AFTER HINKLEY – how to contract for the rest of the nuclear programme

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Whilst a great deal of attention has focussed on the project to build twin European Pressurised Water Reactors (EPR) at Hinkley, less has been paid to what happens next. There are ambitious plans for another twin EPR reactor at Sizewell, and other types of reactors at Moorside, Wyfra and at Bradwell. Together they amount to over 10 GWs.

There is a considerable consensus that whatever the right contractual framework for the first new nuclear reactor Hinkley, it is not necessarily the best model for what might follow. Yet almost nothing yet has been proposed as to how to do it differently. Whilst neutral on whether more nuclear should be built, this paper suggests how, if more are to be built, they could be done. It focuses on the policy contexts, the underlying nuclear strategy, the cost of capital and the role of the government in financing.

An (inevitably) changing policy context

The starting point is that all new nuclear investments arise in particular contexts. This is true for Hinkley and it will be true for what may – or may not – follow. Hinkley was envisaged as part of a plan to be the first of a series of EPR reactors to be built in a sequential programme in Britain. The reactor was designed to be very safe, very large scale, for a pre 9/11, pre Fukishima, pre Energi Wende world and one in which fossil fuel prices were expected to keep going up. It was conceived as a big European industrial project, initially a Franco-German one.

Inevitably the world has turned out differently. It always does. The reactor has proved more difficult to build to time and to budget in Finland and France, and with shale oil and gas and abundant coal, the fossil fuel prices have gone down

not up, as has the wholesale electricity price. The 9/11 attack on the Twin Towers and Fukishima both added to the safety requirements – and the costs. These will not be the only changes –inevitably there will be more to come. There always are.

Nuclear is a long-term business, and with reactor lives of up to 60 years, the short-term markets should be seen in this context. In the mid 1980s fossil fuel prices collapsed and stayed low for more than 15 years. The French (and the Japanese) carried on building nuclear reactors, and rode out the storm. In both countries, their nuclear decisions were part of a very long term and big commitment. Britain, in contrast, only built one of the 10 PWRs announced in 1980.

It was easier last time round. Coal – the competitor – was less connected with the commodity cycle, and the PWR then rolled out in France proved much easier to handle and the costs were largely contained. At one stage France was building 6 reactors in a particular year. Now gas is the competitor, the number of projects is smaller, and the supply chains have to be reinvented.

The British government did not want to commit to a single reactor design or a single company. It preferred to encourage a number of companies and consortia to come forward. Britain would build one of each and see which worked best. Britain would effectively become the test bed and showcase for most of the leading world reactors (the Russians excluded). The lesson here is that in the understandable desire to avoid picking winners the scope for developing and managing supply chains is more limited.

The importance of national strategies

Hinkley has not turned out as initially planned to come on stream in 2017. This is hardly surprising – complex projects like this inevitably change as they develop. But it does imply that firm assumptions about delivery dates and precise costs for future projects are unlikely to be a good way of handling contracting. It just

isn't that sort of technology. But this uncertainty has its own costs. Nuclear is big and lumpy – its timing affects the system margins, and if it is late there are system costs.

Unsurprisingly too, EDF found that it could not carry all the costs, given the state of its balance sheet and other obligations. It needed partners (as all future projects probably will) – others to take a share and raise some of the money. What this revealed is something that should have been obvious, not least to the British government. The players willing to come to the table are mainly state owned companies and national champions with particular and special agendas.

This made a lot of strategic sense to EDF and France because China is the leading country in the world committed to building a lot of nuclear power stations. EDF is already a player there, and hopes (like other nuclear developers) to get more of the market. It also suited George Osborne and his opening to China. Getting Chinese state owned companies to put money into a whole range of infrastructure helps to keep much of this off Britain's public balance sheet.

Chinese investment in Hinkley, like that of the French, is understandably strategic too. China explicitly states that its game plan is to build one of its own reactors in Britain, getting it passed British nuclear regulators, and then being able to showcase this to the world as an example of a major developed country choosing its technology. This is (again explicitly) a step in the path of creating a big player and perhaps even dominating the world's civil nuclear reactor market.

The missing bit here, relevant to future reactors, is the *British* nuclear strategy. This is far from clear. Is it just one low carbon option is a low carbon market? Is it a serious Anglo-French nuclear industrial policy, like the Franco-German Siemens-Areva one that unravelled? Is it to have a major *British* nuclear industry? The French and the Chinese are clear on their strategies: Britain is not. Making up strategy as it goes along is not likely to be very efficient.

Recognising the political dimensions

This matters, not least because a key lesson for the future is that any nuclear power station development has unavoidable and fundamental political elements. Hinkley will bring the Chinese government's national strategic goals a step further forward, it will take forward the French industrial strategy for the international nuclear market and protect French jobs, and it will help to deliver the British government low carbon base load power, off balance sheet. It is a state-to-state project: the French government as the guarantor of EDF; the Chinese government as the owner of its nuclear industry and hence its guarantor; and the British government as the guarantor of the feed-in-tariff for 35 years.

These political dimensions all have political risks attached, and they should be assigned appropriately. This is not to suggest that private sector cannot build the stations – they can and probably should. But private firms cannot decide about the merits of investing, and they cannot absorb all the risks. The consequence is that there are no purely private sector nuclear plants, and there is never likely to be any, certainly not in Britain. Laissez faire, competitive markets will not bring forward new investments without governments. Future projects should be contracted for with this clearly in mind.

Rates of return and costs of capital

Nuclear power stations are capital intensive, making the cost of capital and the allowed rate of return the crucial variables in determining the economics of new build. They are large lumpy investments, taking years to build before they start generating electricity and revenues.

Further nuclear power stations in Britain will need to focus on minimising this cost. The cost of capital is supposed to represent the risks faced by equity and debt investors. These risks fall into two categories: those they can manage and those they can't. Investors should face the project risk – of building the reactor to time and budget. This is what their managements should be able to handle. But

the second category includes the risks that are outside their control – risks they cannot do anything about. These are the political and regulatory risks, and those best able to manage and control these are not the investors, but the governments.

For future projects, the capital structure should therefore be split: the cost of capital for the construction phase; and the cost of capital for the operational phase. The former could easily justify 10% real. Any investor would take one look at the Finnish and French EPR projects (and the Chinese ones too) and clearly see this is a complex and highly uncertain challenge. They might even justify 15%.

But once built the risks are quite different. They are now confined to operational ones, and these could be carried out by a number of companies – just as EDF and Centrica took over the operation of the British Energy power stations when they bought them. The bulk of the risks to investors are now not these, but the reliability of the 35 years FiTs contract guarantee, the carbon price and carbon policies, the subsidies to other competing technologies, and the possibility that the regulators might change the rules – as indeed they typically do after each global nuclear accident, and these have come along roughly every 10 years.

Assigning the risks and the structure of future contracts

We now have not one single overarching part, but three to a nuclear project: the two described above – construction and the operations contracts; and then a contract for the power output. These are obviously very different and they come with different costs of capital. For the construction contract, the obvious way to do this is to invite bids, and these bids will reflect the particular risks of the different technologies in terms of costs and timetables. For the operations, again bids can be invited. In practice, these will probably come from the same companies that build the stations, but they can and should be separately identified. In inviting bids, the government would in effect control the sites. This

is quite different from selling off the sites and leaving it to the owners to decide when and where they might like to develop a specific project.

Once the station is completed and its risk profile changes, it can be refinanced. This is what typically happens in most large projects, and especially for large power projects and for large infrastructure projects. Examples include wind farms, HS1, the Channel Tunnel, and probably HS2. At this point, the cost of capital drops, because there is no construction risk left. It is now more like a regulated utility structure, and the asset itself looks much more like a regulated asset in a utility asset base than an equity investment. The risks are now substantially political, and in the utilities, the guarantee through the regulator that the company can finance its functions produces a debt cost of capital pretty close to that of the government. Whilst construction might have a cost of capital of say 15%, the completed and operating asset might have a risk below 5%.

The primary risk here is to the revenue stream necessary to finance the functions. In the case of the utilities, it is fixed only for short periods, typically between 5 and 8 years. It is then revised. The companies are incentivised to outperform, but over time the returns are normalised close to the (now low) cost of capital. The implication is that the price is not fixed for the long run, and certainly not for 35 years. On the contrary, the price is that which reasonable covers the costs including the refinanced capital once the project is completed.

Bringing the bits together: how to take the nuclear programme forward

The above considerations create a very different structure to that put in place at Hinkley. In the process they radically change the costs, the finances and the final price of nuclear generated electricity.

Stage one is to invite bids for the construction phase. This could be private finance, or it could be by the state. Since the project will be refinanced on completion, the initial finance is for the construction phase only. In effect, the

government – as single buyer – is buying the nuclear power station from constructors like EDF, Hitachi and so on when completed.

In the case of HS1 and HS2, the government is doing stage one on its own account. This is effectively what France is doing with the Flamanville project since it owns most of Areva and EDF. It is pretty close to the practice in China too. But this approach makes the cost of capital look lower than it actually is. A better way would be for the government to raise nuclear bonds, and then provide these as the finance for the construction phase. The bonds could be used on a pay-as-you-go basis, or to finance a guaranteed exit valuation. The bidders would then endogenise this benefit in their bids, and the contract bids would be lower accordingly. They would however still have their own cost of capital for the construction itself, and reflect this in the bids. They will want - and should want - an equity return built into the exit valuation. The important point here is that the risk the bidders should bear is the risk they can and should control: primarily building the power station to cost and time. With this, they should probably also carry the costs to the system of failure to meet contracted deadlines – and the investment that might then be necessary in back-up generation. In other worlds they may have to bid "firm power".

Stage two is when the project is completed and refinanced. It is in effect "bought" by the state using the nuclear bonds as payment. At this stage the price of the electricity needs to be determined. It should not be fixed for a long period, but rather be a series of shorter-term fixed price contracts, reflecting the costs of operating the stations and the market conditions. Since nuclear is close to zero marginal cost, the market price should be at least above its operating costs. To these operating costs need to be added the cost of debt finance, reflecting the "purchase" back of the completed project at the refinancing point as a return on the nuclear bonds.

Assuming the two together are still less than the costs of alternatives, then the market price is the most efficient way of charging for the nuclear output. But as more and more zero marginal cost generation comes onto the system the

wholesale price will fall, and there will probably need to be some form of cost plus – providing a reasonable overall rate of return. This might best be treated as a system cost spread across all consumers.

The new power stations will need to be operated, and to determine the operating costs, this could be tendered. If not, then some form of negotiated contract will be necessary.

This disaggregated approach to contracting would result in a much lower cost than in the Hinkley case, which smears the 10% over the full 35 years. It would remain to deal with the decommissioning costs, and it obviously needs to be recognised that a limited liability company cannot be trusted with these. They are long-term societal risks. It makes sense to build up an explicit pension fund type of vehicle so that when the time comes, the money is ready and available. It should be arms length, and completely ring fenced. This sort of arrangement has never yet been put in place, but it should be, and it would go some way to meet the criticisms of those who argue that nuclear costs are much higher than the advocates suggest, when taken over the full cycle.

A way forward

These considerations lead to an obvious conclusion. The British government needs to take stock and reconsider the whole way it is approaching future nuclear investments, if it wants to place the future programme on sounder and more economic foundations. It should start by clarifying what the British strategy for nuclear is, and whether it is to be regarded as one technology competing with others, or as part of a nuclear industrial strategy. The contractual design should follow, based upon the costs, risks and uncertainties.

There is nothing particularly special about the efficient solution. Nuclear power stations might be technically very complicated, but the economics are in fact rather simple. Nuclear power stations are very large lumps of capital, which take several years to build, and then carry on generating at base load for decades.

What is needed is a contract structure that separates out the key components – construction, operation, decommissioning, waste management, and price – and takes explicit account of the uncertainties about future fossil fuel prices, wholesale electricity prices, and the implications for uncertainty about delivery dates on the system capacity. Whatever the merits of a single 35-year fixed price contract for Hinkley, it is unlikely to be optimal for future nuclear investments.

For future projects, the British government needs to first work out what its nuclear strategy, to recognise that it has a direct interest in nuclear projects and to use its balance sheet to minimise the cost of capital. To this end, it should think again about issuing nuclear bonds, about the costs and risks of delivery, and about the nature of the contracts.