Energy policy

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1. Introduction

The energy sector is in a mess. Consumers are paying too much, the system lacks resilience, the supply market has witnessed 28 bankruptcies and one nationalisation, and the 2035 target for decarbonising electricity looks ever more unlikely to be achieved.

It is a mess both for fundamental reasons – there is no coherent and consistent energy policy – and for immediate reasons, connected to the morass of ever more complex interventions. To use the familiar expression, we are in a hole of mostly our own making, and we keep digging at an ever more frantic pace.

It does not have to be like this. Energy policy is not rocket science. It is about achieving core objectives – security of supply and decarbonisation – and achieving them at the lowest cost. Neither will be met by purely private markets, since the former is a public good and carbon is an externality not properly integrated in competitive markets. Furthermore, energy is a primary good for citizens: not to have energy deprives people and businesses from access to the wider economy and to society. It is a core USO: a Universal Service Obligation. That is why energy cannot be treated like any other commodity, as some of the architects of the "privatisation, liberalisation and competition" paradigm believed. Citizens are more than just consumers.

Security of supply requires a capacity margin: "just in case" rather than "just in time". Decarbonisation requires more renewables, possibly nuclear, and maybe hydrogen, carbon capture and storage (CCS) and an active demand side. Security of supply sits in this decarbonisation context, and because many of the options on the generation side are intermittent, security of supply takes on a much more demanding dimension – not just the old question of access to fuels and power, but the ability to handle large-scale intermittency.

In this brave new world, a great technical change is occurring over and above the intermittency. Much of the new generation is zero marginal cost. It renders the old market designs – in particular, wholesale spot markets – less relevant, and, given the increased fixed and sunk costs, opens up a great opportunity to decide who pays what share of the burden of the decarbonisation path.

The objectives remain the same, but the policies to achieve them need to adapt. Failure to do this, and in particular failure to implement the recommendations of the 2017 *Cost of Energy Review,* have made the current "crisis" much worse than it needs to be.

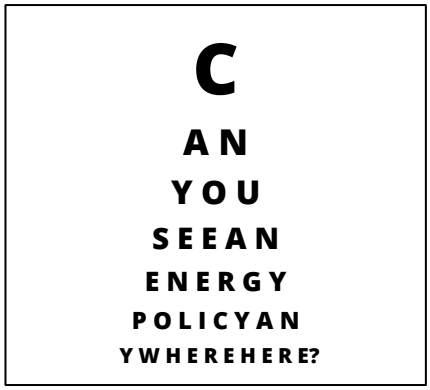
This paper begins with the mess we are in, before setting out what needs to be done to get out of it. Almost all of the main steps required are set out in the *Cost of Energy Review*. The costs of not implementing them are rising.

2. The optician's test – the lobbyist's utopia

The mess is the result of a policy and regulatory process which is generic. However clear an initial policy framework starts out, the process is one of reacting to each problem that comes up by inventing another intervention. Each has unintended consequences, and these unintended consequences need more "fixes". However simple energy policy starts, it always gets more complicated – and there are always vested interests and lobbyists with an interest in complexity, and always ministers who want to be seen to be "doing something".

This pressure to "do something" is most intense in a "crisis", and what is happening right now is a classic example. Lots of interventions currently being proposed by all the lobbyists are likely to make things worse.

One way of comprehending the complexity is to conduct a simple test. Imagine you are at an optician's and you have to read the letters out in a sight test. You get the first two or three lines, then the print gets harder to read.



Now let's try to set up a test with a list of all the current interventions in energy and try to get them on one piece of paper – just the main ones. Make a list of all the recent announcements, and all the targets, strategies, Green and White Paper initiatives, the *Ten Point Plan*, and so on, and all the bodies, organisations, and task forces supposed to implement them. You might add estimates of the many jobs each policy is supposed to achieve, how much levelling up it will do. Even with just the main headline policies and interventions, it quickly descends into a mass of entries to compare with the optician's slide above.

BEIS
The Treasury
No. 10
The Committee on Climate Change
Ofgem
The Environment Agency
The Electricity System Operator
TCE
The Office for Environmental Protection
Offices for…
North Sea Transition Authority
Nuclear Development Renewables
Nuclear Decommissioning Authority
Competition and Markets Authority
Coal Authority
UKAEA
Committee on Fuel Poverty
Committee on Radioactive Waste Management
Nuclear Liabilities Financing Assurance Board
Regulatory Policy Committee
British Business Bank
Commission for Shale Gas

Ten Point Plan
Energy White Paper
6th Carbon Budget
Net Zero Strategy
Net Zero Review
Hydrogen Strategy
Heat Strategy
Green Finance initiatives
Transport Decarbonisation White Paper
2035 target for electricity
2050 target for net zero
Target to phase out petrol and diesel cars
Target to phase out gas boilers
Period reviews for gas, transmission and distribution

Green bonds
CfD for Hinkley
CfD for DRAX
CfD, ROCs and FiTs for renewables
Planning reforms
UK ETS
ECO
RIIO
North Sea taxes
FHI
EII exceptions and deals
Battery plant subsidies
Heat pump subsidies
Lessons from bills
Council Tax discounts
EECs

The point of this comparison is not just to note the sheer complexity, but to illustrate that, just as no one could read the information from a sensible distance of perspective,

no one could name all, or indeed even most, of the main items on the list. No minister, no senior official and no market participant could do this. They may even struggle to name the responsible institutions, let alone each institution's strategy, mission statement and plans to expand its activities. No energy policy with this degree of complexity could work if no one understands it all and if no one can name the policies, let alone the details.

It is worse than this. Complexity is a lobbyist's utopia. Engaged in each consultation, clear about the single aims of its vested interest, able to engage in each and every consultation, able to brief MPs, the media and the ministers, and sow doubt where interests are threatened, it is no wonder that the energy sector is now close to resembling that of agriculture, captured by the core interests. Spending (and it is very large-scale spending) on lobbying keeps going up as the government is more and more engaged in the details of all the main contracts.

These lobby interests have been very successful in getting subsidies and convincing government that the transition to net zero is going to be cheap (just not yet), and that there is no threat to security. Just go for net zero, they argue – on a territorial carbon production basis – sign up for lots and lots of targets and then, once the fish is hooked, play in the threat of failures and hence the case for more and more subsidies. (If it was all so cheap, we could of course abolish the subsidies – but no vested interest is demanding the end to subsidies.)

To date, the subsidies have resulted in legacy costs of around £200 per average bill. This is *before* the further costs of the regulated asset base (RAB) costs of new nuclear, the contract for difference (CfD) for Hinkley, the CfD for DRAX, and all the costs associated with the intermittency of wind (and solar) which are not paid for by those who cause them.

The lobbyists are keen to point to falling renewables costs, and claim that renewables are cost-competitive with gas. Each new wind farm comes with a press release about "enough to power X number of homes". There has never been a press statement which adds the caveat "when the wind blows".

The facts –not only that decarbonisation is essential, but it is going to cost a lot – remain, and they are increasingly emerging. Each time they do, the lobbyists turn to the Treasury and ask the taxpayer to bail them out.

The trouble with this line is that they risk being found out. The Committee on Climate Change (CCC) claims that the costs of net zero are around 1% of GDP.[1] Even the Treasury bought this estimate in its interim *Net Zero Review*. It is sometimes argued that the costs will actually be non-existent, that decarbonisation is GDP-positive. Apart for the obvious rejoinder – that then we can abolish the subsidies now – a better response is to take David Hume's advice when confronted with the claim that a miracle had happened. He asked whether it was better just to believe it (in this case, for fear of being branded a climate sceptic) or to seek some other explanation. The other explanation in this case is that the CCC assumes ever lower costs and, incredibly, that there will be no government failures – that the government will go for and achieve the most efficient solutions.

History suggests otherwise. Against this stands a wall of examples of government failures in the energy sector. Where to start? Smart meters, the repeated "green deals" on home insulation, CCS projects so far, the offshore bilateral links to the coast, nuclear policies… . A better rough assumption would be to take any estimate from government and at least double it.

Even then, 2% GDP might be an underestimate. The government, after endless prevarications, and having taken years to produce its Energy White Paper (finally published in December 2021) and not yet published even a draft Energy Bill, yet nevertheless has endorsed the target of complete decarbonisation of the power sector by 2035 – just 13 years away (or 12.7 years, to be exact). By then the transport sector has to electrify, domestic heating has to be well on the way to getting rid of gas, the gas has to be carbon-captured and stored, and all of this in a context of ever greater electricity generation intermittency. It hardly needs stating that the later the action is

[1] Committee on Climate Change (2019), "Net Zero – The UK's contribution to stopping global warming", 2nd May.

left, the more expensive a crash programme of decarbonisation is going to be (and therefore how unlikely it is to happen).

3. Excess costs and multiple failures

For most consumers, it is not a question of waiting until the prices are unbearable. That is already happening – the increase in the average household bill to almost £2,000 per annum has created a political earthquake. The proximate cause is an increase in gas prices. Yet few other countries have been hit as hard as the UK. That is because it is not just about international gas prices (and the lack of any long-term contracts), but also because of the peculiar configuration of the UK energy and climate policies.

At its simplest, the government has been pursuing decarbonisation without addressing in parallel the security of supply implications. The failures are multiple. It is not just the gas price and the collapse of suppliers; it is also about the balancing market, and the distribution companies. Behind all of these is the lack of a coherent market design fit for the decarbonising purposes.

3.1 Gas prices and the electricity bills

The £2,000 bill is not simply the aggregation of gas costs, though even these are greater than necessary, had the government thought ahead. The UK relied on North Sea gas for decades, and now it still has quite a lot of production. But back in the day, British Gas contracted long-term for North Sea gas production in the UK waters and built out the National Transmission System and the local networks, sure in the knowledge about the supplies of gas and the price. It was incredibly successful – one of the most successful large-scale projects in the UK economy since the Second World War.

The great game in the late 1990s was to shift towards spot markets and to go short-term. That is what broke British Gas and forced Centrica to be spun off, financially weak enough to be able to threaten bankruptcy and therefore force the North Sea gas producers to renegotiate. Spot gas prices were falling, and the government wanted these lower prices to be passed through to customers, thereby helping to sell the story of the success of privatisation.

In the short term it worked, but all the time trouble has been brewing. The shift towards imports was contracted on a spot basis. In 2017, the government declined to step in to keep the Rough storage field open. It is as if the switch from the North Sea to global pipeline and LNG (liquefied natural gas) supplies had no security of supply or price implications.

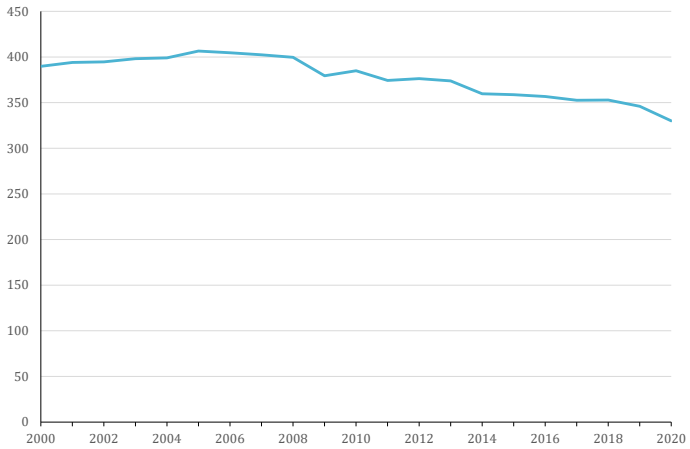
Ministers have been keen to tell us that there is no physical shortage of gas, asserting that there is no threat to security of supply (so presumably no need for any storage). What Ministers do not say is that there is always a price at which gas can be bought. Indeed one LNG tanker, having gone through the Panama Canal from the Gulf of Mexico, turned around and came back through the Panama Canal a second time to head for the UK. Provided enough is paid, the gas will flow to the UK. And Ministers did not say the obvious: that as price goes up, demand goes down. Witness the actions of energy-intensive users who have turned down production, reaching a farcical situation whereby the government had to help pay a fertiliser factory to stay open so that there might be enough carbon dioxide for the food processing industry to avoid a food supply crisis. To repeat: there is no security of supply problem provided someone is prepared to pay whatever it takes, and outbid China and buyers in the Far East. And if customers cannot pay, then there is no demand to meet.

The UK has not been alone in its dash for the short-run and wholesale spot markets. Across the EU (and pushed very hard by the UK), a similar path has been followed. Putin is not entirely without a rationale when he says that long-term contracts have been honoured. It is *voluntary* as to whether to supply the wholesale market, and Russia has consistently argued that long-term contracts are the basis of a stable and secure market. The Europeans in their folly decided that the *only* long-term contracts necessary were with Putin's regime, and declined to take the initiative and act together as a single buyer from the unreliable Russians.

Exposure to the spot markets, with no storage and no special relationship to North Sea producers, is only one reason why the gas price increases hit the UK particularly hard. A second reason is that the UK has built a lot of intermittent wind capacity without thinking through how to manage the intermittency. In the UK (for good reasons) there is very little coal generation capacity left – except DRAX. For all the hype about batteries

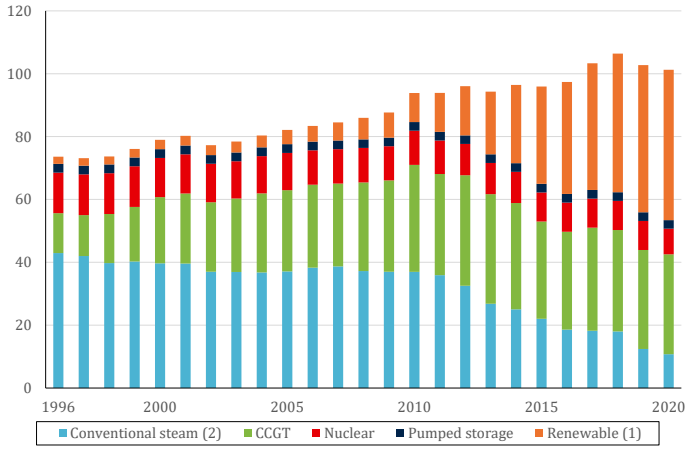
and smart demand management, the fact is that gas (and small diesel generators) is almost all that is currently left to do the heavy lifting. In a renewables energy system, there needs to be a lot more capacity to meet any given demand. In theory, if there was no wind, then there would need to be another complete system to be on standby. As demand keeps going down – in part because of de-industrialisation (industry demand is down 20% since 2000) – capacity has been going up towards the 100GW mark, an increased requirement of over 20GW for a significantly lower total demand. It will need to go up a lot more with 40GW of offshore wind as planned. It seems to have escaped the notice of all those projecting that the costs of the transition would be very low, and claiming that renewables are cost-competitive with fossil fuels, that all this capacity has to earn a reasonable rate of return. It is a cost of renewables.

Electricity demand, 2000–2020 (TWh)



Source: GOV.UK; UK Department for Business, Energy and Industrial Strategy.

Electricity capacity, 1996–2020 (GW)



Notes: (1) Renewable capacity is on an installed capacity basis. Data for other fuels/technologies relates to declared net capacity from 1996 to 2005; data from 2006 onwards is transmission entry capacity. (2) Includes coal, non-combined-cycle gas-turbine (CCGT) gas, oil and mixed/dual-fired. Does not include thermal renewables.

Source: Department for Business, Energy and Industrial Strategy (2021), "UK Energy in Brief", July 29th.

Much of this cost shock is disguised when the amount of wind on the system is low. Up to around 20% of total capacity, the existing systems can handle the intermittency. But as capacity rises beyond this point, the costs start to rise – more than proportionately. Now fast forward 13 years to 2035, when there may be 40GW plus offshore wind. Unless there is a radical breakthrough in battery costs, battery capacity and the time of duration of battery storage, the back-up will continue to rely on gas well into the 2030s.

Needing the gas capacity is only one dimension of the problem. The other is how to deliver it, given that the wind has a marginal cost close to zero. Whereas a conventional gas power station could rely on running most of the time when first built, now it is itself intermittent, depending on whether the wind is blowing. This breaks the conventional back of the economics of gas investment. Hence there is no merchant gas investment. Gas shifts from being driven by a normal wholesale market towards a strategic reserve of capacity. The market design has not caught up with this.

Gas now needs a capacity payment to make its reasonable return, and hence a capacity contract, which only the government can underpin.

It is worse still for gas. Even with a capacity contract, gas also has to decarbonise. It needs CCS, and this CCS is needed at scale and fast by 2035 – in just 13 years' time. You might therefore think, since this is an obvious requirement, that there would already be some CCS projects up and running, a regulatory regime in place, and a North Sea pipeline network in readiness. Not a bit of it. The Treasury promised a £1 billion subsidy for CCS in 2007 – 15 years later, none has been developed and no subsidy paid. The scale of the CCS costs between now and 2035 are awesome. If a RAB model is deployed, these costs will go straight on top of customers' bills, to add to the £2,000/year. So much for rising electricity prices being a temporary phenomenon caused by international market developments and Russia.

3.2 The supply bit and the collapse of supply competition & the regulatory failures

The very concept of a competitive retail energy supply market cuts across the basic idea that energy is a USO. Some think that goes beyond the pure commodity to an essential service necessary for a citizen to participate in society. Without electricity and gas, citizens can die of hyperthermia (quite a lot do each winter), they cannot access the internet, phones may not work, and the freezer thaws out. Any decent society recognises that energy cannot be simply about price, supply and demand. Yet that is precisely what the architects of the privatisation and liberalisation paradigm thought they were doing. The current crisis is not just about whether people can or will pay: it is also about all those voluntary actions to stop using the heating and the electricity, with all the consequences for the poor that this implies. Paying the electricity bill can be a trade-off with food.

But even if the idea of a competitive retail energy market was likely to lead to acceptable outcomes, the design of the UK market built in failure from the outset. The key word is "competitive". How exactly is competition going to work in this sort of market? It started out badly with the "Big 6", many of them engaging in unacceptable behaviour on a grand scale. The techniques were from the playbook of the unacceptable: multiplying the tariffs so that "deals" could not be compared; doorstep salespeople pressures; misleading adverts ; putting mark-ups on the cost pass-throughs of network costs; misusing monies intended to pay the renewables subsidies; and the resulting excess profits. The *Cost of Energy Review* in 2017 documented these, as did countless Ofgem inquiries. It is easily forgotten that many citizens do not really understand percentages, are in no position to understand the competing offers, and that many do not want to waste their evenings trying to make sense of the multitude of deals offered to them.

Locking in customers, exploiting those who did not switch, and concentrating on the savvy switchers was an obvious strategy. British Gas went one stage further: it wanted to make sure it was suppliers who controlled the new smart meters, so that they could cross-sell boiler and other services and lock in the customers. It is a strategy which even

today is blighting the smart meter programme, and most recently the gas boiler insurance policies it sells are not exactly proving an unbridled deal for its customers.

The smart meters programme has been a predictable costly, delayed and inefficient one. Until relatively recently, smart meters were installed which went dumb when customers tried to switch. Surprise, surprise! What did DECC and then BEIS think was going to happen.

All of this might have been "teething problems" if the great push for more entrants had not proved so disastrous. From Ed Davey onwards to the recent BEIS Ministers, the "great triumph" was depicted through claims about how many new entrants there had been, undermining the original Big 6. The current Secretary of State even considered four or five company failures to be part of a normal (desirable?) market.

The rapid entry of new suppliers has resulted in two separate disasters. The first is the well-known one that many have gone bust. What has been revealed is a litany of sharp practices, and a failure to hedge against the price cap. It is convenient to the companies to blame the price cap – as if there were no good reasons for introducing it, no good reasons for protecting customers from short-term price shocks, and no history of some appalling behaviours. It is important to repeat: markets are a *means* to satisfy the ends of customers, *not ends* in themselves. Most customers I suspect would not want spot electricity prices, and would prefer some stability. My guess is that a one-year fixed price arrangement would suit customers better, and in the absence of a proper competitive check on exploitation, a one-year price cap would serve customers much better than six months, or even the much worse three-month cap Ofgem now proposes in response to the wall of lobbying it faces.

The company failures have revealed not only a lack of hedging, but sharp practices, like holding onto customers' monies. Bulb is the largest example of conduct which perhaps company law should make illegal.

But it is the second consequence of the new entry that is most pernicious. It has undermined incentives to enter longer-term contracts. It has driven the dash for short-term spot markets, and engendered the very short-termism which has resulted in the current energy price crisis. The new entrants have built business models on falling

short-term wholesale markets, undercutting the large incumbents which try to contract longer-term. It has turned out to be a form of hit-and-run competition: they took customers, and then when the spot prices turned, used limited liability to exit. In addition to the profits made whilst this game was being played, some even managed to sell their businesses to larger players.

The supply market is now broken, and it is unlikely that many customers will now want to switch – especially amongst the poorer ones. The government has had to step in to bail out Bulb. All electricity customers are now going to pay more than £60 each in their bills to pick up the tab for the costs of sorting out all the company failures. We have come full circle, back to an oligopoly again, and one that will need proper regulation.

It is sometimes argued that if only Ofgem had applied prudential regulation to all the suppliers, these disasters might not have happened. It is true that Ofgem has been found wanting, but it is not true that if it had done its job properly, all would be well. Worse, it would not be good now to simply abolish the price cap (or even shorten its review period), returning us to the status quo before the great entry surge.

The fundamentals – short-term spot market contracting and pricing - would remain, as would the incentive to play games with customers again. The right way to address supply is to start with what customers want, to ensure that the companies serve the customers, not that the customers serve the interests of the suppliers.

3.3 The cost of balancing and the inquiry

All of the above works on the assumption that the short-term markets are actually working well, and competitively. This brings us to the murky world of balancing, and the current inquiry by the Electricity System Operator (ESO) into recent events in the balancing market.

Complex though the day-to-day detail is, the basic principles are quite simple. At any point in time, electricity demand must be met by electricity supply, otherwise the lights go out. The system must always be in balance. The system operator (SO) must make it so.

The problem comes when the system is at points of stress, and there are few players able to offer the necessary balancing extra electricity. These players might game the rules, and they could collude. In the past gaming did take place: Fawley power station on the Solent was a famous case in the 1990s. In theory, these problems should go away as more and more capacity of different types comes to the table. But here the overlap between a capacity market to ensure that there is enough potential generation on the system at any point in time meets the short-term spot price for generation. Rather than treat those generation plants that are given capacity contracts as "strategic reserves" with a fixed price (what might be called an "insurance price"), they just bid into the balancing market. The current ESO inquiry takes us back to the 1990s – profit-maximising companies will always seek ways to game the system. In the electricity market, we, the customers, end up paying if the regulators fail to do their jobs properly.

3.4 The distribution problems

Even if the gas price falls a lot (who knows?), for some customers just getting supplied electricity has moved from near certainty to a more precarious state. It is quite remarkable that a storm (Storm Arwen) could result in some customers being cut off for ten days. The obvious questions are: why did the trees fall on the lines? Why did the companies have so little back-up to deal with the broken lines?

Storms happen. They vary in wind direction and intensity, but the obvious strategy is to make sure that tree lopping is regularly undertaken, just as it is necessary for railway lines. This is a basic operating cost. Might the companies have been skimping on this?

When storms happen there must be emergency procedures and the companies must have planned-out scenarios, identified any problems and possible delays, and then spent the money in building a resilient set of equipment and labour to meet any serious crises.

This time, the impacts have been all the greater because broadband and even telephone calls (voice over broadband) break if electricity is not supplied. It is easy to see the emergencies that follow from people without heating, lighting or communications for even a day, let alone a week. And for small businesses, this is a nightmare scenario.

Some are not taking chances: there is a dash for small diesel generators as there was in the 1970s. In the 1970s, so bad was the threat of the miners striking that some 17% of capacity was in standby generators. This is unlikely to be in anything other than highly polluting capacity. Log-burning stoves may be very helpful too – and even coal.

It may turn out that the networks are not in the condition they should be, that there have been regulatory failures here too, and – the crucial point for the bills – that the catch-up of capital maintenance and greater resilience may result in lots of costs at the next price reviews. Add in the need for distribution networks to play a key role in the electric car charging network rollout, and it is easy to see – as with water and sewerage – that there is a big catch-up cost shock to come.

4. Prices and costs

Though it is true that we are where we are, it is worth considering how it could be different by looking at what is happening elsewhere. Recall the reasons why the gas price increases have hit so hard are that the UK has lots of intermittent wind, and the electricity price is determined by the (marginal) wholesale price. Intermittency reads across to greater demand for gas, and that translates straight into the electricity price. The gas and electricity price paths match each other remarkably closely in the UK.

But what, you might be thinking, if the marginal cost of wind, solar and nuclear is close to zero, why does the price of electricity map so closely onto the price of gas? Surely the electricity price should be dampened by the zero marginal cost generation. Gas is part of the costs of generating electricity, but only a part.

To see how it could be different, consider what is happening in France. It is around 70% nuclear and has a lot of hydropower. As the gas prices have shot up, the cost of nuclear and hydropower has not changed at all. Similarly in the UK, the cost of wind, solar and nuclear generation has not gone up. But now the difference. In France, the price increases are being limited to 4%. This reflects the costs. EDF understandably protests that this will lose it money (around €8 billion), because it could have sold its power into the EU markets at the spot price. But the €8 billion is not a loss, but rather an additional profit that would go to EDF. Since EDF is largely owned by the French state, the €8 billion would be a taxpayer gain, and stands against a customer gain if the benefits of

a stable nuclear power supply go to the French citizens and industry. Quite why Germans should benefit from French nuclear at this point of the gas price crisis, when it has closed its own nuclear fleet, is hard to fathom.

The UK does not have the same energy mix as France, and there are arguments either way on nuclear. Even if the UK went hard for new nuclear, that is a decade or more off. But the general question stands: why are UK citizens paying the marginal cost of gas for that proportion of generation that is not gas?

It is true that there are some renewables which receive a fixed price independent of the wholesale market, but it is also true that there is a long legacy tail of older renewables generation and all the current nuclear, which does not. There is some coal too (DRAX) which is again benefiting from the higher spot price of gas. The general point remains: in a system with lots of zero marginal cost generation, the price of electricity for all the electricity generation should not equal the spot price of gas.

5. The building blocks of a sensible energy policy

Energy policy is all about setting a system framework within which markets operate to deliver what citizens and customers want. It starts with setting the objectives, and then ensures that these are met by a set of institutions, interventions, regulations, licences and auctions and so on.

5.1 The objectives

There are two primary objectives: security of supply and decarbonisation. Unless these are clearly and appropriately specified, no amount of ingenuity about the development of policies will be anything other than inefficient.

Security of supply includes price and costs, as does decarbonisation. Setting either independently of prices and costs make them unlikely to be attainable. In both cases higher prices have an impact on demand and hence the required supply-side infrastructure, reserves, capacity margins and the total envelope of investments. For example, gas security is always possible if the price is high enough. Supply equals demand at a clearing price. Security of supply has to be at reasonable costs, as must decarbonisation.

Both objectives are currently set as if they are independent of prices and costs. Hence they are in doubt: market participants need to try to guess the reaction function of government if and when customers and voters rebel or are simply unable to pay. In particular, there is an assumption as noted above that decarbonisation will be very low cost (perhaps 1% GDP per annum), but this is hopelessly unrealistic – it assumes as noted, for example, not only that the costs of renewables and low-carbon technologies will keep falling, but also that government policy will be perfect. There will be no government failure. This is nonsense. Pretending that the costs are low to get governments signed up is a classic NGO trick, but the unfortunate reality is that the costs do not go away by assumption. In the current circumstances, few can bank on getting the net zero for the electricity sector by 2035. The uncertainty raises risk and hence the cost of capital.

The net zero target is in any event poorly defined. It is for carbon production territorial emissions, and the public have been led to believe (notably by the CCC) that when this is achieved they will no longer be contributing to climate change. If only. By unilaterally reducing carbon production on a territorial basis, there is an implicit subsidy to importers of carbon-intensive goods. Put simply, the best way to achieve the territorial net zero target is to switch from domestic manufacture to imports. An economy that is 80% services has already done a lot of this, handicapping UK manufacturing to the benefit of imported goods from countries like China.

If energy policy is to be effective, the government needs to revisit its net zero objective, define it properly and admit that the costs will be a lot higher than it currently claims. This will put a greater premium on using the most economically efficient mechanisms, notably a uniform carbon price on all goods and services, including imports on the same basis.

The security of supply objective is also ill-defined, if defined at all. How much risk does the government want the economy and its companies and citizens to take that they will face price shocks? It is easy to be very secure, provided the economy can withstand the costs of a range of policies, including strategic stocks, reinforced networks and large capacity margins. We could, for example, agree to pay whatever it takes to secure LNG

cargoes by agreeing to outbid every other country in the world. The costs of all of this would be beyond those that the economy could withstand.

The task of government in general, and BEIS in particular, is to set out serious and sensible objectives, and then delegate their achievement in a credible way.

5.2 Stakes in the ground

There are a number of decisions which cannot be taken by the private sector, or at least not without a very high cost of capital. The government is already the central buyer for almost everything in the electricity sector – directly or indirectly. Almost all new generation comes with a government-backed contract: a capacity contract or a CfD or a RAB. All the networks are regulated, and the regulator has a duty to finance functions in one form or another. The government controls the North Sea licences for oil and gas, and The Crown Estate runs the seabed licences.

This is the polar opposite of what the architects of privatisation had in mind. They envisaged a gradual migration from monopoly to an atomistic merchant power system and unbundling the networks (and they did make the big mistake of taking meters out of distribution networks and giving them to supply). The model that has already emerged is much more like the CEGB (Central Electricity Generating Board) it was intended to get away from. The CEGB was the central buyer.

The first stake in the ground concerns **nuclear**. It can never be a purely private investment, for multiple reasons. Waste is an intergenerational liability. The political nature of nuclear means that investors always face the risk that government performs the sorts of U-turns made in Germany. Limited liability of private sector firms leaves the government with the unlimited liabilities. These considerations trump the further worries about the length of the project, cost and construction overruns, and changing regulatory requirements. Every major incident globally at a nuclear facility leads to a review of safety regulators, and safety regulators usually come up with new tighter regulations as a result.

The fact that nuclear investment decisions lie with governments does not mean that they will be well made. Given that many of the risks are political and regulatory, and

outside the control of management, the obvious approach is for the state to decide, fund and finance, and for a state-owned company to contract for the construction and operations. That is the model for most nuclear power stations around the world. In some cases, it is a closely regulated monopoly in the private sector, but always close to government, and hence the private route tends to be corporatist.

The problem for governments is that now most are heavily constrained by debt and their more immediate public expenditure needs. Spending on CAPEX now yields benefits in the future after several elections. Spending on pensions and health now yields benefits now, before elections. Finance ministries are reluctant to engage and underwrite, even where the debt is notionally private.

The result is very imperfect. Either nuclear should be done properly, as a programme, with a supply chain and sustained through a long period, or not at all. "One of a kind" and only one is the most expensive route. Worse perhaps was the UK approach of the last two decades: try three different designs, see which one works and then add a fourth (the CGN at Bradwell). These mistakes were magnified by the attempts to manipulate the finance so that it did not appear on the government's books. The result was to bring the Chinese nuclear industry, with all its military links, into the heart of the UK nuclear industry, and to end up with a cost of capital of around 9% real for Hinkley. It would be hard to make it worse. The other reactor developers at Wylfa and Moorside walked away, and CGN is being forced to walk away too.

There is the risk that the UK government is about to make the same mistakes all over again. Different reactors are proposed for Wylfa and Sizewell C, and it remains to be seen who will develop Moorside.

The new player is the SMR (small to medium-sized reactor). It is in fact anything but small – at 500MW it is a mid-range sized power station, and it is a PWR (pressurised-water reactor). The play here is a trade-off between the loss of the physical efficiencies that come from the smaller size of the reactor (Hinkley is much bigger) and the gains from factory production. Yet SMRs raise the same political challenges for governments: a factory production process needs *multiple* orders, and not just one to see if it works, and then there are the competing SMRs, with the other US designs in play.

There are two potentially fatal blows that political decisions could deliver to the economics of nuclear. The first comes with the idea of "creative tension". This needs to be traded against the risk of picking the wrong technology. Obviously if the wrong reactor is "picked", as arguably was the case when Tony Benn picked the AGR (advanced gas-cooled reactor) over the PWR, then a programme of the wrong sort compounds the costs of the mistake. But it is a fallacy to think that government can pick several types and let the competition between these play out. The mistakes here are twofold: it takes a decade or more to see what the results of this competition will be; and in a decade's time there may be other reactor choices to make.

A more modest version of the competitive tension argument is that the companies owning competitive technologies will bid more competitive contract prices at the outset. Again, this turns out to be rather less than it seems. The holy grail of governments is that they can have a genuinely fixed price contract for nuclear. Nuclear does not work like this: there are always "adjustments" along the way, and if the company goes bust, the project falls back to government. There is no limited liability. And along the way, there will be "events" that change the regulations and the specifications. If a government really wants a fixed price contract that sticks, the best way to do this is to offer a very high rate of return. The problem here is that the cost of capital is the key to the economics of nuclear power. Hinkley demonstrates this: to fix the contract price, EDF and CGN are paid a real 9% cost of capital, in the context within which the government could borrow the sum at around *minus* 2–4% real.

The contrast with the French nuclear approach could not be more different. The state raises the money (at a negative real rate in the current context), goes for a programme (currently new six power stations), and controls much of the supply chain including EDF.

The second potentially fatal political blow to the economics of nuclear concerns the partner countries. When the decisions about Hinkley were being made, the then government had an "open door" position on China and welcomed it in. Fast forward a decade, and things look very different. It is now all about getting China out of nuclear (and communications too). France was a desirable political partner for Hinkley, and the deal was embraced publicly by Cameron and Hollande. Now there is much hostility to

Macron and France following on from BREXIT. Over a decade or more of a nuclear programme, will we return to being "best friends" with France, or fall out further over the post-BREXIT arrangements? Chopping and changing international partners is not a very robust basis for nuclear. In the days of the CEGB, when it led the Magnox and then the AGR programmes in Britain, there was no need of foreign participation. Now there are no home-grown large-scale nuclear developers in the UK, though there may be in Rolls Royce for SMRs.

Having a nuclear capability is part and parcel of having a robust nuclear programme, as it is of a military nuclear deterrence. Looking ahead, it is possible to envisage a joint UK–France nuclear programme, adding France's six to say four to six in the UK, making a programme of at least ten. This would yield a supply chain. But it would need a UK company as part of the deal and a joint political framework. All of this, in the current context, is fantasy. If the UK does nuclear, it will be far less ambitious, less joined-up, and probably much more costly.

The conclusion that follows is that it is very hard to think of any worse way of taking nuclear decisions than the recent past in Britain. It maximises the cost of capital without complete risk transfer, and it minimises the supply chain efficiencies. Opting for more nuclear now as part of a security and decarbonising strategy requires the ambition to be matched by a more coherent and joined-up commitment, sustained over more than a decade.

A second stake in the ground is **offshore and onshore wind**. The key point about wind is its difficult economics: it is low-density, disaggregated, intermittent and remote from consumers. Nevertheless, its lobbyists claim that wind is the cheapest form of electricity generation. Sadly this is not true once the full costs are taken into account, and that means that it is government that has to decide how much offshore and onshore wind and has to provide the subsidies to the full costs to make it happen. The regulator has to instruct the network companies to build an interconnected system between the offshore wind farms and then between the wind farms and the mainland grids.

Offshore wind – the main play - differs from nuclear in all the above respects. It also differs in having shorter lead times and its components can be manufactured, currently primarily in China.

The stake in the ground decisions about the volume of offshore and onshore wind are conditional on deciding about the system infrastructure to collect and distribute the energy, and how to deal with the intermittency. This is a system question that depends not only on the quantity in GWs of offshore wind in particular, but also on what else is on the system at the same time. It is rarely observed that the decision about wind needs to be taken in conjunction with the decision about gas – at least until there is a large-scale alternative storage technology that can cope with longer periods of low wind, notably in winter (but increasingly in summer, too, as the air conditioning loads grow). Given the 2035 target for decarbonising electricity, the gas decision depends in turn on the CCS decision, since more wind means more gas, which means more CCS if the gas is to meet the net zero requirement by 2035.

This leads to the third stake in the ground – **CCS.** Successive governments have stalled on CCS investments and decisions. As noted, a Treasury paper in 2007 promised £1 billion of support to develop CCS. Fifteen years later, and despite there being even a competition for the £1 billion, CCS remains largely on the drawing board. It requires a regulatory and licences framework, a liability insurance regime, a pipeline system, and a price of carbon sequestrated.

Though all of this is reasonably straightforward, these ancillary stakes in the ground are not yet in place, and the clock is ticking both as the offshore wind develops and the 2035 deadline gets ever closer.

The fourth stake in the new kid on the block - **hydrogen and green ammonia**. It is unlikely to be the last "new kid". The promise of hydrogen is that it can be manufactured by using excess wind and perhaps even solar, thereby being truly "green". (Nuclear could do this too, though it is unlikely to be surplus unless on a French scale.) In the meantime, hydrogen is "blue", made from natural gas, which brings us back to CCS. Blue hydrogen is inconsistent with the net zero targets without CCS.

The hydrogen decision differs from the nuclear and wind stakes in the ground because it is very much at the R&D and demonstration stage. R&D is a public good and hence there is an obvious role here for government support.

As with solar and wind, the temptation is to confuse the decision about the stakes in the ground with industrial strategies (whatever they are) and global competitive advantage in trade. When it comes to hydrogen, the UK is not the only player. On the contrary, green hydrogen is being fast-tracked in Germany and elsewhere. As with solar in Germany, there is little point in doing all the hard work and all the spending on the development of the technology, with a long tail of costs into the future if, for example, China is going to win the race. The case for a European approach to hydrogen is considerable, yet BREXIT stands firmly in the way.

There are several other stakes in the ground, though they tend to be more about the frameworks and less the technology per se. Solar falls into this category, and targets are particularly inappropriate given the major differences between rooftop, household, farmland and other variants. In an ideal world with perfect foresight, governments might want to go further, but there are corollary dangers as the lobbyists get their teeth into government and regulators, and getting the really big decisions right on the above stakes in the ground would be a major achievement. All of the above are decisions which cannot be taken by markets. Governments should resist the temptation to do everything. Just doing a few things well would be a massive improvement on the current policy mess described above.

5.3 Delivering the plan – guidance and the system operator and regional system operators

Government can and indeed has to take the decisions about the major stakes in the ground. What then is required is a plan to deliver the energy system within which these stakes are embedded.

These objectives will not be achieved without a plan. If, for example, the government seriously intends to get to net zero for the electricity sector by 2035, then with 13 years to go, it needs to radically up its game and set out a plan to get from here to there. To give some examples, if part of the plan is to build lots more offshore wind and to increase electricity capacity to tackle transport and some heating, then as noted it will need a lot of gas capacity to back it all up. That in turn will need CCS, since electricity will not be net zero if there is a lot of gas on the system unless the gas is net zero and the only plausible way of doing this is to use very large-scale CCS. Similarly, it makes a lot of

difference to the networks and the capacity requirement whether there is more nuclear or not. To get more nuclear in just 13 years on the system requires a lot of actions now.

The stakes in the ground are for government: the delivery of the system to meet these is an evolving and detailed matter. Things will change. Nuclear might be late, wind costs may increase, and so on. Someone has to manage this process, and whilst the government and BEIS can and should issue guidance – notably in respect of the overall objectives and the stakes in the ground – there need to be a system architect.

The obvious place to start is with the SOs at the national and also at the regional level too. The *Cost of Energy Review* sets out how these should be separated from National Grid and the distribution network operators (DNOs) and details some of the consequences for Ofgem and system regulation. Five years later, the government is still prevaricating about how to do this. Every year means that the system plan remains incomplete, which means that it is harder and harder to meet the 2035 target and the costs of doing so goes up. It has an impact on the generation investment decisions, notably because without a network system in place, uncertainty increases and hence the costs of capital goes up.

5.4 Creating a market fit for the purposes of the twenty-first century

Security of supply entails having enough firm power on the system to meet demand, and with a comfortable margin because the costs of insufficient capacity are asymmetrically larger than not having enough.

The problem with the current market design is that it does not provide an efficient way of achieving this result. Hence the system is always at risk of deficiency, and there have been a number of narrow scrapes in recent years, despite the low economic growth. It cannot be stressed enough that intermittency of wind makes everything else potentially intermittent too, and hence requires system-wide investment to ensure that supply equals demand at a reasonable price.

The *Cost of Energy Review* sets out how to do this. It proposes evolving the existing capacity market into an Equivalent Firm Power (EFP) market. The advantages of this EFP framework is that it achieves the security of supply objective (it is firm power that

is required) and it incentivises those who cause intermittency to try to reduce its impact so they can get a higher EFP rating. It is an evolution on what is currently in place, because the current SO has to do a de-rating exercise for intermittent power and ensure that the system balances at any point in time. EPF decentralises, increases competition in the balancing market and places the incentives where they can be managed best.

The *Cost of Energy Review* describes the way the EFP market works. The reason why this is important to get on with is that the twentieth century wholesale market model is being displaced by a twenty-first-century decarbonising market, with lots more zero marginal cost generation. It is increasingly a utility-style fixed and sunk cost system. The EFP works alongside the expansion of renewables, notably wind power.

5.5 Locking in security for gas supplies – storage and longer-term contracts

The *Cost of Energy Review* does not discuss gas very much. The Russian issue has changed the gas discussions, especially in Europe and Germany. As the UK has run down the North Sea gas fields, it has turned to imports. Ministers are keen to point out that the UK takes very little gas from Russia, but this is disingenuous. It takes a lot of gas from Norway, which is also plugged into the European markets, and increasingly the UK competes with European counties for cargoes of LNG.

In this new world of import dependency, in the absence of storage and with more and more intermittent renewables, the UK has a serious gas security problem, whatever ministers say. It requires a framework of contracts and storage.

The government has a number of levers in its hands. It ultimately owns the licences for North Sea developments, and it could apply terms to these, including flexibility (as British Gas once did), longer-term contracts and further integration of specific fields with the UK energy systems. It could also look to reopening storage fields like Rough, and consider strategic reserves of gas power stations as the increasing wind renders gas power station economics vulnerable to the vagaries of the wind flows. The strategic reserve could be linked to longer-term contracts with new North Sea resources.

6. Conclusions

Energy crises come and go. Usually governments react to crises by assuming the crisis situation is the new normal. Usually they assume that spikes in oil and gas price are permanent. It happened after the 1979 oil shock, and high and volatile gas prices are now being extrapolated to justify all sorts of investments that lobbyists wish to advance.

If we should never waste a crisis, we should also not assume that it is permanent. Rather, as a crisis focuses attention on energy, it should be used as an opportunity to revisit the causes of the crisis and to consider whether there are fundamental flaws in current policies.

The energy price crisis is not new. It was a major motivation for the commissioning of the *Cost of Energy Review* in 2017. The *Review* set out how to rebase energy policy, fit for the purposes of securing supply and decarbonising. It set out the building blocks of a twenty-first energy system, supporting renewables and decarbonising, whilst keeping the lights on at reasonable costs. It demonstrated that energy prices were not well grounded in energy costs, and consequently that consumers were paying too much for their energy. In ignoring its recommendations, the government allowed the current much worse energy prices crisis to happen. It could ignore the recommendations, but not therefore avoid the consequences of ignoring them. Consumers are paying too much for their energy. They should not face an average household bill of £2,000 a year at the start of April 2022.

Critical to rebasing energy policy now is a series of decisions – stakes in the ground – that have been fudged in recent years. Either do nuclear properly or not at all. Recognise the security implications of lots of intermittent wind on the system and plan the system architecture to deal with this. Integrate the offshore and onshore electricity grids. Do not ignore the gas that will be a part of the back-up for at least a decade to come. Do not pretend that stopping new gas production in the North Sea solves the problem of UK consumers consuming a lot of gas by importing it instead. Get on with separating out the regional SOs and the national SO. Evolve quickly to an EFP market to supersede the fossil-fuel-driven wholesale markets of the twentieth century. Take

longer term contracts seriously rather than relying overwhelmingly on spot markets, and extend the price cap periods to a year. Get on with designing and implementing an integrated CCS system offshore.

Do these things, and spend less on perverse subsidies, and the UK can have secure energy at a reasonable cost and decarbonise at the same time. Ignore all these, and not only will the UK lack security, but it will pay higher prices and the 2035 target will fade, and possibly with it the willingness of the public to support the vital objective of decarbonisation.

Net Zero: How we stop causing climate change

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