

Generation yesterday, today, and perhaps tomorrow, Article for Energy World Magazine of the Institute of Energy, Alex Henney¹

In my book "The British Electric Industry 1990-2010: the rise and demise of competition" I try to cover all aspects of the electric industry - the wholesale market with the wasteful and fruitless creation of the New Electricity Trading Arrangements, which was the first step in the demise of the market; the nuclear roller coaster; the corporate whirligig that led to the formation of the oligopoly, which was the second step in the demise of the market; how smart metering is being provided unsmartly and expensively; the initial failure of effective network regulation followed by a slow learning process to innovative approaches; and the greening of the electric industry, including the failure to deliver by both the European Emissions Trading Scheme and the Renewables Obligation, which is fundamentally flawed; and the impossible and expensive ambitions for 2020. These are not only the death knell of the market, but also raise the question of when will the wheels come off the venture as the cost becomes apparent?

The editor of Energy World asked me to review past generation, today's generation, and speculate on the future. The privatisation and the subsequent green ambitions, have had a profound effect on the generation mix regarding nuclear, fossil generation, and wind.

Nuclear

Fed with lies from the Central Electricity Generating Board and the Department of Energy that nuclear was economic (1), the Thatcher government wanted the development of four PWRs of which Sizewell B was to be the first. The attempt to transfer nuclear plants into a commercial framework revealed the truth, and they were withdrawn from the privatisation and put aside for 15 years.

Then the government started a process that ran through consultation papers "The Energy Challenge: Energy Report" in 2006 (2) to "Meeting the Energy Challenge: A White Paper on Nuclear Power" January 2008 (3) to resuscitate them to help decarbonise the electric industry. With the encouragement of the government several continental utilities threw their hats in the ring, with EDF in the lead. It not only bought sites but acquired for top dollar British Energy along with its portfolio of generally idiosyncratic, aging and to varying degrees unreliable AGRs.

The main purpose of the European Emissions Trading Scheme (EU ETS) - described as the "cornerstone of the Government's policy framework to tackle climate change" - was to induce the development of decarbonisation technologies both generally and in the power sector. While (subject to their relative prices) it promoted gas rather than coal, it did nothing to promote more

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expensive technologies such as nuclear and wind because the price of carbon was both too low and too volatile. Indeed, if anything by increasing volatility it mitigated against these technologies.

The original story line from EDF was that nuclear was economic in a market, but with major cost overruns at the Oikiluoto plant in Finland and at Flamanville in France and the failure of the EU ETS to deliver, reality dawned and EDF lobbied for a floor price on carbon. Eventually, last December the government proposed in its Energy Market Review consultation (4) an unspecified contract (for differences). Regrettably the debate has been premised on muddled thinking about the provision of nuclear within a market framework. The electricity market is driven by gas prices and has on top of it the EU ETS. Whereas gas and coal plant have an automatic hedge, nuclear does not. If the aim is to provide nuclear for public policy reasons and it is not economically competitive, then it is inappropriate to expose the income of a nuclear plant - or a windmill - to the vagaries of the market and EU ETS.

The sensible way to structure nuclear is as a regulated asset based on a carefully structured and costed contract as is being done for the Vogtle 3 and 4 plants in Georgia US. The nominal weighted average cost of capital for the scheme is 7.8% which compares more than favourably with the 10.5% cited as being required by EDF. (Other developers may seek more - DECC's consultant (Redpoint) assumes an 11.2% hurdle rate for a nuclear plant with a CfD). According to Citi Investment Research's model, using a construction cost of €3200/kW (which is in line with EDF's claim of £9bn for 3300MW) and their other assumptions, **the resulting cost of nuclear power would be £74/MWh**. With the 7.8% return of the Georgia Power financial framework, **the resulting cost of nuclear power would be £56/MWh**, which is 24% lower and allows significant cost overrun yet still leaves the customers ahead.

While nuclear is in play, we have to wait to see what effect Fukushima has on delay and additional costs. EDF is clearly in the lead and arguably has the government over a barrel. The other consortia may hold back to see how favourably EDF is treated, in particular what it negotiates for construction cost overruns.

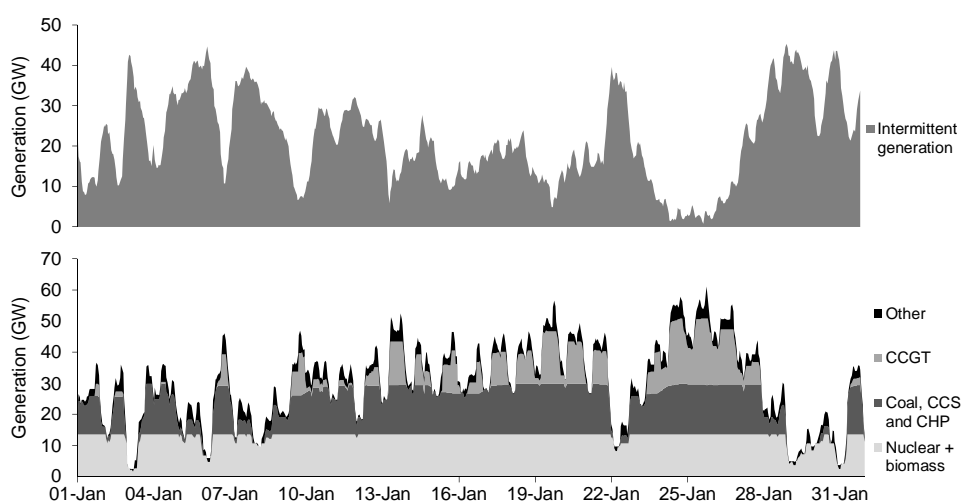
Thermal plant

The CEGB's view in the summer of 1987 was that "the PWR and new coal fired plant, represent the main options for meeting capacity shortfalls in the next decade or so". Barnwood, the CEGB's house of wet dreams, had several 900MW super-critical coal plants in design. But fortuitously privatisation coincided with significant improvements in CCGT technology and the revocation in October 1990 of the European Community's 1975 directive restricting the burning of gas for power

generation. The coal plants were binned and 30GW of CCGTs have been developed over the last two decades. They have been responsible for the significant reduction in CO2 emissions from the power sector to the middle of the last decade, but subsequently in carbon intensity fluctuated (5).

Now, however, their economics are threatened by the significant introduction of wind. Pöyry’s well known simulations of the behaviour of a future with significant level of wind not surprisingly reveals very volatile prices; prices in general are lowered; and also despatch is driven (inversely) by wind, see exhibit 1.

Exhibit 1 British market in January 2030 with 2000 weather



Source: (6)

The running regime of CCGTs and coal plants is highly irregular as they are ‘squeezed’ into intermittent patterns, with more starts per year; and thermal plant load factors are much lower, see table 1.

Table 1 The reducing load factors of thermal plant (%)

	2010	2020	2030
CCGT - older	28	4	1
CCGT - newer	73	57	36
Coal	57	50	28

Source: (6)

The commercial risk of operating a thermal plant in a windy market will be much greater than currently, and consequently the cost of capital required for developing plant will increase.

Yet since the capacity credit for wind is at most 10%, gas plants are required to back up wind. There is not likely to be enough capacity built without support, and so the Energy Market Review is proposing a targeted capacity mechanism which has only been outlined. But come what may with nuclear and wind, gas plant will one way or another be built to keep the lights on.

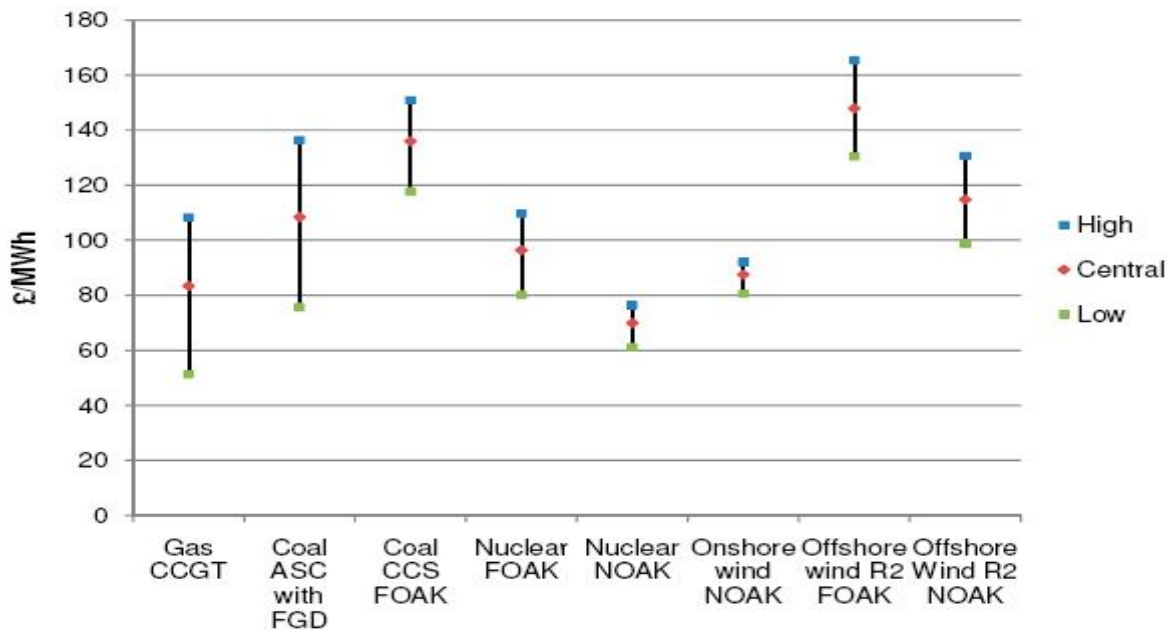
With the carbon floor price and proposed emissions standards, coal will reduce, but finally after delay due to Treasury obstructionism, up to four pilot carbon capture sequestration plants will be built.

One of the topics the government has talked and talked and talked about in my 30 years involvement with the electric industry has been the benefits of, and the need to promote, combined heat and power (CHP) schemes. The nationalized industry obstructed CHP in as many ways as it could; provisions in the Energy Act 1983 were supposed to promote it, but the Act was flawed. In 2000, when CHP capacity totaled 4½GW(e), the government announced a target of achieving at least 10GW of good quality CHP by 2010. But CHP was disadvantaged by the introduction of NETA, which was eventually offset by numerous financial incentives. In the event the target was missed by a mile - only 5.5GW was on the bars in 2009. Here is a technology that is tried, efficient, and carbon effective. But still, after all the talk and paper, the complexity of the dysfunctional BETTA market and the rest of the complex procedures involved in the system are an obstacle to an obvious and (should be) easy win, which is so much cheaper than nuclear and wind.

Wind

My book tracks the words on wind - they come at many a penny, with target after target missed due in significant measure to the ill conceived Renewables Obligation Scheme. This (along with the extraordinarily unwise decision to introduce competitive mass market metering) was an extreme example of what I call "naïve marketism" - an ideological belief in the efficiency and efficacy of markets (in this case a pseudo market) regardless of practicality. It piled irrelevant risk from the ersatz ROCs market, on top of the genuine - but irrelevant - risk of the gas price driven electric market, and so increased the cost of capital. The government then spent years fiddling with the scheme to derisk it. The result was that the target of 10% renewables by 2010 was missed by a mile (6.7% in 2009), and the cost of output was significantly higher than the German feed-in tariff system. Although the cost of the scheme thus far at £1bn or so has not been noticed because it is a stealth tax dumped on energy bills, the big ticket items are on the way with the offshore windmills at 2ROCs/MWh. These schemes make nuclear plants seem cheap, see exhibit 2.

Exhibit 2 Levelised costs of generation technologies



Source: DECC based on Mott MacDonald 2010

The cost of the windmills are only part of the story - the wind is not near the main load, and so in addition to very expensive off-shore transmission the on-shore transmission system will have to be significantly strengthened. The (fairy) story is that capital expenditure by the electric industry will have to double over this decade to deliver £110bn of transmission and generation by 2020.

City Investment Research & Analysis estimates that across the five major European markets (UK, Germany, France, Spain, Italy) the utility sector needs to spend about €940bn this decade to meet requirements for asset renewal and replacement and to meet environmental objectives (7). The level of spend required to meet targets represents at peak about a third of total European corporate capex. The UK should spend about a third of the total (€320bn), of which 70% is environmental capex reflecting the very high cost of off-shore windmills this feasible? Citi points out that over the period March 2009 to September 2010 the utility sector underperformed European stock markets by 30%. Thus while capex could be funded by raising debt for half of the decade, beyond that, unless the financial performance of the utility sector improves from higher prices then Citi assumes “unless the cost of equity falls substantially in the coming years, it seems to us that it is very unlikely that utilities will be willing or able to bridge the financing gap through selling equity.” On its assumptions Citi forecasts a capex underspend of €285bn of which €135bn will be in the UK. The report concludes “In our view...

- Even if - the Utility companies had the appetite to spend €938bn they don't have the organizational capacity to do so
- Even if - they had the organizational capacity to spend the money the supply chain couldn't provide the equipment

- Even if - the supply chain could provide the equipment the Utility companies don't have the balance sheet to finance the investment
- Even if - the Utilities companies could raise the equity they wouldn't be able to afford the cost
- Even if - the Utilities could finance the investment, the consumer wouldn't be able to afford their bills"

Forecast

The history over the last 40 years of decade out forecasts of generation mix have generally been way out. As the Koran says "He who professes to foretell the future lies, even if correct." But here goes for 2020, which is as far out as I dare. With the government in begging mode, EDF may have one (expensive) nuclear power station under construction, and we will have a couple of carbon storage capture plants running. The offshore wind programme and associated upgrade of the transmission system will have been stopped, and opposition to on-shore windmills will have increased. And more CCGTs will be built to keep the lights on. The last sentence in my book is "will someone in a decade write The British Electric Industry 2011-2021: the rise and demise of greenery"?

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