The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The coming UK energy meltdown

Posted by Euan Mearns on July 20, 2011 - 10:35am

This is a guest post by Hugh Sharman, an Engineer by trade and editor of the UK focussed energy blog ***DimWatt****.* ***The post appeared earlier*** *on the highly informative web site* ***European Energy Review****.*

The UK desperately needs a new energy strategy based on a realistic assessment of its assets, its needs and the options available to it. Unfortunately, its freedom for technical and financial manoevre is deeply restricted by its self-imposed Climate Change Act and its commitment to the EU's 20-20-20 targets. Its technically illiterate, if financially canny politicians and civil service do not appear to understand that the world's financiers are not likely to place the required £200 billion of long-term investment into their vision of a "low carbon" infrastructure while this concept remains so woolly and badly defined. If the UK government continues on this course, it will lead the country toward certain energy failure.

After hundreds of years of imperial and industrial power, the UK has suddenly become more or less powerless as a world player. With its North Sea resources fast depleting just when the world's upstream energy producers of oil, coal and gas are struggling to meet rising global demand, saddled with a public debt of £ 1 trillion, and a massive trade deficit, its leading role as an innovative, world-class centre of scientific and manufacturing know-how being ceded to Germany, Japan and now China, it is ill prepared to become a net energy importer. Yet energy import dependence is what the country is rapidly headed for.

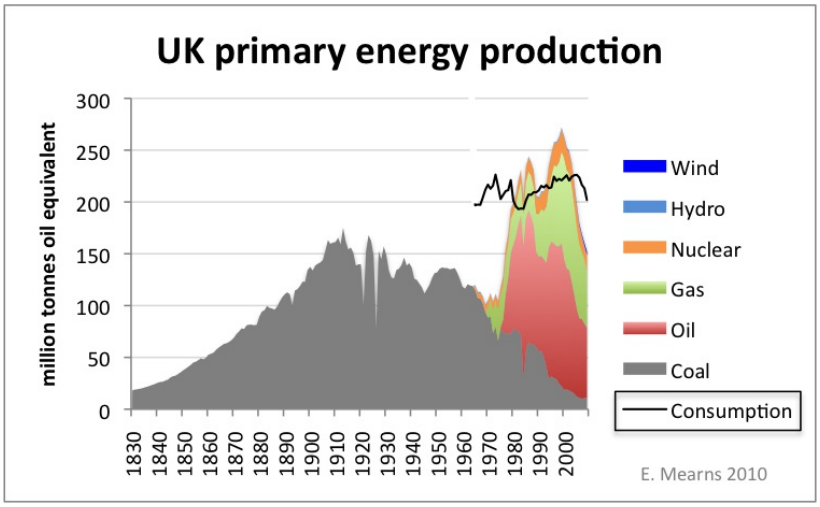

Figure 1

As the dramatic chart of Oil Drum editor Euan Mearns illustrates, the UK has run through most of its hydrocarbon inheritance within the lifetime of anyone over fifty years old today. This means

that the country will be faced with an entirely new situation. In one way or another, Britain has been energy self-sufficient for most of the last five hundred years. The destruction of its forests for ship building and fuel, prior to the industrial revolution, came to an end with the invention of the steam engine and the exploitation of coal, which energized the industrial revolution. The empire-builders of the 19th century ensured secure commodity supplies, including hydrocarbons, by planting the Union Jack on an unprecedented fraction of the World's land surface. Two of the world's top oil companies are still domiciled in the UK (Shell partly).

Britain's luck held out even as its Empire was dismembered during the period from 1947 to 1970. By then, the technology of finding and producing oil and gas in stormy, exposed seas enabled the country to replace oil and gas imports from its colonies and protectorates, with supplies from reservoirs under the North Sea. Very briefly, around the turn of the last century at a period of unprecedented low energy prices, Britain once more became a net energy exporter.

Hundreds of years of energy independence and trading experience appear to have instilled much unrealistic optimism among policymakers over the sharply changed circumstances in which the UK now finds itself. The country's energy and economic policy relies on assumptions that are completely unrealistic in today's multi-polar world.

The "central" fossil energy price projections for 2010 prepared by the Department of Energy and Climate Change (DECC) are summarized below.

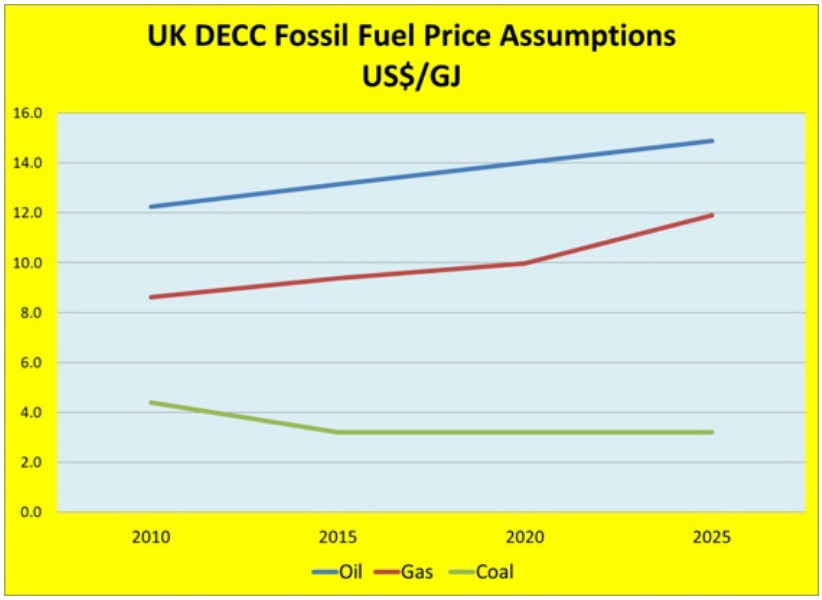

Figure 2

For readers who prefer to think in traditional market trading units, the conversion factors for these are shown below.

To convert from $/GJ		
Oil	to Dollars per barrel multiply by	5.7
Gas NBP	to pence per therm, multiply by	6.7
Coal ARA	to $ per tonne, multiply by	25.0

The central planning scenario with which the new Coalition Government started out in May 2010, was for oil to rise from $70 to $85 per barrel by 2025. It assumed that the price of gas would rise from 58 to 71 p per therm in 2025. And that coal would actually get cheaper over the next 15 years, falling to $80/t.

Just one year later, a snapshot of the present (June 2011) shows Brent oil comfortably over $100/b, gas pushing 70 p/therm this coming winter and coal already 50% more expensive than the government's assumption for 2025!

Similar, unrealistic assumptions are used by the Bank of England, the newly formed Office for Budget Responsibility and the UK Treasury, as key inputs for their economic models, forecasting inflation and economic growth. Even the "high, high" assumption for the oil price in 2010 is just $103 per barrel. Can it be any wonder that the Bank of England seems unable to forecast, let alone affect, inflation by playing around with interest rates?

No one can claim that the current high energy prices could not have been foreseen. A small, vociferous if disunited group of energy experts all over the world, generally and often patronizingly disparaged as "peak oilers", have for years been warning, from irrefutable data, that growing demand could not endlessly and affordably be met by supply. But a little common sense would have led to the same conclusion.

Despite continuously rising oil prices since 2001 and huge global investments in upstream hydrocarbon extractive capacity, global liquid extraction rates have remained more or less the same since 2004. Briefly, during the summer of 2008, just prior to the financial melt-down, total hydrocarbon liquid demand could not be met by supply at 88 million barrels of oil per day and the price of crude soared above $140/b. At this unaffordable and ruinous level, some demand destruction was inevitable. The global economy today has still not recovered from the toxic consequences of high commodity prices and banker-fueled indebtedness from this period.

Serially wrong

The UK's ostrich-like reluctance to see the world as it is, rather than how it wishes the world to be, is shared by many of today's energy-importing members of the OECD, gathered under the auspices of the International Energy Agency. The IEA was set up by the OECD in the wake of the 1973 oil supply crisis. Its primary duty has been to advise its client governments about oil supply and to coordinate oil stocks in the event of supply disruptions. However, the IEA's own record of energy demand, supply and price forecasting has been dismal, especially in recent years.

It has been consistently optimistic - and serially wrong - both as regards the availability and price of crude oil (as well as gas and coal). The following is a table from its flagship annual energy report, the World Energy Outlook (WEO), of 2000.

Table 1.1: **Fossil Fuel Price Assumptions** (in year 2000 dollars)

	2000	2010	2020	2030
IEA crude oil imports ($/barrel)	28	21	25	29
Natural gas ($/MBtu):				
US imports	3.9	2.7	3.4	4.0
European imports	3.0	2.8	3.3	3.8
Japan LNG imports	4.7	3.9	4.4	4.8
OECD steam coal imports ($/tonne)	35	39	41	44

Note: Prices in the first column are data. Gas prices are expressed on a gross calorific value basis (MBtu: million British thermal units).

Figure 3

Four years later, in its WEO 2004, the IEA confidently forecasted that by 2030 global demand for hydrocarbon liquids would be 123 million barrels of oil per day (bpd) and that this would be delivered in 2030 at an expected price of $55 per barrel (in 2004 dollars).

In a welcome break from this record, WEO 2009 was based on a fundamental reassessment of its data base. Instead of accepting third-party, for example OPEC, assertions at face value, it examined the real data of over 800 of the world's largest oil fields during 2009. In the light of this, it saw fit to sharply reduce estimates for demand in 2030 to what it saw might possibly be supplied, namely just 106 million bpd.

Just one year later, this estimate was further reduced to less than 100 million bpd. The following presentation slide comes from the IEA's World Energy Outlook 2010), published in November 2010.

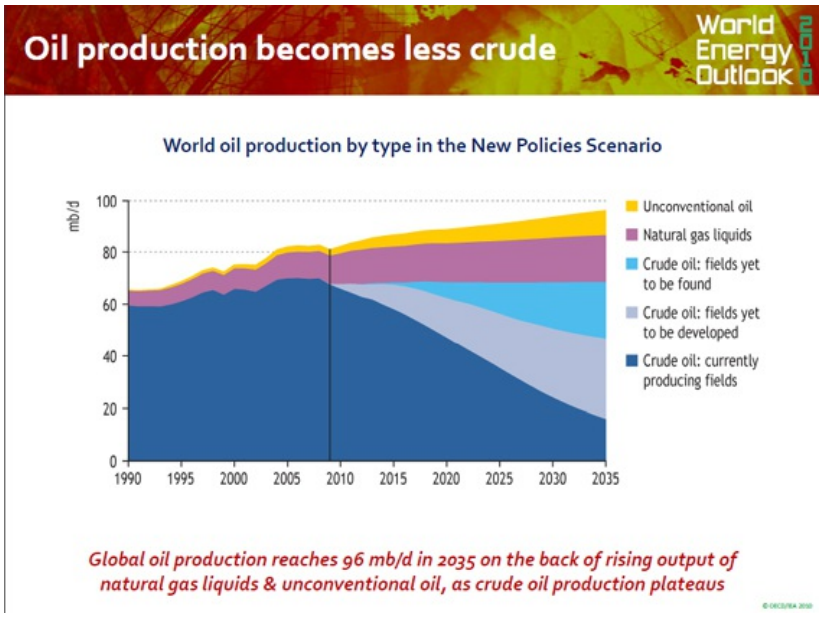

Figure 4

The graphic shows how rapidly depletion is eroding today's crude oil extractive capacity and how

the IEA foresees such depleting capacity being replaced. In order to maintain liquids extraction into the future, at flow rates that will satisfy estimated demand growth, new oil fields must be found, developed and commissioned at the rate of about 2 million barrels of oil per day, per year until 2030 This is equivalent to discovering, developing and commissioning a new "North Sea" every year. Or in other words, simply to raise the rate of hydrocarbon extraction during the next nine years, the global upstream industry must develop the new productive capacity equivalent of two "Saudi Arabia's", more or less from scratch.

This is unlikely at best and probably impossible. It painfully demonstrates the extreme weakness of the assumptions on which OECD (and UK) energy policy is constructed.

The same optimism applies to the availability and price of coal. Until 2008, China, the world's largest coal miner and consumer, burning around 3 billion tons per year (42% of world demand), was a net exporter of coal. In 2010, for the first time in history, it imported 130 million tons of coal from the global ship-borne market. In 2010, this amounted to approximately 700 million tons. China's annual consumption of coal has been increasing at the rate of between 150 and 200 million tons.

A question that should be obsessing the minds of all coal importers right now is how much longer China (and India) can supply their incremental growth from this relatively small global pool of exported coal without causing an international coal-supply crisis? No wonder that the price of coal has recovered from 2009 lows of $60/t and has increased during the last ten years from roughly $30 per ton to $130 today FOB Newcastle (the one in Australia, of course!).

Figure 5

One "solution" for dealing with high priced coal is simply to restrict generation. Rolling blackouts on the east coast of China are already happening in the name of "controlling inflation".

At this moment everyone who can invest in increasing global coal extractive capacity is piling into the market. It remains to be seen whether the rest of the world can develop new mining capacity fast enough to meet China's foreseen demand, let alone the demand of traditional coal importers such as India, the UK and much of the rest of the EU.

Yet, the "central" price assumption of the UK for 2025 (no less) is just $80 per ton.

"Happy talk" about gas

All over the world, there is much “happy talk” about the wonders of shale gas and how the link between oil and gas prices will (finally) be broken by the abundance and low price of this new “wonder” fuel. The following chart maps the oil/gas price ratio from 1984 until 2009. The gas prices used in the calculation are the annual average of LNG CIF Japan and CIF gas into the EU.

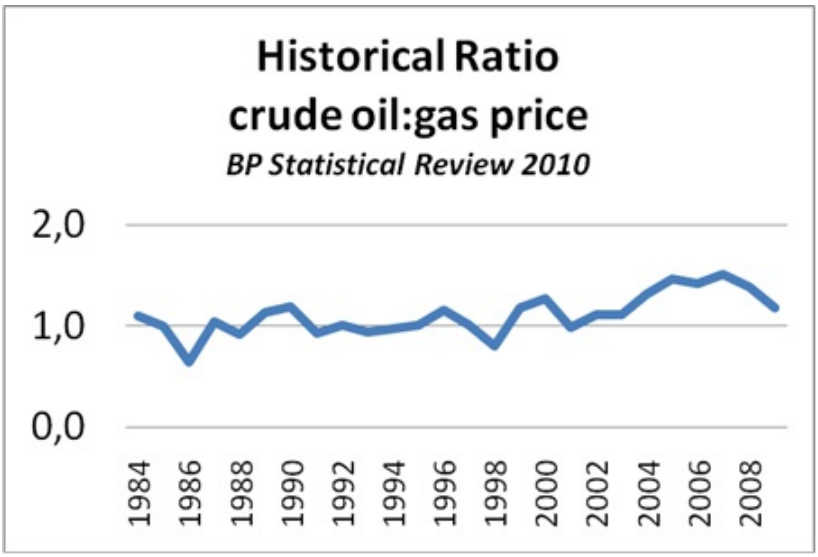

Figure 6

Unfortunately, such “happy talk” is not justified by the facts. Firstly, many pure (dry) shale gas plays in the US are losing money at the low prices that cause such a high level of consumer optimism in the US. Because of this, shale gas drilling in the US has more or less halved since 2008 and new drilling this year is focused on areas where the gas comes up with lots of much more profitable, associated hydrocarbon liquids.

Given the looming energy shortages, it is of course important to look for and where feasible extract shale gas. This would be worth doing at almost any cost so as to reduce Europe’s increasing and potentially crippling reliance on large and near-monopolistic gas exporters like Russia, Qatar and Algeria. These suppliers have no rational interest in reducing the price of their gas and every reason to pursue and maintain their target of price parity with oil.

But Europe must remain clear-eyed. The shale gas technology is not cheap when all its external (in particular, environmental) costs are fully taken into account. So the future of shale gas as a world and UK source of primary energy must, for planning purposes, be regarded as marginal at best, until its full costs of extraction and use are better understood.

Any idea of a gas surplus is premature, to say the least. Note that the US remains a net importer of natural gas and is likely to be for many years to come. Also noteworthy, in the chart below, is how fast its *truly cheap*, conventional natural gas resource is depleting.

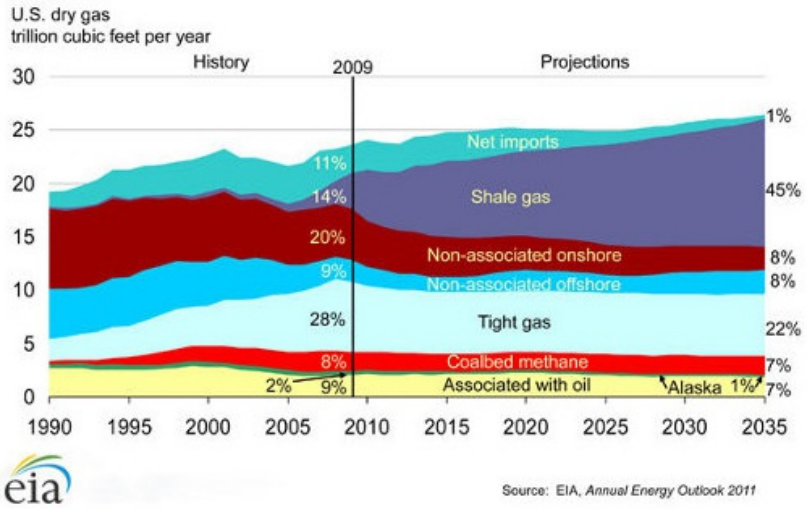

Figure 7

World-class basin

Over-optimism over the future availability and price of fossil fuels has characterized UK energy policy since the discovery of North Sea oil and gas. Optimism reached a peak under the Thatcher Government in the early 1980s which set the UK on the path of deregulating almost all activities concerned with energy production and use. An excellent paper by Oxford energy economist, Dieter Helm can be recommended for those interested in the history of "light touch" UK energy regulation during the years since.

Nevertheless, Thatcher's government, made wary by the risk of further coal-mine strikes during the 1980s, at least did pursue the construction of another nuclear power plant at Sizewell on the south-east English coast that was commissioned in 1993. This was the last major power plant built in the UK that does not rely, more or less entirely, on burning natural gas.

The composition of the fuels used by the UK's fleet of power plants has been revolutionized during the past 40 years, particularly by the arrival of "cheap" North Sea gas and its use in power generation from the early 1990s, as illustrated in the following chart.

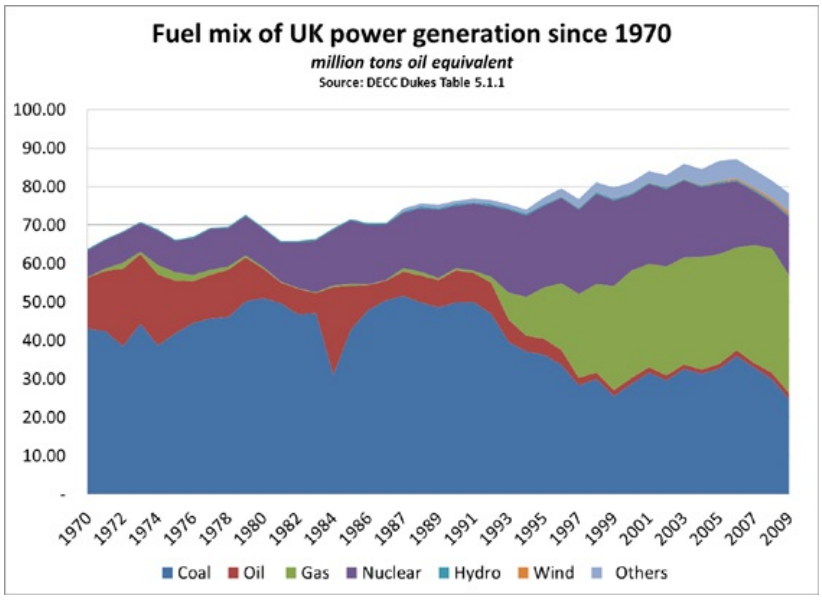

Figure 8

Beside the massive reduction in coal use, note how rapidly the contribution from nuclear power has been diminishing of late.

The direct consequence of the UK's hydrocarbon extraction policy, sometimes but inaccurately spun by politicians of all stripes as a positive contribution by the UK to CO2 reduction, is the loss of almost an entire, world-class hydrocarbon basin within the lifetime of a normal adult. The UK was never obliged to do this. Both the Netherlands and Norway have regulated the rate at which their oil and gas fields have been emptied more rigorously - and so will remain in the extraction business considerably longer, and will most likely obtain a higher extraction rate from their reservoirs than the UK.

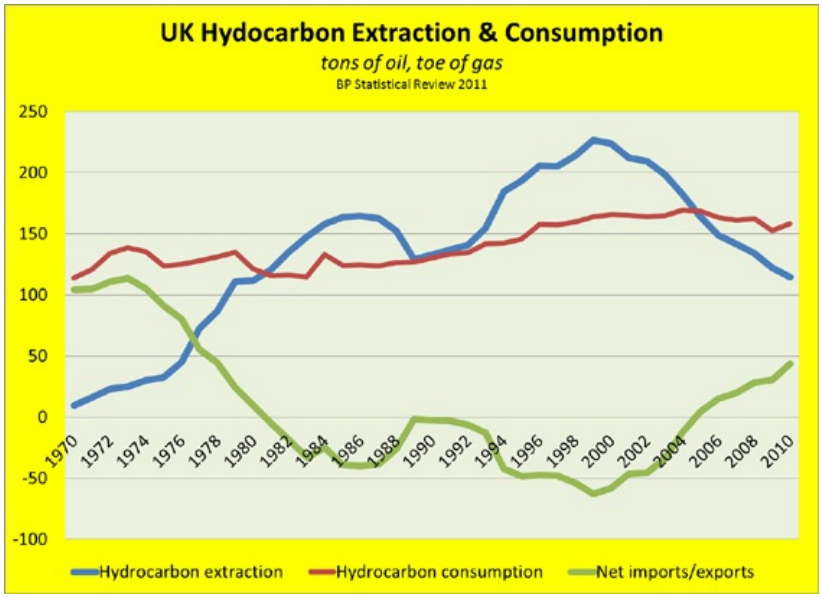

Figure 9

Net hydrocarbon exports peaked at over 60 million tons per year in 2000, ironically at the bottom of the market. Since 2005, the UK has become a net hydrocarbon importer. Import dependency has grown by an average of 10 million tones of oil equivalent (toe) per year over the past decade, so by 2015, net imports are likely to be roughly the same as they were in 1970, around 100 million toe per year.

If the price of gas once more converges with the price of oil, the addition to the trade deficit, with oil at $750/t ($100/b) will be an additional $75 billion per year. If the oil price rises further, it is hard to see how the cost of the hydrocarbon trade deficit can possibly be covered by increased exports in goods and services.

The UK has become one of the largest gas consumers in the world. Only the US, Russia, Iran, China and Japan consume more gas. Most city-dwellers use gas for heating and the country's electricity infrastructure has seen a huge increase in gas-fired power plants since 1990, now totaling 29 GW.

This is bad enough. Worse is to follow.

Doomed plants

By or before the 1st January, 2016, under a treaty with its EU partners, the UK will lose 8 GW (Gigawatt) of ancient, polluting and inefficient, if well-functioning coal capacity and 3 GW of 1980s era oil capacity that is routinely used to cover peak demand. These power stations must close because in 2008 their owners chose not to add flue gas desulfurization equipment that is demanded of all EU power plants that burn coal or sulfur-containing oil.

In addition, by 2018, the roughly 10 GW of nuclear power capacity that was available in 2010 will shrink through obsolescence to 3.6 GW with further closures taking place in 2023.

The financial crisis of 2007 – 2009 resulted in a relatively small overall reduction in energy use, much of it in manufacturing. By 2010, with a weak financial recovery taking hold, energy demand picked up more or less to normal while peak electricity demand during the third cold December in a row, returned to levels last seen during the boom years prior to 2007.

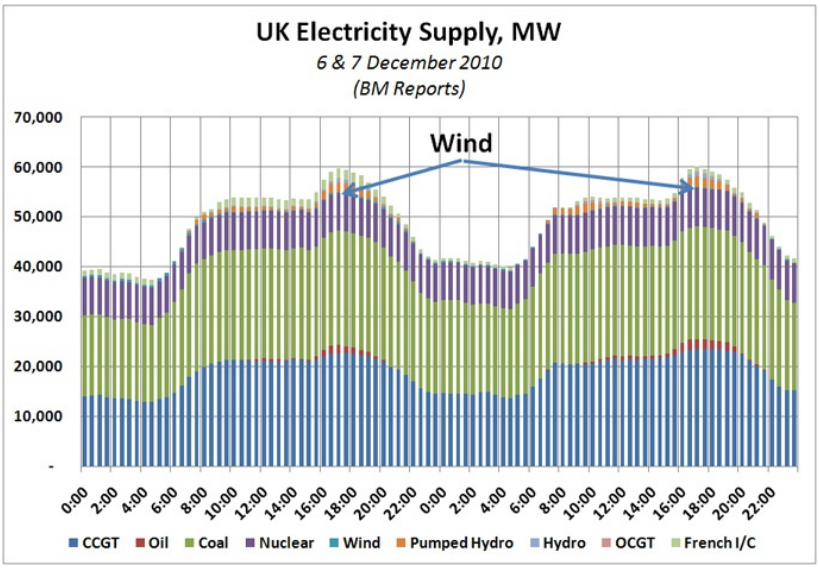

Figure 10 *UK electricity supply in MW for the 6th and 7th December 2010. Peak demand is around 6 pm daily.*

It can be seen from the foregoing chart and from many similar instances all over North Western Europe, that winter peak power often coincides with very large, slow-moving anti-cyclones that bring extreme cold weather and almost no wind, and therefore little or no wind power output.

Further south, similar events in summer coincide with peak air-conditioning loads.

The chart shows that all the "doomed" nuclear, oil and coal-fired plants played a major role in keeping the lights on during the winter of 2010 – 2011. Total "firm" generating capacity stands today at around 72 GW. Clearly, no matter how much wind power is built, if the wind does not blow during periods of peak power demand, its capacity is worth more or less nothing.

The loss of 11 GW of reliable capacity during the next four years, along with 3.4 GW nuclear, almost 15 GW in all, risks precipitating a real capacity (keeping the lights on) crisis by the middle of this decade.

In a "free market", with such obvious signs of coming, extreme stress in the system, one would

expect generators to be lining up to deliver the obviously needed new capacity. There are, indeed, an impressive number of planned power stations, nearly all of them gas-fired. The major generators claim to be ready to build new nuclear power and "clean coal" power plants to replace obsolete capacity. A bright new future beckons during which the figure of £200 billion is regularly cited as the amount of money that "must" be spent to make the UK's tatty energy infrastructure fit for the 21st century. In reality, however, we see that very few new power stations are actually being built. To understand why this is so, we have to look at the recent history of UK energy policies.

Complicated subsidy

The idea behind the liberalisation of the UK energy market started under Margaret Thatcher was to have a free market in generation and sales and a government-regulated transmission and distribution system. Then Energy Minister, later Chancellor (Economics Minister) Nigel Lawson famously said at the time that *"energy (should be) a traded good like any other commodity and its supply was to be settled in the market place"*.

This has more or less come to pass. We have a regulated (privately owned) transmission company, National Grid, that owns the country's high voltage transmission system (as well as the high-pressure gas transmission system). Almost all the major thermal power stations, fossil-fueled and nuclear, are now owned by six large energy corporations, EdF, Centrica, Eon, RWE, Iberdrola and Scottish & Southern Energy (SSE). Consumers are free to switch energy supplier and energy switching rates in Britain are among the highest in the world. Energy prices are not (yet) particularly high compared to the rest of the EU.

Yet all this is irrelevant if in the long term not enough investment is made in power generation while the UK at the same time is becoming dependent on outside suppliers. This will lead to an energy crisis no matter how "the market" is organised. And this is the reality we are headed for. Why is this so?

It should be noted that, rather than leaving the energy market "free", the UK government has embarked on a hugely ambitious climate change program that has far-reaching impacts on the power generation market. In 2008 the UK Parliament voted through the Climate Change Bill and thus made CO2 emission reduction a legal requirement for the Nation, and not just for its own remaining tenure *but all the way through to 2050*. During the same year the UK Government agreed to implement the EU's 20-20-20 targets, which require that the country will deliver 20% of its energy demand from renewable energy and reduce CO2 emissions by 20% by 2020, just eight years from now.

In addition, the Labour Government introduced an expensive subsidy, called the Renewable Energy Obligation. This obliges electricity companies to purchase an ever increasing fraction of their power from OFGEM-approved renewable energy resources. A Renewable Obligation Certificate (or ROC) rewards the wind turbine or biofuel generator with an agreed number of ROCs (between 0.5 and 2) per MWh, over a pre-agreed number of years, depending on which renewable resource the Government wishes to incentivize. The cost is met by the consumer to whose electricity account all of this is charged. The typical value of an ROC to any renewable energy generator since it was launched has been between £30 and £50; it is the subsidy the generator receives on top of the market price. So far, this subsidy has cost consumers £5 billion, with £1 billion in 2010 alone.

This is set to rise to £7 billion per year by 2020, representing an accumulated transfer from consumers to (mostly) wind developers of roughly £40 billion – enough money to pay for a respectably sized nuclear capacity.

So far this incentive is delivering only 6.5% of the UK's electricity whereas the target for 2010 was 10%. The transparent failure of this incentivization programme to achieve its targets should have given the in-coming Government some warning. Instead, it ploughs on regardless, introducing continental–style feed-in tariff (FITs) for roof top PV (annual capacity factor about 6%) costing consumers anything up to 40p/kWh. This is a great way to further transfer funds from poor consumers to rich house owners. None of these renewable energy sources will deliver any firm capacity.

Public consultations

In 2009, OFGEM belatedly realized that the "energy-only" electricity trading system that it set up in 2002, was no longer fit for purpose. This trading arrangement, called NETA, replaced the "energy + capacity" trading system put into place at privatization. Under NETA, generators have no incentive to invest in spare capacity. Now OFGEM and the Government have become aware that a completely new tariff structure will be needed to fund a properly diversified mix of privately owned, dispatchable generating capacity needed to meet the ambitious targets of the Climate Change Bill and the 20-20-20 targets, while also delivering energy security. Far too late, they are realizing that dispatchable "low carbon" capacity does not come cheap. In fact, according to a recent news report, generators are now discussing with the government massive subsidies (to the tune of £10 billion) to build back-up gas-fired power plants that will stand idle for most of the time.

In all, it is estimated that between £100 and £200 billion of investments in offshore wind, transmission lines and back-up capacity are needed to realize the green dreams of the UK government. At this moment, the new Coalition government is studying a proposed Electricity Market Reform (ERM) that will determine the new tariff structure. This is merely the latest round in an endless series of "public consultations" and energy and global-warming related "white papers" that have been produced by the government in the last 14 years since liberalisation. (This included an announcement in 2003 that no new nuclear build was needed to achieve the UK's climate targets followed by one in 2006 that said that nuclear energy is vital.)

The effect of all these U-turns and consultations has been to make the market extremely wary of committing money into the generation sector. The "money men" have not forgotten the introduction of the NETA energy trading system when many billions were lost by private generators who had invested in the UK generating sector under the old rules. The nuclear industry was bankrupted and had to be nationalized. Europe's largest generator, Drax Power, was only saved by its bankers taking a longer view but at a huge cost to its then owner, AES.

The new trading rules that the Coalition is preparing come at a sensitive time, when the media are full of horror stories about price rises while millions per month are being spent by National Grid for compensating wind turbine owners whose output is being curtailed because of network congestion. OFGEM has said the investment required to ensure UK energy security and to decarbonise the power industry to 2020 could see consumer bills increase by anything between 23 and 52 per cent - equivalent to adding between £250 and £600 to today's average annual bill. There is a real risk that consumers "can't pay and won't pay". Under these circumstances, the chances of separating £200 billion of private capital from its owners to be invested in the UK's long-term "low carbon" vision must be slim indeed.

Tipping point

The challenges described in this paper cannot be fixed as long as they remain unrecognized by the people that we elect to write and abolish legislation. Elaborate roadmaps to 2050 and lofty-sounding calls for emission targets in the mid-2020s will be as pointless and useless to future generations as any such "road map" for the nation would have been if written in (say) 1910 or

1934.

Among the chief dangers that the UK faces in 2011 is the critical obsolescence of its electricity infrastructure, its essential bankruptcy and the absolutely unrealistic aspirations of almost its entire political class, although not its population, for a new, low-carbon, high-growth, job-creating, tax-paying economy.

The imminent closure of 16 GW of coal, oil and nuclear power plants and the realization that these simply cannot be replaced by the equivalent - or even much greater - wind power capacity, (even if it could be built, which is doubtful) is widely recognized in most senior echelons of the UK's financial, manufacturing and engineering companies. Speaking at the recent Economist Energy Summit in London, Sam Laidlaw, CEO of Centrica, said: "We are rapidly approaching a tipping point in the energy story of this country and there is a risk that society is not being realistic about the path ahead. (...) Over this next decade three forces are coming together - our growing dependence on increasingly volatile world energy markets; our commitment to make serious cuts in carbon emissions; and our obligation as a society to ensure that energy remains affordable at a time of huge pressure on household incomes."

The problem is not unique to the UK. Major energy and concomitant trade deficits and even national bankruptcy are facing countries all over Europe. Europe cannot afford much more of the same.

It is probably pointless to try and get this message through to the EU's present energy establishment, fixated as it is on perpetuating Kyoto and writing endless "2050 road-maps". But given the extreme fragility of the UK's economy, and the imminence of an electricity supply failure, it may still be possible to bring to the attention of the UK's financially embattled Coalition, the extreme danger of its chosen policies, before the financial plug is pulled and its emission-related targets are exceeded by industrial ruin.

There can be no doubt that the UK must evolve an energy strategy that will liberate the economy from hydrocarbons as fast as possible. But its resources and financial circumstances are increasingly modest. The energy aspirations of its politicians are incoherent and technically illiterate. All this is about to come to a head with the transparent reluctance of international financiers to invest in the "green" economy. A huge U-turn lies ahead when it will have to plead with its EU partners for a derogation on the closure of the coal capacity and with EdF to keep the old nuclear fleet on the road, while developing a more realistic energy plan. This must almost certainly require the electrification of almost everything and the speeding up of nuclear capacity build, wherever possible innovating technically and reducing the costs by depending more on South Korea and China than our partners across the Channel in France.

Hugh Sharman is editor and co-founder of the Energy Blog DimWatt, a 'campaigning web site dedicated to keeping the lights on affordably, maintaining mobility and the UK's position as a manufacturing power in a fast-changing world'. DimWatt aims to bring together utility management personnel, academics, politicians, civil servants, professionals and concerned citizens 'who are committed to rational discussion and debate on the challenges facing UK's energy infrastructure today'.

Sharman is also owner and managing director of the Denmark-based technical energy consultancy Incoteco, which he founded in 1986. He has over thirty years' experience of expertise in providing consultancy services to industries and governments in the fields of energy and the environment. Recently he was the main author for the report "Wind Energy – The Case of Denmark", published by the Danish think tank CEPOS. His current commercial focus is on the use of stationary electricity storage for integrating intermittent energy sources into grid systems. Most of his work in this area is on behalf of PD Energy which is developing

the vanadium redox battery. He can be reached at sharman@incoteco.com.