The Nuclear RAB Model

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If the government decides to invest in further nuclear power station projects, it should obviously try to do so at minimum cost. The Secretary of State, Greg Clark, has suggested that one option might be to develop a Regulated Asset Base (RAB) model. Is this concept fit for the nuclear purposes? How does it compare with the other two options currently under consideration – direct investment and financial guarantees, and the Hinkley-style CfD approach. (No assumption is made here as to whether nuclear projects should be proceeded with: it is about the best means, not the end).

1. Nuclear's technological characteristics

Why do we need anything special for nuclear? Why can't nuclear be treated like any other electricity generation? Why do we need a special model?

Nuclear power is always and everywhere political because it not only involves very capital intensive and long-lived assets, but also because it comes with environmental, military and technology specific risks on a scale which no private market can handle on its own.

Nuclear waste lasts for many generations into the future and the storage of that waste over this long time horizon remains work-in-progress; decommissioning is far into the future and cannot be left to limited liability private companies; nuclear power has important military dimensions and has particular terrorist-related risks; and accidents may create very large scale consequences even if the probabilities are very small, which people tend to have particular high aversion to, and again which private limited liabilities companies cannot fully provide for. All of these characteristics mean that nuclear is a societal and political matter, over many generations. Nuclear safety regulation, nuclear funds for decommissioning, nuclear waste storage and nuclear security and secrecy remain for the state, and cannot be contracted out to private project developers.

What can be contracted out to private companies is the construction and operation of nuclear power stations – in principle. In practice, most nuclear developers are state-owned, in whole or in part, and all have close links to government. This is because of the technology and also the specific endemic challenges of project developments. There are unsurprisingly no purely private sector nuclear projects anywhere in the world.

2. Nuclear's economic characteristics

The economics of a new nuclear power station are surprisingly straightforward. A nuclear power station is a very large sunk and fixed cost investment, which then has a very long operating life, followed by a large end of life decommissioning cost. It requires fuel supply and fuel disposal arrangements. Once the power station is operational, it has very low marginal costs (effectively zero), and it is inflexible, expensive to turn off and on. It is therefore the most baseload of the baseload power stations on electricity systems.

The project costs are dominated by the cost of capital, and by the ability to run as baseload for a long period. The first is what the RAB model and the other options under consideration are designed to optimise. The second is what a contract is designed to solve, given the coming of more and more zero marginal cost and intermittent renewables onto electricity systems. High costs of capital, and being constrained off the system, are the two death-threats to the economics of a nuclear investment.

To these there are two other problems. The first is time inconsistency, and the second is monopoly. Time inconsistency arises because investors sink their capital up front, but will still want to operate the plant even if they can recover only their variable costs plus a bit more. So a government or a regulator has an incentive to get the station built and then *ex post* screw the price down towards marginal cost (or allow it to happen). For this reason there has to be a contract. Investors are right to worry: this has played out in practice by all sorts of political actions, such as the decision first to close, then to extend the lives, then fast track close nuclear plants in Germany in the period between the election of the Red-Green government in 2000 and the 2011 Fukishima accident. (Stopping a power station operating is effectively the same as enforcing *ex post* zero price – as time inconsistent as you can get). The RAB turns out to be a very effective way of solving this time inconsistency problem.

The monopoly (or the oligopoly problem) arises because there are very few nuclear developers, and all come with political baggage. The current British market comprises the French, the Chinese and the Japanese (the Russians being politically unacceptable), and as witnessed in the recent political "crisis summit" on the Wylfa project, all sorts of other considerations come into play, including at the moment BREXIT, the desire not to have a project fail at this critical political time, and the desire for longer term trade deals. In the case of Hinkley, the Chinese involvement caused the PM to hold a review on taking office, and concerns about security over nuclear, including the military dimensions remain an issue in future Chinese projects. The Korean interest in Moorside raises perhaps fewer political and security issues, but these still remain in the background. Competition is limited and there may, once contracted, be significant cost overruns. It is therefore a special concern of government to try to find ways of limiting the exposure of taxpayers and customers.

3. Contracting and the cost of capital

The cost of capital is so dominant that it can explain as much as almost half the costs of a project. Compare Hinkley at say 9% real for 35 years, against the government's cost of borrowing of say 2%. If Hinkley had been financed by government backed nuclear bonds (something I advocated several years ago), the cost of the twin reactors might have been halved, and then it would be providing *baseload* nuclear power at a cost below that of *intermittent* offshore wind.

The government's cost of borrowing is not the same thing as the government's cost of capital, because the equity risks remain in the project. Of all the challenges for the next set of nuclear projects, getting this cost of capital "right" (or at least not badly wrong) is the biggest.

The way to do this is to allocate the risks to those best able to manage them. Regulatory risk is outside the scope of management, as are events like the German "energiewende" decision to close nuclear, whilst presiding over the growth of coal-fired generation. The long-term waste issues are for government as are the rules for decommissioning. These sorts of risks should be with government, and the right answer is to provide for specific contractual arrangements fixed contracts for each of these dimensions of risk, and in particular for a liability pension fund to be funded from the project revenues over the life of the asset.

What is left is the time inconsistency and the operating contract – the risks to the developer that the government will renege on its part of the deal and that the plant will be forced off the system by the investment decisions of others, and in particular where the low carbon investment is decided by and subsidised by government.

Note that the amount of capital is not itself a government risk problem. It is not the size of the upfront investment, but rather the risk exposure that having so much capital in the project invested before the plant generates that matters.

4. How the RAB solves for time inconsistency

The RAB is a statement of the investors' sunk funds in a utility, to which the duty to finance functions applies. It is revised at periodic intervals, when it is updated by additional capital expenditure (CAPEX), subject to *ex post* scrutiny by the regulator to assess whether the CAPEX has been efficiently incurred in line with *ex ante* projections agreed at periodic views.

The RAB is a clear formal solution to the time inconsistency problem, and it is why investors have relied heavily on this mechanism across the utilities, but most notably in water, where the investment requirements have been considerable.

Though developed for utilities, the mechanism is just one version of a long-term contract between investors and customers, in this case mediated through a regulator. The unique characteristic is the link to the regulatory licences and the general duty of the regulator. The duty to finance functions is in theory open to a number of interpretations, but in practice it requires the regulator to honour the RAB, and the regulator is itself backed by statute, so ultimately this duty is backed by the government. The Competition and Markets Authority (CMA) stands behind the regulatory regimes, as the first call for an appeal.

There are differences between the utilities. In water and rail, assets are treated as in perpetuity, and hence there is no depreciation of the RAB. Instead capital maintenance is required. In electricity networks, there is historic cost accounting and the RAB depreciates, returning its value to investors over time.

Because there is regulatory protection against time inconsistency and because ultimately the government stands behind the regulator and the duty to finance functions, investors treat the RAB as a very solid securitisable asset. Though the licence holder could in theory behave in such a way as to put some of the RAB at risk, this is regarded as a fairly low risk, and the element of equity risk in the RAB is negligible. (Indeed, there is an argument to say it is zero). There is nothing much that management can do to change the number, and hence RABs are very close to gilts, and indeed behave similarly in response to interest rates.

The trick for the Treasury has been to put distance into the guarantee to try to keep the RABs off the government's balance sheet. This is further aided because the RAB is remunerated from customers' bills, not taxpayers. The exception is Network Rail, which has as a result been incorporated into government accounts.

Applying these considerations to a nuclear project, there is clearly a time inconsistency problem, and a RAB would solve it. The value of the CAPEX would be agreed in advance and when completed (in part or in whole) there would be a process for passing the CAPEX costs into the RAB. Given the expected life of the assets may be 60 years, it is probably best to regard this as an asset-in-perpetuity and provide for capital maintenance.

There remains a key point about the revenue base. In utilities, it is in effect a monopoly charge. This works best when it is a claim on the use of system costs, and hence inescapable for all users, and not a volume-based charge. In the latter case there is volume risk and hence there is no guarantee that the RAB will be properly financed. As we shall see below, charging the costs of nuclear as a use of system charge makes much more sense anyway in a capacity-driven world, with lots of zero marginal cost generation. It is in any event what will happen with Hinkley's CfD.

5. How the RAB addresses assets-in-the course-of-construction (AICC)

The privatised utilities have been able to finance CAPEX partly because they started life with relatively ungeared balance sheets (and in the case of water with a green dowry of around £1 billion). Water has subsequently witnessed widespread financial engineering and the profits have in aggregate equalled the dividends. Retained earnings have played little part in investment and rights issues have been rare.

But because the RAB model has been abused, and used for these purposes rather than for investment, it does not mean it cannot provide this investment underpinning. It was poor regulation (using un-indexed cost of capital, allowing the financial engineering to take place, and lax approaches to the periodic reviews) that has caused the problems in water.

In the case of a nuclear power station, the RAB could be used to recover costs of AICC in a staged way. In effect, the CAPEX contract would be divided into a series of steps – for example: initial costs of preparing to get started; the costs of laying the foundations; the installation of the reactor; and commissioning - and at each stage, with the costs agreed in advance, there would be scrutiny by the regulator and then, subject to this efficiency test, these costs would then go into the RAB and be recovered from the use of systems charges.

There is nothing particularly novel about this approach. It was used for Terminal 5 at Heathrow, and it is applied in the case of Thames Tideway. More generally the five-year periodic reviews update the RAB on the basis of CAPEX as it goes along. Such an approach is common to building contracts and a host of commercial arrangements in the private sector.

Recovering assets in the course of construction is a variant of *pay-as-you-go*, which was once prevalent across the utilities before privatisation, and is beginning to return as the balance sheets are exhausted.

Pay-as-you-go has other advantages. It makes the financing of the project much more manageable. The issue is really about how to ensure that the developer has sufficient incentives to be efficient, and to guard against cost overruns. To achieve this objective and have pay-as-you-go, the original contract requires careful specification, the milestones for applying the efficiency tests and the cost estimates for subsequent periods need to be carefully specified in advance. This is a rules-based, step-wise contract.

6. Why there is no need for a CfD with a RAB

The RAB is an assets-based concept. It is not amenable to circumstances of commodity provision, and it works best when there is a monopoly charging base – a use of systems charge that customers cannot escape. This charging base is the other side of the contract: the investors take the upfront risk in the interests of consumers, and consumers cannot *ex post* opt out. They cannot behave opportunistically and hence in a time inconsistent way. If consumers want investors to risk their capital, they have to commit to paying, and that is what the RAB model does.

It is immediately apparent that the CfD is neither necessary nor desirable in this model. The CfD is based upon a strike price, on the assumption that the electricity will be sold into the market, and there will be a demand for it.

There are several reasons why this is not a good basis for a nuclear project (or indeed a wind farm). First, the wholesale price to which the CfD relates to is probably going to tend to zero over the life of the nuclear power station, because of the zero marginal cost generation. Second, there is no certainty that the plant will be dispatched in a zero marginal cost world. Third, consumers get locked into higher unit charges than reflects the efficient resource allocation pricing.

The first raises political risk, since the strike price will look increasing at odds with the wholesale market price, raising the cost of capital since it raises the prospect of intervention. The second renders the future revenues uncertain, and perhaps highly uncertain. This also raises the cost of capital. The third leads to a wider resource misallocation, and indeed it can already be seen as the costs of new renewables are falling but the legacy costs of past CfDs, ROCS and FiTs keep pushing prices up. Some might argue that higher prices reduce demand, but there is no good economic reason for reducing demand from low carbon generation because of the drag effect of legacy costs. (See the *Cost of Energy Review* on this).

In the RAB world, the costs that are passed through to customers are the RAB plus the costs of operations and capital maintenance. At each periodic review, the charge to the system is varied according to the way the numbers stack up.

The obvious objection is that the nuclear costs might be above the market cost for capacity, and hence present precisely the drag effect that the renewables legacy costs are now playing. There is a market solution to this: there could be an element of indexing the charges for this nuclear capacity to the market cost of capacity going forward, and this might particularly work in the event that historic cost depreciation recovers the initial investment and hence where the RAB withers away.

7. How the RAB addresses the policy constraint of keeping nuclear off the government's balance sheet

The reason the Treasury is allergic to direct procurement is a mix of economic theory, past experience and chronic tendencies of the public sector to live beyond the means that taxpayers are willing to vote to fund.

The theory is recent. From the 1940s to the 1970s, the assumption was that public investment would be superior to private investment, because it could be planned and coordinated, because the government had serious buying power, and because the cost of public borrowing was much lower than that of the private sector. Since 1980, the Treasury conventional wisdom has been a strong bias towards private provision, because the private sector is assumed to be more efficient that the public sector, because political factors and vested interests tend to capture government and hence bias procurement decisions and make them less efficient, and because there has been a continuous striving to limit and even reduce the commitments made by government given the taxpayers reluctance to pay.

Many would argue that past experience bears out the Treasury's scepticism. The decisions about nuclear at the end of the 1970s, notably by Tony Benn, is a prime exhibit, as is the 1970s *Plan for Coal* and the large excess capacity that built up in the coal and electricity generating industries.

Whether all this is correct is however largely irrelevant in the nuclear case now, because nuclear is always going to be state-backed companies and states that develop nuclear power, not private companies. The state is the contractor for new nuclear, and unless it is prepared to stand behind construction contracts they are not going to happen. So the choice is straightforward, if direct procurement is ruled out, the customers will have to pay, and they can either pay through a CfD like that at Hinkley or they can pay through a RAB.

The RAB gets around the Treasury objections in a neat if rather contrived way. It makes it clear that it is the customers who are taking the risk, not the Treasury directly. Furthermore it gets around the CfD problem by simply not having one. The actual price customers pay can be some combination of the rate of return allowed on the RAB and the market price for capacity. There is no need to fix prices for 35 years.

The RAB also gets around the problem investors face because of time inconsistency. The essence of the RAB is that the state promises not to behave in a time inconsistent way. It promises via the regulator to ensure the legitimate and efficient functions are financed, and it therefore protects the nuclear developer from expropriation either by attempts to force down electricity prices, or from the consequences of decisions like that made in Germany after Fukishima. It does not stop subsequent governments closing down existing nuclear plants and stopping new build. But it does mean that governments cannot escape the consequences of such actions.

8. Practical issues to address in applying the RAB Model

To make the RAB model work, there are a series of steps that will need to be taken. These include:

(i) the regulator

This could be a new nuclear regulator, or it could be OFGEM. It would probably be a mistake to combine safety and economic regulation, as happened in railways, so OFGEM would probably be the appropriate body. If at some future date the utility regulators are combined (and there is a good case for doing this) a cross-utility regulator would be even better.

(ii) the use of system charging base

The bulk of the costs of the electricity industry in the future are going to be fixed system costs. The future is likely to be about capacity, not energy and wholesale markets. The government will need to decide whether to bundle all the existing capacity, FiT and CfD contracts costs together, or to itemise them on customers' bills. The latter is the right answer, since it is clean and transparent, but bundling in a general use of system charge is probably politically more expedient.

(iii) the structure of the construction contract and its milestones

There will need to be a standard nuclear contract format, with identified milestones. There is a strong efficiency reason to make these are simple as possible, with say a couple of trigger points for AICC to be incorporated in the RAB – if an AICC approach is taken. There is also a political reason for simplicity: the more complex, the more likely the vested interests will capture the government and in particular the nuclear industry will insulate itself against the impact of the efficiency incentives in the RAB process.

(iv) the process of evaluating the AICC

The AICC are always going to involve an element of judgement in the decision about their incorporation at the efficient level into the RAB. This presents the regulator with the prospect of very severe lobbying pressures, and indeed also the threat of legal action. To avoid this, the contract needs to be as simple as possible, the rules need to be set out at the outset, and the regulator needs to be clear as to the process to be taken in evaluation.

It is imperative that there are no actual or perceived conflicts of interest, and the regulator will need to demonstrate that this is in fact the case.

(v) the indexing of the capacity contract costs

The concept of indexing some elements of the price of the nuclear output to the actual capacity contracts values over time is one of the few ways of imposing market discipline, and avoiding the trap of setting a CfD *ex ante* over such a long period. It also, as argued above, allows customers to face the correct economic prices and not a price driven by legacy contracts.

To do this the Equivalent Firm Power auction, proposed in the *Cost of Energy Review*, will need to be developed, so that it can be deep and liquid and a market around its current and especially future prices can develop.

(vi) the allowed return on the RAB and continuous market testing

Experience from the water industry indicates that an *ex ante* setting of the cost of capital for the RAB is fraught with difficulties. It has resulted in serious mistakes by the regulators, with excess costs to customers. Since the RAB is mostly equity risk free, it is the cost of debt that matters most. This should be indexed, and there are a number of possible indexes to choose from. The debt premium will quickly get established in the market, and especially if nuclear RAB bonds can be traded.

Rather than try to pick the right answer, the regulator should use market determined numbers and where mistakes are made (which they almost certainly will be) there should be an error correction mechanism.

9. Conclusion

The RAB approach is in a first best world probably inferior to the direct procurement route, but the latter is ruled out by the Treasury imposed constraints. The RAB model is a second best, but much better than the Hinkley style contract.

None of these approaches leads to the conclusion that nuclear is either necessary or desirable to meet the twin objectives of security of supply and decarbonisation, though it would contribute to both. No smart contracting and regulating framework can magic away the deep challenges that nuclear faces, notably: the possibility that in the next 60 years much cheaper new low carbon technologies may become available, possibly including new nuclear ones too; the very large upfront and sunk costs; the risk and the safety regulation; and the challenges of getting rid of the waste.

It is for society to decide whether it wants new nuclear or not. The market cannot decide. If that decision is to proceed, the RAB model is both plausible and preferable to the Hinkley model.