Hinkley Point C and the UK Nuclear Renaissance

Final approval for the new nuclear power station at Hinkley Point in Somerset, which would start the Nuclear Renaissance in Britain, has been just around the corner for several years. Delays were caused by Fukushima, contract price negotiations, State Aid approval from EU and now by seeking funding for the £24bn project from foreign investors.

Some say that Hinkley Point C will never be built. That seems highly unlikely for two main reasons. First, there is a strong need for secure low-carbon energy in the next decade after the closure of many of the aging AGR stations. Second, political capital has been invested in new nuclear by both Labour and Coalition Governments over the last nine years, since nuclear was recognised as part of the answer to Climate Change. If Hinkley Point C were not built, the other prospective nuclear reactors would not be built and a fundamental part of the Government's energy strategy would be in tatters.

The Hinkley Point project suffers from the scale and cost of construction. The investment (£24bn) is too large for any company to fund. This is why EDF is seeking partners in France, UK, China and the Middle East. Capital cost is the prime reason why a high energy price (£92/MWh) is needed for project viability. Capital costs accounts for at least two thirds of the levelised cost of nuclear generation. The overnight capital cost of the two EPRs (£4,850/kWe) is almost three times (in real terms) what was envisaged at the time of the Energy Review (£1,740/kWe), in 2006 [1] . This includes EDF's £2bn set-up cost for licensing, consents etc. which will not required for later EPR stations like Sizewell C.

UK nuclear strategy includes a dozen reactors with five ABWRs being built by Hitachi-owned Horizon Nuclear and three AP1000 by Toshiba/GDF Suez-owned NuGen. Based on experience of ABWR [2] and AP1000 [3, 4] stations built elsewhere, it seems they will be somewhat cheaper and perhaps quicker to build than EPR. This should lead to lower energy prices. Modelling of the mixed fleet of twelve reactors under conditions similar to Hinkley Point C, shows that mean energy prices of about £80/MWh (at 2013 economics) can be expected.

Will these be affordable when current electricity prices are £42.1/MWh (2014 average [5])? This comparison is unfair. Current market prices are being set by older coal and gas plants and using fuels either coal that will not be permitted in future, or gas which has temporary low costs (below £2/mmBTU [6]). A fairer comparison is with existing nuclear stations which remain competitive at these low price levels because their capital costs have also been written down and they have relatively low operating costs.

The competitive comparison for new nuclear is against new gas generation, using future gas prices and carbon taxes. New gas generation prices are given by DECC as £74-84/MWh [7], with what now seem to be heroically high gas prices of £7.4/mmBTU [8], three and half times the current value. Doubling current gas prices would imply energy from gas costs of £55-60/MWh. If the Nuclear Renaissance is to become a reality, nuclear needs to become more competitive otherwise projects will be delayed on cost grounds, or not be funded even with high 'Strike Prices'.

The UK nuclear strategy is conditioned by the experience of constant cost increases of AGRs and of the first PWR - Sizewell B, under the nationalised CEGB and Nuclear Electric. Nuclear new build strategy is based on private investment with multiple competing groups of utilities, to:

- Transfer risk to the investor;
- Generate the large volume of funds required;
- Create a market in nuclear construction and operation to control costs.

The project model developed for Hinkley Point has been successful at making project costs more transparent and in transferring risk to the investor. This has been at the cost of large project contingencies and high project interest rates, the effects of which are magnified by long build schedules.

The funding model is less certain. Hinkley Point C is not yet funded despite having large Government loan guarantees and being only the first project in a £100bn programme.

The negotiation of 'Strike Prices' project-by-project means that no market is being created. The Energy Bill makes provision for technology-neutral price auctions but the scale of the financial risk for nuclear makes this very unlikely.

What can be done to get costs down? Global experience of nuclear construction has been mixed. Are we to follow the US with its 100 reactors almost all of which are different, or France which built 54 reactors with two similar designs, rapidly, at consistent and what seem now low overnight capital costs of £1,000/kWe (at 2013 prices [9])?

Considering the larger programmes: US; France; Japan and S Korea, some key opportunities for cost reduction are evident which would make a large difference:

1. **Reduce the number of designs**. The UK is planning to have three, or perhaps with a Chinese design four reactor types. Each reactor type will have its own licensing and set-up costs, its own supply chain and infrastructure, much of which will be required over the long operating life of the plant.
2. **Standardisation on a low cost design**. Modern reactor designs are very safe and their safety performance depends on how they are constructed, operated and

maintained. Standardising on a reactor which is simpler to construct and can be built quickly reduces both capital and interest costs.

3. **Construction learning**. Nuclear construction has a poor record of productivity. Nuclear projects are not organised to transfer best practice and productivity lessons, to a large degree because of their extreme scale, complexity and long duration. Global experience [10] supports the low rate of cost improvement (3%) over a series of reactors. Only where long-term productivity initiatives have been pursued, such as in Japan and S Korea, are higher learning rates (>5%) achieved, when reactor costs can fall by 30% for a programme with a single reactor type.

	UK Strategy	**Cost Reduced**	**Saving**
Investment £bn	£95.4	£73.4	£22.1
Life time Op Cost £bn	£171.2	£159.2	£11.9
Unit Energy Price £/MWh	£80.1	£66.6	17%
@ 2013 prices			

Application of these ideas to the UK's 16 GWe nuclear programme could save £34bn over its life-time, reducing average energy costs by 17%, from £80/MWh to £67/MWh.

Further reductions below would require completely new reactor designs optimised for factory construction and site assembly. They would employ the same light water technology but be very different, smaller in scale and perhaps simpler in concept. They would be focused on addressing the inefficiencies of building extremely complex high-quality systems, by hand, with tradesmen with no experience of nuclear work, on open construction sites.

Such designs are, for the present, only a glimmer in the eye. The Government should review its programme strategy to enable the large cost reductions that can be made with today's designs, avoiding Hinkley Point C becoming a lone project like Sizewell B, rather than the start of the Nuclear Renaissance in Britain.

Tony Roulstone

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Tony Roulstone established and teaches on the Nuclear Energy masters programme at the University of Cambridge with research interests in the economics and safety of nuclear power. Previously, he was MD of Rolls-Royce Nuclear.