A new British energy policy

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The Social Market Foundation

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1. Introduction

For the last two decades of the twentieth century, energy was largely out of the headlines.[1] With the exceptions of the great miners' strike in the mid 1980s and the privatisations at the end of the 1980s, low prices and abundant supplies meant that policy makers could pursue a policy of benign neglect, leaving the more technical aspects of liberalisation, competition, and regulation to the new independent energy regulators. Once Nigel Lawson, as energy secretary, set out what was then the new market approach to energy policy in 1982, withdrawing the state from its traditional functions of forecasting demand and planning the supply to meet it, the policy task was largely one left to the companies and the technocrats.[2] Security of supply was never a serious problem, and climate change, once it did emerge as a serious problem, was largely taken care of by the closing down of much of the coal industry.

This world of benign neglect was not peculiar to Britain. It was widespread in developing countries, and particularly Anglo-Saxon ones. It bred the conditions which helped to cause the energy shocks which began in 2000 and in the process revealed that this complacency would come at a high cost. At the end of 1999, oil prices began a gradual and sustained rise from around $10 a barrel to over $60 a barrel. The scale of this shock was compounded by the conventional wisdom that prices would stay *low*. Indeed, a major concern in 1999 was that oil prices might fall even lower – perhaps even to $5 a barrel. Major oil companies forecast continuing low prices too, and set their exploration and production (E&P), refinery and infrastructure policies accordingly. The oil price shock led to wider concerns about security of supply as the Middle East proved to be anything but stable. The eviction of US troops from Saudi Arabia in the late 1990s necessitated a rethink of US strategic positioning in the region, and whilst the Iraq invasion had multiple causes, the need for an alternative military base must have played a part, as Saudi's political security posed serious challenges.[3] With little sign of "normalisation" and with oil dependency on the Middle East likely to rise in the next few decades, by 2005 the conventional wisdom has been transformed into one of higher and more volatile prices. Such an energy world, with lots of political and market instability, is radically different from a policy and investment perspective than an energy world where oil prices are at around $5-$10 a barrel.

Other security shocks have added to the sense of unease with energy policy. Energy infrastructures have proved to be particular areas of concern. Widespread blackouts in recent years have been witnessed across Europe, in the US, and in Britain. These are simply not supposed to happen according to the more purist exponents of liberalised and competitive markets, and regulators gave no hint that the infrastructure was vulnerable. The fact that these have been caused by apparently trivial events – the "wrong fuse" in London, a tree falling on the line in Switzerland blacking out northern Italy, and the failure to properly dispatch a single power station in the north east US – has given some misplaced comfort in official circles.[4] For sophisticated networks to be vulnerable in a number of countries to trivial and unexceptional incidences displayed a vulnerability which should have created deep concern. If the causes had been major – a large-scale terrorist attack or a big storm – the events would have been easier to dismiss as exceptional.

Nor were the problems confined to electricity. The oil refineries began to creak under demand pressures and the ageing of their assets. Nothing substantial had been built nationally or internationally to add to capacity in the 1980s and 1990s, and by the early 2000s, there were signs first of vulnerability to shocks and then to physical capacity constraints. A fire in a BP refinery in the US impacted directly on the world price in 2005 and the Katrina hurricane again revealed how tight the supply/demand balance had become.

These immediate security of supply concerns have been

1 The energy policy framework set out in this paper draws on Helm (2004),Helm (2005a) & (2005b), and Helm and Hepburn (2005).

2 Lawson (1982).

3 Klare (2004).

4 See Ofgem (2004), US-Canada Power System Outage Task Force (2004), Natural Resources Canada and US Department of Energy (2004), Swiss Federal Office of Energy (2003), Union for the Coordination of Transmission of Electricity (UCTE) (2003), and Commission de Regulation de l'Energie and Autorita per l'Energia Ellectrica e il Gas (2004).

reinforced by a much wider recognition of energy vulnerability. Energy demand at the global level continues to march upwards, driven in part by the economic growth in the Far East. The International Energy Agency (IEA) has forecast that energy demand will rise by 60% in the first three decades of this century.[5] At least in scale, China and India lead the way, adding to the pressures on oil supplies which, whilst not immediately running out, are widely expected to decline after reaching peak production in the next decade or so. This tension between international supply and demand has focused minds on how that transition to an environment of declining oil production might play out, through both prices and also through political power. Whereas energy had not been such a major factor in international relations in the 1980s and 1990s relative to the OPEC-dominated 1970s, looking forward, the search for secure supplies by not only the West, but also by China and India too will strain international relations, while Saudi Arabia, Iraq, Iran, and Russia will continue to dominate the agenda.

These developments, mainly international in dimensions, should have been enough to trigger a rethink on energy policy – and indeed they did. In 2000 the European Union (EU) produced its Green Paper on Security of Supply, followed by the US Energy Plan (eventually making the statutes in 2005). In Britain, a review began in 2001, produced a White Paper in 2003 and eventually legislation.[6]

However, there is another factor which changed the energy landscape: climate change. Politicians had recognised the enormity of the challenge of shifting from carbon to non-carbon economies in the late 1980s. Mrs Thatcher was famously "converted" in the late 1980s, and by the Earth Summit at Rio in 1992, the Framework Convention on Climate Change set up the International Panel on Climate Change (IPCC) process and eventually led to the Kyoto Protocol.

But how was the climate change problem to be addressed? For some, renewables (mostly wind) and energy efficiency would bridge the gap. For others, a new nuclear dawn provided the solution. Yet others looked at the projected 60% *increase* in energy demand by 2030, observed the centrality of China and India in these projections, and concluded that a combination of large scale technologies, including clean coal, hydrogen, and nuclear, was mandated. This divided the US from the European countries in the Kyoto process, and led to the stand off which emerged from the G8 Gleneagles summit in 2005.

In trying to find policy solutions to the security of supply and climate change problems, the initial response has been to tack on *ad hoc* policy instruments to the existing framework. Though some progress has thereby been made, the scale of the new challenges requires a more thorough rethink of the energy policy framework. The new priorities arise in a changed political and economic context, significantly different enough for the 1980s and 1990s, to represent a structural break. A paradigm shift has taken place. To understand the implications, we need first to set out its characteristics and then analyse how far actual policy has responded, and in particular whether the 2003 Energy White Paper meets the requirements.

There follows an exposition of the key principles and considerations for the design of a new energy policy, which separates out objectives, credible targets and their delivery primarily through market instruments. In particular the case for longer-term carbon contracts and a capacity market is set out. The paper then proposes a substantial rationalisation of the institutions to deliver energy policy, both to enhance credibility and efficiency and to reduce bureaucracy, before concluding with a set of recommendations.

5 IEA (2004).

6 DTI (2003).

2. From the old to the new energy paradigm

The emergence of security of supply and climate change as the key challenges of energy policy in the UK put the spot-light on the main components of the energy policies of the 1980s and 1990s. In that *old* paradigm, the priorities were quite different: the main focus was on cost reductions – on how to use the existing assets more efficiently, rather than investing in new ones.

During the 1980s a radical change in the whole concept of an energy policy took place. Up until the end of the 1970s, it was conventional wisdom that the market failures were so pervasive in the energy sector that the market would hopelessly under-provide. Experience in the 1930s, combined with the demands of the immediate post-second world war economy, led to two central propositions: (a) that competition led to short-termism, and therefore deficient investment, and hence should be made illegal; and (b) that private ownership put private profit before the public interest, and therefore nationalisation would lead to the rational pursuit of the public interest. After the Conservative election victory in 1979, a very different set of assumptions gradually dominated official thinking: that monopoly led to cost inefficiency and excess investment, and hence monopoly should be reduced to a minimum, with competition wherever possible; and that nationalisation encouraged weak management and collusion with trade unions, and privatisation should be carried out across the energy sector. Put simply, the emphasis in 1945-70 was on market failure: after 1979 it was on government failure.

These assumptions persuaded successive governments to privatise almost the entire energy sector, and to introduce radical new elements of competition. Starting with BP under Denis Healey, the oil assets of British Gas were sold off. Then British Gas itself, then most of the Central Electricity Generating Board (CEGB), then British Energy and finally British Coal were privatised, leaving only British Nuclear Fuels (BNFL) and United Kingdom Atomic Energy Authority (UKAEA) in the public sector, and even these are gradually being transferred to the private sector.

Competition was gradually introduced first for industrial customers, and then it was extended to all retail customers at the end of the 1990s. Even the core natural monopolies were chipped away at. Metering was made competitive, and the main transmission owners were split between system operators and network operators.

In the process the long-term contractual structures of the electricity and gas sectors were broken down. Whereas once the coal industry coordinated its planning with the CEGB, which then passed costs through the bulk supply tariff (BST) and onto captured electricity customers, in its place came spot markets and short term contracts. The central pillar of the planning system, the retail monopoly, was knocked away: customers could switch, and hence investment upstream faced the full risk of being stranded. In the gas case, the North Sea had been underwritten by the long-term contracts between the North Sea oil and gas companies and British Gas. These contracts allowed the upstream sunk costs to be recovered, and it also allowed British Gas to use offshore fields as part of its storage system, and thus to reduce the need for onshore storage.

Under the competitive, privatised model, the problem of the risks of investment and sunk costs was not of course magically "solved", but could be largely ignored because very little investment was needed. In Britain, the very sharp recession in 1980-82 reduced energy demand and changed the composition of the economy away from intensive energy users, whilst the power station construction programme from the 1970s bequeathed a capacity margin as much as 40% over peak demand. The decision by Tony Benn to build more Advanced Gas-cooled Reactors (AGRs) at the end of the 1970s was further reinforced by David Howells's programme for ten more Pressurised Water Reactors (PWRs) announced in 1981. The

AGRs are widely agreed to have been a major economic mistake, and a prime example of why governments should avoid "picking winners" – or in this case, losers. Only one PWR, Sizewell B, was actually built.

The theory was that markets could take care of the investment problem through the development of futures markets. Whereas customers had traditionally under-written new investments through the BST (and gas bills), electricity and gas would now be priced in the Electricity Pool, which combined a spot price based upon the system short-run marginal costs and a capacity payment to reflect the need for the insurance that extra peaking capacity provided. Investors in new power stations (whether merchant or incumbents) would be able to invest by fixing contracts on the basis of the future prices in the forward market, and thus risk would be transferred from the consumers to international financial markets.

The theory had merits, but it required rather demanding conditions to be met – and they were not, though the consequences were masked by excess supply. The spot market would price electricity (and gas) "correctly" if it was *competitive*, and this meant more than simply *liberalised*. There needed to be many buyers and many sellers, with everyone a price taker. The Pool had the positive feature that it was compulsory (everyone had to sell their power into the market), and this enabled it to be standardised, liquid, and transparent. The trouble was that there were two dominant generators with market power.

The market power situation led successive governments and regulators to try to find a better way to run the market. Rather than dealing with the market power so obviously revealed in the Pool directly, government instead reached the amazing conclusion that it was the market form – the design of the Pool – which was at fault. This led to the ill-considered replacement of the Pool by the New Electricity Trading Arrangements (neta), which was a voluntary market. Immediately, the generators realised that vertical integration with physical hedges would be an appropriate strategic response, and as the market consolidated, the merchant players were squeezed out. When the retail market was finally liberalised in 1998, prices fell sharply (but not, as Ofgem and the government claimed, *because* of neta). Generators' profits were squeezed, though the vertically integrated players were protected by downstream margins. The seeds of the collapse of British Energy and many Independent Power Producers (IPPs) were sown.

As the industry consolidated around the three dominant European companies – EON (which bought PowerGen), RWE (which bought Innogy, itself the result of a spilt up of National Power) and EDF (which bought a portfolio of generation plant, London Electricity, SEEBOARD, Eastern Electricity distribution, and SEWB supply) – and Scottish Power (including Manweb) and Scottish and Southern (SSE) (combining Scottish Hydro, Southern Electricity and a number of generating assets), the futures market was stymied. It was of limited time horizon (much less than the investment horizon) and, in effect, allowed the key players to trade out their short-term position.

After 1998, neta's inherent volatility and the industry consolidations allowed the vertically integrated players to increase prices and restore a sense of normality. What had emerged was an "oil-company model": the risks of investment had not gone away, and were now borne by a combination of market power and the equity owners of the large companies. EON, RWE and EDF had emerged as the electricity and gas equivalents of BP and Shell, with medium-sized firms like Scottish Power and SSE in their wake. The result has been an oligopoly model, the sustainability of which depends on a delicate interplay of relations between the exploitation of market power, the positioning between the players in respect of investment, and the relationships with government and regulators (always under the threat of regulation, windfall taxes and other constraints).

The second leg of the conventional wisdoms of the 1980s and 1990s, what is here termed the old paradigm, was that the private sector incentives, driven by equity interests, would sweat the assets in an efficient way, in particular in ways which would place proper emphasis on maintaining an infrastructure which continued to meet the security of supply requirements. In networks, regulation would take the place of competition. This was achieved through the RPI-X framework for the distribution and transmission businesses in electricity and gas.

RPI-X is a deceptively simple rule, and over time it has gradually become somewhat more akin to a rate of return rule.

It is just a mechanism for setting prices, which all regulatory regimes have to do. But in the old paradigm form of the 1980s and 1990s, the rule was rigidly applied as an *ex ante* fixed price contract for a fixed period. Prices were set for a period, and then companies could maximise profits by minimising costs. The theory was simple, but the practise was anything but. Companies quickly learned how to game the system by over-stating their costs at periodic reviews, and regulators learnt to distrust the companies' cost estimates and cut them back. Whilst the rule was quite effective when it came to operating costs (labour forces were significantly cut), when it came to investment (capital expenditure or CAPEX), the rule led to short-termism. As regulators got wise to industry gaming, cut backs began to undermine the security of the networks. CAPEX is rarely neatly segmented and squeezed into five-year packages, and such crude fixed-price contracts are not typical in the competitive markets which the RPI-X rule was supposed to mimic. Furthermore, the companies tended to cut back sharply in the early years of a period to boost profits, and then pick up spending as the shadow of the next review began to loom.

However, from an energy policy perspective, there were two features of this regulatory asset sweating game, which have had longer term, detrimental consequences. As regulators learned to anticipate industry gaming, they cut hard into the CAPEX bids by the companies. In the case of the gas network, this is arguably now contributing towards bringing the energy system as a whole closer to its security of supply margin. In particular, Ofgem did not allow Transco's full CAPEX in the 2001/2002 periodic review, on the grounds that need was not proven.[7] This investment would have relieved some of the current constraints on the pipelines, which in turn limit availability of gas to CCGT power stations, and hence cut into the electricity margin.

Whilst Ofgem may have been right in its own estimates, this can only be known *ex post*, and the risk between over and under provision of infrastructure is asymmetrical. Too much infrastructure costs all customers a marginal amount. Spread over most households and companies in the economy, the individual burden is small. But too little infrastructure can have very large consequences, as recently witnessed in the power cuts in the US, Europe and Britain. This is because energy is complimentary to the rest of the economy, and hence the public interest is better served by an element of over provision.

Asset sweating was not just a regulated asset phenomenon. The parallel to the short-term price caps in utilities was the low returns in the oil and gas businesses. The economic returns from investing in the replacement and enhancement of oil and gas pipelines outside the regulatory arena were sharply reduced as oil prices fell in the mid 1980s. Refineries were not replaced, and the oil sector instead drove profits by reducing operating costs and minimising CAPEX.

This process was aided by the way in which information technology improved the management of the supply chain, so that the system could be run in a real-time, just-in-time way. The result was that the slack in the oil supply chain – petrol in the garages and stocks at companies – was radically reduced, making the system less resilient to shocks. This was painfully revealed to politicians in the fuel protest of September 2000, when a small number of tanker drivers managed to create a political crisis for the Government, enabling the Opposition to actually move ahead of the Government in the opinion polls. The vulnerability had a worrying similarity with the apparent isolated and trivial causes of the power cuts in 2003. Each company looked to its own profits – but no one worried about the security of the system as a whole.

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7 Helm (2004, pp. 342-43) for further details of the CAPEX debate.

In the oil company case, the asset sweating approach was reinforced through a major merger wave focused on cost cutting. As also happened in European electricity markets, oil companies scrambled to create ever-bigger companies, with all the market-power consequences that this entailed. Whereas in the 1970s, a British government could reasonably expect BP to take account of the leverage which the government could exert if the British oil market was not given due weight, BP's dependency on Britain is now much smaller. In electricity too, the big three European companies that dominate Britain's electricity market have other home markets to worry about.

These features of the old paradigm have come to matter greatly in the design of energy policy. The energy sector is now well designed to sweat assets and to respond to short-term competitive markets. The problems of the 1980s and 1990s have been largely addressed. But what was presented as a *timeless* solution to the organisation of the energy sector has turned out to be historically conditioned. The legacy – and the need for a radical rethink – is a system which lacks the foundations on which investment can be grounded (a solution to the sunk costs component). The risks are not born by customers (as in the past), and they are not born by financial markets (because there is no futures market over the relevant period). The assets are sweated and, in many cases, are old and in need of replacement.

The result is that investment in power stations has largely been *outside* the market. Combined Cycle Gas Turbines (CCGTs) were built and depreciated ahead of the 1998 liberalisation (and hence the risk was against the old rock of the retail monopoly). Renewables have all needed the protection of the Renewables Obligation (RO). Indeed, none of the technologies currently under discussion to address climate change have thrived in the current market. Subsidies for clean coal and hydrogen have been suggested, and there has even been public discussion of the need for subsidies and tax breaks for refinery investment. In addition, the five-year fixed periods have stymied the development and ability of the distribution networks to take account of the distributed renewable generation, effectively compromising the Government's renewable energy target. In energy terms, five years is very short term relative to the time horizon for the investment agenda of the low-carbon economy.

Focused on security of supply and climate change, the new paradigm cannot thrive under the old paradigm's rules. The common feature of both paradigms is investment, the incentives for it, and the impact of regulation on the allocation of risks. Because so much of the sector is subject, through taxation, pricing rules and environmental constraints, to government and regulators, that risk has and will always have a substantive political element. This is for good reason: the energy sector has system characteristics; it is complementary to the rest of the economy; and it is riddled with market failures. The task then is to create an energy policy framework that addresses them whilst minimising the resulting government failures, thereby marrying up the efficiency of markets and private enterprise with the wider economy and public interests. A first very tentative step towards the new paradigm was made with the 2003 Energy White Paper.

3. The 2003 Energy White Paper

As early as 2001 and immediately after that year's General Election, unease over current policy had surfaced and mandated a review. The Government also faced the challenge of providing a reply to the Royal Commission on Environmental Pollution's 2000 report which had recommended a 60% reduction of CO_2 emissions by 2050, and which the Government had immediately welcomed.[8] What was missing was a credible explanation of how this objective might be achieved. The Government wanted to address climate change, and to be seen as doing so, but had little idea how to achieve its objectives.

The Performance and Innovation Unit (PIU) was duly called in to investigate the twin concerns of security of supply and climate change. On the former, it quickly yet mistakenly convinced itself that since the key issue was gas, and particularly gas supply, and since there was abundant gas available, the problem was a second order one. In particular, the PIU paid too little attention to the gas-electricity interdependency, to the age and state of the power stations, or to the investment needs of the networks. Instead it concentrated on the second problem, climate change, and recommended targets to obtain 20% of electricity supply from renewables and achieve a massive improvement in domestic energy efficiency by 2020.[9]

Following the PIU Report, the Government dithered over whether to formally endorse these 2020 targets and over how to deal with the nuclear issue. In the end, the 2003 Energy White Paper (EWP) set out in just one paragraph, and only just, a broad range of objectives and opted for a renewables/energy efficiency strategy, plus emissions trading, whilst keeping the nuclear option open. All this had the merit, it was claimed, that it would apparently not cost very much – as the Prime Minister had signalled in the foreword to the PIU Report, "cheap energy" was very much the objective. The 2020 targets were turned into "aspirations" at the last minute, and hence the EWP added very little by way of substantive policy changes.

The EWP was however substantive in its bold objectives. It listed these as fourfold: to meet the immediate climate change targets already in place and to move towards the 2050 target (provided others took measures too); to continue along the path announced by John Prescott in 2000 to abolish fuel poverty within the decade; to ensure security of supply; and to maintain competitiveness. No attempt was made to explain how the trade offs between these objectives might be made: politics dictated an inclusive approach – the "and" linked them together, rather than the more politically difficult "or" between them. Indeed, the PIU and the EWP leant support for this fudge: if renewables and energy efficiency were cheap, if energy efficiency reduced fuel poverty and enhanced security of supply, then the Panglossian outlook could be maintained – we really could radically reduce carbon emissions, transforming the economy from a high carbon to a low carbon one, *and* eliminate fuel poverty *and* protect the competitiveness of industry. This provided a convenient illusion, but by 2005 it has become increasingly apparent that it was no more than an illusion.

A separate piece of legislation requires the Government to publish an annual update on progress with the EWP. By the second annual report in 2005, the performance was sufficiently embarrassing that, rather than publicised as a success, it was slipped out right at the end of the summer parliamentary session.[10] The underlying reality was that CO_2 emissions were actually rising 1-2% p.a.; that fuel poverty was rising too (though the update conveniently limited itself to 2003 data); that security of supply was markedly worse, with serious concerns about the ability of the gas network to cope in the 2005/06 winter; and that competitiveness was threatened as prices rose sharply (and with the volatility inherent in neta) into the 2005/06 winter.

Had these adverse trends been due to random shocks, then the supporting framework of policies might not have needed revisiting. But they were not: increased CO_2 emissions reflected

8 RCEP (2000).

9 PIU (2002).

10 DTI (2005).

a larger coal burn because gas prices had risen with the oil price. Officials comforted themselves that a British initiative, particularly during the 2005 EU Presidency, might so liberalise the European gas market that the link to oil prices might be broken, and that the coming of Liquefied Natural Gas (LNG) and some new offshore pipelines might create a glut of gas in Britain in a year or two's time. However, this stance reflected more a failure to understand the new circumstances. Specifically, it reflected neither the exhaustion of the British North Sea reserves nor the likelihood that Norway, having a small population, a limited ability to absorb revenues, and no urgency about rushing to deplete its sector as the British had done in the 1990s, would price off Russian and other supplies. The fundamentals of oil prices had been misjudged as well. Repeatedly officials acted on the expectation that oil prices would fall back. The EWP projection was based upon a forward forecast of a fairly constant $20-$25 a barrel. That the price might reach over $65 was never fully appreciated, and so the conclusion that high gas prices might be a more permanent feature was largely ignored. Hence, the 1990s decline of the coal burn, which had been responsible for almost all of the British reduction in CO_2 emissions since 1990 relative to other developed countries, was extrapolated. Looking forward, the coal burn will be limited by environmental legislation, notably the EU Large Combustion Plant Directive (LCPD) from 2008. However, again extrapolation is a dangerous seduction: the lack of investment in power stations may mean the coal stations continue to be needed to keep the lights on.

The outlook for CO_2 emissions is not only driven by the coal burn. There are important demand side effects, notably in transport. The integrated transport strategy, a major initiative by John Prescott, envisaged a renaissance of trains and a switch from road to rail.[11] To an extent, the former has occurred (howbeit at great cost), but the latter has not. Road transport continues to grow with rail passenger numbers. Alongside this growth is the forecast tripling of air transport by 2030 in *The Future of Air Transport*, the Government's 2004 White Paper, paving the way for the infrastructure in runways to facilitate this.[12]

These trends point to the situation in Britain converging on the European experience on CO_2 emissions – that it is *exceptional* circumstances which facilitate the CO_2 reductions, but the trend is at best level or upwards. In the global context, as noted above, energy demand is expected to *rise* by 60% by 2030, and with it CO_2 emissions as well, swamping British and European efforts to contain demand.

The EWP sought to counter these underlying trends by optimism on energy efficiency and renewables. The former was argued by the Energy Savings Trust (EST) and Defra to be net present value positive over a large range, so that the costs would be negative.[13] In other words, much of the required energy efficiency was already economic, and people would be better off financially if they took the measures the EST and Defra advocated. It was, they argued, better than free. This remarkable claim had a long history, and ex ante cost optimism has repeatedly come up against ex post reality. Unless people are wildly irrational, the evidence points to a much more costly input of public expenditure if the targets are to be met. Though much progress has been made on renewables, the 10% target by 2010 will be hard to meet, and to approach it has required a reserved market at very considerable cost.[14] So far, whatever the claims, however politically correct these approaches have become, and however large the lobbies in support of them are, neither policy has proved it can make substantive inroads into reducing CO_2 emissions.

In a steady state energy sector this would be problematic. However in Britain, the main source of non-CO_2 electricity – nuclear – is set to substantively close down. By around 2020, on current life expectancies, some 20% of total electricity production in nuclear will have been withdrawn or be very close to retirement. Thus even if renewables reached 20% by 2020, it will have only substituted for nuclear and made no net contribution towards the 2050 target – and of course no contribution to providing the energy needs driven by an assumed cumulative economic growth of 2-3%. By the time the 2050 date arrives, it is projected that the British economy, with it all the consumption which a future much richer population will demand, will have at least doubled. Some of this, such as domestic air conditioning and outdoor heating, is already beginning to impact on demand.

The EWP effectively recognises that its twin-track focus on renewables and energy efficiency will not deliver the targets,

11 DETR (1998).

12 Department for Transport (2004).

13 Defra (2004) and House of Lords Select Committee on Science and Technology (2005).

14 NAO (2005) and House of Commons Select Committee on Public Accounts (2005).

and there are two policy strands which make some contribution to the gap. The first is the broad range of economic instruments, notably the Climate Change Levy (CCL) and the UK and EU emissions trading schemes (ETS), but also a host of other tax concessions and subsidies to specific technologies. These economic incentives are, as we shall see below, muddled, overlapping and confused. In any event, they are all dwarfed by the most important event (unanticipated in the EWP), namely the increase in the price of oil (carbon) by a factor of five since the late 1990s. This *carbon tax*, paid to oil producers, is greater than any level contemplated when the CCL was set and is likely to have major and lasting effects, as the price hike in the 1970s, in separating out energy demand from its tight relationship to economic growth.

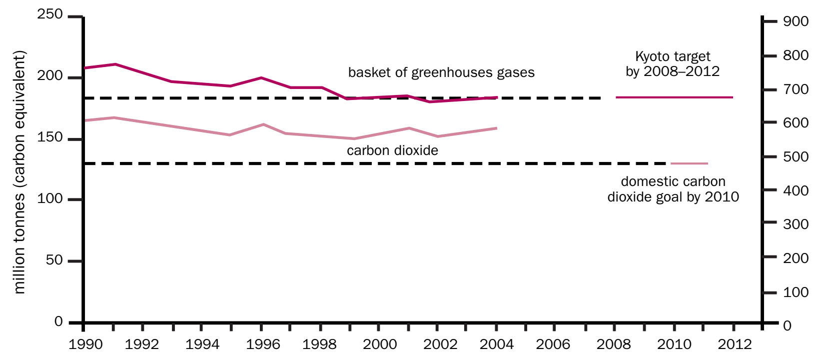
The second contribution to the gap left by the EWP is the Climate Change Review (CCR), which was tasked with finding ways to bring British CO_2 emissions back on course to the domestic 2010 20% target.[15] Given that current emissions levels (see chart over) and projections suggest that 14% is the more likely outcome, the CCR is in effect an admission that the EWP does not even provide the short-term route to CO_2 reductions.

It is thus straightforward to conclude that the climate change strategy in the EWP is inadequate to the task. But the EWP has no serious security of supply strategy either. It is simply assumed that the market plus the regulators will deliver the investments required in a timely and coordinated way. Whilst it is of course true that the market will deliver some investment, the important question is about whether it will deliver enough investment to the system as a whole.

15 Labour Party (2005).

Given that current emissions levels (see chart over) and projections suggest that 14% is the more likely outcome, the CCR is in effect an admission that the EWP does not even provide the short-term route to CO_2 reductions.

Chart 1 - Emissions of greenhouse gases in the UK: 1990-2012



Source: DTI (2005)

As argued in the previous section, the neta-based market does not provide a solution to the sunk cost problem (providing investors with a degree of confidence that the large-scale and long-term capital investments that are required will be adequately rewarded *ex post*). In particular, the market relies on a peak plant being built on the assumption that every so often the investor will "win the lottery", in the sense that prices will rocket as the demand-supply balance tightens. There is no contractual base to carry the risk of sunk costs, and it would be rash for any investor to assume that politicians will stand aside and allow prices to rise to whatever level is necessary to match supply and demand at times when the market is tight.[16]

The abolition of fuel poverty is a target with little recognition of the context. Prescott announced this target as the oil price doubled and since then it has tripled again. It is a matter of arithmetic that any such target will reflect exogenous price movements. In addition, abolishing fuel poverty is a distributional matter. Either it is cross-subsidised from other customers, or it is paid for out of social security. In the former case, the social aspects were placed squarely within the competitive supply businesses after privatisation, rather than in the monopoly distribution businesses, a mistake which limits the scope for cross subsidy. In the latter case, the solution is both trivial (the costs of fuel to the poor are paid for by the Exchequer) and very expensive.

16 The lessons learned from the interventions in California, where politicians stepped in to cap prices at a time of crisis, are highly relevant to Britain.

Finally on competitiveness, there are two related reasons why the British position is likely to worsen relative to the European one. The first is neta, and its gas equivalent, which negate longer-term contracting. This has been a distinct competitive advantage in the excess supply years, and especially immediately after the liberalisation of the retail market. Electricity wholesale prices fell by 40%. But the reason for the sharp fall is that prices were being set in a short-term spot fashion. Now that the demand-supply balance has moved the other way, the absence of the sorts of long-term contracts for supply to industry which were prevalent before the 1980s and 1990s, and which dominate the continent, have exposed industry to the sharp upwards volatility. Spiky, volatile prices are having their effect now, and this is combined with the depletion of North Sea reserves. Hence Britain is on the end of a longer supply chain, dominated by Russia and Germany. Norway may be nearer, but as argued above, it is more of a price follower than a price leader.

4. Designing energy policy

The 2003 Energy White Paper is best seen as the first serious recognition in British energy policy that a main driver of energy policy is climate change. Whether or not the 2050 60% reduction in CO_2 emissions target remains the guiding target, and whether or not the shorter-term targets are met, the EWP represents a major break with the past. However, it collapsed into a series of aspirations, conflicting objectives and a host of *ad hoc* policy measures. There is neither a serious attempt to deal with the inevitable trade-offs between the objectives, nor a recognition of the inconsistencies and inefficiencies of the overlapping policy instruments. Rather, it resembles a wish list and a scattergun collection of initiatives and interventions, backed up by ever more institutions and lobby groups. The result is that the objectives are not being met, and the costs are much greater than they need be. British energy policy is neither successful nor efficient.

The reason why this state of affairs has materialised is not hard to identify. The 2003 EWP is a very good political compromise. All the main vested interests got something (what I have elsewhere described as the “smarties-for-everyone” approach), and creating losers has been studiously avoided. But more importantly, the EWP failed to think through how to design an appropriate energy policy. After the decades of excess supply and low prices, energy policy had fallen into disuse: there was simply no need to maintain or develop policy and consequently no need for a specialist department and the associated energy expertise. Instead energy policy was subsumed into the Department of Trade and Industry (DTI), and in practice delegated in large measure to Ofgem, augmented by bodies like the Environment Agency, EST and the Carbon Trust (CT).

An energy policy comprises a framework within which the private and public sector companies and consumers operate. An effective policy is needed because there are market failures, which are deemed to be sufficiently great as to outweigh government failures, such as the costs of intervention. In the energy sector, this case for developing policy is very easy to make: the market failures are multiple, large, and well known. Some examples include the externalities from pollution (climate change, SO_2, NO_X, and much else); natural monopoly; market power; the public goods of the network systems; the risk and complimentarity with the rest of the economy which underlie the security of supply; and the merit good characteristics which give rise to social issues.

Multiple market failures create a very special problem for energy policy: not only does each market failure need to be addressed, but in a consistent way. This means the trade-offs need to be defined. Energy policy in virtually every developed country claims to be pursuing objectives focussed on sustainable development, which combines a focus on environmental protection, economic growth, and social issues for most countries. Thus, there is nothing revolutionary or new in stating, as the EWP does, that the Government would like to reduce CO_2 emissions, eliminate fuel poverty, make sure the lights stay on and all at a "competitive" price.

The difficult bit in energy policy design comes in saying what *precisely* these objectives mean. It is this link between the general wish list derived from political compromise and the specific policy content on which energy policy should focus. In the British context the relevant energy policy questions are:

- What, *precisely*, are the CO_2 and other greenhouse gas emissions targets?
- What, *precisely*, is the degree of risk with security of supply that the government regards as necessary to constrain the system?
- What, *precisely*, is the fuel poverty target?
- What, *precisely*, is the level of prices which meets the competitiveness concerns?

Now it might be thought that the Government has answered all of these. But here we need one more condition. The answers should not be *aspirations* – they should be credible. It matters not that the Government would like to eliminate fuel poverty. What matters is whether it is credibly committed to achieving this objective. So in this case, the Government passes the first requirement – it has an objective – but not the second – it lacks credibility. As a result, all the companies and consumers can deduce is that, as and when the opportunities arise, and provided it is not too painful, and taking account of the electoral horizons, it is minded to try to move towards its targets. But as with so many of the targets introduced across the policy domain since 1997 (like the switch from road to railways referred to above), it cannot be *relied upon*. That matters, because companies and individuals will not then necessarily act in ways consistent with the targets.

Hard targets bite: they change prices and costs (explicitly or implicitly), and they change behaviour, creating winners and losers. To have a credible energy policy means ensuring that the instruments to achieve the targets are credible and that they will be adjusted over time to achieve the target. A good example of this is the way in which interest rates are set to achieve inflation targets. In monetary policy in 1997, the incoming government, of course, aspired to hold down inflation. It had that objective. The problem was that it was not credible, because financial markets assumed that when it was politically expedient, government would use the Bank to finance increased government spending. Thus, to make the policy credible, the Government set the inflation target and delegated the setting of interest rates to the independent Monetary Policy Committee (MPC) of the Bank of England. Henceforward, the MPC was charged with setting interest rates to achieve a specified inflation target.[17]

The example is not perfect (inflation is not determined solely by interest rates), but it serves to illustrate the credibility problem in energy policy. There is little credibility in the mere statement of the Government's CO_2 targets, its fuel poverty targets, its security of supply targets, or its competitiveness targets. Taking energy policy forward is largely about solving this credibility problem.

The solution has several parts. First, the targets have to be properly specified. Second, there needs to be instruments to achieve them, and these need to be consistently set. Third,

17 See Helm, Hepburn and Mash (2005) for the development of this credibility model to the energy sector.

18 See, for example, the Monopolies and Mergers Commission (MMC) investigation into the CEGB in 1981 (MMC, 1981).

there needs to be a process of adjustment to circumstances – a flexibility built into the instruments, whilst maintaining credibility. Fourth, there need to be institutions which reinforce that credibility.

These are demanding requirements and, historically, the lack of credibility has been dealt with through either internalisation in government through nationalised industries and/or by allowing cost-pass through to customers in rate of return regulation in the old paradigm. The uncertainty about future policy created private sector risks and raised the cost of capital, effectively reducing investment. As inconsistent government policy created the risk, government has been left with the problem of managing it. In Britain, France and much of Europe, the solution was nationalised industries, state planning, and cost pass through to vertically integrated monopoly franchises. The nationalised industry framework produced the problems of the 1970s – unions exploiting monopoly power; poor investment decisions and execution; and inefficiency.[18] In the US, private firms were, in effect, guaranteed a rate of return. Consequently, regulation inflated costs and gold-plated the systems.

Having rejected state planning and nationalisation in the 1980s and 1990s and chosen instead to liberalise markets, the credibility problem is now much more starkly exposed. Government can no longer tell companies what to do, or even fix the prices. It has to create the framework of incentives and constraints within which they operate.

Target setting

Credible targets are ones which are grounded in robust analysis and command support across the political spectrum. They should also command the respect of markets and consumers. A security of supply target is convincing if it derives from cost-benefit analysis – because by incorporating people's willingness to pay, they are less likely to baulk at the costs. Similarly, CO_2 targets grounded in a thorough consideration of the costs and benefits of climate change are likely to command more respect than mere political assertions.[19]

This links to political support: most targets in energy policy are necessarily medium to longer term, and over the life of the target there is the possibility of a change in government. Thus,

19 For a consideration of targets, see the House of Lords Select Committee on Economic Affairs (2005).

the renewables obligation depends for its credibility on Conservative support. For example, the credibility of CO_2 targets after 2012, when the current Kyoto ones expire, obviously depends on cross-party support.

The political dimension is perhaps best reflected in the contrast between French and British nuclear policy. The French have rolled out a large-scale nuclear programme based upon a cross-party consensus. In Britain since the 1970s, no such consensus has existed, and it is hardly surprising that the PWR plans of the early 1980s never made it beyond Sizewell B. Similarly, the Thermal Oxide Reprocessing Plant (THORP) project at Sellafield has been dogged by political uncertainty. In Germany, the entry of the Greens into government derailed their nuclear programme.

It might be argued that the need for cross-party consensus and political sustainability can be sidestepped by removing government from decision-making, as in the example of monetary policy and the MPC considered above. But helpful though such delegation is, the delegation itself needs to be supported by a wider consensus. In the case of the MPC, part of its credibility derives from the fact that all parties now support it. Thus, removing government from the day-to-day implementation of the policy may help, but only if two other conditions are met too: that there is consensus about the target and about the delegation of its delivery. Happily, in the case of the MPC, all these conditions appear to be met (so far). As we shall see below, it may be possible to replicate that success in energy policy too.

Instrument design

The choice of instruments is dictated by a number of general principles, which, whilst well established and grounded in analysis and empirical research, are rarely followed in practice. The first of these is that there should be as many instruments as targets. Thus, if there are four broad targets – climate change, security of supply, fuel poverty and competitiveness – there should be at least four instruments. But there is a corollary too: having more instruments than targets can create overlap and inefficiencies. Taking each market failure, an economic instrument can be targeted onto it. Thus, for the climate change targets, there are market failures in respect of R&D, time horizons for sunk costs, the externality itself, and information costs and asymmetries. So one might have an R&D subsidy, an obligation to purchase the output from a new power station, a carbon tax and an energy-efficiency information campaign. What is less attractive is to set both the price of carbon (for example, through the CCL) and the quantity of carbon (through the EU ETS), as well as the other instruments.

A second principle is consistency: each market failure should be treated in a common and consistent fashion. For example, nuclear power and renewables should attract the same incentives with respect to their non-carbon characteristics. Deviation from this principle is a form of technology bias and courts all the difficulties of picking winners.

A third principle is that uncertainty and political and bureaucratic incentives will together lead to government failures. Hence general instruments are more likely to succeed over specific and detailed interventions. Political considerations tend to favour small vested interest groups that capture the political process, giving power to those with informational advantages. Historically, this has been witnessed in the bias towards nuclear power, but more recently it is reflected in capture by the wind and energy efficiency lobbies. General instruments, like carbon taxes and emissions trading schemes, are less vulnerable to this source of inefficiency, though even here the so-called Climate Change Levy is not based upon carbon (to avoid damage to the coal interest). Similarly, the hypothecation of the revenues benefits the politically attractive wind and energy efficiency lobbies, but not nuclear.

A fourth principle is to avoid sharp discontinuities and "corner" solutions. For example, in reducing carbon usage, the economic incentives should bear on the trade off between more and less carbon intensive technologies, not solely between carbon and non-carbon. In recent years, it has been the substitution from the more carbon intensive coal-fired power stations to the less carbon intensive gas stations which has had a far greater effect than the development of non-carbon wind farms. Substituting from a high to low carbon economy is a matter of degree, not absolutes or corners.

These considerations yield a very strong case for the use of general economic instruments over regulatory and command-and-control approaches. Economic instruments change the prices companies and households face and thus change their behaviour. If companies and households are resistant to changing behaviour as prices rise or fall, then this merely tells us that they value the polluting behaviour highly and/or that changing the outcomes is expensive. Opting instead for technology-based policies and reserved markets for wind, for example, simply disguises the costs: it does not make the policy any cheaper.

Why, then, are there so few economic instruments used in energy policy? The options are straightforward: a carbon tax; a price for capacity for security of supply; a subsidy to the poor; and a subsidy to industry to hold down the energy price effects. The key difference between these policy instruments and the ones actually adopted is that the income effect is transparent. The objective of using economic instruments to change prices is to get the substitution effects of less carbon usage, more supply security, less energy poverty and more competitiveness. However, because energy is typically inelastic in demand and because supply substitution takes time, the initial effects are on income. As witnessed in the recent increases in oil prices, there is very little people and companies can do immediately, except be worse off. It takes time to fit insulation, build wind farms and switch to less energy intensive production technologies.

The correct response, however, is not to try to disguise the policy instrument costs. Rather, it is twofold: to think through the time horizon of the policy and to ensure that the instrument has credibility in the longer term. Because there is little that can be done given existing capital stocks and economic structures, short-term targets, especially in respect of carbon, are likely to be very expensive. A 20% target reduction in CO_2 emissions for 2010 may even be counter-productive, with very high costs and disguised command-and-control policies. However, a 2020 target, or even a 2050 target may be much cheaper, since over these time horizons there will be technical progress and the capital stock will be largely replaced. It takes time to adjust, and policy should be geared to the relevant time horizon. But the second point counts here: companies and households will only invest in less carbon intensive technologies and capital equipment if they believe that future carbon prices will be high. Thus, policy has to be credible in the long run, which, as is discussed below, is where cross-party consensus and credible institutions fit.

The domain of instruments and internationalism

Policy instruments need to take account of the domain of the market failures and the extent to which the target depends upon the behaviour of other players. For three of the four main objectives (climate change, security of supply and competitiveness), their achievement depends upon other countries. They are to varying degrees *multinational*. In these cases, unilateral action will have limited effects. In security of supply, some unilateral actions will enhance the achievement of the objective, notably network investments. But even here, given that quite soon at least half of the electricity generation (and almost all of the direct gas consumption) will depend upon imported fuels, the configuration of pipelines in Europe will affect the network configuration here in Britain. For example, if Germany builds more storage facilities, that will improve security in Britain, because Germany will have a cushion in dealing with Russia. Similarly, the Norwegian fields and pipelines developments, and indeed the rest of Europe's links to the Middle East, will play a vital role in developing supply security.

In climate change, the multinational characteristic of the problem is obvious. Virtually nothing that is done in Britain on a unilateral basis will make much difference. The case for unilateral action only makes sense if it gives Britain moral authority in international negotiations or gains Britain a competitive advantage in low carbon technologies. On the former, the moral authority argument depends crucially on actually achieving the national targets (which Britain is clearly failing to do) and others being swayed in their decisions by this demonstration effect.

In competitiveness terms, it depends very much on who is competing with whom. For large energy intensive industries and manufacturing, there are two dimensions: close neighbour substitutes in Europe and international competition, primarily from the Far East and the US. On the former, it makes sense to set instruments on a common basis with our major trading partners in Europe. However, given that India, China and the US do not have sympathetic targets and instruments, competitiveness in respect of the price of energy can only be met through subsidies – a policy instrument which is largely rejected.

Adjustment and flexibility

Uncertainty, lack of information and asymmetry of information are prevalent in setting instruments. From an efficiency perspective, they need to be taken into account in selecting and implementing instruments. Fortunately, again, there is plenty of analysis and evidence upon which to draw.

In his seminal article on the choice of instruments under uncertainty, Weitzman considered two aspects of the problem: whether it is the costs or the benefits that policy makers are more uncertain about and whether the costs or the damages were expected (despite the uncertainty) to be greater for small changes in the price and output of the pollution (though the analysis is quite general and applies to security of supply as well, as we shall see below).[20]

Weitzman's insights inform the choice between using price mechanisms (taxes and subsidies) and quantity instruments (permits and command-and-control). For example on climate change we are uncertain about the science and the economics, but nevertheless, we know that a small change in carbon emissions will not make much difference to the problem. However, in the short run, given the capital structure, even quite small reductions of carbon emissions can be expensive. Thus, it is reasonable to assume, at least in the short run, that the damage function is fairly flat, relative to a steeper cost function. Hence a tax is better than a permits or a regulatory solution. Note immediately that Britain does the exact opposite, placing a greater emphasis on permit trading.

However, quantity considerations should matter relatively more than price when considering the security of supply. Although we are uncertain about the weather this winter and the reliability of power plant capacity, we know that the damage function from a failure to supply is probably very steep. Power cuts cause widespread disruption and economy-wide costs. However, the cost of a little more supply at the margin (say extra gas pipes) is, spread over the population as a whole, relatively low. The cost function for the economy as a whole is flat-ish. Hence, it is better to be certain of the quantity rather

20 Weitzman (1974).

than the price. Note, however, that rather than emphasise quantity by, for example, introducing permit trading in a capacity market, British policy instead lets price mechanisms drive security of supply.

A further layer of sophistication can be added to Weitzman's framework by noting that it is typically easier to adjust taxes over time than permit quantities. If, for example, new information came along that climate change was more serious, then the tax can be raised. But if the number of permits is suddenly altered, the market in permits would be affected, and the possibility of *ex post* adjustment by policy makers would upset the development of trading. The credibility of instruments depends crucially on the recognition of *ex post* adjustment as new information becomes available and shocks hit the system. It is unrealistic to expect politicians not to intervene in such circumstances. But credibility is not about *whether* politicians intervene, but *how* they intervene, and in particular whether they follow predicted and known revision mechanisms. There is an enormous difference between an instrument with built in error-correction and feedback mechanisms and one which relies on the assumption of no revisions and adaptations.

Institutions

The final and widely neglected aspect of establishing credible instruments is that credibility depends on who sets and revises the instruments. Credibility is not just about instrument design and cross-party support. It is also concerned with institutions. As noted above, in monetary policy this has belatedly been recognised as policy makers have come to terms with the lack of credibility with central finance ministries setting interest rates. It has also been recognised in utility regulation, and in particular price setting for natural monopolies – for example airports, electricity and transmission and distribution, and water. But even in these cases, the ways in which delegation to "independent" institutions works depends upon the objectives given to these bodies, the selection of the individuals who run them, and the subsequent interaction between policy and instruments.

Some general principles include the idea that objectives in the policy framework should be aligned with those of regulators and agencies; that there should be a clear separation between objective setting and instrument implementation; and that the domain of institutions should cover the objectives, to ensure consistency in setting and revising instruments. It is notable that the first does not hold for energy policy (economic regulators look after consumers, whilst the energy policy framework has four clear headings); that the economic regulator clearly interferes in setting targets, while government clearly interferes in setting the instruments (and in the case of economic instruments, the Treasury retains control) and that the institutions have partial and overlapping domains.

There is an enormous difference between an instrument with built in error-correction and feedback mechanisms and one which relies on the assumption of no revisions and adaptations.

5. A new policy framework: credible targets and instruments

So what is to be done? The new paradigm energy policy begins with the changed priorities. The 2003 EWP made a start in this direction. Other than to reaffirm the 2010 targets for CO_2 emissions and for renewables, it did nothing to commit the Government to an interpretation of those objectives on which the market could rely. Neither is entirely credible. The former is almost impossible to achieve, while the latter is embedded in the renewables obligation, for which there is a buy-out price, and network investment needs to be provided in a timely fashion.

Credible targets

Thus the first step in a new energy policy is to define the objectives in a credible way. Credibility depends upon the targets being clear, unambiguous, and having feedback mechanisms. Thus, the 2050 60% target reduction in CO_2 emissions will lack credibility unless certain conditions are met. An appropriate policy should specify what will happen if others do not follow a similar path. The policy should build in support across the political spectrum, and the policy should not be easy to undo by politician and officials.

None of these three conditions for credibility of objectives are currently met for CO_2. The reason is partly international: there is currently no credible international agreement in force to tackle climate change. As argued above, unilateral targets have little merit, except as demonstrations. On the domestic front, the cross-party consensus is best met by an all-party approach to setting the targets, through one of the usual mechanisms, for example a Parliamentary joint committee or a Royal Commission or an independent report with recommendations that can command wide acceptance. The test is whether all main parties would be prepared to incorporate the targets in their next general election manifestos.

In contrast, the domestic aspects of energy policy on security of supply are easier to specify in concrete targets, notwithstanding the international dimensions. With the framework of the IEA and the security framework in the EU, storage requirements, levels of infrastructure resilience, and power station margins can be set – either crudely or in terms of more sophisticated probabilities of interruptions of supply. Unlike climate change, the objectives part of this aspect of a new energy policy is not hard to define. But as with climate change, making policy credible is more demanding.

As discussed above, *ex post* adjustments are both endemic in British energy policy and also economically very costly. Sunk costs are exposed to expropriation, with the result that this potentially very real risk raises the cost of capital. For major infrastructure investments, nuclear power, and R&D of new energy technologies, the costs are so great that some form of protected market or regulatory guarantee has typically been needed. Credibility in this area requires an institutional structure to protect contracts and commitments from this obvious political opportunism, and as we shall see below, some form of independent energy agency is required, analogous to the Monetary Policy Committee of the Bank of England.

Once the two main objectives have been defined (and we return below to what happens if they are not in considering carbon contracts), the next step in a new energy policy is to sort out the instruments and, building on the discussion in the previous section, to harness the market and the private sector, wherever possible, to deliver. Let us consider each of the two main concerns separately, and then see how they fit together. We begin with climate change.

Instruments for climate change and carbon contracts

Given a carbon target, the most efficient instruments are market-based ones. From the Weitzman framework discussed above, the optimal instrument is a carbon tax, because the damage function is expected to be less steep than the cost function. Recent studies of the social cost of carbon have reinforced this view.[21]

Notwithstanding this theoretical and empirical preference for taxes, policy makers have preferred to use tradable permits. Though the reasons are many, a prime one is linked to the credibility issue discussed above. Given that policy makers need to agree to international targets, such agreements are easier to conclude in quantities rather than prices. Thus, tradable fixed-quantity permits as opposed to prices adjusting to the target, may translate better into a more credible signal of compliance.

However, the permits approach in the EU ETS and the associated Kyoto Protocol targets are short term. They define a short term up to 2012, a period over which the capital stock is largely fixed and there is very limited scope for R&D. Climate change presents a rather different problem, namely how to find medium- to longer-term solutions which harness the benefits of non-carbon technologies. Even on the demand side, changing behaviour involves capital investment in the building stock, smart metering, and in capital durable goods. The main effects of the EU ETS are therefore likely to be on the mix of coal and gas burning between existing power stations and on the marginal changes in demand patterns, with the overall effect on climate change close to zero.

However, these conclusions do not invalidate carbon trading and permits. Rather, they highlight the central flaw in existing arrangements: the failure to set permits over a long enough period or, more specifically, the failure to use the alternative of carbon taxes with much more flexibility built in. The obvious solution is to extend the period of the targets. In the British case, there is an indicative target for 2050 for a 60% CO_2 emissions reduction. If this target is seriously intended, and hence binding, then it is possible to devise an envelope of emissions reductions from now to 2050. Then, the emissions reductions can be translated into ceilings on permits. Consequently, permits can be issued accordingly, and the price will rise to achieve the target.

Such an approach has a number of obvious merits. It sets a framework, which fits with the timetable of the problem, signalling to both the demand and supply sides of the market and crucially assisting longer-term capital investments and R&D. Investors will be able to take out longer-term contracts to securitise the value of the carbon savings. Provided that it is credible, then the cheapest solution should be achieved, minimising the GDP cost of the transition to a low carbon economy, the objective of the 2003 EWP.

In practice, there are a number of reasons why such a clear-cut approach is unlikely to be taken, and hence the costs of the transition to a low-carbon economy will be higher. These relate in large measure to the politics of the target setting, rather than the economics of the permit scheme. In particular, there is no international agreement to targets post 2012, and as governments change, so too can decisions. A current government would find it hard to bind its successors in four decades time. The best that can be achieved is to get the current opposition to make pledges. We return to this point below.

The politics indicate that any commitments come with the risk of *ex post* reneging, and hence that credibility, or the lack of credibility, will raise the private cost of capital of projects whose rationale depends upon the price of carbon. On the principle that the risk should be assigned to the party best able to manage it, and since the risk is political, the public sector should bear it. Thus, the Government could issue carbon contracts to private sector investors set by the envelope of the emissions reduction target, or some proportion of it, depending on the risk appetite of the Treasury and the seriousness that the government attaches to climate change. These contracts could then be auctioned – in this case an auction for the minimum subsidy.[22]

The design of the permits could be multidimensional: bidders could bid prices and time duration. For example, a wind farm developer might be prepared to bid for a ten or fifteen year contract, whereas a nuclear developer might find twenty or twenty five years optimal. The bidders could also offer different degrees of flexibility. For example, it might be possible to index the bid to the price of oil, as a higher price of fossil fuels would require less carbon subsidy.

A well-designed, longer-term auction might occur in several stages. The first might be on contract form and duration to create a short-list. Then, once the contract design had been set in light of the first stage, the auction proper could proceed to a final least-cost, net-present-value competition.[23]

Once the contract had been let, the Treasury would then

21 Pearce (2003) and Tol (2005).

22 A more detailed scheme is set out in Helm and Hepburn (2005).

23 There is a large literature and an enormous number of case studies on how to design such auctions. See Klemperer (2004) for a survey.

have to pay on behalf of society for the carbon savings as they begin to materialise. This creates a public liability. However, this liability need not end up costing taxpayers since the government sets the carbon targets, and may in future be participating in an international permit trading system. By buying the carbon savings from the holders of the longer term carbon contracts, the government is in a position to sell these savings to those who need to purchase permits, for example the aviation industry which has limited non-carbon fuel options. Having a bank of such permits also allows the government to influence the market, smoothing out volatility.

Being able to sell permits depends upon polluters in future having to buy some or all of their permits rather than simply being given them (grandfathering) for future rounds of emission trading schemes. The former is typically more economically efficient, but since the income effects are typically large, large energy users tend to lobby hard for grandfathering – and successfully in the first phase of the EU ETS. Here there is a political choice: either subsidise large polluters by grandfathering (and abandon the polluter pays principle) at the expense of the taxpayer, or auction the permits and hence make polluters pay for the decarbonisation of the economy in line with the targets.

If the permits are auctioned, then the Treasury can unwind its liability to pay the investors who acquired the long-term carbon contracts. It might unwind all its liabilities; it might make a profit, or a loss. The residual balance depends upon its management of the political risk it is bearing because there are not long-term binding targets at the outset. Thus the Treasury would have not only a liability to pay, but a balance sheet asset too.

Consider how long term carbon contracts bear upon nuclear new build. There is currently a great deal of debate about the true costs of nuclear power. *Ex ante*, it is impossible for government to come up with a credible single project cost. Indeed it is hopeless to try. The real costs are the outcome of market transactions, such as site contracts, construction contracts, performance guarantees, fuel costs, off-take contracts, waste contracts and decommissioning contracts. From the climate change perspective, the Government's interest is in the value of the carbon saved. The auctioning of long-term contracts solves

this issue. Given a value of the carbon contract, a developer can then put together the appropriate contracts with the private sector for the project and other non-carbon revenues and with the Nuclear Decommissioning Authority (NDA) for the decommissioning and related waste aspects. Whether the value of the project as the sum of all the contracts for the components (including the long term carbon contract) makes the project economic is then a market matter. (We return below to the security of supply aspects in the price of capacity.)

Now compare this approach to the alternative ones variously proposed for supporting a nuclear programme. The most obvious is some form of obligation on suppliers, for example the current and expensive renewables obligation. A nuclear obligation ties suppliers to buy a fixed percentage of nuclear in their total supplies. This is, in effect, a cost pass through and exposes suppliers and their customers to the risk that the project management might be defective, that it might not be built on time, and that it might not work very well. In principle, a buy-out price cap might be imposed to share the risk, but there is still an element of risk sharing between the nuclear project and the suppliers beyond the carbon savings.

An obligation is technology-specific if it involves an element of picking winners. The renewables obligation has this characteristic. It defines what is and what is not a "renewable", rules out carbon-reducing but not zero-carbon technologies, and discriminates against nuclear. All these failures and their costs would be carried across to a nuclear obligation. The long term carbon contract would have the merit of forcing renewables, like wind, to bid against nuclear, clean coal and a host of intermediate carbon technologies.

Instruments for security of supply and capacity markets

The second main objective of energy policy is security of supply and, as with climate change, there is a choice between direct regulatory intervention and using market-based instruments. Here again, instrument choice depends upon the firmness of the definition of the objectives. Fortunately, unlike climate change, there is much less controversy over the desirability of the objective and over the sorts of targets implied. In security of supply, the controversy focuses rather on whether the market will deliver it of its own accord.

Measuring security of supply has been subject to considerable research and much dispute. However, at the policy level, what is meant is that energy supplies should not be physically interrupted, except in extraordinary cold winters or because of terrorism or other "acts of God". The first is usually taken as a one-in-twenty winter. The others are rarely defined, and involve security margins in networks, storage, and other precautionary measures. Here, for analytical ease, we concentrate on the system margin.

In conventional thinking, the system margin boils down to the plant margin, which in turn is targeted at about 20% above "normal" peak demands. As such, it is very crude: what matters is the probability of interruption, and that depends on a number of factors, notably age of plant, maintenance and maintenance scheduling, and the speed with which a plant can be brought back on line and so on.

In terms of instruments, the position on security of supply is the inverse of climate change. As noted above, given the asymmetry of costs of under and over-supply, it is better to fix the quantity and allow the price to adjust. In practice, this means that the acceptable target level for security of supply should be set and the market left to sort out the costs. Put another way, the electricity market can be analytically divided into two parts: a market in the electricity supplied and the insurance that, when the switch is pushed, the lights will come on. Conceptually, these parts define two markets – an energy market and a capacity market.

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Under neta, as discussed above, there is no separate capacity market: energy and capacity costs are combined into a single price. The level of investment in peaking plants, to ensure the security of supply margin, is therefore determined by expected future prices. These may or may not be sufficient, and hence there is no guarantee that the capacity margin will be supplied. Investors considering such projects have to weigh up the likelihood that the system will be short of capacity (the probability of loss of load) and multiply this by the likely prices. In effect, the economic assessment is akin to a lottery – a small chance that a very big prize will be won.

The problem with this approach is not only the uncertainty concerning the physical capital invested, but also the political risk. For if supply and demand come into a tight balance (as it is likely to in the run up to winter 05/06), then the price increases under neta are likely to be sharp. As fuel poverty and the competitiveness of British industry are adversely affected, politicians cannot avoid being sucked into such events. As noted above, the recent example of California is pertinent: although supply and demand could have always been matched through prices (as prices go up eventually people turn their own lights off), politicians and regulators stepped in and capped prices. The very possibility that this might happen in Britain is a deterrent to investment.

The solution is in two parts: fix the quantity, and then devolve responsibility for achieving it. Fixing the quantity is relatively straightforward, provided that it is accepted that the goal is a workable number and not a perfectly calibrated one. Allowing estimates of willingness-to-pay and changing probabilities to feed in at short intervals can introduce complexity, but such complexity creates its own uncertainty and increases the costs of running such a quantity system.

Once the quantity is fixed, the next step is to design a market within which the quantity can be met. Fortunately there have been a host of experiments with capacity markets to draw upon, and whilst there is much debate about which is the optimal model, there is also much agreement about which market designs are not. The capacity component of the British Electricity Pool is widely regarded as a failure: it allowed gaming; it rewarded existing capacity rather than targeted revenues at marginal plants (i.e. those which might otherwise close or be mothballed) and new investments; and it had an extremely crude calculation of the value of lost load (VOLL). But it should not be deduced from the many design failures of the British Pool that *all* capacity markets are flawed.

The success of a capacity market is dependent less on its precision in getting to the optimal margin and more on its credibility. This in turn depends upon avoiding short-term price concerns interfering with the operation of the capacity market and hence the expected returns from new investments. As with climate change targets and instruments, this is an institutional question. It requires a separation of the targets for security of supply – which are ultimately political and therefore matters for governmental institutions (to which we return below) – and the operation of the market itself. In the latter case, there are again several examples to draw upon. These fall into two broad categories: those which delegate to a market operator (as for example with neta) and those which place the responsibility on the grid or system operator.

In the British system, these responsibilities are confused: the grid has a responsibility for producing a seven year statement; the regulators and the DTI combine in a special Joint Energy Security of Supply (JESS) committee; and, in so far as capacity is represented in the single neta price, a market operator determines capacity. The introduction of a capacity market would require clarity of functions, which would be further enhanced by sorting out the institutions of energy policy more generally, as discussed below.

Thus far, the plant capacity margin has been concentrated upon. But there are other aspects of security of supply, notably the networks. These are best regarded for practical purposes as natural monopolies and hence their investment, operation, and pricing are, and are likely to remain, a regulatory matter. In practical terms, the security of supply objective is represented by the planned and actual capital expenditure and maintenance plans of the regulated entities.

The connection between policy and regulation is through the objectives of the regulatory authority – for onshore networks, Ofgem. However, Ofgem does not have security of supply as its primary objective. Rather, it is primarily concerned

with promoting the interests of customers. It has a secondary duty to take account of "guidance" for the relevant secretary of state. As a result, there is considerable scope for Ofgem to use discretion in the interpretation of its general duties, and, for institutional reasons, it is unsurprising that it has tended to lend greater weight to asset sweating rather than investment in system resilience. As discussed above, there has been a game played between regulators and regulated companies, which is an inherent characteristics of the five-year fixed-price contract approach under RPI-X.

This aspect of security of supply is best addressed, as with the plant margin dimension, by a clear distinction between policy and target setting, on the one hand, and implementation on the other. It is for government to define the objective and the associated probability of interruption of supplies and for regulators and companies to ensure compliance. In theory, a value of interruptions could be directly priced onto companies through a compensation regime – as indeed happens across a wide range of infrastructure industries. However, such an approach can never be complete, because network reliability and resilience is a system-wide property, not company-specific. Hence liability rules at the company level fail to take account of how investments in one part of the network impact on other parts. This is not merely a horizontal relationship between companies at the same level, but also vertically between transmission and distribution and between gas and electricity. There is even an interaction between utilities: security of electricity supply is a necessary condition for securing supplies of drinking water. These interrelations need a coordinated response, and a single delivery body is more likely to achieve this. There will always be a residual undefined element to security of supply and this is best dealt with through clarity of responsibility and institutional design, to which we now turn.

6. New institutions

Energy policy is to a large degree about the setting of credible objectives and targets and then designing instruments to achieve them. For climate change, the credibility of targets for CO2 beyond 2010 is the central issue confronting investors in new generation. As coal and nuclear stations reach the end of their lives, they need to be replaced. Whether the replacements are low carbon, nuclear, clean coal, hydrogen or wind, turns on the price of carbon, which itself depends upon whether there are credible targets. Emissions trading on a serious scale depend upon there being a credible ceiling of emissions on which to define property rights. Similarly, investing in marginal plant depends upon the security of supply constraint, and its credibility.

Credibility is not a pervasive feature of energy markets. As noted, the 2010 target is unlikely to be met, and the 2050 target is dependent on others taking similar measures. It is therefore useful to consider how credibility might be increased, and here institutions come into play. The problem is not unique to energy. The issue arises in waste policy, where recycling targets are expected to be missed; and as we have seen, in monetary policy, where governments are widely expected to renege on inflation commitments. In these other areas of policy the central credibility problems set out in this paper are widely recognised. In monetary policy, the government sets the targets, but delegates their implementation to the independent Bank of England and its Monetary Policy Committee. In competition policy, decisions in particular cases once made by a Secretary of State have been delegated to independent competition authorities.

In energy, there is an analogous case. *Government* energy policy should set the targets for security of supply and climate change (and perhaps fuel poverty and competitiveness), but *an independent agency* should implement them. An energy agency mandated to set the instruments to achieve the targets would have considerably more credibility than the current regime.

Such an agency need not be a large bureaucratic one. The argument above was that in both the carbon and the security of supply areas, the use of markets and economic instruments would increase the efficient delivery of the targets. Thus, in the carbon case, rather than have a host of bureaucracies like the Carbon Trust, the Energy Savings Trust and the administration of the complex Renewables Obligation, all overlapping with the DTI, Defra and Ofgem, the energy agency would play a role in establishing longer-term carbon contracts and in monitoring and regulating the emissions trading market, including such things as overseeing accreditation. In the case of security of supply, the role would again be limited if a capacity market came into play.

Reducing bureaucracy is in itself a contribution to greater credibility. Each organisation and body develops its own interests and cultures and has budgets and lobbies to advance its particular interests. This institutional competition is not only costly, but creates uncertainty in markets and encourages interest group and corporate lobbying. In the current mess of overlapping institutions, Friends of the Earth and Greenpeace compete with large users, including the CBI, nuclear interest groups, and wind organisations to lobby each of the bodies to influence the outcomes. Industry finds the resulting interfaces complex and recruits ex politicians and professional lobbyists to help navigate such complicated political waters. The added layers of complexity undermine transparency and thus deplete credibility.

The functions of the energy agency would therefore be to deliver the targets in a way which makes political reneging and opportunism more difficult. One way of capturing this would be to require regular, perhaps quarterly, reports to the House of Commons on progress in each of the key target areas. These reports would be published and the subject of wide media reporting. Select Committees would take an interest, for example by holding an annual hearing with the energy agency.

Producing such reports in a single agency would help to reduce the blurring of responsibilities in the current regime, in particular in respect to the security of supply, where JESS currently straddles the divide. The energy agency would need professional expertise, and it would develop a core competence rather different from the more generalist civil servant model, which moves people between tasks and departments.

This expertise would have the additional benefits of informing the markets and would lend the sort of authority the Bank of England's experts give to the analysis of economic trends. The substantial energy statistical output of the DTI would be transferred to the energy agency. This would leave the DTI with core policy objectives in energy, but not much else, allowing the department to contract.

Single sectoral bodies have proved successful in regulation, too. Indeed, they are now the norm rather than the exception. In aviation, the Civil Aviation Authority has wide duties in aviation, but includes within its remit the regulation of National Air Traffic Services and British Airports Authority. In rail, the reconstructed Office of Rail Regulation has incorporated health and safety and some of the functions of the Strategic Rail Authority, which has been abolished. In communication, Ofcom has absorbed a host of bodies, including the Independent Television Commission and OFTEL. Only water stands out with energy in this way, with a strong separation between the Environment Agency and OFWAT (and its successor, the new water authority). Some of the rationale derives from efficiency and the trend towards more user-friendly regulation, encouraged by the Hampton Review.[24] But it also has a deeper rationale: price regulation is only one aspect of these industries, with outputs and other objectives playing their parts. Single focus bodies, like Ofgem or the Carbon Trust, only work well when there is a single well-defined and separable objective. In energy, there are at least four – climate change, security of supply, fuel poverty and competitiveness.

24 HM Treasury (2005).

7. Conclusions

In the coming decades, the British energy sector faces a period of substantial investment to replace the existing power stations and to facilitate an inevitably increased share for natural gas. This challenge coincides with the need to switch to a low carbon economy. The decades of asset sweating will have to give way to an investment-focused energy policy. Added urgency comes from the turbulence in world oil markets amid the realisation, on the one hand, that the peak of oil production is not far off and, on the other, that demand growth is taking off with the growth of China and India and the increase of the world's population from six to nine billion by mid-century.

What would a new energy policy look like? In this paper, it has been argued that it should comprise the following components:

(i) A clear statement of the overarching objectives of energy policy.

(ii) A clear statement of the targets these objectives imply. In particular, the status and content of carbon targets beyond 2010 and the security of supply minimum.

(iii) A multinational approach to setting carbon targets. Unilateral targets have little to recommend them, since they are unlikely to induce others to follow suit, and then only if they are achieved.

(iv) The establishment of longer-term carbon contracts for the period beyond that of Kyoto, let by the Treasury, and competitively auctioned. These can comprise *some* of the required carbon reductions. The more committed the government is to the 2050 target, the greater the scale of the carbon contracts relative to the total emissions reductions required. Carbon contracts have the advantages of transferring risk to the body best able to bear it. In this case it is the Treasury, since it is the political and regulatory risk of the targets that is at stake. The Treasury can then sell the carbon contracts into the market over time. It will make a profit, break-even or make a loss, depending on its actual carbon targets and their credibility going forward.

(v) The security of supply target should be met through a capacity market.

(vi) The creation of a new energy agency, charged with delivering the targets for climate change and security of supply and subsuming some of the functions of Ofgem, the CT, EST and parts of the DTI. Other functions would be taken over by the market in capacity and in carbon.

Such an energy policy would avoid some of the mistakes of the past, including "picking winners", technology-based obligations, and crude distinctions between zero carbon emissions technologies and the range of more or less polluting options.

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The author calls for a policy with clearly defined objectives supported by a system of credible targets and policy instruments. He contends that a new policy framework would help the UK balance the increasing demand-supply tensions in world energy markets and directly address its security of supply and climate change concerns. Ultimately, only an investment-focused energy policy can credibly advance the transition to a low-carbon economy

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