THE FUTURE OF ENERGY: ARE COMPETITIVE MARKETS AND NUCLEAR POWER THE ANSWER?

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BIOGRAPHY

Stephen is Professor of Energy Policy at the Public Services International Research Unit (PSIRU), part of the Business School. He has been a member of PSIRU, where he leads energy policy work, since 2001. Prior to that, he was a member of the Energy Policy Programme at the Science Policy Research Unit, University of Sussex.

His research focuses particularly on the liberalisation of energy markets and economic and policy issues surrounding nuclear power. His lecture will examine whether further pursuit of competition in energy markets and expansion in the role of nuclear power can be the main elements in a policy to meet Britain's future energy needs.

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1. INTRODUCTION

The traditional objectives of Britain's energy policy have been that energy supplies should be affordable and reliable. In the past couple of decades, an additional requirement has been added: that energy production should not cause significant environmental damage, in short, it should be sustainable or clean. Increasing concern about the impact of fossil fuel (coal, oil and gas) use on the climate, on depletion of fossil fuel reserves and on the political stability and hence reliability of the major fossil fuel producers have meant these policy issues are more firmly in the public eye than ever before.

In 1987, the Conservative party was returned to power in Britain on twin manifesto promises to promote an expansion of nuclear power and to transform the electricity industry from a nationalised monopoly to a privately own competitive market (often termed liberalisation). All subsequent governments have, to a greater or lesser extent, maintained these commitments as their major tools to achieve their energy policy goals. More than two decades on from this promise, nuclear power has suffered several reverses and its contribution to energy supplies is declining, and electricity markets are far from the ideal of cut-throat competition that we were promised. Yet these two policy measures remain at the head of the government's agenda and the commitment to expand nuclear is arguably stronger than at any time in the past 20 years.

In this paper, I will discuss why 20 years of effort to promote nuclear power and create competitive energy markets has achieved so little and whether, in the coming decades, they can be major contributors to meeting the policy goals of security, sustainability and affordability. I will also examine how the prospects for building new nuclear power stations are influenced by how competitive electricity markets are.

1.1 Why do these policy measures still receive popular support?

At first glance, these policies, liberalisation and promoting nuclear power, might seem entirely sensible. There is a common perception that public ownership generally results in inefficiency and that competitive markets give consumers a better deal than a monopoly. Under this logic, privatisation and creation of competition is sure to be worthwhile.

The scale of fossil fuel use that has to be replaced to combat global warming and reserves depletion is so large that only an apparently unlimited resource like nuclear power can do the job. There are respectable arguments of principle that nuclear power should not be pursued, for example on grounds of weapons proliferation, reactor safety and waste disposal. For those that oppose nuclear power on any of these grounds, whether nuclear power is economic and would be an effective way to counter climate change is irrelevant. I make no judgement on these issues but they require serious debate. My arguments centre on the economics of new nuclear power stations.

2. NUCLEAR POWER

2.1 British experience in the past 20 years

Few now believe nuclear will produce 'power too cheap to meter', but the perception that nuclear power is a cheap energy source is still widely held despite all the damning evidence that has emerged in the UK over the past 20 years. This includes:

- In 1989, in the failed attempt to privatise Britain's nuclear power plants, it emerged that the operating costs alone of Britain's existing plants was double the expected wholesale electricity price;
- In 1995, the Sizewell B nuclear power plant was completed at a cost to electricity consumers of more than £3bn, yet a year later when the newer nuclear plants were privatised as British Energy, it and seven other nuclear power plants of about the same size were sold for only about half this cost;
- In 2002, despite acquiring these eight plants for a tiny fraction of their construction cost, British Energy went bankrupt and was saved only by the government committing £10bn of taxpayers' money to it;
- In 2004, despite consumers being charged for 25 years by the companies to pay for decommissioning the nuclear plants, it emerged that little of this money remained. This has left future taxpayers with a bill for about £100bn to pay for decommissioning the existing civil nuclear facilities from which they have derived no benefit.

2.2 Nuclear economics

To understand the economics of nuclear power, it is necessary to look at the relative size of the components of the cost of a kilowatt hour (kWh). Areva NP, the French vendor of nuclear power plants estimates[1] that 70% of the cost of a kWh of nuclear electricity is accounted for by the construction process, 20% by 'fixed' operating costs and the other 10% by 'variable' operating costs. The construction cost part is determined by three elements: the cost of building the plant; the cost of borrowing the money to pay for the plant; and the reliability of the plant (the more output the plant produces, the more thinly the finance costs can be spread). Most of the operating costs are fixed because even when the plant is not producing power it has to be fully staffed and regular maintenance will be required so little money is saved if the plant is not operating. The decommissioning cost is included in this element and is highly uncertain because there is minimal experience worldwide of decommissioning nuclear power stations. It is likely to be of the same order as the construction cost, but the fact that at the time the plant starts operating the expensive part of decommissioning is not likely to be undertaken for 100 years means that a company deciding whether to build a plant is not likely to worry much about the decommissioning cost. If we assume a nuclear power plant would cost £1bn to build and £1bn to decommission, if the owner invests only about £50m now and this earns a real annual interest rate of 3%, over 100 years that sum will have grown sufficiently to pay for decommissioning. Whether this is a secure way to fund decommissioning is a complex issue I will not discuss here.

Of the variable operating cost, perhaps half is fuel and this includes the cost to mine the uranium, 'enrich' it (increase the percentage of the useful uranium isotope), fabricate it into fuel, store it after use and dispose of it in a safe repository where it must remain isolated from the environment for several hundred thousand years. Fuel raises a number of important issues, such as the adequacy of uranium reserves if a large expansion of nuclear power is contemplated and whether it can be assumed 'spent' fuel can be isolated from the environment for this long. If the cost of uranium ore were to rise sharply and remain high because of resource depletion, this would raise serious environmental issues such as the increased impact of mining but from an economic point of view, the cost of uranium ore could go up by a factor of, say, five, and have little impact on the cost of nuclear electricity. The expected cost of spent fuel disposal is high. Like decommissioning, there is little worthwhile experience on which to base the cost estimates, but, like decommissioning, the costs arise too far in the future to be of much concern to the companies that want to build a nuclear plant.

All of the cost components identified above deserve detailed analysis but in this paper, I will focus on construction cost and cost of borrowing, the two elements that are most controversial and which have the largest impact on the overall cost of nuclear electricity.

1 http://www.areva.com/servlet/BlobProvider?blobcol=urluploadedfile&blobheader=application%252Fpdf&blobkey=id&blobtable=Downloads&blobwhere=1246874807296&filename=Overview_June_2009%252C0.pdf

2.3 New nuclear in Britain

While Britain's experience with nuclear power has been poor up to now – there has never been an 'economic kWh of nuclear electricity in Britain - the past is past and if there are compelling reasons to pursue nuclear power now, this poor experience should not be a barrier. Britain's proposed new nuclear power plants are based on a new design generation of plants, which, it is claimed, will be cheaper, quicker and easier to build, safer, will produce less waste and will be cheaper to decommission. This is a remarkable list of advances especially given that, on paper, these new designs do not appear so different to the previous generation of plants. These claims have yet to be tested anywhere in the world as no plant of this new breed is actually in operation yet and only a handful of plants are actually under construction, only two of which started construction before the beginning of 2009.This is also far from the first time that the nuclear industry has claimed that new designs will solve previous issues and past mistakes will not be repeated because they have learnt from their errors.

Some evidence on whether these claims are justified is beginning to emerge on these new designs, at least on construction cost and buildability. When the nuclear industry began to promote these new designs a decade ago, it confidently predicted they could be built for $1000 per kW of generating capacity. Typically, a nuclear plant of this new design generation would have a capacity of 1.5 million kW or 1500 megawatts (MW) and would therefore be expected to cost $1.5bn. Care must be taken in translating this dollar cost into sterling as over the past decade the dollar-pound exchange rate has fluctuated between £1=$1.4 to £1=$2. In October 2009, the exchange rate was about 1.6 and, a decade ago, the exchange rate was also about 1.6. So the forecast cost of one of these new plants a decade ago would have been about £600/kW. The general level of inflation over the decade has been about 30% so to bring that estimate up to today's money would increase it to about £800/kW.

When the UK government carried out a review of nuclear power economics in 2002, it assumed a range of construction costs for new nuclear plants but did not specify its central assumption. It claimed the information was commercially confidential, but the assumption appeared to be around £840/kW, somewhat higher than what the nuclear industry had been claiming would be the case. The government's White Paper concluded[2]:

> 'Its current economics make new nuclear build an unattractive option and there are important issues of nuclear waste to be resolved. Against this background, we conclude it is right to concentrate our efforts on energy efficiency and renewables. We do not, therefore, propose to support new nuclear build now. But we will keep the option open.'

2 Department of Trade and Industry (2003) 'Our energy future: creating a low carbon economy' Cm 5761, TSO, London, p 12. http://www.berr.gov.uk/files/file10719.pdf

In 2008, when the government revisited nuclear economics, its assumed construction cost was £1250/kW, representing a real increase in costs of about 20% over the 2002 figures[3]. Despite this increase in costs, the White Paper's conclusions were very different to those of a few years previously. The White Paper concluded:

> 'Nuclear power is:
>
> • Low-carbon – helping to minimise damaging climate change;
>
> • Affordable – nuclear is currently one of the cheapest low-carbon electricity generation technologies, so could help us deliver our goals cost effectively;
>
> • Dependable – a proven technology with modern reactors capable of producing electricity reliably;
>
> • Safe – backed up by a highly effective regulatory framework;
>
> • Capable of increasing diversity and reducing our dependence on any one technology or country for our energy or fuel supplies.'

The government claimed that nuclear power was the cheapest way to generate power as long as the economic disincentives for using fossil fuels reached the level the government expected[4]. It predicted that, on this basis, power generation companies would choose to build new nuclear plants in preference to other options provided the government gave the necessary political leadership and streamlined licensing and planning procedures. The government made a firm commitment that it would provide no direct subsidies for new nuclear power plants and that the decision whether or not to build nuclear power plants would be with the power companies. This promise of no subsidies was a major factor in persuading some MPs, who were concerned about the large amount of public money in the past that had gone into nuclear power for little return, not to oppose the plan.

2.4 Experience outside UK

However, while the British government's real construction cost estimate did increase by about 20% between 2002 and 2008, in the rest of the world actual experience was much worse. The first order for a new generation design, the EPR, came in 2003 for a plant, Olkiluoto, in Finland of 1600MW for which the contract price was reported to be €3bn or €1875/kW. At the exchange rates of the day (£1=€1.45), this was equivalent to £1300/kW, significantly higher than the government's assumption of only a year before and higher even than its 2008 forecast. Construction started in August 2005 and from the start, things went wrong and continue to go wrong. The scale of problems at the site has become almost farcical. Olkiluoto was expected to take 4 years to build but after 4 years of construction it was still about 4 years away from completion and the expected cost had nearly doubled in Euro terms to about €3500/kW. At 2009 exchange rates (£1=€1.10) this is equivalent to £3200/kW, two and a half times the

3 Department for Business, Enterprise and Regulatory Reform 'Meeting the energy challenge: a white paper on nuclear power' Cm 7296, HMSO, London, p 61. http://www.berr.gov.uk/files/file43006.pdf

4 A 'carbon' price of at least €36/t of CO2.

government's 2008 assumption. The plant vendor, the French company Areva, which is expected to supply plants of this design for the UK market, is suing the utility for about €1bn for negligence and the utility is countersuing the utility for €2bn. The Finnish safety regulator is threatening not to license the plant if design issues are not resolved. The UK safety regulator has echoed these concerns. Resolving these issues might delay build for any UK orders for this design and might increase costs.

The other new generation plant actually under construction (since December 2007), is of the same design as the Finnish plant, and is in France at Flamanville. It is being built by Electricité de France (EDF), the leading utility proposing to operate nuclear plants in UK. After a year of construction, EDF acknowledged it was more than 20% over budget at £2100/kW[5]. EDF has already built 58 nuclear reactors of modern design in France, more than three times as many units as any other utility in the world and if any company can build nuclear power plants efficiently, surely it is EDF. The problems at Flamanville and Olkiluoto put the 'buildability' and the cost estimates for this design in doubt. Experience at only two sites is too little from which to draw unequivocal conclusions, but it is the only experience there is and it is uniformly bad, far worse than even the most determined critics of nuclear power would have forecast.

Elsewhere, electric utilities in the West with plans for new nuclear power plants are at the stage of talking to suppliers, identifying sites and estimating costs. In 2008, E.ON, a company hoping to build new nuclear plants in the UK estimated that the cost of building a plant in the UK would be 70% higher than the government was assuming[6].

In the USA, the US government is also trying to revive nuclear ordering, but in their case by offering very large public subsidies for a few demonstration units. Estimates are beginning to emerge from some of the utilities who plan to build plants there. The utilities' own cost estimates have increased markedly in the past 3-4 years and seemed to clustering around the $5000/kW or about £3000/kW in 2009 with every expectation that prices will increase further as the estimates are firmed up. A cost of $5000/kW is more than three times the UK government's estimate[7]. It should be emphasised that these US figures are all pre-construction estimates. All experience with nuclear power suggests that, as with Olkiluoto and Flamanville, pre-construction cost estimates will be an under-estimate, often by a large margin, of actual costs.

At least two of the claims made for nuclear power by the British government, that it is 'affordable' and 'dependable', now therefore look dubious in the light of Finnish and French experience and the latest cost estimates.

5 Nucleonics Week 'EDF: Flamanville-3 cost rise due to inflation, technical/regulatory changes' December 11, 2008, p 1

6 The Times 'Reactors will cost twice estimate, says E.ON chief', May 5, 2008, p 32.

7 S Thomas & D Hall (2009) 'The financial crisis and nuclear power' NPEC, Washington. http://www.npec-web.org/Frameset.asp?PageType=Projects

2.5 Cost of borrowing

In the past, financing the construction of new nuclear plants has never been a problem because the electricity industry was a monopoly. If costs over-ran or the plant was not reliable, the utility simply put electricity prices up to pay its additional costs. So, to a banker lending money to a utility, a nuclear power plant was a low-risk loan and as a result, the cost of borrowing was correspondingly low. This was a huge advantage for a technology for which the costs are dominated by the cost of construction.

However, after the opening up of electricity to some form of competition, far from perfect as we shall see below, the financial risk moves from the consumer to the utility. In a market, if the cost of your product is too high, you go out of business if you cannot improve your efficiency. This was clearly illustrated in 2002 in the UK when the nuclear company, British Energy, went bankrupt because its operating costs were higher than its income from electricity sales. British Energy could not unilaterally raise its prices to cover its costs, it had to take what the market offered. Those that owned shares in British Energy lost their money. Had the company been building a nuclear power plant, the banks providing the loans would have also lost their money.

The banks that lent money to the Finnish utility building Olkiluoto will be biting their nails to see if it can survive. If it does go under, and there is a serious risk now that it will, the banks that lent to it could lose a significant part of their loans. Banks will therefore now see nuclear investment as highly risky and the cost of borrowing will reflect this. In its White Paper of 2008, the government assumed a range of costs of capital of 7%, 10% and 12%. However, even the 12% rate, which produces an uneconomically high cost of generation, appears far too low given the level of risk building a nuclear power plant entails.

2.6 Can nuclear power significantly reduce greenhouse gas emissions?

If nuclear power really was an essential element to combating climate change then there might be no alternative but to acknowledge that there are economic and other problems and devise ways of reducing their impact. However, electricity accounts for less than 20% of the energy we use and we currently get less than 20% of our electricity from nuclear sources, so even if we replaced all the existing plants (which would need about 6 new reactors) and built enough additional plants to bring the share of nuclear electricity up to 60% (a total of 20 reactors), nuclear power would only be providing about 10% of our energy needs. To make a real impact, electricity generated using nuclear power would have to take over some of the markets currently supplied by oil and gas, such as powering cars and providing space-heating and at the moment, the economics of doing this look very poor. To get nuclear power's share of energy demand up to, say, 40%, would need about 80 new reactors and still the majority of fossil fuel use would remain.

If we were to re-run the government's estimated cost of nuclear power using construction cost estimates more in line with recent estimates, say, £3000/kW and using a real cost of borrowing of 15%, it is likely that we would get an overall price of more than double even the highest estimates made by the government. At that price, a lot of alternatives start to look very attractive. So it seems nuclear can only make a

relatively small contribution to reducing greenhouse gases (for example, getting 10% of our energy from nuclear) and at very high cost.

3. COMPETITIVE MARKETS AND PRIVATISATION

As with the cost of nuclear power, the public probably has a distorted view of how successful the 1990 privatisation of the electricity industry has been. This is based on the conventional wisdom that publicly owned monopolies are always a poor option. This is reinforced by propaganda from the companies and, shamefully, from the electricity regulatory authorities telling us how successful the reforms have been. Few now remember that the electricity industry was not privatised because of any major problems. The electricity industry gave good profits back to the Treasury, electricity supplies were extremely reliable and prices were on a par with those of our main European competitors. Aside from a limited reform in Chile in a very different context, the model introduced in Britain was new and untested. So the reform was an act of faith based on no hard evidence that privatisation and introduction of competition would improve the service and with no particular problems it had to solve.

In principle, the model is very simple. The electricity industry can be divided, or 'unbundled', into four parts: generation of electricity (the power stations); retailing (buying electricity from the wholesale market and selling to consumers including reading meters and sending out bills); transmission (the high voltage cables that take power from the power stations to the demand centres); and distribution (the low voltage cables that deliver power to consumers). In terms of contribution to the overall electricity bill, generation is usually more than half, distribution is perhaps a quarter and transmission and retail both less than 10%.

Up to 1990, the industry was 'integrated' so that two sets of companies carried out these four tasks. In England & Wales, all generation and transmission was carried out by the Central Electricity Generating Board (CEGB). All distribution and retail was carried out by twelve Area Boards, such as the London Electricity Board. All thirteen companies were owned by central government.

In the new model, the industry was unbundled into four separate sets of companies corresponding to the four functions described above. Transmission and distribution remained regulated monopolies: it would make no sense having two or more sets of competing wires going into each house. Generation would be opened up to competition so that companies generating electricity had to compete every half hour of every day to sell their power. Only the lowest cost producers would survive. For retail, consumers would be able to switch between suppliers so that any supplier that did not match the lowest prices would soon lose all their customers. To ensure fair competition, the tariff for use of the network would be the same for all users.

The CEGB was split into three competing generation companies, National Power, Powergen and Nuclear Electric (which was still publicly owned) and a transmission company, National Grid Company. The Area Boards still carried out distribution and retail but had to make a strict separation between these two businesses so their monopoly distribution business could not unfairly cross-subsidise their retail business. The distribution businesses remained a monopoly within each Area Board's existing territory. However, the retail businesses of the Area Boards were able to expand

outside their previous monopoly territories and were able to compete anywhere in Britain. This was expected to mean that consumers would be able to choose for their electricity supplies between at least twelve competing retail companies plus any new companies, such as British Gas, that came into the market to sell electricity.

The elegance and the intuitive logic of this model made the attractions of the 'British Model' compelling. Well before there was any evidence on how well the British reforms had worked, the World Bank, the European Commission, numerous national governments and the big management consultancy companies had been persuaded to adopt the British Model as the policy that should be followed. The World Bank left many developing countries with no choice by making their loans contingent on the British Model being adopted. There is, therefore, a very strong vested interest for these organisations, which had invested a large amount of their credibility in this model, not to acknowledge any failings in the model.

3.1 Ownership

The idea that changing ownership from public to private would be sufficient to improve performance can be easily dismissed. What little evidence there is on the relative performance of privately-owned and publicly-owned utilities shows no evidence of any superiority of private over public. Worldwide, the region where reforms are acknowledged to have been most successful is the Nordic region (Norway, Sweden, Finland and Denmark) which is operated as just one unified market covering all four countries. This system is dominated by publicly owned companies, some nationally-owned, some locally-owned. The reality is that there are good and bad publicly owned companies and good and bad privately owned companies. The logical answer for dealing with the bad publicly-owned companies is to address the problems directly, not simply change ownership in the hope this might, by chance, solve the problems.

3.2 Competition

So if the British Model is to represent a real improvement, it must be through the introduction of competition not change of ownership and the evidence on competition requires more careful consideration. To the consumer, the most obvious difference in the new system is that consumers can now choose between competing energy suppliers. But the real pay-off should have been in the wholesale market. In any properly functioning market, the price should be essentially the same to all buyers so if the wholesale electricity market is working well, the price that retail companies pay for their wholesale supplies should be very similar. Retail costs should represent less than 10% of the total energy bill, so even if one company was dramatically more efficient than the rest, the savings it could offer consumers would be far too small to make it worthwhile to switch. It was reductions in the price of generation resulting from the introduction of competition that held out the promise of significant cost savings for consumers.

3.3 Wholesale markets

It is easy to make wholesale electricity markets seem immensely complex and impossible for the lay person to understand and the British electricity companies and the regulator have done little to de-mystify the market. However, the basic principles are simple. National electricity demand varies constantly, electricity cannot be stored, and supply and demand must match exactly at all times if the system is not to collapse. This means that supply and demand have to be matched every half hour (with some capacity on stand-by to cover the variability within that period) and generators must specify every half hour the price they are prepared to accept to generate power. An efficient market would choose generators in ascending order of price bid until demand is just satisfied so that demand is just met by the cheapest set of plants. When demand increases from one half-hour period to the next, the cheapest generator not already being used should be used to meet the extra demand and when it decreases the most expensive plant operating should be shut down.

This market would be the arena where power would be bought and sold and where the market price would be set. This would make it easy for new generators and retailers to enter the market to challenge the existing companies. If a new generator knew it could beat the prices of its competitors, it could be sure it would be able to sell its power just as any oil producer knows it can sell its oil at the world market price. A new retailer would know it could buy power for no more than its competitors would have to pay, so, if it could be more efficient than the existing companies, it would win customers by offering cheaper prices.

The traditional function of system planning under which a central authority would decide when new power station capacity was needed would no longer be required. If the trend of wholesale prices was upwards reflecting a shortage in capacity, companies would see the 'price signals' and would choose to build new power stations to take advantage of the profits they could make from these high prices.

This form of competition sounds satisfyingly intense, but in practice, it is actually probably too intense to be viable. The inevitable partner of competition is risk. A company wanting to finance construction of a new power station costing perhaps £1bn, would have to go to the banks to borrow the money. But they would not be able to assure the banks how much power they would be successful in selling nor would they know what price they would get when they were successful. In a genuinely competitive market, success is not inevitable and prices are not predictable.

This leads to perhaps what is the greatest danger with electricity liberalisation. If there are no safeguards against market failure, security of supply is in danger because there will be no way to ensure there are sufficient power stations to meet demand. In a free market, no company has (or can have) a duty to ensure security of supply. The competitive model relies for security of supply on an assumption that just enough power stations will be profitable to keep the lights on. Power stations that are not profitable will be closed down. Their owners will not be able to justify to their shareholders keeping a loss-making plant going just because its continued operation is necessary to fully satisfy demand. When security of supply is at risk of being compromised, market prices will go up sufficiently to trigger just enough investment to fill any gap. Given that large power stations are likely to take a decade or more from

start of planning to first generation of power, it is a heroic assumption to make that price signals will be apparent a decade before a shortfall in capacity occurs. If there are safeguards against market failure, the efficiency of the market is compromised.

The result of the risk the market imposes on generators is that they look for ways to keep as much of their power out of the half-hourly wholesale market as possible to make the risk of being a generator tolerable. They can do this by signing long-term contracts at prices not related to the market price directly with the retail companies that by-pass the market. Or, better still from their point of view, buy the retail companies so that the power they generate is sold directly to their own consumers. This is what has happened in the UK, with the 14 regional retail companies (twelve in England and Wales and two in Scotland) all taken over by the five dominant generation companies. The result is that trade in the visible market is negligible, representing 1-2% of all power generated. With such a 'thin' market (the proportion of energy that goes through the visible market) prices will inevitably be highly volatile and unpredictable. Such a thin market will be far too unreliable for potential new generators or new retailers to rely on selling into or buying from. Price signals are unlikely to be dependable enough to base billion-pound investment decisions to build new power plant on.

3.4 Retail markets

While generation is clearly no longer a monopoly, it is far from being the cut-throat market we were promised. This means that if there is to be competition, the onus is on consumers to force the companies to behave competitively by ruthlessly switching supplier to the cheapest one on offer so that the companies know they have to match the prices of the cheapest supplier if they are not to lose their consumers. Is this a burden we should be placing on consumers?

For industrial consumers who have the resources and the negotiating power to squeeze the best deal possible out of the electricity retailers, the answer may be yes but for domestic consumers, the answer is no. This leads to the first major issue. In a competitive market, the lowest prices go to those that can negotiate hardest. Making the electricity market competitive effectively requires small consumers to be as tough negotiators as an aluminium smelter or a chemicals factory. If they are not, the companies will offer their best prices to large consumers and they will make their profits from domestic consumers.

However, even within domestic consumers, the odds are stacked in favour of the strong. Most of us are now accustomed to going to price comparison sites to check the price of the insurance and financial services we use. To use these sites efficiently to choose your energy supplier, it is necessary to know your energy consumption, not such an easy thing to establish now meters are read so infrequently. The price comparison site will identify the company that is charging the cheapest price today. But of course you want to buy electricity in the future and there is no guarantee how long the companies will retain their current prices. For example, in 2008, each of the companies raised their prices four times.

My most recent experience in July 2006 of switching energy supplier is instructive. I established which company was probably the cheapest supplier (I had just moved house so consumption could only be a guess) and began the process of transferring to that company. Ten days later, this company put its prices up and was no longer the cheapest. It took five months, and hours of my time on hold on the telephone trying to sort out the details necessary to transfer to the new company. It was 18 months before I was refunded the money owed me by the company I had transferred from which had continued to supply me for those 5 months. It is clear that, despite my expertise in the area and the vast amount of my time that was wasted, I saved little if any money from this process. It is not an experience I am not keen to repeat, much less every time prices change.

Even if the process of transferring was more efficient, it would be still be a heroic bet on the consumer's part that the company they transferred to would remain the cheapest until they were prepared to switch again. More importantly, the process of switching favours those who are computer literate, comfortable with figures and who have a bank account that is stable enough to allow use of direct debits. The tariffs for those that pay by pre-payment meter or who pay quarterly by cheque are on average about 25% higher than for those who pay by direct debit and operate their account online. There is not a shred of verifiable evidence that this price differential reflects real additional costs on the companies – a crushing indictment of the negligence of the regulator. Is it really a defensible policy for a service as vital as electricity (and gas) to impose a system that leads to low income households paying such a heavy premium to get the same service as richer, better educated consumers?

3.5 Industry structure

Having well-designed markets is of little use if the industry structure is not competitive. If there are too few companies in the market there will be no reason for the companies to compete hard. The initial UK electricity industry structure after privatisation had faults, for example, there were only three competing generators. However, the generation and retail sectors were kept separate. This should have forced the generation companies to sell their power through the wholesale market making it 'liquid' enough to give reliable prices and a number of new generation companies were entering the market. The twelve regional retail companies were privatised intact and should have provided plenty of choice for consumers. However, for reasons the government and the regulator never adequately explained, the logic of the reforms was lost with the decision, seven years after privatisation, to allow the generation and retail sectors to merge and to allow a massive wave of takeovers and mergers of generators and retailers to take place. All the retail companies and almost all of the independent generators were quickly swept up by six large companies. The result is that Britain is now made up of six regional 'duopolies' in which 90% of the market is controlled by the former regional monopoly company and British Gas, which has made significant inroads into the electricity market selling electricity and gas as a package. Expecting a market in which just two companies account for 90% of sales to be competitive is not realistic.

There is also the issue of ownership. Four of the big six companies are owned by European mainland companies, such as EDF. By comparison, the two remaining British companies are small, have no worthwhile presence outside UK and it will be surprising if these are not takeover targets for the four foreign owned companies or by other European raiders. Whether it would matter that our energy companies were all foreign-owned is debateable. No other European country has such a laissez faire attitude to ownership. However, if the field of companies were to go down to four or five, the suggestion that the energy market was competitive would be even harder to argue.

3.6 Is competition a 'free lunch'?

Most people assume, without thinking, that competition has no cost or negligible costs, so that the benefits of companies being forced to continually reduce their costs to remain competitive are the economists' 'free lunch'. But there are always costs of competition. In many cases, the costs are relatively small compared to the potential benefits and there is little doubt that the benefits exceed the costs of competition. However, for a product as complex to deliver as electricity, the costs are significant and diverse.

One very visible set of costs is for marketing. Competing companies do not win new consumers without advertising and offering incentives, and these costs are inevitably passed on to consumers.

A less visible set of costs is that of designing and operating the wholesale and retail markets, which represented some of the most complex IT systems ever built. Each of these cost in the order of about £1bn to design and operate for an initial period. Some of this is building and operating computer software, but for the retail market there is also the cost of the call centres to handle the requests to switch. The design constantly has to be changed so this is not just one-off cost. Updating, maintaining and operating these markets may still be costing consumers in the order of a hundred million pounds per year, although the regulator has made no attempt to establish these costs.

A more difficult set of costs to evaluate is that of bearing the investment risk. Under the old system, as argued above, risk lay wholly with the consumer. While it is galling for consumers to have to pay for the companies' errors, the reality is that risk exists and, one way or another, bearing that risk has to be paid for by consumers. In the old system, consumers paid directly through pass-through of any extra costs in the form of higher prices. If the companies cannot pass on extra costs and their shareholders have to pay for their errors through lower profits, this will be reflected in a higher cost of borrowing because investment will be risky. This higher cost of borrowing will inevitably be passed through to consumers and, because electricity industry costs are so dominated by investment, this will have a significant impact on prices.

For consumers, it seems a 'heads they win, tails we lose' situation. Since consumers will have to pay one way or the other, the issue is then which is the cheapest way to deal with this risk. A well managed and regulated monopoly company with access to low cost capital may well be the cheapest way to do this but nobody asked the question as to whether it was.

Finally, there is the issue of scale economies. For most industries, there would be a common expectation that large companies, especially in technologically challenging industries, would benefit from scale economies, which would allow them to buy equipment efficiently, build and retain skills and develop new technologies. Ironically, it is generally assumed that nuclear power can only be efficiently implemented with large powerful companies. However, the logic of the new system is that there should be large number of small companies competing with each other. In practice, the government's resolve to maintain a competitive field of companies was weak and, as argued above, we now have too few companies to ensure real competition. However, because it is nominally a free market, we cannot oblige the companies to carry out training and R&D and the companies may well choose to generate higher profits than to spend on things they ought to do but are not required to.

3.7 Does liberalisation make achievement of environmental goals easier?

There is a version of history emerging that when privatisation was planned, the priority was improving the economic efficiency of the sector. The environmental objectives that were prominent at that time, such as reducing acid rain, could just as easily be imposed on a competitive industry as a monopoly industry. Under this version, climate change and, to a lesser extent, fossil-fuel depletion and the resulting need to dramatically reduce the use of fossil fuels in electricity generation came out of the blue, well after the reforms were completed. As a result, there is a need to change the model to meet these concerns, albeit still via the private sector and using so-called market mechanisms. It is highly debateable whether these issues really were so unknown at that time, but there should now be no doubt that they must be addressed.

The traditional approach to dealing with environmental issues was so-called 'command and control', under which, for example, government would set the maximum level of emissions of pollutants allowed and plant owners had to meet those targets. This approach was criticised as being inefficient and free market thinkers advocated 'market mechanisms'. Under this, a company would be required to reduce their emissions to a given level via an 'emission permit' and they could do this in the old way, for example, by installing abatement measures. However, if another company that also emitted the same pollutants could reduce its emissions much more cheaply, the first company could pay it to achieve the emissions reduction required of it by 'trading' permits.

Like the idea of competitive energy markets this has a superficial appeal but, like competitive energy markets, the reality is that companies soon find strategies that allow them to profit from these pseudo markets without necessarily meeting the objectives of the markets. Under market mechanisms, using chicken dung from factory farms or transporting palm oil from Indonesia to burn in power stations become 'green' measures. When these mechanisms become international in scope, the ethics of market mechanisms become even more dubious. It is generally far cheaper to deal with environmental issues in developing countries because labour is cheap and environmental protection measures are less rigorously enforced, so market mechanisms can lead to pollution being exported.

There is strong evidence that a large range of energy efficiency measures are a more cost-effective way to meet increased demand for energy services than building new power stations even if there was not a priority on reducing fossil fuel use. However, introducing competition to the energy business effectively closes off one of the simplest ways of implementing energy efficiency measures. In the 1980s in the USA, energy regulators recognised that nobody wants energy for its own sake; they want the service it provides. Consumers therefore do not want the lowest possible kWh price, they want the lowest bill. It may therefore make sense to pay a little more for each kWh and use that extra cost to pay for energy efficiency measures that reduce the number of kWh needed to deliver the required service. Under so-called 'least cost planning', regulators designed tariffs so that a utility would make as much profit from installing energy efficiency measures in its consumers' premises, obviating the need for a new power station, as it did from building the new power station. Consumers got lower energy bills. Least-cost planning had begun to make a real impact on demand in some progressive US states when liberalisation brought these programmes to a halt.

In an open market, no utility is going to spend money on improving its consumers' energy efficiency if, a day after the improvements have been completed, the consumer can switch to a different company leaving the company that did the improvements with no way to recover its costs.

4. ARE LIBERALISATION AND NUCLEAR POWER COMPATIBLE?

When the Conservative party made the twin pledges to introduce competition to the electricity industry and promote nuclear power, there were serious doubts about the compatibility of these two objectives. For example, in 1988, a Parliamentary Select Committee wrote:[8]

> 'The independent witnesses we examined were unanimous in their view that [in a competitive electricity market] private companies would be most unlikely to build new nuclear plants'

There were two interconnected issues. The introduction of competition to electricity was bound to increase investment risk and the poor record, particularly in Britain, of nuclear power plants being built to time and cost and operating reliably meant that nuclear power would be a particularly risky investment. This meant that the cost of capital would be way above the 5% real level that had applied up till then. For a technology for which the overall cost was so dominated by construction cost, doubling or even tripling the cost of capital seemed sure to destroy the economic case. The energy markets created have turned out to be far from perfect and in some respects that makes them even riskier because of their vulnerability to manipulation. There is little experience worldwide in the past couple of decades to suggest that nuclear power investment has become significantly less risky than it was in 1990.

Another issue is the size of company needed to build nuclear power plants. Companies that build nuclear power plants need immense technical and financial strength. This is hard to square with the need, if competition is to be effective, for there to be large numbers of competing companies.

At first glance, the easiest way to stop new uneconomic nuclear plants being built would be to make electricity markets as competitive as possible, while the easiest way to stop the electricity industry being run on competitive principles would be to opt for a large nuclear power programme, but these would be Faustian bargains. Nuclear power should not now be pursued is because it is so expensive that it will tend to impoverish future generations. The likelihood is that the latest British attempt to revitalise the nuclear industry will be no more successful than numerous earlier attempts. However, large amounts of money will be spent on the attempt and, more importantly, alternative options for meeting the policy goals of making electricity affordable, reliable and sustainable will not be vigorously pursued while the nuclear option is pre-empting the available resources.

Competition in electricity markets should not be pursued because it too is economically wasteful. It is also socially regressive, forcing disadvantaged consumers to pay more for a vital product than richer consumers. It will also tend to compromise security of supply and it will make the achievement of environmental goals more difficult. The likelihood is that electricity markets will not become more efficient. Rather they will be increasingly compromised as governments are forced to introduce mechanisms to deal with the risk of market failures.

8 Select Committee on Energy (1988) 'Third report, Session 1987-88, HC 307-1, HMSO, London

4.1 SOLUTIONS

4.1.1 Nuclear power

Nuclear power has survived two decades of unrelieved bad news about its economics, yet despite this, it has come back with stronger political backing than ever before. If this battery of evidence is not sufficient to nail the myth that nuclear power is cheap energy, it is hard to know what is needed. Another nuclear accident on the scale of Chernobyl or even Three Mile Island might be sufficient to dampen the enthusiasm for nuclear but this is not an option any sane person would wish for.

Nuclear power should be off the agenda for new power plants. The existing plants we have will be in operation for many years and it will be more than a century before decommissioning them is complete. So there will be a need for nuclear skills for decades to come. The much greater risk is that we are not even training enough nuclear technicians and scientists to look after the facilities we have let alone to build a new generation of plants.

The lazy dismissals of energy efficiency as only having a marginal effect and of renewables as only working when the wind blows need to be challenged. If nuclear is off the agenda, the financial and political resources that it consumes so voraciously can be diverted to the painstaking work that will be needed to ensure that the energy efficiency of every dwelling in the UK is transformed, as can readily be technically achieved. Resources will also be available to deal effectively with greenhouse gas emissions and that means targeting all energy use, not just electricity consumption.

4.1.2 Liberalisation

The ‘credit crunch’ is probably near enough the financial equivalent of Chernobyl for markets. But, like the conventional wisdom that nuclear power is cheap, the myth that private markets are always the best answer is hard to nail. It is likely that in a very short time, the rhetoric that markets and private companies are always efficient, and that public ownership and universal service through a centralised provider is always inefficient will be as unquestioningly accepted as ever.

As was clear with the traditional utilities’ pursuit of nuclear power, there was plenty wrong with the old model even though in terms of reliability of supply, affordability and equity, there was a lot that was good. What was needed was not to smash up this proven system, but to build on its strengths and address the weaknesses. Whether renationalisation of the companies is desirable is a moot point but it is politically and financially infeasible unless, as was the case with the banks and the rail network, the system fails so abjectly that there is no choice but to take the companies back into public ownership. Like another Chernobyl, the failure of the electricity system is not an event that should be wished for.

The first step would be to recreate national planning processes, not in the utilities but in publicly accountable non-commercial bodies that have a responsibility to ensure that reliable power is available at affordable prices. Brazil, a country that suffered severe consequences from its attempt to implement electricity markets, has already created such an institution with very positive early results. The fallacy that consumer

choice is worthwhile also needs to be abandoned and replaced with properly regulated prices that ensure that low-income consumers get a fair deal. Market forces can be incorporated, for example, when a new power station is needed, the job can go to the company that meets all the performance criteria at the lowest price, but the market must be there to serve us, not vice versa.

4.1.3 What will happen?

While effective solutions are relatively easy to think of - replace nuclear power with energy efficiency and renewable, and replace electricity markets with effective planning – it is hard to imagine the circumstances that will see these solutions being implemented other than catastrophic failures like a severe nuclear accident or a major failure of the electricity system. Both major political parties have invested too much political capital in pursuing these options for them to be able to contemplate reversing their policies. The depressing prospect is that we will continue, as we have for the past two decades, pouring money and effort into nuclear power and markets, with little return for consumers, while ignoring better options.