

This is a transcript of the oral evidence Dr John Constable gave to the House of Lords' industry and regulators committee on 14 September 2021.

The Chair: Good morning, everybody. I welcome you to the sixth oral evidence hearing of this committee's inquiry into Ofgem and net zero. We have two panels today. The first panel is John Constable, energy editor of Global Warming Policy Forum. John is a vocal critic of the Government's energy policy and has argued that the shift to renewable energy will make the economy shrink. Lord Lawson, a Global Warming Policy Forum founding member and, of course, a former Chancellor, wrote only last week to the Prime Minister arguing that the costs of the journey to net zero are likely to be twice and probably three times the Government's £1.4 trillion estimate.

That gets us neatly to the question that I want to ask. You have argued, along with your former chair, that the Government have miscalculated or are using inaccurate numbers on which to base policies. Those numbers, of course, come from the sixth carbon budget. We heard from the Committee on Climate Change last week and its economists. It put forward a very powerful case as to why the budget was a sound basis for making policy decisions, and that seems to have been widely accepted. Perhaps you could tell us why you take a different view and the reasons for that.

Dr John Constable: The straightforward answer to your question is that we start off by looking at empirical sources for current costs and then make plausible assumptions about cost reductions, and indeed some allowance for cost increases, because one cannot assume that every aspect of the transition will induce cost reductions. We find that current costs are very high and in some cases – for example, the operational costs for offshore wind – are rising. We therefore find the Committee on Climate Change assumptions about cost reductions implausible. The target-consistent marginal abatement cost figures published by government itself seem to suggest that certain parts of government are themselves concerned that the cost of abatement will be much higher than that assumed by the Committee on Climate Change, in what we think are optimistic scenarios.

To summarise, we start with empirical material rather than what we think is wishful thinking and optimistic industry propaganda or sales prospectuses about future cost reductions.

The Chair: Have you had the opportunity, in coming to that decision, to explore in detail the sixth carbon budget, the assumptions that lie behind it and the workings of it?

Dr John Constable: As you and the committee will know, my colleague Mr Montford has managed to persuade the Information Commissioner to instruct the committee to release its underlying workings. These spreadsheets have been released in relatively recent weeks. We are now working through them. They are, as Mr Stark told you in a recent evidence session, quite complicated. Indeed, they are quite messy and in some parts they do not reconcile with the reports, so they will take a certain amount of examination. We are going through them, and very shortly we will start to comment on the things we are finding there. Briefly, what we have already seen is very interesting and to a great degree supports our doubts about the projections of future cost coming out of the committee.

The Chair: Could you take us through the costs where you think there is a great deal of doubt and explain why?

Dr John Constable: The principal cost doubts we have with regard to energy supply relate to offshore wind, on which a great deal of the committee's, and indeed the Government's, projections rely. As you will know, only recently the Prime Minister said in answer to a PMQ that the cost of

offshore wind had fallen by some 70% in recent years. We and others have conducted a detailed empirical analysis of over 350 offshore wind companies through their audited accounts. We see no evidence at all for a fall in costs of that scale. Indeed, costs have been stagnant and remained stubbornly high since 2014, and operational costs appear to be rising. Consequently, the levelised cost is still over £100 per megawatt hour, which is nowhere near the contracts for difference bids that the Government rely upon for claiming these substantial falls in cost. Indeed, the operational cost figures suggest to us that, as these wind farms move into deeper water and more difficult territory, costs may actually rise.

That returns to a point I made earlier. One cannot assume that costs will always fall. You are doing something very difficult here, and indeed in some areas costs may start to rise, particularly as renewable energy starts to form the principal input for many of the goods and services that are required by the green industries themselves.

The Chair: Can you explain why there is still a “land grab”, if that is the right term, for offshore acreage for wind turbines from well organised and experienced companies against the background that you are projecting?

Dr John Constable: You are asking why they make those very low bids for contracts for difference. Indeed, it is a very interesting question. Auction bids cannot be taken as a reliable guide to underlying costs. Companies make such bids for complex reasons. In this case, the companies have secured a market position, have inhibited competition, and have generated very good PR for themselves and bad PR for competitors such as nuclear. In many respects it is a short-run, and very successful, public relations strategy and, indeed, market share acquisition strategy.

It is important to remember that these Contracts for Difference, although referred to as contracts, are not actually binding contracts to deliver megawatt hours at that price by a certain date. This is not like some kind of futures contract where a certain amount of copper has to be delivered free on board by a certain date or an enormous penalty is to be paid. The contracts are without serious penalty for abrogation, so companies can undertake these kinds of bidding strategies and regard them as a relatively low-cost gamble.

What are they gambling on? They might be gambling on an increase in wholesale price. Perhaps the wholesale price will rise so as to make them economic in the mid-2020s when these contracts become active, in which case they will simply abrogate the contracts with no particular penalty and take the wholesale price. Alternatively, they may be gambling on a government bail-out. Professor Hughes at the University of Edinburgh, who has conducted these studies for us and, indeed, for a charity that I run, the Renewable Energy Foundation, concludes that this is probably the likeliest strategy. They are relying on the idea that by the mid-2020s the Government will be so committed to offshore wind that they will be willing to supply a bail-out in some form. Whether that is a direct income support subsidy or some indirect method remains to be seen.

So it is a gamble. It is a gamble on market prices, on government support, and perhaps, to a lesser degree, on their own propaganda, in that they believe that their own costs may fall. On current empirical evidence, there is no way that those bids could be economic.

The Chair: If we look at that empirical evidence, the turbine industry is now sufficiently mature to be able to accurately cost the turbine itself. Are you talking about the uncertainties of operational costs in new waters?

Dr John Constable: The audited accounts are quite clear about what their capex figures are, indeed, their opex figures are, so one knows exactly what is going on. You only have to look at their audited accounts to find that out. Indeed, Professor Hughes is not the only person to have done this. This work has been replicated by other researchers. Yes, indeed, these are empirical figures; they are actual costs, not projected costs in the future.

The Chair: In your estimate, they are being wildly optimistic about the operational costs of new fields.

Dr John Constable: The Government are being optimistic about falls in capex and opex, presumably on the basis of the CfD bids. The empirical data in the accounts does not support that optimism. There has been no substantial fall in capex since 2014. Indeed, there might even be some indication of a rising trend. There is already a clear indication of a rising trend for opex.

The Chair: We will have the opportunity of having those companies as witnesses in future hearings, so that is a most interesting question that we can now put to them. What other anomalies in the budget assumptions do you want to explain?

Dr John Constable: One of the key points that I would draw your attention to – I emphasise, by the way, that my remarks are not seeking to be taken on trust; these are references to matters of fact, matters of policy and market facts that you can check for yourselves – is the great discrepancy between the Marginal Abatement Cost and the Social Cost of Carbon.

The Social Cost of Carbon was abandoned by the British Government as a metric in the period from 2008 to 2010, from memory. Yes, that is correct. If that is put to one side, it is impossible for any member of the public, decision-maker or, indeed, regulator to form a view as to whether the abatement cost is a positive contribution to human welfare.

The Government have preferred to move to something that they refer to as a Target-Consistent cost for carbon. In fact, that is simply the cost of meeting the target. Those figures are published by BEIS, and at the moment they range from about £120 a tonne of carbon dioxide to £360 or thereabouts. Estimates for the Social Cost of Carbon, which is the harm done to human welfare by emitting a tonne of carbon dioxide, range from zero up to \$100 or \$200. Most central ranges are in the region of \$50 per tonne.

It seems to me and to many other analysts that we need to return to a situation in which the abatement costs, both now and in the future, are set against rational estimates of the Social Cost of Carbon, and the regulator and other bodies are allowed to mount criticism of certain abatement cost policies. That is not happening at present. We are simply being told that the net-zero target must be met at any cost, effectively. No one is asking, “Is it really rational to undergo abatement costs of somewhere between £120 and £360 a tonne?” In the future, government estimates range up to £580 a tonne. At that point, the policies become much more harmful to human welfare than the emitting of carbon dioxide. This sort of discussion is completely absent from the Committee on Climate Change’s work, and indeed from government’s own assessments. We find that extremely puzzling.

It is not simply the case that the costs of meeting the net-zero target are, in our view, underestimated based on empirical evidence that we can see. There is also a worrying absence of a cost-benefit analysis with regard to the abatement costs even in so far as they can be seen and are admitted to by government.

Q71 Lord Blackwell: I have a quick follow-up to the point that you were raising with Dr Constable just now on his analysis of the accounts. It is a very important point. You say that they are not showing costs falling. I just wonder whether you can distinguish between fixed and marginal capital investment. In other words, I could imagine – I do not know the detail of this – that in the early stages of building wind farms there are some fixed costs of building the platform, laying cables and constructing infrastructure that you incur upfront but, as you expand, the marginal costs are much lower. It is possible that, if you just look at the early costs, you are overestimating the ongoing costs. I do not know whether that is true, but I just wondered whether you could help us to explore that.

Dr John Constable: It is quite true that, as you say, there will be a fixed cost for building a wind farm of any size and scale at that particular site, and therefore expansions might have slightly lower costs. There is some evidence of that in the accounts.

I refer to you to the detailed studies published by Professor Hughes for details on this. I will make sure you have links to that later on. The studies look at, as I say, 350 wind farms. Not all of them are able to take advantage of expansion. Some of them will; some of them will not. So the specific issue is perhaps not quite as important as you think it might be. Nevertheless, it is a relevant question.

The key point to make here is simply that the cost per megawatt for these wind farms and the operational cost results in a break-even cost that is well in excess of the Contracts for Difference. The details of the costs are available in the studies for you to look at, but that is the key finding of them.

Q72 Baroness Bowles of Berkhamsted: In your latter remarks to Lord Hollick's questions, you were beginning to stray into an area that I would like you to expand upon further. In particular, do you accept that the decarbonisation of the energy system needs to take place? I am setting aside the targets that have been set. I mean the general concept of decarbonisation, taking into account issues such as security, geopolitics and, as you have already touched on, welfare. We have issues with air quality and all those kinds of things. So there can be good that potentially comes from decarbonisation beyond addressing climate change. Where are you on the general concept?

Dr John Constable: It is perfectly rational to have a decarbonisation policy, but the decarbonisation policy itself must be rational. In essence, it is an insurance policy, and thus it must pass the basic tests of any insurance policy. First, it must provide real cover. Secondly, the premium must be proportional to the risk, hazard times probability, in so far as one understands it. Thirdly, the premium must be affordable in itself.

In our view – this is my personal view, and I have stated it on many occasions – the climate policies do not pass any of these tests. They do not provide sustainable emissions reduction; the abatement cost is extremely high in relation to the risk, hazard times probability, in so far as we understand it; and they are unaffordable in themselves and, therefore, unlikely to be sustainable in the longer term. In other words, while it is perfectly understandable that government may wish to reduce emissions, the current policies are very likely to stimulate public resistance – indeed, you can see signs of it already – and thus they will not be sustainable in the long term. A radical redesign, reducing the marginal abatement cost to an acceptable level, is desperately needed.

Baroness Bowles of Berkhamsted: Can you look at that the opposite way round from how you have presented it? You are taking the current policy and looking at where it might become unaffordable. What economic costs could be incurring by delaying actions on decarbonisation, if you accept the

basic premise that there can be other goods that come out of it? There still are these issues relating to things such as air quality and geopolitical security. What are the costs if we do not go down that track, especially in terms of research, for example? The rest of the world is coming forward with new products. What are the economic costs if we miss out?

Dr John Constable: The UK is not benefiting from international green manufacturing to any degree at present. As you will be aware, green manufacturing plants in Scotland have recently closed because they were outcompeted by China, in effect because they are not able to make green equipment with coal. There is very little likelihood that the UK will be able to enter green manufacturing businesses while it still has to compete with low-cost fossil fuel manufacturing in Asia. There are no green benefits to be gained there.

You referred to the possibility of technological improvement. Well, that is clearly a possibility, in which case there is every reason not to over-commit to investment now when lower-cost carbon abatement technologies may become available. For example, widespread Small Modular Reactors both for electricity and heat are much discussed at present. These could be extremely cheap in comparison with renewable energy alternatives. I would say, based on the physics, they are inevitably going to be cheaper. The entropy balances suggest that. Therefore, there is a real risk of being too hasty in adoption. A smoother glide path in would be rather better.

I would suggest, as a colleague Dr Aris and I have suggested, that the UK was already on a sustainable decarbonisation trajectory in the early 2000s, based on natural gas and a steady shift to nuclear. That trajectory allows flexibility, keeps the public on board and leaves you able to take advantage of technological improvements in all sectors as and when they become available. At present, you have an extremely inflexible system that seems to be offering sustainable carbon dioxide reductions when, in fact, they are very likely to be unsustainable due to cost.

Baroness Bowles of Berkhamsted: You think the “sit and wait” policy for technology is of economic benefit, and you are basically saying that there is no role in terms of leadership on technology because we could be outcompeted by those who do not use cleaner energy.

Dr John Constable: I referred to the experience of the early 2000s to say that I am not suggesting that we should sit and wait. We were already on a sustainable carbon reduction track in the early 2000s. One could return to something like that, where you have an engineerable future for reducing emissions rather than one based, as at present, on a crash course of wishful thinking. I am not recommending “sit and wait”; I am suggesting that we return to engineering principles such as those we were operating under in the early 2000s.

Q73 Lord Sharkey: Good morning, Dr Constable. The Global Warming Policy Forum has argued that the drive to achieve net zero is likely to be extremely expensive, leaving Ofgem’s responsibilities pulling in two different directions, and that Ofgem is “necessarily failing to protect consumers from price rises”. Do you believe that Ofgem can balance its objectives of affordability and decarbonisation effectively? Does Ofgem’s remit need to change?

Dr John Constable: Ofgem could do a much better job than it is currently doing. To some degree, I have sympathy with the institution about the difficulties in which its current remit places it. As you will know, its terms of reference were changed in 2010 so that it had to have regard to the interest of both present and future consumers in light of climate change. That is a very constricting remit that makes it very difficult for Ofgem as a regulator to criticise climate policies.

The debate between the cost of abatement and consumer welfare has been collapsed and brought into one particular regulatory requirement within Ofgem. In fact, there should be healthy debate between, on the one hand, the Department for Business, Energy and Industrial Strategy – BEIS – and its policies, and, on the other hand, the regulator, Ofgem, questioning the costs of abatement and, indeed, questioning the need for rapid timetables and trajectories.

Ofgem had a fairly liberal remit before 2010, and it would be very helpful if its terms were revised to return it to independence and give it more freedom to criticise government policies, rather than, as it is at the moment, leaving it in effect as yet another instrument of policy delivery. It just becomes a further organ of the state that is part of the delivery of climate change policy rather than being a constructive critic and a consumer champion.

Lord Sharkey: On Ofgem's objectives, we have heard arguments for making net zero Ofgem's primary objective. You have argued in your written submission, for example, that Ofgem's role needs to be more clearly defined, with consumer interests having precedence. Would it be meaningful to talk of a viable compromise between these two positions?

Dr John Constable: That compromise would be the result of healthy debate between the regulator, as a consumer champion, and the Department for Business and Defra making the case for net zero.

The point that we are making about Ofgem, which I have made in other publications, is simply that the revision to Ofgem's remit was yet another instance of the removal of the checks and balances approach to policymaking and implementation. At the moment, rather than there being many different opinions and voices within the governmental machinery, we seem to be moving to a situation where all government departments are co-ordinated in order to deliver a pre-decided policy mechanism.

Is that sustainable and is it politically stable? That is a reasonable question to ask. Debate within government is to be desired on this point. Rather than having a confrontation with the public, it would be better if the Government, through a system of checks and balances, stress-tested their policies to see whether they were likely to be acceptable to the public in the longer term. That is not what we are doing at present, and it explains to a large degree the head-on collision that we are beginning to see between the Government's ambitions for net zero and the general public's concerns about its own welfare through costs.

Q74 Baroness Noakes: I want to shift to the impact of making the UK electricity system more renewable and get your views on what that does to security of supply. Cost is a major issue, as you have said, but there is also a pressing need to ensure that we have security of supply in the UK. I would be interested in your views on the balance around that.

Dr John Constable: The cost of securing the system on a daily basis has risen very significantly. That cost rise is a good index of the erosion of security of supply.

In the early 2000s, Balancing Services Use of System charges – BSUoS, as it is known in the industry – were around about £300 million a year. These are actions taken by the electricity system operator in the last hour, in real time, to secure the system and to match supply and demand. At present, BSUoS charges amount to just about £1.8 billion per year. They have increased from £300 million a year in the early 2000s to £1.8 billion today. I cannot say that all of that is down to renewables, but a very large part of it is.

Briefly, then, that rise in cost is an important index of the erosion of the security of supply. It is becoming much more difficult for the system operator to stabilise the system and ensure that supply meets demand. A similar increase in the cost of transmission network use of system charges – TNUoS – is also observed. A few years ago TNUoS was in the region of £2 billion a year; it is now somewhat over £3 billion a year. Again, I cannot say that all of that increase is down to renewables, but a substantial part of it is.

The cost of maintaining the system, and indeed of stabilising it in the last hour, has risen very dramatically in the presence of renewables. At present we are still in the situation where a system operator can achieve a secure system by throwing money at the problem. The question is how much longer it can go on addressing that problem simply by throwing money at it. Will it be able to throw the money quickly enough to meet the challenges? At the moment, we are seeing quite interesting and difficult problems in the electricity system. Even today, the loss of load probability is quite high, which will ultimately involve very high charges on the consumer.

How much longer can this go on before it becomes an acute problem, one that the electricity system operator cannot deal with? We do not know. National Grid is a very good company, and very good at managing the system. Provided that it has the resources to address the problem, it may be able to do this for quite some time. But the costs will become extremely high; they are already very high. The security of system problem is manifesting itself as cost in the short run, and it is a very important index. We should respond to that cost increase and address the problem before it becomes a physical problem that cannot be resolved by sheer expenditure.

Baroness Noakes: When you say “throwing money at it”, do you mean paying for carbon-intensive electricity generation being bought on stream at the last minute?

Dr John Constable: That is one of the measures that the system operator has to take, of course, but there are many others: for example paying wind farms to reduce their output north of a constraint and then paying other generators to come on to the grid, at short notice, south of that constraint; demand control, which is paying sources of industrial demand either to reduce or increase their load on the network; and, as you say, paying conventional generators to increase or, indeed, reduce their output at short notice to stabilise the system. There is a very wide range of options.

Baroness Noakes: That is the position now. Can you see what would happen as the system moves towards a greater dependence on renewable sources of electricity?

Dr John Constable: The projections entail increased reliance on batteries and, indeed, on interconnectors to stabilise the system. The cost of batteries is very high at present. Although there are some grounds to think the costs may reduce, batteries have to be very, very cheap indeed for them to be an affordable and attractive method of stabilising the electricity supply to consumers. In essence, by using batteries, we are suggesting that we should replace the energy storage that is implicit in the rotating turbine shafts of a large generator with an external device, a battery, that will be very little utilised. It is a very large and expensive object, and it will be relatively underutilised. That is a low-productivity system; you have a lot of batteries that are not used a great deal, are critically important to you but not used very often. Their high capex has to be recovered from a relatively small number of instances when they are used. The charges on the consumer will be very high.

Baroness Noakes: Is there not a case for seeing technological advances and greater levels of production reducing the cost of that, and being used more as there is more renewable energy in the

energy mix? They would not be used on an occasional basis; they would be a core part of the system and, therefore, part of the core infrastructure cost and not an exception.

Dr John Constable: There is every reason to think that there might be cost reductions, but optimising the use of capital expenditure in a stochastically shifted renewable energy system will be intrinsically expensive. There really can be very little doubt about that.

The way to think about this is about the fundamental physics. Wind and solar flows are of high entropy; the service required by the consumer is of low entropy. Correcting that high-entropy disordered flow to produce an ordered flow of energy to consumers implies a great deal of correction, including batteries and all the grid management policies that we have just mentioned. They will be intrinsically expensive, because they are things that you do not have to do with a fossil fuel system. It will be comparatively expensive.

I am not denying there might be some cost reductions and improvements in technique, but this will be a low-productivity system, by definition. It will require very large quantities of capital in the generation sector. The renewable generators, wind and solar farms, have low load factors: 10% for solar, maybe 30% for onshore wind and maybe 45% for offshore wind. There are relatively low utilisations in comparison to fossil fuel plants at present. You will also have a lot of grid and a lot of batteries. The low productivity of the capital implies that, even with cost reductions, this will be a very expensive system in comparison to the kind of system we have enjoyed for the last 50 years.

Baroness Noakes: If we do not increase the amount of renewable energy in the energy mix, is there an alternative rational path towards decarbonisation?

Dr John Constable: Dr Aris and I have published a rational plan for decarbonising the electricity sector with implications for other parts of the economy, in which we suggest that a gas to nuclear transition, as we were in fact undergoing in the early 2000s, is probably the only sustainable way to reduce emissions in the UK. The current policies, we believe, will simply stimulate enormous public resistance, as well as technical problems, and will therefore fail. A gas to nuclear transition would reduce emissions in a cost-effective way, keep the public on board and leave us flexible to take advantage of any technological innovations that appeared.

Baroness Noakes: How realistic is that, given recent experience of stimulating new nuclear?

Dr John Constable: The current UK market is extremely distorted. Subsidies to renewables account for about £10 billion per year. It is a very large fraction of the total cost of the electricity network. It is extremely difficult to correct this problem without firm government intervention. Dr Aris and I speculated in our study that government should buy back contracts for renewables in order to declutter and remove coercions from the system, so that a more efficient decarbonisation programme could be undertaken.

I do not deny the difficulties. It is extreme. Distressed policy correction is always difficult. It is going to be very painful for some, there is no doubt about that, but it is doable. It requires very firm political intervention. After all, these distortions are the result of political intervention. Only political intervention will be able to correct them.

Q75 Lord Grade of Yarmouth: Is your forensic opposition to the Government's policies founded more on a climate-sceptical position or is it founded, as you have just been discussing with Baroness Noakes, on a firm belief that the economic solution to the issue actually lies in the nuclear option?

Dr John Constable: As I said, it is rational to have a climate policy. It is important that your climate policies are rational. The cost of abatement is the key consideration in all these discussions. Unless you are talking about carbon taxation and the cost of abatement, you are not serious. Simply waving your hands and saying, “There’s a grave threat from climate change; we must do something” is empty and not constructive.

You have to offer a low-cost abatement policy track in order to produce a sustainable policy. This seems to me to be so common-sensical as to hardly require defence, and yet it does require defence. We are consistently told that to raise questions about the cost of carbon abatement is simply to wish to stop the abatement procedure altogether. That is not the issue. Indeed, as I have said already in evidence today, the current policy costs are likely to be so high that public resistance will mean that we do not and cannot meet net zero. Therefore, a cheaper option is in fact rather constructive.

Lord Grade of Yarmouth: Much earlier in the exchanges, you referred to some nuclear option. I do not know whether you used the word “modular”. You described some way forward, and I would love to hear a bit more about that.

Dr John Constable: Nuclear reactors do not have to be large-scale energy generators only, and, indeed, there is the very interesting possibility of using small modular reactors – really quite small: only 50 megawatts thermal – in order to generate high-temperature heat.

It is little appreciated outside engineering circles, and a matter of obsessional interest within engineering circles, that heat is the real problem in decarbonisation. High-temperature heat is critical to an industrial society. The provision of high-temperature heat is an area where renewables struggle. Indeed, there is no realistic renewable option for high-temperature heat; that is to say, temperatures above 500 degrees centigrade. Nuclear reactors can do this. The PWR does not; it is a relatively low-temperature reactor, but high-temperature gas-cooled reactors can achieve very high temperatures, over 700 degrees. Not only would such reactors be able to provide industrial process heat, but they might be able – indeed, they can – provide a route to producing hydrogen. Therefore, they might be able to offer low-cost hydrogen for decarbonising transport. This is an area in which many engineers are becoming increasingly interested and excited.

Small modular reactors have a future in generating electricity. Rolls-Royce wishes to do this and has a very interesting proposal, but its machines are quite large; they are several hundred megawatts. We are talking about really quite small devices here. This would produce a system whereby there was a distributed network of smaller modular reactors generating heat and perhaps sometimes electricity. It would be a genuinely resilient and distributed network. It is really a very interesting idea at present. It is an area in which I expect technological innovation to genuinely produce an outcome. Again, to back to the physics, the physics of nuclear is very promising; it is a very low-entropy energy source. It has intrinsic promise. It is an area in which you would expect things to improve and develop. We are really only at the beginning of the nuclear industry.

People sometimes say that nuclear is a very mature technology, and of course in many respects that is true, but we have only been doing it for half a century or so. Steam engines were first introduced in the 1690s; they were not really good until the 1890s. Technological development takes time, even in our own age when it is typically very rapid. The promise of nuclear, particularly small reactors, is very great indeed.

Lord Grade of Yarmouth: On the cost differential, can you provide empirical evidence that that would be a much more palatable and economic way forward?

Dr John Constable: I laid emphasis on empirical costs in the renewable industry. We have a lot of evidence of what those costs are at the moment. We do not yet have a great deal of evidence on what small reactors would cost when actually built. The proof of the pudding will be in the eating, and it is perfectly reasonable to be cautious about that. It would be interesting to see what the industry could build a small reactor for – the first of a kind.

The Japanese have an operating high-temperature gas reactor just north of Tokyo. It is a small one, about 30 megawatts thermal. The prediction from that particular device, on the basis of the cost of construction, is that it would cost roughly £100 million, perhaps a little less, to build a 50 megawatt thermal reactor. With mass production, those costs might fall. As I say, caution would be entirely rational, but it would be interesting to try.

Lord Grade of Yarmouth: What are the reasons, do you think, that the nuclear option is so out of favour?

Dr John Constable: Nuclear energy clearly has connections with the weapons programme, and the iconography of nuclear weapons is so powerful that it hangs over the entire industry. There have of course been some accidents, and these too pollute the reputation of the sector. The smaller reactors should be able to operate very much more safely than the larger ones.

Lord Grade of Yarmouth: Lastly, we come to the poor benighted consumer, with all this going on. Given the Government's current direction of travel, to which you have laid out some very cogent objections on cost grounds, how can we reduce the costs to the consumer? The usual lever is more competition. Is that possible with the Government's present policy? Could Ofgem do more or be more effective in attracting greater competition into the sector for the consumer?

Dr John Constable: Competition is an excellent idea. Unfortunately, the UK electricity markets are so distorted by policies that there is very little competitive market remaining in which there could be such competition. One reads persistently – politicians particularly make these points – that switching supplier is the best way of reducing your costs. As I have just noted, subsidies to renewables alone account for £10 billion a year, and there are many other charges that are socialised over all suppliers and where there can, therefore, be no competitive activity. In principle, competition is excellent. With a market as heavily distorted as our own, its power is very limited indeed.

Most of the charges being imposed on the consumer at present are imposed through policy and therefore not exposed to any market whatsoever. Un-coercing, removing distortions in the market, is a necessary preliminary to introducing beneficial competition.

Lord Reay: Dr Constable, you state in your submission that the electricity market requires some reforming. What reforms to the market would you like to see? Can you also address whether these reforms would be compatible with a net-zero energy system?

Dr John Constable: The shopping list of reforms to the energy market is very long. I am not sure whether we have the rest of the day available. I will do my best to sketch them.

Undistorting, as I have just remarked, would be a necessary preliminary to re-introducing competition. Dr Aris and I have speculated that it would be possible to buy back renewable contracts in order to remove the stochastic elements from the system, so that the costs of operation could be reduced and price signals to investors in reliable low-carbon energy could be restored. At

present, as I say, in such a distorted sector there are very few price signals to investors. Nobody wishes even at the moment to build a high-efficiency combined-cycle gas turbine.

Therefore, reforms are required across the board. You have to remove the renewable subsidies; you have to do something about Ofgem's remit; you have to restore price signals; and, indeed, you have to do something in the short term to secure supply. Will all these reforms add up to a result of net zero by 2050? In honesty, we cannot say. It is too difficult and far off to be certain. I am confident, however, that the current policies will not deliver net zero, simply because consumer resistance will become so strong and the economic damage so manifest. The situation that we are in is not choosing between a net-zero policy set that works and that we have, and an alternative that may not. I am suggesting to you that the current policies will not work, and therefore we have to find a policy set that might just work, producing emissions reductions that are reasonably cheap.

As I have said, the reforms are numerous across many aspects of the market. The key metric would be the abatement cost, bringing me back to my earlier remarks. This will be the key metric of whether these policies are succeeding. As soon as the marginal abatement cost starts to decline, we can start to feel more optimistic about achieving a reasonable level of decarbonisation by 2050.

Lord Reay: I believe you agreed with the point in Sir Dieter Helm's cost of energy review that CfDs should be gradually phased out and merged into a single EFP capacity auction. Could you just go into a bit more detail on that?

Dr John Constable: At the moment, the costs of system operation caused by renewables are not paid for by renewables. The full cost of renewable energy is not laid at the door of the renewable generators themselves. Professor Helm's recommendation is that it should be and that they should have to pay the cost of having to firm up their own contribution to the system. It seems to me entirely rational.

This is a short-term and medium-term policy. I do not believe that renewables will be with us in 30 or 40 years' time, but in the short term we have a great deal of this equipment and we should dispatch it properly while we still have it. The argument for doing that is reliant on reducing the system costs. If you cannot reduce the system costs, it is better to do without them altogether. If you can reduce the system costs, it is rational to retain that plant while the capital life of it remains. An equivalent firm capacity option would put increased pressure on the renewable operators to find a way of reducing their own system costs. It would make it their own problem and therefore motivate them to address it.

At the moment, the problem of stochastic generation is nobody's problem, and therefore it is an extremely expensive problem to deal with. As I say, though, it is intrinsically expensive.

Lord Reay: Can I separately ask you to comment on some technologies and provide your thoughts on their viability going forward as part of the drive to reach net zero? They are hydrogen in the home, carbon capture and storage, and – I know it is far off – fusion as a possibility in the mix.

Dr John Constable: I have written extensively on hydrogen, and I have what I think is a rational approach to it. Hydrogen is an energy carrier. It is an interesting energy carrier, but it is a difficult gas. It is both fugitive and quite dangerous to handle. However, it is genuinely interesting and could allow us to decarbonise some very difficult areas such as transport, particularly international shipping, as ammonia.

The key thing is to make the production of hydrogen cheap. That is important for the consumer of the hydrogen but also because making it safe to use in society will not be a cheap activity in itself. It is going to be expensive to make it safe, so the input costs have to be very low. Therefore, the most promising route for hydrogen production is high-temperature nuclear. This was sketched in the 1970s by the physicist and economist Marchetti, known for Marchetti cycles in energy, and was offered to the Japanese. The Japanese government accepted it and are still working on it. It exists within the Japanese machinery as the new Sunshine project.

It is promising. Will it work? We do not know. It is crucial that the input energy cost is low. Electrolysis from existing nuclear power stations will produce high-cost hydrogen. Electrolysis from renewable energy will produce very high-cost hydrogen. High-temperature nuclear reactors decomposing water thermally, probably in the presence of a catalyst, would in principle produce low-cost hydrogen and might therefore work. If the hydrogen could be low-cost, it would be possible to afford all the safety measures that would be necessary to render it utilisable both in vehicles and in the home. I am open-minded about it and guardedly optimistic.

Q77 The Chair: Can I ask one brief question? You referred earlier to the export by China of low-cost goods produced principally using coal-fired power stations. Do you agree that a carbon border equalisation tariff should be introduced in order to remove the trading advantage from those countries that do not abide by the rules?

Dr John Constable: Preventing carbon leakage is a highly desirable outcome. We often hear boasts that the UK has reduced its emissions very significantly and, indeed, decoupled its economic activity from carbon emissions. The truth of the matter is that we have simply exported our production to Asia, very generally. In effect, we have exported our carbon emissions; they are one of our most successful exports of recent years. It will take more than a carbon border adjustment mechanism to rectify that problem. We have nothing to boast about. All we have done is borrow money to buy Asian goods, which we are dependent upon. You are talking about restoring manufacturing capacity here in the UK. That is very desirable, but it will require reducing the cost of energy here in the UK. At present, of course, we have very high-cost energy, particularly in the electricity sector, due to our decarbonisation policies.

The export of our productive capacity to Asia is in large part the result of the climate policies that have produced the emissions reduction. It is a complex problem. A carbon border mechanism would merely scratch the surface. In essence I am a free trader, so it also contravenes my basic principles. I would rather see us reducing our energy costs, reindustrialising spontaneously and making goods that could compete in the international markets, rather than requiring some kind of special defence wall in order to make them artificially competitive.

The Chair: On that very clear note about your preferences, I will thank you very much indeed.

Q78 Baroness Donaghy: Dr Constable, I welcome very much the opportunity to have this debate from a different point of view. I always had a concern about the fact that future decommissioning of wind farms, for instance, was never taken into consideration. Nobody quite knows who is going to be left to pay for that, come the day that these are decommissioned. However, what would you say to the claim that, basically, those people who are climate change deniers, having lost the argument, will now concentrate on the costs of doing anything? How would you overcome that prejudice, as some would see it?

Dr John Constable: The argument has always been about making the cost proportional to the risk, the hazard times the probability, in so far as we understand it. From our perspective, nothing has changed at all. We have always been saying this, and we are still saying the same thing. It is not that there is no climate change; the question is how much it is rational to pay in order to abate or reduce emissions.

If you think the danger is very great, the social cost of carbon that you propose is very high. We do not think that those very high costs are plausible, and indeed most economists do not. A relatively low social cost of carbon, somewhere in the region of \$50 or maybe \$100 per tonne, is more rational. In summary, we simply do not think that anything has changed. We are consistent about this. We have always talked about the cost and its relationship to the risk, hazard times probability, in so far as we understand it.

Baroness Noakes: You have said several times that consumer resistance may become an important factor in whether the Government's policies are carried through completely. We have been told in evidence a number of times that the real issue is how much of the cost should be borne by the general taxpayer, or by the Government via taxpayer funds, thereby removing the cost directly from visibility in rising energy bills. At the moment, of course, most of the costs of transition are ending up in energy bills, but there is another route, which is that the Government pay for quite a lot of stuff directly so it does not go on bills. Is that an appropriate mechanism to take forward the Government's net-zero policies?

Dr John Constable: Whether these are levies on consumer bills or taxes, the macroeconomic impact will certainly be negative and stimulate public resistance. It is certainly better to fund such things through taxes. When the renewable heat incentive was introduced, some years ago now, the initial proposition was for it to be funded through a levy on gas. I argued very vigorously against it at the time, suggesting that it was, based on the experience of electricity, inefficient and regressive, and therefore a poisonous thing to do to the gas markets. The RHI was funded out of tax. Unfortunately, it is still very expensive.

Taxation is the lesser of two evils, but it is still an evil. It is much better to have low-cost energy that does not require any kind of support.

Q80 Lord Blackwell: Dr Constable, a major part of your argument is for a slower glide path. Your analysis says that wind costs are not falling as anticipated or as projected by some. It is quite difficult to get the detail from an aggregate analysis of accounts. I wonder, as a next step, whether it would be possible for you to provide us with some examples of specific companies' accounts from the analysis you have done, which we could put to those companies and ask them to comment.

Dr John Constable: We can certainly do that. I cannot do it off the top of my head speaking to you now, but we certainly have information, and Professor Hughes has detailed information, which we could relay to you so that you could, as you say, make the inquiries in the appropriate places.

Lord Blackwell: That would be very helpful.

The Chair: Thank you very much, John Constable. That information would be most helpful.

Dr John Constable: I will supply it.

The Chair: Well, thank you very much for this interesting discussion. We will now have a short intermission before our second panel. Thank you very much.