The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

UK Energy Security

Posted by Euan Mearns on October 25, 2007 - 10:00am in The Oil Drum: Europe
Topic: Supply/Production
Tags: coal, imports, natural gas, oil, production, security, trade deficit, united kingdom [list all tags]

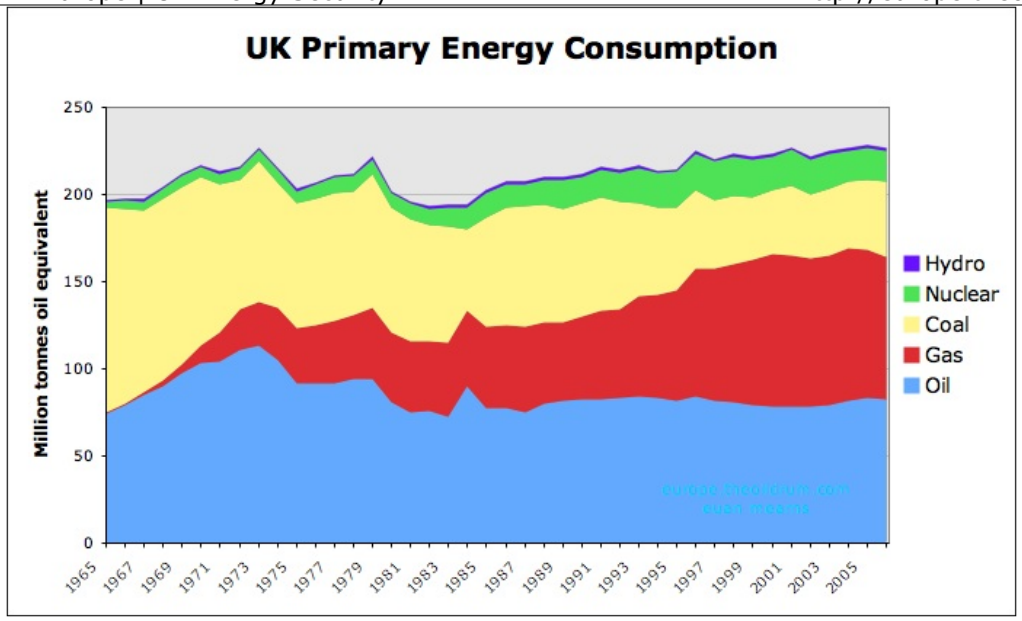
In 2006, 92% of the primary energy consumed in the UK was derived from fossil solar fuels - oil, natural gas and coal.

Not so long ago the UK was self sufficient in these energy resources but now we are importing increasing amounts of all three.

Dependency upon imported energy undermines UK national security and will have potentially dire consequences for the balance of trade.

UK Primary Energy Consumption - basic statistics

A beneficial attribute of the **BP annual statistical review of world energy** (used throughout this report) is that it shows primary energy consumption for the 5 principal energy sources normalised to millions of tonnes of oil equivalent. This eases comparison of energy consumption from oil, natural gas, coal, nuclear and hydroelectric power as shown for the UK (click all charts to enlarge).



In 1965 (when BP records begin) 98% of UK primary energy was derived from burning fossil solar fuels for transporation and power generation purposes. By 2006, the proportion of fossil solar in the energy mix had fallen marginally to 92% - largely due to an increase in nuclear energy.

In this period, the energy mix has changed significantly. In 1965, no natural gas was used. But with the discovery and development of offshore natural gas in the North Sea, the proportion of natural gas in the UK energy mix has increased steadily since 1968 largely at the expense of burning coal.

In 1965, the **UK population** was 54,350,000 and this had grown to 60,245,000 by 2005

This equates to 3.6 tonnes oil equivalent per person per annum in 1965 and 3.8 tonnes oil equivalent per person per annum in 2005. UK per capita energy consumption has been essentially flat in the period. Energy efficiency gains in transportation, building standards and in more energy efficient appliances have been lost to an overall rise in living standards and more prolific use of energy in transportation, single occupancy dwellings, foreign travel etc.

> Each person in the UK uses on average 10 kgs of oil equivalent energy every day. The main message of this post is that it is in the vital national interest that this profligate level of energy consumption (and waste) is substantially reduced.

I will now look at the oil, natural gas and coal production and consumption records for the UK for the past 40 years and show how swings from deficit to surplus and back to deficit have affected our overall balance of trade. I will also examine oil and gas production forecasts for the period to 2012 and project how this will affect the trade balance and energy security.

Oil and gas prices

Historic average annual oil and gas prices are lifted from the BP statistical review. Inflation adjusted prices based on 2005 $US have been used.

Future oil and gas prices are of course impossible to predict with certainty. However, as a central aim of this post is to illustrate the potential impact of energy imports upon UK trade balance it is

essential to make assumptions about future energy costs.

Future oil prices are based upon the oil price model presented **here**. This translates to an average 16% increase per annum to 2012.

Year	$US / barrel
2007	70
2008	80
2009	90
2010	110
2011	130
2012	160

Future gas prices are based on a 5% annual increase as shown below. BP quote gas production figures in BCM (billions of cubic meters) whilst prices are quoted in millions of BTUs (British thermal units). To convert, from BCM to BTU millions the former is multiplied by 36 million (see sheet on conversion factors in the BP review).

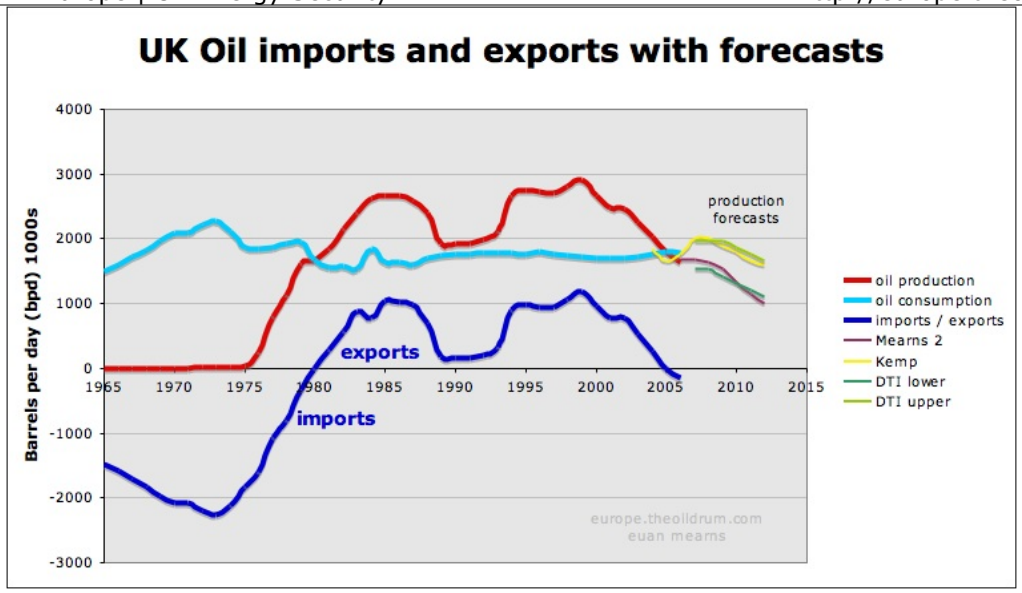
Year	$US / million BTU
2007	7.4
2008	7.7
2009	8.1
2010	8.5
2011	9.0
2012	9.4

Future price estimates do not include adjustment for monetary inflation or changes in exchange rates.

It is taken for granted that some may view the future oil and gas price estimates as too high whilst others may take the view they are too low. **Future price estimates are presented for illustrative purposes only.**

Oil

The historic oil production and consumption data shows large UK oil imports pre 1976. Once North Sea oil production got underway, imports were gradually reduced until in 1981, the UK became a net oil exporter. The UK remained an oil exporter until 2005. But in 2006, with falling production the UK once again resumed importing oil.



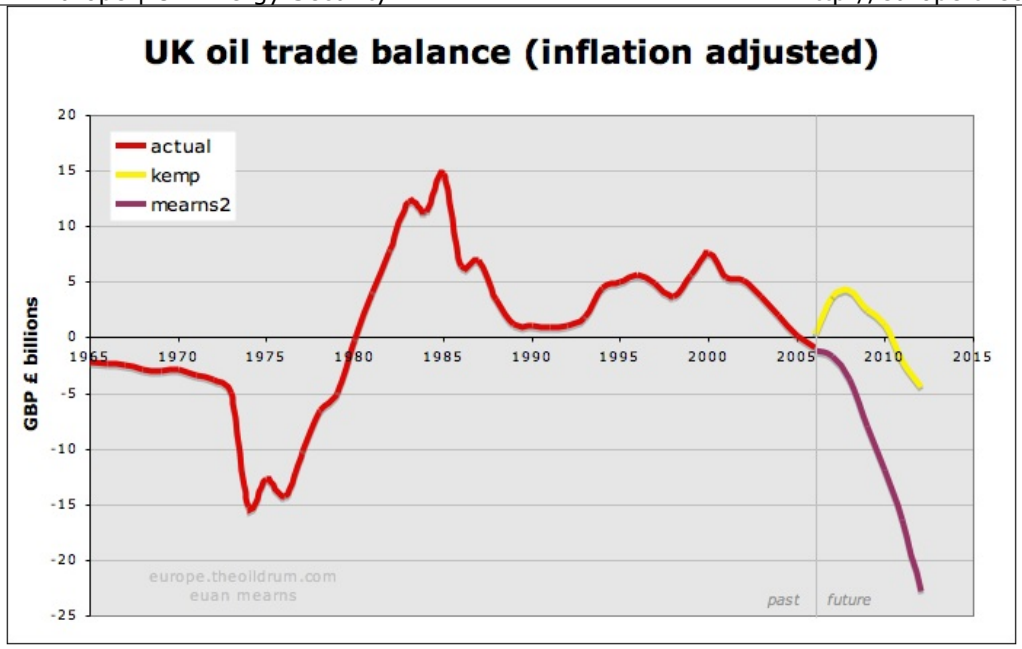
1.74 million barrels per day is a key figure for the UK as this represents the approximate level of daily oil consumption. If we produce more than this amount we can sit back and relax in the sure knowledge that our oil needs can be met from domestic supplies. Less than 1.74 million barrels per day means that the UK must compete for oil imports in the increasingly competitive **world oil export market**.

What will happen next? Three oil production forecasts are shown:

The first is by Alex Kemp who is Schlumberger Professor of Petroleum Economics at the University of Aberdeen. Professor Kemp has recently been appointed as energy economics advisor to the Scottish Parliament. The details of the Kemp forecast can be found **here**.

The second is by myself (Mearns2) the details of which can be found **here** and **here**.

The third is by the **UK Department of Trade and Industry** (DTI) who have responsibility for compiling UK oil and gas production forecasts and reporting those to the UK government. The DTI produce a forecast range. The upper range boundary is more or less coincident with Kemp whilst the lower range boundary is more or less coincident with Mearns2. Given this coincidence, the discussion will only consider the Kemp and Mearns2 forecasts.



The key difference between the Kemp and Mearns2 forecasts is that Kemp sees production rising this year and next and this mainatins the UK oil exporter status for a few years yet. The Mearns2 forecast sees the UK as a permanent oil importer with annual production declining at a rate of around 8% per annum.

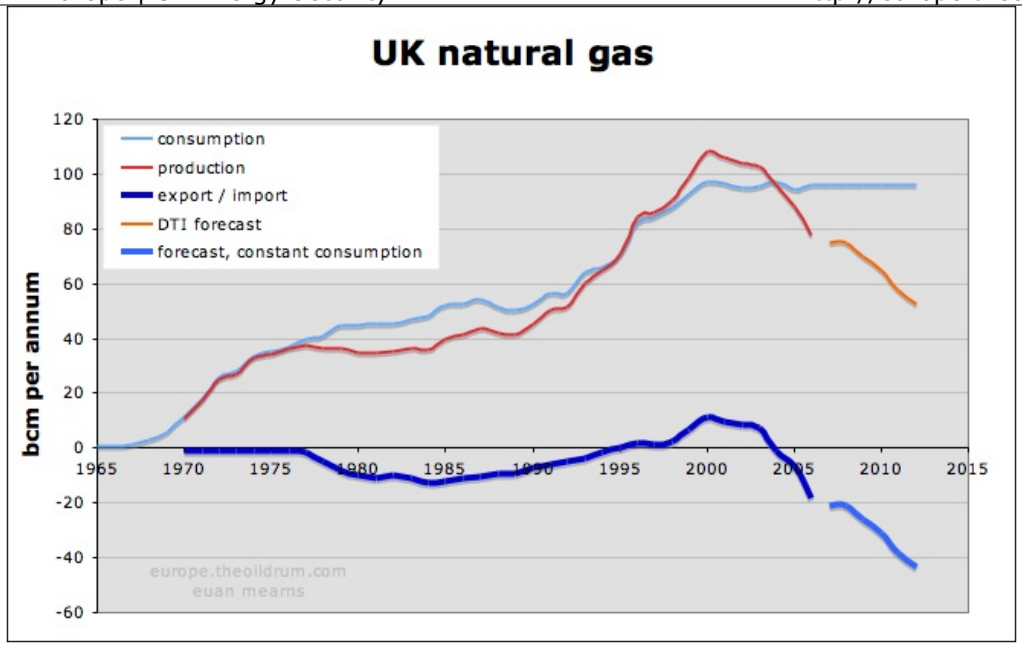
The impact these different forecasts have upon the UK trade balance is quite profound. At times of high oil prices, oil exporters are handsomly rewarded whilst importers are penalised. The falling production and rising oil price implicit in the Mearns2 model shows the UK oil trade balance plunging from a surplus of over £5 billion in 2000 to a deficit of over £20 billion by 2012.

Which forecast is more likely to be correct? Only time will tell. Near term, the biggest impact upon UK oil production is the giant Buzzard Field that came on stream in January 2007. Production from Buzzard has pushed the UK into oil surplus for the first 4 months of the year according to the DTI Table et3_10 (XL spread sheet). However, oil and NGL production was 3.8% lower for Jan-April compared with the same period last year and I calculate an average daily production rate of 1.74 million bpd which is bang on UK average consumption levels and slightly higher than my forecast of 1.67 million bpd for the full year. Offshore maintenance programs combined with the relentless impact of decline means that production during the first half of the year is normally higher than during the second half and I would judge that my forecast for the full year is looking good.

Natural gas

Offshore natural gas production in the UK got underway in earnest around 1968. Production grew steadily for over 30 years and peaked in 2000 and since then gas production has fallen, gradually at first, and then accelerated decline since 2003.

Up until around 1995, most domestic gas production was consumed within the UK. Domestic gas production was allowed to substitue for coal in home heating and in power generation resulting in cleaner air in our cities and helping to solve the acid rain problem associated with burning sulphur rich UK coal in power stations. Up until 1995 the UK also imported North Sea natural gas from Norway and Holland. But then in an extraordinary bout of bravado, the UK exported gas for a brief spell between 1996 and 2003.



The UK has become hooked on natural gas for home heating and power generation and with plummeting production faces serious issues in securing future supplies. The production forecast is the **DTI median forecast** and combining this with assumed constant consumption produces an import requirement of over 40 bcm per annum in 2012. It is by no means certain that consumption will stay constant as new gas fired power generation plants are still being sanctioned and built!

The UK has pinned future gas supplies on a two pronged strategy. The most important strand is the new Langeled pipeline to Norway. This is the world's longest sub-sea pipeline starting at the **Ormen Lange** gas field off Mid Norway and ending in Easington, Yorkshire in the UK. At its peak, Ormen Lange will produce around 22 bcm per annum or around one half of the projected UK import requirement in 2012. It has to be noted that the UK will compete with continental Europe for Ormen Lange gas.

The second strand is to import liquified natural gas (LNG), especially from the North Field in Qatar. The UK will have to compete with the whole of the natural gas importing world to secure these supplies. Three terminals have been built:

The **Isle of Grain** with import capacity of 4.4 bcm per annum

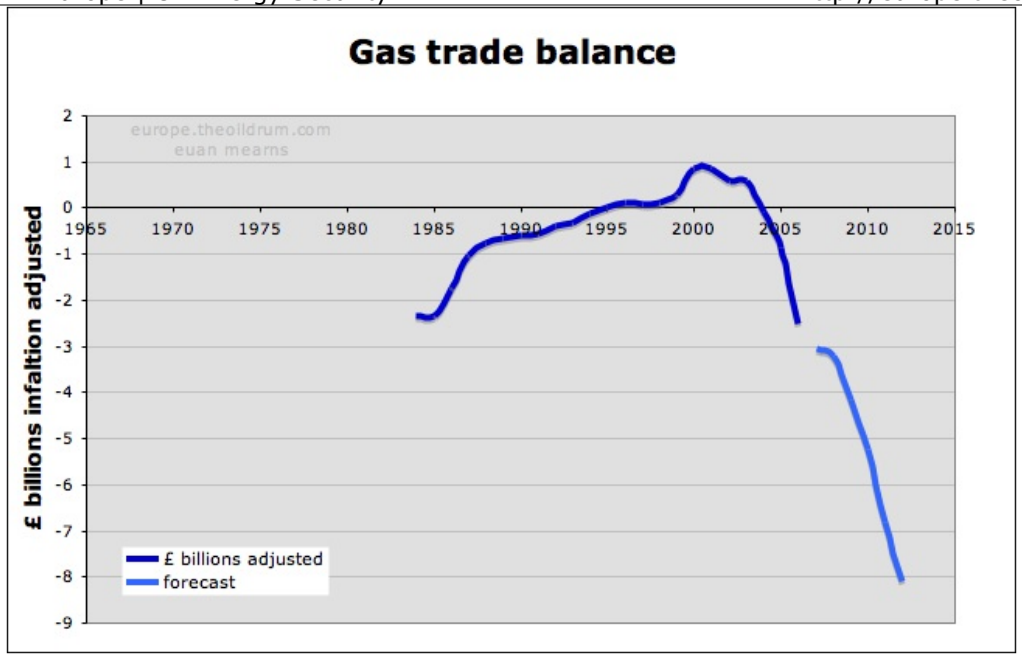
Milford Haven (Dragon) with import capacity of 3 bcm per annum

Milford Haven (South Hook) with initial import capacity of 10.5 bcm per annum

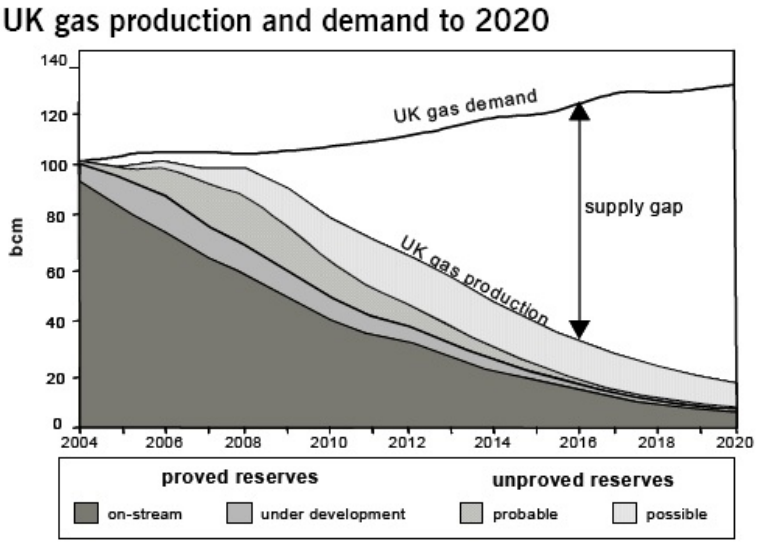
The combined LNG capacity of 17.9 bcm per annum plus Ormen Lange capacity of 22 bcm per annum provides the magic number of 39.9 bcm per annum compared with the projected import requirement of 40 bcm per annum by 2012. So long as no one else wants that Norwegian and Qatari gas the UK should be OK.

UK government sources report Isle of Grain at 5 to 15 bcm per annum and Milford Haven at 10 to 25 bcm per annum.

Whilst there may be doubts about the availability of gas for import to the UK, there seems to be unanimous agreement on the fact that the UK will have to import ever increasing amounts of gas for the foreseeable future and the imapct this will have upon the trade balance is shown below.



A surplus of £1 billion in 2000 is converted to a deficit of £8 billion by 2012. Note that this model assumes no growth in domestic gas consumption and a relatively modest increase in gas prices. There is also the possibility that the DTI forecast for domestic gas production proves over-optimistic.



Source: Modified from WoodMackenzie 2004, 'From surplus to shortage'

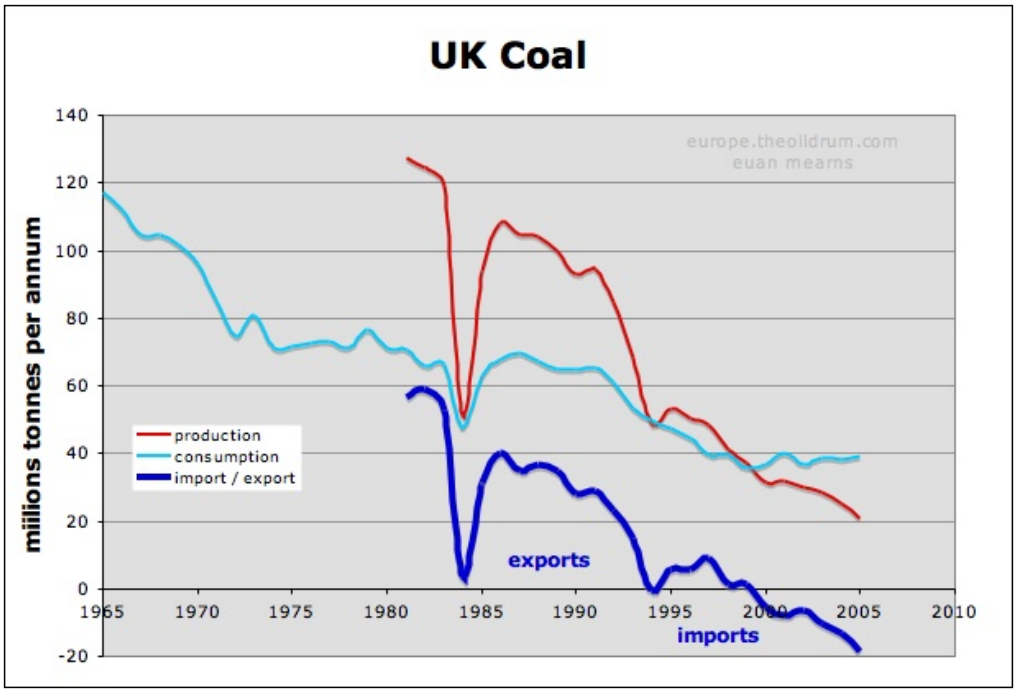
This chart taken from a **UK government report** shows gas demand increasing to 2020 and a gas import requirement of 100 bcm per anum.

How many LNG cargoes is that? **LNG ships** have current capacity of around 2.8 bcf. That translates to around 0.07 bcm, suggesting that the UK alone would require around 1400 LNG deliveries per annum to meet this import requirement.

Coal

Back in 1965 (when BP records begin) coal accounted for around 60% of UK primary energy consumption and most of that was met by domestic supply. Both domestic production and consumption of coal fell steadily from 1965 to 1999 when coal accounted for only 16% of UK energy consumed. The spike down in 1984 represents the miners' strike. Since 1999 coal consumption as a percentage has once again begun to rise and in 2006 it represented 19% of the UK total.

So much for the UK government's feigned concern about global warming. Faced with the choice of switching off the lights, saving the planet and reaping the anger of the electorate, the UK government has made the pragmatic decision to keep the lights on, come what may, whilst voicing concerns for the welfare of polar bears.



In plotting these data I was somewhat surprised to see that the UK was once a significant exporter of coal and need to note that the production / consumption figures in tonnes do not agree with the BP data when transformed into BOE as shown in the next diagram. This shows the UK as a net coal importer since the 1980s. The trends, however, are the same, and show increasing dependence of the UK upon imported coal.

We have had much debate recently on The Oil Drum about the status of UK and Global coal reserves. See for example:

The Coal Question and Climate Change

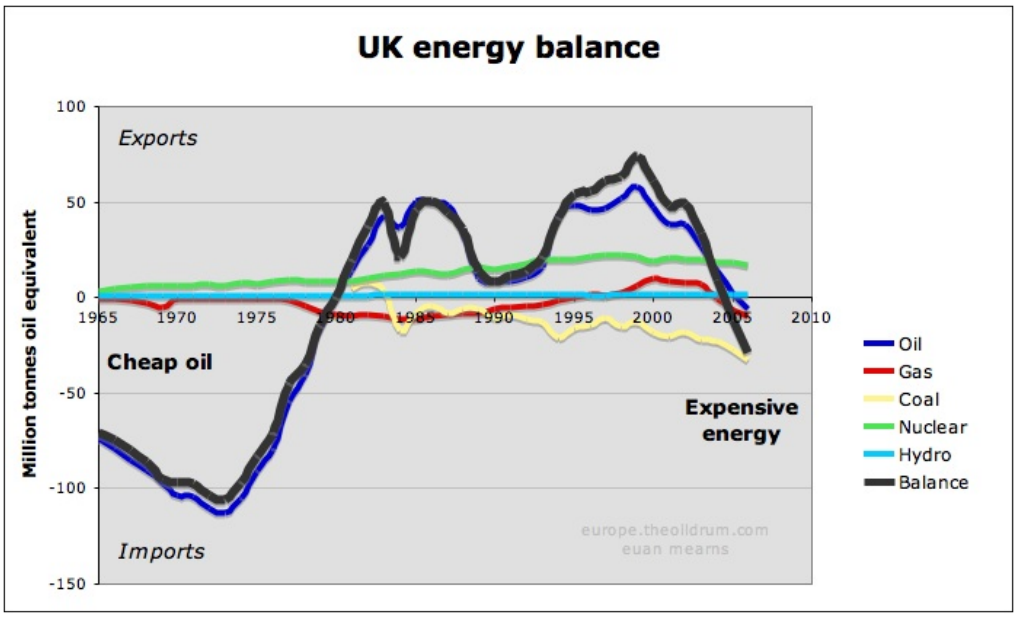
COAL - The Roundup

Coal reserves and resources - a gentle cough

I tend to side with Heading Out on this debate and take the view that the UK has substantial deep coal resources that are uneconomic in the current economic and political climate. I think this climate is about to change and that a soaring energy trade deficit (see below) will result in a political decision to subsidise new deep UK coal mines in order to protect UK energy security and mitigate the plummeting trade deficit.

Energy and Trade Balance

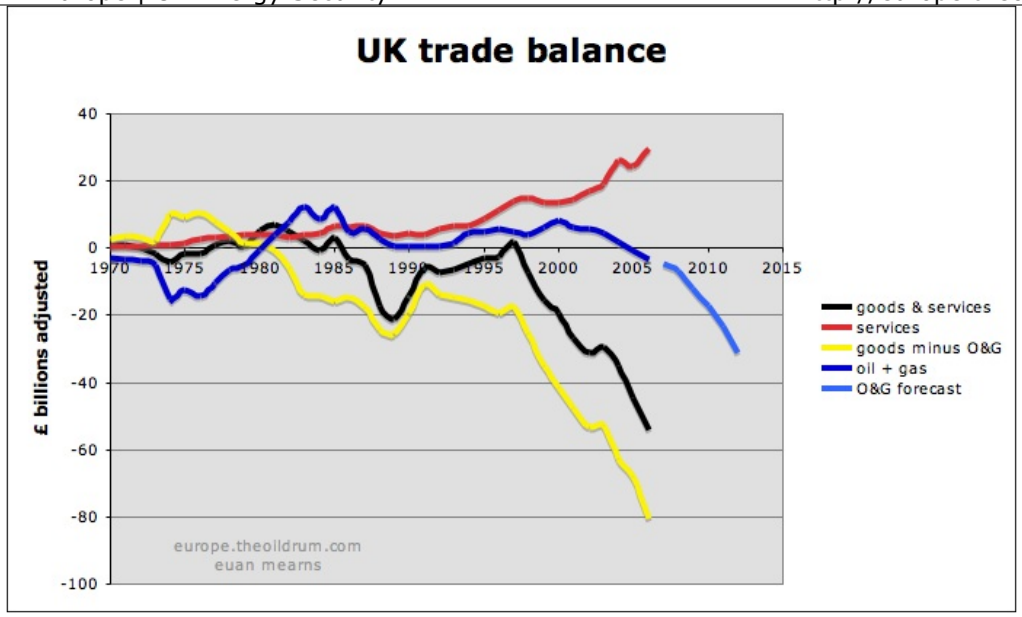
Pulling all the data together for oil, gas and coal with nuclear and hydro provides the following picture of the overall UK energy balance. Note that following consultation with **Jerome**, I have shown nuclear as domestic supply due to the fact that the cost of importing uranium is a negligible part of the total cost of nuclear power (this is open to debate).



What we see is that during the 1960s and 1970s, the UK was a major importer of energy, mainly oil. At that time oil was cheap and the UK had a large manufacturing base, exporting goods all over the world. Trade back then was balanced (see below).

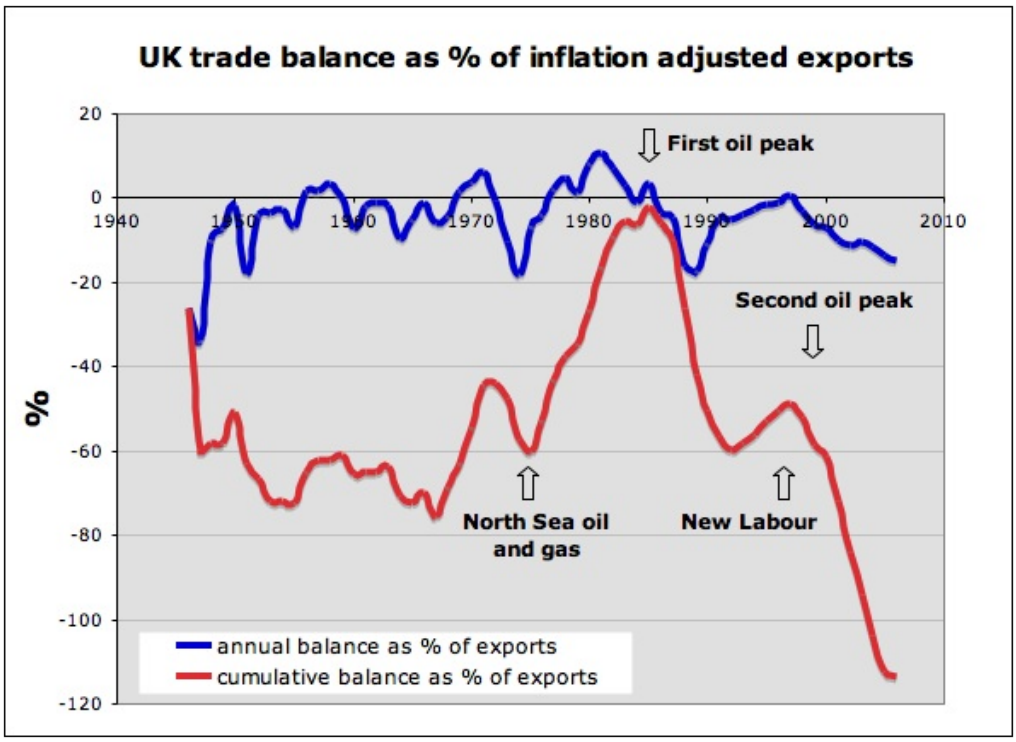
The advent of North Sea oil and gas resulted in a golden era of energy surplus from 1980 to 2004. However, with falling North Sea oil and gas production the energy balance is now plunging back into the red. So are we to return to the circumstances of the 1960s and 1970s? The answer is no! Back then energy was cheap and plentiful and the UK had a major manufacturing and export base. International energy supplies are now increasingly expensive, increasingly scarce, sourced from increasingly hostile geographic and political environments and our economy has lost much of its manufacturing export base that once enabled us to pay our way.

The UK trade balance has 3 main components: 1) goods, 2) oil and gas, and 3) services. The latter is made up mainly of financial services channelled through the major finance centres of London and Edinburgh. The chart is compiled from **official government statistics** using table 300570782. I have deducted oil and gas receipts from the goods column (IKBJ) to provide a separate picture for goods (less oil gas) and for Oil & Gas receipts.



From 1980 to 2004, the rapidly deteriorating trade deficit in goods was partly offset by surpluses in services and Oil & Gas. The Oil & Gas surplus, however, has now disappeared and the deficit looks set to get much worse as shown. The trade deficit of £54 billion recorded in 2006 looks set to hit £100 billion per annum by 2012.

The government and main stream media (MSM) appear to be extremely sanguine about these eye popping numbers and one reason is that the deficit normalised to the size of the growing economy is much less significant.



In percentage terms, the annual deficit is no worse now than on occasions in the past. The absence of a period of surplus for the last 20 years, however, is resulting in the cumulative deficit expanding. Can the cumulative deficit be allowed to expand forever and how will it be repaid?

One of the main points of this post is to point out that rising North Sea oil and gas production rescued the UK trade balance during the 1980s and 1990s. The solution then is the problem now.

Ballooning energy imports are set to make deterioration in the trade balance a whole lot worse.

Government response

The UK government is fully committed to private companies running our energy production and energy distribution industries and to a large extent our transportation infrastructure. These companies have one motive and that is to maximise turnover and profits via the eternal growth paradigm. The government tends only to interfere at the margin via regulation, taxation and occasionally setting strategy.

In recent years the government has:

1. Supported a massive **expansion of UK airports**
2. Supported on-going expansion of the road network
3. Shied away from increasing taxation on energy consumption
4. **Introduced and then doubled windfall taxation** on the profits of North Sea operating comapnies
5. **Prevaricated about climate change**, conservation and renewable energy without taking any decisive action.

The whole energy debate is shrouded in a carbon dioxide mist whilst the main thrust of policy has been to encourage the expansion of fossil fuel based transportation and to penalise the energy producers. The measures supported by the government are in my opinion the exact opposite of what are required to provide greater energy security for the UK.

What needs to be done?

The answer here is very simple. Domestic energy production should be maximised whilst energy consumption should be minimised. The strategy needs to be set within the context of national interest and energy security instead of being obscured by the fog of climate change.

1. The primary energy policy goal should be for the UK to remain in balance with respect to primary energy production and consumption.

2. To achieve this, domestic energy production should be expanded and in the near term this will inevitably mean expanding domestic coal production, nuclear energy and renewables with proven high ERoEI which for the UK means hydro electric and wind power.

2b. Construct a network of combined heat and power generators running on combustible domestic, industrial and agricultural waste.

Expanding these energy sources will unlikely replace the decline in domestic oil and gas supplies and the other side of the equation is conservation.

3. Meaningful energy conservation measures requires a clear and detailed understanding of where most energy is consumed by our society and a first step to conservation should be to audit our energy consumption patterns. Where is most energy being wasted and where can the easiest and least painful conservation measures be made? I suspect that government buildings (schools, hospitals, government housing and offices) and industry are profligate wasters of energy.

4. Set staged targets for per capita energy use reduction and identify stategies to achieve them. This must be linked to the primary objective of achieving energy balance which will likely require large incisions to be made in energy consumption.

5. Cars / automobiles are an obvious target and I would advocate aggressive legislation on motor efficiency that will inevitably mean reduced engine size, power and weight.

6. The strategy for cars should combine with a strategy for phased electrification of the automobile fleet and a proper evaluation / feasibility study of implementing **V2G** (vehicle to grid) technology combined with expansion of renewable energy sources.

7. Electrified mass transit systems should be built where possible.

8. Encourage pan-European taxation of jet fuel.

9. Legislate to discourage single occupancy dwellings and to encourage multi-occupancy. This has the added benefit of solving the apparent shortage of housing and will save the enormous energy cost of building millions of new homes.

10. Legislate to upgrade building standards for homes, industry and public buildings including the incorporation of micro renewables. Enable the upgarding of the existing building stock to improve energy efficiency - ensuring all the while that measures introduced do actually result in significant energy savings.

11. Audit our food production and distribution systems. Legislate in favour of energy efficiency which will inevitably limit choice. Ensure the energy infrastructure exists to guarantee our future food supplies.

12. Mount a public awareness exercise aimed at informing the public about decisions about energy use that are to be made on their behalf and their best interests.

These may seem draconian measures but they are in fact intended to provide a "business as usual model" for the UK based on using significantly less energy. There will inevitably be certain business casualties. But many new business opportunities will also be created.

The alternative may be to face real energy shortages in 2 to 8 years time when the anticipated supplies of imported natural gas and oil do not appear. Energy shortages combined with spiralling energy costs and energy import bills may paralyse our economy.