is very much driven by technological change, although other factors can play a key role. Fouquet (2010) identifies three major changes that have historically featured in the transition: changes to the supply network; changes to the energy source; and changes to the energy service provided. In all cases, the key to the transition has been the creation and delivery of better or different services. This has normally meant that the energy price has needed to fall, and/or that the technology's efficiency has needed to improve. This has allowed 'the diffusion of the technology and the new energy source through the broader market' (ibid.: p. 6592). The transition is invariably complex, involving many different services and sectors.

The second lesson is that the time frame can vary enormously. For example, the transition in Great Britain in domestic heating – i.e. moving from wood to coal – took more than 200 years (Fouquet, 2010). In contrast, the French experience of moving to nuclear power, as described above, took only around 15 years. An illustration of the time dimension can be seen in the concept of 'phases' developed by Grubler, in which a core or innovation phase is followed by expansion to early adopters ('the rim'), and then by another phase of uptake by late adopters ('the periphery') (Grubler, 2012). His research suggests that the duration of each phase is shortening. That said, 'the historical record does seemingly support the mainstream view that energy transitions all take time' (Sovacool, 2016: p. 205).

However, in support of the main thesis of this paper, that the current transition will happen much faster than many realize, recent evidence and experience suggest that 'some energy transitions can occur much more quickly than commonly believed' (ibid.: p. 203).

> Any transition has triggers. Once the trigger has been activated, various reinforcing factors come into play. These may be the result of markets working through adjustments in relative prices, government intervention, or a combination of the two.

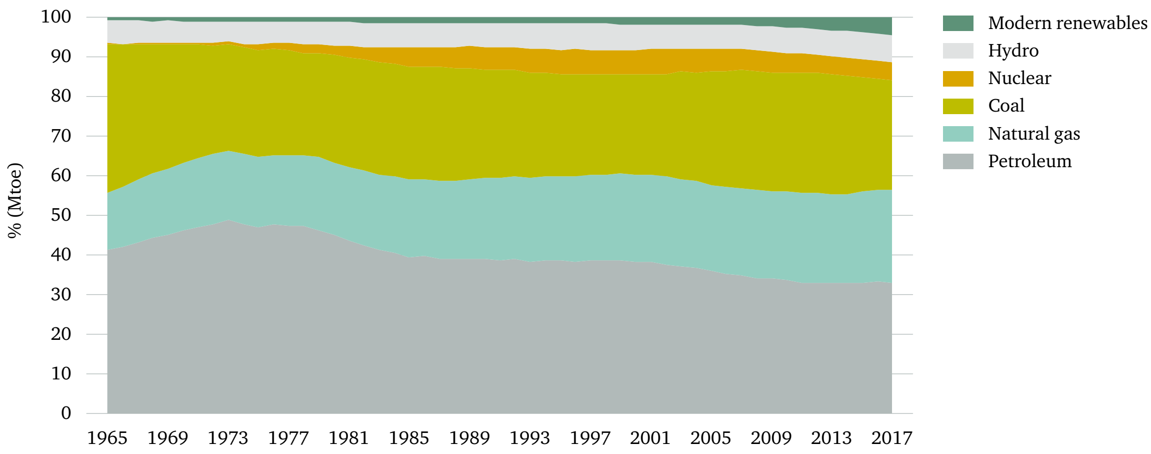
A third lesson is that the current transition is also more *complex* than many originally believed. In the words of a recent study of the subject by the Saudi Arabia-based King Abdullah Petroleum Studies and Research Center (KAPSARC): 'As awareness of the complexity of the energy transition increases, many scenarios are raising the number of possible pathways, a phenomenon that serves to reduce, rather than increase, clarity' (KAPSARC, 2018: p. 4).

A fourth lesson is that the pattern of energy transitions has been one of moving from low-energy-density resources to higher-energy-density resources. It was always the energy density of oil that made it an attractive option, especially in the transport sector. This could raise doubts over the speed of the current transition, suggesting that it might proceed more slowly than the evidence in this paper indicates.

# 3. The Current Energy Transition

The current energy transition entails moving away from an energy system that relies on hydrocarbon molecules to one based around electrons. As can be seen from Figure 3, coal, oil and gas – though still dominant – are gradually making way in the energy consumption mix for nuclear power[11] and renewables.[12]

**Figure 3: Global primary energy consumption by fuel, 1965–2017**




Source: BP, 2018a.

## The environmental triggers: climate change and urban air quality

The initial trigger for the current shift was growing concern about climate change.[13] This was first expressed in a policy context through the process begun in Rio de Janeiro in 1992, leading to the Kyoto Protocol in 1997 and, most recently, the COP21 meeting that concluded with the December 2015 Paris Agreement on climate change. The fundamental objective was to reduce the amount of carbon dioxide ($CO_2$) being emitted into the atmosphere. Hence the need to reduce the use of hydrocarbon fuels.

However, in the past few years, as urbanization has accelerated, a second environmental concern has emerged as a trigger for system change: namely, deteriorating urban air quality and the increased presence of particulate pollution from the burning of coal and diesel. In many countries, this concern is beginning to take over from that surrounding $CO_2$ emissions as the primary driver of the move away from coal and oil. The simple reason for this is that concerns over local air pollution, unlike those over climate change, do not require validation by a panel of scientists arguing that carbon emissions will

[11] Nuclear power gained momentum in the period 1970–2000, but since then its contribution has declined.
[12] BP does not include biomass in its *Statistical Reviews of World Energy* because of the lack of accurate data.
[13] Clearly, the impacts of such concern on hydrocarbons vary. They are worse for coal and oil, but less so for gas. However, there are concerns about fugitive methane emissions, since methane is a far more potent greenhouse gas than $CO_2$.

have some consequent effects in the next few decades. Urban air problems are immediately obvious to anyone walking down a street, and thus are a pressing electoral issue in parts of the world where climate change may not be.

Just as the historical context shows, the activation of both these triggers – concerns over climate change and urban air quality respectively – has in turn attracted reinforcing factors, involving changes in technology and relative prices.

## The reinforcing factors

### Falling costs of renewables

The International Renewable Energy Agency (IRENA) claims that solar photovoltaic (PV) module prices have fallen by around 80 per cent since the end of 2009, while wind turbine prices have fallen by between 30 and 40 per cent (IRENA, 2019a).

Several caveats apply to these falls in costs. First, the figures represent contracted prices in very competitive markets. These prices may well have reflected overambitious attempts to win contracts and thus be lower than fundamentals would otherwise dictate. Second, the above figures represent the costs of generation only. They take no account of the additional costs of incorporating intermittent energy sources into the grid through the installation of back-up generating capacity and interconnectors to other generation sources.[14] Nonetheless, it is clear that modern renewables are pushing coal and gas out of the generating mix in an increasing number of countries.

> Estimates suggest that up to 1 billion people, 50 per cent of them in sub-Saharan Africa, do not have access to electricity. To use conventional thermal power plants to provide electricity to those currently without grid access would require huge investment in distribution networks.

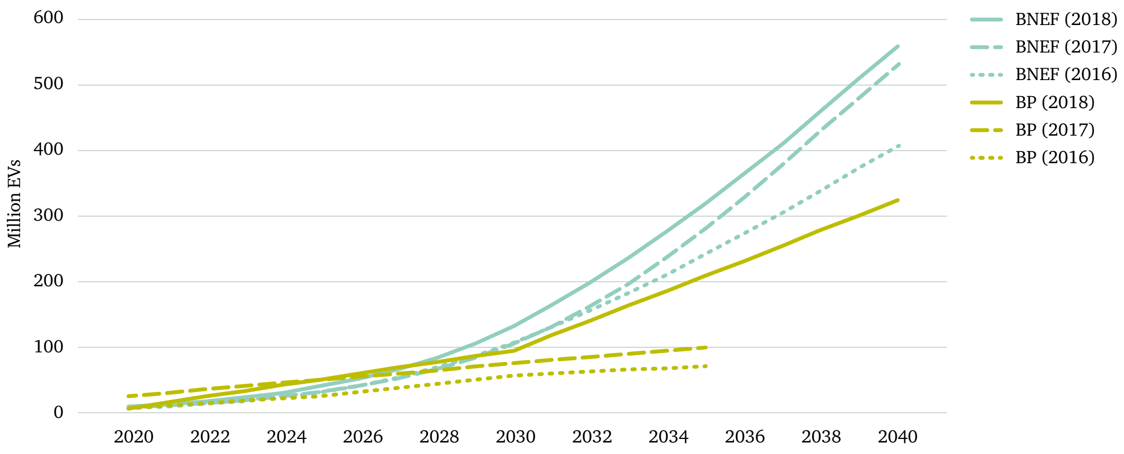
Renewables also have two major advantages over conventional thermal power. First, as domestic sources of energy, they remove the most serious concerns over international security of supply that are associated with imported hydrocarbons. Second, they provide superior consumer *access* to electricity, a major issue in many countries. Estimates suggest that up to 1 billion people, 50 per cent of them in sub-Saharan Africa (UN, 2015), do not have access to electricity. To use conventional thermal power plants to provide electricity to those currently without grid access would require huge investment in distribution networks. However, modern renewables can be delivered locally at small scale without the need for major investment in the grid. The dynamics are similar in some respects to those seen with phone communications in Africa. It was widely assumed 20 or so years ago that, because of the size of the African continent, phone communication would be very slow to develop. In fact, the development of mobile phone technology enabled the continent to 'leapfrog' the traditional landline network stage. As a result, mobile phone communication in Africa is now extremely widespread.

[14] This might be seen as a major barrier, although the decentralized nature of renewables makes adjustments to the grid less relevant. Also, it will be less of a barrier to countries building new grids.

## Technological advances in electric vehicles and electricity storage

Another factor reinforcing the energy transition is the rise of electric vehicles (EVs). Figure 4 presents the changing estimates of future penetration of EVs into the total vehicle fleet or 'car parc',[15] as calculated by two prominent forecasters. Each line represents a single forecast made in a given year, and is presented alongside estimates published by the same forecaster in different years to show how the forecast has changed over time.[16]

### Figure 4: Estimated size of global EV fleet – historical development of forecasts




Source: Collated by Daniel Quiggin of Chatham House. The BP data are taken from various issues of the *BP Energy Outlook* (https://www.bp.com/en/global/corporate/energy-economics/energy-outlook.html); and the Bloomberg New Energy Finance (BNEF) data are taken from *BNEF Energy Outlook* (https://about.bnef.com/new-energy-outlook).

Over the past 10 years or so, projections of EV penetration have, almost without exception, dramatically understated actual penetration levels. Figure 4 shows that major forecasters' estimates of the size of the global EV fleet have typically been adjusted upwards from one year to the next.[17] That these underestimates are so prevalent is surprising given that EVs tick all the right boxes in terms of attributes for energy technologies. They tick the security-of-supply box. If the Strait of Hormuz – a key transit route for oil – is somehow closed,[18] the consuming countries most reliant on petrol or diesel will be the most affected. The higher the penetration of EVs in a given country, the lower the likely impact of disruptions to oil supply. EVs also tick the environmental impact box[19] – with the caveat, in relation to climate concerns, that this assumes that the electricity such vehicles use is generated by renewables, which may not always be the case.[20] In terms of impact on urban air quality, support for EVs assumes that diesel vehicles are displaced. Finally, EVs also present a potential solution to renewables' problem of 'intermittency' – where natural fluctuations in generation (e.g. when the sun doesn't shine or the wind doesn't blow) create reliability-of-supply issues and may require costly

[15] 'Car parc' is a specific bit of technical jargon that refers to the total vehicle fleet.
[16] See also Carbon Tracker, 2019 and Cherif et al., 2017.
[17] However, to put Figure 4 in context, the 2017 BP projection that 100 million EVs will be on the roads by 2035 will be in a global car parc estimated at 947 million vehicles in 2015.
[18] This is an issue revived by the attacks on oil tankers in the Gulf of Oman in June 2019: one a Norwegian-owned tanker, the other a Japanese-owned tanker.
[19] It is being argued that the environmental benefits from EVs have been overstated. Thus the life-cycle emissions are 'not as impressive' as claimed and the wheel-to-wheel overall system efficiencies are 'not as great as first thought' (KAPSARC, 2018: p. 8).
[20] For example, China appears to be building coal-fired stations in remote areas.

back-up generation. Intermittency in renewables can be solved, at least in theory, by storage.[21] One option for short-term grid management is to use batteries. A large car parc would provide significant storage capacity. Thus, the practice of a car in a garage being charged overnight can be replaced by one of a car discharging electricity to supply the grid – with its owner, of course, being paid for it.[22] An even more exciting prospect is that roads could be built with induction strips so that the car can charge itself while driving (Lumb, 2018).

The prospect for a more rapid spread of EVs looks good as the costs of EVs fall, in line with the rapid development of battery technology. Between 2010 and 2016 the costs of an EV battery fell by 73 per cent (BNEF, 2017), and further falls are expected.

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Of course, there are barriers to the spread of EVs (Quiggin, 2017). There has been much concern over the availability of lithium, the basis for much of the battery capacity in many EVs. Such concern has arisen because of lithium's frequent classification as a 'critical metal'. However, the designation 'critical' does not necessarily denote scarcity; it can refer to the criticality of the mineral for certain economic sectors, or the concentration of supply chains. Indeed, the large multinational mining companies are combing their historical records, since historically lots of lithium was found but ignored as having no value.[23] Cobalt, with its heavy reliance on supply from the Democratic Republic of the Congo (DRC), presents another potential supply bottleneck for battery makers. However, researchers are trying to develop batteries that are less cobalt-dependent (Chandler, 2017).

A widespread shift to the use of EVs also has implications for managing and expanding the power grid. If large numbers of motorists drive home and plug in to recharge their EVs at the same time, it could create an unacceptable peak load on the system. However, this should be manageable given modern metering technology. There is also the issue of access to charging points. Not everybody has a garage, an issue potentially of particular relevance for car ownership in high-density urban areas. Thinking about solutions to the environmental challenges posed by the rise of mega-cities requires ideas other than those related to individual car ownership.

It is also increasingly clear that there is a growing policy drive by governments and automotive manufacturers to develop EVs and phase out internal combustion engines (ICEs). Most notably, recent discussions have considered banning diesel vehicles from many cities because of their contribution to particulate pollution.[24] Many national governments have come out with statements illustrating their desire to phase out ICEs and encourage the use of EVs (S&P Global Platts, 2018). China has indicated that one-fifth of new cars will be plug-in or hybrid by 2020,[25] and the authorities there are reported to be 'researching a time line for a complete ban on ICEs'. What happens to EVs in China could be crucial to the future of EVs internationally (Butler, 2018), in much the same way that industry developments

[21] Electricity storage presents very complex issues and there are many barriers. Also, the speed of storage development varies enormously geographically (Ruz and Pollitt, 2016).

[22] In Western Europe, it is estimated that some 80 per cent of car journeys per day are less than 20 km in length. Assuming a battery range of at least 120 km, this represents a very large amount of potential storage that, given current electric meter technology, could earn the car owner money.

[23] Lithium is often found together with lead. So in Cornwall (southwest England), companies are investigating discarded lead mines for lithium potential.

[24] There is growing attention to the health dangers associated with poor air quality in cities, and every day there are newspaper reports of some new health threat from toxic air. See, for example, Carrington, 2018.

[25] Although this target is fairly soon, it is not clear how likely it is to be achieved.

in China have significantly influenced the costs of solar panels. Both the UK and France have said they will halt production and sales of ICEs by 2040. The Indian government has claimed that all new cars sold in India will be electric after 2030. Germany is proposing an ICE sales ban from 2030.[26] Japan, Austria, Denmark and Ireland are discussing setting targets for EV sales. A similar trend can be seen with automotive manufacturers. Volvo, VW Group and BMW have all stated that all their models will have an 'electric option'. Toyota and Nissan have also made claims about plans for zero-emission vehicles in the future. In all these cases, it is necessary to point out that talk is cheap. Until specific policy measures to achieve targets emerge, the claims of governments and the automotive industry need to be treated with caution.

BP has suggested that the introduction of an extra 100 million battery EVs would lower oil demand by 1.4 million barrels per day – a reduction of only 1.5 per cent over total consumption in 2017.

Extensive penetration of EVs into the car parc, if it occurs, will not in itself lead to the demise of oil use, and it would be unwise to overstate the anticipated impact of EV growth on oil demand. The IEA estimates that the billion or so ICE vehicles on the road worldwide account for around 40 per cent of global oil demand.[27] BP has suggested that the introduction of an extra 100 million battery EVs would lower oil demand by 1.4 million barrels per day (b/d) (BP, 2017) – a reduction of only 1.5 per cent over total consumption in 2017.

A number of factors complicate the arithmetic of how EVs may affect oil demand in the future. First, there is the legacy of the existing car parc. For example, BP argues in its *Energy Outlook* (BP, 2018b) that its market scenario in which sales of new ICE vehicles and plug-in hybrid EVs are banned from 2040 assumes that ICEs will still be powering one-third of passenger cars in that year. Second, as EVs begin to dominate the car parc, it is possible that automotive manufacturers will stop investing in research and development to improve ICE efficiency long before any formal ban on ICEs comes into force. This would significantly slow the reduction in oil demand expected from improved energy efficiency. Having said that, much of the improved performance of ICEs over the years has been the result of legislation in the US (for example, the CAFE[28] standards introduced in the 1970s), EU emission standards and policy in China, as part of efforts to reduce dependency on oil imports. There is no reason to assume that effective policy measures cannot be sustained and/or developed in ways that would force automotive manufacturers to continue improving ICE performance.

In terms of the implications for oil consumption, transport is not the only variable to consider, as passenger vehicles that could be replaced by EVs account for less than 20 per cent of total oil demand. Many oil consumption forecasts also assume that the role of oil as a feedstock for petrochemicals will add significantly to future demand. For example, the IEA projects that one-third of the growth in oil demand by 2030 will come from petrochemicals, rising to almost 50 per cent by 2050 (IEA, 2018b). However, as noted earlier, the IEA is arguably highly optimistic about future oil demand. Also, its projection does not take account of growing concerns about the pollution caused by plastics that fail to degrade. This raises a legitimate question: is plastic likely to be the 'new tobacco' in popular opinion, and might we thus expect a strong groundswell of activism seeking to reduce demand

[26] There are voices being raised against this idea, but some regard Germany as a laggard in this area.
[27] It should be pointed out that the IEA's record of forecasting EV penetration, and indeed wind and solar production, has not been particularly good (Hoekstra, 2017).
[28] Corporate Average Fuel Economy.

for petrochemicals in the future? This possibility is reinforced when one realizes that 40 per cent of plastics are used for packaging (Parker, 2018), much of which might reasonably be deemed a non-essential luxury.

There are also other factors at work in relation to oil demand. It is clear that car ownership is declining among much of the younger generation in OECD countries. Rapid urbanization and the spread of asset-sharing models – e.g. car clubs and ride-matching services such as Uber – point to declining car ownership and thus, potentially, lower oil demand in the future. This will be especially true if city planners prioritize public transport and connected-mobility solutions as part of policy efforts to achieve climate and clean air objectives.

## Other technological changes

Other areas of technological change may also influence future demand for oil. First, there is the role of artificial intelligence (AI)[29] and automation, which promise to create a so-called 'fourth industrial revolution'. This takes the third industrial revolution, namely the digital revolution linked to computers and automation, and adds to it cyber physical systems whereby operations are controlled by algorithms integrated into the internet (Schwab, 2016). The implications of this for energy consumption are far from clear. For example, self-driving cars might be expected to operate in a more fuel-efficient manner. But at the same time, there is an interesting potential contradiction between electricity use and information technology. Greater use of information technology may save electricity on the one hand, but on the other hand it may lead to increasing electricity consumption to generate the technology in the first place. AI, automation, the 'big data' revolution and the rise of blockchain computing are emerging as important sources of potential disruption to markets and industries. How specifically all this might affect oil and energy consumption is not entirely clear. It might be assumed that all of these developments in communication and connectivity lead to greater operational efficiency, which would improve energy efficiency. For example, already the oil industry is increasingly using big data both to lower upstream costs and to streamline the transport, refinement and distribution of crude oil and oil products (Marr, 2015; Zaidi, 2017).[30] The development of hydrogen-based fuel cells could also be a source of unexpected disruption to oil industry dynamics.[31] It might also be argued that such technical developments will allow a more flexible power sector to emerge, enabling more renewables to be integrated into the power grid, leading to lower costs.

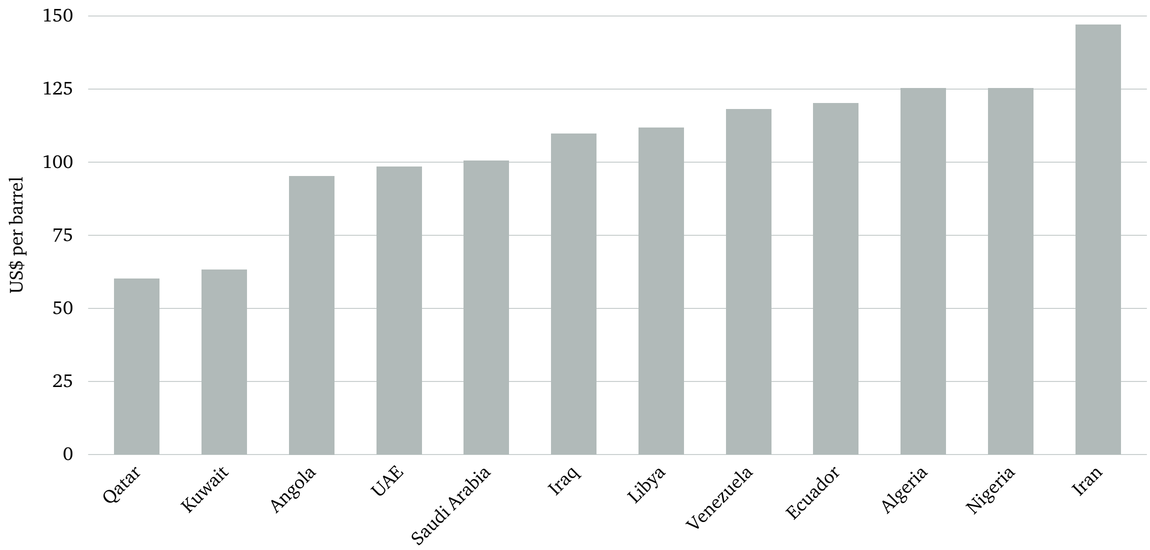
## Another oil price shock?

The MENA region, which accounts for 38.6 per cent of global crude oil exports and 51.4 per cent of global proven oil reserves (BP, 2018a), is currently extremely unstable. Indeed, in the view of this author it is necessary to go back to 1918, at the end of the First World War and during the collapse of the Ottoman Empire, to find a period when the region was so unstable and unpredictable. Furthermore, there is a serious possibility of even greater instability to come. Lower international

[29] Much is made of the potential for driverless vehicles to reduce oil consumption. However, the use of driverless vehicles in urban areas faces severe constraints. In the Lebanese 'highway code', for example, a paragraph states that if two drivers approach a junction and the right of way is not clear, they should get out of their vehicles and decide who should go first. In dense urban traffic it is inconceivable that automatic vehicles, programmed for safety, could manage such a process. Casual observation suggests that congested urban traffic only flows because many drivers ignore the 'rules of the road'. Traffic engineers have dubbed this 'deferential paralysis' (Adams, 2016).
[30] There is always the possibility, of course, that lowering costs will generate a rebound effect as lower costs lead to lower prices and increased consumption.
[31] The Japanese government remains very enthusiastic about this option.

oil prices since mid-2014 have caused serious problems for oil-producing governments in the MENA region, reducing their ability to assuage domestic political unrest through public spending. Figure 5 shows the budgetary break-even oil price for OPEC members shortly before the oil price collapse of 2014.[32]

### Figure 5: OPEC budgetary break-even price, 2014




Source: Aissaoui, 2014.

The weighted average break-even price at that time was $102 per barrel, and only Qatar and Kuwait could survive fiscally at $60 per barrel. Yet the average price per barrel of Brent crude was $54.18 in 2015, $44.67 in 2016 and $54.67 in 2017 (BP, 2018a). Even as lower oil revenues have limited the ability of producer governments to buy off local discontent, the original drivers of the Arab uprisings that began in Tunisia in early 2011 have not been addressed.[33] Discontent has simply been repressed. Add to this maelstrom of uncertainty the impact of US President Donald Trump's disruptive behaviour in the region – especially in respect of Iran, and his blatant bias towards Israel – and the scene is potentially set for major upheaval or even military conflict in the region.[34] This would inevitably cause oil supply outages, in turn likely generating an oil shock in the form of higher prices. It is impossible to determine how high such a spike could go, but it is worth remembering that the price of Brent hit $144 per barrel in mid-July 2008. How long any price spike might last is also extremely uncertain.[35] However, a rise of any magnitude is likely to cause governments in oil-importing countries to step up their efforts to move away from oil as a source of energy, thus reinforcing the current energy

[32] The reason for picking this date is that it illustrates the economic vulnerability of the oil producers just before the oil price collapse that began in the summer of 2014.
[33] Those fighting and demonstrating on the streets of many Arab capitals hated the term 'Arab Spring'. They saw it as a Western media construct and thought that the term's association with the Prague Spring of 1968 implied automatic failure. They preferred either the 'Arab Revolution' or the 'Arab Uprising'.
[34] Trump's strategy for Iran is now clear. He intends to make the life of ordinary Iranians so desperately bad and miserable that they will rise up and overthrow the government in Tehran. It is effectively regime change on the cheap. It is unlikely that the government of Iran will sit back and accept this. What its response might be is difficult to predict, but the classic response to unrest at home is to create a diversion by a crisis abroad. Meanwhile, tensions between Tehran and Washington continue to grow.
[35] By the end of 2008, the price of Brent had fallen to $34 per barrel.

transition. Such a policy response was certainly in evidence in relation to the second oil price shock, in 1979–80, when the G7 governments, at meetings in Tokyo and Venice, all agreed to reduce dependence on oil by using sales taxes to increase oil product prices to the final consumer.

## 'OECD disease' and the rise of oil product prices

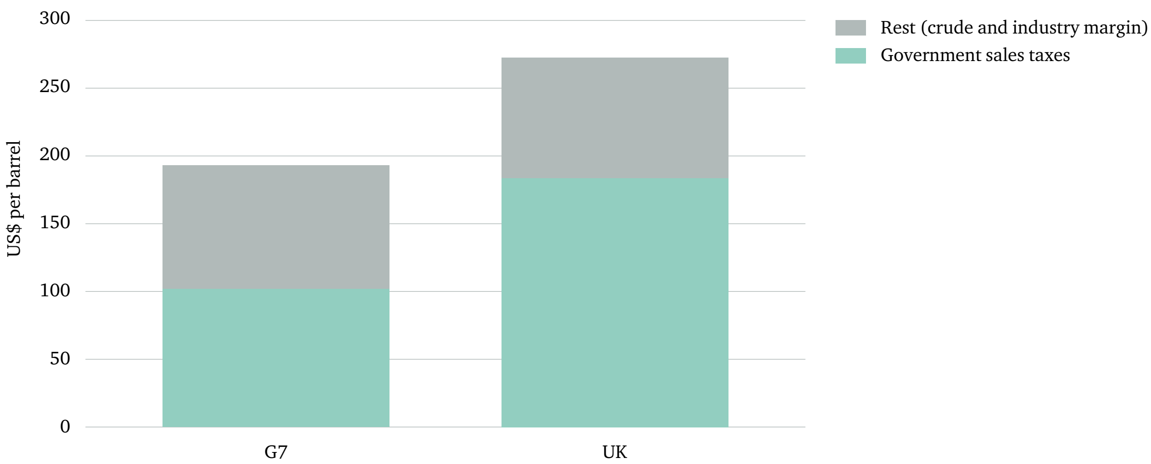
'OECD disease' refers to the policies developed by OECD governments in the early 1980s following the oil price shocks of the 1970s. These policies involved increasing sales taxes on oil products to increase the final price to the consumer, thereby creating incentives for consumers to use less oil. Although these taxes were intended to reduce oil consumption, there was another motivation: taxing oil products is a great way of raising revenue for a government. Oil products are widely used, so offer a very large tax base. Demand for them is inelastic, so high tax rates can be imposed. Finally, the cost of collecting the tax is very low. In theory, all that is needed is to have someone register the tax to be paid each time a tanker leaves a refinery, thereby involving few transactions. The picture in the G7 and the UK before the crude oil price collapse of 2014 can be seen in Figure 6, with government sales taxes dominating the final price to the consumer.

> In recent years many non-OECD governments have also discovered the appeal of increasing sales taxes on oil products in contexts in which, traditionally, governments seeking to raise tax revenue have faced many barriers and problems.

The reason this phenomenon has been called a 'disease' is because it is catching! Thus, in recent years many non-OECD governments have also discovered the appeal of increasing sales taxes on oil products in contexts in which, traditionally, governments seeking to raise tax revenue have faced many barriers and problems. Recent examples have occurred in India since 2002 and China since 2009, and also include measures enacted by many other governments. The key consequence is that *even if crude oil prices were to fall*, higher oil product prices, boosted by sales taxes, could continue to reinforce the energy transition from oil towards renewables.[36]

[36] It is possible to argue, given the experience of fuel protests in the UK in 1999–2000 and the more recent activities of the *gilets jaunes* in France, that there is a limit to what the public will accept in terms of higher prices from imposed sales taxes.

**Figure 6: 'OECD disease', 2014 – sources of the composite product barrel final price to consumers**




Source: OPEC, 2016.

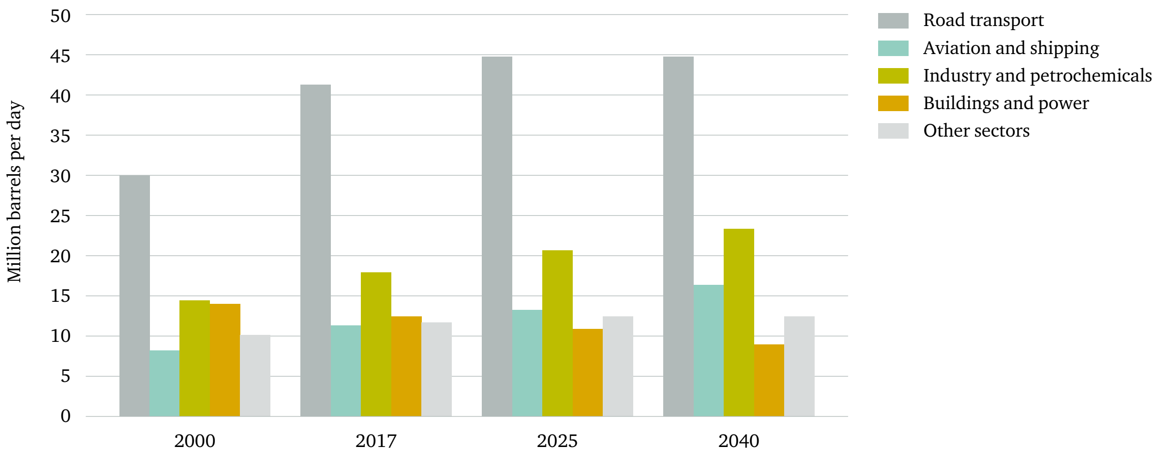
## Other reinforcing factors

A corollary to the 'OECD disease' phenomenon is the question of whether removing subsidies on oil products – in effect raising prices – will also tend to discourage consumption. Many governments have taken advantage of lower crude oil prices since 2014 to remove the high levels of subsidy that have characterized their pricing policies (Kojima, 2016; Fattouh, Sen and Moerenhout, 2016). A process that raised prices for oil products would also be strongly reinforced if carbon pricing became a serious policy option. Also worth noting is that the factors supporting an energy transition are often mutually reinforcing. For example, higher costs for petrol and diesel will encourage further improvements in EV technology. Similarly, electrification of grids using power from renewable sources drives demand for storage that can be provided by a large EV car parc. Improvements in battery technology from EV development enable more renewables to be used on grids. The list of reinforcements of reinforcing factors could go on.

# 4. Long-term Oil Demand is Being Overstated

For the purposes of this paper, the term 'energy establishment' applies to the IEA, the OPEC Secretariat, the US Energy Information Administration (EIA) and numerous other institutions in the business of forecasting energy supply, demand and market developments. It includes the large IOCs that regularly produce energy forecasts. The prevailing view presented by this establishment is that future oil demand will continue to be strong. Figure 7 illustrates a typical forecast from the IEA. Other members of the energy establishment present similar views.

### Figure 7: IEA estimates of oil consumption by sector

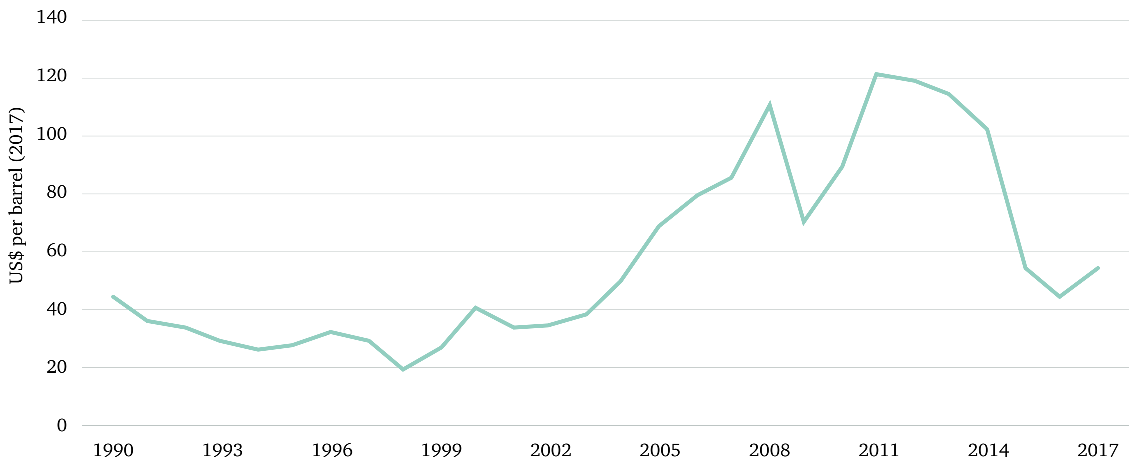



Source: IEA, 2018a.

This view of future oil demand underestimates two factors that could significantly cut oil demand growth.[37] Both are linked to prices. The first is the fact that, as Figure 8 shows, between 1998 and 2011 the price of crude oil rose in real (i.e. inflation-adjusted) terms,[38] and that – as is explained below – this will take time before it begins to affect future demand.

[37] There are, of course, other threats to oil demand. For example, an economic downturn in either India or China 'could have a major impact on global demand growth' (KAPSARC, 2018: p. 4).
[38] The only exception was a short-term fall after the financial crisis of 2008.

### Figure 8: Real oil prices 1990–2017 (Brent)




Source: BP, 2018a.

There is a tendency among energy analysts to forget the time lag between price movements and changes in oil demand. Oil demand is what is termed a 'derived demand'. No one wants a barrel of petrol or a bag of coal. Energy consumers want energy services – light, heat and work. To secure these services requires the use of energy-consuming appliances. A three-stage process therefore affects energy consumption. It involves a series of choices that ultimately determine oil demand. The first is whether to buy the energy-using appliance or facility. While the price of the appliance matters, of greater importance is the income of the consumer. As incomes rise, more appliances are purchased.

The second choice is what type of appliance to buy. Here there are two issues: which fuel should power the appliance, and whether an efficient or inefficient appliance should be preferred. The choice of fuel is determined by the technology. A jet aircraft requires the use of jet fuel, but boilers to generate steam can depend on a variety of fuels. A key determinant of the choice of fuel, depending on the technology available, is the current price of fuels. However, expectations regarding *future energy prices* are probably an even more important factor. As to efficiency, at least historically, more fuel-efficient appliances tend to command higher purchase prices. So this presents a trade-off between the initial price of the appliance versus any savings on running costs that may result from higher fuel efficiency. Once these choices have been made, the appliance stock is fixed for a significant period (as it takes time to change the appliance stock to any extent). For example, the car parc normally takes around 15 years to change, and the housing stock well over 50 years.[39]

Once the appliance stock is fixed, the third and final choice in determining demand for fuel is the capacity utilization of the appliance. Here there is an important conceptual distinction between 'conservation' and 'deprivation'. Doing more or less the same thing with lower capacity utilization constitutes conservation, and can be viewed as a desirable action. However, to save energy through zero capacity utilization – e.g. turning off all the lights and sitting in the dark – is 'deprivation'. This might be seen as undesirable. In the short run, when the appliance stock is fixed, and if no deprivation is to occur, it takes time for higher oil prices to reduce fuel demand to any significant degree. Thus,

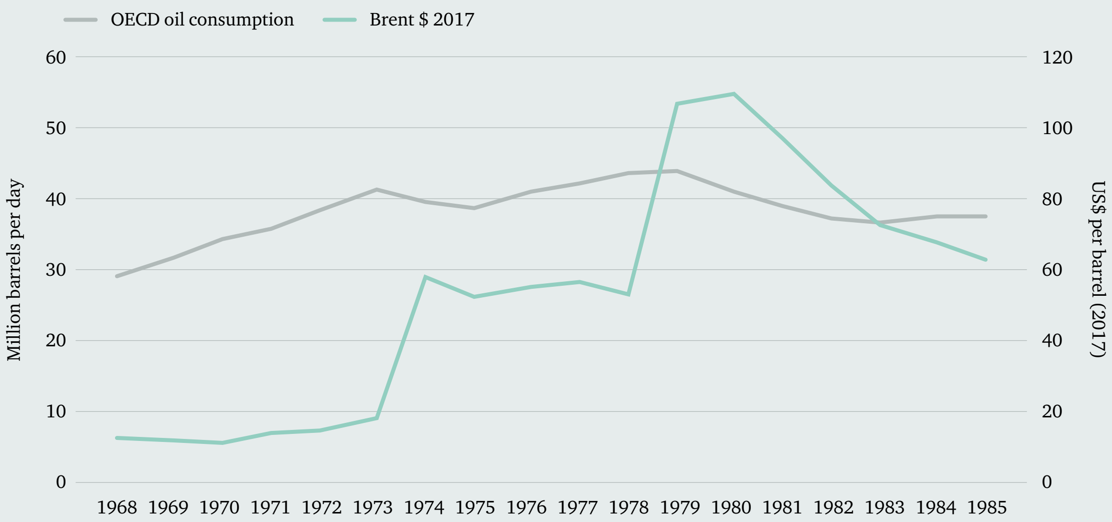
[39] These timings may be shortened if there is the option to retrofit the appliance. Also, some appliances such as light bulbs can be changed very quickly.

the higher prices experienced between 2004 and mid-2014 will take time to reduce oil demand significantly, but they surely will. The experience following the oil price shocks of the 1970s provides a classic example of this phenomenon of lagged demand response, as briefly outlined in Box 1.

### Box 1: The impact of the oil price shocks of the 1970s on OECD oil demand, and how the response is lagged

Figure 9 shows the real crude oil price and OECD oil consumption. The underlying story is as follows. OECD oil consumption was rising rapidly post-1968 in response to two drivers. First, the period after 1970 saw a major economic boom in the OECD, with very high rates of GDP growth.

**Figure 9: OECD oil consumption and Brent oil prices, 1968–85**




Source: BP, 2018a.

Second, oil was increasingly used for power generation as the expectations were that the fall in the oil price at the end of 1960s was expected to continue. Hence (in an example of the three-stage consumption decision described above), generators chose to run new power stations on oil when, as a result of the economic boom, electricity demand was growing very strongly. Then, in 1973–74, the price of oil quadrupled. Immediately, oil consumption fell as the capacity utilization of the oil-using appliance stock fell. In many cases, this change represented 'deprivation' – consumers were unable to afford to use oil for essential energy services. At the same time, oil consumers and manufacturers of oil-using appliances began to respond by trying to improve oil-use efficiency. This was most apparent in automotive manufacturing. However, turnover in the car parc takes time, so the effects were not immediately apparent. Then, in 1979–80, there was a second oil price shock, which was associated with the Iranian revolution. Again, the capacity utilization of oil-using appliances fell. However, this time, the more oil-efficient appliances were beginning to enter the appliance stock at scale, and so overall oil consumption fell to a much greater extent. This provides a classic example of how changes in oil consumption are lagged relative to increases in oil prices.

A second and more recent influence that is set to undermine oil demand growth – likely causing demand forecasts to be revised downwards again – is also related to price. Since mid-2014, the price of crude oil has collapsed in both real and nominal terms. However, 'OECD disease', already discussed, means that these lower crude prices have not yet translated into the lower product prices[40] that drive movements in oil consumption.

The possibility that future oil demand is being overstated has started a discussion about the concept of 'peak oil demand' (Lynch, 2018; Dale and Fattouh, 2018). The original concept of 'peak oil' referred to the idea of a peak in supply occurring as a result of reserves being depleted. The concept was seriously flawed, since it took no account of technology, costs or prices.[41] It was finally effectively buried by the shale technology revolution that dramatically increased recoverable reserves. However, it has now been replaced by the idea of 'peak demand'. There has been much discussion over when global oil demand will peak – indeed, it appears to have already done so in the OECD, having hit its highest level in 2005.

> The more interesting question is not when 'peak demand' will occur, but what will happen afterwards. Will oil consumption gently decline or will there be a collapse? This will be of crucial importance to any assessment of the geopolitical implications of the energy transition.

In some ways, this is the wrong question. The more interesting question is not when the peak will occur, but what will happen afterwards. Will oil consumption gently decline or will there be a collapse? This will be of crucial importance to any assessment of the geopolitical implications of the energy transition. The OECD experience of gentle decline may not necessarily be a good indicator of what to expect in emerging economies. This is because energy sector developments in emerging economies in the coming decades will be subject to structural disruptive forces, rather than to a more predictable interaction between improving energy intensity trends and saturation of car ownership.

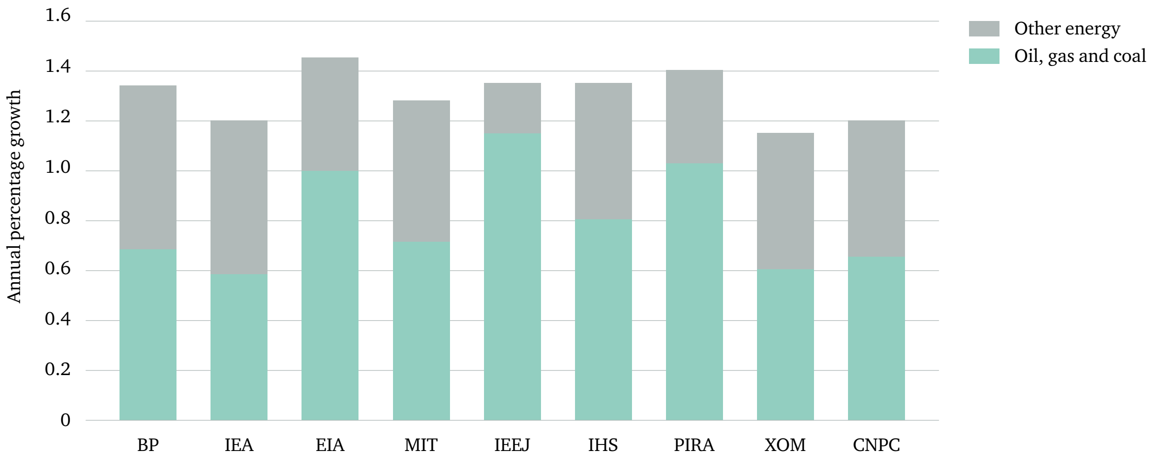
Technology is already arguably bringing the date of the peak nearer. The role of EVs has already been discussed. As outlined in Section 3, other technological developments may also reduce oil demand in the future.

[40] Except in the US.
[41] It has unkindly, but accurately, been described as a concept invented by geologists to upset economists. In that it most definitely succeeded.

# 5. Attitudes to the Current Transition

## The 'energy establishment'

### Figure 10: Contributions to energy consumption growth, 2015–35, various forecasters




Source: Estimated from BP, 2017.
Forecast abbreviations: BP = British Petroleum; IEA = International Energy Agency; EIA = Energy Information Administration – US; MIT = Massachusetts Institute of Technology; IEEJ = Institute of Energy Economics – Japan; IHS = IHS Markit; PIRA= PIRA Energy Group; XOM = Exxon Mobil; CNPC = China National Petroleum Corporation.

A selection of forecasts by the 'energy establishment' is presented in Figure 10. The main observation is that, in the opinion of this author, they underplay the depth and speed of the current energy transition. All of the institutions cited in Figure 10 continue to assume that hydrocarbons will go on dominating the primary energy mix.

It is interesting to speculate why this is the case. One possible explanation is that they are right, and that hydrocarbons will in fact continue to dominate. In most cases, the forecasts contain arguments to justify this view. However, there are other possible explanations. The first is the phenomenon of 'forecaster cluster'. It is difficult to forecast major changes in trends. It is also very difficult, if not impossible, for a forecast to identify the specific discontinuities in trends that will seriously damage the accuracy of the forecast. Therefore, there is safety in hewing to conventional wisdom, on the basis that 'if you are wrong, so is everybody else'. There are other factors applicable to specific institutions. In 1974, in the wake of the first oil shock, Henry Kissinger, then US secretary of state, created the IEA in an attempt to dilute the power of the OPEC countries, and to scare consumer-country governments into reducing their imports of oil. It is part of the IEA's institutional DNA to convince the world that oil demand will continue to grow, and that this will create serious vulnerability for oil-importing countries. At the same time, the IEA is regarded by many as the benchmark for energy forecasting. Other forecasters therefore tend follow its lead. This is despite the fact that over the years many have pointed to the IEA's relatively poor forecasting record[42] (Huntington, 1994; Mackenzie, 2017;[43] Wachtmeister and Höök, 2018). For example, according to Paolo Scaroni, the chief executive of Italian energy firm Eni: 'The International Energy Agency (IEA) has consistently overestimated oil demand since 2004, leading many market operators to predict an impending oil crisis' (Reuters, 2009). More recently: 'Organizations such as the IEA are consistently behind the curve in their predictions of renewable costs and deployment' (Carbon Tracker, 2015).[44]

As for the IOCs, they are in a difficult position. Given their dependence on shareholders, they can hardly produce a public forecast that predicts a serious decline in demand for their main product.

However, many other groups take a very different view of market prospects, one far more supportive of the view that the transition away from hydrocarbons will be faster and deeper than expected by the energy establishment. Some examples are provided below.

## The financial community

Compared to the established energy forecasters, the financial community appears far more supportive of the idea of a rapid energy transition. One obvious reason for this is that it does not have the same vested interest in the status quo. Its mandate – i.e. to protect investor wealth – allows and in fact requires its members to be more dispassionate about oil demand prospects.[45]

This view was encapsulated in a speech by Mark Carney, the governor of the Bank of England, to Lloyds of London in 2015 (Bank of England, 2015). Another example can be found in the views of BlackRock, a global investment management corporation: '… a deep structural shift is underway in how the world's power industry, homes and transportation operate. The implications for infrastructure investors are significant' (BlackRock, 2018).

The World Economic Forum (WEF) also takes the view that 'the world's energy systems are going through unprecedented transition driven by new technological opportunities, policy shifts and change in energy consumption' (WEF, undated).

> Increasingly, there are efforts by financial managers to include the integration of 'transition risk' into investment management frameworks and financial stability regulations.

Increasingly, there are efforts by financial managers to include the integration of 'transition risk' into investment management frameworks and financial stability regulations.

[42] To be fair, the IEA's response is that it produces scenarios rather than forecasts – although this response causes some debate (Mackenzie, 2017).
[43] Mackenzie's article provides many graphic examples of how the IEA, over many years, has seriously underestimated the rise of renewables.
[44] For example, the *2007 World Energy Outlook* (IEA, 2007) predicted that renewable capacity would be 20 GW by 2014. The actual capacity was 175 GW.
[45] For example, see the recent correspondence from Hermes Investment Management, Allianz Group and Legal & General Investment Management to the IEA on this issue (Hook and Raval, 2019).

## The consultancies

A number of consultancies are more aggressive in their views of the speed and depth of the transition. Bloomberg New Energy Finance (BNEF), as can be seen from Figure 4, has been far more optimistic than other forecasters about the penetration of EVs. McKinsey for some time has also been more positive on the issue. Thus: '… Globally, energy systems are experiencing significant and fast change' (quoted in Hund et al., 2012).

## Others

The 'divest campaign', which lobbies financial investors to avoid investing in companies that produce or use hydrocarbons,[46] has been influential in warning investors about the dangers they face from the current transition. The spread of this campaign, which began in the US, has been impressive (Vaughan, 2014).[47] Many investment funds have announced that they will no longer buy into companies associated with carbon production and use. Several good examples (albeit rather strange ones, given their oil-sector origins) include the Rockefeller Foundation and the Norwegian government pension fund.[48] Linked to this campaign is also the work of Carbon Tracker (Carbon Tracker, 2015), a London-based think-tank, which has been warning of the dangers of 'straight-line syndrome'[49] in the energy establishment's forecasts (ibid.).

## Academia

There is also global pressure from university campuses across the world,[50] pressure which to this author is reminiscent of the anti-Vietnam War movements of the 1970s and the anti-apartheid movements of the 1980s. This view is reinforced by the phenomenon of schoolchildren in many parts of the world beginning to hold 'strike days' to register their frustrations at the lack of policy action by their governments (BBC, 2019).

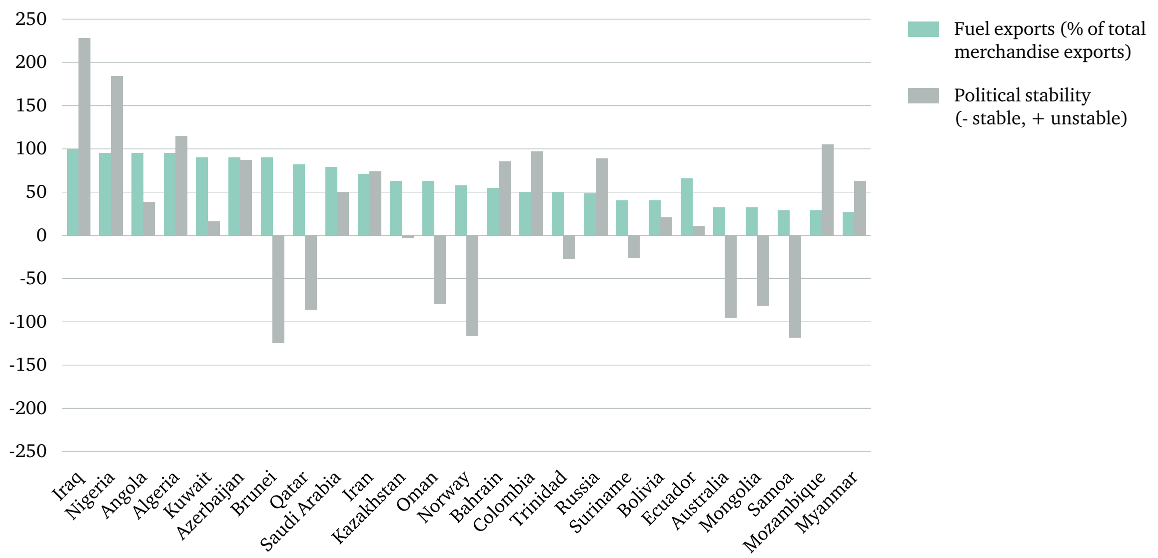
[46] For further details, see https://www.divestinvest.org (accessed 25 Sep. 2018).
[47] There are no hard numbers on the volumes disinvested, so it is impossible to determine if the campaign is having a major effect.
[48] This consists of two separate funds: the Government Pension Fund Global (previously called the Petroleum Fund of Norway) and the Government Pension Fund of Norway.
[49] This is the inability of forecasters to predict discontinuities.
[50] Simply Googling 'divestment campaign' produces an impressive list of sources on this.

# 6. Conclusions to the Current Energy Transition and its Implications

The position of this paper so far is that the energy transition is likely to be deeper and to occur more rapidly that many realize. The next stage is to consider what the implications of this are likely to be. One obvious implication is that the market for hydrocarbons will begin to shrink, and with it the revenue accruing to producers. This is a very large topic, but for the purposes of this paper, the analysis focuses on the major oil-exporting countries. Figure 11 lists those countries in which fuel exports account for more than 25 per cent of total merchandise exports. There are 25 such countries in total. The ability of these countries to meet the challenge of a declining market will depend in large part upon their political stability, data for which are also included in Figure 11 (a 'plus' indicates political instability, a 'minus' indicates political stability).

An important conclusion is that eight of the countries are in the MENA region, and of those only two – Qatar and Oman[51] – could be considered politically stable, according to the source data. Taken together, 15 of the 25 countries listed both depend on fuel for more than 25 per cent of their exports and are politically unstable. Together, these countries account for some 52 per cent of global proven oil reserves.

### Figure 11: Fuel export vulnerability and political instability, 2017




Sources: *Fuel exports:* World Bank, 2018; *Political stability:* adapted from GlobalEconomy.com, 2018. Note that the original political stability index numbers – e.g. 1.17 (Norway, highly stable), negative 2.28 (Iraq, very unstable) – have been multiplied by minus 100 to allow readier comparison with the fuel exports.

[51] This illustrates the uncertainty associated with such indices, given that Oman faces a major problem of political succession and Qatar is currently in a serious dispute with Saudi Arabia and the United Arab Emirates.

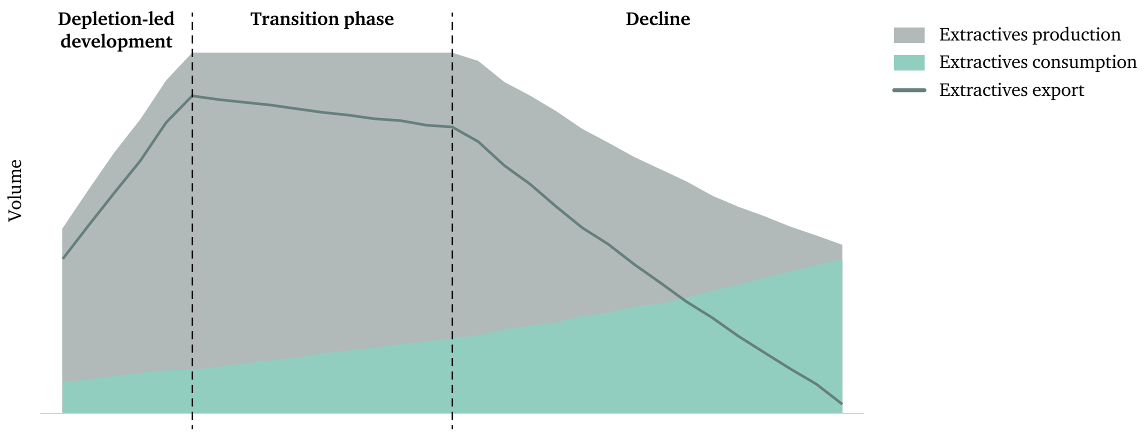
## Policy options for vulnerable countries to manage the transition

The next stage in the analysis is to consider the policy options available to the vulnerable countries in terms of managing the decline in their oil revenues. These options will clearly depend upon the speed of the transition, and on technical and regulatory changes in consumer markets. This raises the key question of how governments (both of oil-consumer and oil-producer countries) and companies should prepare for potential policy changes.

One option concerns the depletion policy of the country in question. If a producer country believes that the transition is imminent, it would make sense for it to maximize production from its reserves to take advantage of prices before they begin to fall. However, such a policy, if followed by a number of producers at the same time without effective coordination by OPEC and possibly 'OPEC+',[52] would cause crude oil prices to fall. At one level, this might inhibit growth in the use of renewables. However, such a view neglects the potential impact of 'OECD disease' in maintaining elevated product prices to consumers, which would leave the choice of fuel for the energy-using appliances largely unaffected. While policies to reduce crude oil prices may not in themselves inhibit investment in renewables, encouraging price volatility could certainly do so.

A more realistic, and indeed desirable, policy would be for producers to pursue policies of diversification away from dependence on oil. The logic is expressed in Figure 12.

### Figure 12: The trajectory of oil production in economic development




Source: Mitchell and Stevens, 2008.

As output rises in the early stages of a country's oil production history, the period can be characterized as one of 'depletion-led development'. This implies that the revenues accruing to the government can be used to promote development in the country as a result of fiscal, forward and backward linkages.[53] However, eventually production will reach a plateau rather than a peak in output. This is simply because the associated infrastructure is expensive and must be operated at close to capacity to minimize fixed costs on a unit cost basis. It is unrealistic that investors would provide

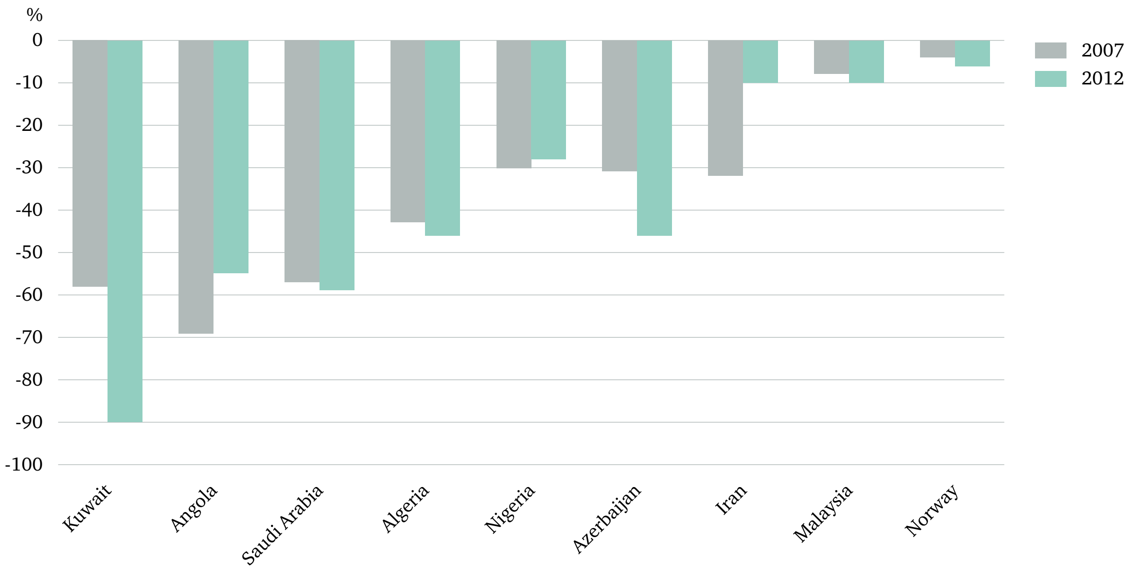
[52] 'OPEC+' consists of the OPEC countries and a number of non-OPEC oil producers, most importantly Russia.
[53] The term 'forward linkages' refers to the inputs from the sector to the rest of the economy. In the case of oil, this obviously refers to the supply of energy, but the term can also cover the managerial skills of the oil companies transferred to the rest of the economy. The term 'backward linkages' refers to the inputs to the sector from the rest of the economy, such as employment for nationals and within the local supply chain.

infrastructure for any short-lived peak. They would inevitably smooth out the peak into a plateau. This period of a plateau can be characterized as the 'transition phase'. In this period, it is essential that the government uses oil revenues to develop the non-oil economy. Oil revenue is not income. It simply reflects a reshuffling of the national portfolio of assets, in which crude oil below ground is in effect exchanged for dollars above ground. The below-ground asset is depletable, either through extraction and usage or through a deliberate transition away from oil. Thus, the new above-ground asset must be used to create an income-earning asset. The reason for this is that the final stage in a country's oil production history is 'decline'. If domestic oil consumption is rising while production is falling, this accelerates the decline in revenue from oil exports. As this occurs, the ability of the oil sector to fund the non-oil sector declines, which then creates serious economic and political problems for the country in question. The level of diversification of an oil-producing economy is measured by the non-oil fiscal balance and the non-oil current-account balance. The former accounts for revenue that supports the fiscal balance in the non-oil sector, the latter foreign-exchange revenue that supports the current account in the non-oil sector.

If domestic oil consumption is rising while production is falling, this accelerates the decline in revenue from oil exports. As this occurs, the ability of the oil sector to fund the non-oil sector declines, which then creates serious economic and political problems for the country in question.

The non-hydrocarbon fiscal positions, over time, of some of the oil-producing countries are shown in Figure 13.

**Figure 13: Non-oil fiscal balance of selected producers, 2007 and 2012**




Source: IMF, 2007.

To diversify an oil-producing economy is not an easy task (Cherif, Hasanov and Zhu, 2016). While Norway has succeeded, its position and experience are unusual. The reasons for this are outlined in Box 2.

### Box 2: Why Norway is a nuisance

There is general agreement in the literature on the role of extractives in economic development that Norway got it right. The country managed to develop its interests in North Sea oil without suffering the usual symptoms associated with the resource curse. At the same time, it managed to diversify its economy away from dependence on crude oil production (as can be seen from Figure 13), while accumulating huge financial reserves. For this reason, it is often held up as a role model of how to make the most out of resource extraction, with the Norwegian government pension fund (see footnote 48) frequently cited as a way to optimize the use of oil revenues. It has also been one of the fastest adopters of EVs and one of the fastest nations to decarbonize, although this is in large part due to the country's hydropower resources.

However, the Norwegian example was born of very special circumstances. When the country was first developing oil, in the early 1970s, Norway was a long-established and fully functioning democracy. It had well-functioning political institutions that were wholly transparent, and a history of very low levels of corruption in the public sector. It also had a small population that was extremely well educated, only a very small percentage of whom were considered to be living in poverty. Moreover, Norway has a history of shipbuilding and significant experience of working at sea in various contexts – a great advantage considering that its oil deposits are offshore. It also had a history of managing resource wealth from fisheries. Such conditions are difficult to find elsewhere, especially among the countries that have potential extractive resources. Norway, arguably, is a special case – the only way its experience can be replicated is to start with 5 million Norwegians. Unfortunately, many policymakers fail to grasp that basic reality.

Source: Adapted with permission from Stevens, Lahn and Kooroshy, 2015.

Many barriers must be considered when planning policy for economic diversification. The first and main barrier is the nature of the ruling elite. In many oil-producing countries, the ruling elite is effectively a kleptocracy whose position has been reinforced by many years of securing oil revenues to support its own interests. By definition, this elite has no incentive to change the status quo. Indeed, its interests are to maintain the sources of its wealth and power. This goes back to the debate in the former Soviet Union at the time of Mikhail Gorbachev, who argued that economic liberalization (*perestroika*) was not possible without political liberalization (*glasnost*).

A number of issues follow on from this view of the world. First, diversification requires a dynamic and active private sector. However, to achieve this requires secure property rights and the rule of law, to protect private investors. At the risk of oversimplification, it is not unreasonable to assert that a kleptocracy comes into existence because the ruling elite is *not* constrained by law. A good example of this has been the recent experience in Saudi Arabia. Following the oil price collapse in the summer of 2014 and the rise of Mohammed bin Salman with the accession in January 2015 of his father, King Salman bin Abdul-Aziz Al Saud, there have been extensive plans to reform the Saudi economy and diversify away from dependence on oil. This has been embodied in the Vision 2030 process. However, in October 2017 more than 100 senior Saudi figures, including many members of the royal family, were arrested and held in detention in the Ritz Carlton Hotel in Riyadh. They were held there until they agreed to pay 'fines'. It is far from clear what the legal basis of this action was. It simply appeared as a whim on the part of the crown prince and his supporters. One obvious consequence, not surprisingly, has been that private-sector investment in the kingdom has dried up, causing growing concern about prospects for the non-oil economy. Indeed, it has been estimated that since the detentions there has been a capital outflow from Saudi Arabia of more than $100 billion (Dudley, 2018).[54]

[54] Ironically, this is the same sum that Crown Prince Mohammed bin Salman claimed would be raised by the (now postponed) privatization of 5 per cent of Saudi Aramco.

A second barrier is that many oil-producing economies suffer from high degrees of state interference in the economy, together with significant distortions associated with mechanisms such as subsidies. This in part reflects the social contract between the rulers and the ruled that has dominated in many oil-producing countries. In return for its acquiescence, the population is given access to goods and services on preferential terms. Changing this social contract is essential for economic reform. However, it is not easy, since it invariably requires the removal of subsidies, which leads to higher prices of basic goods. It also requires political reform on the grounds that there should be 'no taxation without representation'.[55] This requires the ruling elites to relinquish at least some degree of power and influence. Given that such elites gain so much materially from their exercise of power, voluntary relinquishment is not a plausible option.

A third potential barrier to developing the private sector is the availability of the entrepreneurship and skilled labour required by a modern, increasingly digital, economy. In particular, in many oil-producing countries in the Middle East, the quality of publicly provided education is abysmal. For example, one-third of the curriculum in Saudi Arabian elementary schools consists of 'Islamic studies', i.e. rote learning of the Qur'an; in secondary education, the share is still one-quarter. In the kingdom's universities, some two-thirds of students earn degrees in 'Islamic studies' (House, 2012). This is not an adequate preparation for a workforce in a modern economy. Attempts at reform have consistently been resisted by the religious establishment, which the Al Saud family needs to keep on board in its attempts to contain pressure from Islamist militant groups such as Islamic State of Iraq and Syria (ISIS) and Al-Qaeda in the Arabian Peninsula (AQAP).

> Many of the countries currently dependent upon oil are likely to face increasingly serious economic problems and, as a result, domestic political unrest.

All these barriers present a formidable problem for any Middle Eastern government that is serious about trying to diversify its economy away from oil. There have been some signs of success in a few cases: for example, in Iran and the United Arab Emirates, where oil's contribution to GDP and government revenues has fallen. However, in most cases the prospects are not good. Thus, many of the countries listed in Figure 11 as currently dependent upon oil are likely to face increasingly serious economic problems and, as a result, domestic political unrest. This risks fuelling regional conflicts that could further destabilize the MENA region, as outlined in Section 3. This in turn increases the imperative for *oil-consuming* countries to reduce their exposure to oil price instability, thereby increasing the likely pace of the transition to non-hydrocarbon energy. This is a vicious circle as far as the oil-producing countries are concerned.

All of this leads to the final question of this paper: what will be the geopolitical fallout as the energy transition proceeds and speeds up?

[55] This is not always necessary. The classic example was Frederick the Great of Prussia, who once remarked he had a special relationship with his people – namely 'they say what they like and I do what I like!'

# 7. What are the Geopolitical Implications of the Energy Transition?

The geopolitics of energy as a subject of interest and study is a huge one (Victor, Jaffe and Hayes, 2006; Looney, 2012; Dannreuther and Ostrowski, 2013; Fouquet, 2012; Considine and Paik, 2018). It concerns a whole range of variables, encompassing the functioning of international markets for hydrocarbons; trade routes; market power; access to hydrocarbon energy in these international markets; and issues to do with both security of supply for importers and security of demand for suppliers. To illustrate the point, in 2017, according to BP data (BP, 2018a), 55 per cent of global oil exports came from just eight countries, while 60 per cent of global gas exports came from seven countries and the majority of global coal exports from five countries.

This carries implications for many aspects of foreign and domestic policy, ranging from industrial to energy policy at national, regional and international levels. Both explicitly and implicitly, the transition involves competition and potential conflict. A classic historical example was the switch by Britain's Royal Navy in 1914 to fuelling warships with oil rather than with coal, as discussed briefly in Box 3.

### Box 3: Britannia waives the rules – the geopolitical implications of switching fuel for warships

In 1914 the British government switched the warships of the Royal Navy, which had been the cornerstone of British imperial power, from burning coal to burning oil. The decision made excellent sense. Burning coal produced highly visible black smoke at a time when naval gunnery was increasingly accurate at ranges of 16 to 18 kilometres. Handling coal was extremely labour-intensive, while oil could simply flow down a pipe. Furthermore, this could be done while the warship was still at sea, negating the necessity of entering a port to refuel. Finally, oil's greater energy density (1.5 times the energy content by volume compared to coal) allowed smaller boilers to be used and increased ships' range.

There was, however, a problem. While Britain had plenty of coal, it had no oil. Following the end of the First World War, the only major exporters of oil outside what was to become the Soviet Union – off-limits for security reasons – were the US and the Middle East. This context went a long way to explaining British foreign policy up to the 1960s, coupled with the obvious point that the Middle East was also the route to India, until 1947 the jewel in the imperial crown. As a result, much of the UK's foreign policy was aimed at securing oil supplies in the Gulf region to ensure Britain's naval supremacy. This also affected UK policy in other areas. For example, in 1913 the government acquired 50.0025 per cent of the Anglo-Persian Oil Company (later BP), and in 1912 commissioned the Abadan refinery, at the time the largest in the world.

By stark contrast, the study of the geopolitics of renewables is not very fruitful. Modern renewable energy and low-carbon electricity can be delivered on a small scale, offering decentralized sources of supply outside any potential control by suppliers exercising market power (IRENA, 2019b). The transition is therefore unlikely to generate policies of 'electron independence' or provoke cartelization of electron energy supplies.[56] The key significance of this is that, as the transition progresses, the geopolitics of energy will effectively fade away.

This is, of course, a simplification. The geopolitics of energy *per se* will not disappear overnight. During the process of transition, in the short to medium term, the geopolitics of energy will continue to be dominated by the same sorts of issues that have featured prominently since the start of the 20th century. Indeed, such geopolitics may become more intense and threatening for a time. We can expect conflict over oil market share, linked to a contest for hegemony in the Middle East, as oil-producing countries in the region and elsewhere in the world struggle to disguise their economic failure. This could provoke serious military conflict, potentially triggered by another oil price shock and aggravated by the efforts of ever more failed states in the region to distract restive populations with foreign adventures.[57] However, as electrons increasingly replace hydrocarbon molecules in the energy mix, such conflict will diminish.

> We can expect conflict over oil market share, linked to a contest for hegemony in the Middle East, as oil-producing countries in the region and elsewhere in the world struggle to disguise their economic failure.

New geopolitics may well emerge to replace the old paradigms of energy geopolitics associated with hydrocarbons (IRENA, 2019b; Carbon Tracker, 2019). There may well be problems associated with the supply of key metals, especially cobalt. Contestation around a variety of planned electricity interconnector projects – such as China's planned global super-grid, or the 'Desertec' project to supply solar energy from North Africa into Europe – could generate similar conflict to that currently associated with oil and gas pipelines (Stevens, 2009). There is also a real threat that cyberattacks on electricity systems could be used as weapons in conflicts caused by non-energy issues.

[56] This assumes that restrictive international patents do not excessively limit access to renewable technology.
[57] This sort of development is by no means exclusive to the MENA region. For example, of real concern is the possibility that Russia, facing growing economic problems at home, seeks to create distractions by being more belligerent.

# 8. Areas of Future Interest to be Explored

This paper has raised a number of questions that deserve further investigation. The anticipated path of geopolitics during the process of the energy transition would be ideally suited to investigation using a scenario methodology. The sort of questions to consider would include the following:

1. What will be the geopolitical implications of the transition for vulnerable countries (and for other countries more widely)? How will these dynamics be influenced by i) the speed of the transition (or technological and regulatory change in consumer markets); and ii) actions taken by countries? How should governments and businesses prepare for the possible ramifications?

2. What will the 'residual' geopolitics look like once the transition has happened, and in what areas is thinking needed today to prepare for this eventuality? For example, how will governments and industry players address potential insecurity of supply of cobalt from the DRC; issues around major interconnectors; cybersecurity; and questions around the nature and design of future grids? The geopolitics surrounding these issues will not necessarily be as combative or as important for foreign affairs, but will still be worth exploring.

3. How will the transition affect gas?[58] The geopolitics of gas are already shifting in light of various developments: in markets for liquefied natural gas, in the US shale gas industry, and in the Russia–EU gas trade. This is occurring against a backdrop of major uncertainty. While climate plans often explicitly address coal and renewables, gas is often treated as a residual or secondary element. So how would these developments be affected as the energy transition proceeds?

[58] Gas has many dimensions, and comes in many types: blue, green, synthetic, decarbonized, ammonia, hydrogen, just to mention a few.

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# About the Author

**Paul Stevens** is a Distinguished Fellow in the Energy, Environment and Resources Department at Chatham House. He is also professor emeritus at the University of Dundee and a Distinguished Fellow at the Institute of Energy Economics (Japan). Professor Stevens has published extensively on energy economics, the international petroleum industry, economic development issues and the political economy of the Gulf. He also works as a consultant for many companies and governments. He received the 2009 OPEC Award in recognition of his outstanding work in the field of oil and energy research.

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The Royal Institute of International Affairs
Chatham House
10 St James's Square, London SW1Y 4LE
T +44 (0)20 7957 5700 F +44 (0)20 7957 5710
contact@chathamhouse.org www.chathamhouse.org

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