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The economics of nuclear power – has Government got it right?

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In its recent consultation 'The Future of Nuclear Power' the UK Government concludes that: 'Based on this conservative analysis of the economics of nuclear power, the UK Government believes that nuclear power stations would yield economic benefits to the UK …' (Consultation Document, p.74)

Is this a fair conclusion?

In this SEG Policy Briefing, leading nuclear economist Professor Gordon MacKerron examines some of the assumptions that underlie Government's analysis. This demonstrates that Government's position on the economics of nuclear power is overly optimistic as its analysis fails to account for significant risks and uncertainties.

Key messages

1 Government's position on the economics of nuclear power is overly optimistic. It fails to account for the uncertainties inherent in construction costs and overestimates the extent to which carbon pricing will incentivise investment in low carbon energy technologies.

2 Construction costs are likely to be higher than the Government estimates. This is due to:

- a The novelty of the new reactor designs that will be used.
- b The low likelihood of achieving economies of scale by building large numbers of nuclear power stations.
- c Political and regulatory risks arising from the demand for bespoke reactor designs that conform to different national safety regulations.

3 In contrast to the assumption made in the Government's analysis, the price of carbon is unlikely to be accounted for by potential nuclear investors due to likely low and unstable carbon prices and the lack of a floor price in the EU Emissions Trading Scheme (ETS).

4 The simple answer to the question 'what are the economics of nuclear power' is: we don't know – but the risks are very substantial.

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All the reactor designs currently credible in UK conditions represent significant techno-logical change

The centrepiece of the Government's case in favour of nuclear power is a 'net welfare balance' calculation – essentially a cost-benefit analysis showing economic advantage or disadvantage of nuclear generation, using assumptions representing a supposedly most likely outcome. It then looks at variations – sensitivities – using different assumptions about gas prices, nuclear construction costs and the price of carbon. This yields 25 possible outcomes, 17 of which show a net welfare gain (ie a net benefit to society) and eight of which show a loss. This is hardly an unambiguous endorsement of net 'economic benefits'. But the Government analysis is in important ways optimistic. Here we consider:

- the realism of the construction cost analysis
- the assumptions and framework used in forecasting future carbon prices.

Construction costs

Easily the most important element in the overall economics of nuclear power is the construction (capital) cost, accounting for well over half of total generating cost. Government has tried to introduce conservatism into its capital cost estimate by setting its central estimate at a higher level than some international estimates and then by conducting sensitivity tests of both lower and higher capital costs.

The historic capital cost record of nuclear power in the UK is dire, but any future practice will almost inevitably provide improvements on this record. Project management techniques have improved; international tendering should restrain cost growth by promoting greater competition; and a consortium taking on nuclear projects would offer something close to a fixed-price contract rather than the cost-plus contracts (where contractors have all their costs reimbursed, plus a profit margin) that previously were normal.

There has been little progress towards common nuclear regulatory practice even among EU countries

But this does not mean that capital costs of new reactors can be predicted with a high degree of certainty. There are three reasons for this, all of which suggest that cost overruns are more probable than cost reductions:

- the novelty of the relevant reactor designs;
- issues surrounding standardised designs and 'programme' build; and
- political and regulatory risks.

Novelty

All the reactor designs currently credible in UK conditions represent significant technological change compared to reactors currently in operation anywhere in the world. The reactor designs that are likely to be proposed by firms for the UK are the EPR (from Areva in France) and the AP 1000 (a Westinghouse design). In neither case has any reactor yet been completed: for EPRs the first, in Finland, is two years into construction; for AP-1000s, none has yet been started. This represents a high level of technologically derived risk to capital cost estimates. Of the designs currently being offered the EPR displays fewest changes from current reactors. Yet the first example in Finland is now running two years late with only two years construction completed, and its capital cost has already escalated by 25 per cent. The sensitivity test for 'high nuclear costs' in the Government's calculations is a 30 per cent escalation – which looks modest in relation to this recent Finnish experience.

Programmes and economies of scale

The nuclear industry has long argued that it is only possible to achieve acceptably low cost in nuclear construction if a series of identical reactors is built in a programme. The number of identical reactors needed to reap these economies of replication is around eight. But the corollary is that a very small number of reactors will have relatively high costs. The Conservative Government which came to power in 1979 proposed a programme of 10 reactors, later reduced to four – and eventually ended up with just one, built at very high cost (Sizewell B). Conditions then were relatively favourable to a programme. A centralised state utility (the CEGB) could finance a programme and pass any excess costs on to consumers. Conditions now, in a liberalised and more fragmented market, are much less favourable to large, lumpy, 'programme' investment and this substantially increases the risk that only a limited number of reactors will be built – significantly raising costs.

Political and regulatory risk

There has been little progress towards common nuclear regulatory practice even among EU countries. Nation states strongly guard their right to exercise their powers over the safety approval of reactors. The regulatory requirements flowing from these local variations are unpredictable and can add substantially to capital costs. The processes of planning approval can also add to time and cost, especially where there is significant public opposition to plant construction. These risks again suggest that the profile of nuclear capital costs is heavily skewed towards risks of cost overruns.

So while Government has attempted to introduce conservatism into its capital cost estimates, it has not fully succeeded – the risks of higher nuclear construction costs are greater than hopes for low construction costs.

Carbon prices

One of the determinants of the 'welfare balance' is the carbon price. A high carbon price improves the economics of nuclear power by raising the costs of competing gas-fired technology. The Government tests the effects of different possible carbon prices, which are implicitly determined in the EU Emissions Trading Scheme (ETS). At high carbon prices the net benefit of nuclear power is significantly higher than at a zero price. For instance, a high (36 Euro) carbon price increases the benefit of nuclear power (all else equal) from just over zero to over 1500m per station.

However, there is a major problem here. Future carbon prices will be largely determined in the EU ETS, which displays unstable and often low carbon prices. So businesses are unlikely to take any account of positive carbon prices in calculating the potential profitability of nuclear investment.

Conclusion

The large uncertainties attached to nuclear construction costs, with a serious risk of cost escalation, plus the ineffectiveness of the EU ETS as an incentive for investment means that the market will be unlikely to believe that the 'welfare balance' (potential benefits to society) for nuclear power is nearly as favourable as Government argues.

In a technical document supporting its analysis of nuclear new build, the Government provides a more realistic statement than the one quoted at the beginning of this briefing note. It states that: 'The analysis highlights considerable uncertainty surrounding the economic appraisal'. When we add to this the larger construction cost risks than Government allows, as well as the minimal practical benefits to nuclear investment of carbon pricing, the simple answer to the question 'what are the economics of nuclear power' is: we don't know – but the risks are very substantial.

Businesses are unlikely to take any account of positive carbon prices in calculating the potential profitability of nuclear investment

This briefing note is based on SEG's response to the Government's recent consultation on new nuclear power. For a more detailed account of these arguments, please refer to the full consultation response available at
www.sussex.ac.uk/sussexenergygroup/documents/seg_spru_nuclear_response.pdf

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