

HOUSE OF LORDS  
MINUTES OF EVIDENCE  
TAKEN BEFORE  
THE SELECT COMMITTEE ON ECONOMIC AFFAIRS  
**THE ECONOMICS OF RENEWABLE ENERGY**

TUESDAY 3 JUNE 2008

MR CAMPBELL DUNFORD and DR JOHN CONSTABLE

Evidence heard in Public

Questions 110-134

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Present

Griffiths of Fforestfach, L  
Lawson of Blaby, L  
Layard, L  
Moonie, L  
Paul, L  
Turner of Ecchinswell, L  
Vallance of Tummel, L (Chairman)

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Witnesses: **Mr Campbell Dunford**, Chief Executive and **Dr John Constable**, Policy and Research Director, Renewable Energy Foundation (REF), examined.

**Q110 Chairman:** Welcome Mr Dunford and Dr Constable and thank you very much indeed for coming to the Committee and spending some time with us. Before we go on to questions, is there anything that you would like to say by way of introductory remarks or shall we go straight into questions?

**Mr Dunford:** Only My Lord Chairman if there are any questions as to who we are, who we represent; sometimes people are confused.

**Q111 Chairman:** By all means do so, if you wish.

**Mr Dunford:** Quite simply, the Renewable Energy Foundation is a charity. It is funded entirely by private donation. It has no corporate affiliations or corporate funding whatsoever; indeed, we have been at pains to ensure that that should be the case. There are so many vested interests in the renewables field that we have tried to remain truly as impartial a voice as possible. Our purpose has always been to commission and publish independent and empirical research in this field.

**Q112 Chairman:** Thank you very much. Perhaps I might start by asking you a catch-all series of questions. How do the costs of generating electricity from renewables compare to fossil fuel and nuclear generation? What are the current estimates for fuel generation with carbon capture and storage? How do those costs compare with renewables? Finally, what impact do these various forms of electricity generation have on carbon emissions? A very simple set of questions.

**Mr Dunford:** Thank you. We have prepared some detailed written responses which we would like to leave with you, if we may, because we are dealing with an extremely complex matter and there are no quick and easy answers to this. If you are looking at the cost of energy from a generator in all terms, you are looking firstly at the capital expenditure required, the cost of that capital itself and that will, of course, be governed by market perception of the risks, the cost of the fuel input, the load factor which is achievable, the operation and maintenance costs, the de-commissioning costs, which are often overlooked, and integration costs, such as integrating a particular form of generation into the grid so that it is actually of some value, balancing costs and therefore, the overall impact on the system. From a consumer's perspective or indeed from the UK's as an economy, it is really the overall system cost that matters to people and that really varies considerably according to the renewable technology you are looking at and what you are comparing it with. Generally, and right across the spectrum, it is true that renewables are more expensive than their conventional counterparts. We have a lot of data to leave with you on that. There are studies which have been done for BERR, for example, which show the different costs in pence and pounds per kilowatt hour for all of the renewables and also we have had work done for us by IPA Energy which compares conventional power and goes up from the lowest, which would be gas, combined cycle gas turbines, up through the winds to the highest, which was the point of this particular study that we were doing which was the Severn barrage costs. Against the

capital cost of the renewable generators, you have to balance the fact that some of them have very low or zero fuel costs and that is a very real merit and an important consideration. However, to a significant degree, that benefit is counter-balanced by load factors for some of these technologies that are very low indeed compared to conventional sources of generation. The load factor for onshore wind, for example, is generally less than 30 per cent and even offshore wind, which is something that we have championed, is only 35 to 40 per cent. However, when you look at everything in the round and you take all of the estimates together, which we have, renewables are currently more expensive on a pence per kilowatt hour basis than conventional generators and there is no getting away from that and we have provided charts for this. There is also a balancing cost which must be taken into account and this has been estimated by the UK Energy Research Centre at anything between £5 and £8 per megawatt hour for, say, wind energy at a 20 per cent penetration. We would tend to feel that that is probably a bit low, but that is the number which has to be brought in. With regard to overall system impact, there is quite a lot of confusion. It is generally assumed, at a public level, that one unit of renewable energy will automatically replace one unit of conventional power. That is sadly not the case. It could possibly be the case, say, for biomass, because biomass is despatchable power, you know when you are going to get it, so one megawatt hour of biomass power could replace one megawatt hour of coal or gas, but that is not the case for every other renewable that we are aware of. The Severn barrage, for example, would have a capacity credit of only 17 per cent of its installed capacity, so if you had technically this value of 8.6 gigawatts installed, the capacity credit to the system would only be 1.5 gigawatts, so much less than what you think you are getting. We would like to refer the Committee to the experience in Europe, in Germany and Denmark, for example, where there is extensive renewables penetration and they are often cited as examples. The Danish head of their equivalent of our National Grid has said quite clearly that from a planning perspective, for

example, wind there achieves a capacity credit of zero for planning purposes. This actually matters because quite a lot of the work that has been done here, by National Grid for example, assumes that you can take roughly the square root of the installed capacity as firm capacity for the grid, so that from 25 gigawatts of installed capacity you get five gigawatts of power. That is not the case. There is nothing particularly unusual about British wind as opposed to German or Danish wind and the work that we have done, with a very important bit of work coming out shortly, shows the capacity credit for wind in the UK would be very little different from that in Europe, extremely low, about five per cent we think.

**Dr Constable:** I will take up the story of the capacity credit issue. The capacity credit for renewables is critical in the sense that it affects the cost of running other generators alongside them and what you are doing is asking renewables to produce a lot of megawatt hours but you are denying that production to conventional capacity. However, you nevertheless need to retain that conventional capacity, because the capacity credit of the renewables is low and in the case of wind, practically zero. If you can think of this, to take a concrete example, there is much discussion at the moment and talk of producing about 45 per cent of our electricity from renewables and let us say that some 35 percentage points of those 45 points come from wind, that would be something like 135 terawatt hours of energy. To generate that from wind, you would need something like 52 gigawatts installed capacity, assuming a load factor of about 30 per cent. That is a very large installed capacity indeed, a high capital cost, somewhere in the region of £30 to £80 billion depending on the mix of onshore and offshore. Nevertheless, it supplies almost nothing towards the firm capacity requirements of the UK, so its value, its counter-factual cost, is the fuel saved and that is a real value and it could be real but it may be dearly bought and that is one of our concerns. Think of it this way, if you add 52 gigawatts of wind to the portfolio, you still have to have enough conventional despatchable generation equivalent to the peak load plus an acceptable capacity margin, probably 10 per cent, a little

bit more, and that would give you 70 gigawatts. As the Committee will be aware, the UK is currently faced with the necessity of rebuilding something like 30 gigawatts of its fleet, about 40 per cent of the total fleet, by 2020. That in itself is a very large capital burden, somewhere in the region of £15 to £25 billion depending on the mixture of technologies. The overall grip therefore would be closer to 120 gigawatts in total. You would move from a situation as it is today where you have about 70 gigawatts of plant to a total grid capacity of about 120, in other words a very large installed capacity, but the gigawatts-hours market remains the same. So you have lots of generators chasing the same size market and their load factor will drop. By adding a very large quantity of renewables with a low capacity credit, what you are doing is producing a load factor of the still indispensable conventional generators and therefore driving up the costs of those conventional generators and it could rise very significantly, between one pence per kilowatt hour and two pence per kilowatt hour, which would represent an ongoing cost burden of somewhere around about £5 billion a year. Our point here is really that the cost of renewable generators is complicated. It is probably much higher than is superficially apparent and we conclude from this that there are thresholds beyond which the UK should not go. Not that there should be no renewables at all, of course not, but the key is the fuel saving. You must not drive in more capacity than is justified by the fuel saved. That limit may rise as the value of the fuel saving rises, if the price of fossil fuel rises, but ensuring that you get the right quantity to take the benefit of fuel saving without driving up system costs beyond the value of fuel saving is critical. It is not an easy problem to solve and, as far as we are aware, very little attention has been paid to it.

**Q113 Chairman:** I asked you the blockbuster question so you gave me the blockbuster answer, but if you are going to answer all the questions we are going to go for, we will need to be a bit briefer.

**Dr Constable:** Certainly, but that is a very critical reply from us.

**Chairman:** It is extremely critical and we very much look forward to your written submission on this as well.

**Q114 Lord Moonie:** In 2006, you wrote that the Government “has not yet recognised the acute need for security of supply of imported fossil fuels” and that it was “naively sanguine about future fossil fuel prices and availability”. What are the implications of this for renewable energy policy? How do, and should, renewables fit into our overall energy policy?

**Mr Dunford:** The background to that of course is that our existing fleet is in decline and a whole chunk of it is being closed, so we have that investment to make. Renewables will have a role to play and indeed rising fossil fuel prices and rising electricity rises generally will encourage renewables to come in, that goes without saying. We have to make a considerable effort in improvement in our thermal efficiencies. We can do that quite well in this country because our stations are so old; just putting a new kit in is going to make things a great deal better. Renewable generation can only be helpful to that if it is a team player, if it fits in with the rest. If it is supplementary to and sits alongside but does not support the conventional generator, then it is frankly wasted money and wasted effort and not getting the benefit down to the consumers. We believe that it is very important to go for things where the renewable generators can make a contribution. The big unsung area is in heat where a third of our energy goes and where existing renewable technologies can more or less immediately be applied at a domestic level and at a commercial level; you can use solar thermal, you can use ground source heat pumps and do that sort of thing. You can make a material contribution to the third of all our energy needs that is used in heating, for example. Transport? Much more difficult. Without getting into the whole thing about biofuels, we believe that the existing penetration should be really rather local where there is reasonable manufacture of, say, biodiesels or what have you. For transport the long term future is going to be electric vehicles of some sort, however that is fuelled.

**Dr Constable:** I should like to say something quickly about ground source heat pumps instead of thermal. Our view is that ground source heat instead of thermal could play a very significant part in a gas depletion policy and we believe the UK needs a gas depletion policy very badly. Here are technologies which have a potential for cutting gas demand, which is desirable in itself, and also reducing household expenditure; they deliver immediate returns and it is a very desirable thing to do. It is a pity that more is not happening, although with rising fossil fuel prices, they are becoming spontaneously attractive.

**Q115 Chairman:** Do you think that in the UK we are spending too much time thinking about electricity generation and not enough on heat?

**Mr Dunford:** Yes; absolutely.

**Dr Constable:** Yes; certainly in the renewables sector.

**Mr Dunford:** In the renewables sector everybody is fixated with the holy grail of generating electricity at a micro and a macro level and it is a considerable waste of resource and attention and the low-hanging fruit is being missed. Renewables can make an immediate contribution, if encouraged, on the heating sector and on the domestic sector.

**Dr Constable:** Particularly because the UK has become so gas-dependent for its domestic heating.

**Q116 Lord Moonie:** Following on from what you said about cars, you talked about electric power, are you talking about batteries particularly or some sort of hydrogen system?

**Dr Constable:** It has not been decided.

**Q117 Lord Moonie:** What is your hunch?

**Dr Constable:** My hunch is batteries.

**Mr Dunford:** Yes, battery technology will crack it through in the fullness of time.

**Q118 Lord Layard:** I would like to go back to what you said about wind and the zero number that you mentioned for Germany. Is it not the case that if you look at the thing on a national basis, a system-wide basis, you get a different line of thought from if you try to imagine a bit of wind power and the associated backup capacity and diesel? How do you actually look at the thing? What conclusion do you come to when you look at the thing on a system-wide basis?

**Mr Dunford:** We have done this work.

**Dr Constable:** The German and Danish wind carpets are reasonably distributed so that their experience is relevant, although I agree that they are relatively concentrated. The UK is a small geographical area and weather systems are very large. It is therefore interesting to try to model the impact and indeed we have done this; we have obtained the Met Office wind speed database and we have asked consultants, Oswald Consultants, who have done quite a lot of work for us, to construct a power flow model assuming 25 gigawatts of wind distributed in eight locations, eight regions over the UK to test the smoothing hypothesis. We have asked the consultants to construct this power flow model using the Met Office data and that work is now forthcoming in the journal *Energy Policy*. We are very happy to provide a proof print of that study for you. What the study shows is that, yes, you do get smoothing, a not insignificant smoothing but, nevertheless, during the course of a typical January, the wind output will vary between very close to zero, a couple of percent of its theoretical maximum output, and nearly 100 per cent. So the capacity credit is low. Smoothing affects the rates of ramp and decline.

**Mr Dunford:** It is important to say that we took the data right across the entire UK, from the very north of the islands of Scotland, from Shetland right the way down to Cornwall and extrapolated that out and used the actual numbers that the companies themselves and the units

were reporting back and even so, you get very, very alarming rises and drops in power in a very short period, which the grid has to cope with or cannot.

**Dr Constable:** They would be manageable but it might be costly to manage them. From the point of view of providing firm capacity to meet peak load, the experience would be almost identical to that in Germany and Denmark. There is no reason to suppose that smoothing would deliver a significantly higher degree of capacity credit. That is the outcome of this study which I am very happy to provide you.

**Chairman:** If you could, that would be very useful.

**Q119 Lord Griffiths of Fforestfach:** Your manifesto of 2005 went on record as saying that the Government are asking “more of renewables than can be reasonably delivered and is thus condemning the sector to failure“. Is this still the case and, if so, why and how much renewable energy can “be reasonably delivered”?

**Dr Constable:** It is not only still the case but the problem has, if anything, intensified. The EU renewables targets are proposing that some 20 per cent of Europe’s final energy consumption should come from renewables with at least 10 per cent from transport fuels. This is an extraordinary target; for the UK it has been rendered as a target of 15 per cent of final energy consumption by 2020. That would probably entail an enormous burden on the electricity sector. Even if we assume the 10 per cent of transport fuels can be met and the current climate suggests that there will be little political will for biofuels so the burden on electricity will be still greater – 45 per cent of electrical energy from renewable sources, 50 per cent - you are looking at an extraordinary wind fleet to achieve that, somewhere between 50 and 70 gigawatts, vast, resulting in a grid, the total capacity of which is 100 to 120, in excess of 120, and nobody has any idea how to run such a grid, it has never been tried anywhere, nobody has the faintest idea. It is particularly critical because if you have that much fluctuating output, there will be times during the year, perhaps very frequently, when

the output from that combined wind fleet exceeds demand, you cannot store the electrical energy and the wind will have to be curtailed, in which case you have less energy than you thought you were going to have and you will miss your targets. So curtailment is little discussed in this and most of the models assume unconstrained output from the wind fleet. It is quite clear from this that the targets are, practically speaking as things stand, unobtainable and nobody in the electricity industry would privately tell you anything different. Governmentally there is a real risk that governments throughout Europe will succumb to panic and introduce very strong mandates to attempt or to show willing to meet these targets and from the perspective of the renewables industry, that would be disastrous because it will result, as it is actually already resulting, in the adoption of some optimal technology and much of the material that we are putting before you today is concerned with economic costs but this is a very significant opportunity cost. Renewables are very good things and we will need them in the future, but driving them in and driving the adoption of sub-optimal technology may well present a very significant opportunity cost for the UK; we will be damaging the prospects for this industry.

**Mr Dunford:** To put a number to that, we think that the UK could probably stand about 10 gigawatts of renewable power.

**Dr Constable:** Ten gigawatts of wind probably; it may be a little bit more, it is very hard to say.

**Q120 Lord Lawson of Blaby:** May I ask you a question in a number of parts? The Germans do generate much more of their electricity from renewables in general and wind power in particular than we do, so they are ahead of us. What would you say is the main lesson that we can take from the German experience? I have the impression that they are slightly less enthusiastic about it now than they were. Is that correct?

**Mr Dunford:** The German experience of renewables has caused them some technical difficulties as well as considerable cost, of course. They have, for example, the largest wind carpet in Europe. They have major balancing difficulties and they have to export quite a lot of power under duress to neighbouring countries. This has caused complaint, for example, from some of the surrounding economies.

**Dr Constable:** Poland and Holland specifically.

**Mr Dunford:** So yes, that is a problem for them. It has not been an entirely happy experience. They are also having to construct an additional high voltage grid in order to cope with the fluctuations created by this large wind carpet and we understand that Germany is building five new coal stations, which it does not otherwise need, purely to provide covering power for the fluctuations from their wind carpet, so they are driving up their cost quite a lot. The other thing that they have done, which comes up a lot, is that they have a feed-in tariff to encourage the spread of renewables at a local and domestic level. This is certainly a way of encouraging domestic renewables but it again introduces, in addition to the cost, a great deal of uncertainty into the management of your power base. I am not sure that it has been a great success for them.

**Dr Constable:** The German experience is extremely instructive and we should all study it very carefully indeed. The principal difficulties they have had are ones of cost. There are areas in which the German experience is not relevant and they found it much easier to solve their balancing problems because they are so richly interconnected with their neighbours. As Mr Campbell has just said, the neighbours have not always welcomed these overflows and I know at present that the German grid operators are recommending that connections with Denmark should actually be reduced to protect stability in the Danish grid which is highly important. In a positive way, there are areas in which Germany's experience, for example of ground source heat pumps, has been very beneficial and they are beneficial and it has not been

all bad for the Germans. Certainly at the utilities scale, the costs have been extremely high and I would wonder whether it was unduly simple to suggest that German enthusiasm for the 2020 renewables targets was an attempt to ensure an equality of economic burden across Europe, so the competition, at least within Europe, was levelled off for them, whatever it did internationally.

**Mr Dunford:** It is also true that in Germany and Austria there has been a considerable take-up of biogas for example. Virtually every farm or village has a biogas unit available to generate electricity locally and put wealth into the local community. That simply has not happened here because of the way our system is set up and it really should do. Again, it is a low-hanging fruit.

**Q121 Lord Lawson of Blaby:** I absolutely take your point about the low-hanging fruit. Nevertheless, the present policy of the Government is to focus very heavily on wind power. I would like to ask you one or two further questions about that. You mentioned the fluctuations in the intermittency and the need for backup. That produces two consequences. First of all, it adds to the cost obviously and presumably the bigger the proportion of your total electricity supply which comes from wind power, the bigger the extra cost you have, the more important the backup is. It would be helpful if we could have some indication from you - maybe it is in the paper you said you are offering us - about how much this costs extra. Also, you mentioned that in Germany they are building new coal-fired power stations to provide this backup, to deal with this intermittency problem. This obviously means that the amount of carbon dioxide emissions which wind power is meant to cut out is diminished by the amount that is generated by the backup systems. So what is the net effect there? Is it possible to get away from that by having your backup not coal fired or gas fired, not a conventional power station, but nuclear as your back-up? When I was Secretary of State for Energy, it was certainly believed in the department and it was certainly the case then, because that was a

long, long time ago, 25 years ago, that really nuclear was only remotely economic if you had it as a base load. You could not have these kinds of fluctuations which you would need, switching on and off when the wind was not blowing or whatever. I am not up to speed with the new nuclear technology and I wondered whether there was some development in the technology of nuclear power which would enable it to be used in this way.

**Mr Dunford:** If I might take the emissions question first, because that is the easy one, the truth is that in both Denmark and Germany, emissions have risen, not quite in line with the penetration of wind, but their carbon dioxide emissions have risen and continue to rise. They are higher than they were when they started. The inference has to be, we are told, we have not researched the subject ourselves, that this is because they have had to resort to backup. The experience of providing backup to date has always been that the engineers need to respond very quickly, therefore they have used those generating technologies which are capable of being ramped up and down quickly without causing damage and that therefore has tended to be either oil, coal or open cycle gas. Regarding nuclear, John, do you have a view?

**Dr Constable:** Certainly it is true that the older generation nuclear stations were relatively inflexible, technically inflexible, whereas with the latest generation, I understand, it was actually in the licences that they have to be able to follow load and there is no particular reason why a PWR should not be able to do so. However, it is not our field of expertise; I know that simply as incidental knowledge. You would have to ask a nuclear reactor design operator. Economically I would suspect they would prefer to run at full load, but if you are asking them to flex, then I am sure they would do so and charge appropriately.

**Mr Dunford:** The only comment I would add, if I may, is that when you are talking of a large wind carpet and the wind suddenly blows like a hooligan, you have a lot of power already in the system. You do not have a great deal of time to react, to crank things up and down. It is

not that controllable. I have to say I personally would be worried about nuclear plant being turned up and down.

**Q122 Lord Lawson of Blaby:** On the question of cost, how much is the intermittency factor and the consequent need for backup, as you were saying, the bigger the proportion of your electricity supply which is produced in this way, the bigger that problem is, what does this do to the cost of electricity?

*Dr Constable:* There are two senses of backup here often confused and it is very important to keep them separate. One is the need for rapid response reserve and the cost of that is estimated at somewhere between £5 and £8 per megawatt hour of wind energy in the UK. That may be a little low, we are not sure, but it will do. The other cost, which is the most interesting cost in some ways, is the cost of running the rest of your conventional fleet at lower load factor. That is another sense of backup. The Germans call it “shadow capacity”. We refer to it sometimes as “support capacity”. That is relatively easy to work out. You can produce a cost curve for load factors, so you can see the cost for the conventional generator rising as the load factor declines. I have not included such a chart in the document I have with me today, but I am very happy to direct you to an industry standard chart of that kind and you can read more. It is not a linear effect; it is quite a steep curve, so there is effectively a threshold effect, that you reach a point where it becomes significantly more expensive quite suddenly.

**Q123 Chairman:** Dr Constable, last year you said that the UK regime of renewables obligations certificates has been a disaster for the renewables sector. Why do you think that is so? What do you think of the Government’s proposed changes to the scheme and are there other changes to that scheme that you would like to see?

*Dr Constable:* Yes, I have said many things which are critical of the renewable obligations. It is an extraordinary system; it provides 60 per cent of the income for a renewable generator. It is a very blunt instrument. It produces high profit for the least capital intensive ticket to the subsidy stream. In some cases internal rates of return for onshore wind projects exceed 25 per cent. This is remarkable, to say the least. What it has done to the sector is reward serially the least capital intensive technology. Initially, that was landfill gas which is a very good technology but hardly in need of subsidy. Its benefits were very dearly bought. Latterly it has been wind, a technology which, in our view, is limited in scale of deployment and, if correctly sited, at present does not really require subsidy. So what the RO has done for the sector is narrow development focus on to one or two technologies which in fact least require support, the least capital intensive ones, and it has depleted resources available to other technologies which are either in need of technical development or are more capital intensive. We know that because we have innovators and technologists coming to see us all the time, desperate to find capital support and finding it almost impossible. We do our best to help them but it is very difficult. In the wind sector it also created a perverse incentive for wind developers to install plant in locations where there is fundamentally very little wind. For many years the industry has premised its output on a 30 per cent load factor and that is routinely used but in fact, if you look at data which we publish, the load factor for all 900 renewable generators, not just the wind, you can see in fact 80 per cent of onshore wind farms failed to achieve that sort of load factor. I believe you will be receiving submission from Professor Jefferson of London Metropolitan Business School who has been analysing this material. So the RO has created permanent subsidy clients and this is critical because there is a limited capacity for wind in the UK grid and we have incentivised the construction of wind which is saturating it with sub-optimal plant. It is very unfortunate indeed. Wind has a role in the UK's grid but at the moment we have sub-optimal plant. I would find it very difficult

to say anything positive about the obligations, except that the Government doubtless meant well in introducing it. It was a very complex instrument and it has had unforeseen and very unfortunate consequences. We welcome the current proposals to ban the obligation. Last year, we judged that such revision should be seen as a step towards abolition. At present I am prepared to come further forward and say that with rapidly rising fossil fuel prices, the RO is needless and it should simply be abolished.

**Q124 Lord Moonie:** When you talk about the availability from a renewable source, do you count the extra transmission losses into that?

*Dr Constable:* The load factor.

**Q125 Lord Moonie:** Yes,

*Dr Constable:* No, it is usually calculated at the edge of the site.

**Q126 Lord Moonie:** Is that significant?

*Dr Constable:* The voltages are very high and the transmission losses are not very large; I would not say that they were. In the distribution network they are rather higher and that is interesting. It is very little studied and it is very difficult to get data about losses in the distribution sector. The distribution network operators frequently do not keep this data and are not even capable of analysing it.

**Q127 Lord Moonie:** How much investment in Britain's transmission and distribution networks will different renewable energy sources require compared with other forms of generation? Are the current transmission and distribution systems capable of managing a large share of intermittent renewable energy generation and, if not, how should they be changed and are the rules on connecting capacity supportive of renewables?

**Dr Constable:** In a document we are leaving with you, we have given some detailed numbers, some of the estimates. The grid expansion would be very large, if the wind carpet were very large itself. You are really looking for grid in order to allow power flows around the country so you want a very extensive grid. In Germany for example, and this is an aspect of German experience which is highly relevant, they are looking at about 1,200 miles of new extra high voltage by 2020 at a cost of some £2 billion and that is not counting the expansion and reinforcement in the medium voltage grid. It is very significant and we know it is going to be needed; it is not a theoretical matter, it is real. Even more modest levels of renewables would require significant grid expansion. National Grid estimated in 2004 that it would be something like £250,000 per megawatt installed. That is a very significant number and even if we took a lower figure, also used by National Grid, about £125,000, 50 gigawatts would require about £6 billion of grid. Now that is investment which has to be recouped, so you have effectively a standing charge on the customer. We have not done work on this ourselves, but Professor Lawton, one of my advisers, has presented an analysis to me which suggests that for every billion pounds of grid, electricity prices would have to rise by about £3 per megawatt/hour. For £6 billion, well you can do the sums yourselves. It is a significant overhead and not to be ignored. Are the current transmission and distribution systems capable of managing a large share of intermittent renewable? No, they would have to be expanded to handle the capacities currently considered. We would suggest that perhaps those capacities are rather too high and that therefore it should be reduced where the economic burden becomes tolerable and indeed, returning to the fuel saving point, where it does not wipe out any value from the fuel saving. Are the rules on connecting capacity to the grid supportive of renewables? I will hand that over.

**Mr Dunford:** The last speculative number that came out of National Grid as to what they would like to have to strengthen the grid was actually, and I stress that it was a speculative

number, £9 billion. There is pressure at the moment for those who are proposing to create renewable generating assets to have it made mandatory that they be connected to the grid and, if they are not connected to the grid, that they should be paid a fee as though they were connected to the grid, which I find an extraordinary way of looking at life, but there you go. The grid connection rules at the moment provide that connection will take place as the grid judges the value of the power to the overall system. Any changes would inevitably mean that the grid itself was being asked to accept power and cost which was not necessarily contributing to the value of the grid. Frankly, it is a complex matter but it should not be changed lightly because we do not know what the consequences should be. We do know that the costs will be very, very great and we do not know what benefit might accrue.

**Q128 Chairman:** Let me just take you back to the renewables obligation and something I should have picked up when you said that you wanted to see it abolished. Would you want to see anything else in its place? For example, would you like to support feed-in tariffs and, if so, what do you think the impact would be on the investment of the generators?

**Mr Dunford:** We debate that constantly and six months ago we would have argued for a refinement of the renewables obligation and probably a very, very finite life to it. Now, however, electricity prices have risen and are continuing to rise and everything that we see shows that they are just going to carry on going that way. We honestly believe that most technologies should now be able to survive without ongoing subsidy at the very generous level that the RO provides. Let us remember that it is 60 per cent of the income for the average wind turbine now, for example. That said, we do believe that some of the technologies which we see every week need help to come to market. We do not think that a subsidy is the right way to do it because that is taking an infant technology and guaranteeing that it never grows up, you just keep it in swaddling clothes. We do believe that it would be prudent for the UK to look at increasing its level of R&D support and early-stage support.

We are way, way down below competing economies on the amount we spend on R&D in the renewables and energy sector, so we would like to see that going forward. In terms of encouraging penetration into the marketplace, we would probably seek to argue, particularly at a domestic level, for a mechanism of capital grants to help technologies to come forward. Simple straightforward subsidy has skewed the market and we see no reason why it should not continue to skew the market, if it is left as it is.

**Q129 Lord Layard:** You have argued in favour of carbon capture and storage for coal-fired plants. What would you like the Government to do about this?

**Dr Constable:** If you are interested in reducing emissions from the electricity sector, both here in the UK and by example elsewhere in the world, carbon capture and storage are absolutely essential. A consistent theme in the material that we present you with today is that renewables are not a particularly effective method of reducing emissions; they are valuable as a fuel saver, which is a different matter. If you actually wish to reduce your emissions, you are going to have to clean up conventional sectors, not least because it is a matter of fact that the world's fossil fuels are going to be used. China will use its fossil fuels. The IEA, International Energy Agency in Paris, is estimating that in the next eight years China and India combined will build 800 gigawatts of new power stations, 98 per cent of it coal fired. It is not my number but it is a very significant fact. If we care about emissions, CCS seems to be absolutely unavoidable but it will be expensive and it is something governments have to be open to the public about and say that if they want to reduce emissions, they are going to have to pay to do it but there is no reason why that should not happen. Legislation requires that sulphur dioxide be removed from power station outputs and the market was left to find the most effective way of doing it and it has been very successful. It could happen with carbon capture and storage but adoption in my view is absolutely conditional on continued commitment to reduce emissions on a global scale and if there is no coordinated global

policy, the UK would be better off spending its money on adaptation domestically and on funding and granting overseas aid for adaptation responses internationally. It is critical that CCS has to take off globally, if we are going to do it. There is no point in us undertaking that extra cost unless it is a truly international effort.

**Q130 Lord Griffiths of Fforestfach:** You have argued that there has not been enough support for offshore wind. Do you think that Shell's decision to withdraw from the London offshore wind farm is influenced by the lack of support? If you feel more support is needed, then how much and what kind of policies would give rise to that?

**Mr Dunford:** We were disappointed. We have long argued that the place for wind development is offshore where the wind is more constant, it is stronger and where you can position your investment close to the centres of load and demand. Economically, it makes much more sense than scattering the things willy-nilly across the countryside. So we were disappointed.

**Q131 Lord Griffiths of Fforestfach:** How far offshore would the windmills be?

**Dr Constable:** The London Array? I cannot remember. The Greater Gabbard offshore wind is 18 miles.

**Mr Dunford:** We are not privy to Shell's decision making, but, as you will have seen from Exxon's chief executive only this morning, the oil majors are, in current market circumstances, concentrating their efforts and their capital expenditure on making sure that there is enough oil and dealing with increasingly tight geology for that oil. I suppose we should be grateful for that. Shell faced significantly rising costs in Europe and in America where it is also active in wind. Funnily enough, against all predictions, the American subsidy system at the moment is extremely attractive for all forms of renewable investment and I should think that Shell is quite simply switching its resources there. What would we like to

see the Government do? Well, we have argued against subsidy, we continue to argue against subsidy because we do not think in the long term that is going to be healthy, but to enable these very significant investments to get off the ground there has to be some recognition that there is money going to be tied up and there is going to be a commitment. So, once again, we think that a capital grant mechanism or possibly a tax mechanism, a rebate mechanism, rather than a subsidy would be the way forward. I think that answers your question.

**Dr Constable:** It seems to be that the Shell decision is quite an interesting example of the way that international market interventions have distorted the market. I would say probably the obligation in the UK has put the brakes on optional wind, it has not helped, and taking it away would help offshore wind but a major market intervention in the States has convinced Shell that they could get better margins elsewhere. Probably, yes, we would support offshore wind capital grants, which they did receive once, though I have a hunch that with rising fossil fuel prices, large energy companies would invest in offshore wind at a high wind site as a way of diversifying their portfolio and hedging against increasing fossil fuel prices. It would be interesting to test that hypothesis.

**Q132 Lord Lawson of Blaby:** As I understand it, what you were saying a moment ago was that you do not see really any case for wind power in terms of achieving a stabilisation of carbon dioxide concentration in the atmosphere; you see other arguments for wind power, providing it is wind power which is offshore rather than onshore. If we do, however, focus on the issue of stabilising carbon dioxide emissions in the atmosphere which is what the Government's Climate Change Bill is all about and what the climate change committee is all about, you made a point, with which many people would agree, that that only makes sense if you could have a global agreement and a global agreement requires inevitably there to be carbon capture and storage installed globally. Whether that is technologically possible nobody knows, and even if it is technologically possible, nobody knows what the cost would

be of that. However, getting everybody else on board is clearly important and Lord Stern has very recently produced a paper under the aegis of the London School of Economics, which I am sure that you have seen, about how to get a global agreement. What he says is that the developed countries have got to go ahead first; the developing countries would come in in 2020 and meanwhile the developed countries should commit to reducing their carbon dioxide emissions or carbon dioxide equivalent of emissions by between 80 and 90 per cent by 2050 over 1990 base line, which means at least 90 per cent compared with where we are now. Do you believe that that is realistic and if it could be achieved, how could it be achieved and at what cost?

**Dr Constable:** I am a lapsed academic and in my previous life I worked in Japan for a number of years, had many Chinese students and I have some feeling for the way the Chinese see the world; these were very able people. They taught me that the characters for China, a box with a stroke through it and another box with a king inside it, are often translated by western Sinologists like Joseph Rock, as “Middle Kingdom” which makes it sound rather Tolkeinesque and Hobbit and huggable. They told me that it means very literally “country at the centre”. They have a very strong sense of national destiny and it became very clear to me that the only argument that really would affect China was economic and it seems to me that is true for emissions reduction. I cannot imagine the Chinese Government or its people paying any attention to an emissions strategy which was not an economically compelling example. If they look this way and see that we have spent a great deal of money on emissions reduction, they will congratulate themselves and proceed on their own way regardless. So I would be very doubtful about the geopolitical likelihood of securing international agreement unless it were economically compelling and at the moment I would be pessimistic about finding a way to produce an economically compelling example. It would be very difficult; perhaps impossible.

**Mr Dunford:** I happen to have in my bag a statement from Vsevolod Gavrilov, the official in charge of Russia's Kyoto obligations. If I may, I quote "Energy must not be a barrier to our comfort, our emerging middle class demands lots of energy and it is our job to ensure comfortable supply. We do not plan to limit the use of fuel for our industries; we do not think this would be right". This is the official in charge of their Kyoto obligations. The Russians have no intention of doing anything that does not suit Russia. I would be surprised if the Chinese, who are quite bright, would imitate us if we were to do something which was not economically compelling. There is no reason for them so to do, they all have emerging middle classes, they all have coal, if we do not come up with technologies that make it attractive, they are going to burn that coal anyway. I am not a politician, God knows, but I really do not see how the UK, or indeed Europe, disadvantaging itself is somehow going to persuade other countries to change who are desperate to raise their living standards, which means energy. I really do not understand how that could be.

**Q133 Chairman:** May I bring us back from the Middle Kingdom to the United Kingdom just for a moment? We touched on heat and transport earlier on and you said that heat was something which could do with a good deal more emphasis than it has had so far. Are there other things that the Government should be doing to support renewables in the heat and transport sectors?

**Mr Dunford:** Certainly we believe that there has been a vast over-emphasis upon electricity generation in renewables which has not served the interests of other areas at all well. Heat is the obvious area to go for, not least because it is within our technical grasp to do something; it will save fuel and imports for the country, but it will also make a material difference to individual households which some of the stuff we have been talking about is rather remote from. We believe that measures to encourage the take-up of heat saving and heat generation measures within the household are fundamentally good. Again, we would argue for a very

simple system of capital support grants or taxation, not subsidies, not targets and, above all, if we may put in a plea, let us not focus on microgeneration of electricity; we believe that is a very false canard. Would you like to talk about this week's report on that matter?

**Dr Constable:** On Monday a large study into the uptake of microgeneration was published. REF was co-funder with BERR and the main regional development agencies on this. One of the conclusions of that study was, yes, you can drive in a lot of microgeneration, but the cost is very high and with rising fossil fuel prices you will get quite a lot of spontaneous uptake. There is a general principle here which we would extend to other parts of the industry where doing less is more and where the Government do less more will actually happen. Targets probably are not necessary to drive in microgeneration. Let people make up their own minds about it. We are very sceptical of the idea that such complex decisions can be made effectively by civil servants, politicians, however gifted; it means many brains working on a complex scheme as possible. Therefore doing something simple, like further reducing VAT on microgeneration technologies, might actually be very helpful. At the moment it is five per cent, but why not knock it down a few more points and take it off effectively altogether? Doing less may well mean more.

**Q134 Lord Moonie:** Proposed European emissions trading scheme, cost of carbon, how are they going to affect relative costs of renewables and other sources of energy? If we had a more efficient carbon trading scheme, would it remove the need for special support of renewable energy?

**Mr Dunford:** We would like to argue that yes, it would; we would like to believe that it would and it is certainly preferable in terms of market development than any form of artificial subsidy. Yes, we do think it would be preferable. You focus on the ends rather than the means; you let the market do things for itself so the market will choose the most effective route to reduced emissions. A tax could be fine tuned, it has that advantage as well and – this

probably does not go down terribly well - the tax could also be removed if no longer needed.

I am not sure that ever happens but it is possible. Yes, we prefer carbon trading to support.

**Dr Constable:** And we would note the peculiar incoherence in EU policy on this matter. On the one hand we have commitment to the EUETS, which is a least-cost mechanism and then on the other hand you have these extraordinarily ambitious renewables targets. If you believe that renewables are a very effective way of reducing emissions, then they would be incentivised by the ETS and they would be brought in by least-cost means. This conflict between these policies has been noted and it was revealed in leaked BERR documents last year but it is getting insufficient attention within the EU itself and more people ought to be paying attention to it. We would certainly back a carbon tax or the ETS over direct income support mechanisms. Of the two, I would prefer a carbon tax because it can be fine tuned very readily and you have certainty about the cost, if not about the emissions saving that is achieved.

**Chairman:** Well thank you again for your time, thank you for answering our questions and we look forward to seeing your written submissions. Thank you very much indeed.