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Energy, Infrastructure and Utilities

Reaction required…

Introducing the Deloitte nuclear discussion series

"Nuclear power currently generates approximately 23% of the UK's electricity."

The Prime Minister has called climate change "the world's greatest environmental challenge". One of the UK Government's key measures to address this challenge has been to aim for 10% of UK electricity generating capacity to come from renewable sources by 2010, with an aspiration for this to rise to 20% by 2020. However, the carbon benefits of investment in the renewable sector are likely to be significantly offset if the contribution of nuclear power – currently the UK's principal non-carbon emitting electricity generating source – to the energy mix is allowed to fall. Nuclear power currently generates approximately 23% of the UK's electricity. This share is expected to fall to 7% by 2020 unless the lives of existing nuclear power plants (NPPs) are extended and/or a new generation of nuclear power plants are constructed. Yet in contrast to the renewable sector, at present there are no targets, or even clear policies, on nuclear power's share of the mix of electricity generation in the medium to long-term. In the UK, addressing the issue of climate change over this period can only be achieved with a balanced set of measures that meet the carbon, economic and social objectives of government policy. The possible contribution of new nuclear plants to that balance should now be explicitly discussed within the UK situation.

The projected displacement of coal generation with gas fired capacity, and to a lesser extent the growth in renewables generation, is expected to provide for a reduction in carbon emissions by 2020, even if existing NPPs are not replaced or their lives extended. However if such replacement or life extensions do take place, nuclear could provide some additional contribution towards carbon reduction targets by that date. In a carbon-constrained world it appears, prima facie, that there is an argument for the inclusion of nuclear as a measure to assist in reaching the government's emission targets.

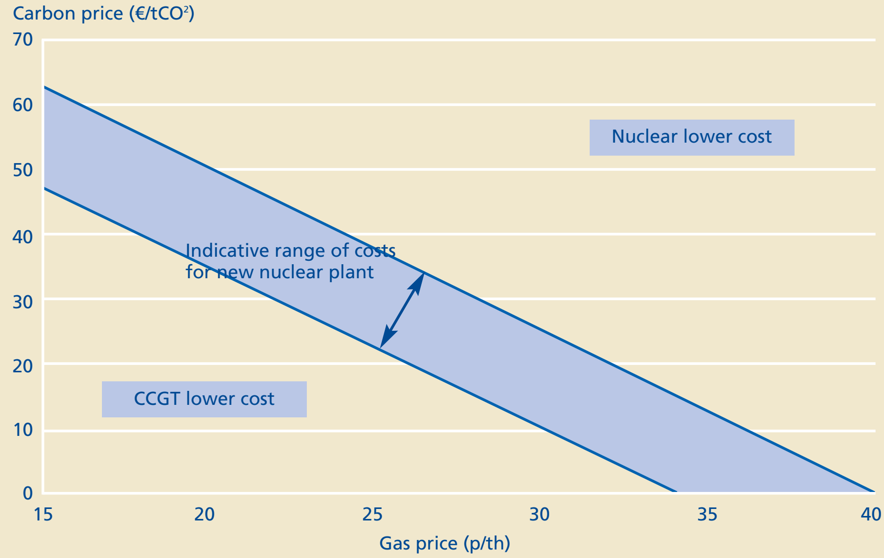
However, since the UK adopted a deregulated and market-led approach to its electricity markets, with the exception of Sizewell B (which was planned and constructed whilst British Energy was still owned by the Government), no nuclear power plants have been commissioned in the UK. Put simply, it appears that to date the private sector, at least in the UK, has not found the potential rewards from investing in new NPPs sufficiently attractive to justify the risks inherent in such projects.

Three issues coincide to critically alter the investment equation for the UK and European private sector as they consider the value new nuclear will bring to their portfolio:

- The development of the EU Emissions Trading Scheme (ETS) has to some extent levelled the playing field between fossil and nuclear generation in terms of environmental costs.
- The relative 'pain' of the cost of emissions allowances is accentuated by the high oil price situation – a pattern that industry analysts are predicting may continue.
- Nuclear technologies have materially altered in terms of economics and efficiencies in recent decades and it seems credible to consider the UK capable of benefiting from a second mover advantage – leveraging the experience and outlay of First Of A Kind costs within European, US and Asian new nuclear plant.

To contribute to the changing debate on nuclear energy, over the coming months Deloitte will publish a series of papers focusing on some of the areas for consideration and, where solutions to problems may require development if the Government wishes to create a framework that might encourage the private sector to think again about the opportunities of investing in new NPPs within the UK. These areas include the issue of carbon pricing, the nature of UK electricity market design, the expected economics of nuclear investments, the role of project structuring and risk transfer, and the issue of back end costs including decommissioning and waste management. This paper begins the series by introducing these issues and their potential impact on the nuclear debate. Further subjects will be added as the series advances.

Figure 1: Indicative comparison of levelised costs of new NPPs and CCGTs



Carbon pricing

There appears to be a consensus that electricity generated by NPPs currently has a higher levelised unit cost than gas fired power plants. In the UK, this position has recently been restated by the Royal Academy of Engineering, and is assumed in the DTI's White Paper modelling work on the cost of electricity generation. In this context, choosing not to invest in new NPPs appears rational.

One of the reasons that nuclear power is currently more expensive to generate than power from fossil fuel plants, and particularly gas-fired plants, is because of the different regulatory requirements regarding pollutants emitted in the course of generating electricity. Whereas the cost of waste disposal up to now has been an internal cost to the owner of an NPP due to the requirement to make financial provision under the nuclear regulatory regime, the pollution emitted in creating electricity from fossil fuel power plants has been an external cost, not reflected in the power plant's cost of generation. This is now changing with the introduction of the EU ETS which requires electricity generators producing carbon pollutants to hold an allowance for each tonne of CO^2 they emit. This effectively imposes a price on emissions equal to the price of an allowance, although at present generators receive some allowances free of charge. In principle, this should help make nuclear power more competitive.

Our first paper will consider the crucial role of the carbon price in the future economics of new build NPPs. The circumstances in which nuclear is economic is shown illustratively in the diagram above. At low carbon and gas prices, the levelised cost of electricity from a gas-fired power plant is likely to be lower than the electricity produced by an NPP. Conversely, at high carbon and gas prices, the levelised cost of electricity from an NPP is likely to be lower than the electricity produced by a gas-fired power plant. The point at which nuclear power becomes cheaper is dependent on several factors, key among which is the capital cost of any new NPP. As this cost remains uncertain at this time – this will be the subject of our third paper. The figure above shows an indicative range of relative economics. At present, we consider that regardless of how the carbon markets develop, EU ETS should not be assumed to be the solution to levelling the playing field between fossil fuel generated power and nuclear power by pricing the carbon cost into fossil fuel generated electricity. Long-term political commitment to EU ETS is not proven – the scheme is only defined to 2012 – and the system is therefore not likely to be considered to be a sufficiently robust basis on which to make 40+ year investment decisions. Furthermore, the process of political decision making across the EU which sets the overall cap for the allowances may in any case fail to set a cap at a level that reflects the long-term value of avoided emissions. It is the longer-term cost of carbon abatement that is the more appropriate basis for assessing the benefits of nuclear power. Indeed, it remains to be seen whether it is possible for the long-term cost of carbon abatement to be established and reflected in the market price of carbon at a level sufficient to counter climate change.

The paper will also consider the steps the UK Government might make outside of, or in addition to, EU ETS to ensure that there is a stable policy commitment to recognising the value of avoided emissions. This commitment may, for example, include the government underwriting carbon contracts for differences (CfDs) guaranteeing a floor for the carbon price to generators, as well as fiscal measures such as reform and extension of the Climate Change Levy.

The UK electricity market

The higher upfront cost of an NPP means the cost of electricity generated includes a much higher element of debt service compared with electricity generated by a fossil fuel plant. As a consequence, in a project-financed structure, the lenders' exposure to delay or non-payment of debt service due to a fall in the market price of electricity is greater in an NPP than in a fossil fuel power plant. To mitigate this risk, investors and funders of a new NPP are likely to require long-term power purchase arrangements that provide security of the revenue stream. However, as a result of both the structural situation of the electricity sector (small number of dominant vertically integrated players) and the nature of the UK trading arrangements, there is relatively limited liquidity in medium to long-term contracts. Given the large output of a typical NPP, this means that it may be difficult for an independent project-financed nuclear operator to place its output in the market with long-term arrangements without for example, some form of nuclear obligation requiring purchasers to buy a part of their portfolio from NPPs or other incentives to optimise the long-term position of nuclear operators. The lessons learnt from the British Energy experience, as a player with an unbalanced portfolio (no sufficient downstream hedge of customers) are instructive.

By contrast, a large vertically integrated player may consider an on-balance sheet funded investment in nuclear as part of its overall portfolio development activities, and within the context of it holding a wide fuel mix and a downstream hedge of retail customers to diversify and manage such risk over the various cycles of the market.

As long as market arrangements do not distort or effectively prevent private sector players from making such choices towards nuclear new-build, this corporate-financed nuclear new build scenario would involve a minimum of market intervention from government or regulators.

In addition, participants within the UK electricity market are faced with a range of ad hoc mechanisms that have evolved to address various aspects of government policy in energy such as the Renewable Obligation and Climate Change Levy, each with varying degrees of complexity and applicability to the industry. The time may be opportune to revisit such diverse measures and streamline the price signals being given to the market in order to reinforce the overall primacy of the climate change objective for the UK.

Our second paper will consider what changes, if any, might need to be made to the design and operation of the UK electricity market to address some of the market barriers that both a vertically integrated and an independent nuclear power developer would face. These may include the form of trading arrangements, incentives on counterparties to contract with a nuclear operator, and the vertical and horizontal structure of the industry over the next decade. This paper will be predicated on the assumption, however, that in supporting any future programme of new nuclear plant, the UK Government's objective will continue to facilitate a market-led approach, as it has done in other sectors of the electricity market.

The economics of nuclear power

Much of the debate around nuclear power is focused on economics: critics claim that it is not competitive when compared with other generating sources, whereas supporters of nuclear power claim that the economics of nuclear power have greatly improved, to the extent that it is now competitive with other generating sources, particularly once the long-term cost of carbon is priced into fossil fuel plants.

The divergence of opinion is in part a result of whether one is considering the often poor historical economic performance of NPPs, particularly in the UK, or the economics of today's best performing reactors coupled with the potential cost and performance improvements of the new generation of reactors that have been developed by many of the leading reactor suppliers. The debate is often further confused by the lack of supporting detail presented with the economic analysis of the new generation of NPPs.

In our third paper, we will present an analysis of the economics of new NPPs in the UK under various scenarios. This will be based on transparent analysis of the input assumptions that will be critical in determining the economics of the new generation of NPPs, for example:

Capital cost – In response to criticism of the high capital cost of NPPs, reactor manufacturers' claim that the new generation of NPPs will have significantly lower capital costs. However, none of these reactors are yet in commercial operation, and so the manufacturers' claims cannot yet be substantiated.

Cost of capital – Given the high capital cost of electricity generating assets, particularly NPPs, differences in the cost of capital applied to different types of asset can have a material impact on the conclusion of any economic analysis. However, given the lack of private sector investment in new NPPs in the UK, the market's return expectations for debt and equity, and the relative contribution of each source to the total capital requirement (gearing), are not yet clear.

Fuel costs – Any conclusions reached in assessing the relative economic advantages of nuclear and fossil fuelled power plants is largely a function of the assumptions made regarding future fuel prices. Are recent upward movements in oil and gas prices the beginning of a long-term trend or a short-term spike in the market price? This paper will consider the economics of nuclear power vis-à-vis fossil fuel plants in a range of different fuel scenarios.

Operating costs – There continue to be significant variations in load factor and operating costs achieved by different nuclear operators around the globe. The economics of nuclear power are highly sensitive to these parameters. Our analysis will consider a range of scenarios, from average present performance to existing and expected international best practice.

Useful economic life – The expected operating life of the new generation of NPPs is expected to be 60 years, as is already being seen in the US where the operating lives of some PWRs have been extended to 60 years, a significant increase in the operating life of the current fleet of UK NPPs.

Decommissioning and waste disposal – The headline cost of decommissioning and waste disposal is significant. However, this cost is incurred at the end of an NPPs operating life, so when assessing the cost in the investment appraisal at the beginning of the project in present value terms the cost is much lower.

This paper will consider how the magnitude and timing of decommissioning and long-term waste disposal costs affect the economic attractiveness of nuclear plant.

Economies of scale – The economics of new NPPs in the UK is likely to change depending on whether a single reactor or several reactors are built. Our paper will consider both these scenarios.

Project structuring and risk transfer

The high risks associated with security, decommissioning, and long-term waste disposal mean that governments cannot be passive observers of the nuclear sector but rather need to ensure that high standards are met to avoid, in the worst case, a catastrophic nuclear incident. These high standards need to be met regardless of market conditions, and neither cost savings from changes in operating procedures nor opportunities for moth-balling are available as alternative tactical strategies for nuclear operators if, for example, there is a prolonged fall in market prices.

Historically, NPPs in the UK and in many parts of the world have been commissioned by publicly owned utilities. However, public investment in a new generation of NPPs would be inconsistent with the market-based structure of the UK electricity market. Our fourth paper will consider potential financing structures that could be used if the private sector was to build a new NPP, including on balance sheet corporate financing and off balance sheet project financing. The analysis will include an assessment of what can be expected in the event of private sector default in each scenario.

A key driver in this analysis will be an assessment of which project risks could be transferred to the private sector, and which will need to remain fully or in part with the public sector. This detailed analysis will consider the risks from the outset of the programme (e.g. licensing risk) to the end (e.g. long-term waste disposal), and will include a detailed discussion of the key risks, including, for example:

Sales risk – Contracts with large industrial consumers have reduced the risk, and therefore cost of capital, on the new Finnish reactor being constructed. Project structure will as a result need to take account of the electricity market structure and industrial energy intensity issues addressed in our second paper.

Insurance risk – Nuclear operators are required to have €1.1bn in insurance for nuclear incident. The ability of a project financed nuclear operator to obtain this level of insurance has not yet been tested, and requiring insurance at this level will be another cost differentiator between nuclear and fossil fuel generated power. Also, the ability of a new private sector operator to obtain terrorism insurance remains uncertain. In the current climate, insurance could be a key driver in project structuring.

Back end costs: decomissioning and waste management

One of the most contentious aspects of nuclear power relates to the method and cost of decommissioning the power plants and long-term waste disposal.

We do not consider that it will be possible for the Government to fully transfer the financial and ownership risks associated with plant decommissioning and long-term waste disposal to the private sector. As the vast majority of these costs fall after the end of the operating period, in a project financed structure, for example, the banks' debt and the shareholders' return will have been repaid/paid out during the operating period. Thus, if the funds set aside for decommissioning and final waste disposal accrued during the plant's operating life are found to be insufficient, the investors may allow the company owning the plant to go into bankruptcy, with no recourse to the investors. In this scenario, the requirement to decommission the site and dispose of the waste remains, and this responsibility is likely to fall on the Government.

Our fifth paper will consider what risks the Government can reasonably expect to transfer to the private sector in relation to decommissioning and long-term waste disposal. Similarly, we will examine possible scenarios of contributions the private sector may need to make to fund such back-end costs, and the materiality of such costs on plant economics. Finally, we will assess whether changes are required to the existing regulatory framework to enable cost effective risk sharing between the public and private sectors in this area.

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