Nuclear lessons for energy policy

Dieter Helm

23rd January 2019

The Hitachi decision has been a long time coming and is not at all surprising. It comes at a crossroads for the energy sector. Government has decided (rightly) to exit coal. It has tried and so far failed to back gas as an interim replacement. Now its plans for 13GWs of new nuclear by around 2030 are in tatters. A large capacity gap is opening up in the next decade, and so far the government does not have much idea how to fill it.

But why should it know? Why should it decide which technologies are going to be the winners? At anytime this sort of determinism is a hazardous task. Now, with technical progress coming faster than at any time for perhaps a century in the energy sector, it is likely to be pretty hopeless.

Recent history of British energy policy provides all the caution that a minister should need. We have had an attempt to resurrect coal, to resurrect nuclear, to resurrect gas, and to pick which renewables are best. It is worth looking at this sorry history, before setting out how to both ensure security of supply and meet the carbon budgets *without* picking winners – or rather losers.

The Labour legacy

At the turn of this century, the Blair government tried to sort out energy policy. Tony Blair wanted to resurrect nuclear, and in this he was aided and abetted by his chief scientist, David King. They *knew* the future would require a lot of new nuclear capacity.

Their immediate problem was Margaret Beckett and Patricia Hewitt, both former CND members and from the side of the Labour party that was deeply suspicious of anything nuclear. In the 2003 Energy White paper, *Our energy future* –

creating a low carbon economy, nuclear was barely kept alive, in just one heavily caveated paragraph.

Blair and King plugged away, convinced that the White paper had to be revisited. It took a long time, and along the way there was a plan to resurrect coal too. A large modern coal power station was proposed for Kingsnorth by the German utility E.ON in 2006. This fitted with the great expansion of coal capacity in Germany which begun in 2000 under the Red-Green Coalition. Over the next fifteen years, Germany would add 13 GWs of new coal capacity, further underpinned by the decision to close nuclear, thereby creating a capacity gap coal filled. It would mean Germany would not be able to meet its 2020 climate target, despite the so-called *energiewende*.

Fortunately the plans for Kingsnorth bit the dust in 2010. Britain, unlike Germany, would build no more coal. And unlike Germany it would eventually plump for a nuclear renaissance.

Nuclear mistakes of the past

Britain has been here before. At the beginning of the 1980s, Dennis Howell made a statement in the House of Commons announcing a programme of 10 new PWRs, one a year. This was very much Thatcher's policy – she wanted *both* a competitive energy market to beat down the miners *and* to emulate the French plan EDF was delivering. At one point France was building 6 new PWRs at the same time. Britain had the CEGB, and Thatcher saw no reason why the CEGB could not match its French state owned sister company, EDF.

That programme resulted in just one new PWR, Sizewell B, which came on stream 14 years later. Privatisation put an end to the dream of new fleet of nuclear power stations in the private sector. Instead the prospect of privatisation spurred on British Energy to raise its game dramatically, greatly improving the efficiency and performance of the existing AGRs.

For the period up to and beyond 2010, Britain could do without new nuclear. The massive excessive capacity carried over from the 1970s met a stagnant demand as Britain deindustrialised and then the 2007/08 financial crash reduced demand some more. The gas stations built in the 1990s had added to that capacity, whilst the old coal stations kept going.

The Huhne-Davy muddle

But more than this, privatisation had created a difficulty that the Liberal Democrat Secretaries of State, Chris Huhne and Edward Davey would struggle with between 2010 and 2015. Although both of them were confirmed peak oilers, and both believed the gas price was going to rise so high as to render both nuclear and renewables economic, the market stubbornly refused to oblige.

There was an additional problem. The Liberal Democrats were not actually in favour of nuclear. In the Coalition Agreement this had to be finessed. Huhne claimed that he was not actually against nuclear, but just thought it would be uneconomic. So a fudge was engineered. Nuclear would be fine provided there was no public subsidy, and this was sanctified in the Coalition Agreement. Notwithstanding his subsequent statements since losing office, Davey was happy to push nuclear along, when he succeeded Huhne after the latter's conviction and imprisonment.

The problem Huhne and Davey confronted was how to keep this pretence of no public money in play. When the nuclear sites had come on offer, a number of companies entered the fray, including the EDF, German utilities E.ON and RWE, and also Spain's Iberdrola. The Europeans (except EDF) were replaced in due course by Toshiba (Moorside) and Hitachi (Wylfa). It gradually became apparent that the private sector could not put these sorts of projects together and finance them on their own. Public money would indeed be needed.

At this stage, the government could have made a bold strategic decision, as EDF had done. It could have decided to build a fleet of new nuclear power stations,

around a single design and hence reap all the economies of a series of projects and a unified supply chain. It could, as in France, have been a big national project.

Making such a bold strategic decision is not the sort of thing British governments typically do. Even when the government owned the CEGB, it ended up with Magnox, AGR and eventually started a PWR. Tony Benn, as Secretary of State for Energy in the late 1970s, wanted to buy more of the more British design, the AGR, not the American PWR, when it was plainly obvious that the PWR was a better bet.

This time around the government did something really stupid. Having opened up the nuclear sites to several players, it effectively bet on trying out three different technologies to see which would work best. It deliberately did the opposite of creating a series of projects and a supply chain in favour of trying everything on offer. Indeed, worse the plan was to have a fourth different technology, by allowing the possibility that the Chinese CGN could try out its own design at Bradwell.

The CfD trick and ever rising wholesale price forecasts

To make matters even worse, the government then decided to try out three different financing packages. For Hinkley, there would be a Contract for Differences (CfD). Indeed the CfD was invented to get over the politically difficult problem of extending the supports to the renewable onto nuclear (in a contorted attempt to claim no "special" subsidy to nuclear). Renewable Obligation Certificates (ROCs) would be replaced with Feed in Tariffs (FiTs) and CfDs, leaving everything else to a wholesale market increasing coming under pressure from zero marginal cost, but intermittent, renewables.

The CfD had one other political advantage. Since Huhne and Davey *knew* that fossil fuel prices were going to go up, a CfD would pay out and demonstrate the public gains from having nuclear. As the fossil fuel prices drove up the wholesale electricity price above the CfD level, customers would be in the money. Nuclear

would be without public subsidy because customers not taxpayers were paying for the CfD, and it would be a demonstrable good deal because the wholesale electricity price would go above the CfD.

The CfD was set at £92.50 MWH, indexed to inflation, for 35 years. Davey's hapless DECC forecast in 2014 that the wholesale price would indeed keep going up, and so demonstrated that it was good value for money. It left the project with a real rate of return for the largely state-owned companies of around 8-9%.

This represented energy policy at its worst. It assumed ministers *knew* what future fossil fuel prices would be, *knew* what the relation between fossil fuel prices and the wholesale electricity price would be, and were willing to sacrifice the benefits of serial projects by going for different technologies on several of the nuclear sites.

Even with the CfD, it soon transpired that no private sector company and no pension or infrastructure funds would be prepared to fund the Hinckley project. In the end the only candidates were state-owned companies – EDF (85% owned by the French state) and CGN. In the latter case, the British government was willing to let a military and civil Chinese nuclear company into the heart of the British energy sector. Mrs May had her doubts, and immediately after becoming PM she launched a quick review. But it was too late: Britain let China into its nuclear industry for the sake of a few billion, which it could have contributed itself.

The pretence of "no public subsidy" dropped away after Hinkley, and following the collapse of the Toshiba project at Moorside, and the failure to entice KEPCO to take the project over. What was not possible at Hinkley became possible for Wylfa. The government offered to become a direct investor and to provide the debt for the construction phase, as well as grant a CfD. Why? Because Hitachi would not proceed on its own, and it could not raise the money. Wylfa became a tripartite project between the British and Japanese governments (with a third each) and the rest with Hitachi. In the end, even with the British government

providing the project finance debt too, it was not sufficient to get Hitachi over the line. Hence the debacle now.

The remaining projects – Sizewell C and Bradwell

That leaves two more projects – Sizewell C and Bradwell. Having tried the CfD for Hinkley, Davey's assumption on the wholesale price quickly proved seriously in error. The wholesale price went down not up and within a year or so politicians, officials and even those academics who should have known better were quickly claiming that of course they never believed in peak oil. The world was awash with oil and gas, and far from running out, it turned out that there was enough to fry the planet several times over. US shale oil and gas, hardly noticed at the time by Huhne and Davey, turned the US into the world's largest producer and gas started being exported from the US, rather than the huge volumes of imports that had been assumed. With Australia about to match Qatar for LNG exports, in addition to the new US exports, the gas situation has been transformed. Davey's forecasts could not have been more wrong.

So what was government to do about the other projects? It could not rerun the CFD at £92.5, and £72.50 MWH at Hitachi's Wylfa was not enough. The obvious answer was to try something different, and of all the options for financing nuclear, the government finally began to entertain a Regulated Asset Base (RAB) model for Sizewell C. This treats nuclear not as just another electricity generating technology, but as a utility. It shifts from pay-when-delivered (and paid with a CfD) to pay-as-you-go. It is a well-tried model, it should produce a lower cost of capital, and it should offer a very different risk sharing profile.

The RAB model comes in two versions. The first is pure cost pass through. Money spent is money recovered from customers, as the project proceeds. The second is pay-as-you-cross-milestones. As each project stage is successfully completed, monies are paid and released to the developer, subject to an efficiency test. This is close to how many large construction projects work, and also US rate of return regulation, with the efficiency tests that go with the US model.

The RAB model would transform one aspect of the nuclear economics. At 9% real Hinkley is always going to come with a very large total project cost. Why? Because the key variable in a nuclear project is the cost of capital. If it were to be a more modest 4-5% per cent (rather than the 8-9% at Hinkley), the capital costs would tumble. If it were to turn out like Thames Tideway, the total project cost might even halve. At this sort of cost of capital, Sizewell C might be cost competitive with offshore wind, on an equivalent power basis, once wind had been re-rated for intermittency.

That leaves Bradwell. CGN and the Chinese government are very clear on their objectives. They have a strategy: to dominate the world nuclear market with their own reactor design. China started on this path by getting various reactor types built in China, notably the AP1000 and the European PWR. Unlike in Britain, where trying different technologies was a strategy to see which on worked, the Chinese focussed on technological transfer. They wanted to learn all about the reactors they imported, in order to build their own. Britain by contrast had given up on having a British reactor, when it sold off BNFL.

With technological transfers, the next step for China is to build their own and get it licenced in a country with a high reputation for safety and risk assessment, so it can then market it around the world. Britain is an obvious candidate, and that is what CGN are now doing.

It all makes perfect sense for CGN. Indeed even its investment in Hinckley can be seen as primarily driven by the desire to get their reactor built at Bradwell. But this is not the issue. Rather it is whether this makes sense for Britain. Here, as noted above, the military and security questions cannot be avoided. Military and civil nuclear are always entwined. Britain has independent nuclear weapons. Britain is a member of NATO and a close ally of the US (Trump notwithstanding). Suppose the tensions between the US and China escalate in the South China Seas, between China and Japan over the disputed islands, and suppose the Chinese leader carries through his promise to take back Taiwan. Any and all of these

could happen over the 60-year life of a nuclear power station. Would Britain in such a conflict context want the Chinese inside its nuclear industry and its power sector? Even adding Rolls Royce to the project is not a solution to what is fundamentally a defence and foreign policy matter.

This is particularly relevant when the price of not having CGN build Bradwell is taken into account. There are other alternatives, and this is going to be the first of a kind with all the financial risks that go with it. Is it sensible for example to have a pay-as-you-go RAB for Bradwell for a first of its kind?

The promise of Bradwell was made in the Cameron-Osborne context of an open door to China and a policy of close alignment with what was perceived as a crucial market for their "global Britain". May, as noted, has taken a different view.

Should we go on with nuclear?

The above discussion brings out one central feature of nuclear: it is always going to be a public and not a private sector play, with long timeframes and with long-term waste issues. It is not only going to be public sector, but highly political too. It requires deep commitments by the state, over decades, and across the political spectrum. Such credible political commitments are essential if the cost of capital is to kept within reasonable bounds. It is not clear whether Britain meets these requirements.

But if the government really wants to do nuclear, trying three different technologies and three different financial models is not a sensible way to proceed. It should either do nuclear properly or not bother. That means it has to make key strategic decisions, stick to them over the long term and allow a supply chain to be developed and sustained over decades.

Sticking credibly to a long-term policy comes up against two big changes of circumstance from when Blair and then Huhne and Davey were promoting

nuclear. These are: the prospect of falling fossil fuel prices; and fast technical change. The first means that nuclear needs to be able to rely on governments pushing up the price of carbon to offset the possibility of falling fossil fuel prices, and especially gas prices. The second threatens to erode the one crucial difference between nuclear and renewables as low carbon options. Technical change may not only drive down the cost of solar and perhaps wind too, but more importantly it might begin to ameliorate and then perhaps solve the Achilles heal of many renewables, their intermittency.

Nuclear offers large-scale low carbon electricity; renewables still need to meet this challenge and to cope with winters. The key question is whether renewables can, without nuclear, meet the carbon budgets and targets at reasonable cost, and whether the intermittency problem is going to get solved. Without more nuclear renewables would have to fill the capacity left by not only coal and gas, but also nuclear stations as they retire from the system. This is the choice government needs to make. It has to decide, one way or the other.

Do we need an energy policy review?

Whether or not the government turns out to be serious about nuclear and able to sustain a long-term strategy and commit to the funding requirements remains to be seen. But whatever it decides, there is going to be a capacity gap. How should it be filled?

It is at this point that there are the usual calls for a "review of energy policy". This time it is led by the FT. But why is it needed? A review is sensible if there are new facts to be discovered, if these new facts are not discoverable by BEIS in the normal course of events, and if they would change the decisions.

In the case of energy (like rail), it is not obvious that any of these conditions are met. There has been a recent review, the *Cost of Energy Review*, which proposed a solution to determining the capacity. It comprises: Equivalent Firm Power (EFP) auctions, run by a national system operator (NSO), and regional system

operators (RSOs). The government would decide how much capacity is required to meet the security of supply requirement. The system operators, subject to meeting the carbon budgets, would auction this capacity requirement. These would be most efficiently met by having an economy-wide carbon price, but politicians seem unwilling to confront the polluters with the costs they cause, and prefer less efficient and hence more expensive ways of making technological choices and hence picking winners. As the *Cost of Energy Review* reveals, the legacy costs of avoiding carbon pricing are very considerable, creating the paradoxical result that as the cost of generation is falling, the price of electricity is being driven ever upwards by these legacy costs.

The EFP approach has several merits. It is a deep and liquid auction, and therefore maximises competition and is likely to drive down the cost of meeting the two objectives of security of supply and carbon budgets. It translates and internalises the costs of intermittency and applies them to those who cause them, and which are also those best able to manage and ameliorate them. It encourages all sorts of market transactions to reduce the level of de-rating, thereby stimulating markets in storage, peaking generation and demand-side management.

Provided the NSO auctions sufficient capacity contracts, the capacity gap will be filled. The market will dictate which technologies win the contracts. Crucially, ministers do not need to decide.

The EFP auctions are inevitable in any event. As the renewables move towards being subsidy free, they will want to get capacity contracts, and hence enter the capacity market. Instead of being de-rated outside the capacity market, they will be de-rated in it.

Whereas an energy review would not have many (or indeed any) major new facts to discover, it would be another great opportunity for all the lobby groups and vested interests to ply their preferred technologies. There will be arguments from the gas lobby to make special arrangements for CCGTs, from the CCS lobby

to ensure its technology is applied to new gas CCGTs which it might encourage, from the offshore and onshore wind industries for a longer subsidy period before being "subsidy free" and continued special treatment in respect of grids and networks, and from solar. All would want to make their case to be picked as winners. This is not a business the government should generally be in, and that is the point of the EFP proposal. Nuclear is special in that it really is a government decision, and no auction can sort out the sort of credible commitments and government investment that it entails. Nothing else is quite like nuclear. Net of nuclear, the EFP auctions sort out the capacity gap.

Solve the problems by implementing the *Cost of Energy Review*

The question those clamouring for a new review do not address is why yet another burst of intensive lobbying will do any better than a market-driven outcome to achieve the twin energy policy objectives. Why would another option produce a better outcome than an EFP auction process, driven by an NSO and independent and RSOs, charged with achieving the security of supply and carbon objectives?

The *Cost of Energy Review* produced a coherent and efficient energy policy framework. The problem is the lack of urgency in implementing its recommendations. It is not that we need yet another review of energy policy. Government just needs to implement the one we have already had, and it needs to make up its mind whether it is a serious about nuclear, prepared to do it properly, or abandon the current vintage of nuclear power stations. Small modular reactors might have a part to play, but this is still an R&D and innovation project, and a matter for industrial strategy, not about the current energy policy.