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UK Energy Security: Challenges, Threats and Solutions

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Abstract: Over the last few decades, the debate about '*Peak Oil*' became increasingly common and frustrating to governments, oil companies and individuals. Also in the last decade or so, some unusual events took places, which have raised the concern about the future of energy resources.[i] These events and the peak oil debate lead policy makers, particularly in the industrialised countries, to consider what is known today as '*Energy Security*'.

The UK is one of these countries that fears the unknown future should petroleum resources worldwide become scarce or vanish. After the dwindling of the North Sea production, the UK found itself on the brink of losing its energy self-sufficiency (Macalister, 2010). This paper sets the following questions: has the UK's oil and gas production peaked yet? If so, does the UK have a serious energy security problem? and if so, how this problem may be solved and what are the possible short, medium and long-term solutions for such a concern? In answering these questions, the paper discusses the concerns and challenges to the UK energy security and brings about the Government plans for tackling these concerns. In other words, the paper seeks to uncover the UK energy security position and shed light on any possible challenges and threats to this position. It also highlights the solutions to the energy security concern. Our analysis is based on quantitative data extracted from Governmental and industrial sources. It is found that the UK does not experience an energy security problem on the short to medium-term, but it may suffer energy insecurity on the longer-term.

Key words: Energy Security; UK; Peak Oil

1. INTRODUCTION

The issue of energy security has been a hot topic over the last few years. Research on this subject has focused, sometimes, on the issue from a global prospective, and, some other times, from a less wide coverage to include an entire Continent, for example Europe. In the light of results of previous similar research, this study is conducted at a one-country level; it aims at defining the UK current position in terms of its oil and gas production, exporting, importing and consumption. Hence, it aims at describing any existing or potential energy security problems in the

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UK. The paper offers explanation and suggestions to the policy-maker in tackling such a problem which may be used for more effective regulations and practice in terms of energy production, importing, and consumption.

The results of this research project may be firstly beneficial to the UK citizens who are interested in a continuous affordable energy supply; secondly to the policy makers who are in charge of developing policies that ensure a continuous flow of affordable energy to the British end user. Thirdly, energy companies in general, and oil and gas companies in particular could find the result of this analysis useful as it highlights the challenges involved with the overall UK energy policy. The research methodology and results may be used worldwide by academics and analysts to undertake similar research in different countries, or in the UK but from different prospective.

In the following sections of this paper, firstly the two key terms of "peak oil" and "energy security" will be defined and explained; and then the link between the peak oil debate and the raise of energy security concerns is discussed. Following this, the paper focuses on the UK energy security with a discussion of whether meeting the energy security concern would represents a challenge for the Government, or if that concern may develop into a threat to the UK should proposed plans fail to meet what it requires to face that concern. The paper then discusses potential alternatives and solutions to the energy security issue by answering a number of related research questions which form a ground for the concluding section of this paper.

2. METHODOLOGY

This research uses quantitative and qualitative approaches in answering the above set of questions. It uses historical statistical data; these data are related to UK energy production, consumption, import, export, number of fields in production, exploration and development expenditure and UK oil and gas supply and demand. These statistical data are collected from different sources such as the Department of Energy and Climate Change (DECC) and the BP statistical review of World Energy. To address the issues related to discussions of policy in this paper, Governmental documents and publications related to energy matters are searched and analysed.

3. PEAK OIL

Peak oil is an invented term which summarises the concept that production of oil, as well as that of all finite resources, grows, reach a peak and then decline gradually to zero (Aleklett et al, 2010: 1398; Bardi, 2009: 323; Hubbert, 1956: 6). In other words, peak oil refers to the future decline in world production of crude oil and to the accompanying potentially calamitous effects (Holland, 2008; Sorrell et al., 2009). King Hubbert was the first to introduce the problem of peak oil in 1949, his analytical approach in 1956 has subsequently become a central theme of the peak oil debate. However, Hubbert's theory of peak oil is questionable for defining the types of oil and gas reserves in question; this questioning is supported by the advances in technology, for example see (Clarke, 2007).

Some authors argue that peak oil production did not occur yet and so far in time as to be irrelevant, for example see Jackson (2006). However, a matter of fact is that 'peak oil discovery' has already taken place many decades ago at least in some 50 countries; and since 1980, more oil was produced than what was discovered (Campbell and Laherrère, 1998; Sorrell et al., 2009). In this regard, Almedia and Silva (2009: 1268) state that "…so that today new fields being discovered represent only about a fourth of the oil being extracted". Furthermore, Campbell and Laherrère (1998) claim that 90% of the world oil has already been discovered. The peak of discovery must deliver a corresponding peak of production. This is simply true because production is viable of only successful discoveries. In other words, production lines mirror discovery lines (Bardi, 2009).

A number of authors convey optimistic view of the timing of peak oil and the available fossil fuel and other alternative energy resources. For example, Aguilera et al (2009) researched depletion and future availability of petroleum resources. They concluded that conventional and unconventional petroleum resources combined are likely to last for longer than many now expect. Sorrell et al (2009) and Campbell and Laherrère (1998) seem to much agree with this path. Moreover and in this regard, Youngs (2009: 7) states "Some analysts recalled that in the 1970s there were predictions that oil production would peak around 2000, but fostered two (apparently) benign decades in energy security".

However, others such as (Campbell, 1997; Campbell and Laherrère, 1998; Clarke, 2007; Deffeyes, 2006), who express a pessimistic view, claim that behaviour of giant oil and gas companies indicates the decline of oil and gas production. For example, although US refineries are running close to capacity and oil tanker ships are always fully booked no new refineries have been built since 1976 and outdated tankers being retired faster than new ones are being built. This behaviour can only be justified on the bases that if world oil production is about to decline, then what is the point of adding new refineries or increasing the size of the tanker fleet. In fact, Almeida and Silva

(2009) concluded that most of the published research about peak oil points to a significant probability of the peak of oil production occurring prior to 2015.

It is worth noting that the significance of the peak oil debate is not centred about the physical end of oil; it is more about the consequences of oil production being decreased beyond the inflection point where supply would lag behind demand and oil prices would increase. Therefore, the debate if focused on the end of cheap oil and the associated social and economic consequences (Almeida and Silva, 2009; Campbell and Laherrère, 1998; Umbach, 2010). This debate of less supply and higher prices is linked to the debate of energy security.

4. ENERGY SECURITY

Energy security is defined as "*adequacy of energy supply at a reasonable price*" (Haghighi, 2007: 14). But what is the '*reasonable*' price? If it means 'cheap' or 'easy' this for sure will only be short-lived; cheap oil has gone now and there is no escaping from the fact of expensive oil (Botts, 2008; Campbell and Laherrère, 1998; Sorrell et al., 2009). The IEA defines energy security as "stems from the welfare impact of either the physical unavailability of energy, or prices that are not competitive or overly volatile" (2007: 12). The European Union seems to have adopted a similar definition of the energy security matter, see (European Commission, 2001). The above definitions focus on two factors the may individually or collectively derive energy insecurity in a given country, or in the world. These are physical availability and prices, however, these two elements are mutually connected in that scarcity of energy sources leads to price spikes and decrease in energy prices leads to reduction in production decisions, and hence lesser supply. Added to the physical availability and reasonable prices is the timely availability of energy when needed. Some authors, for example Löschel et at (2010) argues that energy security exists if the energy sector does not cause major welfare-reducing frictions in the economy at national and global levels. This opinion is share by Bohi and Toman (1996) and seems to be throwing the blame on the energy producers and regulators for any energy insecurity problems.

Energy security has bedevilled energy policy debate. It has become a shorthand term for the board debate among policy makers (Umbach, 2010), academics and energy consultants concerning what steps should nations take to reduce their vulnerability to oil price shocks, geopolitical pressure on oil and gas short supply, climate change risks and the fear of commotion to domestic electricity supplies (Roberts, 2005; White, 2010).

The main energy demands are for transport and energy in buildings. Oil leads the way, it enters into everything because it is almost the main energy source being used in transport and transport enters into everything; and gas is a main energy source being used in buildings, basically to generate electricity, and for customary heating purposes. In the aftermath of the Russian-Ukrainian gas conflict in the winter of 2005-06, the future security of European energy security of supply has become the focus of a broader debate (Umbach, 2010). This paper will address the UK energy security with focus on oil and gas, or what is known as primary fuel, this is the subject of the next section.

The initial energy security problem arises from the fact that oil is in a limited supply and the global tank of oil is going to run too low to fuel the world growing demand sooner or later (Howell and Nakhle, 2007; Sorrell et al., 2009). Also, the mechanics of supply and demand of oil are unusual. This is because on the short-term basis both demand and supply are highly inelastic, and this is due to lack of suitable alternative to oil on the same basis (Goos, 2007). In particular, demand for energy is growing rapid driven by the rapidly growing economics, such as India, China and Brazil.

World demand for oil and gas is growing faster than ever, far above many predictions. Supplier countries may fail to meet this increasing demand possibly due to not making timely investment. Another reason may be political disruptions in these countries, such as the recent revolutionary events in Tunisia, Egypt, Bahrain, Libya, Syria and Yemen; or because of natural disasters in the sort of the recent earthquake in Japan and its due effect on Fukushima nuclear power station. This would increase the competition between consuming countries to secure their energy needs and hence putting more pressure on the demand for energy, which may increase energy prices (DTI, 2006; Sorrell et al., 2009).

This raise the question of whether global oil and gas supply would be sufficient to meet possible future increased demand for these two commodities. The uncertainty surrounding the answer to such a question drives the concern about future energy security, and requires quick attention to potential risks of possible disruption to gas supply and the adverse effect of the instability of oil prices (Bird, 2007). In addition, depending on politically unstable regions for energy supply means increasing the concern of energy security which leads to a necessity for changing direction of energy policies of consuming nations.

However, energy security may have different meaning from oil to gas. This is because these two commodities have physical and marketable differences between each other, in that a disruption in oil supply in one part of the world may affect the whole world whereas gas disruption does not have worldwide effect (DECC, 2010). Supply and demand of oil, compared to all other commodities, are most inelastic in the very short term; in that, when commercial and political conditions allow it takes quite a while for investors, companies and countries to find, invest in and open up new fields (Howell and Nakhle, 2007). Furthermore, historically, oil has been used as a political weapon; this gives the energy security issue, beside its economic dimension, a political description (Löschel et al., 2010; Winston et al., 2007). A related point is that the political and economic history has witnessed seven cases where oil disruption has been purely for political, rather than physical, reasons.[ii]

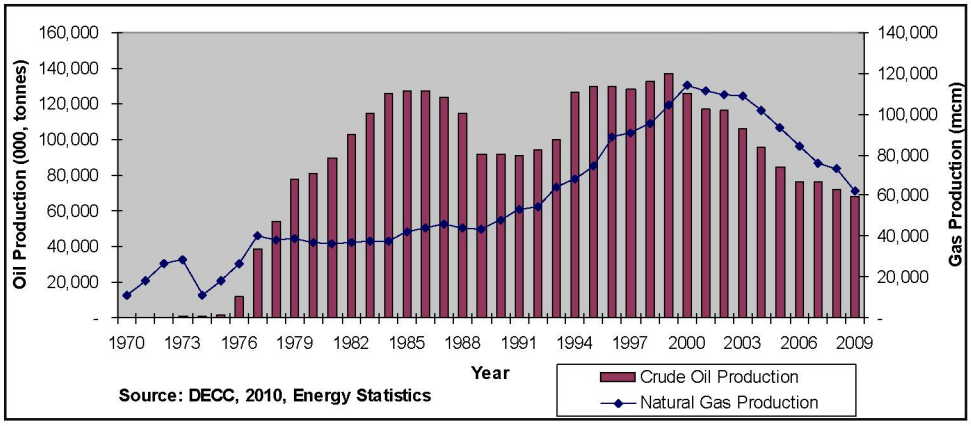
To touch on electricity, electricity security of supply is only met by the ability to provide electricity, via production or import, to meet demand levels. Since electricity is expensive and difficult to store, demand and supply must be closely matched on a moment to moment basis. In fact, covering the exact demand does not deliver a security state of supply. There is always an important factor in ensuring continuous security of electricity supplies. This factor is that there must be sufficient and increasingly low carbon capacity to generate electricity to meet demand, this including a reasonable level of spare capacity (DECC, 2009).

Kerschner and Hubacek (2009) applied the Input-Output modelling on the UK oil sector and studied the possible effects of a 10 per cent reduction in oil supply, as an input, on different economic sectors of the country. Their results show that if only this to happen, the most hard-hit sectors would be electricity, railways, air transport, postal service and the wholesale. This result supports the argument that if *Peak Oil* is imminent urgent action has to be made to secure both energy supply and a smooth, easy and correct transition to alternative energy sources (State of Guernsey, 2009). This, some argue, can only be witnessed by innovation in technology and reliance on price mechanism (Campbell and Laherrère, 1998). Thinking of such a scenario may be the reason for governments to be so concerned about their current and future energy security.

5. THE UK ENERGY SECURITY

North Sea oil came into existence in the late 1960s, this was not far from the market but posing a whole new generation of challenges with oil fields not only underground but under an angry sea. Growing supplies of British oil and gas did not last long, though the UK is now a net oil importer (Leggett, 2005).

The concern about any increase in energy prices which will have huge effect on the different forms of transport in the UK that are currently dependent on petroleum products. Coupled with the decrease in UK oil and gas production (see Fig.1) and the unlikely of finding oil and gas reserves of the large size category in the North Sea, driven the UK concern about its future energy security (Sorrell et al., 2009).



Source: DECC, 2010, Energy Statistics.

Fig. 1: Crude Oil and Natural Gas Production in the UKCS 1970-2009

It may be interesting to note that UK oil production had an increasing trend between 1970 and 1999. after that it followed a decreasing pattern. We have noticed that the total UK oil production between 1970-79 was 185.2 million tonnes (mt), it totalled 1,098.3 mt between 1980-89, 1,161.4 mt between 1990-99 and 938 mt between 2000-09. This means that total UK oil production between 2000 and 2009 became less than the production of the period 1980-89. One more note is that the total UK oil production between 1970 and 2009 equalled to 3,383 mt, of

this quantity 5.5 % was produced during 1970-79, 32.5% during 1980-89, 34.3% during 1990-99 and 27.7% during the period 2000-09.

Charting oil and gas production in Fig.1 shows a bell-shaped figures for both commodities. If we , theoretically, divided the bell-shape into four parts, it shows that the current UK oil and gas production has almost reached the fourth and final part of the bell. This agrees with Hubberts (1956) assumption that production curves of mineral resources starts slowly and then rises more steeply until an inflection point is reached after which it becomes concave downward. With regard to UK oil production, the inflection point was reached in 1999, and in 2000 for gas.

Evidence reveals that in the short-term, the UK's oil use is fairly inelastic and there has not been a reduction in oil consumption in recent years despite higher prices (Bird, 2007). Furthermore, any damage to the international fuel transport network, generating capacities and distribution networks may disrupt the UK energy supply. One of the main concerns in this regard is the global loss of surplus oil production which has resulted in an increased uncertainty for sufficient oil supply and reasonable oil and gas prices. Political instability of oil and gas producing countries and the undefined Russian energy policy with regard to its gas supply increases this concern and makes the energy security problem clearer (White, 2010).

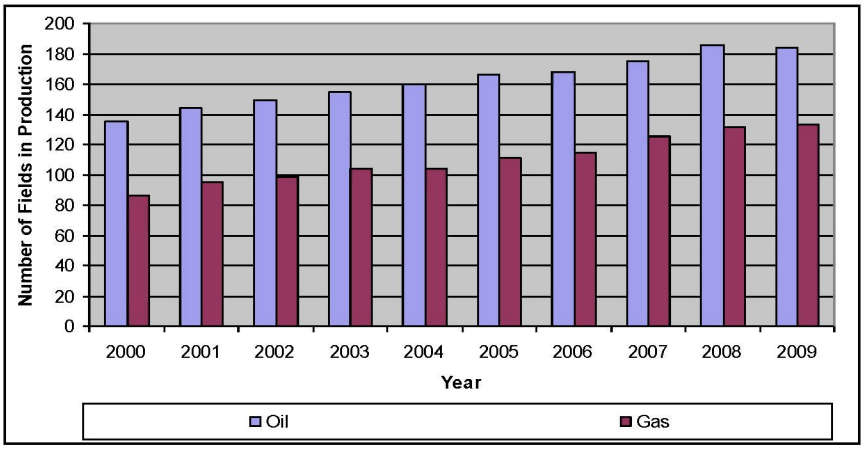
Upon any discussion of the UK energy security, two major long-term issues come up to the surface. These are: a- climate changes which require a cut in damaging emissions, and b- the need to deliver secure supplies of clean energy at affordable prices. These two objectives have been specified by the UK Government since 2002 (Bird, 2007; DECC, 2009; DTI, 2002; Winston et al., 2007). This concern has been officially expressed by the previous Secretary of State for energy and climate change, Edward Miliband , by stating that the Government's objective is to ensure secure, reliable and sustainable supply of energy at an affordable prices which support the transition to a low-carbon economy in Britain and globally (DECC, 2009).

Dwindling oil and gas reserves in the North Sea in the recent years made the energy security in the UK one of the hottest issues. The UK has moved from self-sufficiency, in terms of oil and gas, into a position of being a net importer of these two commodities. In fact, the UK has been consistently a net importer of crude oil since 2005. For example, in 2008, production of oil and natural gas liquids from the UK continental shelf (UKCS) equalled 71.5 million tonnes of oil (mto), an equivalent of 91% of total UK demand. In the same year, gas production amounted to 68 billion cubic metres (bcm), an equivalent to 73% of total UK gas consumption (DECC, 2009). The transition into a dependency is occurring relatively quickly, this raises the issue of UK energy security to higher levels. While demand for both oil and natural gas liquids is expected to be around 84 mto compared to 71.5 mto produced in 2008, it is predicted that UK gas production will fall to 34 bcm by 2020. If this to happen, gas import dependency would raise. However, gas import infrastructure being expanded for a capacity of 17.5 bcm and new proposals for further expansion to a capacity of 24.5 bcm is launched (DECC, 2009).

Security of supply has been a key component of the UK energy policy. The Government's strategic role in this regard is to ensure that the overall energy policy framework is clear, promotes security of supply, endorse energy efficiency and encourage and support investment in energy infrastructure (DECC, 2009). The UK has been practicing, for a long time, a policy based on opening the energy market up for competition even for small players. This is considered as a crucial element in securing and sustaining energy supply at reasonable prices. However, this policy was recommended by the European Commission to the member states for adoption earlier in 2007 (Winston et al., 2007). Moreover, under the European Union law, the UK must hold at least 67.5 day's worth of oil stock in case of emergency; this figure will increase as domestic production falls (Bird, 2007).

The UK had reached its states of self-sufficiency in 1980 and 1995 in terms of oil and gas respectively. These states were lost in 2004 and 2006 for gas and oil respectively. This has been coupled with a sharp increase in total capital and operating expenditures on oil and gas investment activities after 2004 and a decrease in oil and gas production, above all oil prices have more than trebled after 2004 peaking at just less than $150 a barrel in 2008. On the other hand, although the number of oil and gas fields being put in production has always increased up to 2009 (see Fig.2), oil and gas production has decreased over the last decade or so (see Fig.1). This can be explained by the fact that new fields are of smaller size, compared to older discoveries, which means lower production capacity of these new fields, and hence lower overall total production from the UKCS. These indicators mean that the UK has in fact reached its *Peak Oil* already; In fact, oil production in the UK peaked in 1999 and gas production peaked in 2000 (Fig.1) and currently production of both commodities is in decline (DECC, 2009). Even though, does that mean the UK is subject to an energy security problem? If so, how serious this problem might be? And what are the possible solutions to this problem? By addressing these questions, this paper discusses the relevant issues and provides some answers to these questions.

To touch on coal, although coal power stations provide the UK with significant energy supply the Government planned the closures of 8 GW of the existing 28 GW of coal capacity by the end of 2015 due to its massive carbon emission. If coal is to be continuously used, new coal power stations are required to demonstrate carbon capture and storage technology (CCS) at commercial scale. Russia currently supplies about half of the UK coal import. Therefore, a new energy policy framework should account for any possible political, environmental, economical or marketing factors that may shake the security of supply and also the reasonable prices paid for imported coal. However, depending on coal while implanting the CCS should decrease reliance on imported oil and gas (DECC, 2009; DECC, 2010).



Source: DECC, 2010, UK oil and gas resources

Fig. 2: Offshore Oil and Gas Fields in Production

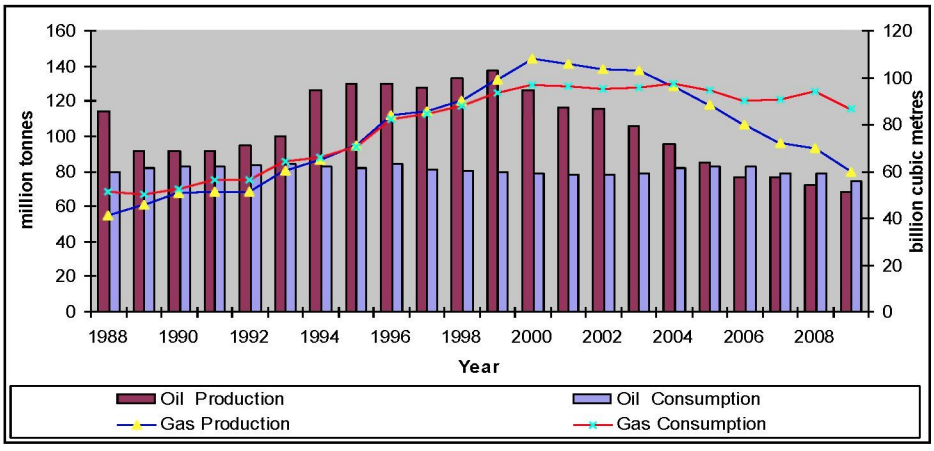
Based on the above, it can be understood that because of the increase in energy demand and the lesser domestic energy production which fall behind the demand the UK's concern about its energy security is genuine. The UK fears a possible cut in energy supply or a mad increase in energy prices.

6. ANALYSIS AND DISCUSSION

This section provides an analysis to the UK oil and gas security concern. This will start by exploring how serious this concern might be by using statistical data extracted from different governmental resources. The analysis will then highlights why energy security may present a challenge or be a threat to the UK energy policy; and finally, it will provide an explanation to different alternatives to tackle the energy security concern.

6.1 The Seriousness of the UK Energy Security Concern

How deep is the UK energy security problem? The following analysis will try to answer this question in some details.

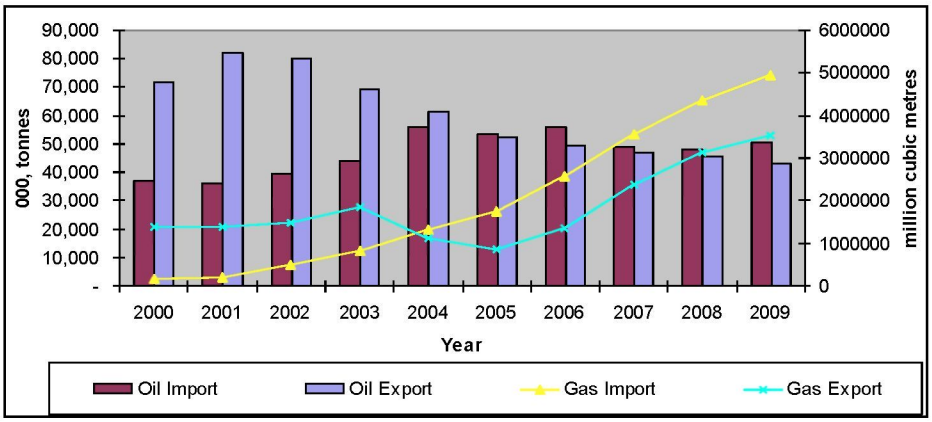


Source: BP Statistical Review of World Energy, 2010

Fig. 3: UK Total Oil and Gas Production and Consumption 1988-2009

UK oil production had increased from 132.6 million tonnes (mt) in 1998 to peak at 137.1 mt in 1999 after which it decreased gradually. UK gas production peaked in the year of 2000 at 108,305 mcm (see Fig.1). But, even though both oil and gas production peaked in 1999 and 2000 respectively, does this mean that the UK has experienced energy security problem afterwards? Fig.1 does not imply the existence of an energy security problem in the UK. A more representative figure is one that compares total UK oil and gas productions with consumptions over an extended period. Fig.3 shows that total UK oil production had always exceeded total UK oil consumption until 2006 when oil production totalled 76.6 million tonnes (mt) while total oil consumption equalled 82.3 mt. This pattern continued after 2006. The figure also shows that gas production exceeded consumption up until 2004 when the former equalled 96.4 billion cubic metres (bcm) and the latter stood at 97.4 bcm. This pattern continued afterwards.

It can be seen from Fig.3 that the total UK oil and gas production became less sufficient to meet the total UK domestic needs of these two commodities. This implies that the UK had to depend on import to fulfil any necessary requirements of oil and/or gas. The UK import of crude oil was always less than its export up until 2005 when the UK imported 53.4 mt of crude oil and exported 52.6 mt. After 2005 imported quantities of crude oil exceeded exported quantities. This is just normal because of the gap between totals of UK oil production and consumption. In terms of UK gas, imports went above exports from 2004 when the former totalled 120,951 mcm and the latter totalled 102,031 mcm. Fig.4 depicts import and export statistics of UK crude oil and natural gas between 2000 and 2009.



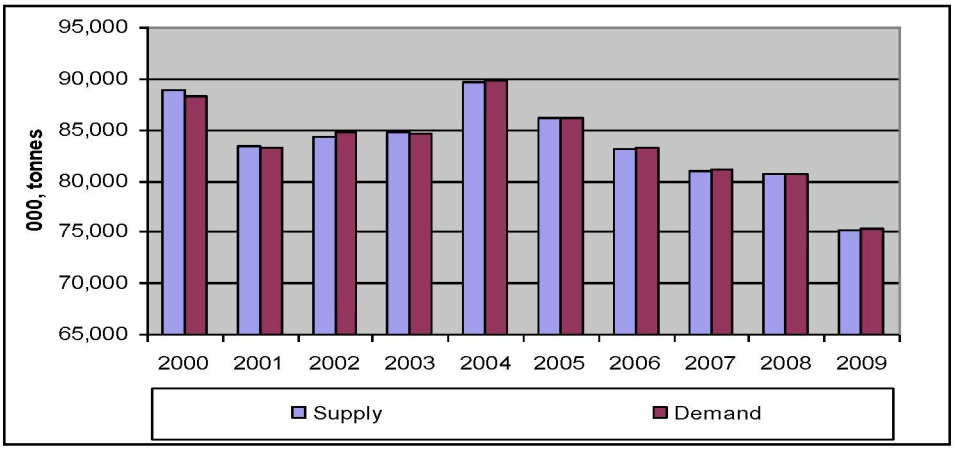
Source: DECC, 2010 Energy Statistics: Gas

Fig. 4: UK Oil and Gas Import and Export 2000-2009

On the supply and demand side, the UK demand for oil has always been slightly higher than the supply; this may indicate the increased need for oil and gas resources to meet the economic growth. Most of the UK's crude oil imports come from Norway, Russia and Algeria. Fig.5 shows a picture of the historical oil supply and demand between the period 1998 and 2009.

From the above analysis, it can be seen that UK oil and gas domestic consumption has already exceeded domestic production; also oil and gas imports exceeded export and oil and gas self-sufficiency states have already been lost. This may imply a start of energy security problem. One may ask, what is the role of renewable sources of energy in tackling this potential energy security problem?

Expanding on renewable energy production should have a clear impact on reducing import dependency and hence on increasing future security of supply. The UK has the largest potential wind energy resources in Europe. In fact, the world's biggest offshore wind farm was opened seven miles off the Kent coast on 23rd September 2010 (Prigg, 2010). By 2020 the country should meet 15% of its overall energy consumption from renewable sources (HM Government, 2009); however renewable sources of energy accounted for 2.4% of the overall energy consumed in 2008 (Conservatives, 2009; DECC, 2009). The Government introduced a Renewable Obligation (RO) in 2002 which is an obligation on all electricity suppliers to generate a pre-determined proportion of electricity from eligible renewable sources (DECC, 2009a). As a result of implementing the RO electricity derived from renewable sources increased to 5.4% in 2008 from 4.8% and 4.5% in 2007 and 2006 respectively. These percentages are still below the pre-set target by the Government which aimed that 10% of electricity to be generated using renewable sources by 2010 (DTI, 2007). However, the UK is still too far from its 15% renewable energy target and it is not clear how the Government may achieve this target by 2020.



Source: DECC, 2010 Energy Statistics: Oil

Fig. 5: UK Oil:Supply and Demand between 2000 and 2009

6.2 A Challenge or a Threat?

The UK energy policy faces challenges on short, medium and long terms. Since the security of supply position is dynamic, the UK energy policy defines different concerns. On the short-term scale, the attention is directed to the extent to which energy can be delivered when and where needed using the existing infrastructure. On the medium-term scale, the concern is towards ensuring a healthy investment. While on the long-term scale, the large scale investment is the centre of attention (DECC, 2009). However, these scales can be reclassified into short to medium terms and medium to long terms for simplification.

On the short to medium-term, these challenges require coping with different impacts, these are global and EU low carbon energy policies and at the same time sustaining the overall economic activity in the UK. The global recession, which started in 2007, seems to have helped the UK to keep a tough balance between these variables due to a reduction in demand for energy sources. However, global economies, including the UK's, are emerging from recession now and the current threat is that with the recovery of economic activities demand for different energy sources would increase and with no suitable and efficient substitute for fossil fuels in place yet energy prices would increase and more carbon would emerge. This would present a real threat to the UK energy security state on the short to medium-term on the supply and price sides, also on the ability to keep up with the global and the EU regulations (DECC, 2009).

On the medium to long-term, the UK government proposes that changing the way energy is consumed by providing levels of energy efficiency and switching to less carbon intensive forms of energy use in transport and heat would help to meet the energy security goals on the demand side. On the supply side, turning more into renewable sources of energy would contribute to the energy mix and this would smoothly balance the decreased demand on non-renewables. However, eliminating the security of supply risk is not a feasible smooth task and assessing the appropriate level of security of supply is a crucial challenge for the Government (DECC, 2009). These proposals denote a significant challenge to the Government on the medium to long-term which requires the UK to move towards a substantially de-carbonated energy sector that will deliver an 80% reduction in carbon emission by 2050. The real threat arises with the possibility of failure to meet the above proposed objectives in a good time. This is merely because of the uncertainties surrounding future investments, developments and sustainability of energy supply and demand in the UK.

The shortage of supply threat has in fact two roots, each one of these roots is a threat by itself. These roots are domestic scarcity of oil and gas; and less access to global oil and gas sources (Stern, 2006). However, while the first is presumably driven by shortage in domestic oil and gas production, the second arises as an inability to have sufficient access to global oil and gas sources and supply. These two factors present a genuine threat to the UK energy security. The UK domestic oil and gas supply is already in decline and the global demand for energy is rising driven by emerging economies such as India, China and Brazil. This may put the UK in a challenging position to secure the required supply of energy commodities at affordable prices.

The factual challenge for the UK in terms of energy security is to keep up with its investment plans in the energy sector. This fear emerge because by 2015 a notable number of older coal and oil fired power stations, which are being used for generating electricity, will be closed to meet European environmental legislation. Furthermore,

existing plans indicate that after 2023 only one nuclear power station would be in operation, two stations would be subject to closure by 2018 and 2020 (DECC, 2009).

A true challenge to the UK energy security on the physical security measure is avoiding involuntary physical interruptions to consumption of energy (Alm, 1981; Hirsch, 1987). The threat is that lights going off and oil and gas supplies are being cut off. On the price security measure, avoiding price spikes due to any possible imbalance of the energy policy components. The threat is that energy prices may go mad, similar to the 2008 experience, where low income families cannot afford to keep their lights on during dark nights and their houses warm enough during cold winters.

How these challenges and fears may be dealt with? The next section discusses different alternatives and possibilities to meet the challenges.

6.3 Tackling the Energy Security Problem

The concern over energy security is in fact a reflection of a number of other problems surrounding and linked directly to energy sources. Designing an energy strategy takes a number of basic key elements into consideration, such as energy demand and supply, physical infrastructure and the functioning of energy market; these key factors are merely elements of the energy policy of a given country (Toman, 1993; Youngs, 2009).

If we agree that supply and demand of energy play a pivotal role in defining the issue of energy security, thus some steps may be required to ensure healthy supply and demand. One important issue for the policy maker is not to solely depend on merely one source and/or one supplier, so in times of difficulties a switch from one source/supplier to another could be made possible. Environmental concerns may obstruct a smooth and free switch from one source of energy, i.e., oil or coal, to another, i.e., natural gas or nuclear (Campbell and Laherrère, 1998). However, energy policies and energy mix vary from one country to another, which means that difficulties in switching from one energy source to another varies as well. On the other hand, tightening energy security of energy consuming countries could even be via building and sustaining stable political and economic relationships with energy producing countries. Adding to this later point is that most of oil and gas is located in parts of the world characterised by conflict and political instability (Egenhofer and Legge, 2001; Haghighi, 2007; Winston et al., 2007). A related point is that since instability in energy producing countries affect energy security of consuming countries, therefore it could be beneficial for consuming countries to include in their energy policies aspects that ensure boosting economic development and bring more political stability for energy producing countries. However, this does not always work because sanctions against producer countries for political reasons can undermine long-term security of supply.

Tackling the energy security matter on the supply side takes different aspects. Securing long-term supply contracts with producing countries could ease off a fear of supply problems. In addition, building an investment regime could be a more reliable way of energy security. This could happen if an energy importer country designs a strong investment regime both in exploration for and production of energy, for example the China's current presence in Africa. This will allow the importer country access to the energy resources where benefits of supply contracts could be made more feasible. Concession type of agreements allows direct access to energy reserves and guarantees better energy security (Haghighi, 2007). However, producing countries take steps that prevent international oil and gas companies from having an easy and non-controllable access to their energy resources (Mackenzie, 2010; Umbach, 2010)). For example, the renationalisation of Venezuela's oil companies, also the Russian's 'resource nationalisation' scheme meant less access for foreign investment and this may reduce global production rates.

The demand side of the equation is very important; this is what termed sometimes as 'internal side of the security'. The demand side includes energy saving, energy efficiency, rules on taxation of energy products, state aid rules and so forth. However, focusing merely on the internal side of the energy security is justified when dependence on energy outsourcing can be greatly reduced. This may happen in the case of depending on renewable or other sources of energy, i.e., wind and/or coal. However, although supply of renewable energy-sources is growing fast and is less vulnerable to disruption they are currently still more costly and less reliable than non-renewable sources .i .e., oil and gas. Reducing demand for energy may be an easy way to improve energy security, but this option contradicts economic growth aims. The connection between the availability of energy and the economic development of a country necessitate a drafting of a policy which secures continues flow of affordable energy supply. If energy is unavailable or too costly the daily routinely functioning of such a country would be brought to a standstill (Cotantini and Martini, 2010; Haghighi, 2007).

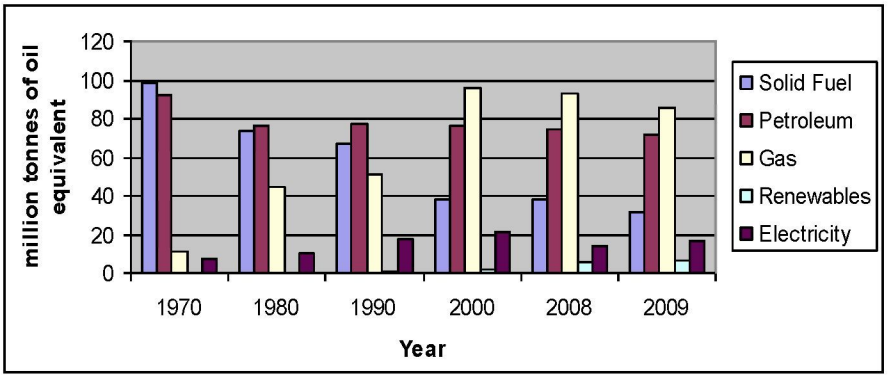
Kelly (1998) and Campbell and Laherrère (1998) claim that deepwater and polar regions provide a significant opportunity for nations as being a possible answer to the energy security concern. This claim could be the right answer to this concern, in particular that the oil and gas industry's definition of deepwater has changed over the last 30 years or so from 1,000 feet to 10,000 feet water depth. White (2007) supports Kelly's claim by describing deepwater oil as a strategically important component of the world's oil and gas industry. However, enhancing deepwater oil drilling is likelier to occur in an era of high oil prices, but market incentives are still low after the down slide of oil prices from record highs in the summer of 2008 (Reisser, 2009). Nevertheless, what impact will deepwater drilling have on oil supplies and prices? No certain answers may be readily available to these questions. What is certain is that oil prices need to remain above a certain level to maintain the attractiveness of deepwater oil drilling; and deepwater oil drilling may only provide a short-term remedy to the energy security concern.

Least but not last, securing transit routes and energy facilities is just a continuation and building up on the supply side of the energy security concern. In this regard, it is worth mentioning that 'non-state actors', who may represent national or international groups of pressure, may have strong impact on energy sources, such as Al-Qaeda's threats against Saudi Arabia and Yemeni facilities. Sudan, Colombia and Nigeria are other examples of countries being targeted by these groups who may carry out violent actions against oil producing companies in their regions as a pressure tool to serve their objectives of fulfilling some basic needs, such as electricity supply, schools, roads and medical centres (Roberts, 2004; Winston et al., 2007).

6.4 How does the UK tackle its Energy Security?

With regard to the UK case, it is believed that energy security can be best managed via dependence on a diversity of energy sources, and maintaining oil and gas investment in the UKCS in order to enhance recovery from North Sea fields (see Fig.6). However, some authors, such as Friedland (2010), suggest that in a situation where oil and gas production peaks investment into domestic oil and gas supply will make no significant difference. Since oil and gas are running out the feasible long-term solution would be to switch to investment and development of new energy sources.

Solutions to the energy security challenge are seen in a variety of supply routes, international markets that efficiently allocate resources, back-up facilities such as storage, and a robust infrastructure (Winston et al., 2007). Expanding the investment in renewable energy sources presents part of the long-term solution to the energy security. Also, developing renewable energy sources would aid the energy policy in twofold; firstly, in addressing the climate change issue; secondly in reducing import of fossil fuel which helps in tackling the energy security question (DECC, 2009).



Source: DECC, 2010, long-term trends

Fig. 6: Final Energy Consumption by Fuel in Primary Energy Equivalent (mtoe)

Signing contracts with rich energy sources countries does not always guarantee secure supply; this is due to being these contracts unenforceable. In some cases when oil companies drill a dry hole they bear the cost, but when they hit a major discovery contracts may suddenly be subject for renegotiation (Deffeyes, 2006; Sorrell et al., 2009). This brings about another restriction on the UK energy security due to lesser opportunities and higher political risk for UK oil and gas companies to invest in new projects abroad. This is due to access to most of world oil and gas reserves is restricted in most cases to state-owned companies and the standing possibilities of renegotiating exploration and production contracts (Bird, 2007; Umbach, 2010).

One of the main challenges to the UK security of supply is to manage the increased dependence on oil and gas imports. This challenge becomes bigger with the decline in domestic production of oil and gas from the UKCS reserves which pushes towards an increasing reliance on international markets (see Tab.1) for access to the

required supplies (DTI, 2006). In tackling this issue, the UK government is reviewing its energy policy and taking steps to facilitate new nuclear power stations, also proposing to increase the life of the renewable obligations by supporting qualifying offshore wind farms and also by supporting four commercial-scale CCS (DECC, 2009; HM Government, 2009). However, the question that may be asked here is that does dependence on imported energy raises the energy security concern for the UK on the short to medium and medium to long-terms?

It can be seen from the above table that the UK has always depended on different sources for oil and gas import. This diversifies the sources of energy supply and reduces the risk burden on the energy security. It may be important to mention here that Norway is considered to remain a significant supplier of gas to the UK in the medium term, along with Algeria and Qatar. Potential gas suppliers to the UK are Russia, the Caspian and Nigeria (DTI, 2006; Howell and Nakhle, 2008). However, on the long-term, the European energy scenarios are focusing on the ice packed northern parts of the planet.

On the electricity side, the current UK electricity demand is estimated to be between 9 and 17 Giga Watt (GW). It was estimated that by the end of 2008 the UK had a total of 83.5 GW of electricity generating capacity (DECC, 2009). However, the national Grid forecasted that in 2020 electricity peak demand to range from 33 to 88 GW. Also, it is projected that by 2020 up to 7.4 GW of existing nuclear generation capacity will be closed; on the other hand it is proposed that 19.8 GW of electricity generating capacity will be built. This makes the total electricity supply capacity stand at 95.9 GW which is well above the expected demand by 2020. This suggests that if every thing goes as planned, the UK will not have a concern over its electricity security up until 2020.

The UK Government tried to implement a new legislation in the 2010 Energy Bill to improve energy efficiency in British homes and businesses, to promote low carbon energy production, and to secure energy supplies. It is hoped that this Bill would deliver a national programme of energy efficiency measures to homes and businesses. It may also introduce powers to regulate the emissions from coal-fired power stations, reform energy markets to deliver security of supply and ensure fair competition. It is also expected that the Bill would be a driver for putting in place a framework to deliver a future with secure, low carbon energy supplies and fair competition in the energy markets.

In tackling the energy security concern a number of measures can be taken at the industry level to reduce the risk of disruption and hence to increase the security of energy supply. These measures are: storage close to consumers and the physical ability to supply enough energy to meet demand, i.e., capacity and availability; interruptible supplier and the likelihood of technical problems, i.e., reliability; and encouragement of new entrants and short-term markets, i.e., diversity of energy sources – diversity may be geographic. physical or technological. One more measure could be by increasing the number of players in the energy market which increases the competition between suppliers and hence increase the security of supply. This is feasible because in a competitive market, if energy suppliers fail to deliver to customer expectations they will lose market share. Further, in some cases regulations may penalise suppliers if they fail to match supply with demand (DECC, 2009; Egenhofer and Legge, 2001). In addition to these measures, the UK Government places a significant importance for energy saving measures as keys in meeting security of supply objectives (DTI, 2006). It may be worth mentioning here that the UK benefits from an energy system with a track record of maintaining supplies with very few interruptions (DECC, 2009).

To sum up, tackling the energy security concern can be met by:

i. adopting energy efficiency culture by saving on energy consumption;

ii. depending on diversity of energy sources and technologies;

iii. competition via liberalisation and market efficiency; and

iv. adopting suitable regulatory framework and energy legislation to regulate and control these key factors.

Focusing on deep water drilling may ease the energy security concern off for a definite period. Increasing dependency on renewables, safe nuclear power and growing the use of carbon capture and storage could be an indefinite remedy for any energy security problem (Campbell and Laherrère, 1998).

7. CONCLUSION

The UK government has to ensure that energy policy and market framework delivers the needed investment for sufficient, affordable and timely secure supplies of low carbon energy. The current notion of energy security is too narrow and must be expanded to include many new factors. Security of energy wedges in the relations among different countries and how they interact differently with one another. The UK energy security challenge should be addressed first, through energy- specific policies and second, alongside related broader foreign policies,

including though an understanding of how internal markets liberalization within the UK itself conditioned this external dimension.

Building gas plants may raise the level of energy security but still this is not an adequate measure. Reliable gas supply all of the time is required. This should be coupled with sufficient storage capacity and long-term contracts with reliable suppliers; also, on the demand side energy efficiency measures should be implemented. However, gas import is expected to rise to 70% of the UK demand beyond 2017. If this to happen the UK has to search other possible alternatives to secure its gas supply while providing a fair deal to customers.

From the above analysis and discussion, it seems that the UK is not experiencing an energy security problem on the short to medium-term. The demand for energy, although increasing, is currently met by diversified sources of energy, both physical and geographical. The Government is persuading energy efficiency saving measures and practices on the individual citizens' level. These are clear from the Government support of different energy saving schemes such as loft and cavity walls insulations at reduced prices, installation of solar saver systems for residential houses and business, also by providing financial support for renewable electricity and heat. Furthermore, the Government seems to be supporting new entrants to the energy market and this should guarantee more energy supply possibly at reduced prices or improved service quality or both.

On the medium to long-terms, the Government may experience different levels and phases of energy security problem if investments in different aspects of energy generation do not go as was planned. The Government may avoid any unnecessary energy cut or spiky increase in energy prices by continuing to diversify the energy sources on the long-term. Regulations and fiscal regime should be support more and wider investment in energy.

Before coming to power, the Conservatives criticised the Labour Government for, in their words, not doing anything about potential energy crisis. Since the Conservatives are in power now it would be beneficial to see new measures and energy policies been introduced to avoid any possible energy insecurity.

Tab. 1: UK Import of Crude Oil and Natural Gas by Country 2000-2009

	Country	2000		2002		2004		2006		2008		2009	
		Oil (thousands tonnes)	Gas (GWh)	Oil (thousands tonnes)	Gas (GWh)	Oil (thousands tonnes)	Gas (GWh)	Oil (thousands tonnes)	Gas (GWh)	Oil (thousands tonnes)	Gas (GWh)	Oil (thousands tonnes)	Gas (GWh)
Middle East	Qatar								779				61,159
	Iran									40		562	
	Saudi Arabia	1,573		324		1,363							
	Other Countriues	233		846		247		979		255		241	
Total Middle East		**1,806**	**0**	**1,170**	**0**	**1,611**	**0**	**979**	**779**	**295**	**0**	**803**	**61159**
Non Middle East Countries	Egypt								12,465				5,804
	Algeria	1,992		2,025		1,477		2,178	20,718	1,586	3,113	1,194	19,392
	Angola			127						1,375		953	
	Latvia	27		49									
	Libya	155				155		1,126		1,967		1872	
	Lithuania			86									
	Mexico	782		820		323		165		356			
	Netherlands			36				22	9,135	85	90,563	35	69,529
	Nigeria	252		293		249		539		1,991		1842	
	Norway	27,523	11,279	29,057	37,886	39,938	95,359	39,699	157,035	31,168	283,722	35,007	262,300
	Russia	1,487		3,568		7,489		7,275		5,609		4068	
	Venezuela	674		383		1,254		1,915		835		965	
	Trindad & Tobago								3,614		5,799		20,766
	Interconnector via		2,995		6,645		25,592		30,505		12,174		7,945
	Other countries	2,204		1,691		3,402		1,028		1,750		3918	1,596
Total Non Middle East		**36,092**	**14274**	**38,551**	**44531**	**54,288**	**120951**	**53,945**	**233,472**	**46,721**	**396371**	**49854**	**387332**
Total Import		36,898	14,274	39,722	44,531	55,898	120,951	54,924	234,251	47,017	395,371	50,657	448,491

Source: DECC, 2010, foreign trade

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[i] Some of these events were, for example, the spiky increase in oil prices between 2002 and 2008; the black attack of the 11th September 2001 on the World Trade Centre and the issue of terrorism war in Afghanistan; the Anglo-American invasion of Iraq; the stand off between the West and Iran because of the latter's nuclear programme; the more frequent attack on Nigerian oil facilities; the political interruptions to Venezuelan oil production and the many natural obstructions to oil production in different parts of the world, such as Hurricane Katrina in 2005 in the US.

[ii] These seven cases are 1- (1951-53) Iranian Boycott; 2- (1956) Suez Crisis; 3- (June 1967) Arab-Israelis War; 4- (October 1973) Arab-Israelis War; 5- (1979) Iranian Revolution; 6- (1980-88) Iraq-Iran War; and 7- (1990-91) Gulf Crisis.