

THE COLLAPSE OF THE GOVERNMENT'S ELECTRICITY GENERATION POLICIES,
Alex Henney¹, 11 May 2012

"When the facts change, I change my mind. What do you do sir?"

J.M. Keynes

1. EXECUTIVE SUMMARY

The New Labour government and the Coalition - which signed up to Labour's ambitions - published profusely on the need to decarbonise the electricity industry and moved from opposition to nuclear to supporting it. Against the advice of his ministers Blair signed Britain up to achieve 15% of *total* energy consumption from renewables by 2020, which implies achieving the virtually impossible level of 30% electricity from renewables (mainly wind), up from 5% in 2007.

The government introduced the Renewables Obligation scheme for subsidizing renewables, which was an ill-conceived scheme based on a naïve belief in the efficacy of markets². It unnecessarily exposes renewables developers to multiple price risks and consequently increased the cost of capital and thus the cost of renewable energy was higher than necessary. Windmills in England have a lamentably low load factor averaging 21% in 2009-11 (well below the 30% spun by the wind industry) and obviously many are well below 20%. **That developers want to build at such low performance shows the subsidy is too high.** New Labour also put in place feed-in tariffs for a range of small renewable generators of less than 5MW. In the British climate and at current costs photovoltaic solar panels are a daft way of producing trivial amounts of electricity currently at very high cost.

As part of its greenwash the government boasted about Britain leading the world, but others are not following, least of all China and India which are forecast by 2035 to increase coal based electricity production by 30 times British coal based output. It also produced a lot of spin about "green jobs" but the majority of photovoltaic panels and windmills are made overseas. A European Commission study predicts the consequence of a high level of renewables for the UK is relative economic contraction, and in all but one scenario up to 30,000 net job losses, with the costs of policies destroying more jobs than are created even in some of the more optimistic scenarios. **In reality subsidised "green" jobs generally destroy other jobs.** Furthermore, since about two thirds of the windmills are foreign owned, we transfer £½bn p.a. in subsidies overseas. Now, with over-market subsidized plant, market competition to produce electricity has been replaced by political competition for subsidy.

¹ Thanks are due to a number of people most of who wish to remain anonymous lest they miss out on the opportunity of tea and biscuits at DECC. Comments welcome to alexhenney@aol.com.

² In 1987 I wrote the Centre for Policy Study's pamphlet "Privatise Power" which advocated a competitive power market, and in October 1987 a paper for the government "The Operation of a power market" which progressed the business.

The wheels began to come off the green venture with the cut to the “sun rush” as developers leased fields to smother them with photovoltaic panels. Then the government ineptly ran foul of the courts as it attempted to cut the feed-in tariff for all schemes. Next, the government’s nuclear ambitions were hit by the 2011 Fukushima nuclear disaster. The German government announced nuclear plants would be closed, which hurt the already weakened finances of RWE and E.On. In March 2012 they pulled the plug on their joint British nuclear venture. Iberdrola, which is in a joint nuclear project with GDF/Suez, has a weak balance sheet, and will not be in a hurry, and EDF Energy may proceed more slowly than the government had hoped for.

In 2003 the government was “urgent” about getting a Carbon Capture Storage demonstration project off the ground. It has dilly-dallied since then and Treasury delays undermined its first competition. It is now about to commence a second competition - the earliest any plant could be built is by 2016.

Onshore windmills are expensive, and many people regard them as unsightly in our crowded land and planning objections are increasing. Offshore windmills are extraordinarily expensive and it is an immature technology and the integrity of the support structures unproven. Using the latest figures for the basic production cost of wind and adding in the costs of system integration and transmission we get the medium scenario costs:-

	(£/MWh)
onshore	105
offshore round 2	145
offshore round 3	200

Wind makes nuclear (latest under-estimate £74/MWh and excluding transmission) look cheap. These figures compare with the £53.3/MWh for the winter 2012 seasonal power contract.

The final nail in the case against windmills is the finding from both Irish and US systems that in a thermal based system like the one in Britain they reduce CO2 emissions by a fraction of their output because they require thermal plants to cycle, which reduces their thermal efficiency and thus increases their output of CO2/MWh and so mitigates the apparent CO2 savings from wind.

Windmills make electricity prices very volatile and reduce the operation of gas plant, so making investment more risky. DECC is undertaking the Electricity Market Reform (EMR) project to replace the Renewables Obligation scheme for windmills with feed-in tariffs; to develop long-term contracts for nuclear power plants; and to devise a capacity payment mechanism to support the gas plant required to back-up the windmills. The EMR is misnamed - it is not about reforming a market but about replacing the investment function of a market with central planning - indeed in the case

of renewables, micro central planning - and with what are in effect regulated price contracts designed to de-risk investment. The conventional investment role of a normal market has been eliminated, and also the "spot" market price will be further distorted by the must-run subsidized renewables and nuclear plant.

Two years on from project inception no tariffs have been tabled; no proposals for risk sharing and incentives for nuclear contracts have been made in public; and the development of a capacity market has been a naïve mess. Officials first proposed the wrong type of capacity mechanism and then confused the type of instrument. The EMR has a number of additional flaws (including a failure to sort out the shortcomings of the existing market properly), and has been undertaken for the most part behind closed doors. The EMR is a case example of how not to restructure an industry. While politicians have had some say over the general direction of policies, there can be no doubt that the major failures of the last dozen or so years are the result of the incompetence of DECC officials due to their lack of experience and technical and commercial professionalism. Their shortcomings are exacerbated by the frequency with which they (and ministers) change jobs; their naïve marketism; and the interest some have in greenness at the expense of reality and cost.

To achieve its target requires Britain spending about a quarter of all of the cost incurred by member states in achieving the EU target, with a figure of £110bn cited by the government for electricity capex this decade. **Citigroup repeatedly told anyone who cared to listen that the green cost for Europe in general and Britain in particular was not financially feasible and "in terms of the overall target it will not happen".**

The annual cost of subsidy (*excluding system integration costs*) for windmills in 2011 was almost £0.9bn³ and of subsidies for other renewables was about £0.65bn making a total of £1.5bn. DECC forecast the cost of ROCs increasing to £3.2bn in 2014-15 and the Renewable Energy Foundation has extended the forecast to £8bn in 2020⁴ for onshore wind. Implementing the government's green ambitions has already increased the price of electricity to households by 13%; achieving its targets for 2020 would increase prices by 25%. The number of fuel poor households in the UK has increased from 2m in 2004 to 5½m in 2009 and will increase significantly driven in part by green measures. **We cannot afford the green dream on top of being squeezed to pay off our debts.**

So what can we do? There was once a sensible alternative option to central planning of adopting a market approach to decarbonising/introducing renewables. But after all of the micro-meddling that

³ These figures are derived from multiplying the ROCs issued by £50/ROC. The subsidy for offshore windmills was £368m implying a plus up of nearly twice times the price of electricity (less carbon tax) and £509m for onshore windmills implying a plus up of the price of electricity.

⁴ Energy Policy and Consumer Hardship, Renewable Energy Foundation, 2011.

is not longer feasible. Obviously stop building windmills - but if we must have some then ensure the developers have an incentive to build them in wind efficient locations. This can be achieved by 1) tapering the subsidy the lower the load factor, and 2) as in Spain, not paying for constraining off.

Next we should seek a derogation from the Large Combustion Plant Directive which requires closure of some 12,000MW of coal and oil plant by the end of 2015. We will need more gas plant, as Secretary of State Ed Davey admitted on 17 March 2012, which he claimed the capacity market would assist. Furthermore we should also exploit our reserves of shale gas as quickly as possible.

There is scope to improve energy efficiency including the level of thermal insulation of buildings. Although *notional* house building insulation standards have improved they are still below those in other north European countries with similar climates. But the real shortcoming is that there is no effort to ensure compliance, and many new dwellings are not compliant.

The government has talked for decades about promoting more combined heat and power schemes (CHP), which can achieve a high overall thermal efficiency and low CO₂, but the talk has achieved little. NETA had an adverse effect, and so to offset NETA the government introduced a number of financial incentives including exempting CHP from the Climate Change Levy, which is currently worth about £5/MWh. With the exquisite timing the Chancellor announced removal of the exemption on 21/3/12, a week before the Secretary of State published "The Future of Heating: A strategic framework for low carbon heat in the UK" which is full of fluffy words about government support policies for CHP. We need real policies, not more words.

The only substantial low carbon option for Britain in the medium term appears to be nuclear power provided that we have a long term depository, and that the costs can be contained. This requires a commercial arrangement where the customer base underwrites the investment to keep down the cost of capital.

Finally we need a genuinely reforming government that will make an effort to improve the performance of the civil service by improving its technical professionalism and the rigour of its analysis. But given the inertia of the civil service that is easier said than done. In any case it is another story.

2. NEW LABOUR AND THE COALITION SAVING THE PLANET

At the beginning of the last decade Prime Minister Blair wanted to save the planet. He sponsored a series of White Papers⁵, which set out a decarbonising and green vision, and initiated the "Stern Review: The Economics of Climate Change", which warned that "5-6 degrees centigrade warming is a real possibility for the next century". (In common with a widespread misapprehension, Stern argued that the science on anthropogenic global warming is "settled" - it is not⁶).

2.1 Nuclear and renewables to the fore

In a series of White Papers commencing in 2003 New Labour shifted its stance from opposition to support of nuclear power. It introduced a generic safety licensing regime and a centralized planning approach for major infrastructure projects. In 2008 it encouraged British Energy, which owned all of the British nuclear plants, to accept an offer for its shares (by which time the government owned nearly a third) from EDF Energy.

Unfortunately, nuclear energy⁷ and renewable energy are expensive compared to gas generated power and thus must be subsidized. The latest estimate prepared for the government of the levelised cost⁸ of nuclear power⁹ is £74/MWh, but that may well be too low¹⁰. But nuclear is cheap compared with wind. Take National Grid's figures for Gone Green, which implies developing another (say) 6GW onshore and 15GW offshore, and the Electricity Network Strategy Group's assessment of the cost of upgrading the network and relate costs to onshore and offshore wind. Then using the latest figures for the basic production cost of wind and adding in the costs of system integration and transmission we get the medium scenario costs, see Annex:-

	(£/MWh)
onshore	105
offshore round 2	145
offshore round 3	200

These figures compare with the £53.3/MWh for the winter 2012 seasonal power contract¹¹.

⁵ A significant part of the evidence base for this paper is in my book "The British Electric Industry 1990-2010: the rise and demise of competition", available from www.alexhenney.com. Thus chapter 13 "Greening the Electric Industry - policies and paper" sets out the stream of papers produced by the government. And chapter 14 "Greening the Electric industry - implementation to date" sets out the targets and (with the exception of the conservation programme) the almost total failure to meet them.

⁶ See Richard Lindzen, Professor of Meteorology at the Massachusetts Institute of Technology, who gave a seminar to MPs on 22/2/12, "Global Warming: How to approach the science", http://i.telegraph.co.uk/multimedia/archive/02148/RSL-HouseOfCommons_2148505a.pdf.

⁷ In 2007 the government forecast the construction cost of a nuclear power plant as £1250/kW; in 2010 Mott MacDonald for the government forecast £3743/kW. A study of the French programme of 58 nuclear plants found no learning benefit - the later reactors were twice the cost/kW of the early ones in real terms.

⁸ "Levelised generation costs" (also called "life cycle costs") are the lifetime discounted costs of acquiring, operating and decommissioning a generation asset converted into an equivalent unit cost of generation in £/MWh or p/kWh.

⁹ Electricity Generation Cost Model - 2011 Update Revision 1, prepared by Parsons Brinckerhoff, prepared for DECC, 4 August 2011.

¹⁰ The cost assumes a 10% real discount rate which is lower than the 11.2% rate advised to DECC by Redpoint.

¹¹ Issue 324 of Energy Spectrum, 16/4/2012.

To promote the development of renewable sources of energy - especially wind - the government introduced the Renewables Obligation scheme for subsidizing renewables. The scheme required licensed suppliers to procure an annually increasing proportion of their electricity supplies from certificated renewable energy sources. The Renewable Obligation Certificates (ROCs) could be purchased separately or the obligation could be bought out at a fixed price. The buy-out fund was returned to the renewable generators pro-rata to their output. This was an ill-conceived scheme based on a naïve belief in markets as a panacea. For no useful economic purpose it required renewables generators to sell their power and implicitly assume the risks of the Balancing Mechanism for which they had to pay 10% or so of their electricity price income in order to sell their power to a party that would assume the risk¹². It also exposed renewables developers to the risks of gas driven prices in the wholesale electricity market; to the politically driven price risk of the EU Emissions Trading Scheme; and finally to the future indeterminate value of the buy-out fund for ROCs. Risk was piled on risk was piled on risk, and consequently the cost of capital - and hence the cost of renewable energy - was unnecessarily high. And if all that were not enough, as the Pöyry analysis for banding (op.cit.) pointed out in its sensitivity analyses, the amount of renewables built depends in part on the price of electricity. The British scheme was about a fifth more expensive than the simple German feed-in tariffs (FIT)¹³ and failed to deliver much because there was a perverse incentive to under-deliver in order to push up the value of the buy-out fund. Initially the scheme was technology neutral, but in order to make offshore wind development (and some other technologies) attractive "banding" was introduced that varied the number of ROCs associated with the output from different renewable technologies, thus introducing further regulatory risk. Over the years the government fiddled and then fiddled again with the scheme, making it very complex and effectively turning it into a premium FIT.

In May 2007 at the Spring European Council, against the advice of his ministers Blair signed up Britain to achieve 15% of *all* final energy consumption from renewables by 2020. This implied that the electric industry would have to achieve about 30% of final consumption from renewables, up from 5% in 2007¹⁴. To achieve its target requires Britain spending about a quarter of all of the cost incurred by member states in achieving the European target.

¹² Pöyry observed "In our experience, generators generally incur transaction costs in the sale of electricity. This is typically around 10% of the wholesale electricity price", see Potential impact of revised renewables obligation technology bands, a report to DECC, December 2011, <http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/4081-Pöyry-revised-ro-bands-review.pdf>.

¹³ A feed-in tariff (FIT) is a payment for producing and shipping power into the grid. The simplest FIT is a straightforward payment/kWh; a premium FIT is a sum added to the basic price of electricity. For German and British cost effectiveness see Comparison of feed-in tariff, quota and auction mechanisms to support wind power development, Lucy Butler and Karsten Neuhoff, CMI Working Paper 20, 21 December 2004 <http://www.econ.cam.ac.uk/electricity/publications/wp/wp70.pdf>.

¹⁴ Note that this renewables objective does not reduce greenhouse gas emissions, which are limited by the European Union Emissions Trading Scheme. Rather it displaces cheaper means of reducing green house gas emissions with more expensive renewables measures and depresses the price of EU Allowances, the "carbon tickets" that are traded.

Parliament passed the Climate Change Act 2008 introducing a legally binding framework that requires a reduction in greenhouse gas emissions of 34% by 2020 and 80% by 2050¹⁵. The Act also created the Climate Change Committee which sets a quinquennial carbon budget, and has to report to Parliament annually on the UK's progress in meeting the targets.

The final support measure which New Labour put in place in 2010 were feed-in tariffs for a range of small renewable generators of less than 5MW. These tariffs were supposedly a means of "Bringing electricity generation closer to the public and involving individuals...". The government's cost/benefit analysis for household photovoltaic solar panels gave the net present cost of the scheme as £8.6bn¹⁶ compared with a net benefit of £420m giving a net disbenefit of £8.2bn, which is going some even by the profligate standards of DECC. In the British climate, where the sun shone for an average of 1480 hours annually at Heathrow over the years 2009-11 (compared with about 3300 hours in southern Spain where the sun is also stronger) solar panels at current prices are a daft way of producing trivial amounts of electricity at very high cost, benefiting those that sign up at the expense of the rest of customers.

Both parties to the Coalition are green and the Coalition Agreement of May 2010 proposes for the electric industry to "implement a full programme of measures to fulfill our joint ambitions for a low carbon and eco-friendly economy". The Coalition's first Secretary of State for Energy and Climate Change, Chris Huhne, took over all of New Labour's policies including nuclear (notwithstanding that he had once commented that nuclear was a "tried, tested, and failed technology").

¹⁵ The Royal Academy of Engineering looked at the engineering implications of the 2050 target in "Generating the Future: UK Energy Systems Fit for 2050", www.raeng.org.uk/gtf. The report observes:-

"Although the scale of the challenge has often been acknowledged, very few have sought to try to put numbers to it. We do so and come up with numbers which are currently beyond the capacity of the energy industry to deliver. Turning the theoretical emissions reduction targets into reality will require more than political will: it will require nothing short of the biggest peacetime programme of change ever seen in the UK."

It estimates for a scenario with constant demand that we would require 77GW of nuclear/CCS plus:-

9,600 2.5 MW turbines ¹⁰
38 London Arrays ¹¹
25 million 3.2 kW solar panels
1,000 miles of Pelamis machines
2,300 SeaGen turbines
1 Severn barrage
1,000 hydro schemes

¹⁶ At the then price of pv panels.

2.2 Greenwash - economic loss and political "competition"

Along with the green mood and the Climate Change Act came boasting about Britain "leading the world" in greenery¹⁷. But politicians neglected to tell us that while maybe Germany and Denmark were up with us, others were not following, least of all China and India. The International Energy Agency forecasts their output of coal generated power to double over the period 2008-2035 by 3000TWh p.a., *an increase which is 30 times the UK's current output of coal generated power.*

There was also spin about "green jobs". In fact China provides much of the material for solar panels, while Siemens in Germany and Vestas in Denmark provide most of the windmills with the Chinese coming into contention for onshore windmills and several other companies entering the market for offshore machines¹⁸. A spokesman for Vattenfall, the Swedish developer of the Thanet wind farm of 300MW, estimated that "nearly 20% of our capex [of £900m] has been given to businesses in the UK", implying 80% went offshore. This figure is, however, "better than the 10% reported by E.On and its partners for the London Array scheme", which is three times the size of the Thanet scheme.

In April 2009 the European Commission published "Employ RES: The Impact of Renewable Energy Policy on Economic Growth and Employment in the European Union"¹⁹. The study (based on macro-economic models which examine both the gains in the renewables sectors and the losses in other economic sectors due to higher energy prices) finds that even in the most optimistic (arguably unrealistic) scenarios where EU countries retain more than half of the global green technology market (and presumably the Americans, Chinese and Indians sit on their hands) overall benefits from renewables policies are "slight". For the UK the study predicts relative economic contraction, and in all but one scenario up to 30,000 net job losses, with the costs of policies destroying more jobs than are created even in some of the more optimistic scenarios.

In reality the government is imposing a tax on people²⁰ by requiring them to subsidise an expensive product from Germany and Denmark, which reduces demand for other goods and services - and hence employment - in other sectors of the economy. *Subsidised "green" jobs²¹ destroy other jobs unless we can export the expensive green products.* Furthermore, since about two thirds of the windmills are foreign owned, we transfer £½bn a year in subsidies overseas²², and the

¹⁷ In fact the only area in which Britain is "leading the world" is in the quantum of offshore windmills, a race that few others intend to join because they have more financial sense.

¹⁸ Turbines comprise up to half of the cost of offshore wind farms.

¹⁹ http://ec.europa.eu/energy/renewables/studies/doc/renewables/2009_employ_res_report.pdf.

²⁰ The ROCs count as public expenditure.

²¹ Renewable UK estimated that there were 9200 FTE workers in wind in 2009/10, which gives a figure of subsidy/worker of approximately £57,000 per worker which is about twice the median earnings in the public (£29,000) and private (£25,000) sectors, The Green Mirage, John Constable, Civitas.

²² Calculations by the Renewable Energy Foundation published in the Sunday Telegraph, 18/9/11.

manufacturing jobs “created” are foreign. There is both a deflationary impact on the economy and a balance of payments burden to add to that already resulting from high oil prices²³.

From 2000 for a few years the wholesale market was reasonably competitive, and generators were free to build plant and hope for profit from selling their product. Now, with heavily subsidized plant operations, market competition has been replaced by political competition for subsidy, which in practice means attempting to get their hand in customers’ pockets via DECC. This was shown clearly in the way that the government increased the subsidy for offshore windmills to get the London Array going, and the howls of protest when the government proposed cutting the subsidy for solar panels.

3. THE WHEELS ARE COMING OFF DECARBONISATION/GREENING

The wheels began to come off the decarbonising/greening venture with the solar panels. Although the average household installation is 3kW the subsidy applies to schemes of up to 1300 times this. So there was a “sun rush” as developers leased fields to smother them with panels. The government stopped this in 2011, and then ineptly ran foul of the courts as it attempted to cut the feed-in tariff for all schemes without allowing for adequate consultation.

3.1 The nuclear roller coaster rolls on²⁴

Next, the government’s nuclear ambitions were hit by the 2011 Fukushima nuclear electric disaster in Japan. The German government announced that German nuclear plants would be closed, which hurt the finances of RWE and E.On at a time when their share price had been significantly underperforming the market. This was due in part to losses on the long-term oil indexed gas contracts they had signed; decreased output and depressed prices from wind and solar; and to environmental taxes. On 29 March 2012 they pulled the plug on their joint nuclear venture Horizon, which had intended to develop up to 6600MW of new build power. Although Horizon’s business may be sold to another foreign company which will delay development by years, especially if a new reactor design has to be licensed. Moorside, a joint venture between French GDF Suez and Spanish Iberdrola/Scottish Power to develop a nuclear plant of up to 3600MW, is not likely to proceed in a hurry because Iberdrola’s balance sheet needs strengthening, which will take time. Finally, while EDF Energy has made the biggest commitment to nuclear in Britain, it will proceed more slowly than the government had hoped for.

Professor Gordon MacKerron recently observed²⁵ that “there is no way yet to know what UK nuclear constructions costs will be - this is the largest item of cost not addressed by EMR.” He pointed to enduring UK uncertainty because: -

²³ The alternative to windmills is gas, which at current prices is cheaper to import than windmills.

²⁴ The nuclear roller coaster is the title of chapter 5 of my book.

- No EPR reactor has yet been completed anywhere
- The UK regulatory process is incomplete
- There is no realistic 'turnkey' basis for contracts
- There is uncertainty over how many units will be built to given designs
- There is likely to be a high degree of vendor market power

Looking at nuclear development from the perspective of companies investing, Peter Atherton of Citigroup²⁶ points out that there are five big risks for nuclear power developers:-

1. Planning
2. Construction - potential corporate killer
3. Power price (revenue) - potential corporate killer
4. Operational (output and safety) - unique systemic risk and potential corporate killer
5. Waste and decommissioning

He asks whether the EMR proposals (see below) help address the major risks, and concludes that although they mitigate the power price (revenue) risk by transferring it to the customer, but do not "guarantee returns" - they merely underpin revenue. EMR does nothing for construction risk, nor does it lead to operational risk. Therefore it is questionable whether the proposals reduce the cost of capital. He argues that the state will also have to assume the risks of construction, and waste and decommissioning.

The prospect that a nuclear plant will be completed is receding into the 2020s; and there is no prospect that anywhere near the 26GW of nuclear that the Climate Change Committee sees as necessary by 2027 will be built²⁷.

3.2 "Urgent" CCS

In 2003 the government said it would set up "an urgent implementation plan...to get a Carbon Capture Storage (CCS) demonstration project off the ground". The first attempt was in 2005 by BP, which owned the depleting Millar gas/oil field, and Scottish & Southern for a pre-combustion scheme at Peterhead. They pulled out in 2007 because they believed government support was inadequate. The government then launched a competition for a coal fired power station with CCS but specified that eligibility was limited to post-combustion coal technology. The competition for four plants took four years to complete in significant part because the Treasury were opposed to the project and put every obstacle in the way. Eventually in Gordon Brown's last spending spree in 2009 the money was released. But by then all but two of the competitors had dropped out, and eventually only one scheme (a retrofit of Longannet by Scottish Power) was left. In late 2011 the government concluded that the scheme was too expensive, and said they would launch another

²⁵ "Will the EMR deliver nuclear power?", Conference organised by Cornwell Energy Associates, 17/4/12.

²⁶ Head of European Utility Sector Research, Future of Utilities Conference, Allen & Overy, 30/4/12.

²⁷ Interestingly in Pöyry op.cit. we read in 3.3.4 "It was also assumed that 9.6GW of nuclear and 3.4GW of CCS coal and gas combined, would come forward under the FiT CfD by 2040." Pöyry stated that "All the main input assumptions were provided to Pöyry by DECC."

competition for four projects; they also said they would welcome applications from gas fired stations²⁸. That competition is now underway but the level of ambition seems to have been scaled down and the earliest any plant could be built is by 2016. The “urgency” of 2003 drags on!

3.3 Don Quixote’s green and expensive dreams

There are two types of windmills, onshore and offshore. The onshore windmills are expensive and many people regard them as unsightly in our crowded land. The wind industry is too often given to spinning their capabilities, claiming a load factor of 30%²⁹ when in fact the average load factor of wind farms in England was 22% in 2009; 18% in 2010; and 22% up to November 2011³⁰ - the low average implies that many are below the average. Wind developers are loath to disclose at planning enquiries their estimate of load factor, but the fact that they are keen to develop at such low load factors indicates that the subsidy is too high. The Sunday Times of 15/4/12 reported that Climate Change Minister Greg Barker has “declared there will be no significant expansion in the number of turbines on land beyond those in the pipeline”, but that statement allows for ambiguity.

The offshore windmills are extraordinarily expensive; the supply chain is far from developed for the scale of British dreams; and it is an immature technology³¹. It is not too far fetched to imagine that in future the machines in the North Sea will stand battered and broken³², and our successors may look on them as we look at the temples to the water gods which Mayan shamans built in the ninth century to end the drought which never ended - a fantasy.

As well as being expensive to construct, since the wind blows when the wind blows - and it does not usually blow when there are high pressure periods in winter when it is cold - wind also in practice wind contributes little reliable capacity. With a large wind fleet the system needs almost the equivalent capacity of conventional thermal (mainly gas) plant to meet the peak demand and ensure the lights stay on.

²⁸ The National Audit Office prepared a report “Carbon capture and storage: lessons from the competition for the first UK demonstration”, 12 March 2012.

²⁹ i.e. that over time a 10MW wind farm would produce the equivalent of a 3MW plant running continuously.

³⁰ Capacity Concepts and Perceptions - Evidence from the UK Wind Energy Sector”, Michael Jefferson, International Association for Energy Economics, Second Quarter, 2012, and e-mail.

³¹ There is talk of reducing costs from a learning effect, and DECC has a target for offshore wind of £100/MWh by 2020. But subsidies shelter industries from competition and tend to “infantilise” them, so one may be skeptical about such claims. A study “Great Expectations: The cost of offshore wind in UK waters - understanding the past and projecting the future”, a report by Technology and Policy Assessment Function of the UK Energy Research Centre “...is concerned with recent cost escalations in offshore wind...This report finds evidence that cost increases may have peaked, but does not see any meaningful reduction in the period to 2015...” In the longer term the report finds “reason for cautious optimism.”

³² Great Expectations (op.cit.) records “UK offshore farms have experienced higher than expected loss of generation - in particular from gearbox failure (especially bearings); generator failures; subsea cable damage; and operator access limitations (BVG Associates, 2007). Feng et al. (2010) analysed the operational experience of UK Round 1 projects and found that at only 80.3% the average availability had indeed fallen well short of expectations. As a result, the annual average capacity factor for reporting UK Round 1 wind farms has been 29.5% (Feng et al., 2010) - higher than the average value of 27.3% reported in 2007 for UK *onshore* wind farms but lower than the expected 35.0%...”.

The final nail in the case against windmills is the finding of Dutch physicist Fred Udo that in a system like the one in Britain with very little hydro for regulating short term variations³³ their efficiency in reducing CO2 emissions is low. The efficiency of windmills in saving CO2 emissions depends upon the type of plant that has to respond to the variability of wind output to regulate the system to keep supply and demand in balance all the time. Since wind production is not closely correlated with demand, as wind output increases in the short term, then other dispatchable plant has to back down to regulate the system, and vice versa. If the regulating plants are flexible hydro facilities and the wind is displacing gas or coal production then there is a saving in CO2 emissions equivalent to the avoided thermal production (as is the case in Denmark where the regulation is provided by hydro in Norway³⁴). If, however, the regulating plant is a gas or coal plant which is forced to "cycle", then this reduces the thermal efficiency of the plants and hence increases their CO2 emissions. Thus the net saving of CO2 emissions depends empirically on the behaviour of a real system, not on emissions figures derived from test runs or plants running continuously.

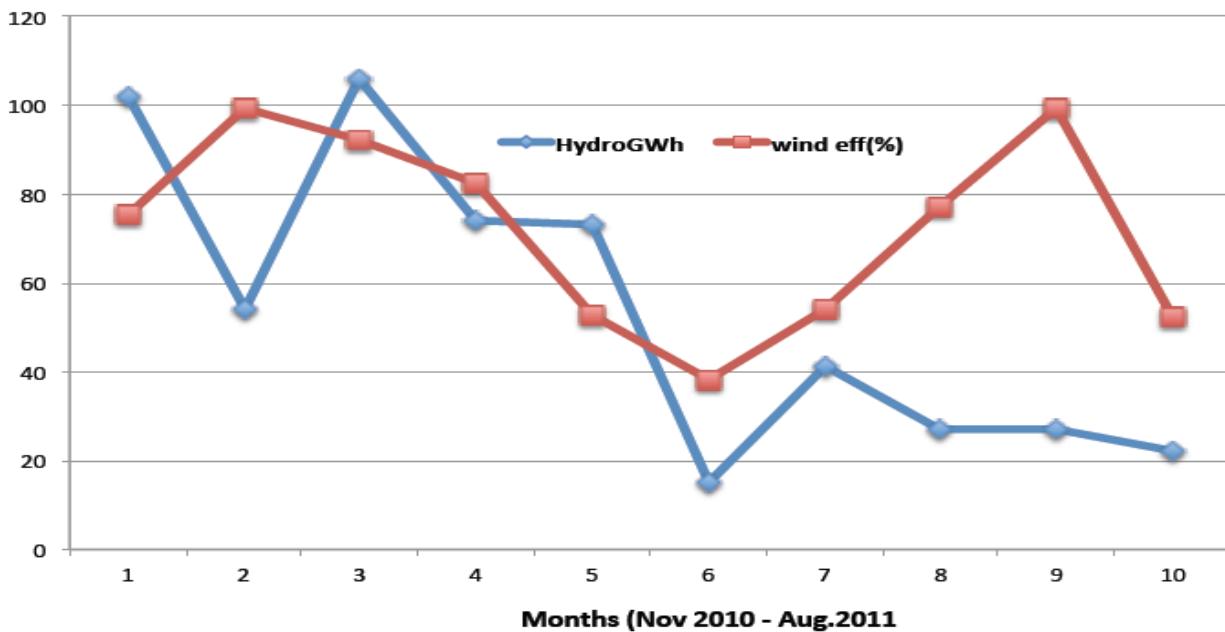
Udo analysed the Irish electric system (www.clepair.net/Udo-okt-e.html) which has a proportionately much higher level of wind production than the British system and generally (but not always) regulates wind variability with hydro³⁵, but sometimes the system is short of hydro and thermal plant regulates; the system operator calculates the emissions of CO2 every 15 minutes and also measures the production by windmills. For ten months with varying hydro situations he calculated the "efficiency of wind" as the ratio of actual CO2 emissions to what they would have been if the output of wind had saved 100% of the thermal generated CO2 which it theoretically displaced, see exhibit 1.

³³ The British system currently needs about 4GW of regulating capacity available at all times. Pumped storage provides about 1.8GW; part-loaded CCGT and coal plants provide the remainder of about 2GW. Most, if not all, of the additional 3GW required under the Gone Green scenario for 2020 is likely to be thermal plant.

³⁴ Wind Power and CO2 Emissions 2011, Paul-Frederik Bach, 11 March 2012, <http://pfbach.dk>.

³⁵ In Eirgrid most of the regulation is provided by a 270MW pumped storage facility and 3 hydro facilities totaling about 180MW that have the reservoir capacity.

Wind efficiency and hydroproduction



The “efficiency” is dependent upon the availability of hydro for regulation - in April 2011 when hydro was low the proportion of wind output was 12% but the reduction of CO₂ emissions was only 4%.

A similar study in the US of the emissions impact of wind energy on Public Service Company of Colorado and of the main Texas system of ERCOT, which are both predominantly thermal systems, concluded that NO_x and SO_x emissions increased significantly, and CO₂ savings are “minimal at best”³⁶.

The Irish system has proportionately significantly more hydro for regulating than the British system, which relies more on thermal plant, so British wind efficiency in reducing CO₂ emissions will be much lower and with more wind, will become even lower - as per the Colorado system. IN BRITAIN WINDMILLS DO NOT DO WHAT THEY CLAIM ON THE TIN.

3.4 The Electricity Market “Replacement” project

The introduction of a significant level of wind leads both to very volatile prices and to cycling of plant, which increases the riskiness of investing in the gas plant required to back-up the windmills. Indeed, many might be reluctant to invest. Following reports by Ofgem and then the New Labour government the Coalition government announced that it was going to undertake the “Electricity Market Reform” (EMR), which was claimed necessary to “keep the lights on” and to “make Britain one of the best places to do energy business”. The intention was to replace the ROCs for windmills with a feed-in tariff; to develop contracts for nuclear power plants; to support CCS with contracts;

³⁶ How less became more: wind, power and unintended consequences in the Colorado Energy Market, Bentek Energy LLC, 16 April 2010, <http://docs.wind-watch.org/BENTEK-How-Less-Became-More.pdf>.

and to devise a capacity payment mechanism to financially support the gas plant necessary to back up the windmills and to ensure security of supply because about a fifth of the existing portfolio of plant will be retired by 2020. The project is misnamed - it is not about reforming a market but about replacing the investment function of a market with central planning (indeed in the case of renewables, micro central planning³⁷) and with what are in effect regulated price contracts designed to de-risk investment. *The conventional investment role of a normal market has been eliminated and the "spot" market price will be depressed and distorted by the must-run subsidised renewables.*

Two years later no indicative prices have been tabled for nuclear, nor outline proposals for risk sharing and incentives. According to a report in the Financial Times (21/4/12) Centrica (which has publicly indicated it is not willing to assume construction cost and time risk) is fidgeting about its involvement in the joint venture with EDF Energy at Hinkley Point. The only clue to cost has been a consultant's suggestion that the appropriate post-tax weighted average cost of capital for a nuclear plant would be 11.2%. DECC has seemingly rejected the financing approach adopted for the only nuclear power plant being developed in the US of building against the regulated asset base (which has a post-tax cost of capital of 7.8%) because it clings to naïve delusions that this development is in unexplained ways market related. The difference in the cost of capital between 11.2% and 7.8% results in a production cost of about £80/MWh versus £56/MWh, and represents a saving of £bn for customers³⁸. DECC appears to be proposing to repeat the mistake of the Renewables Obligation Scheme at the expense of customers.

At least up to the end of 2011 the development of a capacity market has been a naïve mess. First, DECC proposed an approach adopted in Sweden of a so called "strategic reserve". While this was appropriate for the potential problem the Swedes wished to address of having a few thousand MW available to meet a possible water shortage, it was not appropriate for providing and keeping online the many thousands of MW required to back-up windmills. Next, although the author advised DECC in September 2010 that reliability options (ROs) had been implemented in the New England market following advocacy and work by an American colleague³⁹, DECC's EMR green paper of December 2010 referred to ROs as "academically interesting but not applied in practice". In early January 2011 I corrected this misapprehension and provided an article by my colleague describing the New England ROs. In its next consultation paper of July 2011 DECC had many pages on the RO concept, but got its nature wrong, describing it as a financial option when in fact it is an option on electricity production. Eventually a Spaniard put DECC officials to rights both on the Swedish issue

³⁷ The Pöyry report for DECC on banding (op. cit.) makes this very obvious with a set of figures showing modeled levels of renewables generation for 11 types of generation for 4 options of banding.

³⁸ "Developing trading arrangements for a windy electric industry" available on request from alexhenney@aol.com.

³⁹ He and I developed the concept in 2003 in a study for the Amsterdam Power Exchange, and subsequently in a study for a number of European regulators in 2005. Concurrently Spaniards at a university in Madrid developed and applied ROCs in Columbia.

and the RO, but not before DECC had wasted more than a year and the time of people in electric companies.

Further shortcomings of the EMR are:-

- The lack of provision of information to industry participants. As Nigel Cornwall observed⁴⁰ "The proposals as they stand do not give sufficient clarity and confidence for investors to proceed"
- There has been no indication as to where DECC has got with trying to resolve the very difficult issue of striking a balance between 1) revenues and profits to investors and 2) the interests of customers (which it failed to do with the ROCs)
- The seeming failure to look at the impact of the CFDs on the rest of the market, notably the impact on small generators and suppliers
- Stating the capacity market will not be introduced until it is shown there is a need for it will encourage developers to delay investment until it becomes necessary to implement it
- The failure to sort out NETA properly⁴¹ but merely have Ofgem undertake yet another cash-out review⁴², and not to address the issues raised by the EU's "target model" in market splitting between Scotland and England and the related issue of using locational incentives to minimise costs

The EMR is a case example of how not to restructure an industry. While politicians have had some say over the general direction of policies and too often want to be seen to be doing something, there can be no doubt that the major failures of the last dozen or so years - the expensive and fruitless introduction of NETA (which is an intellectual abortion) and its flawed extension to BETTA; the expensive ROC system; the overly generous FITs for solar panels; the incompetent mess made of capacity payments; the nuclear misconception; the proposal to waste £bn on an ill-conceived implementation of smart meters planned to cost about twice that of the Italian and Spanish roll-outs and with no obvious benefits⁴³ - are due to the incompetence of DECC officials. In part this is because of lack of technical and commercial professionalism resulting from civil service selection procedures and belief in generalists, and it is exacerbated by the continual job switching⁴⁴. In

⁴⁰ Op.cit. Conference on 17/4/12.

⁴¹ The aims should be to simplify its procedures and governance; to eliminate the excessive imbalance risk; to introduce a locational component; and to increase liquidity in the contract market.

⁴² Since NETA was introduced there have been cash-out reviews in 2004, 2007, and sort of in 2009, with criticism of cash-out prices in 2010. From 1993 until now the Swedes only changed their cash-out prices once, and that was not because they were not satisfied with them, but as part of a Nordic compromise to align cash-out prices with Denmark, Finland and Norway.

⁴³ See "A critique of the impact assessment (IA) of smart meter roll-out for the domestic sector (GB) 18/07/2011", Alex Henney, EEE Ltd, March 2012, available from the author at www.alexhenney.com. In 2007 engineering consultant Mott MacDonald undertook a cost-benefit analysis of a domestic roll-out of smart meters and came to the conclusion there was a net *disbenefit* of £4.3bn - by August 2001 the civil servants had changed the figures into a net benefit of £4.9bn. Their Impact Assessment lacked information about the assumptions made; did not appraise some of the risks realistically; had some flawed methodology; did not consider the cheaper costs of roll-outs in other countries; and was poorly drafted. The consequence of its shortcomings was that it was the most optimistic - and unrealistic - assessment of 8 others roll-outs I analysed in Europe and ANZAC.

⁴⁴ One organisation observed that "During the 21 month period of the Coalition Government "we have dealt with ever changing personnel in a number of departments and especially at DECC. Officials with limited or no experience in a sector are brought in to a team part way through policy development and the whole process slows dramatically. The generalists,

consequence there is very little corporate memory of why and how things were done and what worked and did not work, and little knowledge of foreign electric systems. Furthermore there must be a suspicion that analyses are politicized. *DECC's main "competences" appear to be an ability to produce vacuous waffle - it appears to confuse "roadmaps" with action to judge numbers; to create complicated bureaucracy; to fudge numbers, some of which are frankly deceitful; and to throw customers' money at vested interests which knock at its door.*

Although the government learns not to make the same mistake twice, it seems incapable of improving the rigour (*mortis!*) of its decision making. So it gaily goes on and makes new – and avoidable – expensive mistakes. The experience of the EMR endorses the view in my book that “Perhaps fundamentally a competitive electric industry is just too complicated for political and bureaucratic processes.” The last sentence of my book is “In a decade or so will someone write a “History of the British electric industry – 2011 to 2020: the rise and demise of greenery”? It is no bad thing that the wheels are coming off sooner rather than later because it will curb the profligate waste of money. But in the process its legacy may be that we mess up the market even more. We make changes on the assumption that there will be significant wind, but this may not be realized. Thus instead of improving the market to rectify the shortcomings of NETA, we create new problems and complexities.

3.5 The unaffordable costs

The government and Ofgem cite a figure of £110bn for electricity capex this decade. Atherton⁴⁵ told anyone who cared to listen that the cost of the renewables ambition for Europe in general and Britain in particular was not financially feasible. He commented recently that the “chasm between reality and the target is now galactic...in terms of hitting the overall target it will not happen.” He pointed out that the European utilities sector (which is the fourth largest sector of the stock markets) has since February 2009 been derated by 40% against the market as a whole⁴⁶ and by 50% against US utilities, and has only performed 9% better than the European banking sector most of which is effectively bust. Atherton points out that there have been recent tax grabs on energy companies in Italy, Germany, Finland, the Czech Republic, Belgium and Spain, a political risk which does not enthuse investors. He observes that government estimates of the price impact on customers are not credible, and that “When faced with a choice, politicians have, in our view, sided with consumer over investor. Will UK ministers in 2018 defend record prices and record profits?” As a consequence of financial strain and distrust European utilities have cut back their capex from a peak of nearly €70bn in 2009 coming down to €45bn in 2015, which is much lower than required to

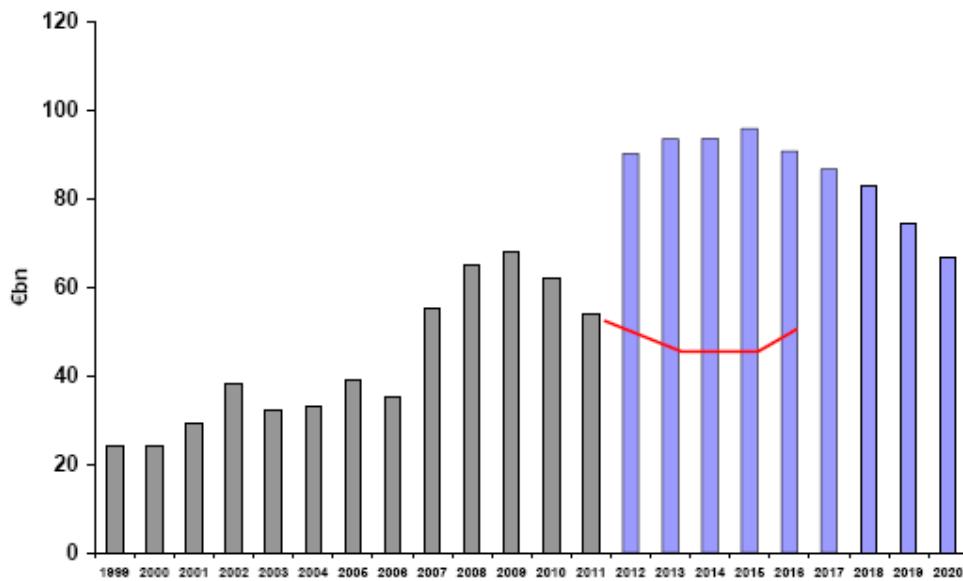
albeit bright, are not capable of dealing with the technical issues.” The Spaniard who advised on the capacity market commented the officials were bright and open minded, but ever changing jobs.

⁴⁵ Op. cit.

⁴⁶ The market cap of renewable energy stacks list a high between August 2007 to August 2008 of €45-55bn and have bombed to €7bn

meet the European Commission's estimated spend necessary to meet the 2020 renewables target, see exhibit 2. But politicians chose not to listen; now with the withdrawal of RWE and E.On reality is dawning at least in the nuclear world, see below.

Exhibit 2 Utility Sector Annual EU Energy Capex - actual and required



Also there is increasing awareness of the cost to customers of the green agenda. The annual cost of subsidy for windmills in 2011 was almost £0.9bn⁴⁷ and of subsidies for other renewables was about £0.65bn making a total of £1.5bn to which should be added the additional costs of constraints and system balancing. DECC forecast the cost of ROCs increasing to £3.2bn in 2014-15 and the Renewable Energy Foundation has extended the forecast to £8bn in 2020⁴⁸. In addition we have the additional costs of transmission and transmission constraints; system balancing; the EU ETS; nuclear contracts; other green initiatives; and (unless the approach is altered) a waste of several £bn on smart metering. Then on top of all this we have VAT at a direct rate of 5% for electricity consumption and 20% flowing through other VATable goods totalling well over £1bn.

The Committee on Climate Change estimated that green measures cost the average customer £75 in 2010 representing 13% of the bill, increasing in 2020 to 25% of the bill⁴⁹. Do people want to pay 25% more for greenery? A survey of 1,774 people in May 2008 by Politics Home were asked:-

"How willing or unwilling would you be to pay higher electricity bills if the extra money funded renewable power sources like wind or solar power. The response was that:-

- 37% said they were very unwilling

⁴⁷ These figures are derived from multiplying the ROCs issued by £50/ROC. The subsidy for offshore windmills was £368m implying a plus up of nearly twice times the price of electricity and £509m for onshore windmills implying a plus up of the price of electricity.

⁴⁸ Figure 4 of Energy Policy and Consumer Hardship, Renewable Energy Foundation, 2011.

⁴⁹ Household Energy Bill, 15 December 2011, Committee on Climate Change.

- 24% said they were fairly unwilling
- 25% said they were neither willing or unwilling
- 12% said they were fairly willing
- 3% said they were willing”

We cannot afford the green dream on top of being squeezed to pay off our debts.

The backlash has already begun in the Daily and Sunday Telegraph⁵⁰ and Daily Mail⁵¹. *It is not surprising that with the increase of gas prices plus the “green” costs, the number of fuel poor households in the UK has increased from 2 million in 2004 to 5½ million in 2009*⁵². *Green ambitions will push them higher and increase political pressure.*

4. WHAT IS TO BE DONE?

There was once an alternative approach to what in effect has become central planning, which has been set out by Simon Less of the Policy Exchange⁵³. Namely he points to the experience over decades of the unreliability of electricity related forecasts - of demand, of fuel availability and prices - citing as recent examples the consequence of shale gas in the US which halved the gas price there, and the significant reduction in photovoltaic costs which embarrassed DECC. The lesson to draw from failed forecasts of fuel prices and technological innovation is that one should make as few assumptions as possible and let the market sort out how to respond to the quantity constraints of the EU ETS possibly backed by a carbon floor price. This approach would avoid the need for government forecasts; government technology choices; and subsidies with associated complexity and rent seeking. Unfortunately it may now be too late to pursue this approach because of the damage caused by the continual meddling that has gone on for the last dozen years. And it may involve too much loss of face for the Coalition, so it would be the sort of change that can only occur with a change of government.

So what can we do by way of damage limitation? Obviously stop building windmills - but if we must have some then ensure the developers have an incentive to build them in wind efficient locations. This can be achieved by 1) tapering the subsidy the lower the load factor, and 2) as in Spain, not paying for constraining off.

Next, although we currently have sufficient capacity there may be a shortage later this decade or early next decade because we signed up to the Large Combustion Plant Directive which requires closure of some 12,000MW of coal and oil plant by the end of 2015 and new nuclear plants are slipping. We should seek a derogation. Next we need to build some more gas plant, which the

⁵⁰ For example there was a set of letters to the editor on 23/9/10 under the banner heading “The cost to every household of subsidizing energy generation by wind farms”.

⁵¹ Green taxes add 15% to your energy bills, 17/2/12.

⁵² Fuel Poverty in the UK and England, 2009, DECC 2011.

⁵³ At the conference on 17/4/12, op.cit.

government has already proposed. On 17 March 2012 the Secretary of State Ed Davey stated that "Gas will continue to play a vital role in a low carbon economy." He explained that "The Capacity Market will be designed to bring forward sufficient investment in new capacity...to provide certainty to gas investors."⁵⁴ Chancellor George Osborne followed up in the budget four days later commenting "Gas is cheap, has much less carbon than coal and will be the largest single source of our electricity in the coming years." It is good to know there is still some commonsense around! And linked with more gas plant we should exploit our reserves of shale gas as quickly as can be done in a safe manner.

There is scope to improve energy efficiency. While the programmes implemented by suppliers over the past decade (EEC, CERT, and CESP) have been reasonably successful, there is much more that can be done, especially to improve the level of thermal insulation of buildings. A fifth of all final energy consumption is used for the space heating of dwellings. According to the Association for the Conservation of Energy, although notional house building standards have improved they are still below those in northern France, Netherlands, Germany, and Denmark⁵⁵,⁵⁶. But the real shortcoming is that there is no effort to ensure compliance, and perhaps as many as half of the new dwellings are not compliant. While the aspirations of the Coalition government may be worthy, will it deliver more than talk?

Conservation does not keep the lights on. The government has talked for decades about promoting more combined heat and power schemes (CHP), which can achieve an overall thermal efficiency of 80% and more⁵⁷ (compared with a modern CCGT of 55%). Thus in 2000 the government

⁵⁴ Davey sets out measures to provide certainty to gas investors, DECC Press Release 2012/025, 17/3/12, http://www.decc.gov.uk/en/content/cms/news/pn12_025/pn12_025.aspx.

⁵⁵ The Renewable Energy Foundation estimates that adjusting for climate "It is evident that the Scandinavian countries are more efficient in their energy consumption for heating dwellings with Sweden, Denmark, and Norway consuming 5%, 11% and 41% less energy respectively than the UK", op.cit.

⁵⁶ In Building in Ignorance, prepared for Energy Efficiency Advice Services for Oxfordshire, October 2001, David Olivier observed:-

"Previous Part L revisions[of the building regulations] in 1982, 1990, 1995 - cumulatively were supposed to reduce energy consumption for space heating by 60%. No evidence exists to show that these benefits were achieved in practice and the net effect may have been only a third of this target. The present aim of a further reduction of 23% may well be barely 10% in practice. This Report demonstrates that our current Building Regulations commit us to dwellings with unnecessarily high carbon dioxide emissions, for the life of the building - decades, if not centuries. British householders will also be subject to higher energy bills than could have been the case."

New British houses retain the heat less effectively than Scandinavian houses built before the Second World War; Swedish high standards have added only 1% to building costs; homes are now consistently so well built that testing for air leakage is no longer necessary."

⁵⁷ The Renewable Energy Foundation (op.cit) observes that "Denmark's consumer-owned, regionally-organized, electricity industry was created early in the last century, and from the outset the thermal power plants have been developed to run as CHP units delivering district heating... Approximately 1.5 million households, or 60% of the total, are connected to district heating networks. All the base-load power plants in Denmark are over 42% efficient in condensing mode - (i.e. when delivering no district heating in high summer) - and up to 93% fuel efficient in full CHP mode. Denmark still boasts several coal-fired plants that are the most efficient in the world. Nordjyllandværket near Aalborg, for example, is 48% efficient in condensing mode, and as a consequence of this, only a small fraction of the primary energy used is lost to the environment in winter. In contrast to Denmark, the UK's coal fired power plants are about forty years old on average, and

announced a target of achieving at least 10GW of Good Quality CHP by 2010, and in 2004 came "The Government's Strategy for Combined Heat and Power to 2010". In supporting NETA the government claimed that it would not adversely affect CHP as compared with the Pool (which was designed to be friendly to small generators). Clearly the government did not know what it was talking about. The complexity of the arrangements; the penalty of the Balancing Mechanism for plants that were not operated by the Big Six⁵⁸; the lack of liquidity of the contract market; and the fact that the EU ETS does not fully credit CHP schemes with the carbon saved⁵⁹; have all had a serious adverse affect on CHP schemes.

To offset NETA and promote CHP the government introduced a number of financial incentives including exempting schemes from the Climate Change Levy for indirect electricity supplies, which is currently worth about £5/MWh. With the exquisite timing illustrative of the frequent inability of Whitehall to "join up", the Chancellor reneged on the government's decision in 2009 that the exemption would last until 2023, and on 21/3/12 removed the exemption a week before the Secretary of State published "The Future of Heating: A strategic framework for low carbon heat in the UK". *This points out that after a decade of talk there is currently only 5.9GWe of industrial CHP* although "There is a further established technical potential of 24GWe by 2020" (but all may not be economic). The government also extols the benefits of heat grids for buildings; cites Copenhagen; and advocates the development of heat grids⁶⁰. The report has fluffy words about government support policies for both; we can be reasonably sure they are merely more words.

The only proven and substantial low carbon option for Britain in the medium term appears to be nuclear power provided we have a long term depository, and the costs can be contained⁶¹. But for nuclear to proceed it will require a commercial arrangement where government or the customer base assumes critical risks and effectively underwrites many aspects of the investment. If this means central purchasing and a legally guaranteed franchise or levy on customer then so be it - it would as explained above significantly reduce the cost of capital.

they are at best only capable of about 37% efficiency when in condensing mode. None of these plants delivers district heating." (6.2.10 to 6.2.15). (Note the Danish efficiencies look very high compared with the British figures - perhaps the Danish figures are for net calorific values while the British are for gross calorific values. But the point still stands).

⁵⁸ As pointed out earlier, schemes that are not owned by the Big Six lose 10% of their price from selling their output to a party which can manage the Balancing Mechanism risk.

⁵⁹ Viz from heat-only boilers which the CHP displaces.

⁶⁰ In a 2009 report for DECC "The potential and costs of district heating networks" by Pöyry and Faber Maunsell, AECOM, (<http://www.decc.gov.uk/assets/decc/what%20we%20do/uk%20energy%20supply/energy%20mix/distributed%20energy%20heat/1467-potential-costs-district-heating-network.pdf>) the consultants suggest that "Under appropriate conditions, district heating could feasibly provide up to 14% of the UK's building heat demand. To achieve this, the main economic barriers facing new projects - high risk and upfront capital costs - would have to be addressed. We believe, and international experience has shown, that the role of the public sector (and local authorities in particular) is crucial in enabling developers to construct low-risk district heating business models...Our analysis suggest that, where district heating networks can achieve a high penetration (in the region of 80%) in a built-up area, the carbon abatement costs of district heating options can be better than the most cost-effective stand-alone renewable technology."

⁶¹ I have no illusions about nuclear power. In 1989 I wrote "The economic failure of nuclear power in Great Britain", published by Greenpeace.

Finally we need a genuinely reforming government that will make an effort to improve the performance of the civil service by improving its technical professionalism and the rigour of its analysis. But given the inertia of the civil service that is easier said than done. In any case it is another story.

Annex The going forward cost of wind

The conventional manner in which the cost of generation is presented is as a "levelised" cost using low, central, and high estimates and basing the costs on the capital cost of the facility; its availability; its fixed and variable O&M; its fuel cost; and (if significant) its decommissioning cost. DECC is using cost estimates prepared by Ove Arup and Partners with assistance from Ernst & Young as the basis for its review of banding⁶². Arup's estimates for the levelised costs of (large) onshore and offshore wind farms of >5MW for 2015 are as follows:-

		£/MWh
£/MWh		
Onshore	low	72
	medium	88
	high	105
Offshore	low	123
	medium	139
	high	158
Offshore round 3	low	168
	medium	192
	high	225

The basic "production" costs are, however, only part of the story *when there is a significant level of wind*. For a start National Grid estimates the extra system cost required to handle the variability of wind for 2020 at £286m for a wind output of about 70TWh p.a. say an average of £4/MWh⁶³. Next the Electricity Network Strategy Group has just reported "The total estimated cost of the potential reinforcements contained in this report, based on National Grid's Gone Green 2011 scenario is around £8.8bn"⁶⁴. The ENSG report assesses the reasons for, need for, and cost of transmission reinforcement in - areas of the country as follows:-

Scotland, which is divided into:-

- SHETL where "The volume of generation...is expected to increase over the coming years due to the growing capacity of renewable generation" and it refers to various wind developments. The Gone Green 2011 (GG2011) scenario refers to 2.2GW offshore; 4.5GW onshore
- SPT - "The volume of generation...is similarly expected to increase...due to the growing capacity of onshore wind farms...together with the Crown Estate Round 3 offshore wind farm in the Firth of Forth." GG2011 refers to 1GW offshore and 4GW onshore

The estimated cost of reinforcements in Scotland for the GG2011 scenario is £2.5bn.

⁶² Department of Energy and Climate Change, Review of the generation costs and deployment potential of renewable electricity technologies in the UK, Study Report, Arup, October 2011,

<http://www.decc.gov.uk/assets/decc/11/consultation/ro-banding/3237-cons-ro-banding-arup-report.pdf>.

⁶³ Operating the Electricity Transmission Networks in 2020 – Update June 2011, National Grid.

⁶⁴ ENSG 'Our Electricity Transmission Network: A Vision For 2020', 11D/954, February 2012,

<http://www.decc.gov.uk/assets/decc/11/meeting-energy-demand/future-elec-network/4263-ensgFull.pdf>.

Scotland-England interface: "A number of potential reinforcements have been identified which have the ability to increase the boundary capacity to meet the increasing transfers from Scotland to England" due to increased generation of 9GW of Scottish Wind (namely the above 11.7GW, minus 2.5GW of existing onshore capacity). The reinforcement includes both the Western HVDC link (around £1bn) for which "The main driver...is the large volume of renewable generation that is expected to connect Scotland to Northern England over the next ten years." It also includes the East Coast HVDC Link 1 between the North East of Scotland and the North East of England (£1.2bn) for which the "main driver...is the large volume of renewable generation (mainly onshore wind and some offshore wind and tidal) that is expected to connect in the North of Scotland...". The reinforcement also includes increasing the three Scotland/England onshore boundaries to give a total cost of £3.5bn.

The total "Scottish" cost is £6bn of which (say) a £5.7bn share is due to wind of which there is 3.2GW new offshore wind and 6GW *new* onshore. Pro-rating according to capacity gives £2.3bn for 3.2GW offshore and £4.4bn for 6GW onshore wind.

North Wales: a net increase of 2.8GW of generation is forecast under the GG2011 scenario because of a nuclear plant at Wylfa of 1.2GW (current nuclear capacity is 1.0GW) and 2.6GW of offshore wind at a cost of £1.1bn, then on a pro-rata basis £0.75bn is for offshore wind.

Mid Wales: "The area has been identified as one that has significant potential for onshore wind generation" and is marked for 0.8GW at a cost of £0.2bn.

South West: GG2011 forecasts "a significant amount of new nuclear (1.6GW) and wind generation" (offshore 1.1GW) at a cost of £0.5bn. Pro-rating credits £0.2bn to 1.1GW of offshore wind.

East Coast and East Anglia: GG2011 foresees a cost of £0.75bn driven by 6GW of offshore wind.

London, Thames Estuary and South Coast: GG2011 foresees 1.5GW of offshore wind incurring a cost of £2-400m (say £0.3bn).

Thus for a total of 14.4GW of offshore wind we are incurring £3.8bn of transmission investment and for 6GW of onshore wind a total of £3.9bn. If we annuitise the investment at 6.25% over 40 years we get a charge of about £240m for 14.4GW offshore wind and £240m for 6GW of onshore wind. Suppose the offshore windmills generate with a load factor of 34% and onshore at 25% then we get a charge of about £5/MWh for offshore and £16/MWh for onshore wind.

Thus the medium scenarios for wind in 2015 are costs for offshore of £144/MWh(say £145/MWh) and £197/MWh (say £200/MWh) for round 3, and £104/MWh(say £105/MWh) for onshore.