HOUSE OF COMMONS

Energy and Climate Change Committee

Oral evidence: Low carbon innovation, HC 747

Wednesday 26 February 2014

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Written evidence from witnesses:

- Renewable UK
- SSE
- EEF, The manufacturers' organisation
- Will McDowall
- Mineral Products Association
- Friends of the Supergrid
- EDF
- UK Hydrogen & Fuel Cell Association

Watch the meeting

Members present: Sir Robert Smith (Chair); Mr Peter Lilley; Albert Owen; Christopher Pincher; Graham Stringer; Ian Lavery; Dr Philip Lee; Dr Alan Whitehead

Questions 45-134

Witnesses: **Dr Gordon Edge,** RenewableUK; **Dr Keith MacLean,** Policy and Research Director, SSE; **Susanne Baker,** Senior Climate & Environment Policy Adviser, EEF, the manufacturers' organisation; **Will McDowall,** UCL Institute for Sustainable Resources; **Dr Richard Leese,** Director, Energy and Climate Change, Mineral Products Association; **Joe Corbett,** Head of Technology, Mainstream Renewable Power. Friends of the Supergrid**; Filomena La Porta,** Head of R&D Smart Energy Supply, EDF; **Dennis Hayter,** Chair, UK Hydrogen & Fuel Cell Association, gave evidence.

Examination of Witnesses

Witnesses: **Dr Gordon Edge**, Director of Policy, RenewableUK, **Dr Keith MacLean**, Policy and Research Director, SSE, **Susanne Baker**, Senior Climate & Environment Policy Adviser, EEF, and **Will McDowall**, UCL Institute for Sustainable Resources, gave evidence.

Q45 Chair: Thank you very much for agreeing to come and give evidence in our inquiry into low carbon innovation policy. Before the meeting starts, I should remind the Committee of my entries in the Register of Members' Interest, in particular related to the oil and gas industry and a shareholding in Shell. Today, we have two panels of four each time. If you feel your question has already been answered by someone else on the panel, it will be quite acceptable to say that it has been dealt with. For the record, could you introduce yourself and the organisation you represent, starting on my left?

Susanne Baker: My name is Susanne Baker. I am a Senior Climate and Environment Policy Adviser at EEF, the manufacturers' organisation. We represent manufacturers from all sectors and our membership includes UK Steel.

Dr Edge: My name is Gordon Edge. I am Director of Policy at RenewableUK. We are the trade association for the wind, wave and tidal stream power sectors in the UK.

Dr MacLean: I am Keith MacLean. I am Policy and Research Director of SSE, and also Co-Chair of the Energy Research Partnership, which is a public-private sector organisation looking at innovation spend.

Will McDowall: I am Will McDowall. I am a research associate at the UCL Energy Institute and Institute of Sustainable Resources. I teach on energy innovation and energy innovation policy and have research interests in this area.

Q46 Chair: We could open with the fact that the Government has been working since 2010 to improve its support for low carbon innovation. Has it succeeded at all? Have there been improvements in its support for low carbon innovation? Do you have a positive or negative view?

Dr MacLean: I think that we have made good progress, and the setting up of the Low Carbon Innovation Co-ordination Group has certainly helped. Funding for innovation is a very complex area, with a lot of bodies involved, and introducing that has been very helpful. There has been a lot of progress since then. It is worth noting, as the National Audit Office do in their report, that the overall level of spend on energy innovation is still relatively low compared to comparable countries across the world. There is still some way to go, but I think we would certainly agree that there has been a much better integrated approach across the public sector. What we now need to ensure is optimal alignment between the public and the private sector.

Will McDowall: I was going to say something reasonably similar to the extent that LCICG has been a positive step. Yes, funding is still low comparable to competitors. One of the problems, though, with LCICG is that it was born out of a recognised need, just as some of the funders were realising that they were starting to duplicate each other, and it was created to overcome that, which is obviously very important. It was a kind of sticking plaster brought in to avoid that problem. While it has expanded now to meet the needs of co-ordinating some of the low carbon spending, it does not really co-ordinate low carbon innovation, the spending, with some of the demand pool measures, which I think would be very important. It still excludes, in terms of its core membership, some very important players like Ofgem. We have come a long way, but there is still quite a lot of work to do in terms of reforming LCICG and making it more fit for purpose.

Susanne Baker: I was going to make a similar point that the spending on energy and environment R&D, as a proportion of total Government spend, is among the lowest in OECD

countries. Even in absolute terms, we are being outpaced by competitors. As a relative proportion of the money that we have available for R&D, we are very much down the ranks. We also support the establishment of the Low Carbon Innovation Co-ordination Group, but we think there is a lot more that needs to be done. It still appears quite fragmented and overlapping from the outside. While there are clearly improvements in how the co-ordination of activities is occurring inside, that now needs to be made visible for businesses and manufacturers externally. The system would benefit from stronger signalling of what is happening, when and who is leading on what.

Dr Edge: I am in pretty violent agreement with everyone here. The Technology Innovation Needs Assessments have been pretty useful in highlighting what is required, but the issue is more about then communicating from within this closed group of innovation funders with the industry for whom this is being done.

Q47 Chair: Do you have any concrete examples of where the strategy has influenced any of your organisations or promoted an action?

Dr Edge: We try to do it the other way round to try to influence them to make sure they do the right things.

Dr MacLean: I think Gordon makes a good point about the Technology Innovation Needs Assessments. They have been very good. They do look across the different types of technologies, but they need to be much more open. There needs to be more opportunity for public engagement through consultation before they are finalised, and getting the industry input into these is absolutely essential. We would recommend using a body like, for instance, the Energy Research Partnership, which does bring together all of the public sector funding and the main industry players, to work together in the development of those joint priorities rather than just priorities across the public sector.

Q48 Chair: If there was no Government assistance and the market was left to regulate itself, what do you think would have been the likely outcome?

Will McDowall: There are several ways of answering this. First of all, if you look at the way that the private sector energy innovation funding globally largely works, it is currently very heavily focused on fossil fuels. Globally public sector funding is much more heavily focused on low carbon innovation and that is clearly because many parts of global business simply do not believe that, globally, we are going to get our act together and deal with the very significant global externality that is climate change. Left completely to its own devices without very credible carbon policy, we would not expect to see significant innovation in low carbon technologies and so public support for the innovation system is very important in enabling that to take place. Secondly, of course, if you do not have public support for innovation at all, you get much less innovation from the private sector than is socially optimal. There are spill-overs, market failures in terms of appropriability of knowledge. It is very clear you get much less innovation research and development activity than is desirable, particularly in the energy sector.

Dr Edge: We should also note the role of innovation policy as a tool of industrial policy. Without there being public spending in these areas, it is much less likely that you get UK companies coming forward with these technologies and building up supply chains within the UK. It is clear

that we need to have that pump priming that the innovation spending causes in order for us to have any chance of success in these new low carbon industries of the future.

Susanne Baker: I think another important role is accelerating progress because in certain areas there will be companies doing duplicate research. It is fragmented. There may not be co-ordination across the supply chain. We are very much supportive of the work that the Energy Technology Institute has been doing in trying to overcome some of those business barriers to delivering a co-ordinated response.

Q49 Albert Owen: I think I am detecting some mild criticism of the LCICG and in particular the way it engages with the wider community. Is that fair? What can it do to improve engagement?

Susanne Baker: Communication is absolutely key, and I will give you an example. The strategic framework has been published this month, and it was only by looking on their website in preparation for today that I discovered it. I had not seen a press release. We had not been notified that it had been published. There is an event planned in March, and we have not had an invite to that briefing event. There needs to be a change in communication. There needs to be a communication culture, press releases, more engagement with the press, newsletters. They need to really build on that. It has been neglected thus far.

Dr Edge: People do not even know that they exist. There is cognescenti—

Q50 Albert Owen: Whose fault is that? Is it the group itself or DECC and Government or both?

Dr MacLean: I think it is possibly a function of there are lot of different funding bodies who are involved in LCICG. If it was not as complicated, we probably would not need the co-ordinating group in the first instance. Some of the activities that result from the LCICG work will be publicised by the individual organisations themselves. The Research Councils will put out calls for what they are doing, DECC or BIS or TSB will put out calls for what they are doing, rather than necessarily there being a centralised communication machine that says this is everything that is coming out from it. There is probably some recognition that that needs to be done. I would not say it is necessarily criticism. It is just saying that this could make the work much better.

Q51 Albert Owen: The National Audit Office have criticised it on a couple of occasions. The criticism has been made by an independent body and Ms Baker was just saying now she stumbles across information. What I am asking you is, how can that be improved?

Dr MacLean: I think the suggestion for taking a more proactive approach from the central organisation, rather than from only the individual funding bodies themselves, is a very good suggestion.

Q52 Albert Owen: How useful do you find the website? You stumbled across it, and I am going to have a look at it when I leave here. Are the rest of you aware of the website and do you find it useful?

Will McDowall: It is perfectly okay in that it has the strategic framework, who is involved and the TINA documents. It does not have very much else. There are two problems for LCICG in this

context. Firstly, it has been under-resourced. I think there has been a tendency across science and technology policy over the last few years to be very careful about not reducing funding too much for science and technology spending, but the infrastructure through which we make decisions about what to prioritise, what to spend money on, has suffered quite a lot. If you want to go and talk to anyone in the Research Councils, you cannot because they are too busy and too stressed because they have had their budgets cut. There is a real problem there that under-resourcing the infrastructure through which we make research and development and innovation decisions is stressed.

Secondly, with LCICG, you have lots of different bodies without a clear view of who is there to crack heads together and say, "Okay, we really need to push this forward or we need to push that forward." We do not have anyone who is there to take responsibility for things like public profile and all of these sorts of things. It seems much more distributed. The experiences of people who have been involved with LCICG as consultants or in terms of offering advice have often found that it is quite fragmented and that is the nature of it as a co-ordination body without a clear lead.

Q53 Albert Owen: That is very useful. You have put that on the record here and certainly the reason for this Committee is to find out these things. Are you aware of any organisations that are lobbying for this to happen? Is there strong lobbying for additional resources and for better communications?

Will McDowall: From the perspective of LCICG, I am not aware of anybody saying that, apart from me because I think it is a good idea. But from the perspective of the Research Councils, for example, Professor Jim Skea, in his review of the energy research landscape, has said clearly that doing energy research strategy and properly organising that does not come cheap. You need to have the kind of infrastructure within the Research Councils to do the prioritisation, to understand what technology road maps are looking like, where the development opportunities are, where the skills are and where the skills gaps are. If you do not do that properly, you might still be ring-fencing your science spending, but you are not using it to best effect.

Q54 Albert Owen: What about industry? Is industry concerned about this enough to be lobbying for more resources as a group?

Susanne Baker: We have a public position that we should match or aim to meet OECD average spend as a proportion of total R&D spend on energy and environment. We recognise that can't be done immediately, so we have called for that to be made over successive spending rounds. Certainly, the strategic framework identifies that there is a clear gap between what the co-ordination group want to do and what is possible with the money they are expecting.

Dr Edge: The calls for more engagement from the Low Carbon Innovation Group require people to know that it exists. It is the point I made earlier. If you do not know it is there, how can you know to say them, "You need to do this and that."? The individual members, people like the Carbon Trust and the Offshore Renewable Energy Catapult, are quite well known. People do know to go to them, potentially, but they do not know that this co-ordination group is there and it should be this central focus. The awareness needs to start and then you can start saying, "We know that it is there. Therefore, we need it to do this and that." I think it would be helpful if it was not a closed shop of the funders but had more voices from within the industry and outside to make it more transparent.

Susanne Baker: What we see work with innovation elsewhere is stability, institutional stability and stability with the policy measures, and I think that is what is needed here. There has been a

lot of change over the last few years, lots of new bodies coming in. We have the co-ordination group now established. Their funding is only guaranteed in some pockets up until 2015. I do not think that is particularly helpful. It would be good for an extended visibility of their funding going forward. We need stability and visibility over what they are intending to do and when, for that to be communicated well.

Q55 Albert Owen: Could I move on to SSE? In your evidence that you submitted you were expressing concerns about the governance of the Energy Technology Institute as one of the founding members. Would you like to elaborate on that for the Committee? What are your concerns?

Dr MacLean: We are not a member of the ETI at all.

Q56 Albert Owen: They are a founding member of the LCICG.

Dr MacLean: Yes. The ETI is an unusual mix of private and public funding and there were six—I think it has gone down to five now—key industry members. The ETI has done a lot of very good work. The question that has arisen for many is that, with so much public funding going into it, how is it possible to access some of the intellectual property that has been developed in that, using the public money that at the moment others than the five or six key members do not have access to. The key point in there is making sure that, from all the public money that has gone into that, we get the appropriate information coming back out again.

Q57 Albert Owen: Thank you. You made the point. Do others have concerns about protecting IP?

Dr Edge: Clearly that point I made about this being a tool for industrial development. IP is central to that. If you do not have IP that can be exploited so everyone can get at it because it has been publicly funded, then that will not happen. There needs to be a delicate balance drawn between money that goes in from the public purse providing public goods and supporting, on the other hand, companies in developing their own intellectual property that they can then exploit as a private property. It is not clear where the balance is and needs to be.

Q58 Albert Owen: It needs greater clarity.

Will McDowall: From a very practical perspective from universities, it is not always very attractive to partner with and get involved in ETI projects simply because the complexities around the IP regime are off-putting for a lot of academics.

Albert Owen: That is very helpful. Thank you.

Q59 Dr Lee: A few questions following on from Albert. How many partners are in the co-ordination group? There were three originals—Government Departments. Do we know the total number of organisations that are covered by the group?

Will McDowall: Unfortunately, it slightly depends on where exactly you draw the lines between different organisations, because some of the organisations are funded by other organisations who are also members. It depends on whether you mean associates or core.

Q60 Dr Lee: A simple question then: are they all originally taxpayer-funded organisations?

Will McDowall: Yes, although the Energy Technology Institute is a core member and that is not solely taxpayer-funded.

Q61 Dr Lee: What proportion of their funding is taxpayer?

Will McDowall: Of ETI, it is 50%. Of LCICG overall, I suspect it is much larger than that.

Q62 Dr Lee: Has anybody made an assessment of the administrative costs of having so many groups putting money into a group from which we are supposed to be drawing support for innovation?

Will McDowall: LCICG itself is not a funder. LCICG is a co-ordination mechanism.

Q63 Dr Lee: No, but it begs the question why is there not one?

Will McDowall: One single energy innovation agency?

Q64 Dr Lee: I am just asking—Ms Baker talked about the OECD average—do we have an OECD average on administrative costs?

Will McDowall: I think that is a very good question. The argument has always been made that different bits of LCICG or different bits of innovation funding in any sector, not just energy—

Q65 Dr Lee: No one has made the assessment?

Will McDowall: I think that is probably true.

Q66 Dr Lee: Do you think that assessment should be made?

Will McDowall: It might be useful, but I do not think it would solve problems wholly because you still have—

Q67 Dr Lee: Forgive me, I have arrived here blind and I have already heard that no one has heard of the group—a group that is populated by a load of other groups that are all predominantly funded by the taxpayer. It does not sound like it is doing a particularly bang-on job. I think it is relevant that we have lots of groups under a group that no one has heard of to fund something in a way that does not seem to be being funded in the most appropriate manner. It sounds to me like there are quite a lot of people employed doing things that they do not need to be doing.

Will McDowall: I am going to respectfully disagree because the funders are doing things that they need to be doing. If you started cutting back on the Research Council energy programme—

Q68 Dr Lee: I am not suggesting cutting back on the funding. I am suggesting cutting back on the way in which it is administered.

Will McDowall: Yes, which is the question about co-ordination, and that is really whether or not the mechanism for co-ordination is delivering best value.

Q69 Dr Lee: Sure, in which case, if we were to cut back on that, do we get closer to the OECD average that you seem so desperate to reach?

Susanne Baker: No, probably not.

Q70 Dr Lee: Is there a pound-for-pound return? It is all very well that everybody keeps raising the bar on the OECD average. Are those countries that are spending above the OECD average demonstrably getting better return for their money on energy innovation?

Will McDowall: Yes.

Q71 Dr Lee: Is there is strong evidence for that?

Will McDowall: Yes, very good evidence from patents, very good evidence from development of firms and sharing of new technologies and so on.

Q72 Dr Lee: That leads me neatly on to the final additional question, which is on intellectual property. We are talking 80% to 90% public money. Does the state own these patents, intellectual property?

Will McDowall: I think the answer to that is largely no.

Q73 Dr Lee: In which case, we could be funding companies that could be privately owned or could be foreign-owned with British taxpayers' money and the intellectual property then goes away, and for any of the innovations that we create, the manufacturing thereof can be internationalised. Is that what you are saying?

Will McDowall: Yes.

Q74 Dr Lee: In which case, it begs the question, what on earth are we doing spending British taxpayers' money on it? If we cannot guarantee that we will retain the patents and hence the

manufacture, because we are all bandying around industrial policy terms, what on earth are we doing?

Will McDowall: The argument is that if we retain ownership of the patents as the state and become a state innovation agency that retains all of the intellectual property then you get all sorts of problems because the state is not necessarily the best place to own all of that intellectual property.

Q75 Dr Lee: I am not suggesting that it is; I am saying that we are paying for it though.

Will McDowall: Yes, absolutely. The argument is that the benefits to the nation and not necessarily solely to the state, the benefits to private enterprise and so on are—

Q76 Dr Lee: But if that private enterprise goes offshore—we have seen wind farms, as one technology that we invented and the Danes profiteered from. We have a good track record of development in this country across all sectors and not then commercialising that intellectual property. We are pretty dreadful at it.

Will McDowall: This is part of the very basic difficulty with innovation policy, never mind energy innovation policy. Innovation policy across the board is that there are spill-overs. Once you have an idea, it is pretty easy to copy it, and so if you funded it, it is very difficult to appropriate that. The question is, do we fund any innovation in this country, which I think is basically what you are implying? If we are going to fund science, innovation, technology development in the UK, which we know from a whole range of empirical studies is necessary to have a vibrant business sector, then we need to suffer the fact that some of that innovation, the benefits of that innovation will drift overseas. I think that is inevitable.

Dr MacLean: And vice versa.

Will McDowall: And vice versa.

Dr MacLean: Can I add that there is not one answer to this? If you look at Ofgem, for instance, it is at the other extreme. Ofgem provides almost 100% funding—it is 90%-plus—so that means that the people who are getting that funding have very little skin in the game. At the end of that, though, everything that comes out of those projects is in the public domain. It does not belong to any of the organisations, but they have no real incentive to do anything other than put forward a project that will fit the funding criteria rather than to do a project that they think is of value and that they are ultimately going to get some value from. Most of the good practice in funding would suggest that you have a far lower level of public funding to ensure that you have matched funding from industry that is achieving something, but in order to do that there has to be an incentive for industry to do it. If you look at oil and gas, there is far more will be done in commercial development work in oil and gas because the returns that you can get from doing that are much higher than they are, for instance, in a regulated monopoly wires business. That is why in some areas like the wires business you have far more intervention.

I think there is an answer somewhere in the middle and you could take the debate as, is Android right in going open source, or is Apple right in doing everything with protection? Will mentioned earlier on that IP models can get in the way and stop things happening because there is so much

wrangling about who it is going to belong to. That is in nobody's interests either. The pragmatic approach is that in overall average terms, if you have some going out and some coming in, that is okay, but you are right that we have some fairly notable examples where we have seen more outflux than influx.

Dr Edge: I will back that up by saying that while the Low Carbon Innovation Co-ordination Group is primarily public funding, it is funding work that is collaboratively funded. I am thinking of things like the Offshore Wind Accelerator that the Carbon Trust has, a lot of the work that will come out of the Offshore Renewable Energy Catapult, a lot of the DECC funding, which is grants to help develop, alongside individual companies, the goods and services and components that are coming forward. We need to be clear that it is not just public money paying for intellectual advances. It is public money helping other people make intellectual advances and therefore you have to negotiate where the intellectual property sits.

Susanne Baker: I was going to make the point that the work of the co-ordination group and the TINAs has shown that there are significant benefits for the UK by pursuing innovations in these areas. Huge reductions in energy supply costs are potentially in the offing and there is a huge potential for GDP between now and 2050. The estimates are between £39 billion to £126 billion to UK GDP between now and 2050. But you are quite right about the commercialisation being very poor in the UK. This is why we think that there needs to be institutional stability and a forward look on the funding going forward because that allows you to plan for bringing forward technologies across the whole innovation pathway in a way that you might not be able to do if you have only a three-year window.

Q77 Dr Lee: My point was that if we are going to invest to try to innovate—and there are arguments in all sectors of science, medicine, whatever, where public money has delivered innovation, of course there are—we will not get the GDP quota you are talking about unless we own that property and are able to commercialise it.
I suppose this neatly moves into my questions that I am supposed to have gone straight to on breaking international markets. Sorry, Chair. How effective do you think the co-ordination group and Government have been in helping UK industry find international partners and access international markets with their products, their innovations?

Susanne Baker: This is not something we have specifically explored with our members, but British business are among the best in Europe to collaborate internationally and we would very much advocate that. The co-ordination group really builds on this. We would like to see much stronger links internationally and not just in terms of export markets, but also collaboration with R&D. There has been a lot of talk thus far about energy R&D, but we think there is also a lot of industrial low carbon innovation that needs to occur. It may be that the UK does not have the scale of activity to warrant investment on a UK basis, but we need to leverage funding on an international basis to explore and break down barriers to low carbon innovation for energy-intensive sectors—for example, in the manufacturing sector. There is a role not only for exploring export markets, but also for ensuring that international collaboration occurs and is with the right people.

Dr MacLean: We need to be very clear about what it is that we are trying to achieve, and if I give an example that we have seen in the past, it might help clarify that. Back in about 2006, we were looking at CCS and decided that the main focus of our CCS policy and support funding would be for coal and that that was to support potential exports to China and India, whereas if you were looking at it in terms of what makes most sense from a UK energy policy, or even an EU-wide

energy policy, you would have done it on gas. In terms of prioritising the innovation funding and the international picture, we need to understand are we doing this in order to create an opportunity for our industry to export, or are we doing something because it makes sense for energy policy.

If you look at where we are at the moment, perhaps with offshore wind, if we have a pure focus only on doing something for the UK, we may not reach the critical mass we need in order to get the cost reductions and the other innovations that will be needed to bring the costs down. It may be far more sensible if we look at a collaborative approach across northwest Europe in order to do that and make sure that we do have the critical mass. We need to be absolutely clear why it is that we are supporting this, why it is that we are putting the money into this. Is it energy policy? Is it industrial policy? As you see with the example in CCS, it can bring you to completely different answers, depending on which one you choose.

Q78 Dr Lee: There is evidence that academia has benefited internationally more than industry from Government support for low carbon innovation. What has been your experience of this, and if that has occurred, what should be done to address the balance?

Susanne Baker: Can I pick this one up? I will go back to the point about stronger signalling. I think at the moment the system with quite short timescales for businesses to respond to is not meeting the needs of manufacturers. We need to make sure the system works for business and that means, as I have already touched on, improved communications, signposting of opportunities, but also the paperwork needs to be much easier. Low carbon innovation is not easy. It is not risky, but a lot of companies do not understand the process and are deterred by the paperwork. We need to make it easy for people to engage in the process, particularly SMEs.

The other point I would make is that, with the short timescales, you have a lot of research centres and academics who are poised to make applications for funding to carry out research but the same is not true within business. They are not sitting there waiting for opportunities to get funding and they would need to clear decisions with the board. That takes time. They need to fit it in with their investment cycles and decision-making processes, and inevitably that is a longer process and takes a longer time to respond to. This is why we think it is important that there is some forward sight about what is happening so that business can gear themselves up to be ready to respond when the opportunity is available to do so.

Will McDowall: What you are really highlighting is a potential weakness of the UK innovation system as whole, in that we are widely recognised for having a world-class science base, but we are not always as good at translating that into commercialisation. Ironically, people have said it for a very long time, but it was not as true as it is now and it has become more true. If you look at the energy R&D budget and portfolio, I think around half of it goes through the Research Council UK energy programme. Almost all of that goes to academics, so the funding is weighted towards academics. There are potentially good reasons for that in the sense that that is where only Government can operate, typically, and industry comes in as a larger share of funding as you move up the innovation chain. There are questions to be asked about the way that support has been structured, the balance across different elements and the way that some of the wider innovation system supports can be given to enable that commercialisation to take place.

Q79 Dr Lee: Finally, the Government is developing a network of catapult centres to support small UK businesses collaborate internationally. There is one such centre in Glasgow to develop offshore renewable energy. How, if at all, have you engaged with the catapult centres?

Dr Edge: The Offshore Renewable Energy Catapult has been extremely active in getting out to the industry, not least because our chairman of RenewableUK was recruited to become the chief executive, so we have had very good engagement with that catapult. We are hopeful that the proactive leadership that we have seen there will mean that it gets out in front of the sector, and indeed into the wider business, very actively. We are quite encouraged by that catapult.

Dr MacLean: The principle behind it is very good, and I think Gordon is right that they have made a lot of effort to get out there. It is also fair to make another general point that energy policy must support and be going in the same direction as innovation policy. In offshore wind at the moment, we have a major problem in that pretty much everything that is happening on the policy front, particularly now with a number of the state aid issues that have arisen, is meaning that it is very unattractive to invest in offshore wind development. It has suddenly flipped over in the last year from being an area that everybody was pushing forward with great vigour to an area—and you have probably heard a number of announcements from London Array, Atlantic Array and so on—of people pulling back because the policy now is not supportive of the level of innovation spend that was previously the case.

Q80 Dr Whitehead: Could we turn to Technology Innovation Needs Assessments and how that influences the spend on various priorities as far as the departmental research budgets and innovation budgets are concerned? Do you think 11 priority areas are too many?

Will McDowall: In a sense, they are not enough. There are some very important omissions from the TINA assessment. I think what is not at all clear is how those 11 were selected and why exactly those 11 were selected. The TINA process has been a process of identifying technology innovation needs in core areas, which is great. The core areas though, how they were chosen and the kind of process that was used to identify the areas in which we needed to know more about the innovation needs, have not been made nearly clear enough. I see from the strategic framework document that prioritisation and the method for collectively prioritising technology areas for analysis is something that LCICG is planning to do in the future. It is a shame it was not done more clearly, publicly and coherently in the past.

Dr MacLean: It is slightly circular—isn't it?—because the TINAs are there to assess a need and if that assessment shows there is not a need then nothing will happen. They have an interesting structure in that they are designed to be able to compare needs and benefits across very diverse approaches. Overall, they are a very worthwhile addition to the process of informing where the funding should go. I do not think the number of them is necessarily an issue, but overall your point is very fair. Once we have that information, we need to be clear what the priorities are, and almost by definition, you can only have a limited number of those.

Dr Edge: I would point to the equivalent European process, which is the Strategic Energy Technology Plan: consequently, for instance, the wind technology platform that was an industry-public collaboration trying to identify what the research needs were and consequently the European industrial initiatives. We have not seen the industry participation in the LCICG and we have not seen the clear driver from the industry for what the innovation needs are. While they may not end up being massively different from what the TINAs were, at least you would have the buy-in from industry to make these things happen. While I think TINAs are very good, your point about how you prioritise between them has not been made and we need to go back, for instance, to the early Carbon Trust work that clearly set out a framework for which technologies and

sectors we should be aiming to support. We think that approach needs to be revisited and looked at in terms of which of those TINAs are the ones we focus on.

Q81 Dr Whitehead: What I got from some of those answers is that to some extent they are self-predicting, that where there is seen to be a need, which is perhaps evidenced by the fact that it is there already, that focuses the priority, whereas when there is not perceived to be a need, by perhaps rather subjective means, that focuses a non-priority. Would that be a fair description?

Dr MacLean: I think so. The one point I would add to the process—and we touched on it earlier—is Ofgem and the networks side of things. Ofgem is not a funder, but the amount of money that it allows network companies to invest now makes that the second largest area of innovation investment in energy behind the Research Councils. Ofgem, as the independent regulator, is only an observer in the LCICG despite being the second largest participant. Being independent does not naturally form the partnerships and join up the work across the different areas in the way that the TINAs are trying to do. Understanding, for instance, the needs within infrastructure and regulated monopolies and how those should feature in there and how those should be integrated probably has not yet come to the fore, and we have not yet found a way of getting Ofgem to participate. Perhaps we need to think of Ofgem as having oversight over that spend but having some other organisation that is able to engage, be a partner and participate to look at how it is spent after that higher level decision about how much is made by the regulator.

Susanne Baker: I was going to agree with you that there is a visibility issue here. I agree with members of the panel that we would benefit from a more outward consideration of what needs to be prioritised. The fact there has been no public consultation on which areas should be looked at, using what criteria, is a concern.

Going back to the visibility point, for industrial innovation needs, to move sectors like manufacturing to a low carbon basis has been pretty much neglected and quite overlooked in the Carbon Plan. There has been a natural bias to look at energy supply, which is probably quite right but there is a huge gap in how we are going to move manufacturing to a low carbon future, particularly energy-intensives that emit carbon dioxide as part of their processes. We have high hopes that the road maps that are being developed with DECC, academics and industry at the moment, looking at eight energy-intensive sectors, will help to identify what the innovation needs are between now and 2050. What is important for those sectors is that they also have only one or two investment cycles between now and 2050. It is absolutely vital that the technology is available and in a position to be used commercially at the point at which those investment decisions are being made. Hopefully, these road maps will start to identify what those innovation needs are for those sectors and we would like to see that being reflected in future TINAs. There needs to be a constant refinement and revisiting of what needs to occur.

Dr Edge: One of the problems you have with the prioritisation among the technologies is this black hole in the centre of our energy policy. We do not know which of these technologies we are going to be using most. Post-2020, DECC's forecasts are all over the place. Offshore wind, we could be doing nothing in the 2020s, or we could be doing 30 GW, if you look at the scenarios they put out. How is anyone meant to prioritise the funding for the innovation if we do not know we are going to be doing any of it or a lot of it? That makes a real problem for the funders if they say we could put a lot of money into third generation solar, but we end up not doing it, for instance.

Q82 Dr Whitehead: But in practice, though, is there not a sufficient flexibility to reallocate that funding into different slices as new evidence becomes available? Are you saying that some of the potential new evidence available does not even get to the starting line?

Dr Edge: There is a lag effect. You have to wind people up to do this research, to put it out there, to demonstrate. This takes years. We can't just do that on the basis that we might change our mind. We have to have much more clarity about what the long-term objectives are in our energy policy more widely in order for people to invest against those in the long term with large amounts of money to bring forward the large-scale generation technology we are talking about. Unless we have that guiding light, how can we make these investments? It does not make a lot of sense to me, unless we start thinking about it.

Q83 Dr Whitehead: Is there not a backward-working effect? We heard that the funding tended to get skewed towards energy efficiency where there appears to be greater investor certainty and greater landscape certainty and away from, for example, renewables where there appears to be a patch of rougher water ahead. Is that not a natural process of how that investment will go, or should there be positive interventions to prevent that happening and how might that work?

Dr Edge: You do not achieve your long-term ambitions in that case. If you have a lack of clarity about which technologies you want to go down, you are not going to be spending the money on bringing the cost of those technologies down and making them more effective and, therefore, you destroy that option for yourself going forward. It is a downward spiral when you want a virtuous circle going up.

Dr MacLean: It is important to remember that you are not just talking about how you allocate the public funding in this. You are looking to leverage funding from private investors so if, as you say, you embark on one route and then find we will move over on to another one, that money has been wasted and your board next time will think twice about signing off an innovation. Uncertainty is a very bad thing for innovation investment because it is probably the first thing we will stop doing and probably the last thing we will restart doing when there are any question marks around it. That is probably where we are at the moment.

Q84 Mr Lilley: The answers so far to my colleagues' questions paint a very disturbing picture. The characteristic weakness of British research and development effort seems to me to have been focused on inputs—how much money we are spending and whether we are spending the same amount as other people—and bureaucratic structures, not outputs. Is that also the case in this sphere? Has anyone defined what sort of output they are hoping to produce? Is it a better industrial strategy, or is it an altruistic improvement in the knowledge base of the world? Perhaps you can answer that.

Will McDowall: I think this discussion has largely been about inputs and structures because, as I understand it, we have been talking about LCICG, which is a structure for delivering inputs. LCICG went through a process about a year ago in which they tried to develop a set of metrics through which they could assess value for money across all the different areas of spending in terms of things like patents, energy cost reductions achieved and so on. It was very much an output-focused set of indicators. There has certainly been work under way to do exactly as you suggest,

to focus on output metrics in order to be able to better target and understand value for money of the inputs, the spending.

Q85 Mr Lilley: That is a helpful answer, but those outputs, as you have described them, are not ultimate outputs, are they? Is the ultimate output British companies producing things, exporting them to the world, creating value added in this country that otherwise would not be there, or is it increasing the knowledge base of the world, so that we have more effective ways of using electricity or generating electricity that are available to the Chinese, the Germans and everybody else?

Dr Edge: I do not think we have made it clear which of those or what the balance is between those. Certainly, when it comes to offshore wind, the focus is very much on cost reduction. This is flowing on from our Offshore Wind Cost Reduction Task Force, and now the work of the Offshore Wind Programme Board, and that has been driving the stated innovation needs for offshore wind. It is about cost reduction.

I think it would be beneficial if there was more focus on driving that into the industrial base in the UK. We have some indications of that. We are working alongside the Manufacturing Advisory Service on a programme called GROW: OffshoreWind, funded by the Regional Growth Fund, that is going out to small and medium-sized enterprises, looking to help them develop goods and services for offshore wind to try to take advantage of that, partly through innovation. There is money there for them to develop new products and innovate. We could do more of that and there is some of that out there, but we have not been clear as to what the balance is from our innovation funding in this area.

Susanne Baker: I was going to mention that, in the strategic framework, it says that the common criteria for programme and project selection were looking at three core areas. One was the impact on energy policy objectives; the second was economic growth objectives; and the third was the impact on knowledge, skills and capabilities. That sounds about right, although I would argue that the impact on energy policy objectives might be broadened out towards low carbon policy objectives, part of which would be energy.

Q86 Mr Lilley: That covers everything, does it not? Our priority should be to do everything. That is not a priority. I would have thought the EEF would be in favour of the second objective.

Susanne Baker: Absolutely, yes, but the skills, capability and knowledge is also an important facet. We need to have the right—

Mr Lilley: As part of it.

Susanne Baker: Yes, exactly.

Q87 Mr Lilley: But certainly when I was Secretary of State for Trade and Industry, you complained all the time that we did not have an industrial strategy. Here we have a fund of money that could be used for an industrial strategy and instead half of it is being used on academics and most of it on improving the knowledge base of the world. Is there a single example so far of an industry we have developed or strengthened in this country as a result of public money that is now exporting to the world in low carbon energy?

Dr Edge: The sectors are not in major exporting mode, but certainly it is in—

Q88 Mr Lilley: Is anyone buying them at all?

Dr Edge: To a small extent. We are still in primarily the technology development mode, but there is a great promise for that as we are the leading industrial power, in as far as it is an industry, and there is plenty of opportunity when those technologies are fully commercial in the market that people will be buying them.

Susanne Baker: Overall, the UK is sixth in the 3.4 trillion international low carbon goods and environmental services markets. Manufacturing accounts for the largest proportion of activity of that sector, accounting for about 20% of activity. While there was a small contraction during 2010-11—

Q89 Mr Lilley: Are these annual figures?

Susanne Baker: These are annual figures.

Q90 Mr Lilley: So there is £600 million manufacturing a year.

Susanne Baker: There are around 190,000 people employed in that sector within manufacturing. The last available figures were for 2011-12 and the output was £26 billion. That was up from £25 billion the year before, so there is growth in the markets. There was about 3.8% growth from the year before. The Government had predicted 4.6% growth over the five years it was looking at, so there is growth. That is an industry that is in surplus, so we are exporting more than we are importing.

Q91 Mr Lilley: What sort of things do we export?

Susanne Baker: It is from a whole range of different sectors. I can get you some more briefing to break it further down, if that is okay.

Chair Yes, if you could send us some breakdown of that, that would be very helpful.

Susanne Baker: I would be very happy to.

Q92 Mr Lilley: Is there any indication of whether any of that has depended on this research effort?

Susanne Baker: I do not think you can tell that from the figures, but you can certainly—

Mr Lilley: Purely qualitative.

Susanne Baker: Yes.

Mr Lilley: I have lots of other rather boring questions, but if the Committee wants them asked we could ask for written answers.

Q93 Ian Lavery: Do you have confidence in the ongoing Government support for the low carbon innovation beyond 2015?

Will McDowall: Do you mean confidence in low carbon innovation strategy or in low carbon innovation funding? I am not quite clear.

Ian Lavery: I will ask the question again, because it is quite simple. It is asking whether you have confidence in the ongoing Government support for low carbon innovation beyond the next election in 2015, ongoing Government support?

Will McDowall: I think there will be ongoing Government support.

Q94 Ian Lavery: Do you have confidence in the ongoing Government support?

***Will McDowall*:** Broadly, yes.

Dr Edge: The question becomes at what level, and then you are into larger scale questions about Government finances overall and how much is being devoted from the limited funds that we would expect in the next Parliament across the governmental board that would be focused in this direction. That is a question we have not had answered and I suspect will not have answered for some time to come.

Q95 Ian Lavery: I think you are right. Probably there should be an answer that would say yes. I think you are right, Dr Edge, it is what level of support you would expect to receive in 2015. Are there any specific signals you would like to see from the Government in support of low carbon innovation beyond that date?

Susanne Baker: From our perspective, we would like to see a commitment to keep the institutional structure stable, to continue to fund those and give a longer-term window on what the funding intentions are likely to be. Alongside the point already discussed around prioritisation of needs, we think we have to be selective if we are going to have the budgets that we are expecting to have to work with. While we are scared of picking winners, selectivity would also give us a greater chance of focus on commercialisation and help to enable us to compete internationally.

Dr MacLean: I think the longer the term and the greater visibility there is about the individual funding programmes the better. We have just employed somebody to come in and work with us on the Horizon 2020 programme from the European Commission. That is a programme that is set out with a very clear set of criteria and everything else right through to 2020. We do not know exactly what it is that we will be working on, but we have the confidence that because there is a programme there it is worth while employing somebody to then help us put forward the responses to the calls that will come from that and influence them. Energy is particularly long term by its nature and therefore the longer term these programmes are and Government commitments are to it the better, because it allows industry to invest in the human resource as well as in the innovation work itself in order to support that. I do not think there is anything specific around that.

There is one other area, though, it would be useful to see a greater commitment to across parties and that is to support demonstration programmes. A lot of what we have talked about today has been the research and development end of things and in general the UK is recognised as being quite good at that. But in order to be able to get the best out of the technologies, we need to be demonstrating and then finally deploying them and that is something we find very difficult. We were delighted this week that we finally got the confirmation of support for the engineering work to be done at Peterhead for the first gas CCS project, but we remember that we were in a similar position in 2006 and it has taken us eight years to get to that point. It is not the money to do it; it is the money to do the engineering study in front of that.

I feel sometimes we put in place competitive processes rather than collaborative processes around demonstration. Collaboration is an important theme right across the piece, between the public and the private sector and within the private sector, in order to get more out of the demonstration stage. That is the sort of thing that hopefully is going to drive future jobs and future economic benefit for the UK.

Dr Edge: The biggest thing you can do to build confidence in the sector about innovation is, coming back to my point about the wider energy policy goals, if you know that is where you are going, you will feel confident that Government will support that in due course with the innovation funding that it needs. Unless you have that clarity first, you are going to be more uncertain that the innovation funding is going to be there for you.

Q96 Ian Lavery: Do you think the Government should step back and let the private sector lead fully on low carbon developments?

Dr MacLean: It goes back to that balancing point I mentioned earlier on. If you want all of the risks to be taken in the private sector then you have to accept a level of return that perhaps in the energy world is not politically acceptable and probably not optimal either. I think sharing the risk in the way that a lot of the programmes are designed is the best way to go. Therefore, we need to find better ways of ensuring that that money is being spent on the right things, and making sure everybody has enough skin in the game I think is a key driver for that.

Q97 Ian Lavery: The Government's new strategic framework for low carbon innovation was launched on 13 February. What are your views on that?

Will McDowall: Are you referring to the LCICG?

Ian Lavery: Yes.

Will McDowall: I think it is helpful. It is a shame it has only just been published in its final form. All but one of the TINA documents have been produced over the last couple of years and this is the first time we have seen publicly the strategic framework within which they sit. I think that is unfortunate. It does fill in some of the questions that were outstanding about how the whole process is intended to work, but I think it still leaves lots of questions unanswered, and it is a shame it has come at the end of the whole TINA process rather than right upfront.

Q98 Ian Lavery: Given the challenges of meeting low carbon targets, such as the Climate Change Act that requires the UK to reduce its emissions by at least 8% by 2050, do you think the right long-term incentives and signals are in place to encourage radical transformative innovations?

Will McDowall: I am not sure they are sufficiently. I think part of the problem is that LCICG is trying to meet what was a clear need to do a bit of co-ordination between the various innovation funding agencies that were all developed with slightly different purposes to fund different bits of the innovation chain. I think the thing that is lacking is co-ordination with longer-term policy aspirations and in particular present day policy instruments designed to bring forward particular forms of technology and to create market enablers.

Whether those are technology neutral policies such as emissions pricing policies or are technology-specific things like renewables obligations, I think it is a real pity that there seems to be much less emphasis on co-ordinating innovation with those longer-term policy goals through those kinds of things. One might expect, for example, to have the Green Investment Bank sitting alongside or involved in some of the co-ordination activities for low carbon innovation, and yet they are not there. What we do not have is a clear sense of how the innovation system is being structured in order to deliver those radical innovations.

Dr Edge: I would also say that we have that long-term target, but we do not have a real sense of the pathway that we are going to travel to get there. Unless you have a better sense of that, how do you make that investment in the innovation to meet it?

Susanne Baker: I think this is why we are so hopeful about the road maps that we are developing at the moment with DECC on the energy-intensive sectors. For the first time, we are literally going to be plotting that path to 2050 and exploring and unpicking exactly what needs to be done in order to get there. That can focus innovation efforts and give the forward view that companies desperately need.

Chair: Thank you very much. It was very helpful and the Minister will be appearing before us soon to take on those challenges in due course.

Examination of Witnesses

Witnesses: **Dr Richard Leese**, Director, Energy and Climate Change, Mineral Products Association, **Joe Corbett**, Head of Technology, Mainstream Renewable Power, Friends of the Supergrid, **Filomena La Porta**, Head of R&D Smart Energy Supply, EDF, and **Dennis Hayter**, Chair, UK Hydrogen & Fuel Cell Association, gave evidence.

Q99 Chair: Thank you very much for agreeing to give evidence. You will have seen the line of questioning earlier so again, if it has been said already, you can point to it and paraphrase and say, "I agree with what was said." That would be helpful. If we can start on the left with name and organisation.

Filomena La Porta: Good morning. I am Filomena La Porta from EDF Energy, Head of R&D Smart Energy Supply. I have 10 years experience in energy innovation, academia, public sector and industry. I moved from TSB to EDF Energy because of the opportunity of setting up R&D in the UK.

Dr Leese: I am Richard Leese, Director of Energy and Climate Change at the Mineral Products Association. We are the trade association for the aggregates, asphalt, concrete, lime, mortar and silica sand industries.

Joe Corbett: Good morning. I am Joe Corbett, the Head of Technology at Mainstream Renewable Power. We are primarily a developer of wind at scale and solar PV. We have some offshore projects in the UK waters, in the North Sea and off the coast of Scotland. I am also representing the Friends of the Supergrid.

Dennis Hayter: Good morning. Dennis Hayter from the UK Hydrogen and Fuel Cell Association, an association that represents the variety of companies in the sector, from relatively small start-ups with just a few personnel and a good idea through to multinational corporations involved in industrial gases with thousands of employees and turnover of multi-billions.

Q100 Chair: I will start again with the same opening question. Has the Government achieved anything in improving support for low carbon innovation?

Filomena La Porta: I think that the Government has gone a long way since 2004, and I would go back to 2004 when everything changed about the innovation in energy in the UK. That is when the Government started. I think that we are up to a point now where there is a very buoyant environment. There are a lot of actors, a lot of players, a lot of debate. People are involved at all levels. We can see energy innovation in the news. It is an exciting place to be, and that is why we have set up the R&D centre in the UK.

I think that what needs to be built on is perhaps a bit more visibility of the Low Carbon Innovation Co-ordination Group. How can we be visible as a team rather than an individual member organisation, for example? How to step up, how to move from just co-ordination and just providing an environment to setting what I would define as an ecosystem, because for innovation you need everything. You need markets, the people that are doing the innovation, regulation, knowledge, and it is not just about an environment. You need also to work together.

Dr Leese: I think the Government has shown a tremendous enthusiasm for taxation and placing costs on industry to try to drive low carbon innovation that way. What we have not seen is that enthusiasm matched by low carbon innovation funding. If I take the cement sector as an example, in 2013 we are looking at about £50 million in costs through energy taxation and carbon taxation and that could rise to around £250 million in 2020. What we do not see is how that is hypothecated, how that is filtering down to the manufacturers on the ground. What we see is an emphasis on the research establishments that are well set up for looking after the academic sector. What we do not see is operators and industrialists carrying out low carbon innovation because the funding is not directed towards them.

Joe Corbett: I would like to draw attention to an example called the Offshore Wind Accelerator, which to me has been what I would regard as a success in this field. The reason I feel it is successful is because it is a collaboration between Government and industry, or at least the people who are developing offshore wind generation facilities. It is joint-funded and there is a clear vision. There are eight developers—there is the Carbon Trust—and it has a clear vision of where it wants to go, a clear objective to deliver, to reduce the cost of offshore wind. The industry helps to shape the agenda, and I think that is very important.

One of the things we heard in the previous panel was an issue around communication and how, for example, the co-ordination group is communicating or not, as the case may be, with industry and with the population in general in order to achieve specific objectives. I think that collaboration, clear objectives and setting the agenda in the correct way is important.

Q101 Chair: At the risk of cutting across questions that are still to come, on that offshore wind, is there follow through with the electricity signals in the electricity market reform to build on that innovation, or has there been a stalling?

Joe Corbett: One example I know of is where a competition was held to look at innovative foundations—for example, reducing the costs of foundations. My own company has trialled one of these in the North Sea on a met mast and that is a good example of the collaboration, going from an innovative design into a demonstration project.

Dennis Hayter: I will pick up and say from the perspective of the UK Hydrogen and Fuel Cell Association, the context, the low carbon sector, the innovation support is nice to have, but it is not structured to facilitate the introduction of relatively new technologies. This is particularly for diverse technologies such as hydrogen and fuel cells where its applicability goes right the way through from personal power products to stationary power, combined heat and power at the domestic scale, hydrogen generation, energy storage and fuel cell electric vehicles and hydrogen refuelling station infrastructure for the delivery of those vehicles into operation on UK roads.

That is very difficult. It is therefore very complex to be able to map and manage how that is achieved. By and large, the companies that have been involved in this sector in the UK have undertaken the investment as industrial investment, looking at the commercial opportunities for the introduction of their technologies over the past decade or so and making fairly significant contributions. Certainly, in the last few years, for example, I would estimate that the members of the association have spent about £400 million of their own money or their investors' money growing jobs and building capability in the supply chain themselves to move their technologies forward, to continue to innovate and move them forward. There are plenty of examples of how they have done that in those different technology areas that are nested across our sector.

Q102 Chair: If there was no Government support and it was left to the market, would it be delivering?

Dennis Hayter: There would still be delivery. It would not be as fast because the part of the support mechanism and the recognition that is given is important to get investor funding to come into it. I can give a good example where ITM Power, a company that is involved in electrolysis—so hydrogen generation from renewable energy sources for different uses of hydrogen—have been readily able to raise money from the City because they are able to show to investors that there is a pathway for the deployment of hydrogen as a transport fuel and that investors are looking at new renewable fuel sources and new energy sources in transportation as well.

Filomena La Porta: I would agree to a point. I think that if left completely to the private sector there would not only be slow but also limited innovation happening or innovation that perhaps is less risky, the innovation that already has the supply chain in place, because the added value of the common funding is putting together collaboration that otherwise would not happen. In an industry like ours, for example, we don't make the technology, the innovation; we use it. So there

is a need for a supply chain in place. We need the innovators that invent it, the innovators that make it and the innovators that sell it, that maintain it. There is a complete supply chain that needs to be in place, and that will not happen without the full set of funding, in terms of collaboration.

Joe Corbett: I think the Government's role is to take a long-term view of what the industry in particular is going to look like and in the power sector—for example, what the power system might look like in 2050. I think there is a general consensus that the power system in 2050 is going to look completely different to what it does today. In setting that long-term view then work with industry to develop the so-called road map to deliver that, and part of that then is going to require not just research, pure research that will occur perhaps in academic organisations, but also innovation in putting different technologies together from different industries. We see that as a big opportunity for innovation and for creating not just jobs but also GDP enhancements.

Q103 Albert Owen: You will have heard the previous panel, as Mr Corbett said, with regards to the co-ordination group. Do you think it is doing its job? Do you think it is improving and doing its job and engaging with industry and stakeholders?

Joe Corbett: To be quite frank, I didn't know about it until two weeks ago. I had heard there was some co-ordination going on and I started looking at the website about two weeks ago. Earlier, I said that the Offshore Wind Accelerator was to me a very good example of industry and Government co-ordinating together. On the downside, you would say that in the UK there are probably too many organisations trying to deliver similar results and a co-ordination group is certainly going to be very useful. I have looked at the outputs from it, and I think some of them are very good. I think some of the TINA results are good. I would say they are starting to point in the right direction in terms of delivering for the future.

Q104 Albert Owen: Let me just push you on that. Now that you have discovered it, you have been on the website. Do you find that a useful tool? Do you think that your company and the supply chain that you are involved in should get involved with the co-ordination group and have dialogue?

Joe Corbett: I think so, but I think that there is a requirement for industry participation. There are other groups like the Offshore Wind Programme Group, which tries to combine both Government and industry at a more general level than say the Offshore Wind Accelerator. I think the co-ordination group would be much enhanced by having industrial input.

Dr Leese: I would agree with that. I think co-ordination as a principle is good. This is a very complex area, stretching from everything from invention straight through to deployment, and it is a very difficult area to penetrate. I think the earlier questioning has highlighted that the communication from this group is extremely poor. Not many people are aware of it; my members are certainly unaware of its activity. I think that this core group is limited and it does not have the industry input that I think it needs. I would like to see some industry representation there because I think, as the earlier questioning has drawn out, at the moment it seems to lend itself to self-interest because of the make-up of the funding and the funded sitting on the same core group.

Q105 Albert Owen: Did I hear, with regard to EDF, earlier that you believe that this would happen anyway, that the supply chain is there, the products are there, and it would happen without having a co-ordination group? Is that the way I heard you?

Filomena La Porta: No. I said that in the absence of public sector funding, it would be a limited happening in innovation and only that innovation where the supply chain is established. What we see in reality is that there is quite a lot of innovation. However, most of it is at a stage that needs to be demonstrated and most of it is at a stage that the supply chain is not in place to deliver and commercialise. Ultimately, the success is commercialisation.

Q106 Albert Owen: I understand that, but can I ask you specifically, as a company, would you be interested in going on this website and would you be interested in collaborating with other companies?

Filomena La Porta: Absolutely. We have been to this website and the publication strategy has been a very positive thing. I have to say that engagement with individual members happens and it is positive. We have contributed to the team exercise through engagement with the individual members. I think that what is missing is to see them together as a team, rather than talking with the PSFC, TSB, DECC or BIS. You do not see the recovery innovation group and how it all happens together.

The other element in the strategy that has been published is it would be good to see it stepping it up again and moving to a more longer-term type of support. It is a sentiment that was expressed in the previous panel. To have a consistent programme approach gives certainty and it would attract more private sector participation in the dialogue. The most dangerous thing for innovation is to start and stop. The previous panel has given an example and energy storage is another example.

Q107 Albert Owen: That is very useful. Are there any other comments before I make a final point?

Dennis Hayter: I would echo a number of the comments in terms of uncertainty about the framework, the involvement, knowledge, communications. The association has been involved in some of TINAs and have seen quite a few of the TINAs now emerge, but again without understanding what the nature of the co-ordination is, how they have been managed and what the longer term targets are. I reiterate the message from the industry perspective that a long-term perspective and a long-term vision such as that in Germany—a national innovation programme for hydrogen and fuel cell technology, 10 years, €1.4 billion to support very specific targeted outputs, not inputs but outputs, to achieve energy goals and transportation-related goals—is the sort of vision that we would like to see implemented as well.

Q108 Albert Owen: That is very useful. The final point I would like to make is with regards to intellectual property. You heard what the previous panel said on this. To what extent do concerns about protecting IP prevent greater sharing of knowledge across the low carbon economy?

Dennis Hayter: I will answer that first as predominantly a private sector company and the intelligent energy company I work for, privately owned and funded, is an intellectual property company. The concept of handing over that intellectual property right to Government where we have created over 400 patents in about 30-odd parent families and so on—that is where we derive the benefit. The long-term commercial value of the company is around achieving growth and development in the patent families and applying them. We are not the only company in that particular perspective that would see that as being the wrong move. You take that intellectual property; you use it with partners on the input side, so through the supply chain, explaining how you work, keep your background, develop the foreground and move the technology on, and then you exploit overseas. We see that as being an immediate and recognisable step for commercialisation and protecting the value for the UK as well.

Joe Corbett: In the electro-technical business quite a lot of the companies that are involved are multinational companies by their very nature, but in one particular case with modern high voltage direct current—HVDC—technology the centres of excellence for HVDC of two of the major European companies are based in the UK. We have already seen the impact of offshore wind and the impact of increased discussions around more interconnection within the European context. We have seen a market pull for this technology and a lot of the developments we know are occurring here. IP should belong to the people who develop it, and we would certainly see that the UK has an opportunity to move the—

Q109 Albert Owen: You mentioned we have seen the benefits of wind energy. Have we seen the full benefits though? Isn't there a slight contradiction there? It is a multinational sort of business and you said there are some centres in the UK. You gave an example of wind, but a lot of the wind development has been done elsewhere and has just been assembled here in the UK and put off our shores.

Joe Corbett: But I think that the technological developments required for the power systems of the future are not just in wind turbines, which definitely have been developed elsewhere. I think it is in the power system itself and it ranges from the generation side all the way through to the transmission side and all the way down to the distribution side. I think that is where the real opportunities are for the UK, because here there is access to offshore wind and there has been a programme for development of it. There is innovation occurring in the space and innovation may not be occurring in the turbines, but it is certainly occurring in installation, in development of logistics and those areas. When you look at how they connect all of that, it is all around high-voltage DC or high-voltage cabling. There are not many manufacturers in the world; they are European based; it is European technology. Going from the high-voltage side and all the way down to the distribution side, we talk about smart grids and people have already mentioned storage. There are huge opportunities in the development of these. These are all part of the mix of the future.

Q110 Albert Owen: We are doing an inquiry into distribution and I think we will be very interested in what you just said on that. Back to IP, do you think there are concerns about the sharing of it?

Filomena La Porta: Yes. IP has value if it is exploited, and I do not think it is very linear and just like a pass the parcel type of machine. So who is best placed to exploit IP? It might not be the people that have developed the IP and it might not be in the country where the IP has developed. For me, it is about really analysing where is the balance of the best exploitation. Just to give you an example, which is an internal EDF example: we have developed an IP, but because we are not a manufacturer, we have partnered with a small company here in the UK to give the IP in order to eventually deploy it; otherwise we just sit on an IP and it does nothing.

Dr Leese: I can give you an example. In the cement industry, co-ordination is happening at European level to develop carbon capture and storage and what we see now is the global companies coming together to fund a programme. The first pilot plant for carbon capture and storage in the cement industry is going to take place in Norway and that is going to be the first of its kind in Europe. We are going through an information-sharing exercise by the companies that fund the European Cement Research Academy. All of that is taking place outside the UK.

Q111 Albert Owen: So not much benefit for Britain plc then?

Dr Leese: No, other than the fact that we are involved but what we are seeing is that other countries are ahead of the curve.

Q112 Christopher Pincher: Staying outside of the UK, the LCICG has an ambitious strategy to help UK firms break into international markets, although from what you have said, Dr Leese and Mr Corbett, perhaps they should begin with some more modest domestic ambitions. We were told in a previous evidence session by Professor Fisk of the Chartered Institute for Building Service Engineers that perhaps that strategy is not as productive as it might be. He said that, "One can easily innovate a product, but if it does not have a European Committee for Standardisation standard that supports it, it will never get sold in Europe." How does one go about getting that standard, and how is the LCICG helping to obtain those standards, do you think?

Joe Corbett: I can't comment on how the LCICG is helping in that vein, but I can say that in order to make sure that whatever you develop complies with European standards, you should be in there influencing the standards. I know in our own sphere, in the electro-technical space, there are bodies that influence and submit documentation to the standards bodies before standards are written. You make sure that you are in by influencing the standards.

Filomena La Porta: In the strategy document, the LCICG has clarified that is not their remit. However, the challenge that I mentioned earlier is stepping up from co-ordination of funding to providing an ecosystem. I do agree certification is part of an ecosystem and is part of creating the market—a product that is not certified cannot be sold—but the certification process is towards the back end of the innovation journey and it goes almost alongside the demonstration. If the innovators get to a point of putting more effort in demonstration then it is time to start thinking about what is happening in terms of the certification for that regulatory environment. I do not

know if the Government support there is about funding or whether it is about policy co-ordination, but certainly support would be helpful.

Dennis Hayter: There are instances in the hydrogen and fuel cell sector where we are still looking at uncertainty over the regulatory framework. The regulation codes and standards are still being developed. It is not stopping the roll-out of vehicles and hydrogen refuelling stations. There are challenges, therefore, in terms of interpretation of, for example, separation distances between storage of hydrogen, refuelling of vehicles, in housing, in commercial operation. It is not stopping the industry per se, but it is a hindrance. I am not quite sure what LCICG is doing in this particular area, but any support would be welcome.

When it comes down to the individual product, again individual companies work to the closest possible definition of the standard CE mark instead where at least you self-certify if there is an applicable standard in order to be able to move and start to get product into the marketplace.

Dr Leese: Product standards are obviously very important, particularly in an area like cement work, the construction of buildings. You need long-term testing and you need that standardisation across Europe. If I draw the difference between that and technological or manufacturing innovation, you were right in your opening remark that more effort could be spent in the UK. We do have technologies that don't require the kind of standardisation that could deliver reduced carbon emissions. We could see that in the UK manufacturing sector with a better process.

Where standardisation might help is with the funding bodies, with the co-ordination group, to standardise the way in which they communicate what is available. We need to know what the funding level is, what proportion of it needs to be matched by the operator and what are the application criteria, what are the terms of the loan or grant or whatever? If each of the funding bodies was asked to standardise that then it would be much easier for operators and companies to penetrate this very complex system of accessing grants—something that the academics and some of the specialists in this area spend a lot of time doing. They seem to be readily set up to access the grant system, whereas companies who are on the cusp of introducing low carbon technology seem to have much more difficulty. I think that was picked up in the earlier session with the complex application process and the paperwork point.

Q113 Christopher Pincher: We will come on the skew effect between academia and money spent and industry and money spent in a moment. But just to stick with the question of standardisation, regardless of whether it is the LCICG's responsibility to help with that standardisation process, do you feel that that is a road block to penetrating international markets and that some form of help, whether it is the LCICG or another body, needs to provide it?

Dr Leese: The standardisation system is very specialist and you need product or technology-specific people sitting on those committees. Personally, I don't think the co-ordination group could potentially assist in that area, particularly in my industries.

Filomena La Porta: Could I give an example of the type of blockage that innovation can have in the absence of standardisation? A couple of weeks ago there was in the news that Google had bought Nest, the company that makes energy management devices. The problem with these devices is that because they have been developed in the States, they are not suitable for the 220 voltage network that we have in Europe. We looked at the products and we have challenges because of the standardisation. It is an example of that.

Q114 Christopher Pincher: I have just been told by the Chairman, in his very polite way, that I need to shut up very quickly as we are running short of time. But can I move on to the question that I think, Dr Leese, you have been very clear about, which is that there is too much focus on academic research and not necessarily enough focus on industry. A network of catapult centres have been set up apparently around the country to help companies, particularly small companies, collaborate internationally. Something like £46 million in public and private funding has been allocated to set up the Offshore Renewable Energy Catapult centre in Glasgow. Have you heard of these centres, and are they supporting your organisations and your trade bodies?

Dr Leese: I have heard of them. I am aware of them. I am totally unaware of how they are benefiting my members right now. I do not see any benefit coming from them into my sector.

Joe Corbett: Yes, we have heard of the catapult centres.

Q115 Christopher Pincher: Have you engaged with the one in Glasgow?

Joe Corbett: As far as I am aware. We have a so-called floating LiDAR. A LiDAR is a laser device that you put out to sea to measure wind speed, and it is one of those initiatives that is helping us to get one of these out into the Firth of Forth to measure wind speeds. It avoids you putting up a met mast, which is a very expensive thing to do. It is on trial at the moment at Narec. We intend to move it out to the Firth of Forth within the next two months or so.

Q116 Christopher Pincher: It has been of benefit to you.

Joe Corbett: It has been a direct benefit to us.

Dennis Hayter: We are aware of the catapults as an association and the extent to which they are able to directly or indirectly benefit is still to be proven. Those that are involved on the automotive side and the production-engineering side have been able to look at some of the catapults, at least into the low carbon vehicle input, but it is indirect rather than direct I would say.

Filomena La Porta: We are aware of the catapults. We are collaborating on floating LiDAR, but there is also a European project that is on the floating LiDAR that has been mentioned by a colleague before. They are probably a bit slow, but it does take time to set up a brand new organisation. Maybe there could be some acceleration in providing this network and these opportunities.

Christopher Pincher: Three out of four.

Q117 Dr Whitehead: You have heard earlier about the scale or width of the TINA arrangements. Do you think that is a reasonably robust way of prioritising investments, or do you think, as the number of priorities might suggest, that it is a bit of a cop out in not selecting those areas that really are going to go?

Dennis Hayter: I have mentioned TINAs earlier on in the sense that UK Hydrogen and Fuel Cell members and the association itself would support it, particularly the transport TINA, and would note that that process of support and the development is somewhat opaque. We are looking to see it move on, but we are also seeing that there are other TINAs in relation to hydrogen managed by the Carbon Trust. There are now CCS and heat. It is becoming a little fragmented and, from my association's viewpoint, we have lost the ability to be able to deliver effectively to one or more of those TINAs because of the degree of fragmentation.

Joe Corbett: I have read the one for the electricity networks and I would have to say that it pretty much ticks all the boxes that people are talking about today. In fact, if you looked at the list and you look at the Horizon 2020 scoping list, there is a lot of commonality. While it ticks many of the boxes, the one thing that it might benefit from would be more collaboration at the earlier stage in defining the scope in order to present it with a context and a context that is driven by two things. One I have mentioned before, which is a vision of where we need to go to in the future, but also how industry believes we can get there. What should the road map be? I think the TINA would benefit very much from that collaboration at a much earlier stage than that.

Dr Leese: The UK cement industry has created a greenhouse gas road map to 2050, the first of its kind internationally for a national sector to produce. What I don't see with the TINAs is how they are linking with the sector road maps. We heard earlier that the steel sector are involved in the Government road map and we will have our turn in the summer when we will be working with DECC to develop the cement sector road map. But the TINAs at the moment are not linked with what industry and manufacturing industry, the energy-intensive industries, can do, so I would like to see that gap narrowed. The TINAs are sitting under the framework of the strategy that was mentioned earlier, and the strategy has come out with no consultation, as far as I can see. How do we contribute to this process of strategy and TINA development? It seems to be very opaque at the moment.

Filomena La Porta: We would broadly agree with the generalities of the TINA outcomes. Again, to push it a bit further is to agree underneath a set of deliverables together with the industry, in collaboration with the industry. It is acceptable that the priorities are broader than many because I don't think that there is an expectation that one single body, entity or industry will deliver the entirety. Underneath this list of needs, it is important to agree who does what and with whom. That is where it will be interesting to see more collaboration with the Low Carbon Innovation Co-ordination Group.

Q118 Dr Whitehead: But in a sense, although you have the priorities, you have the carving up of the pie not apparently terribly balanced. Certainly, in terms of what we have heard earlier, the carving up is based, to some extent, on what looks like greater innovation certainty over a period. Therefore, those areas that look like they have less certainty ahead lose out and a self-reinforcement mechanism takes place, as far as that allocation is concerned. Is that a criticism you would share?

Dennis Hayter: I would certainly agree with that. In the context of hydrogen and fuel cell, at this moment there is no road map for the technologies that are underpinning those. Where those best are delivered, whether it is hydrogen into energy storage, hydrogen into transport fuel, renewable integration and so on, does not exist at this moment. Therefore, some of those strategies are not necessarily based on accurate information.

Joe Corbett: I would agree that if you write down a list and that is where your funding goes, it is self-fulfilling to a certain extent. I would agree that, as we talked about earlier, there seems to be,

from our perspective, a lack of a vision or a context for where this is all going and how to get there. An example might be we talk about using big grids, and I have talked about it before. If you look at the fuel portfolio that we will have in 2050, it is going to be a lot different to what we have today. There will be a lot of wind, whether we like it or not—at least that is our belief—and wind is a continental resource, so we need to have more interconnection in order to do that. I do not see that built into it. I see energy storage; I see things about smart grids and some of these things, but not those kind. In fact, during the late discussions for Horizon 2020, the idea of having a scope item on the North Sea's grid was pushed back to a 2015 call because of some objections, none by the UK incidentally, but by some of the southern European states. Again, this is having an impact on innovation in the space that we believe is very important for the power system of the future.

Q119 Dr Whitehead: Do you think the system perhaps lacks flexibility in order to bring those in?

Joe Corbett: Yes, that would be a fair comment.

Dr Leese: There are some very specific TINAs on energy technology, and then industry gets a TINA and "industry" is quite a broad term. There is, perhaps rightly so, considerable focus on decarbonising power generation within the co-ordination group, but we are well aware that decarbonising power generation is an ambition. It is very well funded with RO and Contracts for Difference and Carbon Price Support. We can see the support going into power generation. What we can't see is how industry and manufacturing is getting an equivalent amount of support and that is where the TINAs need a link to the road maps. We need to recognise that there is a double dividend from decarbonising industry and the fact that we decarbonise the products that we need for our low carbon economy, but also we retain jobs in manufacturing and build growth in the UK.

Q120 Mr Lilley: If the objective of this expenditure is to build up British industrial capacity—as Dr Leese said there is lip service at least paid to that—wouldn't the appropriate thing to do be to see where British industry has strengths that are relevant to climate low carbon objectives and build on those strengths? We have a fairly hollowed-out manufacturing industrial base. There is no point in trying to create industries where they don't exist, but to develop industrial capacity where it does exist but is relevant to low carbon. Would you agree with that approach?

Dr Leese: There are certain industries that we can't do without. Cement and concrete is something that is going to be needed into the future; it is going to be needed for a low carbon economy. We should focus on these energy-intensive industries and try to maximise that potential for low carbon. I have already talked about the road maps. The industry knows what is theoretically needed to decarbonise; a minus 81% is in our greenhouse gas strategy for cement. We know what is needed for that. What we do not have is the vehicles and the support to get there. That is why we need to close the gap between the innovation funding area and development and manufacturing in the UK.

Q121 Mr Lilley: Do we stand to lose those industries if we do not go down that route or simply raise the cost to us? Will we import cement or—

Dr Leese: Absolutely. We import 10% of the UK's consumption. Cement is often regarded as a heavy material that doesn't travel well and yet we import 10%, even without a strong carbon

price. If we add a high carbon price, we have high-energy taxation. There is capacity in North Africa, Turkey and places not too far away to supply the UK. We have plenty of import terminals in the UK to import the material, which is crazy because we have limestone that is one of the most abundant geologies and we have it in abundance in the UK. There is no reason why we should import any cement.

Q122 Mr Lilley: That is a defending our existing industries argument, which is valid. How about building up industries with export and international capacity? It would not apply so much, I would have thought, in your sector but perhaps in the other sectors and perhaps Mr Hayter's sector. Are we credibly going to build up hydrogen-based industries?

Dennis Hayter: Certainly, on the fuel cell side, there are some very innovative companies based here in the UK that are looking at an international market. It is not about trying to apply locally because these energy technologies apply no matter whether it be China, Asia, North America. There are a lot of capabilities here for stationary, for automotive, for consumer electronics. I have said that we get lost in the noise that is also on the hydrogen side, against wind, against the other mainstream renewables. We would like to see a focus that is very specific to the capabilities of the industries. As we are progressing to manufacture, this is the opportunity to do it now before decisions are made to manufacture in China or elsewhere and bring the technologies into the marketplace: targeted investment, selective support through the last stages of innovation, continuing innovation, so that you have the refresh and the development of the technologies and then drive it into the markets through support mechanisms, but allowing the manufacturing to take place and into export markets.

Q123 Mr Lilley: Do you get any feeling that there is any drive within this bureaucratic labyrinth that is directed to achieving that objective?

Dennis Hayter: Sometimes, it can be more of a challenge than a support.

Q124 Mr Lilley: Be a little less elusive. Is there anyone there that shares your ambition?

Dennis Hayter: Certainly, UKTI was always helpful in being able to look at market opportunity support activities in foreign markets, so there is no question once you have targeted the opportunity, yes. But developing and getting to the point that you can pick up the opportunity is where we still have the challenge here and now.

Q125 Mr Lilley: But we have a £185 million research budget and up to £7.6 billion a year subsidies to renewables. Is any of that coming your way?

Dennis Hayter: Hydrogen and fuel cells are not classified as renewables. That is the unfortunate part of our industry sector.

Q126 Mr Lilley: Are there any regulatory barriers to innovation?

Dennis Hayter: I don't see regulatory barriers, no.

Q127 Mr Lilley: This is a question about creating the right market demand for your products. Presumably, these are products people want to buy. No one needs to create the market for them, do they? I will hand back to the Chairman to speed things up.

Dennis Hayter: I would just point out that if we see that there are regulatory barriers, certainly around EMR and so on in terms of driving through introduction of technologies, that is a different form of regulatory barrier to the one you were referring to, but if I have misunderstood it, we can offer further evidence.

Q128 Ian Lavery: What levels of confidence do you have with regards to Government support for low carbon innovation beyond 2015?

Dr Leese: The National Audit Office, in your briefing, pointed out that there is limited commitment beyond 2015, and we would recognise that. We need to highlight the investment cycle within industrial manufacturing. We probably have one, maybe two opportunities for breakthrough investments between now and 2050 in our industries. If we are going to make those the best opportunities then we need a longer-term commitment than up to 2015.

Q129 Ian Lavery: Are there any real positive signals you want to see from Government with regard to the low carbon innovation work beyond that date?

Joe Corbett: I would reiterate the question of having a vision of deciding what the future is likely to be, creating the road map to get there and then creating the regulatory environment to allow it to happen. In the power sector, for example, Europe has been talking for the last 17 or 18 years about a single electricity market, and I think that would have great benefit. As I said earlier, the resources we are going to have in the future are continental resources in many ways and that has to change the way you deliver.

It is very difficult with the current regulatory regimes, where we have 28 regulators in Europe, to connect them all together. That is very difficult to do under the current regulatory environment. If we are going to have innovation in this space—and innovation will be required in order to make sure that the costs come down—then we have to have the regulatory environment that allows the projects to happen, so that we can move from so-called visions to real projects that help deliver the road map towards that future. That requires the regulators to be able to sit together and agree and hammer out or be incentivised to agree on how that can happen.

Q130 Ian Lavery: From the responses I have had, I am not sure what levels of confidence you have as individuals.

Filomena La Porta: Long-term support and long-term commitment is crucial because innovation takes a long time. It needs to get to a stage that is demonstrated in order to be commercial, in order to create the opportunities that were mentioned earlier. It needs to build in the capability to learn from the mistakes, to learn from what is not working and take it back to the element of the innovation chain. Without this longer-term framework it is very difficult.

Dennis Hayter: From the hydrogen and fuel cell side, there are pockets of certainty—for example, around the fact that there is an advanced automotive propulsion centre that would

include hydrogen and fuel cell technologies in powertrain technology development. That runs for five years from this year. Within the ultra-low emission vehicle strategy from OLEV that runs from 2015 to 2020, fuel cell electric vehicles are included as the ULEV technologies for support and infrastructure support. That is it. We have seen perhaps more uncertainty in other areas and continuing difficulties to be able to get the technologies into play against stationary and other power applications where there is no mechanism to support that early stage roll-out.

Dr Leese: My confidence is low right now in the fact that I do not see the funding coming into manufacturing. When you add in the political and budgetary governance uncertainty in the future, I think my confidence is even lower.

Q131 Ian Lavery: Do you think the Government should step back and let the private sector lead fully on low carbon developments?

Joe Corbett: As I said earlier, I think the Government has a role to set the context.

Dennis Hayter: Agreed. There has to be the framework, because it comes back to small companies to larger companies in this sector needing the confidence that they can convince the board and their investors that this is an area worth investing in because the products are due to come to meet market need.

Dr Leese: The Government is intervening in the generation sector and derisking some of the developed generation sector investments. There is definitely a role for the Government to help de-risk some of the manufacturing investments in low carbon technology.

Q132 Ian Lavery: The LCICG have said that, "The market signals—such as long-term private-sector investment in low carbon—may be more important than current government signals on long-term support." What would your view be on that?

Dennis Hayter: With emerging technologies, you would need the long-term perspective. You need the ability to recoup the costs, the investment in capital, and then in operating, where you do have a differential on the pricing, to recover that through whether it be a feed-in tariff, a price differential, a CfD, for example. In the application of the technology, whether it be for hydrogens as transport fuel, they are the longer-term mechanisms. Industry will continue to support and do the development, but those perspectives, that mechanism and that framework, are essential and it needs to be more than just a few years ahead.

Q133 Ian Lavery: Finally, I would like to ask with regard to the huge challenges in meeting low carbon targets, such as the Climate Change Act, which will require the UK to reduce its emissions by at least 80% by 2050, do you think that the right long-term incentives and signals are in place to encourage radical, transformative innovations?

Dennis Hayter: No, not in their entirety at all.

Q134 Ian Lavery: Would that be the same?

Dr Leese: The road map work will be important to show what we can achieve in various industrial sectors. Government have set out their stall in the Climate Change Act with the aspirational targets. There is certainly a role now for Government to be assisting us, as manufacturers, to get to that point.

Ian Lavery: That is a politician's answer.

Chair: Thank you very much. If there is anything you feel you wanted to expand on and did not have the time to, please write to us, so that we can put it to the Minister. We will also be in touch if there is anything we have missed or we wanted to get to the bottom of. Thank you again for providing the evidence. It has been most helpful.